

Analysis of Accident Predictability and the Use of Driver Behaviour Questionnaire: A Systematic Review

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ABSTRACT

Road Traffic Accidents (RTAs) have continued to be a menace in the world with the rising increase in road crashes due to driver behaviours. Despite using the Driver Behaviour Questionnaire (DBQ) for examining driver behaviours, little is known about the variability in predicting accident. The present systematic literature review study investigated the variation of accident predictors through DBQ approach. The PRISMA procedure was used to extract the reviewed articles from Scopus database using the keywords, “Driver Behaviour Questionnaire” OR “Driver Behavior Questionnaire” OR “DBQ” AND “Accident prediction” OR “Accident Predictor” OR “Crash Prediction” OR “Crash Predictor”. Broadly, results from this review show that road traffic crash involvement is predicted by violations, car lobbying, gender, marital status, household size, daily driving time, driving skills, and time, while aberrant driving behaviours predictors are average monthly salary, driving experience, distance driven per year or annual mileage, previous crash involvement, religion beliefs, age, driving hour/day, attention regulation and impulsivity, and living without a partner. This review can aid researchers in a more detailed understanding of the variables that predict accidents, thus influencing necessary mitigation strategies from policymakers and aiding driver trainers with specialized training to alleviate accidents in drivers through training or retraining.

Keywords: Accident Prediction, Drivers, Risky Behaviours, Driver Behaviour Questionnaire, Road Traffic Accidents

INTRODUCTION

The issue of road traffic safety is a global concern that is generating research interest due to rising figures of road fatalities. Annually, over a million lives are lost due to road traffic accidents globally World Health Organization (2015). It has posed an untold danger to the wealth of nations in terms of monetary decline, affecting the gross domestic product (GDP) and calling for dire concern (Hussain et al., 2020). Thus, the need for a means to accurately predict accident occurrence to decrease the rising figures.

With the rising awareness of driving in research, studies have shown that human behaviour (factor) is the largest contributor to road crashes (Adeleke et al., 2020; Bucsházy et al., 2020; Khattak et al., 2021).

According to Petridou & Moustaki (2000), drivers' behaviour and attitude cause over 90% of road traffic accidents. Similarly, 93% of road traffic accidents are attributed to errors by men (National Highway Traffic Safety Administration, 2008). The predictability of these behaviours is possible and has led to the use of different methods in harnessing drivers' behaviour and relating them to accident involvement. One of the methods is the driver behaviour questionnaire (DBQ) which is cheap and easy for collecting large amounts of driver data.

Several authors in different countries have attempted to explain the extent of man's role in road traffic crashes by using the driver behavior questionnaire (DBQ) to examine their behavior. Some of the countries in which the DBQ studies have been carried out include India (Gupta et al., 2021), North America (Cordazzo et al., 2016), Denmark (Martinussen et al., 2013), Malaysia (Rosli et al., 2020), New Zealand (Sullman et al., 2019), East Europe (Kontogiannis et al., 2002), Serbia (Maslač et al., 2017), Australia (Stephens & Fitzharris, 2016), Nigeria (Oluwadiya et al., 2020; Taiwo et al., 2023; Taiwo, Mahmud, et al., 2024).

The DBQ is an in-depth model or constructs for measuring daily driving (driver's) behaviour (Hussain et al., 2020), the rate of the exhibition and how they trigger traffic collisions (Cordazzo et al., 2016) and has undergone several modifications, revisions, and improvement resulting in its heterogeneity (with respect to versions) from different researchers (Cordazzo et al., 2016; Özkan & Lajunen, 2005). It was introduced by Reason et al. (1990) with the motive of delineating errors and violations as a result of the thoughts that they stem from dissimilar psychological sources (Cordazzo et al., 2016). Therefore, the theory of DBQ is centered on distinguishing the difference between errors and violations with the premise that they both have varying initiating and triggering sources psychologically, thus differing in intervention (Reason et al., 1990). In understanding the concept of error, Reason (1990, p.9), described it as a "generic term to encompass all those occasions in which a planned sequence of mental or physical activities fails to achieve its intended outcome and when these failures cannot be attributed to the intervention of some chance agency."

As a behavioral questionnaire, the DBQ stands out with a superimposing advantage of creating the borderline between intentional and unintentional aberrant practices (Hezaveh, Nordfjærn, et al., 2018; Useche et al., 2020). In grasping the diversities in risk drivers' behavior, the DBQ is a tested and proven tool (De Winter & Dodou, 2010) that has been used in France for the elderly (Gabaude et al., 2010), Nigeria for Taxi drivers (Taiwo, Hassan, et al., 2024), Spain for long-haul professional drivers (Useche et al., 2021). It has been used for over 30 years with different versions, and it still stands as a crucial instrument for risky behavioral analysis (B. Hussain et al., 2020; Useche et al., 2021) ranging from the variation of drivers' behavior across cultures, and aberrant driving behavior (for instance in De Winter & Dodou, 2010; Guého et al., 2014; Hussain & Shi, 2019). Despite the use of DBQs, little is known about their precise and specific use as a means to arrive at predicting road traffic accidents.

Although the DBQ has been useful in driver behaviour studies (Cordazzo et al., 2016), its use across all continents and accident predictive capabilities are sparse. This review is aimed at examining how the prediction of the driver behavior questionnaire varies concerning accident predictors by analyzing previous studies across factors, countries, analytical methods, and categories of drivers to identify disparities and similarities in their findings to suggest areas that need clarity through more research and analysis.

METHOD

Prisma Statement and Protocol

Referred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) were adopted for this review. The plethora of procedures for conducting the process of systematic literature review has been

provided by the PRISMA statement, including the collection of items that aid in robust and quality improvement when executing systematic review and meta-analysis. The original purpose of the PRISMA method was to handle cases of suboptimal reporting in the medical field, but was upgraded to include manifold conceptual and practical advances in the science of systematic reviews and other types of research (Moher et al., 2009).

One peculiarity and novelty about the PRISMA method is its use in comparative analysis of studies hinged on experiments as a result of the process in which experiments that are done could influence their result, thus, there is less rigor for analysis that is a general review. A detailed documented report on the process adopted to extract articles which is known as the protocol is a requirement for systematic review publications as it aids replication, comparison, and extrapolation for other studies towards assessing the method of review (Bobermin et al., 2021).

Eligibility Criteria

The selection criteria were based on the PRISMA statement (Moher et al, 2009). First, this review search mainly focused on mapping existing literature on the “Driver Behaviour Questionnaire” and “accident prediction” in engineering, social sciences, computer sciences, accident prevention, psychology, and environmental science.

The search span was from the Scopus database inception to 2023. The search also focused on all countries without any exclusion i.e., all existing articles from any country were included. 213 research articles were excluded at this stage, leaving 42 records to be extracted. An additional 20 articles were found and included through further snowball searching.

Search Strategy

For this systematic search, we developed a search strategy to identify relevant literature. This search strategy was tailored to the Scopus database and the search terms used were the following: “Driver Behaviour Questionnaire” OR “Driver Behavior Questionnaire” OR “DBQ” AND “Accident prediction” OR “Accident Predictor” OR “Crash Prediction” OR “Crash Predictor”. All searches spanned from database inception until 2023 and included journal articles and conference papers published in English only. The search through advanced search was limited to open access articles from subject areas like engineering, social, sciences, computer science, multidisciplinary, psychology, and environmental science. Only documents at the final stage of publication were selected.

Quality Assessment

The study is based only on original research articles, and conference papers. To maintain the quality of the review, all duplications were checked thoroughly. Abstracts were painstakingly checked for the analysis and purification of the articles to ensure the quality and relevance of academic literature included in the review process. A careful evaluation of each research paper was carried out later by reading through all the articles. The next exclusion was to limit the papers published only in English. Furthermore, after the filtration of duplicate records. We selected 28 articles after assessing each article on the aforementioned inclusion and exclusion criteria. Figure 1 shows the methodology adopted.

Data Extraction

In the data extraction phase, 28 articles were selected, and the characteristics extracted were:

1. The article must be an original paper, and a conference paper. Published reports were excluded.
2. The article must be in the English language and from the field of engineering, transportation safety,

- traffic psychology, social science, computer science, environmental science, accident and prevention.
- 3. Extracted articles were published between the inception of Scopus and to 2023
- 4. The extracted papers were from all countries with published articles that matched our search criteria.

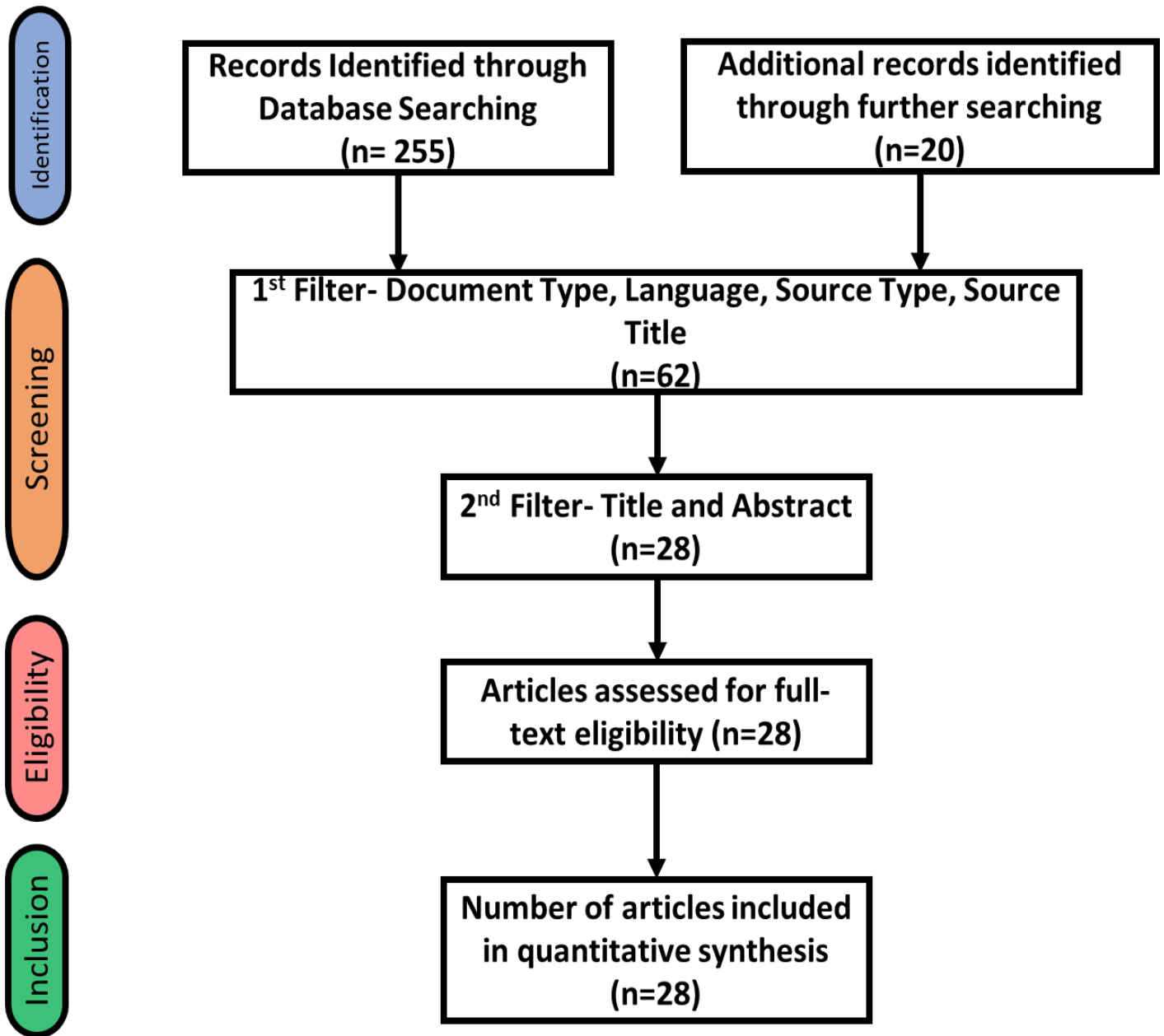


Fig. 1: PRISMA Procedure used to Select Studies for Review and Synthesis

Publication Growth by Year and Citation

The distribution of research articles by year of publication assists researchers in determining and comprehending the evolution of the topic under review (Zakaria et al., 2021). The chart distribution of published articles from the beginning of Scopus database until 2023 (Figure 2) indicates gradual growth in the number of publications from 2008 to 2015, when there is a sharp increase in the number of publications. Also, researchers’ resurgence in driver behavior questionnaire studies and accident prediction is reflected in 2020 with 5 publications. The sharp decline from the year 2020 may be due to the COVID-19 pandemic, which affects global economic activities and inclusive research. There seems to be a gradual rise from 2022 to 2023, indicating a rebound for more studies on DBQ and road traffic accident prediction.

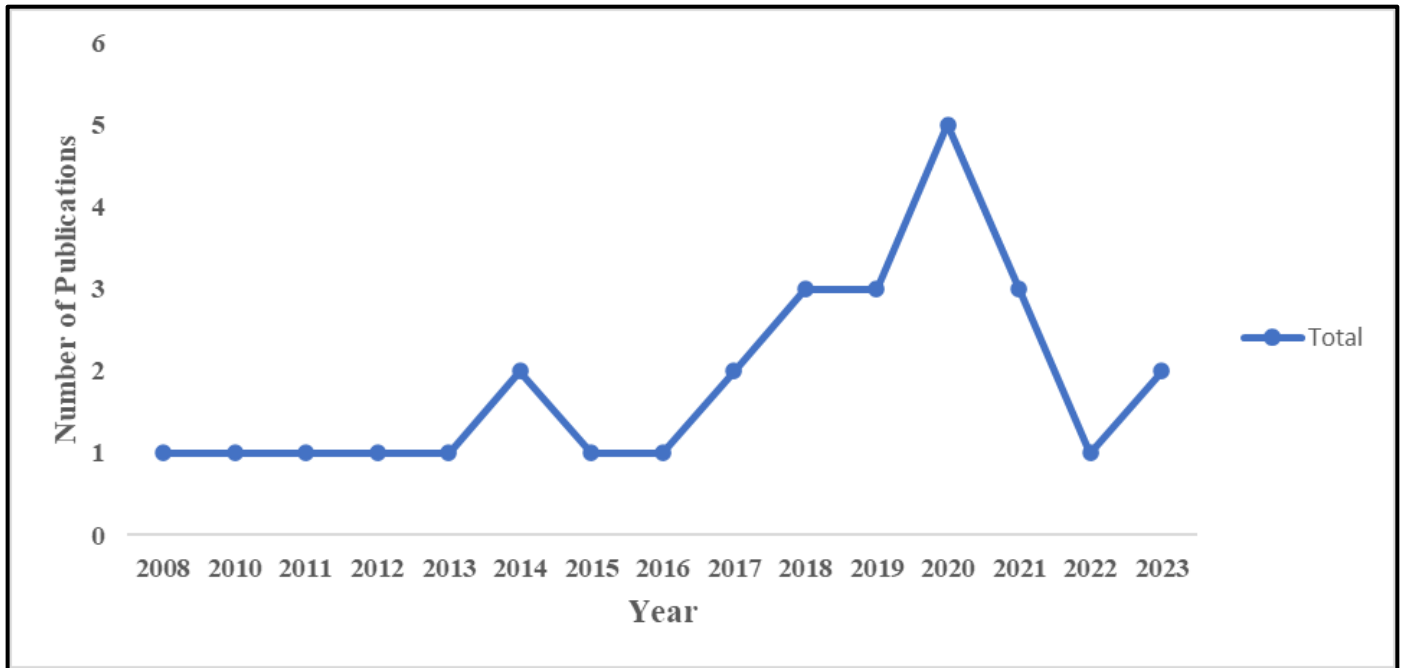


Figure 2: Research Article Distribution by Year

The number of citations for the articles were also analysed. The citations of the publications show that the older articles had the highest citations, with Wickens et al. (2008) and Rowden et al. (2011) having over a hundred citations. Some of the recent articles from 2020-2023 had low citations, as shown below (Figure 3). This may indicate slow-growing interest in the DBQ and accident prediction in recent articles but expected to rise with time.

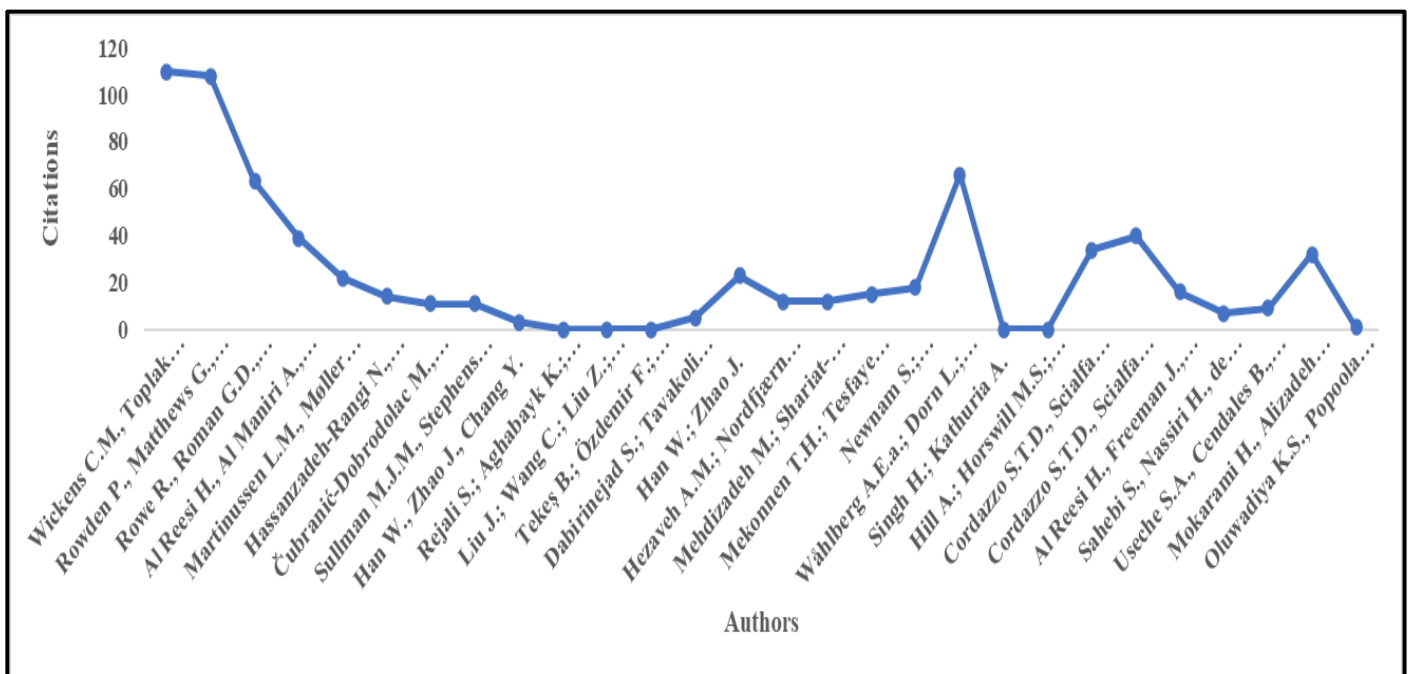


Figure 3: Citation by Author

Publication Distribution by Country

Figure 4 depicts the distribution of publications in various countries. This analysis was carried out to view

and understand the distribution of the reviewed articles concerning accident prediction using the DBQ. The highest publications were found to appear in Iran, followed by Australia, then China and the United Kingdom, which suggests most of the studies have been carried out in high-income countries with good road networks compared to low-income countries. There is a need for accident prediction studies using the DBQ to be encouraged in low-income countries with high road accident deaths and injuries. Among the reviewed articles, only one did not include study location(country) and was indicated as non in Figure 4.

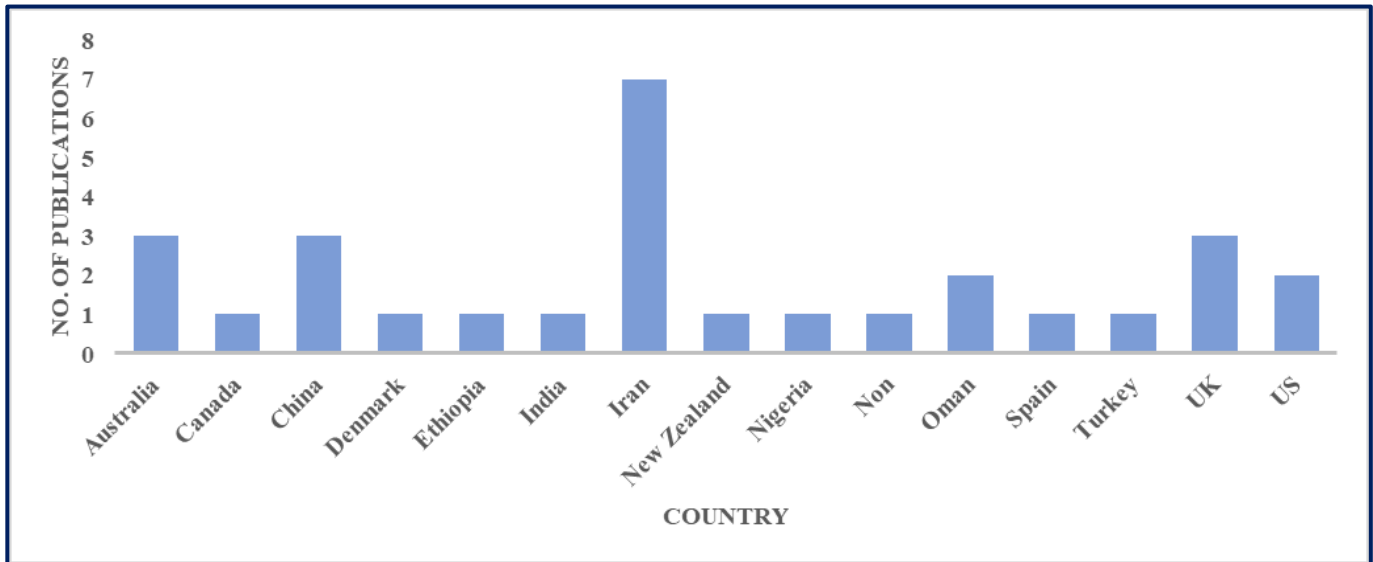


Figure 4: Articles Publication per Countries

Analytical Methods

The 28 studies reviewed utilized different analytical techniques, mostly regression analysis and different regression models (logistic regression and multiple regression), and just a few used structural equation modeling (SEM) (Figure 5).

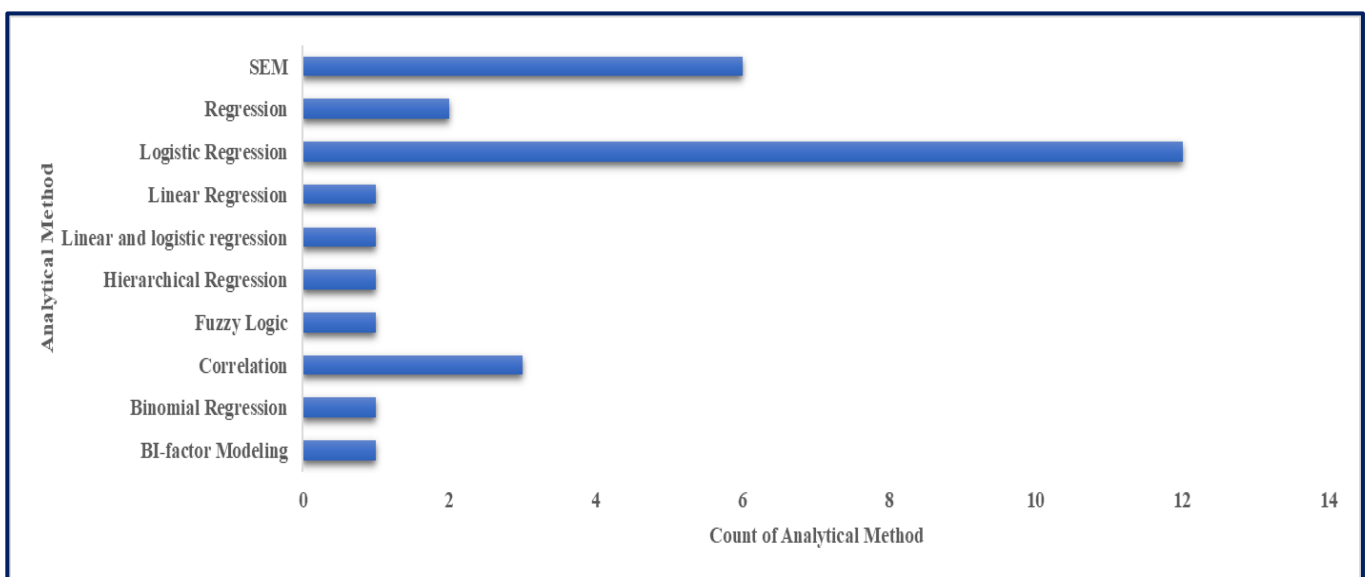


Figure 5: Article Distribution by Analytical Method

Only one article used bifactor modeling to predict crash involvement (Rowe et al., 2015) with 19 of the 28 articles using regression technique (logistic, binomial and multiple regressions) as the predictive analytical

method (Hezaveh, Nordfjærn, et al., 2018; L. M. M. Martinussen et al., 2017; Rejali et al., 2022). Similarly, 6 of the 28 used second-generation SEM techniques for their prediction articles (Dabirinejad et al., 2020; Mehdizadeh et al., 2018). There are only 2 articles that specifically use only correlation analysis due to the investigation of associations between variables (af Wåhlberg et al., 2010; Teke et al., 2020). Fuzzy logic was also adopted by one article (Čubranić -Dobrodolac et al., 2020).

The study of Mehdizadeh et al. (2018) is the only study that tested the direct and indirect relationships between background variables, aberrant driving behavior (through the identified DBQ factors and accident involvement among lorry drivers in Iran with the Structural Equation Modeling method (SEM). The use of the SEM for accident prediction studies is considered more reliable and less biased than traditional statistical techniques (Dangi et al., 2019).

RESULTS

All 28 articles reviewed in the study are summarized in Table 1. Most of the studies centered on accident prediction with the use of the DBQ while some focus on improving the use of the DBQ in driver behavior studies. The reviewed studies are tabulated below, indicating the year of publication, sample size, country, the class of drivers studied, predictors, predicted variables, type of DBQ, and prediction method. The reviewed article distribution based on the year of publication indicated that 2020 had the highest number after a gradual increase from the inception of publication in the Scopus database.

Table 1 Summary of Studies Selected

Authors/Year	Sample Size	Country	Class of Drivers	Predictors	Predicted Variable	DBQ	Method of Prediction
Singh & Kathuria (2023)	135	India	Bus Rapid Transit Drivers	violations, errors, and positives behaviour, education, driving experience, and alcohol consumption	Crash Involvement	26-Item DBQ	Logistic Regression
Hill et al. (2023)	122	Australian	General Drivers	Ordinary violations	Speed	20-Item DBQ	Binomial Regression
Rejali et al. (2022)	548	Iran	Taxi Drivers	Aggressive Violation ^a Ordinary Violation ^a Inattention Errors ^b Aggressive Violations ^b	High Risk Drivers ^a Medium/High Risk Drivers ^b	27-Item DBQ	Logistic Regression
Useche et al. (2021)	982	Spain	Long Haul Drivers	Fatigue and job stress	Risky driving behaviour	8-Item DBQ	SEM

Oluwadiya et al. (2020)	600	Nigeria	General Drivers	Aggressive and ordinary violation, Age, experience, and alcohol	Crash involvement	19-Item DBQ	Logistic Regression
(J. Liu et al. (2021)	266	China	Mixed Drivers	Educational Background Crash Involvement Risk perception Driving Experience Age	Errors Lapses Violations	50-Item DBQ	Multiple Linear Regression
Han et al. (2021)	202	China	Semi-trailer truck drivers	Negligence, lapses, driving time	Traffic accidents	20-Item DBQ	Logistic regression
Teke et al. (2020)	203	Turkey	Young Drivers	Past Positive and future time perspective	Safety Skills Errors Violations	28-Item DBQ	Zero-Order Correlation
Dabirinejad et al. (2020)	1260	Iran	Car Drivers	Car Lobbying Religion and Morality Culture	Errors Lapses Ordinary Violations Aggressive Violations	28-Item DBQ	Structural Equation Modeling
Han & Zhao (2020)	220	China	Bus Drivers	Driving Time Positive Driving Behaviour Driving Safety Aberrant Driving Behaviour	Traffic Accident	40-Item DBQ	Logistic Regression

Čubranić-Dobrodolac et al. (2020)	305	Not Specified	Drivers (private, bus and truck drivers)	Barratt impulsiveness scale, aggressive driving behaviour questionnaire, Manchester driver attitude questionnaire, questionnaire for self-assessment of driving ability	Propensity for Traffic accidents	20-Item DBQ	Fuzzy logic
Sahebi et al. (2019)	712	Iran	General drivers	Speed and non-speeding violations	Accident involvement	29-Item DBQ	Linear and logistic regression
Mokarami et al. (2019)	336	Iran	Public Bus Drivers	Unsafe behaviours (violation)	Accidents	46-Item DBQ	SEM
A. M. Hezaveh et al. (2018)	632	Iran	Mixed Drivers	Violation Causing Inattention Speeding and Pushing Violations	Accident (Self-Reported Crashes)	28-Item DBQ	Logistic Regression
Al Reesi et al. (2018)	1319	Oman	Young Drivers	Mood driving, speeding, distracted driving, fatigue, and close following	Crash Involvement	26-Item DBQ	Logistics Regression
Mehdizadeh et al. (2018)		Iran	Lorry Drivers	Ordinary Violation Aggressive Violation	Accident	27-Item DBQ	Structural Equation Modeling
Sullman et al. (2017)	339	New Zealand	Truck drivers	Safety climate	Accident involvement	28-Item DBQ	SEM
Martinussen et al. (2017)	3683	Denmark		Violating unsafe drivers, gender, living without a partner, criminal record for non-traffic offense	Traffic offense	Not Specified	Logistic regression

Mekonnen et al. (2019)		Ethiopia	Car Drivers	Average monthly salary, driving experience, distance travel per year, previous crash involvement	Accident	Not reported	Multi-Variable Logistic Regression
Cordazzo et al. (2016)	3295	US	General Drivers	Inattention Errors, Age-Related Problems, Distraction and Hurry, and Aggressive Violations	At fault collisions and police citations	105-Items DBQ	Logistic Regression
Rowe et al. (2015)	12012	UK	Mixed Novice Drivers	Ordinary Violation General Factor	Crash Involvement	27-Item DBQ	Bi factor Modeling
Hassanzadeh-Rangi et al. (2014)	190	Iran	Bus Drivers	Occupation cognitive failure	deliberate violations, unintended violations, driving slips and driving mistakes	50-Item DBQ	Logistic regression
Cordazzo et al. (2014)	2902	US	General Drivers	Violation and lapses	Self-Reported Accidents	36-Item DBQ	Logistics Regression
Al Reesi et al. (2013)	1003	Oman	University Students and Staff	Driving experience, history of offences, errors, and aggressive violation	Road traffic crash	26-Item DBQ	Regression
Newnam & Vonschuckmann (2012)	248	Australia	Occupational Drivers	Organizational Factors	Occupational DBQ	20-Item DBQ	Hierarchical Regression
						12-Item ODBQ	
Rowden et al. (2011)	247	Australia	Public Sector Employee	DSI negative affect; DSI risk taking; and extraneous influences	Lapses, errors, and violation	24-Item DBQ	SEM

af Wählberg et al. (2010)	10,935	UK	Bus Drivers, Fleer Drivers, Police Drivers, Truck Drivers	Correlation of Accidents (Recorded and Self-reported crashes) and Social Desirability to test lie scales		Not Reported	Correlation
Wickens et al. (2008)	115	Canada	Undergraduate Students	Attention Regulation Impulsivity	Errors, Gender, and Violations	24-Item DBQ	Regression

Measurement of Driving Behavior of Drivers

The measurement techniques used to measure driving behavior and self-reported crashes were the same across all the studies. Specifically, concerning the DBQ, all the selected articles used the DBQ since the respondents were drivers. However, some studies used other scales in conjunction with DBQ. For instance, Teke et al. (2020) used DBQ and Time Perspective Inventory (TPI), and Driving Skill Inventory (DSI), while Liu et al. (2021) and Martinussen et al. (2017) applied DBQ and DSI. The participants in all the studies were asked to select values on a scale like a 5-6-point Likert scale, with the lowest values representing never and the highest representing that the drivers always indulge in aberrant driving behaviour.

There are different methods of data collection for self-reported accidents or crashes for drivers. The approaches used in the selected studies are all the same, i.e., self-reported questionnaires that are subject to respondents. The use of the questionnaires could be due to the advantages it offers to researchers in terms of low resource intensity, the possibility of collecting large volumes of data from large respondents or participants, ease of diverse analysis, cost reduction compared to simulators or instrumented vehicles (Isabel et al., 2020).

Some of the studies used the existing original DBQ developed by Reason et al. (1990) with different modifications, for instance, Taiwo et al. (2024) and Han & Zhao (2020) used the modified DBQ for commercial drivers (truck and taxi drivers) and bus drivers respectively while Newnam & Vonschuckmann (2012) used the occupation DBQ which is different from the Reason et al's DBQ.

There are objective methods for data collection which involve adopting real-world and naturalistic methods (Huang et al., 2020). This objective method may include using an observer who is not biased but knowledgeable in driving to observe, assess, and score the driving performance of respondents (Wood et al., 2008), the on-board diagnostic port which is an installed device that automatically records live driving behavior patterns (Blanchard & Myers, 2010), and using driving simulations (Freund et al., 2005). In some cases, both subjective self-report method and objective method may be used jointly for driving data collection (Huang et al., 2020).

DBQ Variations

Different variations of the DBQ have evolved from the original 50-item DBQ developed by Reason et al. (1990) due to culture, environment, types of respondents, and ease. The 20-Item and 28-Item DBQ were commonly used versions among the articles reviewed. Also, all the articles used the DBQ as self-reported methods with 7 of the 28 having 27 and 28-item DBQs (Figure 6). However, using different item measures

for driver behaviour assessment may present mixed results that may not be coherent. In driver behaviour studies, using long versions of DBQ may cause respondents apathy or generate biased results due to the challenge of filling out the questionnaires. As shown in Figure 2, most articles used DBQ items within the range of 20-28 items, which may be moderate and less time-consuming for potential respondents.

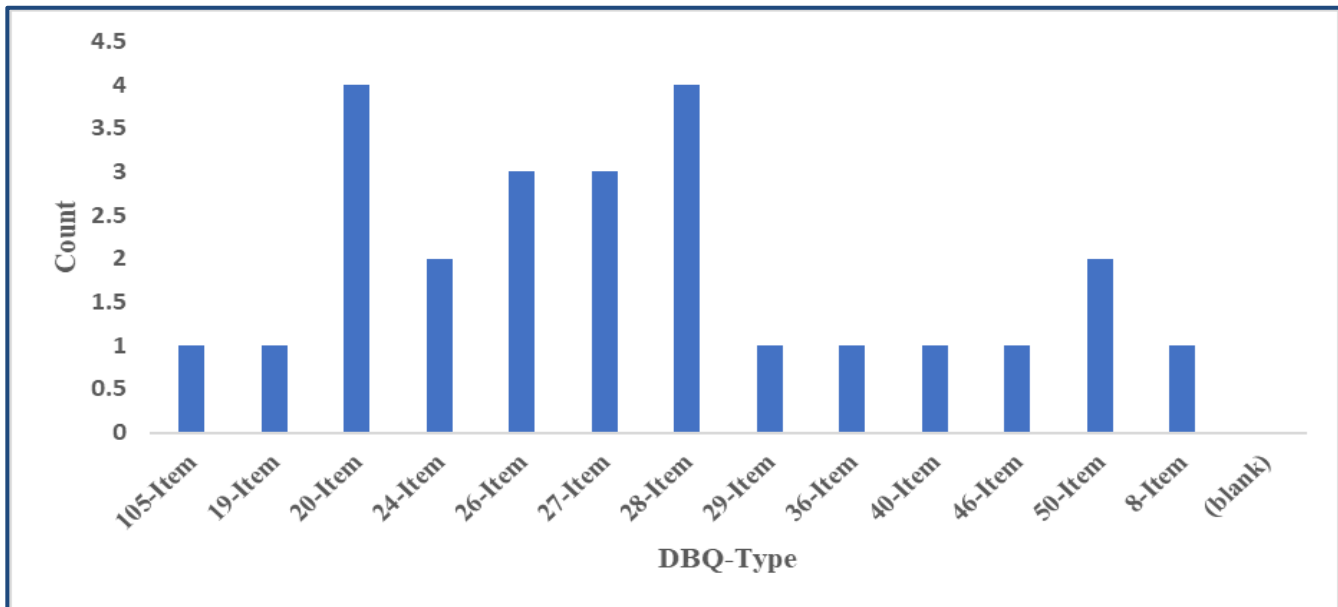


Figure 6: DBQ items Distribution

Road Traffic Crash Predictors

Different factors were investigated as predictors in the 28 articles. Only 16 of the 29 articles specifically investigated road traffic crash predictors. These predictors are dominantly driver related. They include: violation causing inattention, speeding and pushing violations (Hezaveh, Nordfjærn, et al., 2018; Sahebi et al., 2019), aggressive violation, ordinary violation (Cordazzo et al., 2014; Mehdizadeh et al., 2018; Oluwadiya et al., 2020; Rowe et al., 2015), errors and aggressive violation (Al Reesi et al., 2013; Cordazzo et al., 2016; Singh & Kathuria, 2023), unsafe behaviours (violation) or aberrant driving behaviour (Han & Zhao, 2020; Mokarami et al., 2019) positive driving behaviour (Han & Zhao, 2020; Singh & Kathuria, 2023), lapses (Cordazzo et al., 2014; Han et al., 2021), negligence (Han et al., 2021), driving safety (Han & Zhao, 2020) and safety climate (Sullman et al., 2017), , driving experience (Al Reesi et al., 2013; Mekonnen et al., 2019; Oluwadiya et al., 2020; Singh & Kathuria, 2023), average monthly salary , distance travel per year (Mekonnen et al., 2019) and driving time (Han et al., 2021; Han & Zhao, 2020), previous crash involvement(Mekonnen et al., 2019) and history of offences (Al Reesi et al., 2013). Others are barratt impulsiveness scale, aggressive driving behaviour questionnaire, manchester driver attitude questionnaire, questionnaire for self-assessment of driving ability (Ćubranić-Dobrodolac et al., 2020), age-related problems (Cordazzo et al., 2016), age (Oluwadiya et al., 2020), distraction (Al Reesi et al., 2018; Cordazzo et al., 2016) and hurry (Cordazzo et al., 2016), , mood driving, speeding, fatigue and close following (Al Reesi et al., 2018), alcohol consumption (Oluwadiya et al., 2020; Singh & Kathuria, 2023), education(Singh & Kathuria, 2023).

Risky Driving Behaviour Predictors

There is a notable difference between accidents and traffic violations, which is aberrant driving behaviour in terms of cause. According to Martinussen et al. (2017), traffic violation occurs due to a driver indulging in aberrant behaviours while accidents could occur without a driver’s direct involvement in a traffic violation. In other words, accidents could be due to other people’s reckless driving.

Risky driving behaviour were predicted by aggressive violation, ordinary violation, inattention errors, annual driving mileage (Rejali et al., 2022) past positive and future time perspective (Teke et al., 2020), fatigue and job stress (Useche et al., 2021), occupation cognitive failure (Hassanzadeh-Rangi et al., 2014), DSI negative affect; DSI risk taking; and extraneous influences (Rowden et al., 2011). Some studies also identified risky driving behaviour predictors are attention regulation, impulsivity (Wickens et al., 2008), car lobbying, religion and morality, culture (Dabirinejad et al., 2020), educational background, crash involvement, risk perception, driving experience, age, and presence of street light (Y. Liu et al., 2021), criminal record for non-traffic offence, gender, living without a partner, self-employed (Martinussen et al., 2017).

DISCUSSION

The current reviewed articles centered on the synthesis of existing knowledge on driver behaviour questionnaires and accident predictions. The synthesis of the 28 articles unveils knowledge regarding accident predictors among drivers, predicted variables, and the analytical methods for accident predictions. The helicopter view of the reviewed articles centers around the use of the driving behaviors questionnaire (DBQ) for crash involvement predictions from driver behaviors.

The Predictability of Accident Involvement among Drivers

The main findings from this article review reveal that the using DBQ, road traffic accidents among drivers is predicted through the following factors: violations (aggressive and ordinary), positive driving behaviour, lapses, negligence, driving safety and safety climate, driving experience, average monthly salary, distance travel per year and driving time, previous crash involvement and history of offences, age-related problems, distracted and hurry driving (speeding) , mood driving, fatigue and close following, alcohol consumption, and education.

Among the studies, driving violations were the most reported variables of driving behaviours that are accident predictors. This provides substantive evidence of the predictive role of driving violations among drivers in road traffic accidents. It can be argued that both aggressive and ordinary violations such as speeding, distraction, or inattention involving mobile phone use, and aggressive driving are related to accidents and can elevate the severity. Moreso, it can be assumed that the presence of aggressive and ordinary violations among drivers placing them in a high-risk group may be due to their long hours of driving, hastiness in scouting for passengers, and lack of proper training. This is in line with the study of (Han & Zhao, 2020) in which violations were found to be precursors to accident causation. These imply that violations must be curbed to curtail accidents, which can be achieved through education, campaigns, training, and enforcement.

Positive driving behaviour influence on traffic accidents can be seen as promoting a conducive and smooth driving environment for drivers and other road users. This agrees with the findings of Singh & Kathuria (2023) and Han & Zhao (2020) that positive driving behaviour creates a safe driving environment. Positive behaviours like avoiding tailgating, defensive driving, and driving with courtesy can be encouraged among drivers through safety training, retraining, and reward systems.

This review also identified lapses as a critical factor in accident prediction that is necessary to enhance driver and road safety. This can be achieved through sensitization to the danger of lapses, driver attentiveness awareness, and solutions. Lapses are also related to negligence in which drivers ignore traffic rules, road signs, risky driving behaviours, and hazardous road conditions. These are liable to make drivers susceptible to road traffic accidents because they are less likely to promptly handle emergency situations while driving. This is supported by the findings of Han et al. (2021) that negligent drivers are prone to

accidents.

Driving Safety also predicts road traffic accidents due to safety training that drivers may have received. It is expected that drivers with good safety practices show exhibit driving behaviours that promote safety and reduce traffic accidents. On the other hand, when there is a decline in driving safety, traffic accidents are expected to rise. This aligns with the study of Han & Zhao (2020).

Driving experience among drivers is a crucial factor in accident prediction as drivers with more experience are expected to exhibit better driving skills, apt decision-making abilities, more situational awareness, and possible hazard anticipation. These can aid the driver in driving defensively, thus curtailing their involvement in traffic accidents. This is consistent with the results of Singh & Kathuria (2023) and Mekonnen et al. (2019).

The tendency of the average monthly salary to predict accidents was found in the reviewed articles. This is because low-income drivers may experience financial burdens, which could lead to overworking or long hours driving, lack of rest leading to fatigue and other health-related issues, and use of poorly maintained vehicles, which can expose the drivers to accidents. Sometimes, drivers with robust incomes to cater for their financial needs may also engage in risky behaviours that precede road traffic accidents. This is based on the findings of Mekonnen et al. (2019) who found high-income drivers to be more involved in road accidents and suggested it could be due to the quest to make more money for social lifestyles. However, Han & Zhao (2020) reported decreased risky behaviours due to increased driver salary. Variations in findings may be due to types of drivers and driving environment.

Average distance traveled per year and driving time are factors that influence driver exposure to varying road conditions and driving behaviour, thus, accidents. Drivers who engage in long-distance travel and frequent travel are liable to encounter traffic congestion, complex traffic terrains, risky driving behaviours, and unfamiliar routes. These can lead to impaired driving performance, distracted driving, and fatigue, especially for long driving hours, which increase the chances of RTA. This is consistent with the findings of Han & Zhao (2020) and Mekonnen et al. (2019) that drivers who travel long distances or have more driving time are likely to exhibit more risky driving behaviours due to more opportunities to violate traffic laws.

Drivers with previous crash involvement and a history of offences have chances of being involved in accidents. This is because they have a higher risk of exhibiting risky behaviour like aggressive driving and disregarding traffic rules, resulting in crashes. This is in line with the findings of Mekonnen et al. (2019) that drivers with previous crash antecedents may adopt risky driving practices as a driving habit. However, in some cases where drivers' behaviour is addressed through training and retraining, the influence of their previous crash involvement and history of offences can depend on how they handle their experiences. In other words, previous crash history and offences can make a driver drive with more caution to avoid a repeat of a previous crash or offence.

Age-related problems are associated with accident prediction among drivers. These age-related challenges may include vision impairments and a decline in cognition and physical abilities. Specifically, vision impairment, such as a decline in visual acuity and impaired depth perception, may impair hazard perception abilities among older drivers. This could increase the likelihood of road accidents, unlike for drivers with sound visual ability. This agrees with the study of Cordazzo et al. (2016) that the higher the age-related challenges of a driver, the higher the tendency for their accident involvement.

Distracted driving among drivers is linked to accidents as this causes attention decline. Driving distraction can stem from fiddling with phones, in-vehicle technologies, and other secondary activities that divert attention from driving. Drivers guilty of such practices may be more inclined to involve themselves in an accident. Also, drivers often attempt to drive hastily due to time pressure or meeting targets and deadlines,

resulting in hurried driving or speeding, which aggravates their risk of accident involvement. This is supported by the findings of Al Reesi et al. (2018) and Cordazzo et al. (2016) that distraction among drivers results in traffic accidents.

Drivers' mood is also a critical factor that can significantly influence their accident predictability. Moods like anger, stress, excitement, and sadness can be negative or positive. A negative mood like anger can becloud a driver's decision, leading to aggressive driving, yelling at other drivers, tailgating, inappropriate lane change, over speeding, and can escalate traffic accidents. Similarly, uncontrolled excitement while driving can cause distraction, making a driver prone to accidents or risky driving. This is consistent with the findings of Al Reesi et al. (2018).

Fatigue usually develops from stress, prolonged driving, and sleep deprivation, which could impair driving performance and attention. This has been found to be an accident predictor as it increases the likelihood of occurrence due to poor alertness and fast decision-making in the case of hazards or emergencies when driving. Fatigue is connected to close following of vehicles due to decreased driving attention, making emergency stopping difficult when needed. This agrees with the results of Al Reesi et al. (2018) that fatigue can increase driver accident involvement chances.

The driving performance of drivers with alcohol consumption influence can result in accident involvement due to impaired driving attention. This is because driving under the influence of alcohol can affect driving attention, cognitive functions, attention, and ability to concisely respond to driving hazards, which can lead to accidents, as found by Oluwadiya et al. (2020) and Singh & Kathuria (2023).

The impact of education in shaping drivers' knowledge and compliance with driving safety rules is crucial. Educated drivers are expected to understand traffic signs better, driving safety requirements, and defensive driving skills that can alleviate their involvement in traffic accidents. Also, due to the tendency of education to transform attitude, highly educated drivers are likely to exhibit more courteous driving behaviour, like avoiding aggressive driving gestures and behaviour, compared to illiterate drivers. This concurs with the findings of Singh & Kathuria (2023), who found risky driving behaviours decrease as driver education increases.

The different accident predictors identified in this review may be due to differences in variations of DBQ types and cultural diversity that could have influenced the responses of the drivers in-line with the assertion of Maslač et al. (2018) that population/cultural differences and different versions of DBQs influence driver behaviour results. Furthermore, this may suggest that the influential tendencies from different analytical methods used in the different studies should not be ignored as they have varying degrees of predictive precisions.

RECOMMENDATIONS

The results in the current review show that investigating how accident prediction of drivers through the use of driver behavior questionnaires varies with regards to predictors is worthwhile. Broadly, road traffic crash involvement is predicted by driver-related behaviours. Nevertheless, it can be argued that not so much attention has been given specifically to accident prediction based on environmental and mechanical factors and driver behaviour questionnaires, especially in developing countries like Nigeria, despite the many studies on DBQs. Furthermore, only a few studies have used structural equation modeling (SEM) in accident prediction, which offers more reliable prediction and exploratory research on possible mediations to road traffic accidents among drivers.

In terms of specificity and assessing uniqueness in the class of drivers e.g., truck, bus, taxi, novice drivers, there is a need for more future studies to be specific on the class of drivers than generalizing studies and

findings for all drivers. This is because the peculiarity and uniqueness of drivers' behaviour may not be ignored, especially concerning road traffic accidents. Such studies can aid in having more precise and validated DBQ structures that fit classes of drivers. None of the studies examine composite reliability, convergent validity, discriminant validity, and effect sizes of factors using the SEM with a commercial driver sample. This could also be another peculiar line of investigation for future research.

All the DBQs in the current review focus on driver behaviours concerning driving alone but not with vehicle maintenance, which could also be a precursor to road accidents. Future DBQs should include behavioral items like "I do not carry out maintenance checks regularly," "I overuse my vehicle and exceed routine maintenance dates before going for service," etc. This will help researchers examine the human deficiency in vehicle maintenance and its influence on road traffic crashes.

Future research can broaden the scope of the investigation to include environmental and mechanical factors alongside driver behavior. This holistic approach would provide a more comprehensive understanding of road traffic accidents and facilitate the development of effective intervention strategies. Also, researchers can employ advanced analytical techniques like SEM to enhance the precision and validity of accident prediction models and better elucidate the complex relationships between various predictors and road traffic accidents.

LIMITATIONS

In general, some limitations peculiar to systematic review methods must not be ignored. The possibility of the effect of retrieval bias cannot be ruled out because only peer-reviewed journal articles in their final stage were reviewed. Likely, information from other kinds of literature (e.g., reports, thesis, books, dissertations, articles in press or not published) that may have been important is left out in the review. More so, this review excluded articles not written in English by including only articles in English; thus, language bias is possible (Cooper et al., 2019; Song et al., 2010). Some articles' tendency to be left out due to search criteria cannot be ruled out even though a systematic search procedure was adopted.

CONCLUSIONS

In conclusion, this review has aided in understanding the different predictors in drivers' behaviour concerning road traffic accidents and other risky driving behaviours. Beyond accident predictors, aberrant driving behaviours predictors in the reviewed articles are average monthly salary, driving experience, distance driver per year or annual mileage, previous car crash involvement, religious beliefs, age, driving hour/day, attention regulation and impulsivity, and living without a partner. While this review has provided knowledge of road traffic accident predictors among drivers, future research should use a better analytical method to investigate predictors for a more specific class of drivers. This will give more knowledge on accident predictors and the degree of the accident caused.

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