

# Seat Belt Compliance of Drivers and Front Passengers: A Review of Data Collection, Analysis, and Safety Countermeasures

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## Introduction

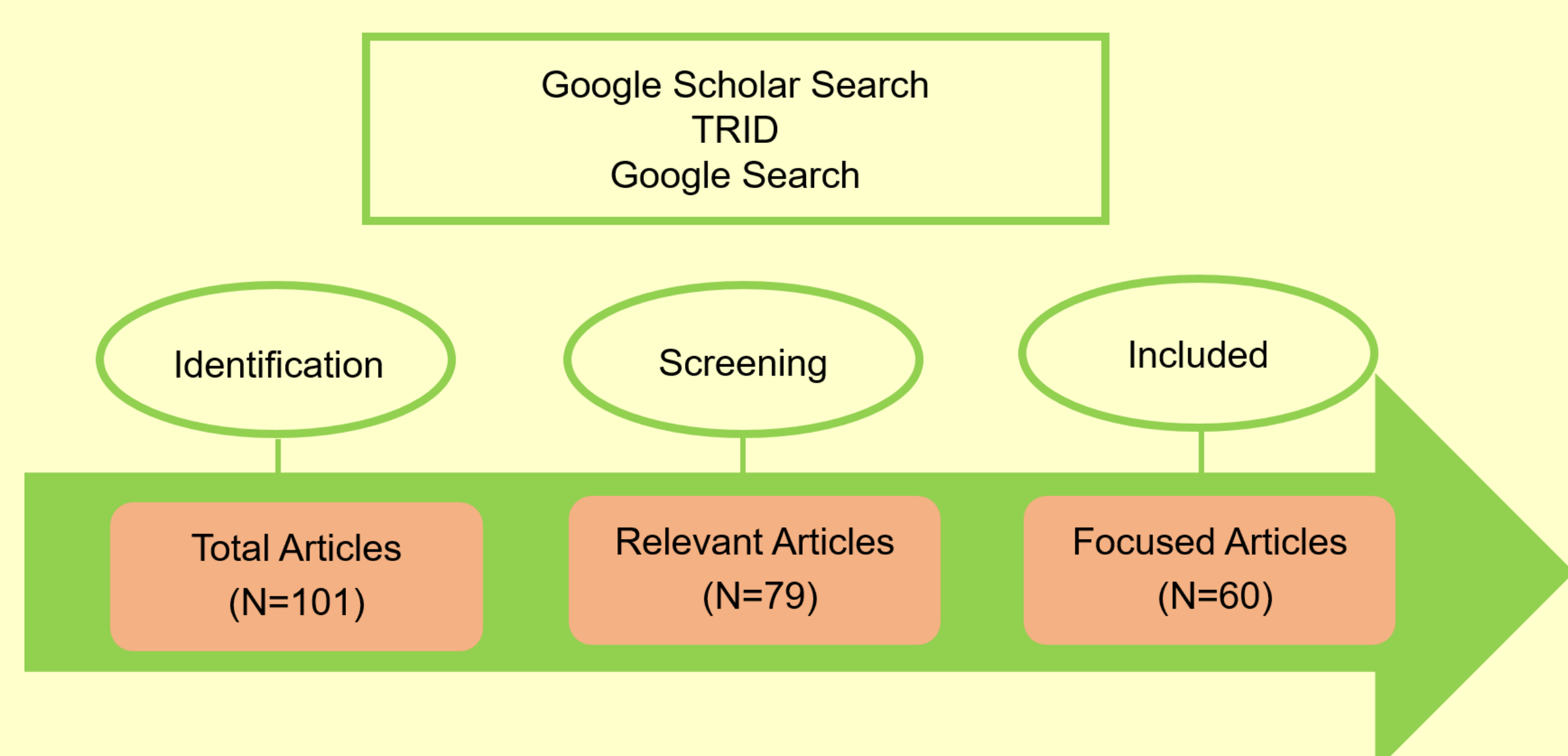
- According to the National Highway Traffic Safety Administration (NHTSA), 51% of the 23,824 people killed in traffic crashes were not wearing seat belts in the United States.
- Seat belts saved 14,955 lives in 2017 and may have saved an additional 2,549 lives if they had been used.

## Objective

- To conduct a comprehensive literature review to interpret seatbelt compliance behavior of drivers and passengers.

## Research Methodology

- 22 years (2001-2022) of research (articles, reports, conference proceedings) on seatbelt compliance was considered for literature review.



## Data Collection

- Surveys: Nationwide surveys were conducted by National Occupant Protection Use Survey (NOPUS) to comprehend seatbelt compliance.
- Crash Reports: Crash reports were utilized to comprehend the patterns of driving behavior and factors associated with non-compliance of seatbelt use.
- Observational Studies: Roadside observational studies (mostly cross sectional at intersections) were used to observe seatbelt compliance of drivers and passengers.
- Use of Camera: Use of Camera: Most of the studies recorded driver's and passenger's seatbelt compliance behaviors inside the vehicle using high resolution dash cameras.
- New Technology: Near infrared (NIR) and color (RGB) surveillance camera system were used by surveillance cameras to detect seatbelt non-compliance. Edge detection is also used for detecting seatbelt images.

## Data Analysis

- Statistical Models: Logistic regression models, ordered logit models, and probit models were utilized to analyze seatbelt compliance studies and survey reports. These models also helped identify the contributing factors of seatbelt compliance and driver behavior.
- Machine Learning and Deep Learning Algorithms: Machine learning (Support Vector Machine, Bayesian Network) and deep learning algorithms (CNN, YOLO, SSD) were helpful in detecting seatbelt use from the recorded images and videos.
- Model Training: Most of the AI models used their own custom database for training purpose.
- Model Evaluation: Accuracy, False Negative values are mostly used for the AI based model evaluation.

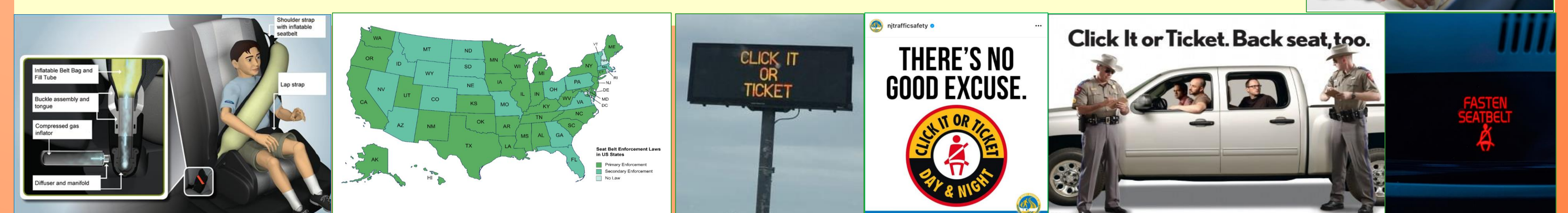
## Contributing Factors

Factors increasing the non-compliance of seatbelt use are:

- Driver Attributes: Young, male, low-income, alcohol/drug involvement, speeding
- Roadway Features: Rural road, less enforced area, densely populated area
- Travel Properties: Driving alone, shorter distance travel
- Environmental Features: Non-adverse weather, poor lighting
- Vehicular Attributes: Heavy vehicles, uncomfortable seatbelt design
- Temporal Variables: Weekends, evening time driving

## Countermeasures

- 3' E Approach (Engineering, Education and Enforcement).
- Engineering: Interlock, Accelerator counter force, advanced reminder.
- Education: Awareness campaigns, educational materials.
- Enforcement: Primary bans (in 34 states), "Click it, or ticket".



## Key Findings

- Globally, Young drivers' and passengers have shown less compliance to seatbelt laws compared to the older drivers and passengers.
- Driver's seatbelt use data are collected using newer types of equipment (dash camera, pole-mounted camera, etc.).
- Detection of seatbelt use are performed using artificial intelligence (deep learning algorithms like CNN, SSD, YOLO).
- High visibility enforcement measures (like Click it or ticket) helped to increase the use of seatbelt in several states.