



# Assessing the Effects of Various Factors on the Driving Ability of Individuals: A State-of-the-Art Review of the Existing Practices

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## ABSTRACT

- One of the major challenges in transportation planning is to accurately estimate basic driving performance indicators (e.g., travel time, travel speed) due to a large number of factors that may affect those performance indicators;
- Traffic flow characteristics (e.g., total volume, capacity of a given roadway segment) and geometric characteristics (e.g., lane width, shoulder width, presence of a median) have been used to calculate various driving performance indicators;
- However, there are many other factors which should be taken into account (e.g., driver characteristics, weather conditions, temporal attributes);
- This study performs a state-of-the-art review of the existing practices, reported in the academic literature, to identify the major factors that may influence the driving ability of individuals;
- Findings from this study will assist various private and public agencies with transportation planning and development of accurate models for calculating various driving performance indicators.

## LITERATURE REVIEW METHODOLOGY

- A review of the scientific literature was performed using the Content Analysis research method which is used to make inferences from the text to the context of its use;
- The Content Analysis method is an empirically grounded method, which is exploratory in process and predictive or inferential in intent;
- The Content Analysis method transcends traditional notions of symbols, contents, and intents, and allows the researchers execution, critical planning, detailed communication of findings, reproduction of methodology, planning and assessment of result analysis;
- The main steps of the Content Analysis method used throughout the literature review in this study are presented in Figure 1 and include the following: 1) Identify research questions; 2) Conduct a literature survey; 3) Review the literature; 4) Interpret findings and make deductions; and 5) Answer research questions.

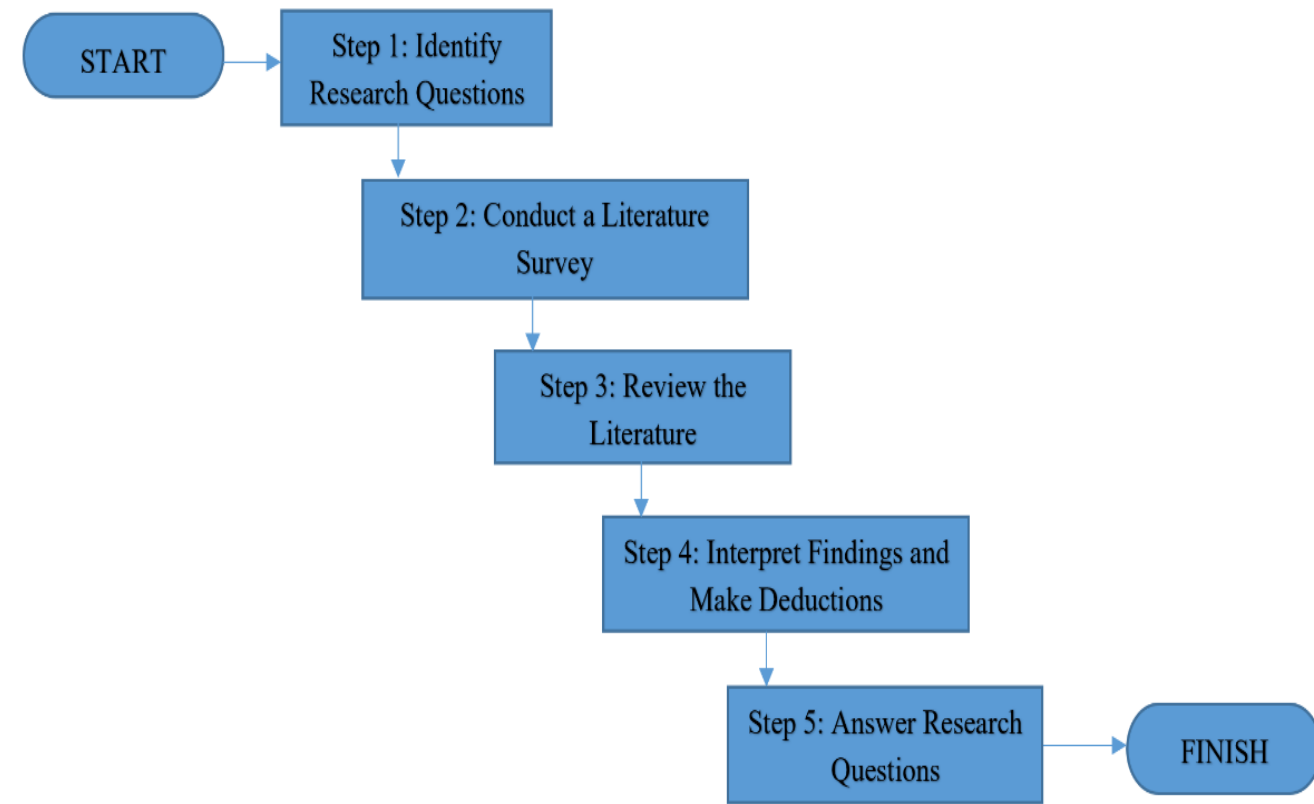


Figure 1 Literature Review Methodology

## RESEARCH QUESTIONS

- RQ1. What are the driver characteristics (e.g., age, gender, driving experience, residency) that affect driving ability under normal driving conditions?
- RQ2. What are the driver characteristics that affect driving ability during an emergency evacuation?
- RQ3. What are the roadway characteristics (e.g., curvature, road width, road class) that affect driving ability under normal driving conditions?
- RQ4. What are the roadway characteristics that affect driving ability during an emergency evacuation?
- RQ5. What are the other factors (e.g., weather, time of the day, day of the week, alcohol) that may influence driving ability under both normal and disruptive driving conditions?
- RQ6. What are the driving performance indicators?
- RQ7. What are the models used to estimate the driving performance indicators based on the driver characteristics?
- RQ8. What are the research methods commonly used to study the driver characteristics that affect driving ability and assess the driving performance indicators?
- RQ9. What are the challenges in estimating the driving performance indicators?

• Based on the findings regarding each of the research questions posed, this study will present a detailed description of the driver characteristics, as well as other relevant factors that affect the driving ability of different population groups. This study will also identify the gaps that should be explored in the future

## LITREATURE SURVEY

The following delimitations were posed throughout the literature search process:  
i. The studies considered were selected from the peer-reviewed scientific journals majorly in social and behavioral sciences, psychology, transportation, and engineering only.  
ii. Publications discussing the human behavior without assessing how it affects driving ability were not considered.

## DESCRIPTIVE ANALYSIS

Over a thousand articles were identified as a result of a literature survey. A total of 204 papers that were relevant to the research questions posed were selected for a detailed review.

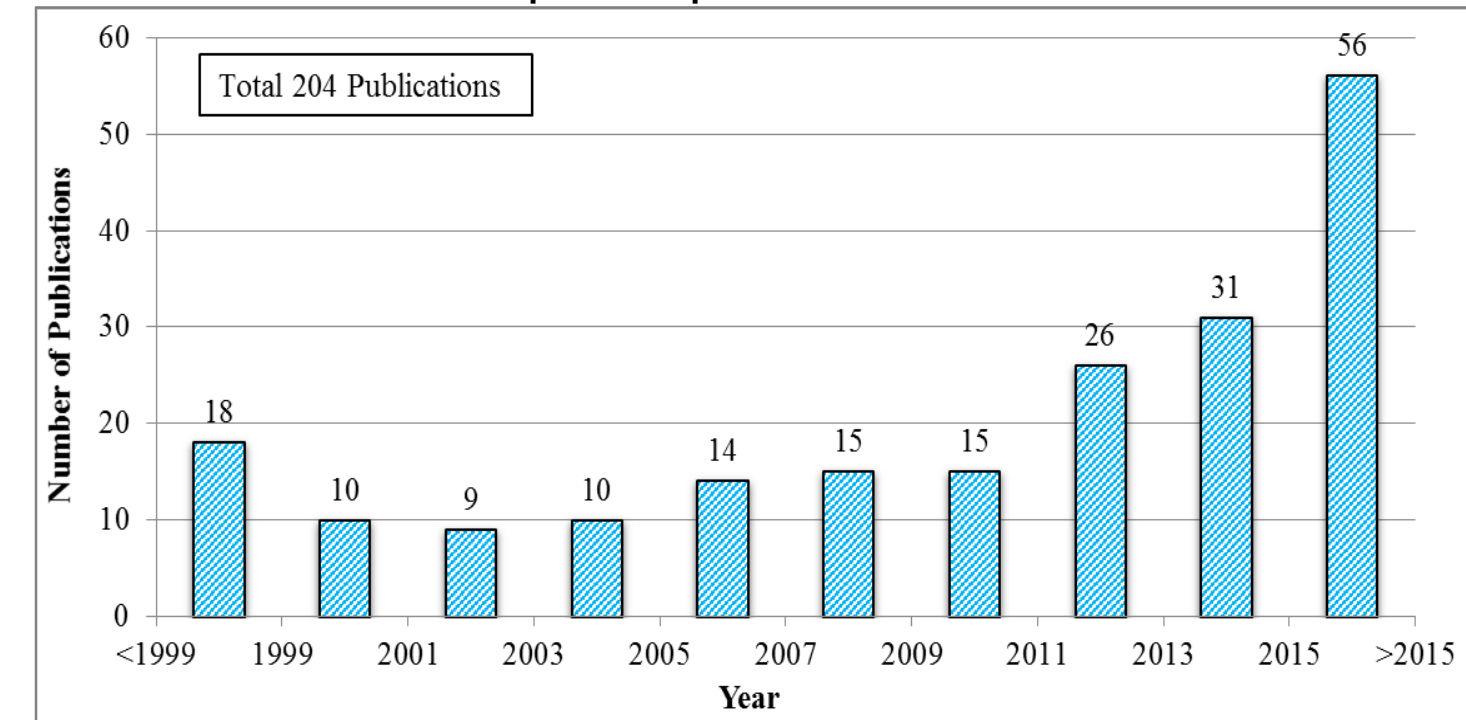


Figure 2 Distribution of publications by year

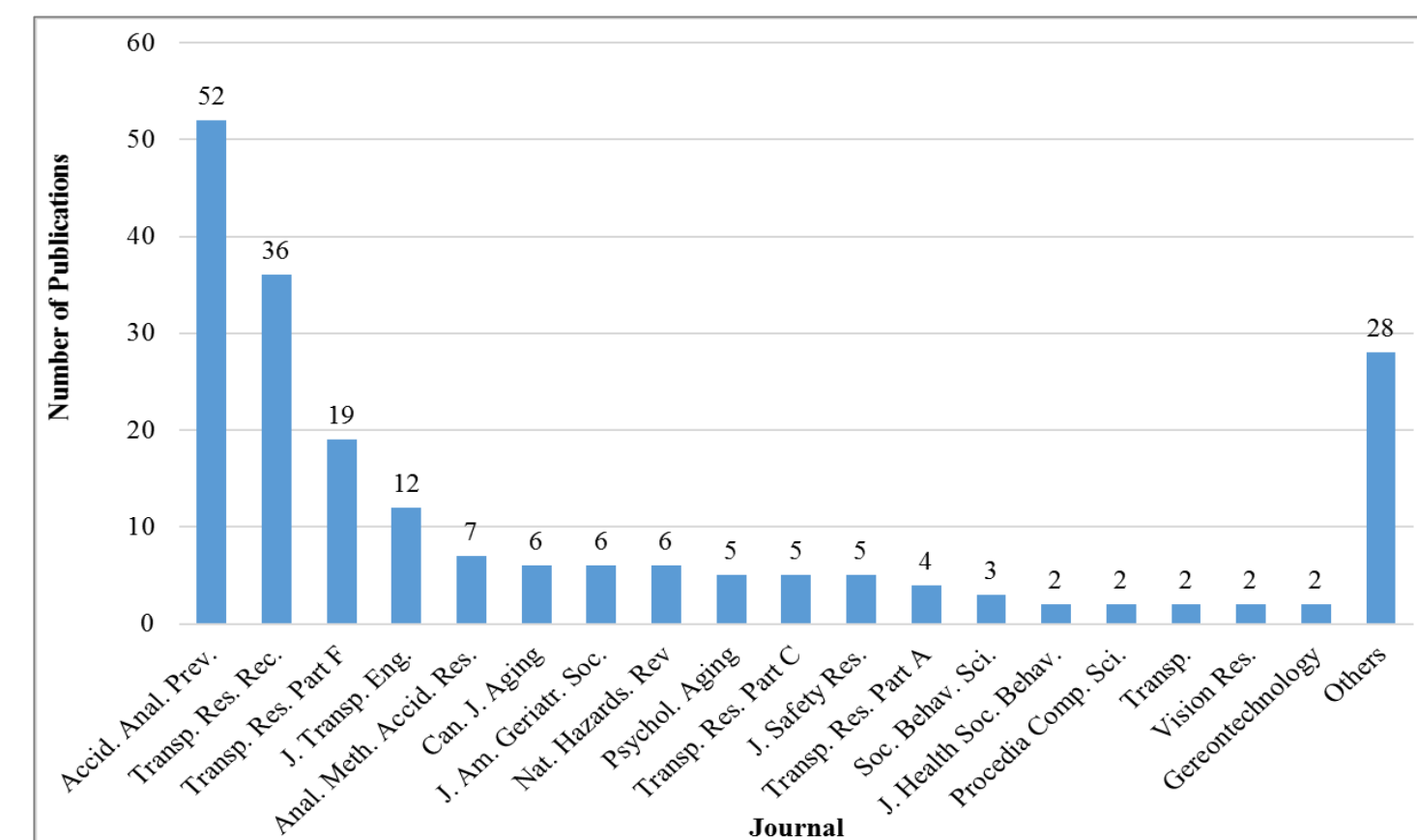


Figure 3 Distribution of publications by journal

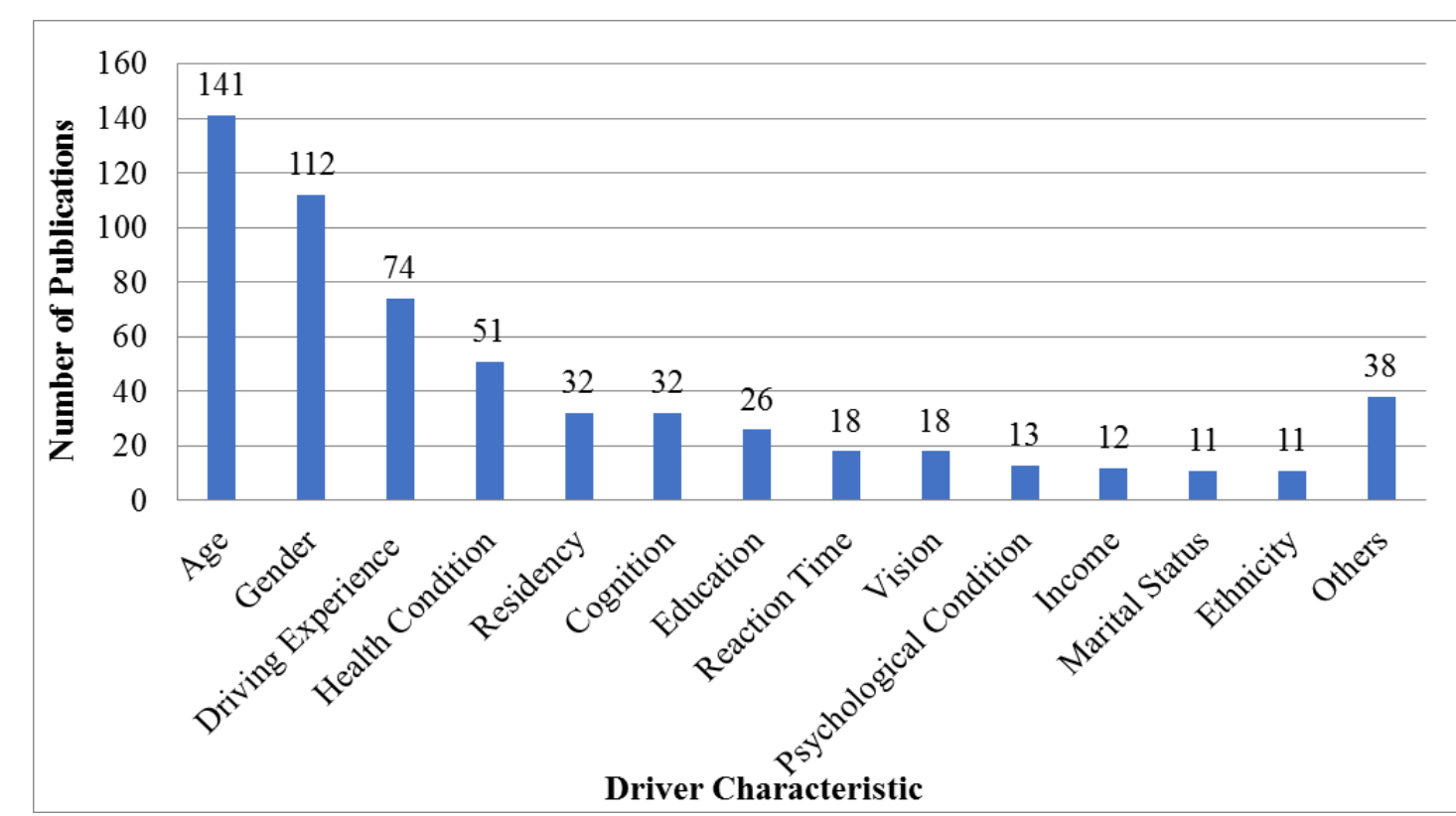


Figure 4 Distribution of publications by driver characteristics

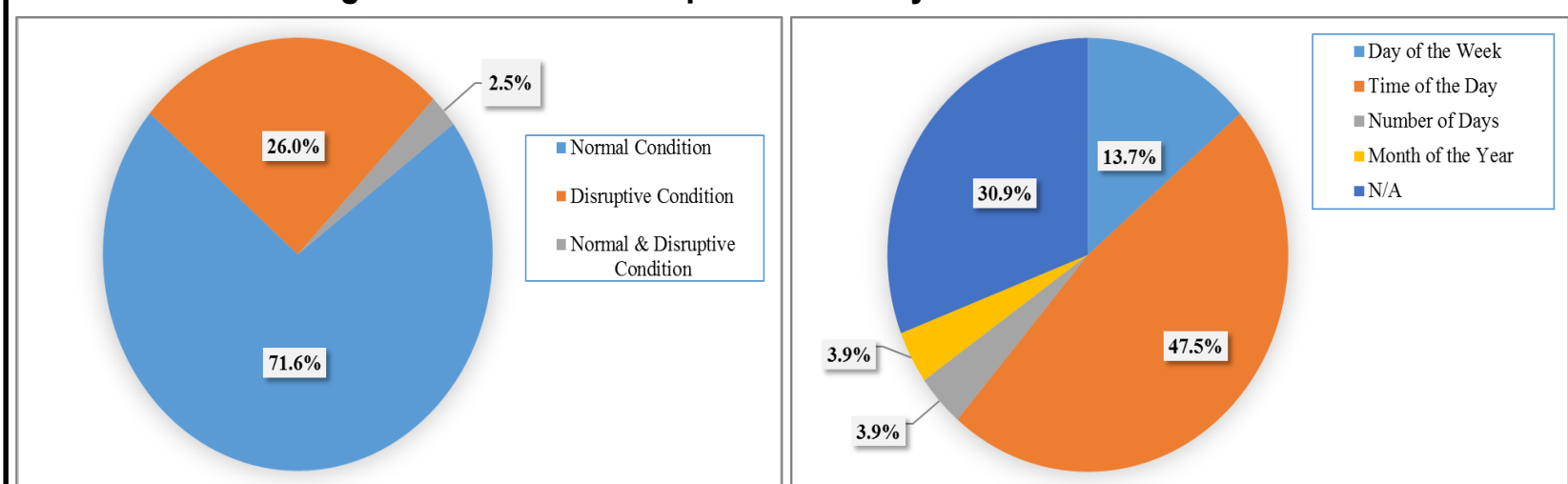


Figure 5 Distribution of publications by driving conditions modeled

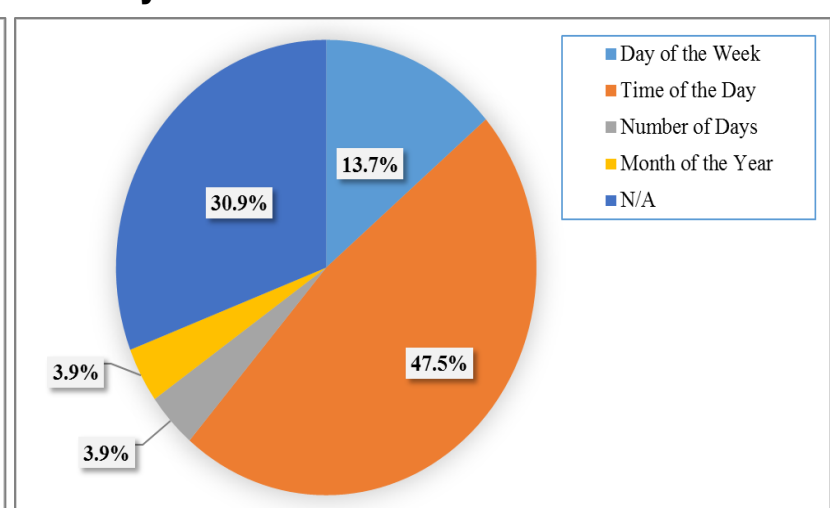


Figure 6 Distribution of publications by temporal attributes highlighted

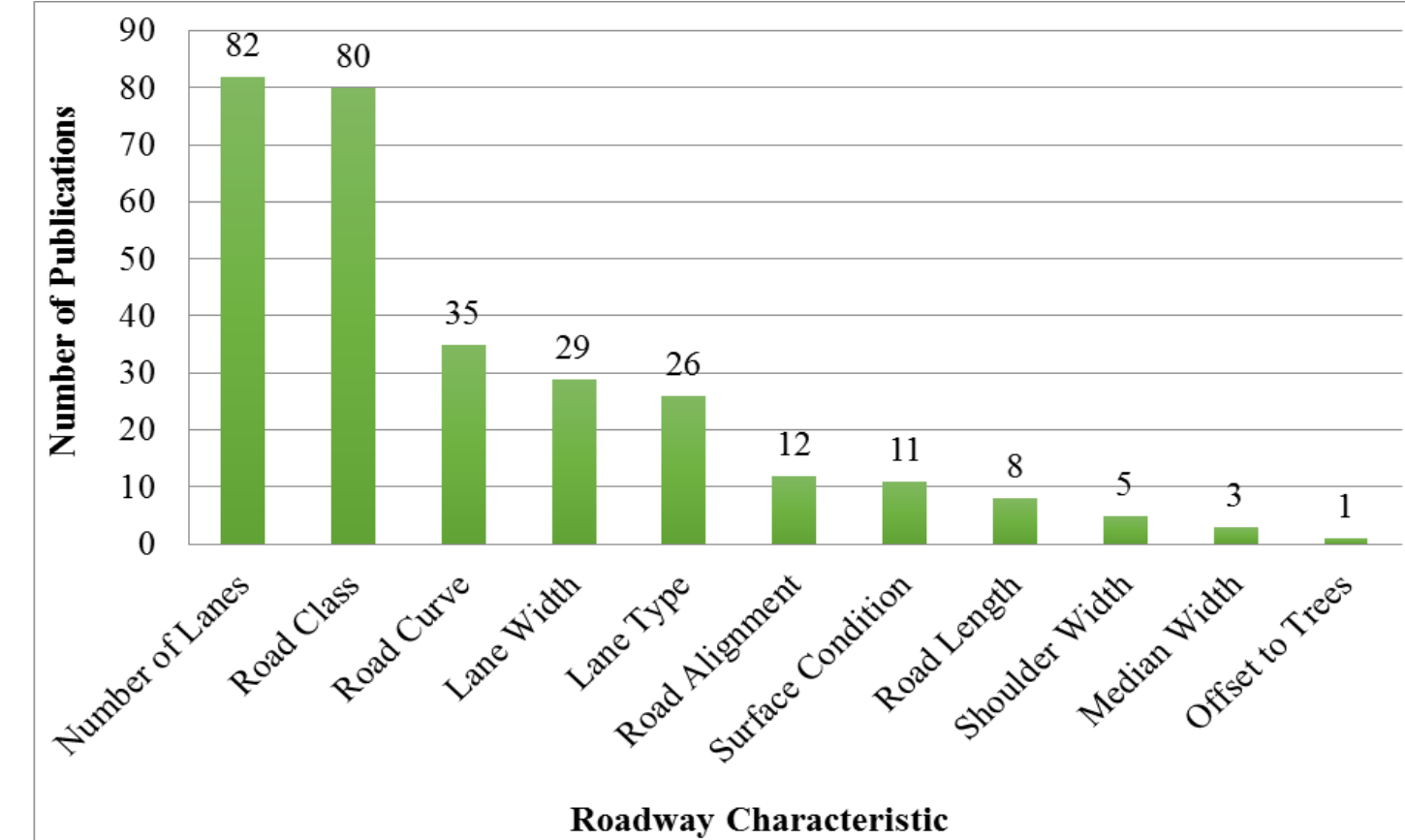


Figure 7 Distribution of publications by roadway characteristics

Table 1 Distribution of publications by other traffic and driver attributes

a/a	Traffic and Driver attributes	#Papers	%Papers
1	Speed	67	32.8%
2	Weather	24	11.8%
3	Alcohol & Drug Use	18	8.8%
4	Acceleration	14	6.9%
5	Traffic Flow	14	6.9%
6	Lightening Condition	14	6.9%
7	Deceleration	14	6.9%
8	Braking	14	6.9%
9	Steering	13	6.4%
10	Lane Change	13	6.4%
11	Vehicle Type	12	5.9%
12	Traffic Violation	11	5.4%
13	Travel Path/Route	10	4.9%
14	Gap Acceptance	9	4.4%
15	Headway	9	4.4%
16	Turning Movement	9	4.4%
17	Crash Type	8	3.9%
18	Transit	8	3.9%
19	Medication Use	7	3.4%
20	Disaster Type	6	2.9%

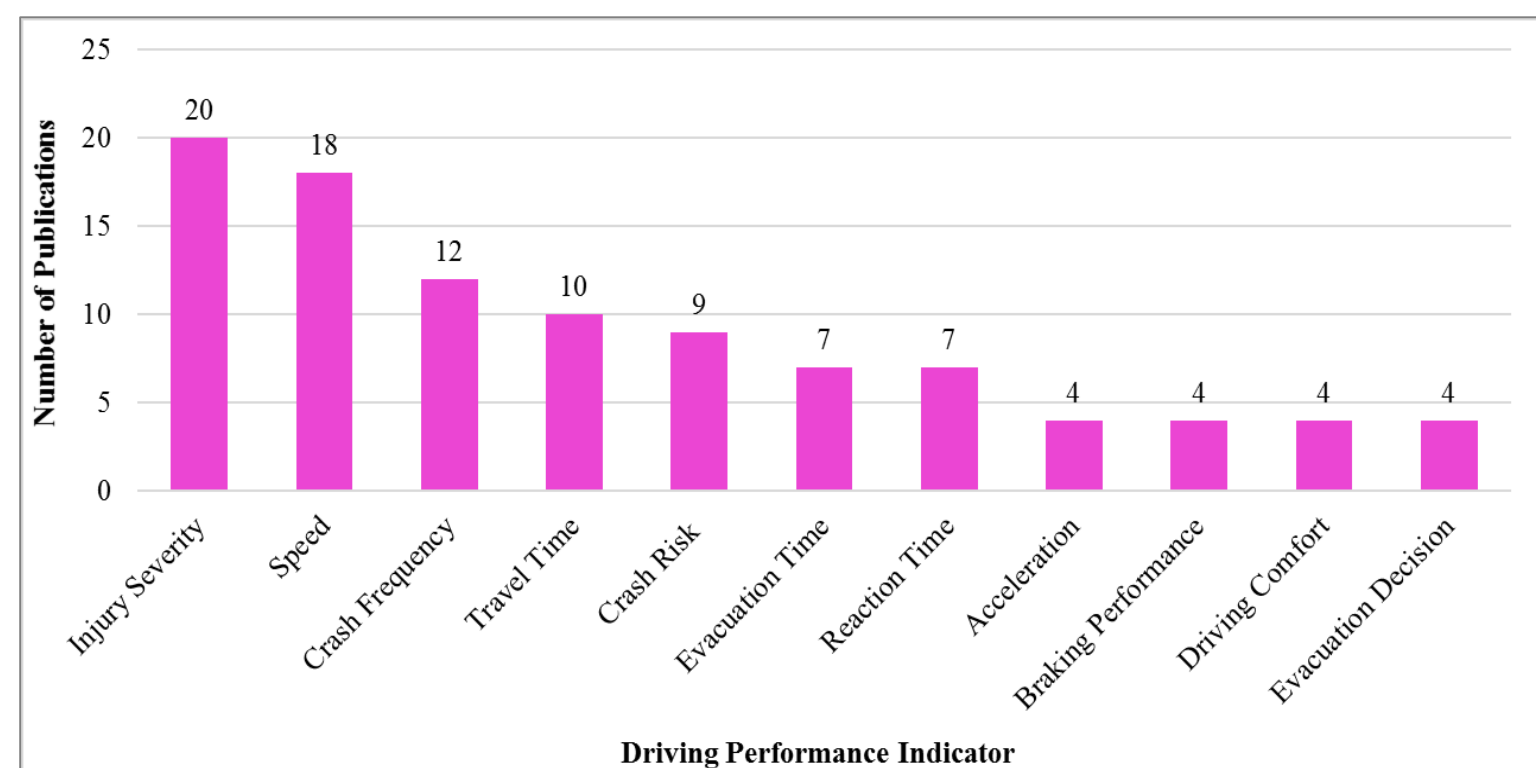


Figure 8 Distribution of publications by driving performance indicators

Table 2 Distribution of publications by model adopted

a/a	Model(s) Used	#Papers	%Papers
1	Simulation model	24	11.8%
2	Logit regression model	21	10.3%
3	ANOVA	20	9.8%
4	Linear regression model	15	7.4%
5	Negative binomial regression model	4	2.0%
6	Hierarchical regression analyses	4	2.0%
7	Pearson's product-moment correlations	3	1.5%
8	Poisson regression model	3	1.5%
9	Spearman correlation coefficient	2	1.0%
10	Bayesian multivariate count data model	2	1.0%
11	Optimization model	2	1.0%
12	Others	29	14.2%

## SUMMARY OF FINDINGS

- **Finding 1:** The age, gender, ethnicity, income, driving experience, residency, health condition, driving experience, attention, education, reaction time, cognition, lifestyle, and marital status were found to be the major driver characteristics discussed in papers affecting the driving ability.
- **Finding 2:** The review of literature reveals that the age, gender, ethnicity, income, social experience, education, residency, health condition, driving experience, reaction time, cognition, lifestyle, and marital status are the key driver characteristics that affect the driving ability.
- **Finding 3:** The review of scientific literature indicates that the lane width, number of lanes, lane type, road curve, and road class are some of the roadway characteristics mostly affect the driving ability. Other roadway characteristics considered include median width, shoulder width, offset to trees, road surface, and road alignment.
- **Finding 4:** Some other key factors highlighted in the studies that may affect driving ability under both normal and disruptive conditions include speed (32.8% of publications), weather (11.8% of publications), and alcohol & drug use (8.8% of publications).
- **Finding 5:** A large variety of indicators for measuring the driving performance under both normal and disruptive driving conditions are discovered as a result of the conducted literature review, including the following: injury severity, speed, crash frequency, travel time, and crash risk.
- **Finding 6:** The majority of reviewed publications (11.8%) use simulation to model the effects of driver characteristics and other factors on the driving performance. Many studies rely on different types of regression models, including the following: logit regression model, linear regression model, negative binomial regression model, hierarchical regression model, and Poisson regression model.
- **Finding 7:** The majority of reviewed publications (11.8%) use simulation to model the effects of driver characteristics and other factors on the driving performance. Many studies rely on different types of regression models
- **Finding 8:** Some of the biggest challenges in estimating the driving performance indicators identified from the literature review include: 1) a small sample size or an incomplete dataset; 2) assessing the driver performance under disruptive conditions; 3) a variation in the population attributes of the study location; 4) the driving simulator sickness experienced by some participants for studies that used the driving simulator; and 5) estimating the effects from a combination of individual driver characteristics.

## CONCLUSIONS AND FUTURE WORK

Age, gender, driving experience, and medical condition were found to be the primary driver characteristics affecting the driving performance indicators under both normal and disruptive driving conditions. Certain studies also underlined the importance of such driver characteristics as residency, income, lifestyle, and social experience, when assessing the driving ability under disruptive conditions. The work, conducted in this study, could be extended in several directions. First, the literature search could be expanded by relaxing some of the delimitations (e.g., include the conference papers and articles from on-line transportation and psychology journals). Second, additional scientific publishers can be considered (e.g., Emerald Insight; SAGE -; Taylor and Francis; and others). Third, a more comprehensive survey of technical reports may be performed to collect additional studies relevant to the research questions posed.

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