

# The Influence of Socio-demographics Background on the Driving Behavior: A Short Review

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REVIEW

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**Abstract** – *Reckless driving behavior might result in a higher risk of an accident. Many factors are known to be the cause of this driving behavior. One of the factors is the socio-demographic background of the driver. This study aims to review currently available literature that investigates the relationship between driving behavior and any known socio-demographic characteristics. The review also focuses on the method used in the data collection as well as the tools used to perform the analysis to correlate the driving behavior and socio-demographic background. The review found that the influence of socio-demographic background on driving behavior study has not been explored in detail especially from the ethnicity point of view. With regards to the data collection, most of the study utilised the self-report survey, in which the targeted respondents are young adults. There are also studies covering all age groups that made use of the Driving Behaviour Questionnaire, data of traffic accidents or police reports, and virtual reality to collect the data. SAS/STAT statistical software package was found to be a popular choice among researchers when analyzing the data. This review concludes that driving behavior study in the multi-racial country for instance in Malaysia should explore further the relationship between driving behavior and socio-demographic background, especially from the ethnic perspective.*

**Keywords:** Driving behavior, socio-demographics, ethnicity

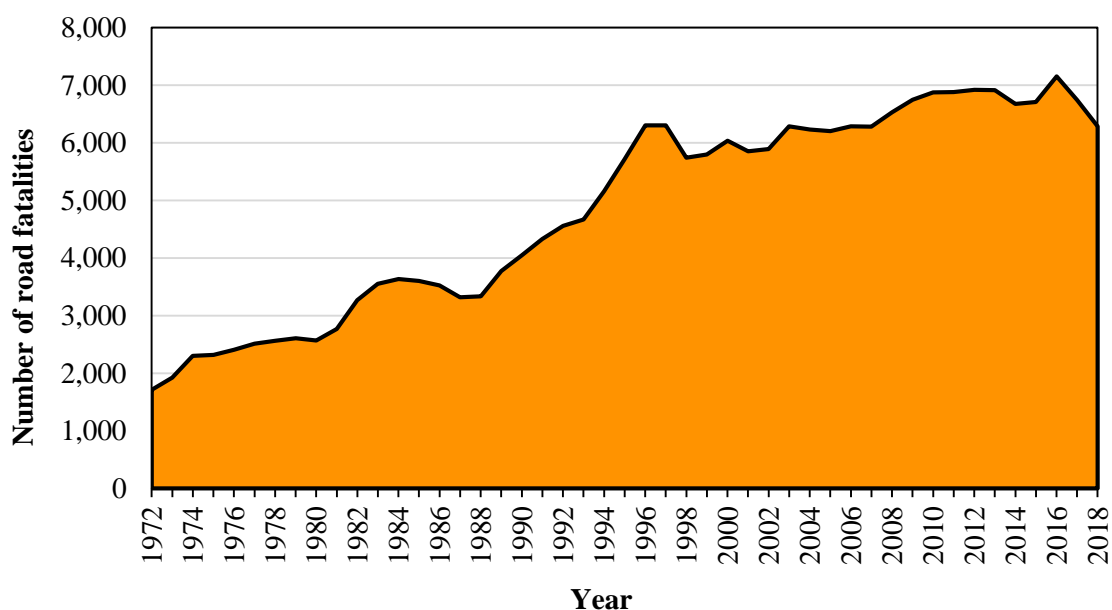
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## 1.0 INTRODUCTION

Traffic fatality has become the leading cause of death especially for children and male young adults aged 5 to 29 years old according to the Global Status Report on Road Safety 2018 by WHO (2018). It is worth to mention that road traffic accident is the only injury-related cause of death in the list, while health-related issues are the ones dominating the list of cause of death. The traffic injuries under the section of transport injuries have dominated 84.8% of the total transport injuries incidence counts in 2017 (Murray, 2018).

High-income countries such as the United States of America and Europe succeeded to reduce the rate of traffic fatality to 15.6 and 9.3 deaths per 100,000 people, respectively, but it is otherwise in the middle to low-income countries. Africa and Southeast Asia are still battling to reduce the traffic fatality rate, which is currently at the rate of 26.6 and 20.7 deaths per 100,000 people, respectively. Global stakeholders such as World Health Organization, Transport Research Laboratory, The World Bank, and the country's policymakers are struggling to deliberate the solutions to reduce the traffic fatalities. One of the current initiatives is the Decade of Action for Road Safety 2011–2020 which is proclaimed by the United Nations General Assembly. The main purpose of the campaign is to reduce road fatalities around the globe and to support Sustainable Development Goals Agenda 2030 (United Nations, 2018)

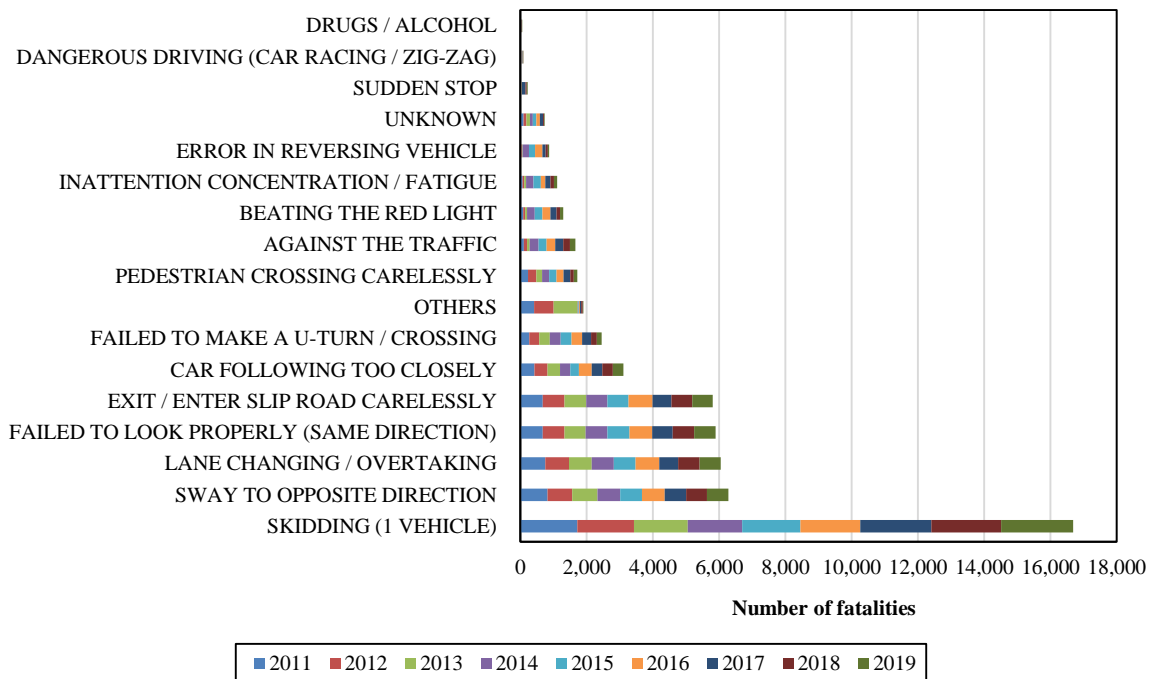
Malaysia, one of the countries in Southeast Asia also contributes to the rate of traffic fatalities. The traffic fatality cases in Malaysia are increasing from 1988 until 1996 with a sudden upsurge from 1992 until 1996 as shown in Figure 1. The number of traffic fatality cases also steadily rise above 6,000 cases since nearly two decades ago. Department of Statistics Malaysia (2019) has recorded that traffic accidents are ranked at number four in the list of Malaysian leading causes of death in 2018. In 2018, the Selangor state was reported to have the highest number of traffic fatality meanwhile Kelantan state had the highest number of injuries with a record of 1,046 fatality cases and 1,626 injury cases respectively. The number of traffic accidents cases is increased given that the increment of the registered vehicle each year.



**Figure 1:** Number of traffic fatalities in Malaysia from 1972 until 2018

Previously, the number of traffic fatalities was simulated by using Smeed’s Law. It was predicted that the number of road deaths would rise to 8,115 cases in 2015 and 9,172 cases in 2020 (Karim, 1995). Subsequently, Sarani et al. (2012) predicted the fatality cases would increase to 8,760 cases in 2015 and over 10,000 cases in 2020 by utilizing the Auto-Regressive Integrated Moving Average (ARIMA) time series model. In 2017, by using Generalized Estimating Equation - Negative Binomial Regression (GEE-NBR), Danlami et al. (2017) predicted the fatality cases in 2015 and 2020 would be 8,178 cases and 9,324 cases, respectively. These predictions had an error of between 21% to 30.6% as compared to the actual fatality cases. Conversely, Radzuan et al. (2020) above all has improved the prediction by only 4.6% error to the actual traffic fatality cases in 2015 by means of a machine learning algorithm (Radzuan, Hassan, Abdul Majeed, et al., 2020; Radzuan, Hassan, Majeed, et al., 2020) with the predicted traffic fatality number of 6,399 cases. These predictions are an elementary step to a national road safety plan because the target of traffic fatality reduction must be defined before the implementation of any road safety regulation, education and training, improvements in road safety engineering and media campaign.

Drivers, vehicle drivability, and road environment have an influence on safe driving. The interrelationship among these three characteristics must be well-understood by traffic and highway engineers in order to administer safer facilities and traffic control services to the other traffic users. Nonetheless, the traffic is hard to be controlled due to the variety of drivers’ behavior and skills, different vehicle operating capabilities, and highway design as well as natural surroundings that might be unpredictable at times. Figure 2 shows the causes of traffic fatalities in Malaysia from 2011 until 2019. Almost all the listed factors are related to driving behavior which traffic accidents can be avoided if safe driving behavior is implemented and thus minimizing driving errors.



**Figure 2:** The causes of road traffic fatalities in Malaysia from 2011 until 2019

Driving behavior is a unique issue because it depends on individual personality and the environment of the traffic occurrence. It may differ from one individual to another, yet it also may differ at different times of traffic occurrence scenario. Most researchers need to generate surveys to understand the perception and behavior in a community to investigate an issue including traffic behavior. For that matter, a mutual parameter should be defined to describe the pattern of driving behavior. This study aims to perceive the mutual socio-demographics background based on previous studies then focused on their correlation to driving behavior.

## 2.0 METHODOLOGY

Published articles before October 2020 were searched in the Scopus database. Scopus digital library is a reliable database with a significant amount of peer-reviewed scientific journals, books and conference proceedings that contains more than 22,800 serial titles and 150,000 books by over 5,000 publishers worldwide. The keyword search in Scopus digital library was divided into three main focuses: the main topic, the method of data collection, and socio-demographics background as listed in Table 1.

The authors enhanced the synonym of “driving behavior” to alternative words such as “driving attitude” and “driving ethics” to avoid missing any relevant articles. This also applies when searching for articles related to the method of data collection and socio-demographic features as listed in Table 1. Boolean operators, truncation, and phrase searching were used to ensure an appropriate keyword combination is achieved.

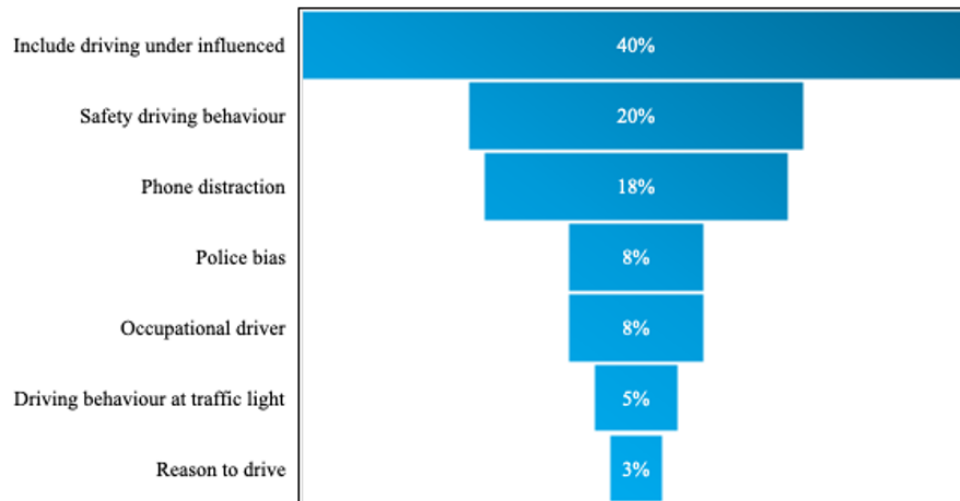
**Table 1:** Articles search configuration

<b>Keyword A: Main topic</b>	<b>Keyword B: Data collection method</b>	<b>Keyword C: Socio-demographics background</b>	<b>Time span</b>	<b>Target fields</b>
Driving behavior, Driving attitude, Driving ethics.	Questionnaire, Survey, Virtual reality, Model development, Video recording.	Demographic, Age, Gender, Academic Level, Marital status, Salary, Race.	1988 to October 2020	Title, Abstract, Keyword, Full Text

Over 2,000 articles were found from the search. Then, the non-related articles were eliminated by skimming and scanning the title of the article and its abstract. Keywords of “race”, “ethnicity”, and “religion” were prioritized because this study aims to observe the correlation between driving behavior and ethnicity. When eliminating articles that are not related to ethnicity and driving behavior, only 40 articles were retained and studied for this short review.

## 3.0 SOCIO-DEMOGRAPHICS BACKGROUND

Articles that were selected are cross-sectional studies from multiple countries such as the United States of America (USA), Canada, Greece, Sweden, Israel, Qatar, New Zealand, and Indonesia. Figure 3 shows that the studies were diverse in terms of research themes from risky behavior to reason to drive during COVID-19 movement restriction. 26 scholarly articles were focusing on the population of the USA; therefore, it is worth mentioning that the USA dominated the cross-sectional studies by 65% compared to other countries.



**Figure 3:** Research theme of gathered cross-sectional studies

### 3.1 Socio-Demographics Background

The common socio-demographic characteristics collected in the cross-sectional studies were the respondents' age, gender, ethnicity, localization, and religion. More than half of the surveys were focused on young adults including teenagers. These age groups could be in school, college, university, or even drop-outs. Research focusing on young adults is mainly to understand the risk behavior perception among them. Several surveys that evaluated teenager's risk behavior were performed once in several years such as Adolescent Health Risk Behaviour (AHRB) (Maslowsky et al., 2019), Youth Risk Behaviour Survey (Li et al., 2018; Olsen et al., 2013), Traffic Safety Culture Index Surveys (Rudisill et al., 2018), NEXT Generation Health Study (Trivedi et al., 2017), Youth Risk Behaviour Surveillance System (YRBSS) (Monroe et al., 2020; Sen et al., 2014), "REACT" adolescent driving attention (Stavrinos et al., 2020), and other self-report youth health surveys (Osilla et al., 2019; Ouimet et al., 2008; Rasanathan et al., 2008; Schotzko et al., 2005; Solomon et al., 2010; Watson et al., 2003).

These surveys primarily focused on teenagers' risk behavior in general, for instance, physical injuries during recreational activities, practising safe sexual activities, consuming alcohol or drugs, and smoking cigarettes. Despite that, the surveys were included in this short review because the surveys contain driving behavior questions, particularly their willingness to be a passenger of a drunk driver's car (Maslowsky et al., 2019; Watson et al., 2003), wearing a seatbelt (Li et al., 2018; Monroe et al., 2020; Rasanathan et al., 2008; Sen et al., 2014; Watson et al., 2003), distraction while driving (Bazargan-Hejazi et al., 2017; Li et al., 2018; Olsen et al., 2013; Rudisill et al., 2018; Trivedi & Beck, 2018), and traffic regulation violation (Papacostas & Synodinos, 1988; Rasanathan et al., 2008; Rudisill & Zhu, 2017; Schotzko et al., 2005). In short, the perception of risky behavior among young adults is well understood although the regulation and safe practice were not being followed due to sensation seeking.

The studies that focused on all age groups also cover traffic regulation violation topics. For example, texting while driving and violations at the stop sign and beating red traffic light (Bener et al., 2013; Blows et al., 2005; Chliaoutakis et al., 2005; Debnam & Beck, 2011; Elias & Shifan, 2017; Factor et al., 2012; Jahanfar, 2018; Matthews & Norris, 2002; Romano et al., 2005, 2006; Rudisill & Zhu, 2017; Sloan et al., 2013; Smith et al., 2019). In addition to that, Almallah et al. (2020) attempted to make a comparison between ethnicities for green

phase acceleration reaction at a traffic light. The study hypothesized that a high standard deviation in mean startup speed could be predicted as an aggressive driver. The study's experiment also indicated that young drivers are more aggressive than older drivers.

According to these surveys, comparison between gender mostly appears to be significant where women were seen to drive carefully, be less aggressive, and engaged in minimum traffic violations compared to men. Meanwhile, studies that compare ethnicities sometimes appear statistically significant and sometimes were not. For instance, Almallah et al. (2020), Debnam and Beck (2011), Maslowsky et al. (2019), Rasanathan et al. (2008), and Romano et al. (2006) shows no statistical difference between ethnicities in acceleration and jerk at startup speed at a traffic light, traffic violations, young adult's risky behavior, and stop sign violations. Also, while making a comparison among ethnicities, Bergdahl, (2007) found Hispanic to be statistically significant in having the ability to withstand higher alcohol consumption before being detected in Blood Alcohol Concentration (BAC) test than other comparable ethnicities.

Driving behavior studies of occupational drivers were also conducted to assess the drivers' behavior (Af Wåhlberg, 2018; Dorothy et al., 1998; Kurniasih, 2019). Another interesting topic of driving behavior is the perception of drivers to police bias while stopping them whereas minor ethnicities (i.e. Black or Hispanics) claimed that police of major ethnicity (i.e. White) were biased to them (Debnam & Beck, 2011; Gau & Brunson, 2012; Sloan et al., 2013; Smith et al., 2019). Even though claims were made, the studies demonstrated proof and were linked to traffic accident data.

From this short review, it was found that age and gender are among the socio-demographic backgrounds that were discussed deliberately in the driving behavior study. These studies attempted to evaluate the state of mind and the maturity in driver's decision making in correlation to their socio-demographic background. However, it was found that the ethnicity data were collected has not been analysed in detail, whereby it was used as a comparison. The lack of discussion with regards to ethnicity perspective might be attributed to the limited number of articles found. This shows that the relationship between socio-demographic backgrounds, such as age, ethnicity, religion, education level, marital status, salary, and so on has not been investigated in detail. For a multiracial country like Malaysia that comprises many ethnicities and religions, the influence of socio-demographic background on driving behavior and decision making while driving should be investigated further.

#### **4.0 DATA COLLECTION METHOD**

From the review of literature, it was found that among the data collection method used in the published articles were surveys, analysis of traffic accident or police report data, and using virtual reality experiments. Af Wåhlberg (2018), Matthews and Norris (2002), Bener et al. (2013), Factor et al. (2012), Papacostas and Synodinos (1988), Patil et al. (2006), and Putranto and Alyandi (2019) carried out surveys to understand driving behavior. This is called the Driver Behaviour Questionnaire (DBQ) that consists of lapses, mistakes, and slips. The versatility of DBQ makes it possible to be tailored according to countries such as United Arab Emirates (Bener et al., 2013) and Indonesia (Putranto & Alyandi, 2019). Matthews and Norris (2002) on the other hand were assessing provocation towards anger and aggressiveness between age, gender, and ethnicity. The result clarified that risky driving behavior could be explained by age and aggressiveness but not limited to gender and ethnic difference.

Traffic accidents and police reports were also used to investigate the pattern of violations made by drivers (Blows et al., 2005; Gau & Brunson, 2012; Romano et al., 2005, 2006; Smith et al., 2019). As it is different from a mere self-report study, the data also presented a true incident that has taken place. The respondents of the self-report study may tend to forget their driving behavior or accident events (Chapman & Underwood, 2000; Lajunen & Summala, 2003) and may be influenced by self-deception in answering the DBQ (Groeger & Grande, 1996; McKenna et al., 1991).

In addition, Almallah et al. (2020) investigated the driving behavior by conducting an experiment using virtual reality in form of a driving simulator. This is a good method to assess the driving skills of respondents without having them answering any questionnaires. The respondents may feel comfortable driving as if they are driving their actual car if the simulator is set up properly, such that it is immersive and mimics the real driving environment. This may lessen the pressure on the respondents and increase the accuracy of the data collected.

The development of virtual reality has begun as early as the 1990s where the National Advanced Driving Simulator (NADS) had been developed by a transportation safety research center in the University of Iowa's College of Engineering (Haug et al., 1990). The driving simulator was complicated earlier at the beginning of its era. The hardware set-up consists high-definition video monitor and sensor cockpits where acceleration and braking may take place. Bayarri et al. (1996) and Lee et al. (1998) thereafter focused on data structure such as traffic scenarios including road environment layout, traffic signalized device, and other moving vehicles or pedestrians. These data structures were being input layer by layer to finally provide integration between hardware and software.

According to previous research, an assessment of behavioral personality and social sciences study commonly convey self-report study and acquirement of a traffic accident and police report data. On the contrary, more complex research aims for instance assessing the technical driving skills may involve the employment of a driving simulator. It is important to realize that not all research institutes have the privilege of purchasing such a driving simulator despite the ability of the driving simulator to provide real-time simulation. Additionally, the driving simulator handling must involve skills of software engineers in preparing traffic layout that is suitable to the research aim which it could be a downside of the employment of driving simulator in traffic studies. The vast technology of virtual reality today has improved from a bulky driving simulator to a smaller headset with very minimal handling of traffic scenario set up. Therefore, today's researchers should make use of the current technology in driving behavior study in case the result could be as promising as a driving simulator.

## **5.0 ANALYSIS TOOLS**

The type of research which investigates driving behavior will normally result in statistical analysis as it is crucial to perceive the relationship between collected parameters to another. It is worth mentioning that the data analysis in driving behavior study is always large in-row data and has many categories even though the principal of these data is either quantitative or qualitative data. For this reason, statistical software is needed to avoid miscalculation or misinterpretation of the data as well as to foresee the pattern of the data then later forecast the future data based on the current trend.

The majority of the previous studies in this review did not disclose the statistical analysis software used but only the parametric tests such as regression, comparison, or correlation. Researchers chose to develop linear regression for qualitative data sets or logistic regression for categorical data sets. Besides, correlation tests such as Pearson Correlation or Chi-Square were selected to check whether two variables are related depending on whether the predictor or outcome variables are continuous or categorical respectively.

The second and third commonly used software to analyse the data in the reviewed studies is the SAS/STAT software (SAS Institute, Cary, North Carolina) and the IBM Statistical Package for Social Sciences (SPSS). SAS/STAT is a statistical programming language meanwhile SPSS is one of the oldest statistical tools. Both are known to be good in analyzing data quickly but SAS/STAT software is capable to handle large data sets while processing in acceptable computation time. However, SPSS is best used by non-statistician who need to make simple statistical analyses due to its user-friendly interface.

In addition, STATA (StataCorp LLC, Texas), SUDAAN (Research Triangle Institute, Research Triangle Park, North Carolina), and Mplus (Muthén & Muthén, Los Angeles, California) were also used in some studies. Sometimes these software can be paired for a productive research study for example by combining SAS and STATA software such as the study by Li et al. (2018), which investigates distracted driving in young adults in the USA. Watson et al. (2003) also combined the usage of SAS version 8.2 and SUDAAN version 7.5 to assess the health behaviors of students in secondary school in New Zealand.

To summarize, the abundance of statistical software packages in the market makes it easy for researchers to choose what is needed according to their study. For example, the ability to perform data manipulation, affordable price, the capability of handling large datasets, faster in producing result analysis, and familiarity with the software are among the important things that a researcher used to consider when looking for a statistical software package. The researchers, however, must be able to interpret the statistical result based on the needs of the study to ensure accurate and reliable results can be obtained. In the end, the software is just a tool. The quality of the results produced by the statistical software depends on the quality of the inputs, that is the data itself, and the knowledge of the researcher to perform the analysis.

## 6.0 CONCLUSION

The influence of socio-demographics background on driving behavior has been studied by some researchers, nonetheless, the number of published articles in this regard is limited. Among the socio-demographic factors studied were age, gender, ethnicity, localization, and religion. The relationship between age and gender to driving behavior were discussed by some researchers. Nonetheless, it was found that the study on the influence of ethnicity and religion on driving behavior is scarce. It is crucial for a multi-racial country especially Malaysia to investigate further the driving behavior from the ethnicity point of view since it was hypothesized that different ethnicities do think differently, and so does their behavior while driving. Furthermore, the influence of education level, marital status, among others on the driving behavior among Malaysian drivers needs to be investigated to further understand how these socio-demographic backgrounds affect driving decisions and behavior.

Due to the limited number of studies conducted in this regard, the methodology used is also limited to surveys and questionnaires. Other researchers had discussed the issue and challenges of self-report driving behavior studies; hence it is hypothesized that the use of a



more immersive environment such as a virtual reality headset during data collection might increase the reliability of the results. Not to mention the advancement of recent technology in virtual reality data collection has resulted in a more economical approach as well as an effective method. Therefore, virtual reality tools (i.e. virtual reality headsets) should be explored to obtain an accurate and reliable result whichever is suitable to the researchers' aim of the study.

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