

# Exploring the nexus between risk perception, driving tasks perception, and road safety attitudes among oil and gas tanker drivers

Aliyu Mustapha <sup>a,b,\*</sup>, Mazli Mustapha <sup>a</sup>, Noorhayati Saad <sup>c</sup>, Ahmad Majdi Abdul-Rani <sup>a</sup>

<sup>a</sup> Department of Mechanical Engineering, Universiti Teknologi PETRONAS, Seri Iskandar 32610, Malaysia

<sup>b</sup> Industrial and Technology Education Department, Federal University of Technology Minna, Nigeria

<sup>c</sup> The Design School, Faculty of Innovation and Technology, Taylor's University, 47500 Subang Jaya, Selangor, Malaysia

## ARTICLE INFO

### Keywords:

Driving tasks perception  
Risk perception  
Road accidents  
Road safety attitude  
Traffic rules

## ABSTRACT

Road accidents globally have an 18 % fatality rate per 100,000 population, with significant regional variations, particularly affecting Africa. The increasing frequency of oil and gas tanker accidents in Nigeria exemplifies this trend, highlighting the need to explore the relationship between risk perception, driving task perception, and road safety attitudes among Nigerian oil and gas tanker drivers. This study utilised a sample of 375 drivers, with 311 valid questionnaires analysed, reflecting consistent and comprehensive responses. Exploratory factor analysis identified three key factors, with factor loadings ranging from 0.580 to 0.915. In contrast, while confirmatory factor analysis validated these constructs  $\chi^2/df = 1.285$ , CFI = 0.996, TLI = 0.971, NFI = 0.984, GFI = 0.995, AGFI = 0.949, RMSEA = 0.048, and SRMR = 0.040. Structural equation modelling further assessed the relationships between drivers' risk perception, driving task perception, and road safety attitudes, revealing a positive correlation between Risk Perception and Road Safety Attitude ( $\beta = 0.611$ ,  $p < 0.05$ ). There is a positive correlation between Risk Perception and Road Safety Attitude ( $\beta = 0.611$ ,  $p < 0.05$ ) and a positive correlation between Non-Driving Activities impacting road safety ( $\beta = 0.145$ ,  $p < 0.05$ ). The study found that mid-career drivers, particularly those with limited educational backgrounds, demonstrated specific attitudes and behaviours related to road safety. These findings underscore the need for targeted interventions that address risk perception and driving tasks to improve safety attitudes. Recommendations include tailored training programs for different age groups and experience levels, awareness campaigns to enhance adherence to traffic rules, and continuous monitoring of risk perception and road conditions to facilitate adaptive safety interventions.

## 1. Introduction

Road accidents are a prevalent global issue that warrants significant attention as a major public health concern (Sheykhfard et al., 2022). Such incidents can yield profound consequences, including loss of life, economic and financial setbacks, and bodily harm resulting in deformities (Mustapha et al., 2024). Despite ongoing efforts to improve road safety, the global road traffic fatality rate remains alarmingly high at 18 per cent per 100,000 population, with middle-income countries experiencing a much higher rate of 20.1 per cent compared to 8.7 per cent in high-income countries (Akande, 2020; Wegman, 2017). Specifically, middle-income countries experience an annual road traffic fatality rate of 20.1 per cent per 100,000 individuals, in contrast to the 8.7 per cent rate observed in high-income countries (Akande, 2020). Approximately 80 % of fatalities on the road take place in low and

middle-income nations, which make up 72.2 per cent of the world's inhabitants (Wegman, 2017). This disparity highlights the urgent need to address road safety in regions with inadequate infrastructure and limited resources. The regional breakdown of road traffic accidents, expressed as percentages, illustrates the share of global road traffic accidents in each region. This is determined by the annual toll of 1.3 million lives claimed by road traffic accidents (Mustapha et al., 2022).

Road traffic accidents remain a significant global concern, with certain regions experiencing disproportionately high rates. Africa, with 26.6 % of the world's road traffic accidents, has the highest percentage, highlighting a critical road safety challenge despite its smaller population than other regions. South-East Asia follows closely with 20.7 %, reflecting substantial road safety management and infrastructure challenges in road safety management and infrastructure. The Eastern Mediterranean region, accounting for 18 % of global accidents, faces

\* Corresponding author at: Department of Mechanical Engineering, Universiti Teknologi PETRONAS, Seri Iskandar 32610, Malaysia.

E-mail addresses: [aliyu\\_22000469@utp.edu.my](mailto:aliyu_22000469@utp.edu.my), [al.mustapha@futminna.edu.ng](mailto:al.mustapha@futminna.edu.ng) (A. Mustapha).

<https://doi.org/10.1016/j.tbs.2024.100959>

Received 22 January 2024; Received in revised form 10 September 2024; Accepted 11 November 2024

2214-367X/© 2024 Hong Kong Society for Transportation Studies. Published by Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

notable road safety issues. The West Pacific region contributes 16.9 % to the worldwide burden, underscoring ongoing accident prevention and safety measures challenges in accident prevention and safety measures. The Americas, with 15.6 %, show considerable variation in road safety across the continent, influenced by diverse infrastructure and safety practices. In contrast, Europe's smallest share, at 9.3 %, demonstrates advanced road safety measures, contributing to its lower percentage of global traffic accidents.

The data emphasises notable differences in mortality rates across regions, with Africa experiencing the most significant impact. South-East Asia and the Eastern Mediterranean also grapple with substantial mortality burdens. Meanwhile, the Americas, West Pacific, and Europe contribute to the overall death toll, each region contributing with distinct proportions. This variation in the distribution of mortality emphasises that factors such as road infrastructure, traffic density, public transport availability, and behavioural and demographic considerations contribute to the discernible contrast in accident statistics among nations (Chand et al., 2021). Africa, in particular, bears a disproportionate burden, accounting for 26.6 % of the world's road traffic accidents despite having a smaller population relative to other regions (Mustapha et al., 2022). This situation underscores the critical road safety challenges in the area, exacerbated by factors such as poor road conditions, inadequate vehicle maintenance, and cultural issues related to driving behaviours (Casado-Sanz et al., 2020).

The rise in road accidents can be attributed to expanding road networks, rising vehicles, and growing populations (Alvi et al., 2020). For example, Nigeria has seen a 79 per cent rise in accidental deaths among oil and gas tanker drivers, partly due to these factors. Additionally, human errors such as dangerous driving and road sign violations further

aggravate the issue, resulting in significant safety and economic consequences (Olapoju & Olawole, 2018). Considering these trends in rising road fatalities and serious injuries, there is an urgent need to address these challenges. The goal is to reduce annual road fatalities and injuries by 1.9 million by 2020, aiming to save five million lives and prevent 50 million serious injuries over the next decade (Zarocostas, 2011). Fig. 1 provides an overview of incidents involving oil and gas tankers in Nigeria from 2007 to 2021, highlighting trends in tanker involvement, road traffic crashes (RTCs), fatalities, and injuries.

The data indicates fluctuations in these incidents, with a noticeable increase towards the latter part of the period. The increase in casualties, particularly in 2018 through 2021, reflects growing road safety concerns related to oil and gas tankers. This escalating trend underscores the severity of the problem of road traffic accidents (RTAs), emphasising the need for targeted interventions to mitigate the associated risks.

RTAs transpire due to numerous factors, including weather, vehicle speed, traffic, experience and driving habits, and road status (Khanpour et al., 2023). The latter is significantly influenced by road infrastructure and the physical and social environment. Significant elements encompass road features like width, lane count, curves, bends, slopes, and lighting, influencing vehicle speed. Additionally, factors such as drivers' inattentiveness, lack of speed control, distraction, and failure to adjust speed to the road or hazardous conditions impact the frequency of mishaps on roads (Ahmed et al., 2023; Chand et al., 2022; Etika, 2018). Lowering the probability of traffic accidents requires regular vehicle upkeep, thorough training, and education on safe driving habits (Idris & Mustapha, 2019). Road safety and urban resilience are shaped by factors such as the availability and quality of infrastructure, accessibility of public transport, economic conditions, and the perception of safety

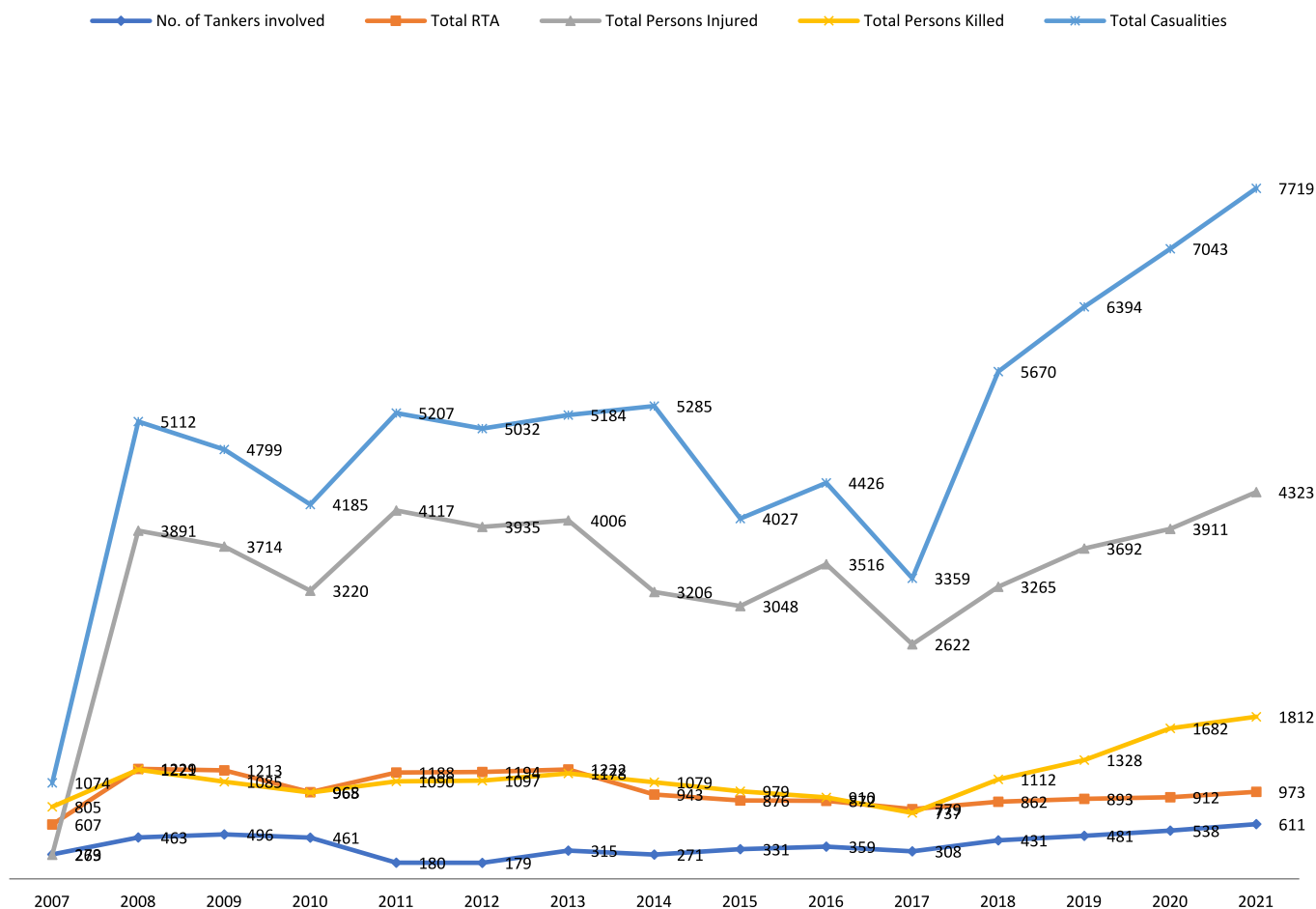


Fig. 1. Oil and gas tankers road traffic accident data 2007–2021. Source: FRSC road traffic accident data 2007–2021.

among residents (Gonçalves & Ribeiro, 2020). Poor road conditions, inadequate vehicle maintenance, drivers' health issues, traffic law infractions, and cultural issues are critical contributors to accidents (Casado-Sanz et al., 2020). Hence, it is essential to examine the impact of behavioural aspects on drivers' attitudes toward road safety while considering the complexity of these components.

### 1.1. Conceptual framework

The occurrence of road accidents is significantly influenced by the behavioural aspects of drivers, especially their perception of danger and road safety mindset. A person's attitude comprises emotive, cognitive, and behavioural elements that reflect how they view various circumstances, people, and events. Road safety attitudes can be broadly divided into general viewpoints on traffic safety and specific opinions on issues like speeding, driving under the influence, caring for other road users, and personal responsibility (Sheykhfard et al., 2023). Notably, drivers' attitudes play a crucial role in determining the risk of road accidents (Bouhsissin et al., 2023). The conceptual framework for this study is anchored on four key factors: risk perception, safety awareness, compliance with traffic rules, and driving experience.

Risk perception refers to drivers' awareness and assessment of potential dangers associated with driving, including their understanding of the likelihood and severity of traffic accidents. This leads to more cautious behaviours like adherence to speed limits and maintaining safe distances. Safety awareness encompasses knowledge of safety practices and traffic regulations, such as the importance of seat belts, the risks of driving under fatigue, and vehicle maintenance, which are expected to improve adherence to traffic rules. Compliance with traffic rules, influenced by attitudes toward enforcement and perceived consequences, reflects how well drivers follow laws, including speed limits and the use of safety gear. Driving experience, characterised by the length and diversity of a driver's time on the road, is believed to contribute to better coping strategies and safer driving habits, with repeated exposure leading to more automatic and efficient behaviours.

These factors are dynamically interrelated. For instance, a driver with a high-risk perception is more likely to exhibit cautious driving behaviours, reinforcing their safety awareness and compliance with traffic regulations. Additionally, compliance with traffic rules not only reflects behaviour but also mirrors attitudes toward authority and risk. Driving experience may moderate the relationship between risk perception and driving behaviours, with more experienced drivers being less reactive to perceived risks due to their familiarity with driving tasks. Numerous studies have delved into the connection between behaviour and attitude and how people perceive the hazards of traffic accidents (Chen et al., 2022; Kummeneje & Rundmo, 2020; Li et al., 2021).

Nevertheless, risk perception can influence human behaviour, and drivers' awareness of the likelihood of traffic accidents may encourage people to take precautions against such incidents. Understanding human and behavioural factors is crucial for unravelling the complexities associated with road accidents (Bęczkowska & Grabarek, 2021). Drivers' attitudes toward traffic laws, participation in non-driving activities, and sense of driving duty are greatly influenced by their perception of risk (Ram & Chand, 2016).

### 1.2. Theoretical framework

Three theories highlight the complex interplay between risk perception, attitudes, and behaviours. They provide frameworks for understanding how individuals assess risks, perceive the severity and susceptibility of potential outcomes, and decide on appropriate actions to mitigate them. These theories are:

1. The Health Belief Model posits that an individual's health-related actions are guided by their perceptions of the threat posed by a health issue and the advantages of avoiding or mitigating that threat.

In risk perception, people are more likely to act if they believe the consequences may be severe (perceived severity) and a specific action can reduce their vulnerability or severity (perceived benefits). Consequently, risk perception is a pivotal factor in shaping attitudes and behaviours related to health.

2. The Protection Motivation Theory expands upon the Health Belief Model by integrating cognitive processes, including threat and coping appraisal. Threat appraisal evaluates a threat's perceived severity and susceptibility while coping appraisal assesses the effectiveness of available coping strategies. High-risk perception, coupled with the belief that one can effectively cope with the risk, will likely result in a motivated protective response. This theory underscores that perceived threat and the perceived efficacy of protective behaviours influence behavioural intentions and actions.
3. The Cultural Theory of Risk postulates that cultural values and worldviews influence individuals' attitudes and behaviours. It identifies four cultural biases or worldviews, hierarchies, individualist, egalitarian, and fatalist, that shape how people perceive and respond to risks. For instance, those with an individualist worldview may be more accepting of personal risks and less inclined to adhere to regulations. In contrast, those with an egalitarian worldview may prioritise collective well-being and follow safety guidelines. This theory underscores the role of culture in shaping risk perceptions and subsequent attitudes and behaviours.

As a prevalent psychological phenomenon, risk perception can directly and indirectly affect attitudes toward road safety. Road safety attitudes, however, are shaped by a multitude of factors beyond just risk perception. Environmental stress factors are a common cause of traffic accidents. The severity of these incidents varies based on several factors, such as human error, safety procedures, the accident's precise time and location, and the age of the vehicle (Wu et al., 2020).

The idea of how one perceives the work of driving is closely related to behaviour and road safety. The task of driving requires the simultaneous management of pattern recognition, lateral and longitudinal location, and other higher-order cognitive functions. The technology of motor vehicles has advanced significantly over the last three decades, particularly with the explosive growth of electronic content (Băjenescu, 2022). This development has complicated driving, substantially impacting traffic safety and long-term driving behaviours.

Visual-manual activities can negatively impact driving performance, and driving speed can be decreased by secondary duties like using a phone and interacting with a navigation system (Yao et al., 2020). When drivers successfully manage the intrinsic demands of the driving task, safe driving behaviour results. Driving performance, especially speed and overtaking, is statistically significantly impacted by experience with the activity, and the repetitious quality of the tasks may cause concentration to fade (He et al., 2023).

This study is based on the idea that drivers' attitudes and behaviours may be changed and improved by having a better knowledge of how road accidents are seen as risky and how driving is perceived as a chore. Drivers are responsible for enhancing road safety by adhering strictly to traffic regulations (Alyamani et al., 2023). It is incumbent upon every driver to conscientiously observe traffic rules. Notably, a concerning statistic reveals that 40 per cent of trucks lack the installation of seat belts (Alexa et al., 2020). Furthermore, a prevalent issue among truck drivers is inadequate rest after prolonged drives.

The use of safety accessories can reduce injuries from road accidents. However, it is recognised that specific drivers feel uneasy wearing helmets (Hasan et al., 2023). According to Tarlochan et al. (2022), male drivers are more likely to be involved in traffic accidents than female drivers. This is frequently because they drive older cars, do not use seat belts, and speed without maintaining a safe following distance. This does not only raise anxiety but also heightens the risk of accidents.

Although substantial research has been conducted on the impact of road infrastructure, traffic density, and demographic factors on RTAs,

there is a notable gap in understanding the complex interplay between drivers' behavioural factors, risk perception, and adherence to traffic regulations, particularly in low and middle-income countries like Nigeria. Previous studies have primarily focused on isolated factors, such as driver distraction or vehicle speed, without adequately considering how these elements interact to influence RTAs (Chen et al., 2022; Kummeneje & Rundmo, 2020). Moreover, while existing research has explored the relationship between drivers' attitudes and road safety (Bouhsissin et al., 2023), there is insufficient empirical evidence on how these attitudes are shaped by risk perception and the perception of driving tasks. Additionally, the role of non-driving activities and their impact on driving performance in RTAs involving oil and gas tankers still needs to be explored. Fig. 2 shows the study framework.

1.3. Aim of the study

This study aims to fill these gaps by developing an integrated model that examines the relationship between risk perception, driving task perception, adherence to traffic rules, and drivers' attitudes toward road safety. It explicitly focuses on oil and gas tanker drivers in Nigeria. The study will also explore how non-driving activities contribute to RTAs in this context.

1.4. Objectives of the study

1. To investigate the impact of drivers' risk perception on their attitudes toward road safety.
2. To examine the influence of driving task perception on adherence to traffic rules among oil and gas tanker drivers.
3. To assess how non-driving activities affect driving performance and contribute to RTAs.
4. To analyse the relationship between risk perception, driving task perception, and road safety attitudes.
5. To provide recommendations for interventions to enhance road safety among oil and gas tanker drivers in Nigeria.

1.5. Research hypotheses

The subsequent section delineates the associations between fundamental variables and other external factors, visually represented in Fig. 3.

1.6. Road safety attitude (RSA)

Road safety attitude includes drivers' cognitive and affective

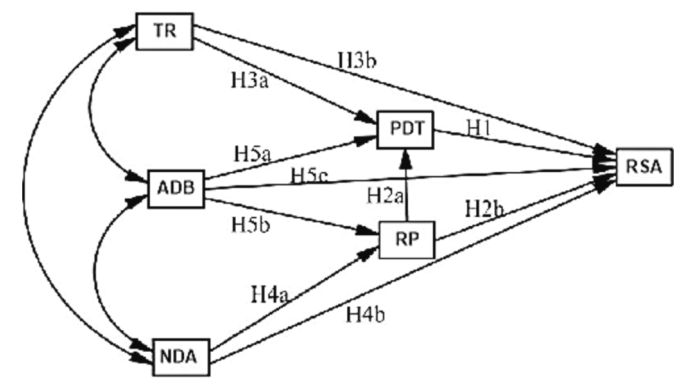


Fig. 3. Relationships between the hypotheses.

comprehension of traffic laws and regulations and how they drive and treat other drivers and pedestrians with respect and attention. Drivers are likelier to drive safely if they respect others and know traffic laws and regulations. According to Cutello et al. (2020), driver's attitude toward road safety significantly predicts their conduct.

Drivers' vehicle speed is influenced by various factors, such as personal traits, attitude, risk perception, awareness of speed limits, the chance of law enforcement detection, the seriousness of traffic infractions, and the possibility of time saves or losses (Kim et al., 2021). Adhering to traffic rules and regulations is a means by which drivers can enhance road safety. Positive driving behaviour is crucial in fostering compliance with traffic signals. Camera enforcement is estimated to reduce injuries from road accidents by 21.7 per cent (Ang et al., 2020) and a 12 per cent reduction in fatal and injury crashes, with fatal and severe injury crashes declining by 15 per cent (Tilahun, 2023).

A positive correlation has been identified between a propensity for risk-taking and engagement in risky driving behaviour (Adavikottu & Velaga, 2021). This inclination towards risk-taking is a predictive factor for engaging in behaviours such as violating traffic rules, speeding, driving carelessly, and operating a vehicle under the influence. Various factors, including seatbelt usage, optimism bias, gender disparities, exposure, driving experience, cultural diversity, and age prejudice influence driving behaviour (Adavikottu & Velaga, 2021). These elements contribute to the intricate dynamics that shape drivers' actions on the road.

1.7. Perception of driving tasks (PDT)

Among the many duties assigned to drivers are judging the speed of

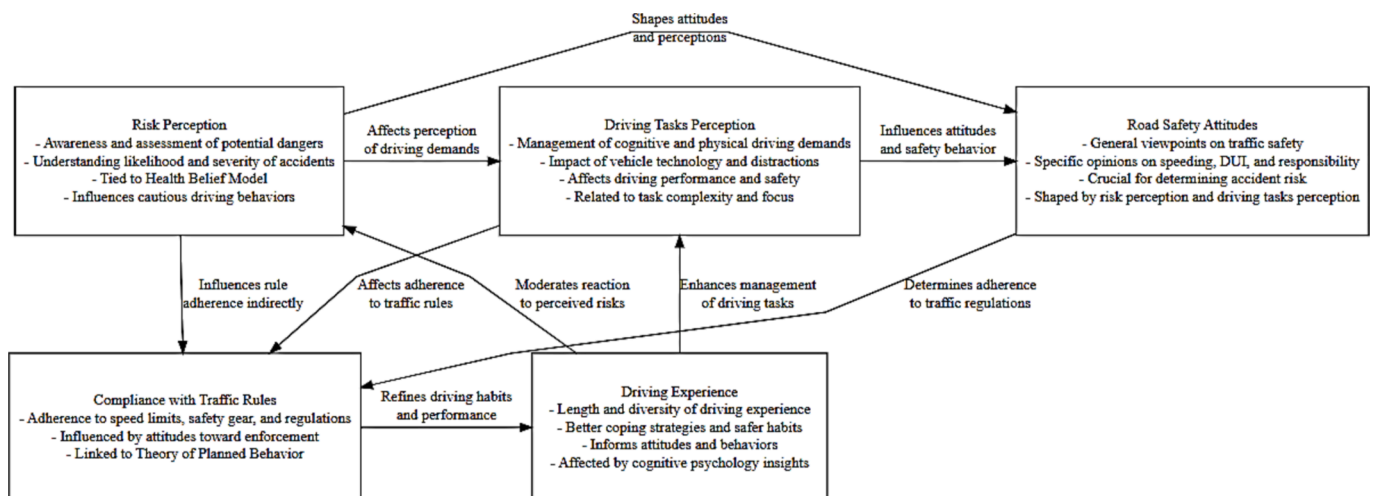


Fig. 2. Study framework.

approaching and preceding cars, shifting gears, and analysing the state of the road. The drivers' position comprises all these duties, and how they view their roles directly impacts the chance of incidents turning into accidents. There is a tight correlation between drivers' perception of driving tasks and the frequency of road accidents (Hu et al., 2020). This correlation can be understood through three levels: environmental, vehicle, and human factors that collectively influence driving responsibilities. For instance, slick roads and adverse weather conditions, such as rain or fog, reduce traction and visibility, necessitating more cautious driving behaviours to prevent accidents (Druta et al., 2020; Hsu, 2024). Traffic congestion heightens driver stress and increases braking frequency, which can lead to rear-end collisions (Yang et al., 2024). On the vehicle level, sudden mechanical failures, such as brake malfunctions or tyre blowouts, require immediate and precise corrective actions to maintain vehicle control (Fonzone et al., 2024). Human factors, including distractions like cell phone use, fatigue-induced sleep, and emotional states such as anger or frustration, impair reaction times and situational awareness, significantly raising the risk of accidents (Benlagha & Charfeddine, 2020; De Reuver & Biron, 2024; Hong et al., 2020; Idris & Mustapha, 2019). These examples underscore the complex interplay between these variables and their critical impact on driving responsibilities.

Remarkably, 72.9 per cent of driving distractions are caused by steady traffic conditions (Obeidat et al., 2022). Direction changes and overtaking are responsible for 11.1 and 6.7 per cent of traffic incidents, respectively (Alvi et al., 2020). An increased chance of getting involved in a road accident arises from a driver's incapacity to appropriately estimate road conditions. Additionally, there is a strong association between poor overtaking and speeding. For example, overtaking and diverging manoeuvres resulted in over 48,000 deaths in traffic accidents in India in 2014 (Honavar, 2022). The fact that speeding was a significant factor in these collisions highlights how important it is for speeding to cause traffic accidents. The statistics underscore the imperative of addressing driving behaviours associated with overtaking and diverging manoeuvres to mitigate the toll of road accidents. The hypothesis regarding PDT was formulated as follows:

**Hypothesis 1 (H1):** PDT positively and directly influences oil and gas tanker RSA.

### 1.8. Risk perception (RP)

Risk perception is an intrinsic characteristic shared by humans and animals, manifesting as the ability to discern potential dangers in varying conditions or situations. This subjective phenomenon is influenced by an individual's previous experiences and social and personal factors. Individuals with a heightened sense of risk perception tend to exhibit caution and diligence in their behaviour. It is noteworthy to mention that animals also show this characteristic; this is demonstrated by the way stray animals behave on Nigerian highways. It has been shown that both predators and prey may modify how they perceive danger (Sahoo & Samanta, 2021).

Risk perception is essential in fostering the adoption of protective behaviours. Risk perception in the context of road safety particularly relates to a driver's awareness of threats in the traffic environment. It depends on the driver's ability to recognise and comprehend these possible risks, a critical component that directly affects the frequency of actual accidents (Sahu et al., 2022). Notably, a significant association exists between excessive speed, diminished perception of risk, and road accidents (Guerrero et al., 2020), underlining the critical role of risk perception in promoting safe driving practices.

There is a strong correlation between risk perception and auto accidents (Herrero-Fernández et al., 2020). Furthermore, several studies have shown that risk perception significantly impacts dangerous driving behaviour (Herrero-Fernández et al., 2020; Măirean et al., 2022). Uzundu et al. (2020) conducted a study on drivers in Nigeria, indicating a prevalent pattern of low-risk perception. Notably, there is a definite

inverse relationship between one's sense of danger and inclination to take risks (Lobanova & Evtiukov, 2020). Age, experience, and driving instruction affect how much risk a driver perceives (Qi et al., 2021). Research confirms that adequate driving instruction significantly enhances drivers' sense of risk (Lobanova & Evtiukov, 2020). Furthermore, risk perception and risk-taking behaviour are influenced by the driver's age (Lyon et al., 2020), and driving experience favourably enhances risk perception (Wang et al., 2023). The substantial correlation between risk perception, reckless driving behaviour, and risk-taking attitudes is supported by Advikottu & Velaga's (2021) research. Additionally, a measurable connection is discovered between:

**Hypothesis 2a (H2a):** RP positively and directly influences oil and gas tanker PDT.

**Hypothesis 2b (H2b):** RP positively and directly influences oil and gas tanker RSA.

### 1.9. Traffic rules (TR)

Since the government intends traffic laws to establish a secure and orderly travelling environment for all road users, observing them is essential to preventing traffic accidents. Traffic laws can be broken with profound consequences, including accidents on the road. It is observed that a significant portion of traffic accidents are caused by insufficient enforcement of traffic regulations (Adedeji et al., 2016; Umeh et al., 2018).

Behaviours including speeding, overtaking, and drunk driving cause a significant percentage of traffic accidents are caused. According to Awoniyi et al. (2021); Falkenstein et al. (2020); Konyeha & Osa (2020), elderly drivers, overtaking manoeuvres, and poor vehicle maintenance are common causes of traffic accidents. Notably, speeding and driving while intoxicated are the leading causes of traffic accidents (Beanland et al., 2013; Timmermans et al., 2020). Overtaking and overloading are responsible for a significant percentage (66 %) of traffic accidents (Mohammed, 2021). According to Liu et al. (2023), speeding alone is to blame for half of all traffic-related injuries. Driving on the incorrect side of the road has also been found to be a contributing factor in traffic accidents (Guerrero et al., 2020).

It is also vital to emphasise that traffic accidents originate from law infractions rather than accidental errors. Certain driving behaviours, such as driving abruptly and recklessly, speeding, disobeying traffic signals, driving the wrong way, not wearing safety belts, and manoeuvring through dangerous circumstances, are significantly more common among male drivers (Cordellieri et al., 2016). Drivers engaged in incidents are far less likely to suffer injuries or lose their lives when wearing seat belts (Touahmia, 2018). On the other hand, 35 per cent of traffic accidents are caused by drivers who fail to buckle up while operating a vehicle (Tarek et al., 2021). These results highlight the significance of following traffic laws and regulations and encouraging safe driving practices to reduce the frequency and seriousness of traffic accidents.

**Hypothesis 3a (H3a):** TR positively and directly influences oil and gas tanker PDT.

**Hypothesis 3b (H3b):** TR positively and directly influences oil and gas tanker RSA.

### 1.10. Non-driving activities (NDA)

Drivers frequently engage in things other than driving, which can cause them to get preoccupied or lose focus while operating a car. Non-driving behaviours like smoking, utilising mobile phones, modifying music, and interacting with passengers can seriously jeopardise road safety. The following are some examples of variables that might affect a driver's performance: sleepiness, exhaustion, eating, acute stress, drunkenness, and brief interruptions (Ade et al., 2022; Dai et al., 2018; Inuwa et al., 2017; Kolsi et al., 2021; Lalla-Edward et al., 2019).

According to Jain et al. (2021), smoking raises a person's chance of

getting in a car accident by 1.5 times when compared to non-smokers. Drivers can reduce their chance of being involved in an accident by avoiding distractions. Risky driving behaviours are more common among drivers who participate in distracted driving (Mekonnen et al., 2019). Removing these distractions is essential to preserving a concentrated and secure driving environment. Regarding NDA, the hypothesis was:

**Hypothesis 4a (H4a):** NA positively and directly influences oil and gas tanker RP.

**Hypothesis 4b (H4b):** NA positively and directly influences oil and gas tanker RSA.

1.11. Aggressive driving behaviour (ADB)

Drivers might yield to the urge of suddenly accelerating their vehicles when overtaken by others. They may sometimes engage in reckless manoeuvres, such as dangerously turning the car or applying sudden brakes, to showcase their driving prowess. Such behaviours are antithetical to the principles of road safety. It is noteworthy that excessive and inappropriate speed contributes to one-third of fatal and severe accidents (Høye, 2020). Therefore, accidents frequently occur when driving capabilities and vehicle speed surpass safe limits.

There is a strong correlation between speeding and a higher risk of getting into an accident. Regulating driving speed is crucial in reducing the occurrence of road accidents. Notably, Khan et al. (2015) underscored that many road accidents, especially among young drivers, can be attributed to vehicle speed. Young drivers, often lacking a profound fear of the potential loss of life, are disproportionately involved in road accidents, with most of such incidents occurring within the age group of under 25 years. The most significant contributing factor to young driver accidents is excessive and inappropriate speeds. Jain et al. (2021) Drivers who display aggression while operating their vehicles are more prone to road accidents. This underscores the imperative of fostering a responsible and controlled approach to driving speeds to enhance road safety. The hypothesis regarding ADB was stated as follows:

**Hypothesis 5a (H5a):** ADB positively and directly influences oil and gas tanker PDT.

**Hypothesis 5b (H5b):** ADB positively and directly influences oil and gas tanker RP.

**Hypothesis 5c (H5c):** ADB positively and directly influences oil and gas tanker RSA.

2. Methods

2.1. Data/Materials

This research utilized a cross-sectional and correlational design to assess associations between dependent and independent variables. The study was conducted in North Central Nigeria, a region known for its high incidence of road accidents, as shown in Fig. 4.

The region comprises six states, from which a sample was drawn from four: Benue, Kwara, Niger, and Plateau. These states were explicitly selected due to their many oil and gas distribution stations (Table 1).

As shown in Table 2, the total number of respondents consists of 6,020 oil and gas tanker drivers.

To ensure that the sample accurately reflects the distribution of registered oil and gas tanker drivers across the sampled states, a rigorous approach involving the Cochran formula and probability proportionate to size (PPS) was employed. These formulas ensured that the sample size was determined accurately and proportionally across the states based on their population sizes.

$$n = \frac{NZ^2p(1-p)}{(N-1)e^2 + Z^2p(1-p)} \tag{1}$$

Where:

- n = required sample size
- N = population size
- Z = Z-value (1.96 for a 95 % confidence level)
- p = estimated proportion of the population (0.5 for maximum variability)
- e = margin of error (0.05 for 5 %)

The sample size of 375 drivers was determined, and it is allocated to each stratum (state) proportionally to its population size; these include

**Table 1**  
North-central Nigerian states on oil and gas distribution stations.

S/N	State	Number of distribution stations
1	Benue	2
2	Federal Capital Territory, Abuja	0
3	Kogi	0
4	Kwara	1
5	Nasarawa	0
6	Niger	2
7	Plateau	1

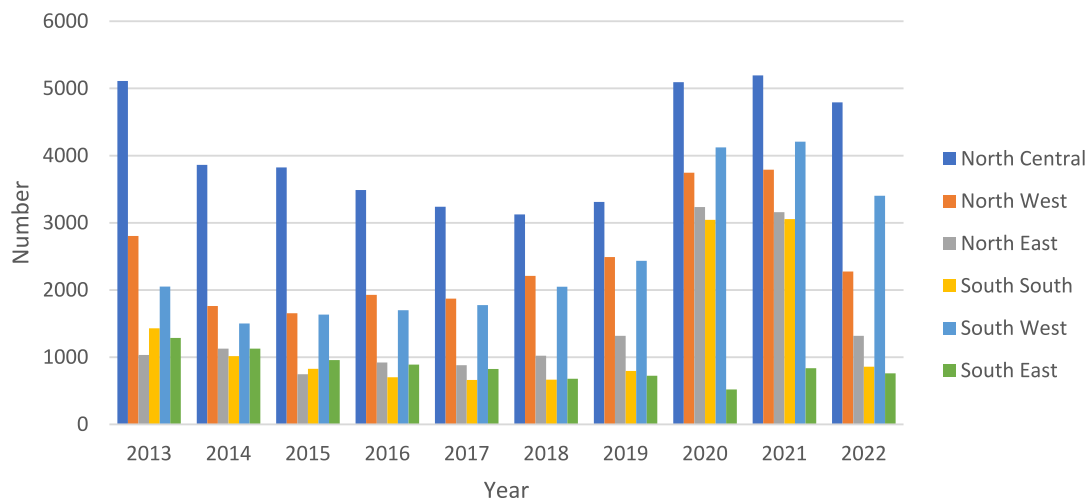


Fig. 4. FRSC annual report- Nigeria Road Safety (NRSS II) Strategy 2021–2030.

**Table 2**  
Population of the registered oil and gas tanker drivers in the sampled states.

S/N	State	Number
1	Benue	1633
2	Kwara	1254
3	Niger	2021
4	Plateau	1112
Total		6020

Source: Petroleum Tanker Drivers Association (2023).

102 from Benue, 78 from Kwara, 126 from Niger, and 69 from Plateau state. The formula for allocating the sample to each state is:

$$n_i = \frac{N_i}{N}n \tag{2}$$

Where:

- $n_i$  = sample size for state
- $N_i$  = population size of state
- $N$  = total population size (sum of populations of all states)
- $n$  = total sample size

Convenience sampling was used to recruit participants, with drivers selected based on geographical proximity to the researcher or specific location criteria (Leavy, 2019). Participants had to meet the following criteria: (1) Nigerian nationality, (2) possession of a valid class G driving license, and (3) being registered oil and gas tanker drivers.

A structured questionnaire was employed to evaluate drivers' attitudes toward road safety, perception of danger, and appraisal of driving tasks. The questionnaire had two sections: Part 1 collected demographic data, including age, gender, years of driving experience, and traffic incident frequency. Part 2 was divided into six sections (A-F), with items scored on a five-point Likert scale. The study received 311 valid questionnaire responses, yielding an 82.9 % response rate (Table 4).

## 2.2. Data analysis

### 2.2.1. Validity and reliability

To ensure the validity and reliability of the measurements used in this study, the following procedures were implemented:

#### 2.2.1.1. Validity.

- **Content Validity:** Traffic safety Experts in traffic safety and risk perception were consulted to review and refine the measurement instruments. A pilot study was conducted in Northeast Nigeria, specifically in Kaduna State. This region was selected because it is adjacent to North Central Nigeria regarding RTA and is not in the same region as the main study area. The pilot study ensured that the items effectively covered the constructs of interest, enhancing the measurement instruments' content validity.
- **Construct Validity:** Exploratory and confirmatory factor analyses were conducted, confirming that the items for risk perception and

**Table 3**  
Internal consistency of constructs.

	Cronbach's Alpha
RSA	0.756
PDT	0.843
RP	0.768
TR	0.813
ADB	0.851
NA	0.754
Average	0.798

**Table 4**  
Response rate.

Items	Total	Percentage (%)
Distributed questionnaire	375	100.00
Completed returned questionnaire	319	85.07
Unreturned questionnaire	56	14.93
Rejected questionnaire	8	2.13
Valid questionnaire	311	82.93

driving task perception aligned with theoretical expectations, with items clustering appropriately around the intended constructs.

**2.2.1.2. Reliability.** Cronbach's Alpha evaluates the internal consistency or reliability of a set of scale items intended to measure a single construct. It assesses how well the items on a scale correlate with each other, indicating whether they consistently reflect the same underlying concept (Han & Zhao, 2020; Shrestha, 2021). The Cronbach's Alpha values presented reflect the internal consistency of the various constructs used in the study. With values ranging from 0.754 to 0.851 and an average of 0.798, the results revealed a high level of reliability. The ADB scale demonstrates the highest reliability at 0.851, indicating that it has the most consistent items among the constructs. Conversely, with an alpha of 0.756, the RSA scale exhibits slightly lower, but still acceptable, internal consistency. Therefore, the average alpha of 0.798 indicates that the scales reliably measure the constructs, thus ensuring consistency across the sample. This level of reliability underpins the robustness of the data and supports the validity of the study's conclusions (Table 3).

### 2.2.2. Modelling

**2.2.2.1. Structural equation modelling (SEM).** Structural equation modelling (SEM) was employed to analyse the complex relationships between latent components. SEM, a sophisticated statistical technique combining regression and component analysis (Farrukh et al., 2019), offers more accurate estimations by controlling correlations between latent components and accounting for measurement errors in observable indicator variables. Goodness-of-fit analysis was conducted using indices such as the Root Mean Square Error of Approximation (RMSEA), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI), with values above 0.90 considered adequate (Mustapha et al., 2023). Due to the categorical nature of the Likert responses, Robust Maximum Likelihood Estimation was utilized.

## 3. Results

### 3.1. Response rate

Out of the 375 questionnaires distributed, a sizeable portion, 319, which represents 85.07 %, were completed and returned. This high response rate indicates that most respondents were willing and able to participate in the study, indicating the data reliability. However, 56 questionnaires, representing 14.93 %, were not returned. This missing data could be due to distinct reasons, such as respondents' lack of time, interest, or other personal constraints that prevented them from completing the survey. Of the 319 returned questionnaires, 8 (2.13 %) were rejected. These rejections could have been due to incomplete responses, inconsistent answers, or other errors that made them unusable for the analysis. After accounting for the rejected questionnaires, 311 valid questionnaires remained, 82.93 % of the total distributed. These 311 valid questionnaires were used for the analysis, as shown in Table 4.

### 3.2. Descriptive statistics

Descriptive statistics outlining the characteristics of the participating

oil and gas tanker drivers are detailed in Table 5.

Table 5 shows the demographic distribution of survey participants across various categories. A significant concentration is observed in the 25–30 age range, constituting 55.6 % of the respondents. In contrast, participants aged 41 years and above represent the smallest group at 2.3 %. Being early in their careers, drivers in the 25–30 age range may exhibit more cautious behaviour and be more receptive to training and compliance with safety protocols. In contrast, older drivers (41 years and above), who represent a smaller percentage, may rely more on their experience but could also be more resistant to adopting new safety practices.

Most respondents hold a primary school certificate (39.5 %), followed by a secondary school certificate (30.2 %), with none having a PhD. The high percentage of drivers with primary (39.5 %) and secondary school certificates (30.2 %) suggests limited formal education, which may impact their understanding and application of safety protocols. However, those with higher education, though fewer in number, may have a better understanding of the importance of road safety due to their broader educational background.

Many respondents have less than 5 years of driving experience (48.9 %), while those with 30 years and above constitute the smallest group (3.2 %). Drivers with less than 5 years of experience (48.9 %) still develop RSA. They might be more susceptible to risky behaviours or positively influenced by targeted safety training. In contrast, drivers with 21–30 years of experience (5.5 %) may have ingrained habits that could positively or negatively influence their safety attitudes, depending on their past experiences and training.

### 3.3. Exploratory factor analysis (EFA)

Before conducting Exploratory Factor Analysis (EFA), the questionnaire’s suitability was assessed using Bartlett’s test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy. The results in Table 6 indicate a KMO value of 0.746, suggesting moderate suitability for factor analysis. The significant result of Bartlett’s test ( $p$ -value = 0.000) further justified factor analysis.

The extraction communalities, presented in Table 7, revealed high values (all exceeding 0.500), indicating satisfactory correlations among variables for factor analysis.

The Promax rotation is an oblique rotation method that allows for correlation between the extracted components. The rotation converged

**Table 5**  
Demographic information for oil and gas tanker drivers.

Category	Values	Frequency	Valid Percentage	Cumulative Percentage
Age	18–24 years	70	22.5	22.5
	25–30 years	173	55.6	78.1
	31–40 years	61	19.6	97.8
	41 years and above	7	2.3	100.0
Educational qualification	Primary school certificate	123	39.5	39.5
	Secondary school certificate	94	30.2	69.8
	NCE	53	17.1	86.8
	Degree	31	10.0	96.8
	Postgraduate Diploma	8	2.6	99.4
	Master’s Degree	2	0.6	100.0
Years of driving experience	PhD	0	0	100.0
	Less than 5 years	152	48.9	48.9
	5–10 years	94	30.2	79.1
	11–20 years	38	12.2	91.3
	21–30 years	17	5.5	96.8
	30 years and above	10	3.2	100.0

**Table 6**  
KMO and Bartlett’s test.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.746
Bartlett’s test of Sphericity	Approx. Chi-Square	214.086
	Df	15
	Sig.	0.000

**Table 7**  
Communalities.

	Initial	Extraction
RSA	1.000	0.703
PDT	1.000	0.728
RP	1.000	0.822
TR	1.000	0.611
ADB	1.000	0.835
NA	1.000	0.669

Extraction Method: Principal Component Analysis.

in 7 iterations, indicating stability in the rotated solution. The pattern matrix provides a clearer understanding of how each variable contributes to the identified components post-rotation. The loadings indicate the strength and direction of the relationship between each variable and the underlying components. The factor structure exhibits convergent and discriminant validity, as evidenced by high loadings within factors and the absence of cross-loadings between factors. The factors demonstrate satisfactory convergent validity, with all loadings exceeding 0.500 for a sample size of 311. Table 8 presents the pattern matrix for each of the factors.

The result revealed that RP and PDT. Individuals who perceive risks and have a perception of their driving tasks tend to have high loadings on Component 1. TR, RSA, and NDA. Individuals who pay attention to traffic rules, have a positive attitude toward road safety, and engage in non-driving activities tend to have high loadings on Component 2. ADB. Individuals with distinct perceptions or attitudes about road conditions tend to have high loadings on Component 3. Table 9 shows the component correlation matrix.

There is a positive correlation of 0.200 between Component 1 and Component 2. This suggests that there is a modest tendency for individuals who score high on Component 1 to also score high on Component 2. There is a negative correlation of  $-0.079$  between Component 1 and Component 3. This implies a slight tendency for individuals who score high on Component 1 to score lower on Component 3. There is a negative correlation of  $-0.090$  between Component 2 and Component 3. This indicates a modest tendency for individuals who score high on Component 2 to score lower on Component 3. Moreover, the factors exhibit satisfactory discriminant validity. In conclusion, this three-factor model accounts for a total explained variance of 67.801 %, and all extracted factors have eigenvalues exceeding 1.0.

**Table 8**  
Pattern Matrix.

	Component		
	1	2	3
RP	0.822		
PDT	0.806		
TR		0.795	
RSA		0.678	
NA		0.580	
ADB			0.915

Extraction Method: Principal Component Analysis.  
Rotation Method: Promax with Kaiser Normalization.  
a. Rotation converged in 7 iterations.

**Table 9**  
Component correlation matrix.

Component	1	2	3
1	1.000	0.200	-0.079
2	0.200	1.000	-0.090
3	-0.079	-0.090	1.000

Extraction Method: Principal Component Analysis.  
Rotation Method: Promax with Kaiser Normalization.

3.4. Evaluation of the measurement model

The indices chi-square = 726.102, chi-square/df = 4.174, TLI = 0.932, CFI = 0.945, RMSEA = 0.046, and SRMR = 0.035 demonstrated that the measurement model matched the data well. As suggested, the absolute fit indicators, RMSEA and SRMR, were less than 0.08. In contrast, the incremental fit indicators, CFI and TLI, were greater than 0.90, signifying an acceptable fit. Table 10 demonstrates that every factor loading, ranging from 0.637 to 0.864, was statistically significant and suggested reliable estimation findings. R<sup>2</sup> values greater than 0.50 demonstrated that the model accounted for more than half of the variation in each item, further corroborating the accuracy of the estimation findings. Strong dependability was indicated by high Cronbach's alpha values (above 0.80), and AVE indices above 0.50 were validated.

Table 11 represents the discriminant validity for a measurement model, including constructs such as RSA, RP, PDT, NDA, RC, and TR.

To evaluate discriminant validity, we compared the square root of the average variance extracted (AVE) for each construct with the correlations between that construct and all others. The off-diagonal values in Table 10 represent these correlations, all of which are less than 1, affirming discriminant validity. This implies that the measurement model demonstrates satisfactory discriminant validity, indicating that the chosen constructs are distinct from each other and effectively measure different aspects of the overall theoretical framework.

3.5. Evaluation of the structural model

The structural model, depicted in Fig. 5, demonstrated a good fit with the data according to various indices. The goodness-of-fit measures include CMIN/DF (1.285), TLI (0.971), CFI (0.996), NFI (0.984), GFI (0.995), AGFI (0.949), RMSEA (0.048), and SRMR (0.040).

**Table 10**  
Outcomes of the measurement model.

Item	SE	t-value	R <sup>2</sup>	AVE	Cronbach's alpha
RSA1	0.726	30.625	0.513	0.532	0.812
RSA2	0.770	28.726	0.656		
RSA3	0.713	38.216	0.776		
RSA4	0.637	21.923	0.524		
RP1	0.715	30.102	0.531	0.576	0.801
RP2	0.775	39.487	0.634		
RP3	0.667	35.563	0.532		
PDT1	0.823	25.971	0.623	0.654	0.876
PDT2	0.775	52.891	0.591		
PDT3	0.778	36.125	0.532		
NA1	0.737	43.231	0.692	0.599	0.868
NA2	0.682	36.516	0.601		
NA3	0.816	33.658	0.536		
ADB1	0.704	71.421	0.524	0.535	0.811
ADB2	0.658	54.478	0.522		
ADB3	0.863	33.974	0.686		
ADB4	0.864	32.432	0.512		
TR1	0.840	29.843	0.537	0.631	0.815
TR2	0.698	30.213	0.576		
TR3	0.765	31.243	0.664		
TR4	0.835	35.324	0.523		

SE: standardized estimate; AVE: average variance extracted.

**Table 11**  
Measurement model's discriminant validity.

Construct	RSA	RP	PDT	NDA	ADB	TR
RSA	(0.729)					
RP	0.535**	(0.759)				
PDT	0.325**	0.368**	(0.809)			
NDA	0.394**	0.360**	0.551**	(0.774)		
ADB	0.254**	0.311**	0.547**	0.771**	(0.731)	
TR	0.685**	0.532**	0.303**	0.292**	0.151**	(0.794)

\*\*p < 0.01. Diagonal in parentheses: Square root of average variance extracted from observed variables (items); and off-diagonal: correlations between constructs.

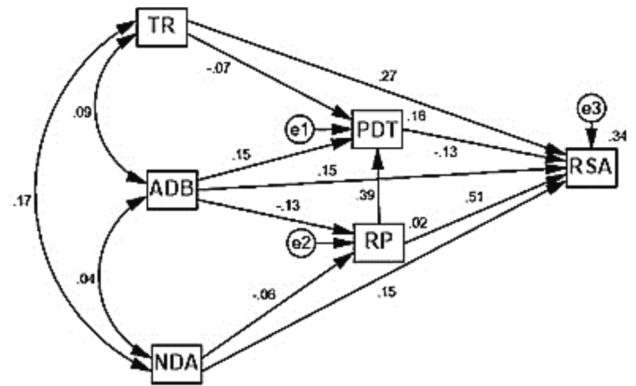


Fig. 5. Final structural model.

3.6. Testing of hypotheses

The verified hypotheses substantiate the relationships among the chosen variables, as indicated by remarkable path coefficients and t-values. Eight of the ten hypotheses were valid (Table 12).

3.7. Key findings

The Structural Equation Modeling (SEM) analysis revealed several key findings regarding the relationships between the latent components in the study. The final structural model demonstrated a good fit, supported by various goodness-of-fit indices, including CMIN/DF, TLI, CFI, NFI, GFI, AGFI, RMSEA, and SRMR.

The analysis confirmed the significance of most hypothesized relationships. For instance, RP had a positive and significant influence on both PDT (Path coefficient = 0.516, t-value = 7.916) and RSA (Path coefficient = 0.611, t-value = 8.514), suggesting that individuals who perceive higher risks also have stronger perceptions of their driving tasks and a more positive attitude toward road safety.

Moreover, TR significantly impacted both PDT (Path coefficient = -0.203, t-value = -3.191) and RSA (Path coefficient = 0.233, t-value = 3.765\*\*\*).

**Table 12**  
Hypotheses tested.

Hypotheses	Path	Path coefficient	t-value	Remarks
H1	RSA←PDT	-0.219	-3.059**	Supported
H2a	PDT←RP	0.516	7.916***	Supported
H2b	RSA←RP	0.611	8.514***	Supported
H3a	PDT←TR	-0.203	-3.191***	Supported
H3b	RSA←TR	0.233	3.765***	Supported
H4a	RP←NDA	-0.034	-4.63	Not supported
H4b	RSA←NDA	0.145	2.407*	Supported
H5a	PDT←ADB	0.054	0.826	Not supported
H5b	RP←ADB	-0.238	-3.236***	Supported
H5c	RSA←ADB	0.196	3.168***	Supported

\*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

3.765), indicating that adherence to TR is associated with lower PDT but a higher positive attitude toward road safety.

NDA influenced RSA (Path coefficient = 0.145, t-value = 2.407), showing that engagement in NDA positively affects RSA; however, its effect on RP was not significant.

Regarding ADB, the findings showed that they negatively influenced RP (Path coefficient = -0.238, t-value = -3.236) and positively influenced RSA (Path coefficient = 0.196, t-value = 3.168). However, their effect on PDT was not significant.

#### 4. Discussions

The study provides a comprehensive insight into the demographic makeup of oil and gas tanker drivers, illuminating critical aspects such as age distribution, educational qualifications, and years of driving experience. This demographic breakdown is indispensable for understanding the study participants, enabling the extraction of valuable insights that can significantly impact the investigation's broader context.

The age distribution reveals a noteworthy concentration of participants within the 25–30 age range, constituting 55.3 % of the respondents. This indicates that many oil and gas tanker drivers operate within the mid-range of their professional careers. Conversely, individuals aged 41 years and above form the smallest demographic segment, representing merely 2.6 % of the total respondents. This result breakdown offers a valuable lens through which to contextualize the experiences and viewpoints of individuals at distinct stages of their professional journey within the oil and gas industry.

Transitioning to educational qualifications, it is observed that most participants hold a primary school certificate, constituting 39.5 % of the respondents. Following closely are those with a secondary school certificate at 30.2 %. Notably, none of the respondents possess a Ph.D., providing a clear snapshot of the educational and occupational landscape of the respondents.

The breakdown of driving experience years introduces another dimension to the demographic overview. It is worth highlighting that almost half of the participants (48.9 %) possess less than 5 years of driving experience, signifying a significant influx of new entrants into the field. In contrast, individuals with 30 years of driving experience and above form the smallest group at 3.2 %. This data unveils insights into the varying levels of expertise within the cohort, offering a foundation for understanding potential disparities in attitudes, practices, and challenges among drivers with diverse experience levels.

The study presents a comprehensive analysis of the hypotheses, providing valuable insights into the relationships among varied factors influencing road safety attitudes. The study indicates a negative correlation between drivers' RSA and their perception of PDT. This implies that attitudes toward road safety tend to become less favourable when driving duties are perceived as more negative. This is consistent with the findings of Larocca et al. (2018) and Schütz et al. (2015), which emphasise how important it is for drivers to perceive distance, speed, and movements to drive safely. Drivers with a more negative PDT had lower RSA, which contradicts the assumption that a thorough understanding of one's driving role would always lead to improved safety attitudes. This result may imply that perceived task challenges could negatively affect attitudes if not appropriately addressed in training programs.

Drivers prefer to feel more threats when their PDT is negatively connected, as seen by the positive correlation between their PDT and RP. This is in line with the study by Kummeneje & Rundmo (2020), which emphasises the connection between elevated risk perception and more positive attitudes toward traffic safety.

The study unveils a positive correlation between drivers' RSA and RP, suggesting that RSA becomes more positive as RP increases. These findings align with the research conducted by Distefano (2019), underscoring the impact of RP on driving behaviour and overall RSA.

The study has found a negative link between drivers' adherence to

TR and their PDT, suggesting that drivers are likelier to exhibit less adherence to TR when their PDT is more unfavourable. This result is consistent with the study by Hu et al. (2021), which showed a link between attitudes toward road safety and driving activities that are perceived negatively.

The study found a positive correlation between drivers' adherence to TR and their RSA, suggesting that drivers are more likely to follow traffic laws when their RSA is higher. These results support the idea that drivers' compliance with traffic laws is strongly influenced by their good views about road safety (Iversen, 2004).

No significant correlation is found between RP and engagement in NDA. This implies that risk perception does not directly impact involvement in NDA. While engaging in well-being activities can enhance safety attitudes, these activities alone may not directly influence PDT. The study diverges from the findings of previous research. It indicates that risk perception may not be a significant factor in determining engagement in NDA (Ram & Chand, 2016). This discrepancy might impact the interpretation by indicating that improving risk perception may require more focused interventions beyond general well-being activities.

The study indicates a positive correlation between drivers' RSA and engagement in NDA. This implies that drivers are less likely to engage in NDA as RSA becomes more positive. These results align with previous research by Ram & Chand (2016) & Zhao et al. (2019), highlighting the importance of driver training and traffic issues in improving driving safety.

Road conditions do not appear to directly impact how driving tasks are perceived since the study finds no significant link between PDT and ADB. The results of the survey differ from those of Islam et al. (2020), Khan et al. (2015), Sayyar & Sadiq (2018), suggesting that road conditions could not significantly impact how drivers see their driving jobs.

A negative correlation is found between RP and ADB. This implies that as RP increases, the influence of ADB on risk perception decreases. The study indicates that road conditions shape risk perception but are not the sole determining factor. These findings support the idea that unsafe driving behaviours significantly impact drivers' perceptions of traffic crash risk (Machado-León et al., 2016).

The study reveals a positive correlation between drivers' RSA and ADB. This implies that as RSA becomes more positive, drivers tend to perceive road conditions more favourably. The findings align with Khan et al. (2015) & Sheykhfard et al. (2023), emphasizing the association between road safety attitudes and the perception of traffic risk in various driving conditions.

#### 5. Conclusions

This study examines the demographic composition, educational qualifications, and driving experience of oil and gas tanker drivers. It unravels intricate patterns and correlations significantly impacting road safety attitudes and behaviours. The breakdown of age distribution underscores a predominant presence in the 25–30 age range, highlighting a concentration of professionals in the mid-career phase. Conversely, individuals aged 41 years and above represent a minor demographic, offering insights into the diverse experiences of drivers at different career stages. An exploration of educational backgrounds reveals a majority with primary school certificates, followed by those with secondary school certificates. The absence of individuals with Ph.D. qualifications underscores the specific educational profile prevalent among oil and gas tanker drivers in this study. The distribution of driving experience further contributes to the understanding of the heterogeneous nature of the driver population, with a substantial influx of newcomers with less than 5 years of experience and a smaller cohort with 30 years and above. Moving beyond demographics, the study rigorously examines complex relationships between PDT, RP, and RSA. Negative correlations between PDT and RSA and PDT and adherence to TR underscore the intricate dynamics influencing drivers' attitudes and

behaviours. Positive correlations between PDT and RP, RSA and RP, and RSA and adherence to TR shed light on the interconnected nature of these factors. These findings underscore the necessity of collectively considering RP, PDT, and RSA in developing targeted safety interventions.

A multifaceted approach is recommended to enhance road safety. This includes improving risk perception through interactive workshops and simulation-based training, strengthening traffic rules education with real-life case studies, and addressing driving task perception with targeted educational programs. Additionally, it fosters collaboration between drivers and road management authorities to address road conditions and implement effective feedback mechanisms. Continuous professional development should be supported with tailored refresher courses and intensive training. Finally, use data-driven insights to design customized safety campaigns and training programs that meet the specific needs of drivers.

Future research should focus on evaluating the long-term effects of interventions on drivers' risk perception and road safety behaviours. Through controlled trials, it should assess the effectiveness of specific measures like risk perception training and professional development. Additionally, exploring innovative technologies such as advanced driver-assistance systems (ADAS) and mobile apps and investigating behavioural and psychological factors influencing risk perception are crucial. Research should also examine how study findings can inform policy and regulation, conduct comparative studies across different cultures and regions, and optimize feedback mechanisms for reporting and addressing road condition issues.

#### CRedit authorship contribution statement

**Aliyu Mustapha:** Data curation, Formal analysis, Methodology, Software, Writing – original draft, Writing – review & editing. **Mazli Mustapha:** Conceptualization, Formal analysis, Investigation, Software, Supervision, Visualization, Writing – review & editing. **Noorhayati Saad:** Methodology, Supervision, Visualization, Writing – review & editing. **Ahmad Majdi Abdul-Rani:** Conceptualization, Supervision, Visualization, Writing – review & editing.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Acknowledgements

The authors express gratitude to the Petroleum Technology Development Fund (PTDF) Nigeria, which sponsored the PhD for Aliyu Mustapha; Mechanical Engineering Department, Universiti Teknologi PETRONAS (UTP) Malaysia; Federal Road Safety Corps (FRSC) Nigeria, National Bureau of Statistics (NBS), Petroleum Tanker Drivers Association (PTDA) Nigeria, Taylors' University Malaysia, Industrial and Technology Education Department, Federal University of Technology Minna (FUTMinna) Nigeria and Taylors University Malaysia for their support in the research.

#### References

- Adavikottu, A., Velaga, N.R., 2021. Analysis of factors influencing aggressive driver behavior and crash involvement. *Traffic Inj. Prev.* 22 (S1), S21–S26. <https://doi.org/10.1080/15389588.2021.1965590>.
- Ade, S., Flatin, M.C., Wachinou, P.A., Badirou, A.S., Cissé, I.M., Adjibimey, M., Agodokpessi, G., Harries, A.D., 2022. Risk of obstructive sleep apnea among taxi–motorbike drivers in Parakou city in West Africa and associated factors with road traffic accidents. *Chron. Respir. Dis.* 19. <https://doi.org/10.1177/14799731211063231>.
- Adedeji, J.A., Oluqbenga, A.S., Hassan, M.M. (2016). *Effectiveness of communication tools in road transportation: Nigerian perspective*. <http://ir.cut.ac.za/handle/11462/1227>.

- Ahmed, S.M., Rao, P.R., Chakrabarty, N., Pothula, V.K., 2023. Counter measures to control and reduce fatal accidents by improving driving capabilities in aged adults in India. *Cognit. Sci. Technol.* 707–723. [https://doi.org/10.1007/978-981-19-2358-6\\_63](https://doi.org/10.1007/978-981-19-2358-6_63).
- Akande, A.T., 2020. Impact of driver's license status of commercial drivers and the rate of road traffic accidents in Nigeria: a case study of Abuja and Lagos. *Int. J. Sci. Technol.* 8 (5), 278. <https://doi.org/10.24940/theijst/2020/v8/i5/st2005-022>.
- Alexa, V., Cioată, V.G., Rațiu, S.A., Dascăl, A.A., 2020. Testing the functionality of the safety belts of road vehicles in the production process phase. *J. Phys. Conf. Ser.* 1426 (1). <https://doi.org/10.1088/1742-6596/1426/1/012039>.
- Alvi, U., Khattak, M.A.K., Shabir, B., Malik, A.W., Muhammad, S.R., 2020. A comprehensive study on IoT based accident detection systems for smart vehicles. *IEEE Access* 8, 122480–122497. <https://doi.org/10.1109/ACCESS.2020.3006887>.
- Alyamani, H., Alharbi, N., Roboey, A., Kavakli, M., 2023. The impact of gamifications and serious games on driving under unfamiliar traffic regulations. *Appl. Sci. (Switzerland)* 13 (5). <https://doi.org/10.3390/app13053262>.
- Ang, A., Christensen, P., Vieira, R., 2020. Should congested cities reduce their speed limits? Evidence from São Paulo, Brazil. *J. Public Econ.* 184. <https://doi.org/10.1016/j.jpubeco.2020.104155>.
- Awoniyi, O., Hart, A., Argote-Aramendiz, K., Voskanyan, A., Sarin, R., Molloy, M.S., Ciottone, G.R., 2021. Trend analysis on road traffic collision occurrence in Nigeria. *Disaster Med. Public Health Prep.* 1–7. <https://doi.org/10.1017/dmp.2021.166>.
- Băjenescu, T.M.I., 2022. Electronics: the innovation driver of the automotive industry. *EEA - Electrotehnica, Electronica, Automatica* 70 (1), 51–59. <https://doi.org/10.46904/eea.22.70.1.1108006>.
- Beanland, V., Fitzharris, M., Young, K.L., Lenné, M.G., 2013. Driver inattention and driver distraction in serious casualty crashes: data from the Australian National Crash In-depth Study. *Accid. Anal. Prev.* 54, 99–107. <https://doi.org/10.1016/j.aap.2012.12.043>.
- Bęczkowska, S.A., Grabarek, I., 2021. The importance of the human factor in safety for the transport of dangerous goods. *Int. J. Environ. Res. Public Health* 18 (14). <https://doi.org/10.3390/ijerph18147525>.
- Benlagha, N., Charfeddine, L., 2020. Risk factors of road accident severity and the development of a new system for prevention: new insights from China. *Accid. Anal. Prev.* 136, 1–15. <https://doi.org/10.1016/j.aap.2019.105411>.
- Bouhsissin, S., Sael, N., Benabbou, F., 2023. Driver behavior classification: a systematic literature review. *IEEE Access* 11, 14128–14153. <https://doi.org/10.1109/ACCESS.2023.3243865>.
- Casado-Sanz, N., Guirao, B., Attard, M., 2020. Analysis of the risk factors affecting the severity of traffic accidents on Spanish crosstown roads: the driver's perspective. *Sustainability (Switzerland)* 12 (6). <https://doi.org/10.3390/su12062237>.
- Chand, A., Jayesh, S., Bhasi, A.B., 2021. Road traffic accidents: an overview of data sources, analysis techniques and contributing factors. *Mater. Today Proc.* 47, 5135–5141. <https://doi.org/10.1016/j.matpr.2021.05.415>.
- Chand, S., Li, Z., Alsultan, A., Dixit, V.V., 2022. Comparing and contrasting the impacts of macro-level factors on crash duration and frequency. *Int. J. Environ. Res. Public Health* 19 (9). <https://doi.org/10.3390/ijerph19095726>.
- Chen, Y., Liu, X., Xu, J., Liu, H., 2022. Underestimated risk perception characteristics of drivers based on extended theory of planned behavior. *Int. J. Environ. Res. Public Health* 19 (5). <https://doi.org/10.3390/ijerph19052744>.
- Cordellieri, P., Baralla, F., Ferlazzo, F., Sgalla, R., Piccardi, L., Giannini, A.M., 2016. Gender effects in young road users on road safety attitudes, behaviors and risk perception. *Front. Psychol.* 7, 1412. <https://doi.org/10.3389/fpsyg.2016.01412>.
- Cutello, C.A., Hellier, E., Stander, J., Hanoch, Y., 2020. Evaluating the effectiveness of a young driver-education intervention: Learn2Live. *Transport. Res. F: Traffic Psychol. Behav.* 69, 375–384. <https://doi.org/10.1016/j.trf.2020.02.009>.
- Dai, W., Liu, A., Kamminga, A.C., Deng, J., Lai, Z., Yang, J., Wen, S.W., 2018. Prevalence of acute stress disorder among road traffic accident survivors: a meta-analysis. *BMC Psychiatry* 18 (1). <https://doi.org/10.1186/s12888-018-1769-9>.
- De Reuver, B., Biron, M., 2024. The effect of morning commutes on emotional exhaustion and task performance: taking mental effort and cognitive appraisal into account. *Travel Behav. Soc.* 34, 1–10. <https://doi.org/10.1016/j.tbs.2023.100697>.
- Distefano, N., 2019. Italians' public opinion on the road roundabouts safety. *Curr. Trends Civ. Struct. Eng.* 1 (5). <https://doi.org/10.33552/ctsc.2019.01.000521>.
- Druta, C., Kassing, A., Gibbons, R., Alden, V.A., 2020. Assessing driver behavior using shrp2 adverse weather data. *J. Saf. Res.* 73, 283–295. <https://doi.org/10.1016/j.jsr.2020.03.013>.
- Etika, A.A. (2018). *Developing an effective speed limit compliance intervention for Nigerian drivers*. December. <http://theses.whiterose.ac.uk/22368/>.
- Falkenstein, M., Karthaus, M., Brüne-Cohrs, U., 2020. Age-related diseases and driving safety. *Geriatrics (Switzerland)* 5 (4), 1–28. <https://doi.org/10.3390/geriatrics5040080>.
- Farrukh, M., Lee, J.W.C., Sajid, M., Waheed, A., 2019. Entrepreneurial intentions: The role of individualism and collectivism in perspective of theory of planned behaviour. *Educ. Train.* 61 (7–8), 984–1000. <https://doi.org/10.1108/ET-09-2018-0194>.
- Fonzone, A., Fountas, G., Downey, L., 2024. Automated bus services – To whom are they appealing in their early stages? *Travel Behav. Soc.* 34 (2024), 1–16. <https://doi.org/10.1016/j.tbs.2023.100647>.
- Gonçalves, L.A.P.J., Ribeiro, P.J.G., 2020. Resilience of urban transportation systems. Concept, characteristics, and methods. *J. Transp. Geogr.* 85. <https://doi.org/10.1016/j.jtrangeo.2020.102727>.
- Guerrero, T.E., de Dios Ortuzar, J., Raveau, S., 2020. Traffic accident risk perception among drivers: a latent variable approach. *Transp. Plan. Technol.* 43 (3), 313–324. <https://doi.org/10.1080/03081060.2020.1735763>.

- Han, W., Zhao, J., 2020. Driver behaviour and traffic accident involvement among professional urban bus drivers in China. *Transport. Res. F: Traffic Psychol. Behav.* 74, 184–197. <https://doi.org/10.1016/j.trf.2020.08.007>.
- Hasan, M.F., Mahmud, S.M.S., Raihan, M.A., Akter, A., Bhattacharjee, A., 2023. Motorcyclist safety risk and attitude to using helmet. *J. Eng. Sci.* 13 (2), 11–20. <https://doi.org/10.3329/jes.v13i2.63722>.
- He, D., DeGuzman, C.A., Donmez, B., 2023. Anticipatory driving in automated vehicles: the effects of driving experience and distraction. *Hum. Factors* 65 (4), 663. <https://doi.org/10.1177/00187208211026133>.
- Herrero-Fernández, D., Parada-Fernández, P., Oliva-Macías, M., Jorge, R., 2020. The influence of emotional state on risk perception in pedestrians: a psychophysiological approach. *Saf. Sci.* 130. <https://doi.org/10.1016/j.ssci.2020.104857>.
- Honavar, S., 2022. Should visual function tests be mandatory for a driving license? *Indian J. Ophthalmol.* 70 (6), 1871–1874. [https://doi.org/10.4103/ijoo.IJO\\_1273\\_22](https://doi.org/10.4103/ijoo.IJO_1273_22).
- Hong, W., Liu, R.D., Ding, Y., Sheng, X., Zhen, R., 2020. Mobile phone addiction and cognitive failures in daily life: The mediating roles of sleep duration and quality and the moderating role of trait self-regulation. *Addict. Behav.* 107, 1–8. <https://doi.org/10.1016/j.addbeh.2020.106383>.
- Høy, A., 2020. Speeding and impaired driving in fatal crashes—Results from in-depth investigations. *Traffic Inj. Prev.* 21 (7), 425–430. <https://doi.org/10.1080/15389588.2020.1775822>.
- Hsu, C.K., 2024. Reconsidering seasonality, weather, and road safety in non-temperate areas: the case of Kaohsiung, Taiwan. *Travel Behav. Soc.* 34, 1–10. <https://doi.org/10.1016/j.tbs.2023.100710>.
- Hu, L., Bao, X., Wu, H., Wu, W., 2020. A study on correlation of traffic accident tendency with driver characters using in-depth traffic accident data. *J. Adv. Transp.* 2020. <https://doi.org/10.1155/2020/9084245>.
- Hu, L., Bao, X., Lin, M., Yu, C., Wang, F., 2021. Research on risky driving behavior evaluation model based on CIDAS real data. *Proc. Inst. Mech. Eng., Part D: J. Automobile Eng.* 235 (8), 2176–2187. <https://doi.org/10.1177/0954407020985972>.
- Idris, A.M., Mustapha, A., 2019. *Safety and Highway Codes: A Guide to Motor Vehicle Driving*. Usmanu Danfodiyo University Press.
- Inuwa, N., Jikan-Jatum, A.M., Bello, D.H.Y., 2017. Motorcycles health and traffic safety: evidence from commercial motorcyclists in Gombe State, Nigeria. *J. Arts Humanities* 6 (5), 33. <https://doi.org/10.18533/journal.v6i5.1101>.
- Islam, M., Ali Khan, M., Hossain, M., Mani, K.C., Min, R., 2020. Road traffic accidents in Bangladesh: why people have poor knowledge and awareness about traffic rules? *Int. J. Crit. Illness Injury Sci.* 10 (2), 70–75. [https://doi.org/10.4103/IJCIS.IJCIS.65\\_19](https://doi.org/10.4103/IJCIS.IJCIS.65_19).
- Iversen, H., 2004. Risk-taking attitudes and risky driving behaviour. *Transport. Res. F: Traffic Psychol. Behav.* 7 (3), 135–150. <https://doi.org/10.1016/j.trf.2003.11.003>.
- Jain, P., Mudgal, V., Niranjan, V., Pal, V., 2021. A study of road rage in India. *Eur. Psychiatry* 64 (S1), S711–S. <https://doi.org/10.1192/j.eurpsy.2021.1884>.
- Khan, S.ur.R., Khalifah, Z.B., Munir, Y., Islam, T., Nazir, T., Khan, H., 2015. Driving behaviours, traffic risk and road safety: comparative study between Malaysia and Singapore. *Int. J. Inj. Contr. Saf. Promot.* 22 (4), 359–367. <https://doi.org/10.1080/17457300.2014.925938>.
- Khanpour, A., King, M., Sheykhsfard, A., Haghghi, F., 2023. Drivers' reported crash history, sensitivity to reward and punishment, personality, and demographics: a case study in Iran. *Transp. Res. Interdiscip. Perspect.* 21 (March 2022), 100902. <https://doi.org/10.1016/j.trip.2023.100902>.
- Kim, S.H., Kim, Y.J., Jeong, Y.J., Park, J.H., Lee, S.Y., Choi, M.S., Kim, S.Y., 2021. Construction of a non-contact community treatment center for asymptomatic and mildly symptomatic COVID 19 patients during the COVID-19 pandemic. *Epidemiol. Infect.* 149, e111.
- Kolsi, S., Hentati, S., Baati, I., 2021. Matricide in psychotic patients: about 3 case reports. *Eur. Psychiatry* 64 (S1), S538–S. <https://doi.org/10.1192/j.eurpsy.2021.1435>.
- Konyeha, S., Osa, E., 2020. Deployment of vanets infrastructure to aid road transport systems in developing countries. *Eur. J. Electr. Eng. Comput. Sci.* 4 (6). <https://doi.org/10.24018/ejece.2020.4.6.253>.
- Kummeneje, A.M., Rundtom, T., 2020. Attitudes, risk perception and risk-taking behaviour among regular cyclists in Norway. *Transport. Res. F: Traffic Psychol. Behav.* 69, 135–150. <https://doi.org/10.1016/j.trf.2020.01.007>.
- Lalla-Edward, S.T., Fischer, A.E., Venter, W.D.F., Scheuermaier, K., Meel, R., Hankins, C., Gomez, G., Klipstein-Grobusch, K., Draaijer, M., Vos, A.G., 2019. Cross-sectional study of the health of southern African truck drivers. *BMJ Open* 9 (10). <https://doi.org/10.1136/bmjopen-2019-032025>.
- Larocca, A.P.C., Ribeiro, R.L., da Cruz Figueira, A., de Oliveira, P.T.M.e.S., Lulio, L.C., Rangel, M.A.C., 2018. Analysis of perception of vertical signaling of highways by drivers in a simulated driving environment. *Transport. Res. F: Traffic Psychol. Behav.* 58, 471–487. <https://doi.org/10.1016/j.trf.2018.06.034>.
- Leavy, P., 2019. *Research Design*. The Guilford Press, New York.
- Li, Z., Man, S.S., Chan, A.H.S., Zhu, J., 2021. Integration of theory of planned behavior, sensation seeking, and risk perception to explain the risky driving behavior of truck drivers. *Sustainability (Switzerland)* 13 (9). <https://doi.org/10.3390/su13095214>.
- Liu, X., Huang, S., Chen, Q., 2023. Analysis of the causes of expressway traffic accidents based on statistics of accidents on the Hunan Provincial expressway in 2012–2018. *Transp. Saf. Environ.* <https://doi.org/10.1093/tse/tdad010>.
- Lobanova, Y., Evtiukov, S., 2020. Role and methods of accident ability diagnosis in ensuring traffic safety. *Transp. Res. Procedia* 50, 363–372. <https://doi.org/10.1016/j.trpro.2020.10.043>.
- Lyon, C., Mayhew, D., Granié, M.A., Robertson, R., Vanlaar, W., Woods-Fry, H., Thevenet, C., Furian, G., Soteropoulos, A., 2020. Age and road safety performance: focusing on elderly and young drivers. *IATSS Res.* 44 (3), 212–219. <https://doi.org/10.1016/j.iatssr.2020.08.005>.
- Machado-León, J.L., De Oña, J., De Oña, R., Eboli, L., Mazzulla, G., 2016. Socio-economic and driving experience factors affecting drivers' perceptions of traffic crash risk. *Transport. Res. F: Traffic Psychol. Behav.* 37, 41–51. <https://doi.org/10.1016/j.trf.2015.11.010>.
- Mairean, C., Havârneau, G.M., Barić, D., Havârneau, C., 2022. Cognitive biases, risk perception, and risky driving behaviour. *Sustainability (Switzerland)* 14 (1). <https://doi.org/10.3390/su14010077>.
- Mekonnen, T.H., Tesfaye, Y.A., Moges, H.G., Gebremedin, R.B., 2019. Factors associated with risky driving behaviors for road traffic crashes among professional car drivers in Bahirdar city, northwest Ethiopia, 2016: a cross-sectional study. *Environ. Health Prevent. Med.* 24 (1). <https://doi.org/10.1186/s12199-019-0772-1>.
- Mohammed, K.A., 2021. Assessment of Traffic safety problems and awareness of road users, the case of Shashemene Town. *Int. J. Transp. Eng. Technol.* 7 (2), 33. <https://doi.org/10.11648/j.ijtet.20210702.11>.
- Mustapha, A., Abdul-Rani, A.M., Saad, N.B., Mustapha, M., 2022. Association of road user intrapersonal behaviours to road signs compliance and their relationship to road traffic accidents in Nigeria: a pilot study. *SSRN Electron. J.* <https://doi.org/10.2139/ssrn.4204391>.
- Mustapha, A., Abdul-Rani, A.M., Saad, N., Mustapha, M., 2024. Road safety officers' perceptions of awareness and compliance to safety measures among oil and gas tanker drivers in north-central Nigeria: implications for sustainable development goals. *IATSS Res. Interdiscip. Stud.* 6 (2), 131–145. <https://doi.org/10.5281/zenodo.11634567>.
- Obeidat, M.S., Rababa, M.M., Tyfour, W.R., 2022. Effects of vehicle's human machine interface devices on driving distractions. *Theor. Issues Ergon. Sci.* 23 (4), 414–434. <https://doi.org/10.1080/1463922X.2021.1975171>.
- Olapoju, O.M., Olawole, M.O., 2018. Understanding the spatial patterns of tanker accidents in Nigeria using geographically weighted regression. *Int. J. Veh. Saf.* 10 (1), 58. <https://doi.org/10.1504/ijvs.2018.10014088>.
- Qi, W., Shen, B., Yang, Y., Qu, X., 2021. Modeling drivers' scrambling behavior in China: an application of theory of planned behavior. *Travel Behav. Soc.* 24, 164–171. <https://doi.org/10.1016/j.tbs.2021.03.008>.
- Ram, T., Chand, K., 2016. Effect of drivers' risk perception and perception of driving tasks on road safety attitude. *Transport. Res. F: Traffic Psychol. Behav.* 42, 162–176. <https://doi.org/10.1016/j.trf.2016.07.012>.
- Sahoo, D., Samanta, G.P., 2021. Impact of fear effect in a two prey-one predator system with switching behaviour in predation. *Different. Equat. Dyn. Syst.* <https://doi.org/10.1007/s12591-021-00575-7>.
- Sahu, P.K., Maji, A., Nath, B., Roh, H.J., 2022. Questionnaire based study of drivers' error and violation at four-legged signalized intersection. *Transp. Lett.* 14 (9), 944–955. <https://doi.org/10.1080/19427867.2021.1961992>.
- Sayyar, A., Sadiq, M.S.K., 2018. Road traffic accidents and fatal injuries. *J. Bahria Univ. Med. Dental College* 8 (2), 129–130. <https://doi.org/10.51985/jbumdc2018039>.
- Schütz, A.C., Billino, J., Brodri, P., Polin, D., Khanh, T.Q., Gegenfurtner, K.R., 2015. Robust underestimation of speed during driving: a field study. *Perception* 44 (12), 1356–1370. <https://doi.org/10.1177/0301006615599137>.
- Sheykhsfard, A., Qin, X., Shaaban, K., Koppel, S., 2022. An exploration of the role of driving experience on self-reported and real-world aberrant driving behaviors. *Accid. Anal. Prev.* 178. <https://doi.org/10.1016/j.aap.2022.106873>.
- Sheykhsfard, A., Haghghi, F., Fountas, G., Das, S., Khanpour, A., 2023. How do driving behavior and attitudes toward road safety vary between developed and developing countries? Evidence from Iran and the Netherlands. *J. Saf. Res.* 85, 210–221. <https://doi.org/10.1016/j.jsr.2023.02.005>.
- Shrestha, N., 2021. Factor analysis as a tool for survey analysis. *Am. J. Appl. Math. Stat.* 9 (1), 4–11. <https://doi.org/10.12691/ajams-9-1-2>.
- Tarek, M.E., Abdulmajeed, A.A., Tariq, A.A., Saleh, A.A., Hany, H., Arulantham, Z.J., 2021. Heavy truck driving attitude and behavior contributing to road traffic accidents. *Int. J. Rev. Life Sci.* 11 (1), 1–15. <https://doi.org/10.26452/ijrsl.v11i1.1399>.
- Tarlochan, F., Ibrahim, M.I.M., Gaben, B., 2022. Understanding traffic accidents among young drivers in Qatar. *Int. J. Environ. Res. Public Health* 19 (1). <https://doi.org/10.3390/ijerph19010514>.
- Tilahun, N., 2023. Safety impact of automated speed camera enforcement: empirical findings based on Chicago's speed camera. *Transp. Res. Rec.* 2677 (1), 1490–1498. <https://doi.org/10.1177/03611981221104808>.
- Timmermans, C.P.M., Alhajyaseen, W.K.M., Ross, V., Nakamura, H., 2020. Introducing a multi-variate classification method: Risky driving acceptance among different heterogeneous driver sub-cultures. *J. Saf. Res.* 73, 81–91. <https://doi.org/10.1016/j.jsr.2020.02.009>.
- Touahmia, M., 2018. Identification of risk factors influencing road traffic accidents. *Eng. Technol. Appl. Sci. Res.* 8 (1), 2417–2421. <https://doi.org/10.48084/etasr.1615>.
- Umeh, P.P., Ojeh, V.N., Arisabor, L., Ikporukpo, C.O., 2018. Spatio-temporal pattern of motorcycle accidents in Anambra State, Nigeria. *Asian J. Geogr. Res.* 1 (2), 1–28. <https://doi.org/10.9734/ajgr/2018/v1i229598>.
- Uzundu, C., Jamson, S., Hibberd, D., 2020. Can infrastructure improvements mitigate unsafe traffic safety culture: a driving simulator study exploring cross cultural differences. *Transport. Res. F: Traffic Psychol. Behav.* 73, 205–221. <https://doi.org/10.1016/j.trf.2020.06.022>.
- Wang, S., Zhang, Y., Sun, L., 2023. Effects of personality traits on bus drivers' prosocial and aggressive behaviours: the moderated mediating role of risk perception and gender. *PLoS One* 18 (2 February). <https://doi.org/10.1371/journal.pone.0281473>.
- Wegman, F., 2017. The future of road safety: a worldwide perspective. *IATSS Res.* 40 (2), 66–71. <https://doi.org/10.1016/j.iatssr.2016.05.003>.
- Wu, G.F., Liu, F.J., Dong, G.L. (2020). Analysis of the Influencing Factors of Road Environment in Road Traffic Accidents. *Proceedings - 2020 4th Annual International Conference on Data Science and Business Analytics, ICDSBA 2020*, 83–85. <https://doi.org/10.1109/ICDSBA51020.2020.00028>.

- Yang, H., Hu, N., Jia, R., Zhang, X., Xie, X., Liu, X., Chen, N., 2024. How does driver fatigue monitor system design affect carsharing drivers? An approach to the quantification of driver mental stress and visual attention. *Travel Behav. Soc.* 35. <https://doi.org/10.1016/j.tbs.2024.100755>.
- Yao, Y., Zhao, X., Feng, X., Rong, J., 2020. Assessment of secondary tasks based on drivers' eye-movement features. *IEEE Access* 8, 136108–136118. <https://doi.org/10.1109/ACCESS.2020.3010797>.
- Zarocostas, J., 2011. Road safety plan aims to save five million lives in next 10 years. *BMJ (Clin. Res. Ed.)* 342. <https://doi.org/10.1136/bmj.d2918>.
- Zhao, X., Xu, W., Ma, J., Li, H., Chen, Y., 2019. An analysis of the relationship between driver characteristics and driving safety using structural equation models. *Transport. Res. F: Traffic Psychol. Behav.* 62, 529–545. <https://doi.org/10.1016/j.trf.2019.02.004>.