

Behavioral and Non-Behavioral Correlates of Seat Belt Usage among Bus Passengers Insights from a Cross-sectional Research in Iran

ABSTRACT

Background and Aim: Despite evidence supporting the protective effect of seatbelts, compliance in bus travel is understudied, particularly in Iran. The purpose of this study was to determine the predictors of seatbelt use in passengers of intercity buses.

Materials & Methods: A cross-sectional study was conducted with 448 passengers recruited from intercity bus terminals in Tehran using a multistage sampling method. Data were collected through a validated 57-item questionnaire. Logistic regression analyses were applied to examine predictors of seatbelt non-use across three models incorporating behavioral, demographic, and background variables. SPSS 16 software was used to analyze the data.

Results: Only 24% of passengers consistently used seatbelts. In the final logistic regression model, significant predictors of seatbelt non-use included perceived barriers (OR = 1.08, 95% CI: 1.02–1.15, $p = 0.003$), Low & supervision (OR = 1.13, 95% CI: 1.00–1.28, $p = 0.04$), health locus of control (OR = 1.18, 95% CI: 0.99–1.40, $p = 0.05$) and poor law adherence (OR = 2.60, 95% CI: 1.67–4.06, $p < 0.001$). Conversely, subjective norms (OR = 0.75, 95% CI: 0.65–0.87, $p < 0.001$) and environmental factors (OR = 0.82, 95% CI: 0.69–0.97, $p = 0.02$) were associated with higher seatbelt use. The model showed acceptable goodness-of-fit (Hosmer–Lemeshow $p = 0.08$) and good discrimination (AUC = 0.78; 95% CI: 0.74–0.87).

Conclusion: Seatbelt use among intercity bus passengers in Iran is low and externally motivated. Interventions should enhance awareness, address ergonomic and accessibility barriers, and ensure seatbelt functionality.

Keywords: Seat belt, behavioral factors, non-behavioral factors, bus, passenger.

INTRODUCTION

Road Traffic Crashes (RTCs) are sudden events that can cause predictable and preventable injuries (1). They remain a critical global public health challenge, claiming approximately 1.25 million lives annually and causing 20–50 million non-fatal injuries, many of which result in long-term disability (2). RTCs are the leading cause of death among individuals aged 15–29 years, accounting for the loss of life during the most productive years (3). Globally, RTCs rank as the ninth leading cause of death across all age groups and are projected to become the seventh by 2030 (4). Iran faces a disproportionately high burden of RTCs, with an average of 20,000–28,000 fatalities annually between 2005 and 2015 (5). Despite international and national efforts, including WHO recommendations and legislative interventions (6), Iran continues to experience one of the highest traffic-related mortality rates worldwide. Although recent years have witnessed a modest decline in deaths, the overall burden remains substantial, highlighting the need for ongoing public health strategies (5). In the Iranian context, the long distances between provinces and the heavy reliance on the intercity bus fleet for public transportation make bus safety a national priority (7).

Seat belts are a primary protective measure against injuries in vehicle crashes, significantly reducing mortality and severe injuries (8, 9). While compliance rates for private cars have improved due to enforcement and awareness campaigns, the use of seat belts in other modes of transport, particularly intercity buses, remains critically under-researched and under-utilized. Although buses are generally safer than cars per vehicle-kilometer, passengers in intercity bus crashes are still at significant risk of traumatic injuries, especially in rollover or high-speed impact scenarios where unrestrained ejection or internal impact occurs (10). A limited number of studies indicate that, paradoxically, bus passengers often perceive their environment as safe due to professional driving and vehicle size, leading to lower adherence to safety protocols compared to car drivers (11). Globally, adherence to seat belt use varies widely and depends on enforcement, awareness, and behavioral factors (12, 13). In Iran, only 85% of front-seat and 10% of rear-seat passengers comply with seat belt regulations (5, 13). Behavioral, human, and environmental factors—including non-compliance with traffic rules, alcohol or substance use, lack of awareness, and vehicle conditions—interact to influence crash outcomes (14–16). Comprehensive interventions targeting five key factors—seat belts, child restraints, helmets, speed control, and impaired driving—have demonstrated significant reductions

in RTC mortality (12, 17). Despite this, there is a critical gap in understanding the determinants of seat belt use specifically among intercity bus passengers, with few studies focusing on this population (11, 18). Addressing this knowledge gap is essential for designing effective health promotion interventions and policy strategies. To effectively increase compliance, it is essential to understand the underlying behavioral determinants, such as subjective norms, perceived barriers, and environmental constraints, which often dictate health-protective actions in collective settings (19). Accordingly, this cross-sectional study aimed to (1) assess the prevalence of seat belt use among intercity bus passengers in Tehran, Iran, and (2) identify the behavioral, demographic, and environmental determinants associated with seat belt compliance. Findings from this study are expected to guide targeted interventions that enhance road safety, reduce traffic-related injuries, and mitigate the socio-economic impact of bus accidents in Iran.

MATERIALS & METHODS

Study Design and Participants

This cross-sectional analytical study was conducted among passengers at intercity bus terminals in Tehran. A total of 458 passengers were recruited, of whom 10 were excluded due to incomplete questionnaires, leaving 448 participants for the final analysis. A multistage sampling method was applied. Each terminal in Tehran (West, South, North, East) was considered a class, and the passenger cooperatives within each terminal were treated as clusters. From each terminal, one cooperative was randomly selected, and eligible passengers were recruited from that cooperative. Inclusion criteria were: age ≥ 14 years, no physical restrictions on fastening a seat belt, basic reading and writing literacy, and willingness to participate.

Data Collection

Data were collected using a researcher-developed questionnaire, the psychometric properties of which were rigorously evaluated. The instrument underwent comprehensive validation, including face validity assessed qualitatively with bus passengers, content validity reviewed by an expert panel and quantified via CVI (0.95) and CVR, and construct validity confirmed through exploratory factor analysis. Reliability was demonstrated by internal consistency (Cronbach's $\alpha=0.80$) and stability over time using a test-retest procedure (ICC=0.78).

The questionnaire used in this study consisted of two sections. The first section captured demographic information, including age, gender, marital status, education level, bus type, travel distance, and adherence to traffic laws. The second section comprised 57 items across 13 dimensions—awareness, perceived susceptibility, perceived severity, perceived barriers, behavioral beliefs, evaluation of behavioral outcomes, law and supervision, observational learning, peripheral trust, subjective norms, self-efficacy, health locus of control, and environment—to assess determinants of seat belt use among bus passengers. Items scored on a three-point Likert scale (0 = disagree, 1 = uncertain, 2 = agree), with awareness items scored 2 for correct, 1 for "I do not know," and 0 for incorrect responses. Awareness measured using 8 dedicated items.

Data Analysis

Data were analyzed using SPSS version 16. Logistic regression was conducted to identify behavioral and non-behavioral predictors of seat belt use. The outcome variable was dichotomized (0 = seat belt use, 1 = non-use), and three models were implemented. Model 1 included only behavioral predictors; Model 2 added age and gender to the variables in Model 1; and Model 3 further incorporated other background variables with p-values < 0.2 in univariate analyses (including marital status, adherence to traffic laws, travel distance, bus type, and education level). Model fit was evaluated using the Hosmer-Lemeshow test and the area under the receiver operating characteristic curve (AUC).

RESULTS

The mean age of participants was 28.35 ± 6.1 years, with 47% male and 53% female. Most were single (62%), resided in urban areas (89.1%), and held an associate or bachelor's degree (46.2%). Seat belt use was higher in private vehicles (61%, 95% CI) compared to buses (24%). The majority preferred front seats (38.6%) and VIP buses (63.8%). Common reasons for using a seat belt included police presence, high bus speeds, nighttime travel, and adverse weather conditions, while 60.2% of participants reported no prior training on seat belt use.

Among behavioral predictors, Evaluation of Behavioral Outcomes had the highest mean score (89.77

	Variable	Number of questions	Mean	Range of scores	SD
1	Knowledge	6	84.01	0 -100	18.96
2	Perceived Susceptibility	3	87.07	0 -100	16.34
3	Perceived Severity	5	85.37	0 -100	18.27
4	Perceived Barriers	9	36.67	0 -100	16.12
5	Behavioral Beliefs	6	64.49	0 -100	20.34
6	Evaluation of Behavioral Outcome	6	89.77	0 -100	17.01
7	Law & Supervision	3	56.25	0 -100	12.39
8	Observational Learning	5	65.46	0 -100	9.06
9	Peripheral Trust	2	27.55	0 -100	16.19
10	Subjective Norms	4	81.08	0 -100	14.17
11	Self-Efficacy	4	88.94	0 -100	11.09
12	Health Locus of Control	2	76.33	0 -100	13.08
13	Environment	2	73.33	0 -100	21.18

± 17.01), whereas Peripheral Trust had the lowest (27.55 ± 16.19) (Table 1). Logistic regression analyses were conducted to examine predictors of seat belt non-use across three models. Model 1 included only behavioral predictors; Model 2 additionally incorporated age and gender; and Model 3 further included background variables with $p < 0.2$ in univariate analyses, such as marital status, bus type, travel distance, adherence to traffic laws, and education (Tables 2, 3).

In the final logistic regression model (Model 3), perceived barriers positively predicted seat belt non-use (OR = 1.08, 95% CI: 1.02–1.15, $p = 0.003$), with each unit increase in score associated with a 9% higher likelihood of non-use. Law and supervision showed a consistent positive association with non-use (OR = 1.13, 95% CI: 1.00–1.28, $p = 0.04$). Conversely, subjective norms were inversely associated with non-use (OR = 0.75, 95% CI: 0.65–0.87, $p < 0.001$), increasing the likelihood of seat belt use by about 25%, and environmental factors were similarly protective (OR = 0.82, 95% CI: 0.69–0.97, $p = 0.02$). Health locus of control also showed a borderline association (OR = 1.18, 95% CI: 0.99–1.40, $p = 0.05$). Observational learning initially showed a negative association, which lost significance after adjustment in Model 3.

Regarding non-behavioral predictors, bus type was a strong determinant; passengers of ordinary buses were 2.2 times more likely not to use a seat belt compared to VIP bus passengers (OR = 2.20, 95% CI: 1.38–3.05, $p = 0.001$). Similarly, poor adherence to traffic laws markedly increased non-use (OR = 2.60, 95% CI: 1.67–4.06, $p < 0.001$). Age, gender, marital status, and education were not significantly associated with seat belt use. Model fit was evaluated using ROC analysis, with Model 3 showing superior fit (AUC = 0.78, 95% CI: 0.74–0.83), indicating that the included predictors correctly classified seat belt use in 78% of cases (Fig. 1, Table 3). The Hosmer–Lemeshow test confirmed good fit for Model 3 ($p = 0.8$), supporting its adequacy over the other models.

Table 1: Number of questions, mean, standard deviation and range of scores for the variables

Table 2: Predictive factors for bus seat belt use by logistic regression model

Variable	Model 1*	Model 2**	Model 3***
	OR (CI:95%)	OR (CI:95%)	OR (CI:95%)
Knowledge	(0.94 -1.14) 1.03	(0.93 -1.14) 1.03	(0.93 -1.15) 1.04
Perceived susceptibility	(0.90 -1.30) 1.08	(0.90 -1.30) 1.08	(0.90 -1.31) 1.08

Perceived Severity	(0.90-1.11) 0.99	(0.89-1.11) 0.99	(0.91-1.15) 1.02
Perceived barriers	(1.03 -1.15) 1.09	(1.03 -1.15) 1.09	(1.02 -1.15) 1.08
Behavioral Beliefs	(0.84 -1.03) 0.93	(0.84 -1.04) 0.93	(0.83 -1.04) 0.93
Evaluation of Behavioral Outcome	(0.88 -1.13) 1.04	(0.88 -1.13) 1.00	(0.88 -1.14) 1.05
Law & Supervision	(1.02-1.30) 1.15	(1.02-1.30) 1.15	(1.02-1.28) 1.13
Observational learning	(1.05 -1.17) 1.08	(1.06 -1.17) 1.08	(0.99 -1.17) 1.08
Peripheral Trust	(0.72 -1.01) 0.85	(0.72 -1.01) 0.85	(0.68 -1) 0.82
Subjective Norms	(0.65 -0.87) 0.75	(0.65 -0.87) 0.75	(0.65 -0.87) 0.75
Self-Efficacy	(0.78 -1.57) 0.92	(0.78 -1.57) 0.92	(0.80 -1.11) 0.94
Locus of control	(0.96 -1.34) 1.14	(0.96 -1.34) 1.13	(0.99 -1.40) 1.18
Environment	(0.73 -0.99) 0.85	(0.73 -0.99) 0.85	(0.66 -0.97) 0.82

Model 1*: Unadjusted

Model 2**: Model 1 - Adjusted for Age and Sex

Model 3***: Model 2 – Adjusted for Marriage, Education, Bus Type, Frequency use of bus and Non-compliance of law

Table 3: Estimating the area *under the ROC curve* by logistic regression models to determine the behavior and non-behavior predictors of not using seat belt

	AUC*	Standard Error	P-Value	CI (95%)
Model 1	0.733	0.24	<0/001	(0.686 – 0.779)
Model 2	0.733	0.24	<0/001	(0.687 – 0.780)
Model 3	0.784	0.22	<0/001	(0.741 – 0.872)

AUC*: Area Under the Curve

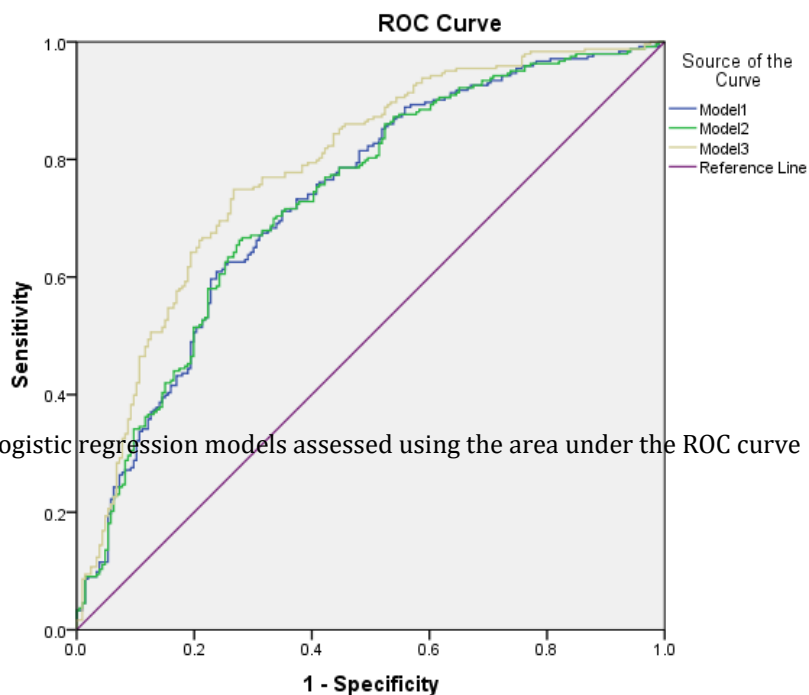


Figure 1. Fit of logistic regression models assessed using the area under the ROC curve

DISCUSSION

To our knowledge, this is the first study to systematically evaluate seatbelt use among intercity bus passengers in Iran. While compliance in private vehicles has been reported as relatively favorable, our findings indicate that only 24% of bus passengers consistently used seatbelts, with the majority reporting compliance solely at police checkpoints (20, 21). This significant disparity highlights a mode-specific behavioral gap, suggesting that safety behaviors in private cars do not automatically transfer to public or collective transport. This pattern suggests that seatbelt use is perceived more as a legal requirement than a preventive health behavior. Such a perception highlights a critical challenge for intervention design, as the adoption of seatbelt use appears to be externally motivated rather than internally valued as a protective measure. Accordingly, both behavioral and structural approaches are required to shift the perception of seatbelt use from an imposed obligation toward a self-protective norm (22, 23). Among behavioral determinants, subjective norms emerged as the most powerful predictor. A one-unit increase in subjective norms was associated with a 25% higher likelihood of seatbelt use. This finding aligns with previous studies among taxi passengers, where approval from significant others—such as drivers, traffic police, parents, and peers—was strongly linked to compliance (24, 25). Passengers who perceived higher social expectations demonstrated greater adherence, whereas those lacking normative support were less likely to comply. These results emphasize the importance of integrating normative belief strategies into interventions, for example, through public messaging and driver-led reinforcement, to enhance the salience of social approval in bus settings. Environmental determinants also played a substantial role. Each unit increase in the environmental score corresponded to an 18% higher probability of seatbelt use. Availability, accessibility, and functional integrity of seatbelts were among the most frequently cited factors, consistent with previous research highlighting the importance of equipment quality and accessibility in health-protective behaviors (26-28). Inadequate or defective seatbelts undermine compliance and weaken passenger trust in the utility of safety measures. These findings underline the need for regulatory policies that ensure the proper installation and maintenance of functional seatbelts across the intercity bus fleet. This also aligns with the finding that bus type was a strong non-behavioral determinant; passengers of ordinary buses were 2.2 times more likely not to use seatbelts compared to VIP bus passengers (OR = 2.20; $p = 0.001$). This suggests that seatbelt availability, accessibility, and functional integrity are superior in VIP buses, whereas ordinary buses may suffer from defective or inaccessible equipment. This discrepancy highlights the need for regulatory policies that ensure equitable standards of safety infrastructure across all bus types, rather than allowing comfort level to dictate safety features.

Perceived barriers represented another critical determinant. Each unit increase in perceived barriers increased the odds of non-use by 9%. Discomfort, stiffness, restricted movement, sweating in hot weather, and embarrassment were the most commonly reported barriers, in line with prior studies in both private vehicle and bus settings (9, 29). Similar to other preventive behaviors such as helmet use among cyclists, perceived barriers consistently emerge as the most powerful inhibitors of compliance (30). Addressing these barriers requires both ergonomic modifications to seatbelt design and passenger education to mitigate misconceptions about discomfort and inconvenience. Contrary to expectations, observational learning demonstrated a negative association with seatbelt use in the initial models, although this effect attenuated after adjustment. While prior research suggests that modeling is a critical mechanism for adopting preventive behaviors (31). The attenuation of observational learning also may reflect the transient nature of intercity travel, where passengers have limited engagement with others, reducing the impact of modeling. Our findings indicate that, among adult bus passengers, observational cues are less influential than cognitive and attitudinal determinants. This may be explained by the reduced role of imitation in adults compared with children, as well as the stronger influence of personal perceptions such as barriers and subjective norms. Interventions should therefore prioritize psychological and structural determinants rather than rely solely on modeling strategies.

Finally, enforcement and supervision showed a limited and even inverse association with consistent seatbelt use. Unlike private vehicles, collective transport environments diffuse individual responsibility, diminishing the effectiveness of legal oversight (32). These findings underscore the necessity of integrated approaches that combine continuous enforcement with educational and environmental modifications. Tailored strategies that address behavioral determinants, reduce barriers, and strengthen normative support are essential for promoting sustained seatbelt use among intercity bus passengers.

Strengths and Limitations

A notable strength of this study is that it is the first to systematically investigate the behavioral determinants of seatbelt use among Iranian intercity bus passengers, addressing a significant gap in road safety literature. However, certain limitations must be acknowledged. First, the reliance on self-reported data may introduce social desirability bias, where passengers might overestimate their compliance. Future studies could consider incorporating direct observational methods or camera-based monitoring. Additionally, while the data was collected from major terminals in Tehran—the primary hub for intercity transportation in Iran—future research should encompass a broader geographical diversity to account for potential regional cultural differences in safety behaviors.

CONCLUSION

This study demonstrates that seatbelt use among intercity bus passengers in Iran remains low, with only 24% reporting consistent use, primarily in response to police presence rather than as a protective health behavior. Behavioral determinants—including subjective norms, perceived barriers, and environmental factors—significantly influenced compliance, while bus type also affected usage. Passengers reported discomfort, restricted movement, and accessibility issues as key barriers, highlighting the need for ergonomic and user-friendly seatbelt designs. Interventions should focus on enhancing passenger awareness and attitudes, reducing barriers through design improvements, and ensuring seatbelt functionality and maintenance before each trip. A comprehensive approach addressing behavioral, environmental, and structural factors is essential to promote consistent seatbelt use and improve passenger safety.

DECLARATIONS

Ethics approval and consent to participate: The researchers observed all the ethical codes including informed consent, confidentiality, plagiarism, double publication, data manipulation, and fake data generation. The study has been performed in accordance with the Declaration of Helsinki and received approval ethical research code from ethics Committee of Shahid Beheshti University of Medical Sciences (Approval ID: IR. IR.SBMU.PHNS.REC.1395.106). It should be noted that, informed consent was obtained from all participants.

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Authors' contributions:

All authors contributed to the study conception and design as well as read and approve the final manuscript.

J. H. contributed in acquisition of data, analysis and interpretation of data.

S. R. contributed in methodology, data analysis and interpretation of data.

F. B. contributed in writing original draft.

M. Gh. contributed in supervision, methodology, review & editing, project administration.

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