



Research paper

Security perceptions in ride-sharing services: Influencing factors and effective solutions[☆]Marzieh Afsari^{ID}*, Salar Salehi^{ID}, Lory Michelle Bresciani Miristice^{ID}, Guido Gentile^{ID}

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ABSTRACT

Ride-sharing offers flexibility and cost-efficiency, but presents security challenges, especially in developing countries. In Iran, a country with a longstanding tradition of ride-sharing, this study investigates how users perceive security, and which measures they consider effective. We collected survey data from 270 participants and applied factor analysis to identify latent dimensions influencing perceived security, including experiences, social influences, family norm, and religion. These factors and demographics were included in an ordered logit model to assess their impact on perceived security. Results show gender is the strongest predictor, with women reporting lower security than men. However, men also feel insecure, especially at night or outside urban areas. These findings underscore the need to combine gender-neutral and gender-sensitive strategies to ensure fairness while addressing the diverse security needs. Other significant variables include age, past harassment experience, media exposure, and family norms. Those with very low perceived security are less responsive to interventions than those with moderate or higher security. We also evaluated user preferences for a range of proposed measures. Cameras and tracking received strong support, with many expressing a willingness to pay for increased security. Security apps showed promise, but users stressed the need for better privacy, preventive functions, and real-time response.

1. Introduction

Ride-sharing is a transportation service that enables passengers to share a vehicle traveling along fully or partially overlapping routes (Lokhandwala & Cai, 2018). Positioned between public and private transportation, ride-sharing offers benefits such as cost savings, reduced traffic congestion, and lower carbon emissions (Afsari, Ippolito, Mistrice, & Gentile, 2024a, 2024b). However, these advantages come with trade-offs, including longer travel times and the need to share space with strangers. One defining feature is the shared backseat, traditionally viewed as private, now occupied by unfamiliar individuals, leading to new social dynamics. These interactions can foster community but also create discomfort, security concerns, and even discrimination (Jan Hrnčič & Jakob, 2015; Sarriera, Álvarez, Blynn, Alesbury, Scully, & Zhao, 2017). While these social aspects are central to user experience, they remain understudied compared to economic and environmental dimensions. Factors such as security, comfort, and trust play a critical role in shaping ride-sharing adoption, sometimes outweighing traditional considerations like cost and travel time (Meshram, Choudhary, & Velaga, 2020; Sener, Sibü, & Hansen, 2023). Understanding

how users perceive these dynamics is essential for designing inclusive and widely accepted ride-sharing systems.

Gender differences in travel behavior significantly shape how individuals experience ride-sharing. These behavioral patterns are deeply influenced by gender roles and responsibilities in daily life. Women often shoulder a larger share of unpaid household labor including childcare, shopping, and eldercare, even when participating in the workforce (Craig & van Tienoven, 2019; Taylor, Ralph, & Smart, 2015). This lifestyle structure leads to more complex travel needs, often requiring multiple stops in a single trip, a pattern known as trip chaining (McQuaid & Chen, 2012). Consequently, women tend to make shorter, more frequent trips and rely more heavily on public transportation for daily errands (Viswanath, 2013). In addition, they are more likely to prioritize safety, security, and environmental factors in their travel decisions, especially when private transportation is unavailable (Ng & Acker, 2018; Sovacool, Kester, Noel, & Zarazua de Rubens, 2018). In contrast, men are more likely to prioritize efficiency and affordability in their transportation choices.

Gender differences extend to perceptions of safety and security. Women's sense of security in transportation environments is often

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influenced by factors such as lighting, visibility, and the presence of surveillance systems, particularly in shared spaces like public transport and ride-sharing (Loukaitou-Sideris & Fink, 2008). Enhanced security measures, including in-vehicle cameras and real-time tracking, are more likely to encourage women to use these services (Levin, 1982). Men, on the other hand, are generally more driven by convenience and cost, with security becoming a priority only in situations where explicit risks are perceived.

These individual security concerns are shaped not only by personal experience but also by broader social and cultural conditions. In many developing countries, including Iran, societal norms and structural barriers such as restrictions on women's mobility or limited gender-sensitive transport policies can constrain access to secure, reliable ride-sharing options (Civitas, 2018; Pollard & Wagnild, 2017). Designing inclusive mobility systems requires sensitivity to these layered influences. While several studies have examined gender-based mobility barriers or perceptions of security in ride-sharing, few have explicitly analyzed how these concerns intersect with cultural norms and user preferences for specific security measures. Much of the existing research focuses on women's experiences (Firoozi Yeganeh, Khademi, Farahani, & Besharat, 2022) or general user behavior without exploring gender differences in depth (Meshram et al., 2020; Mostofi, Masoumi, & Dienel, 2020). Less is known about how men and women perceive specific security measures, such as women-only services, when used in culturally conservative settings with strong gender norms.

This study contributes to those gaps by examining how demographic, experience, family norm, and religion shape perceived security and by assessing which measures are considered acceptable by both genders. Understanding users' trust and behavioral intentions requires attention to cultural and institutional settings, which significantly influence user behavior (Marcén & Morales, 2021). Focusing on Iran allows us to explore these dynamics in a country with long-standing ride-sharing use, distinct gender norms, and women-only transport systems. This context provides a unique opportunity to evaluate how culturally grounded solutions influence security perceptions and inclusivity in ride-sharing.

This study aims to provide critical insights into the social impacts of ride-sharing and evaluate how tailored interventions can address diverse user needs, contributing to more inclusive and culturally sensitive transportation systems.

Building on these aims, the research addresses the following questions in the context of Iran:

1. Which demographic and experiential factors (e.g., harassment experience, media exposure) most strongly influence perceived security in ride-sharing services?
2. How do male and female users differ in their perception of security across specific ride-sharing scenarios (e.g., time of day, co-passenger gender)?
3. Which security measures, such as tracking apps, surveillance features, and women-only options, are perceived as acceptable and preferable by both male and female users in ride-sharing services?

The paper is organized as follows, Section 2 reviews the relevant literature on ride-sharing, security perceptions, and gender-related mobility concerns, identifying key research gaps. Section 3 has introduced the conceptual framework guiding this research. Section 4 introduces the study area, outlining the geographical and demographic context relevant to this research. Section 5 details the participants, the questionnaire, and the methodology employed, including factor analysis (FA) and the development of the ordered logit model (OLM). Section 6 presents the results, followed by a discussion of security solutions for ride-sharing in Section 7. Section 8 addresses the study's limitations, and Section 9 concludes the paper.

2. Literature review

A robust body of work confirms that who the passenger is and what they have lived through largely determine how secure they feel in a ride-sharing context. Across continents, women report significantly lower perceived security than men, a gap most pronounced when prior harassment is involved (Fileborn, Cama, & Young, 2022; Hu & Yang, 2024). Large-sample surveys in China show that younger, low-income women are the group most anxious about route deviation or driver misconduct (Hu & Yang, 2024), a pattern mirrored among university women in Mexico City (Scholl, Oviedo, & Sabogal-Cardona, 2021). Age, income and heavy media exposure independently predict heightened worry, consistent with cultivation theory's claim that frequent exposure to crime news increases fear even in the absence of direct victimization (Ceccato & Loukaitou-Sideris, 2022).

Experiential factors amplify these baseline differences. Victims of harassment or those who have merely witnessed incidents, report sharply reduced security ratings in Australia and South Africa alike (Duri, 2023; Fileborn et al., 2022). In many studies the personal or social proximity of an incident outweighs media coverage in shaping fear: first-hand or friend-of-friend accounts cut deeper than headlines alone (Fileborn et al., 2022). Two culturally specific variables, under-examined in Western work, are salient in the Middle East: (i) family norms, which can restrict women's solo mobility, and (ii) religiosity, which may legitimize or discourage use of commercialized mixed-gender transport. Research on Iranian and Gulf cities shows that strong family approval is often a prerequisite for women's night travel, while higher religious commitment can tilt perceptions either way depending on local doctrine (Saffari, Mohammadi Zeidi, Pakpour, & Koenig, 2012; Shaaban & Maher, 2019).

Perceived security is highly context-dependent. Women's concerns spike in what the literature calls "high-risk ride contexts": night-time travel, unfamiliar or dimly lit neighborhoods, and rides shared with male strangers (Hu & Yang, 2024; Scholl et al., 2021). In Mexico City, women are 64% less likely than men to agree to pooled rides if the co-passenger is unknown (Scholl et al., 2021); similar reluctance appears in Chinese and South African samples (Duri, 2023; Hu & Yang, 2024). Conversely, traveling with a familiar companion raises women's safety ratings to near-male levels (Hu & Yang, 2024). Men also prefer safer environments but their fear usually targets property crime rather than sexual harassment (Fileborn et al., 2022).

Spatial setting matters; a study finds that poorly lit, low-traffic zones exacerbate fear, especially among women who have faced harassment before (Duri, 2023). Such scenario effects are often modeled via interaction terms in ordered-logit or structural-equation frameworks, confirming that gender gaps widen under adverse conditions (Scholl et al., 2021).

Although these studies were conducted in diverse contexts, from Australia and China to Mexico and South Africa, the underlying behavioral and social mechanisms influencing perceived security in ride-sharing appear consistent across societies. Factors such as gender norms, prior harassment, social learning, and media exposure operate through comparable psychological pathways, even if their intensity or expression differs by culture. This alignment allows the findings from international contexts to inform the Iranian case, where cultural and institutional settings modify rather than overturn these patterns. Conversely, insights from Iran can enrich the global understanding of how universal concerns about security and gender manifest within distinct socio-cultural frameworks.

2.1. Security measures and policy responses

In response to widespread security concerns, researchers and policymakers have explored various interventions to enhance perceived security in ride-sharing. These solutions span technological innovations, institutional regulations, and gender-sensitive service designs.

While global evidence highlights some convergence in preferred measures, contextual and cultural differences, especially in societies with strict gender norms, remain critical in shaping their effectiveness and public acceptance.

Riders worldwide endorse a suite of technological and institutional measures to mitigate risk. Low-friction tech (GPS live tracking, share-my-trip functions, and in-app emergency buttons) tops user preference rankings in China, Mexico, the USA and Australia alike (Fileborn et al., 2022; Scholl et al., 2021). In Mexico City, women are 2.14 times more likely than men to activate the panic button (Scholl et al., 2021). Surveillance devices (interior cameras, tamper-proof audio) receive cautious but growing support, provided data are handled responsibly (Fileborn et al., 2022).

Institutional safeguards are equally critical. Rigorous driver background checks, periodic licence renewal, driver training in professional conduct and harassment prevention, and swift suspension following complaints are consistently rated “essential” by both genders (Duri, 2023; Shaikh, Glavee-Geo, Zhakupbekova, & Turginbayeva, 2025). Where regulation is weak, perceived security and willingness to use the service drop markedly (Shaikh et al., 2025).

The concept of women-only transportation as a security measure is divisive. Some women’s rights groups argue that it reinforces gender separation, making true equality harder to achieve. Although it offers a temporary solution for security, it is essential to assess whether it truly leads to a more equal and secure public transit system for everyone (Dunckel-Graglia, 2013). Dunckel-Graglia suggests that the rise of women-only transportation globally reflects not just safety concerns but deeper issues of how cities meet women’s needs (Dunckel-Graglia, 2013), highlighting a broader problem of gender inequality in urban navigation. Similarly, Mexico City’s transit authority views women-only transportation as both a safe travel option and a tool to raise awareness about violence and harassment against women. In contexts with strict gender norms, women-only services (“pink taxis”) have emerged as a targeted fix. Iran pioneered all-female taxis in 2006; similar schemes exist in Rio de Janeiro, Lahore, Jakarta, Dubai and Tokyo (Dunckel-Graglia, 2013).

Recognizing the need for more secure public transit, several Latin American cities are pioneering innovative strategies. Examples include São Paulo and other cities’ hotlines and apps for direct reporting of incidents to transit authorities (Ceccato & Paz, 2017). Quito’s text message hotline goes a step further by encouraging bystander intervention through automated alerts within vehicles upon receiving a report (Paredes & Berbey-Alvarez, 2019). High smartphone ownership among adults worldwide, presents opportunities for enhanced security interventions. There is increasing interest in using smartphone technology for safety and security, with various apps developed to help people stay safe. These apps include features like location sharing with friends and family and emergency call functions (Doria et al., 2021; Maxwell, Sanders, Skues, & Wise, 2019; Reynald, 2018). However, they rarely teach users how to spot, avoid, or respond to potential threats. Moreover, most apps react after an incident rather than prevent it, thus they may not stop individuals from being targeted (Maxwell et al., 2019).

An important aspect of addressing security issues is the effective reporting of incidents, and security apps can play a crucial role in this regard. Currently, there are no standardized protocols for reporting security-related issues, particularly sexual violence, assault, or harassment. Harassment on public transit exists along a continuum, encompassing visual, verbal, and physical forms, many of which may be subtle and less perceptible to men. Women are the most frequent victims, but LGBTQ+ individuals also face elevated risks (Madan & Nalla, 2016). While men are also impacted, the effects are generally less severe (Spears, Houston, & Boarnet, 2013; Spicer & Song, 2017). Despite its seriousness, many urban planners often dismiss sexual assault on public transit as a minor inconvenience, leading to its frequent neglect in urban planning and safety measures (Ball & Wesson, 2017;

Clark, Jeglic, Calkins, & Tatar, 2014). Research highlights that both experiencing and fearing sexual assault on public transit can significantly restrict people’s mobility and access to public spaces and lead them to use more private cars if it is available (Loukaitou-Sideris, 2014; del Mar Rodas-Zuleta, Cardona, & Escobar, 2022). Consequently, a significant number of these incidents go widely underreported. Victims often find the reporting process emotionally distressing and ultimately ineffective, which further exacerbates the problem (Priya Uteng, 2021). A study conducted in Bogotá, Colombia, found that sexual harassment is common in public transport and public spaces, yet these incidents are largely underreported (Quinones, 2020). This underreporting is largely due to widespread distrust in authorities and police in some countries (Quinones, 2020). Fear of a negative response from authorities further deters many victims from reporting. Concerns about dismissive attitudes, insensitive questioning, and victim-blaming contribute to this fear (Natarajan, Schmuhl, Sudula, & Mandala, 2017; Tripathi, Borrior, & Belur, 2017). As a result, the extent of the problem remains largely hidden (Ceccato & Paz, 2017).

Despite growing interest in technological and institutional security measures, evidence on their long-term effectiveness remains limited, particularly in culturally specific contexts. The debate over women-only transport also reveals a tension between immediate security benefits and broader goals of gender equality. To address these gaps, this study investigates users’ preferences and acceptance for both gender-specific and mixed-gender security enhancements in Iran. By capturing culturally grounded, gender-differentiated attitudes, the research aims to support more inclusive and context-sensitive security policies.

3. Conceptual framework

Synthesizing the literature, this study is guided by a conceptual framework Fig. 1 that posits perceived security in ride-sharing is not determined by isolated factors, but emerges from a dynamic interplay between an individual’s socio-cultural context, economic constraints, and direct and indirect experiences. These elements collectively shape users’ security perceptions, which in turn influence behavioral and economic outcomes, specifically, the acceptability of and willingness-to-pay for security measures. The framework outlines four interrelated components:

1. **Socio-Cultural Context:** This foundational layer comprises stable characteristics and social norms. Gender is a primary determinant, with women expected to report lower baseline security perceptions. This relationship is moderated by family norms and religiosity, which shape mobility permissions and perceived risk.
2. **Economic Context and Constraints:** This layer captures the user’s capacity to participate in the ride-sharing market. Income directly affects affordability and service choice, while employment status (e.g., student, business owner) influences travel frequency, exposure to risk, and economic priorities, as also reflected in our empirical results.
3. **Direct and Indirect Experiences:** This layer encompasses proximal influences on perceived security. Direct experiences, such as harassment, exert a strong negative effect, whereas indirect experiences, including social learning and media exposure, also erode perceived security through informational amplification.
4. **Security Perceptions and Socio-Economic Outcomes:** The culmination of these factors is the individual’s overall perception of security, which serves as the dependent variable. This perception, in turn, shapes attitudinal (acceptability of measures) and behavioral-economic (willingness-to-pay) outcomes, linking subjective security to tangible market behaviors.

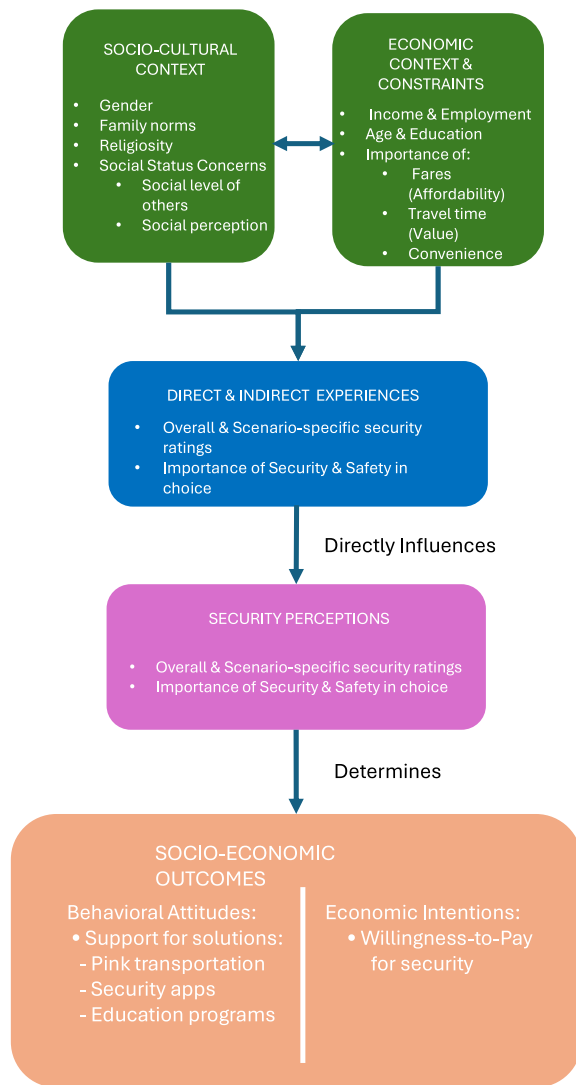


Fig. 1. Conceptual framework.

4. Study area

Tehran, the political and economic hub of Iran, and the adjacent Alborz Province together form the country's principal urban corridor (Fig. 2). With a combined population of roughly 17 million, thousands of residents commute daily between the two provinces, placing intense demand on their shared transport network. Travel behavior in this corridor reflects deeply rooted socio-economic patterns: a largely male, petroleum-oriented labor market and family-centered norms still constrain women's mobility. A salient example is the current regulation that bars women from riding motorcycles (Beigi, Nayyeri, & Shirmohammadi, 2020).

The supply of urban transport is diverse. Formal modes, metro, bus and Bus Rapid Transit, carry 22% of trips; shared taxis account for 18.1%, motorcycles 7%, and app-based ride-hailing services 1.9%. Bicycles register under 1%, while private cars dominate at 46.4% (Firoozi Yeganeh et al., 2022). Informal minibuses and moto-taxis fill coverage gaps, especially in peripheral districts (Soltani, 2017).

Gender segregation is a defining feature of Iran's formal public transport. Buses and metro trains provide women-only sections (pink transportation), to mitigate harassment in crowded vehicles. Shared taxis, by contrast, are mixed-gender. Two service types exist: *circulating* taxis ply flexible routes within zones, picking up multiple passengers,

whereas *fixed-route* taxis shuttle between designated stations (Firoozi Yeganeh et al., 2022). Women's reliance on shared taxis varies with household car ownership (Transportation & Studies, 2022). Among women in car-less households (19.5% of adult females), shared taxis fulfill 41.3% of trips, largely because mass-transit options are limited or overcrowded. When a household owns one car (67.5%), male members typically have priority, and women still use shared taxis for 25.6% of journeys. Even in two-car households (13%), shared taxis remain relevant at 14% of trips, underscoring their cross-cutting role in female mobility. Qualitative fieldwork likewise indicates that the great majority of women who rely on shared taxis have personally experienced some form of harassment, reinforcing that safety, not merely convenience, drives their modal choices (Goodarzi, Firoozi, & Saeidi, 2021).

App-based ride-hailing has altered the landscape since 2014. Local platforms such as *Snapp* and *Tapsi*, modeled on global services like Uber, leverage smartphone apps for booking and payment. By 2023 they had attracted more than ten million registered users, signaling a rapid shift toward digital ride-sharing (Beigi et al., 2020).

Iran's economic landscape, similar to that of many developing countries, is characterized by rising household incomes alongside persistent inequality that influences daily mobility and access to transport. Broader macroeconomic forces—such as trade openness, investment flows, and labor market structures—continue to shape these disparities (Naoaj, 2023). Although average earnings have increased in recent years, the Gini index of about 35.9 in 2023 indicates that income distribution remains uneven, and national analyses link higher per-capita GDP, inflation, and unemployment to widening inequality (Fakhrhosseini, 2024). This unequal pattern of growth particularly affects urban areas such as Tehran and Alborz, where living costs and transport expenses have risen faster than wages. Consequently, affordability has become a defining constraint on mobility, especially for low-income users. These conditions situate Iran within the broader developing-country context, where economic inequality, affordability, and social norms intersect to shape how individuals perceive and experience security in ride-sharing.

5. Methodology

The study followed the multi-stage workflow shown in Fig. 3. First, a literature review identified key variables and research gaps. Based on these insights, we designed a questionnaire and piloted it to ensure the clarity and effectiveness, which was then administered online to collect data from participants. The analytical stage began with descriptive statistics and reliability checks. Next, we applied exploratory factor analysis (FA) to condense highly correlated perception items into a smaller set of conceptually coherent latent factors. Using factor scores rather than individual items reduces dimensionality and mitigates multicollinearity.

Finally, we estimated an ordered logit model (OLM) to explore how the latent factors and background covariates relate to the ordinal dependent variable. OLM is specifically designed for ordered outcomes and is more efficient than alternatives such as multinomial logit, which ignore the inherent ranking of response categories. Combining FA with OLM therefore preserves information, yields stable parameter estimates, and facilitates an interpretable assessment of the determinants of security perception.

5.1. Questionnaire design

After a comprehensive review of the literature on ride-sharing adoption, several key variables influencing individuals' decisions to use such services were identified. These include demographic characteristics as well as preferences regarding comfort, privacy, and social dynamics experienced during shared rides. Based on these insights, an online questionnaire was developed. Prior to distribution, a pilot



Fig. 2. Geographical location of Tehran and Alborz provinces.

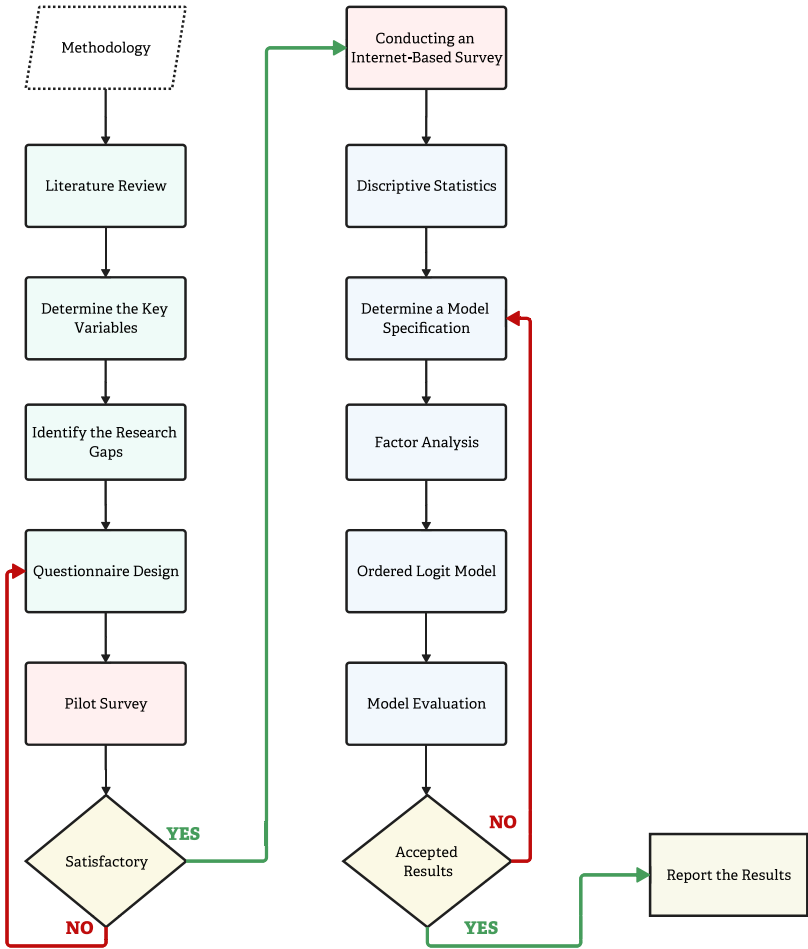


Fig. 3. Research methodology flowchart.

survey was conducted with 10 volunteers to ensure clarity, effectiveness, and accuracy of the questions. The finalized questionnaire was subsequently disseminated via three widely-used Iranian social media platforms: LinkedIn (professional network), Instagram (stories and direct messages), and Telegram (groups and channels). Distribution was performed directly by the authors. Each post included a brief study description and an active survey link. Participation was entirely voluntary, anonymous, and uncompensated; no monetary or non-monetary incentives were provided.

The questionnaire consists of four distinct sections, each capturing specific dimensions relevant to the study. A summary of each section is provided below, with full questions and their corresponding response options presented in Table 5 of the appendix for reference, allowing readers to see the full scope of the questionnaire and understand the context of the responses collected. Additionally, a concise overview of

all surveyed variables, organized by questionnaire section, is provided in Table 1.

1. **Demographic Data:** Collects data on participants' gender, age, education, and income level.
2. **Ride-Sharing Choice and Contextual Security:** Evaluates the perceived importance of various factors when selecting ride-sharing services, including security, safety, travel time, cleanliness, fares, and convenience. Additionally, respondents rated their feelings of security across different ride-sharing contexts (e.g., day/night, urban/non-urban, companion familiarity and gender).
3. **Influences on Travel Behavior:** Drawing on insights from Firoozi Yeganeh et al. (2022), who examined women's travel experiences in Tehran, this section investigates socio-cultural factors influencing individuals' intentions to use shared taxis.

Table 1
Survey variables.

Questionnaire section	Variables
Demographic data	Age; Gender; Education; Income
Ride-sharing choice & contextual security	Importance of: Security; Safety; Convenience; Travel time; Fares; Cleanliness; Social level of other passengers; Concern about social perception; Perceived security <i>overall</i> ; With familiar companion; With female strangers; With male strangers; Daytime; Night-time; Inside urban area; Outside urban area
Influences on travel behavior	Family travel restrictions; Weight given to family advice; Organizational religious attendance; Private religious activities; Intrinsic beliefs; Actual sexual harassment; Perceived (imaginary) harassment; Witnessed harassment; Heard of harassment from acquaintances; Media reports of harassment; Experienced/witnessed taxi robbery
Views on proposed solutions	Support for pink transportation; Support for security apps; Support for in-vehicle safety equipment; Support for education/awareness programmes

Factors include harassment experiences, familial or societal restrictions, gender norms, personal beliefs, and indirect social learning. Additionally, standardized religiosity measures from the Iranian adaptation of the Duke University Religion Index (DUREL) were included to reliably assess organizational, non-organizational, and intrinsic religious behaviors (Koenig & Büssing, 2010; Saffari et al., 2012). Clear definitions of actual harassment (any unwelcome behavior, action, or communication that demeans, threatens, or intimidates an individual, often creating an uncomfortable, hostile, or offensive environment, and taking various forms such as verbal, physical, or psychological, typically involving repeated actions) and perceived (or imaginary) harassment (the feeling or belief that one is being harassed, based on personal interpretation of behaviors or situations, irrespective of whether objective harassment occurs) were provided before related questions.

- Views on Proposed Solutions:** Participants evaluated current and potential security enhancement measures in ride-sharing, including gender-segregated (pink) transportation, security-focused mobile apps, onboard safety equipment, and education or awareness initiatives. Insights gathered from this section can guide policy improvements.

The survey was conducted from June to July 2024, resulting in 300 initial responses. After excluding incomplete, inconsistent, or low-quality submissions (identified through attention checks and logical consistency checks), a final sample of 270 valid respondents was retained. This sample size aligns with the Cochran formula (Nanjundeswaraswamy & Divakar, 2021), ensuring a 90% confidence level with a $\pm 5\%$ margin of error for large populations. Cochran's formula (Eq. (1)) calculates necessary sample sizes based on desired precision (e), confidence level (Z^2), and estimated attribute proportion in the population (p):

$$n_0 = \frac{Z^2 \cdot p \cdot (1 - p)}{e^2} \quad (1)$$

Ethical considerations were strictly observed, especially regarding sensitive harassment topics. Anonymity of responses was guaranteed, participation was entirely voluntary, and careful wording was employed to minimize participant discomfort.

5.2. Preliminary analysis of questionnaire

Table 2 presents the demographic breakdown of the sample population by comparing percentages of females and males across various categories and further enriches this profile by listing the sample share for each category alongside the corresponding percentage in the general population (Statistical Center of Iran, 2016). It highlights notable gender disparities, females are highly represented in the 35–49 and 50–64 age groups. They dominate the 'Employed,' 'Retired,' and 'Unemployed' occupation categories and make up a larger share of Bachelor's degree

holders. However, males are the predominant group among the self-employed and hold a strong majority at the Master's/PhD education level. While females have a higher representation in the average income bracket, their proportional advantage decreases in the higher income brackets, with males showing increased representation as income rises.

Table 2 serves as a benchmark for demographic analysis. By comparing these two, we can assess how closely the sample reflects the broader demographic trends observed in this study area. Compared to the general population, the sample is older (with more individuals aged 20–34 and fewer under 18) has a slightly higher proportion of women, a greater share of university graduates, and a higher employment rate with fewer students, unemployed, or retired individuals. While these minor differences are expected given the nature of survey studies, the findings remain consistent with broader trends. Nevertheless, the results should be interpreted with appropriate caution, acknowledging that the analysis focuses on revealing meaningful patterns and associations rather than making direct inferences to the entire population.

Our descriptive analysis of ride-sharing security perceptions reveals a complex landscape. At a baseline, trust in the service is relatively high, with only 5% of respondents feeling that ride-sharing in Iran is not secure, a figure that drops to just 2% when accompanied by a familiar person. However, this sense of security is highly situational. Feelings of insecurity increase significantly outside urban areas or at night, affecting a majority of users (55% of women and 42% of men). This finding underscores the critical importance of including men's perspectives in security planning, as they are also subject to widespread insecurity in specific contexts. The prevalence of harassment experiences further highlights this point: 30% of women and 17% of men report having faced harassment, indicating that while women are disproportionately affected, men are not immune. Furthermore, the concept of "imaginary harassment", the fear or perception of a potential threat, was reported by 36% of women and 24% of men, underscoring the psychological dimension of security and the need for inclusive measures that address both real and perceived risks.

Regarding specific security features, we found strong support for technological interventions. More than 60% of both genders support implementing real-time driver tracking and in-taxi cameras. In contrast, sending location information to trusted contacts was perceived as less important. Additionally, over half of respondents have used security apps but report significant concerns about their privacy, suggesting a key area for improvement in future security solutions.

5.2.1. Descriptive analysis of economic preferences

Beyond the model of security perceptions, the survey provides direct insights into the economic dimensions of ride-sharing choices, particularly the valuation of security and its trade-offs with other service attributes. The data reveals that security is the paramount concern for users, far surpassing all other considerations. An overwhelming 74.8% of respondents rated security as 'Very Important' (5/5), with only 1.5% considering it unimportant (ratings 1–2). This prioritization

Table 2
Demographic characteristics of the survey sample and the general population.

Variable	Category	Female %	Male %	Sample %	Population %
Age group					
	Under 18	62.5	37.5	3.0	21.0
	18–24	37.9	62.1	10.8	14.0
	25–34	54.7	45.3	51.7	23.1
	35–49	69.9	30.1	27.1	30.7
	50–64 (50–69)	73.7	26.3	7.1	11.1
	65 and above	–	–	0.4	0.1
Gender					
	Female	–	–	58.0	50.0
	Male	–	–	42.0	50.0
Education level					
	Diploma or less	41.3	58.7	17.1	52.0
	Bachelor's degree	62.3	37.3	–	–
	Master's/PhD	30.2	69.4	–	–
	University degree (all)	–	–	82.9	48.0
Occupation					
	Employed	69.4	30.0	65.4	52.0
	Self-employed	35.6	64.4	–	–
	Student	62.3	37.3	22.7	33.0
	Retired	72.2	27.8	6.7	7.6
	Unemployed	64.3	35.7	5.2	7.4
Income					
	Well below average	66.7	3.3	2.2	–
	Below average	64.0	36.0	9.3	–
	Average	59.4	40.6	53.2	–
	Above average	56.2	43.8	33.1	–
	Much above average	50.0	50.0	2.2	–

Note: “–” indicates data not available from national statistics or not applicable.

of security over other factors establishes it as the primary determinant of ride-sharing choice in the Iranian context.

When asked about their willingness to pay (WTP) a premium for enhanced security features, user responses revealed strong demand for safety. The most common preference was for an 11%–20% price increase (32.9% of respondents), followed by 0%–10% (26.7%). Cumulatively, 86.7% of all users expressed willingness to pay some premium for improved security, with only 8.9% completely unwilling to pay more. Gender analysis revealed distinct economic behaviors. Women were significantly more likely to choose the mid-range premium (38.6% of women vs. 25.2% of men preferred the 11%–20% tier), while men showed greater preference for the lowest price increase (30.6% of men vs. 24.1% of women preferred 0%–10%). This pattern suggests women place a higher economic value on security enhancements.

The distribution of WTP across income groups revealed expected economic patterns. Respondents identifying with 'Much above average' income showed the strongest preference for higher premiums (75% preferred 21%–30% increases), while those with 'Well below average' income were most represented in the 'unwilling to pay' category (33.3%). This confirms that capacity to pay influences security investment preferences.

Despite the overwhelming priority given to security, users face clear economic trade-offs. When compared to travel time-another critical economic factor in transportation choice-the data shows security is valued substantially higher. While 74.8% gave security the highest importance rating, only 55.0% gave travel time the same top rating. This preference structure indicates users are willing to sacrifice time efficiency for greater security, representing a significant economic trade-off in their decision-making calculus. These results paint a nuanced economic picture: users demonstrate strong willingness to invest in security and prioritize it above traditional economic factors like travel time, while maintaining sensitivity to overall transportation costs. This creates a complex environment for implementing and pricing security measures.

The economic data reveals a consistent pattern where security functions as a superior good in transportation choice, dominating traditional economic factors like travel time and cost efficiency. The analysis demonstrates that security operates as a valued economic attribute with clear behavioral patterns: women show stronger preference for mid-range security premiums, higher-income users prefer more substantial security investments, and all user groups prioritize security over time savings in their decision-making calculus. However, the identified trade-offs reveal inherent tensions: while security is highly valued, universal implementation that increases base fares could disproportionately affect cost-sensitive and low-income users. The gender and income disparities in security valuation further highlight the need for differentiated approaches to address varying economic capacities and preferences across user segments.

5.3. Factor analysis for perception variables

FA is a multivariate statistical technique used to uncover the underlying structure of a set of observed variables. Specifically, Exploratory Factor Analysis (EFA) seeks to identify the smallest number of hypothetical constructs (known as factors, dimensions, latent variables, or internal attributes) that can account for the correlations among observed variables. By determining these common factors, EFA aims to explain the order and structure present in the data, simplifying complex datasets into more manageable components (Watkins, 2018). EFA is widely accessible in many commercial statistical packages. Among these, the R programming language offers comprehensive tools for EFA through various packages. Statistical analysis was conducted using R version 4.1.0 (Team, 2021). The following packages were utilized in this research: psych (Revelle, 2024), corrplot (Wei & Simko, 2021), polycor (Fox, 2022), factextra (Kassambara & Mundt, 2020), devtools (Wickham, Hester, & Chang, 2025), and nFactors (Raiche & Magis, 2022).

5.4. Ordered logit model

The Ordered Logit Model (OLM), also known as the proportional odds model, is specifically designed for ordinal outcomes, where the response categories follow a meaningful order (e.g., low, medium, high). This model examines the cumulative probabilities of the response variable and assumes that the logarithm of these cumulative probabilities (the logit) can be expressed as a linear function of the predictor variables. The regression coefficients represent the relationship between the covariates and the response variable. These coefficients remain the same across all categories of the response variable, in accordance with the parallel regression assumption (Grilli & Rampichini, 2023). The OLM is preferred for ordinal data due to its interpretability, the coefficients offer a clear measure of the effect of predictors on the likelihood of being in or below a specific category (Fullerton & Anderson, 2023). The OLM is a latent variable model that links the observed ordinal outcome Y to an underlying continuous measure y . The relationship can be expressed as Eq. (2):

$$Y = j \quad \text{if } \tau_{j-1} \leq y < \tau_j, \quad \forall j \in \{1, 2, \dots, J\}, \quad (2)$$

where:

- J is the total number of categories,
- τ_j are the cutpoints (thresholds) separating adjacent categories.

The cumulative probability of $Y \leq j$ is defined as Eq. (3).

$$P(Y \leq j | \mathbf{X}) = P(y \leq \tau_j | \mathbf{X}) = \frac{\exp(\tau_j - \beta' \mathbf{X})}{1 + \exp(\tau_j - \beta' \mathbf{X})}, \quad (3)$$

where:

- β are the regression coefficients,
- $\mathbf{X}$ is the vector of predictor variables.

The proportional odds assumption constrains the slopes (β) to be constant across all categories. This reduces the number of parameters to estimate, ensuring model parsimony. For each observation i , the likelihood L_i is defined as Eq. (4).

$$L_i = \begin{cases} P(Y_i \leq j) - P(Y_i \leq j-1), & \text{if } Y_i = j, \\ P(Y_i \leq 1), & \text{if } Y_i = 1, \\ 1 - P(Y_i \leq J-1), & \text{if } Y_i = J, \end{cases} \quad (4)$$

The log-likelihood function for all observations is as Eq. (5).

$$\log L = \sum_{i=1}^n \log L_i. \quad (5)$$

The OLM was implemented using the statsmodels library in Python (Seabold & Perktold, 2010). The model estimation utilizes the Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm. The BFGS algorithm is an iterative optimization technique designed to solve unconstrained nonlinear optimization problems. As a quasi-Newton method, BFGS approximates the Hessian matrix, which represents the second-order partial derivatives of the objective function. This approximation guides the search for the optimal parameters by improving the convergence efficiency and stability of the model fitting process. The choice of the BFGS algorithm ensures robust and accurate estimation of the model coefficients (Yang, 2010).

6. Results

The process of conducting EFA is summarized in the flowchart shown in Fig. 4. Before performing EFA, two preliminary evaluations were conducted to ensure the dataset's suitability. Bartlett's Test of Sphericity (Bartlett, 1954) assessed whether the correlation matrix significantly deviates from an identity matrix, where such a deviation suggests the presence of relationships among variables. The test yielded

a chi-square value of 3917.10 with a p -value of 0.00, confirming that the data was appropriate for EFA. Additionally, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1974) evaluated the proportion of variance in the variables that could be explained by underlying factors. KMO values range from 0 to 1, where values of 0.70 or higher are considered acceptable, and values below 0.50 are deemed insufficient. The KMO value, calculated at 0.76, indicated that the dataset met the criteria for factor analysis. To account for the ordinal nature of the perception variables, which might render Pearson correlations insufficient for capturing their relationships (Watkins, 2018), polychoric correlations were employed instead, as illustrated in Fig. 6.

Selecting the appropriate number of factors to retain is a critical decision in EFA. However, no single method is universally effective across all scenarios; therefore, it is essential to use multiple approaches and evaluate each potential solution to determine the most suitable factor structure (Watkins, 2018). Parallel Analysis (Horn, 1965) and Minimum Average Partial (MAP) analysis (Velicer, 1976) are two widely recognized empirical approaches for determining the optimal number of factors. In this study, these methods were employed to estimate the number of factors, with both analyses conducted using the psych package. Parallel Analysis which compares the eigenvalues from our actual data with those from randomly generated data (Fig. 5), suggested retaining six factors, while the MAP method, which is used to find the point at which adding more factors did not significantly reduce the average partial correlation among the variables, indicated the retention of four. After carefully evaluating these results alongside the theoretical interpretability of the factor structure, a decision was made to retain six factors to better capture the underlying structure of the data.

Factor rotation aims to simplify the solution and enhance theoretical interpretability by adjusting the axes within the factor space to align more closely with the variables' positions (Watkins, 2018). This adjustment adheres to the distinction between orthogonal and oblique rotations from a geometric perspective. In this analysis, an oblique rotation was employed to minimize correlations between factors, utilizing the promax rotation technique. Table 3 displays the factor loadings for each variable in relation to the factors. Loadings greater than 0.4 are presented, with those exceeding 0.6 highlighted in bold. Furthermore, Cronbach's alpha was calculated for each factor and reported. It is worth mentioning that factor scores were calculated using the maximum likelihood method. When certain variables exhibited loadings greater than 0.4 across multiple factors, the factor with the highest loading for each variable was prioritized. In addition, the table also presents the latent factors, which represent underlying dimensions identified through the analysis. Each latent factor is named based on the common characteristics of the variables that load highly onto it, and these names are displayed alongside the factor loadings in the Table 3.

Fig. 7 depicts the results of factor analysis, offering a systematic framework to identify and group variables based on their shared underlying relationships. The diagram illustrates how observed variables are associated with specific latent factors. The first factor, *Security perception in ride-sharing*, contains eight variables and accounts for 16% of the total variance. These variables relate to the feeling of security in various ride-sharing scenarios, such as at night, during the day, and in urban areas. Another key factor is the *Social influences and media impact* which contains nearly 14% of the variance and includes variables related to the social aspects of ride-sharing, such as the importance of the social level of other passengers, concerns about social perception, and being witness to ride-sharing problems in society. Media reports also impact this factor. The loadings reveal that personal witness experiences have a greater effect on the factor than media reports, underscoring the significant influence of direct societal experiences on individual decisions and thinking. By examining the polychoric correlation matrix (Fig. 6), it is observed that the variables related to the first factor have strong positive correlations with each other and strong negative correlations with the variables associated

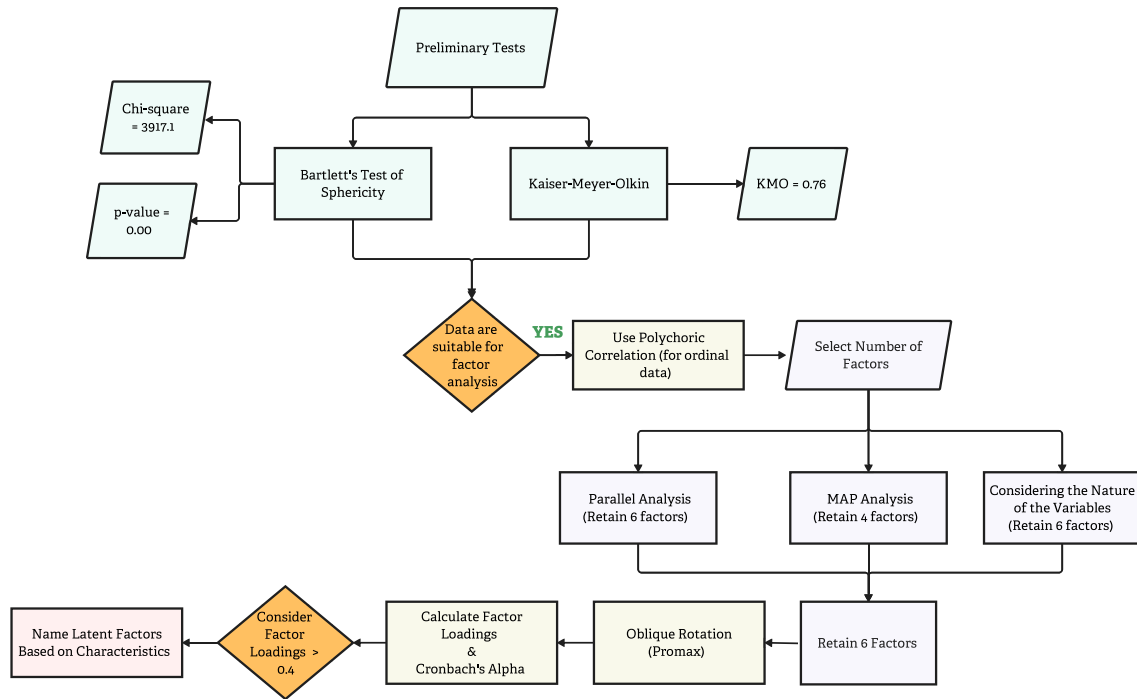


Fig. 4. Flowchart of the Exploratory Factor Analysis process and results.

Parallel Analysis Scree Plots

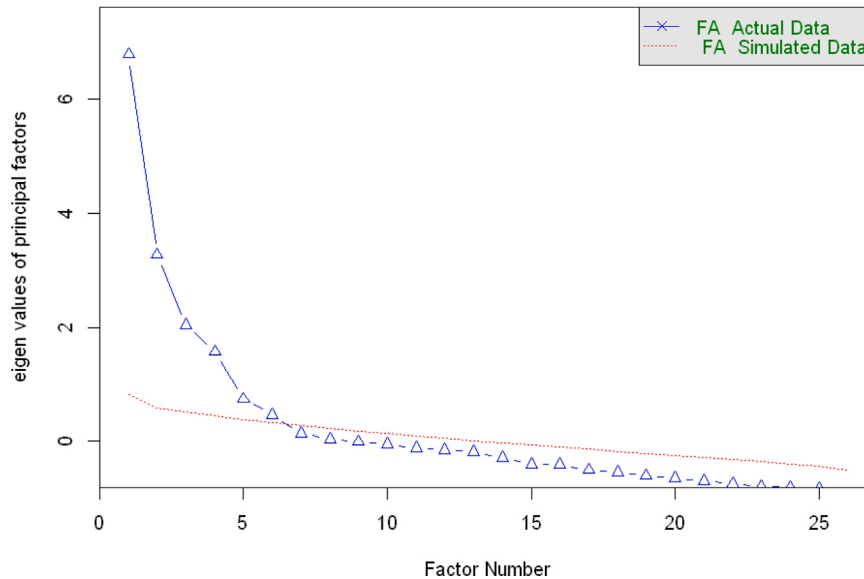


Fig. 5. Visual representation of the parallel analysis method for factor extraction.

with the second factor, *Social influences and media impact*. The negative correlation between these two indicates that negative social feedback could undermine perceived security.

The third factor, *User View on the Ride-sharing System*, comprises six variables. The polychoric correlation matrix of Fig. 6 shows that the impact of the first two variables, safety, and security, is higher compared to others. The remaining three factors-*Harassment Experience*, *Family Norm*, and *Religion*-each includes two variables. Generally, rotated factors with two or fewer variables should be interpreted cautiously. A factor with two variables is considered reliable only if those variables show a high correlation with each other ($r > 0.70$) and are relatively uncorrelated with other variables (Yong, 2013). In this case, strong

correlations of pairs of variables with each other and low correlations with others in the matrix, affirm their reliability. Overall, these six factors explain nearly 65% of the variance in the data.

The first factor extracted, *Security Perception in Ride-Sharing*, summarizes users' sense of security across various contexts and serves as the dependent variable in the ordered logit model, which evaluates its relationship with the other latent and demographic factors (Train, 2009). The model outcomes are detailed in Table 4, which includes the odd ratios (OR), standard errors (SE), and p -value. Initial diagnostics revealed some degree of multicollinearity among the exogenous variables, potentially affecting coefficient stability under minor model changes. Variance Inflation Factor (VIF) analysis showed high values

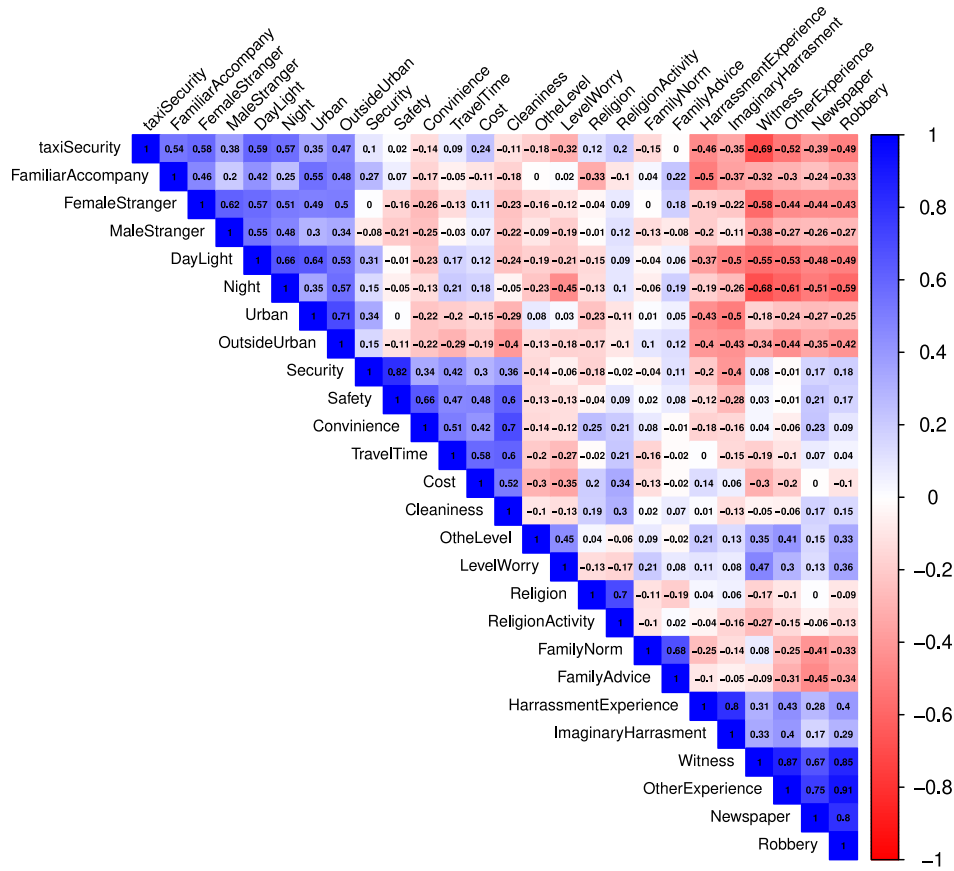


Fig. 6. Polychoric correlation matrix.

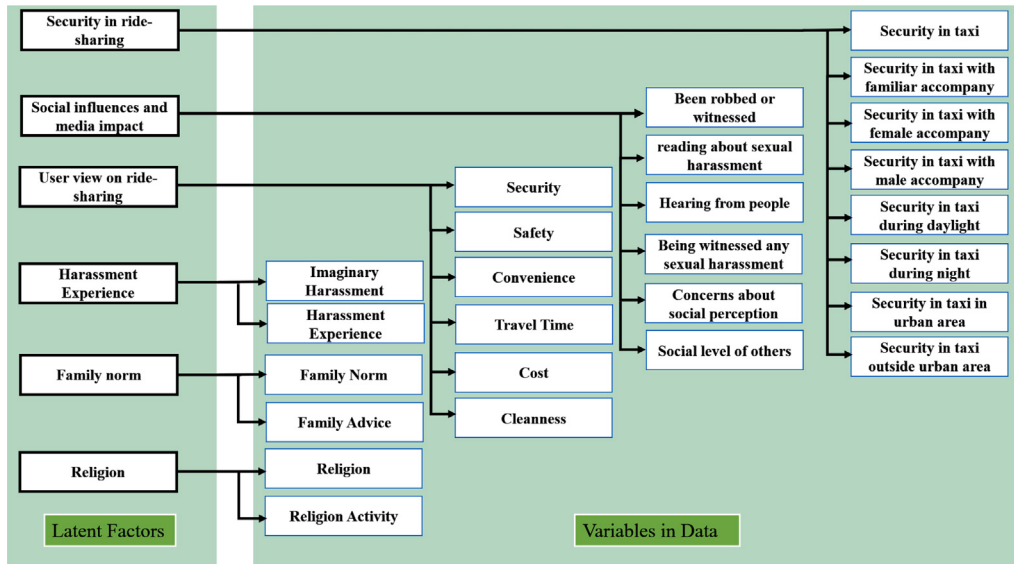


Fig. 7. Factor Analysis diagram.

for dummy-coded levels of the variable “User view on ride-sharing” (10.88 and 11.66), indicating localized multicollinearity. However, the overall condition index remained low (maximum 8.72), suggesting that the model as a whole does not suffer from severe multicollinearity. To address the localized issue, we collapsed the original categories into three broader groups (“important”, “relatively important”, and “not important”), which reduced the VIFs to acceptable levels (3.7 and 4.18), thereby improving model robustness.

The results from OLM provide valuable insights into how various factors influence security perceptions in ride-sharing services, with a particular focus on gender differences. The significant odds ratio for *gender* (OR = 2.364, *p*-value = 0.000) indicates that females are 2.364 times more likely than males to have heightened security concerns when using ride-sharing services. This gender difference underscores the need for targeted security measures and tailored communication

Table 3
Factor Analysis of variables.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Perceived security while traveling with ride-sharing	0.545					
Perceived security with familiar accompany	0.471					
Perceived security with female strangers	0.753					
Perceived security with male strangers	0.589					
Perceived security while traveling during day time	0.813					
Perceived security while traveling at night	0.567					
Perceived security while traveling inside urban area	0.773					
Perceived security while traveling outside urban area	0.596					
Importance of security when using ride-sharing	0.437		0.964			
Importance of safety when using ride-sharing			0.953			
Importance of convenience and ease when using ride-sharing			0.539			
Importance of travel time when using ride-sharing			0.614			
Importance of fares when using ride-sharing			0.591			
Importance of cleanness when using ride-sharing			0.637			
Importance of social level of other passengers		0.555				
Concerns about social perception when using ride-sharing services		0.529				
Going to a religious place						0.753
Engaging in private religious activities						0.811
Impact of family restrictions on travel decisions					0.882	
Considering family advice when making travel decisions					0.825	
Having an unpleasant experience involving sexual harassment				0.925		
Having any imaginary sexual harassment experience				0.782		
Being witnessed any sexual harassment		0.830				
Hearing from people who were sexually harassed in ride-sharing		0.812				
Hearing or reading about sexual harassment in ride-sharing through the media or newspapers		0.532				
Been robbed or witnessed a robbery while using a taxi		0.818				
Cronbach's alpha index	0.760	0.730	0.820	0.800	0.780	0.740
Cumulative Variance	0.159	0.293	0.430	0.508	0.586	0.654
Latent Factors	Security perception in ride-sharing	Social influences and media impact	User view on ride-sharing system	Harassment experience	Family norm	Religion

strategies to address the specific concerns of female users.

Age also plays a significant role in shaping security perceptions. The odds ratio for age ($OR = 0.661$, $p\text{-value} = 0.019$) suggests that older individuals generally have lower security concerns compared to younger users. Although *education* is not statistically significant at the 5% level, it exhibits a trend where higher education levels are associated with lower security concerns ($OR = 0.743$, $p\text{-value} = 0.083$). Income, on the other hand, does not have a significant impact on security perceptions. *Employment status* is another influential factor. Business owners ($OR=0.615$, $p\text{-value}: 0.004$) and students ($OR=0.627$, $p\text{-value}: 0.008$) tend to have lower security concerns compared to employees. These findings suggest that occupation influences how users perceive security in ride-sharing services.

Social influences and media impact significantly affect security perceptions, particularly at the extremes. Users who perceive a very high influence from social and media content ($OR = 0.159$, $p\text{-value} = 0.000$) tend to have significantly lower security perceptions. Similarly, those reporting moderate influence also exhibit lower security perceptions

($OR = 0.643$, $p\text{-value} = 0.015$). This suggests that both high and moderate exposure to social and media content related to ride-sharing can negatively impact users' feelings of security.

The factor *user view on ride-sharing*, which reflects the importance users place on aspects such as cleanliness, security, safety, fare, and travel time, is negatively associated with their perception of security in ride-sharing services. Specifically, users who consider these aspects relatively important are less likely to have a favorable view of security in ride-sharing ($OR: 0.526$, $p\text{-value}: 0.015$).

This study shows that *harassment* experiences are critical in shaping security perceptions. Users who have experienced harassment, whether sometimes ($OR = 0.734$, $p\text{-value}: 0.027$) or mostly ($OR = 0.643$, $p\text{-value}: 0.004$), tend to have significantly lower security perceptions. These results indicate that past negative experiences, whether occasional or frequent, substantially lower users' sense of security when using ride-sharing services. The non-significant result for the many times category of harassment experience is likely due to an insufficient sample size, resulting in increased variability and reduced statistical power to detect a meaningful effect.

Table 4
Ordered model results.

Dep. Variable:	Security perception in ride-sharing					
Model:	Ordered Model					
Method:	Maximum Likelihood					
Log-Likelihood:	-205.49					
AIC:	471.0					
BIC:	574.0					
Variables	OR	SE	z	P> z	OR[0.025]	OR[0.975]
Gender (RC: Male)	2.364	0.170	5.059	0.000	1.694	3.300
Age (RC:<18)	0.661	0.177	-2.341	0.019	0.467	0.935
Education (RC: Diploma or less)	0.743	0.171	-1.732	0.083	0.531	1.040
Income (RC: Well below average)	1.193	0.145	1.214	0.225	0.897	1.586
Social media perceptions (RC: Very Low Influence)						
Low influence	1.019	0.173	0.110	0.913	0.726	1.430
Moderate influence	0.643	0.181	-2.437	0.015	0.451	0.917
High influence	1.014	0.209	0.069	0.945	0.674	1.528
Very high influence	0.159	0.244	-7.506	0.000	0.099	0.258
User view on ride-sharing (RC: Not important)						
Relatively important	0.526	0.264	-2.430	0.015	0.314	0.883
Important	0.942	0.291	-0.204	0.838	0.533	1.666
Harassment experience (RC: Never)						
Rarely	0.854	0.158	-0.998	0.318	0.626	1.165
Sometimes	0.734	0.140	-2.206	0.027	0.557	0.966
Mostly	0.643	0.152	-2.908	0.004	0.477	0.866
Many times	0.808	0.182	-1.170	0.242	0.566	1.155
Family norm (RC: Not important)						
Somewhat important	1.190	0.183	0.952	0.341	0.832	1.703
Relatively important	1.354	0.173	1.748	0.080	0.964	1.902
Important	1.501	0.205	1.985	0.047	1.005	2.241
Very important	0.702	0.210	-1.681	0.093	0.465	1.061
Religion (RC: Not religious)						
Slightly religious	1.032	0.156	0.204	0.838	0.760	1.402
Moderately religious	0.792	0.145	-1.605	0.109	0.597	1.053
Very religious	0.835	0.154	-1.175	0.240	0.618	1.128
Extremely religious	1.087	0.148	0.568	0.570	-0.206	0.373
Job (RC: Employee)						
My own business	0.615	0.169	-2.872	0.004	0.442	0.857
Retired	0.990	0.175	-0.058	0.954	0.702	1.396
Student	0.627	0.177	-2.633	0.008	0.443	0.887
Unemployed	0.912	0.153	-0.605	0.545	0.676	1.230
Security in ride-sharing						
Very unsecured/Unsecured	0.001	1.081	-6.855	0.000	0.000	0.005
Unsecured/Relatively secured	4.808	0.221	7.112	0.000	3.119	7.412
Relatively secured/Secured	3.299	0.107	11.185	0.000	2.677	4.067
Secured/Very secured	2.971	0.111	9.799	0.000	2.390	3.695

RC = reference category

Family norms play a role as well, with important family norms associated with higher security concerns (OR = 1.501, p -value = 0.047). This reflects the influence of family values on individual perceptions of safety. Family is one of the fundamental institutions that shape the behaviors of individuals. This provides essential logic-comprised of material practices and symbolic systems like values and beliefs-that give meaning to daily activities. Family, in particular, plays pivotal roles and carries a core logic that dictates appropriate behaviors within their respective social settings (Beigi et al., 2020).

Religion is often viewed as a complex and multifaceted concept that significantly impacts various aspects of human life. However, this study finds no significant effect of religiosity on security perceptions, as none of the religious categories produced significant results.

The results reveal distinct differences in security perceptions across various levels of ride-sharing. Notably, individuals who feel “very unsecured” or “unsecured” (OR = 0.001, p -value = 0.000) are highly resistant to shifting toward a more secure perception, indicating a persistent sense of insecurity within this group. This finding underscores the need for targeted policies aimed specifically at addressing the unique concerns of those with the lowest security perceptions. In

contrast, the odds ratios for transitions between “unsecured” and “relatively secured” (OR = 4.808, p -value = 0.000), “relatively secured” and “secured” (OR = 3.299, p -value = 0.000), and “secured” and “very secured” (OR = 2.971, p -value = 0.000) indicate a strong tendency for users to perceive increasing levels of security once they surpass the lowest category. This suggests that individuals who already feel some level of security are more likely to experience continued improvements in their security perceptions over time.

7. Discussion

In response to RQ1, this study examined the factors that shape users’ perceptions of security in ride-sharing. The findings show that these perceptions are influenced by a combination of demographic characteristics, personal experiences, and social norms. For example, older users generally reported feeling more secure than younger users, possibly because of greater risk tolerance or more established travel routines. Employment status also mattered: students and business owners tended to feel safer than employees, which may reflect differences in travel timing, exposure to crowding, or the stress of commuting during peak hours.

Social influence and personal experience also play a key role in shaping how secure users feel. Many participants reported that exposure to negative stories about ride-sharing, whether through news, social media, or word of mouth, lowered their sense of security. This effect was even stronger among those who had experienced harassment themselves. Whether the incidents were occasional or frequent, users with such experiences consistently reported lower levels of perceived security, underscoring the long-term impact of personal security incidents on trust in ride-sharing services.

Family norms further shape security concerns, with stronger family expectations linked to heightened feelings of insecurity, likely due to protective attitudes and traditional values regarding safety. While religiosity is often viewed as a multidimensional construct that influences attitudes, behaviors, and perceptions across various cultural, socioeconomic, and political domains (Szaflarski et al., 2010; Tezcür & AZADARMAKİ, 2008), this study found no significant effect of religiosity on security perceptions. Prior research has highlighted religion's potential role in shaping behavior and security-related attitudes (Nabipour, Khanjani, Nakhaee, Moradlou, & Sullman, 2015; Perloff, 2017), suggesting that its influence may vary depending on the cultural and contextual settings of the study population.

Gendered security perceptions in ride-sharing are a global issue, often experienced more acutely in developing countries such as Iran. Existing research often highlights women, who face heightened security risks. To further explore the RQ2, this study confirms that gender significantly influences the perception of security in ride-sharing services, with women being more sensitive to security concerns. However, it is important to note that men also experience feelings of insecurity. This study reveals that 23% of men feel insecure or very insecure while using ride-sharing services. This percentage escalates to 37% when traveling outside urban areas and 55% when riding at night.

Another critical aspect examined in this study is how the gender of fellow passengers and drivers affects security perceptions among both men and women. The findings reveal that both genders feel significantly more secure when sharing a ride with familiar companions. Conversely, when sharing the backseat with strangers, both genders report increased insecurity. Notably, the gender of these strangers further impacts security perceptions: when accompanied by a male stranger, women tend to feel insecure, whereas men report feeling relatively secure. In contrast, both genders feel relatively secure when accompanied by a female stranger. Similarly, the gender of the driver plays an essential role in perceived security. While 38% of men and 32% of women report no preference regarding the driver's gender, a majority of men prefer male drivers for safety reasons instead. Likewise, 57% of women express a preference for male drivers, with only 7% of women choosing female drivers for security purposes.

Based on the responses in this study, the experiences of harassment and imaginary harassment differ significantly between genders. Women report higher instances of both types of harassment compared to men, highlighting a clear gender disparity in personal experiences. However, both genders share a high level of awareness of the issue, as many have witnessed harassment frequently in ride-sharing services. These findings underscore the contrasting nature of their experiences while emphasizing the need for tailored strategies to address the distinct challenges faced by each gender.

These findings reveal that not only do men and women feel insecurity differently, but the factors influencing their perceptions are also distinct and complex. Tailored measures that account for gendered perspectives, experiences, and preferences are essential. However, it is crucial to note that both genders experience a certain level of insecurity. This underscores the importance of considering the needs of both genders separately to address their unique concerns, while simultaneously implementing strategies that ensure fairness and inclusivity for all users.

To address RQ3, this study evaluates several solutions aimed at enhancing security in ride-sharing services, beginning with the concept

of pink transportation. Iran has a long history of using ride-sharing services, which makes it particularly well-suited for examining public opinion on these interventions. To capture this perspective, the questionnaire asked participants whether they felt pink transportation had effectively resolved security concerns. About 60% of respondents said it had not. Their feedback is especially valuable, as it reflects lived experiences with the system over time, not just theoretical views. However, this approach has limitations: it addresses the concerns of women only and overlooks the fact that men also experience insecurity in ride-sharing contexts.

Beyond gender-segregated options, the study also examined broader technological and behavioral strategies aimed at improving security for all users. Nearly 44% of both genders reported using security apps, indicating their value as a solution for enhancing personal security. However, 71% of women and 76% of men expressed concerns about privacy when using these apps. To increase their acceptance and effectiveness, it is essential to clearly define the functionality of these apps and address privacy issues comprehensively. Moreover, focusing on preventive features within these apps can further enhance their effectiveness in ensuring user safety.

The results of this study indicate that most people prefer to report problems directly or inform a friend, anonymous reporting and reporting through an app being relatively unpopular, as only 2% and 6% of both genders choose these options, respectively. Specifically, 52% of men prefer to call the police directly after encountering a problem, compared to 25% of women. In contrast, 54% of women prefer to contact an acquaintance, while only 31% of men opt for this approach. Furthermore, there is potential for security apps to enhance their effectiveness by incorporating features that allow users to report incidents directly to the police through the app itself. This integration could bridge the gap between traditional reporting methods and the growing use of digital tools for safety. These findings underscore the need for security apps to accommodate diverse reporting preferences and offer functionalities that align with user needs and behaviors.

While reporting behaviors varied by gender, respondents also shared clear opinions on which security features they considered most important. Nearly 60% of respondents indicated that installing cameras inside vehicles is of "very important" significance for their sense of security. Similarly, 70% of respondents considered real-time vehicle tracking to be very important for enhancing security. Furthermore, findings indicate that a significant proportion of ride-sharing users are willing to pay up to 20% more for enhanced security features. This willingness to pay presents a substantial opportunity for companies to invest in and improve security measures within the ride-sharing sector. However, this stated willingness to pay should be interpreted as an indication of user interest rather than a reliable predictor of actual payment behavior. While technology like in-vehicle cameras and real-time tracking can enhance security, concerns remain about how such data is collected, stored, and used. If not managed responsibly, these tools risk compromising user privacy.

In addition to technological and behavioral solutions, education plays a vital role in shaping long-term security perceptions, even if not directly tied to immediate feelings of security. The results of this research show that information shared through various channels—such as word of mouth, media, and family—significantly influences how security is perceived. Educational initiatives, including public awareness campaigns, have been shown to be effective in increasing knowledge and promoting a safer environment. These campaigns are designed to raise awareness about security issues and educate the public on how to prevent and address them. For instance, the Massachusetts Bay Transportation Authority (MBTA) launched a public awareness campaign in 2008, which was revived in 2013. Similarly, Paris's "Take Back the Metro" campaign, initiated in 2014, led to the nationwide "Stop, Enough is Enough" campaign in 2015 (Priya Uteng, 2021). These campaigns utilize various media, including advertisements, social media, and public service announcements, to reach broad audiences

and instill critical knowledge about security issues. By educating the public on recognizing and responding to this kind of issues, these initiatives contribute to a more informed and vigilant society.

Moreover, educational efforts in schools can significantly impact long-term perceptions of security. Incorporating lessons on personal safety, respect, and consent into school curricula helps to build awareness from a young age. Educational programs that involve community engagement and interactive workshops can further enhance understanding and promote safer behaviors. The results of this study highlight the need for effective public education and awareness campaigns about security, challenging harmful stereotypes, and fostering a culture of consent.

In Iran, most ride-sharing services, particularly shared taxis, are directly managed by municipalities and currently operate without dedicated digital platforms. Nevertheless, our survey demonstrates strong public interest in security-related technologies. A low-cost, municipality-supported security app could be rolled out quickly and would include clear privacy settings, transparent data-use policies with opt-in controls, direct incident reporting to police and municipal offices, and brief educational modules on personal safety. Although any new technology requires cost-benefit analysis, developing and maintaining an app is far less expensive than installing hardware. Moreover, enhanced passenger confidence is likely to draw more riders, boosting fare revenues for drivers, increasing ridership subsidies for municipalities, and delivering broader network benefits for urban transport.

Although this study focuses on Iran, its findings are relevant to other developing countries where similar social and cultural dynamics, such as gender norms, prior harassment experiences, low institutional trust, and limited reporting mechanisms, shape users' perceptions of security in ride-sharing. By identifying the most influential demographic and experiential variables, along with users' preferences and concerns regarding specific security measures, the study provides transferable insights to support the development of user-centered interventions in comparable contexts.

8. Limitations

It is worth mentioning that conducting this survey online through platforms such as LinkedIn may have limited access for certain demographics. This mode of distribution could have inadvertently resulted in a sample skewed toward individuals with higher education levels or those who are employed. Although the authors endeavored to minimize bias in the recruitment process, it is challenging to fully account for these influences. Moreover, as the number of valid responses was sufficient for the applied analyses but not extensive enough to explore all possible relationships in depth, future studies are encouraged to include a broader dataset to allow for more detailed subgroup investigations and further validation of the findings.

9. Conclusion

This study investigates and models the factors influencing users' perceptions of security in ride-sharing services in Iran, based on a questionnaire survey conducted in Tehran and Alborz provinces. Using FA and an OLM, the research identifies key factors influencing perceived security and evaluates how demographic, social, and contextual variables shape users' security perceptions. While existing literature often emphasizes gender-related barriers in mobility, this research addresses both shared and distinct concerns, advocating for inclusive security solutions that cater to the needs of all passengers.

The findings reveal that security concerns are more pronounced among women, younger individuals, and those heavily influenced by social media. Although gender-neutral measures aim to provide equal resources, they often fail to address the specific needs of different user groups, highlighting the importance of integrating gender-sensitive

strategies with gender-neutral approaches. This study identifies security measures deemed acceptable by both genders to enhance ride-sharing security. Women-only transportation, while offering certain benefits, is not a holistic solution and cannot fully address the security needs of all users. Key security features, such as in-vehicle cameras and real-time tracking, are highly valued, with many users expressing a willingness to pay premium fares for these enhancements. This highlights the growing demand for advanced security technologies to improve user satisfaction. Furthermore, social and media influences significantly impact security perceptions, emphasizing the need for public education campaigns to counter misinformation, raise awareness, and promote informed usage of ride-sharing services. Security apps also hold promise, provided they incorporate features like direct communication with authorities and trusted contacts, respect user privacy, and include educational modules to foster proactive safety practices.

For policymakers, these findings provide actionable insights to improve ride-sharing services, particularly in developing countries. Persistent insecurity among individuals with low security perceptions underscores the need for targeted policies addressing their specific concerns, as these users are less likely to experience improved security over time. By tackling these challenges, policymakers can design and implement strategies that enhance overall user security and satisfaction, fostering a safer and more inclusive ride-sharing ecosystem. Education plays a pivotal role in these efforts, with public campaigns countering misinformation, raising awareness about security practices, and equipping users with the knowledge to prevent and respond to threats. Integrating security lessons into school curricula can further foster long-term behavioral changes, promoting a culture of safe, secure, and informed mobility.

CRedit authorship contribution statement

Marzieh Afsari: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Salar Salehi:** Writing – review & editing, Software, Data curation. **Lory Michelle Bresciani Miristice:** Writing – review & editing, Software. **Guido Gentile:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to polish language and correct grammar. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

See [Table 5](#).

Data availability

Data will be made available on request.

Table 5
Survey questions and options.

Questions	Options
Demographic Data	
What is your gender?	Male, Female
How old are you?	<18 years, 18–24, 25–34, 35–49, 50–69, >70
What is your highest level of education?	Diploma or less, Bachelor's degree, Master's degree or PhD
What is your current employment status?	Student, Employee, Self-employed, Retired, Unemployed
Compared to other families in your country, how would you describe your family's income?	Much lower than average, Lower than average, Average, Higher than average, Much higher than average
Factors in Choosing Ride-Sharing Services	
Please describe your experience using taxis with the scale below.	I have never used ride-sharing taxis, I have used regular ride-sharing taxis, I have used internet ride-sharing taxis, I have used both regular and internet ride-sharing taxis
How do you rate the security of city taxis?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel when using a taxi with a 'familiar person'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel when other passengers in the taxi are 'unknown women'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel when other passengers in the taxi are 'unknown men'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel using a taxi 'during the day'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel using a taxi 'at night'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel using a taxi in 'urban areas'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
How secure do you feel using a taxi in 'outside-urban areas'?	Very insecure, Insecure, Somewhat secure, Secure, Very secure
Do you have a preference for the 'gender of the driver' in a ride-sharing taxi?	Yes, I prefer male drivers because their driving is better and safer, Yes, I prefer male drivers because I feel more secure with them, Yes, I prefer female drivers because their driving is better and safer, Yes, I prefer female drivers because I feel more secure with them, No preference
Do you think your willingness or unwillingness to talk to strangers might affect your choice of taxi services?	Yes, it affects, I like talking to people, Yes, it affects, I feel uncomfortable talking to strangers, No, It does not affect my choice, No, it does not affect, though I like talking to people, No, it does not affect, though I feel uncomfortable talking to strangers
Please rate the importance of each topic in using taxis on a scale of 1–5, where 1 means 'not important' and 5 means 'very important'.	Security, Safety, Comfort and convenience (like air conditioning, seat comfort, etc.), Travel time, Cleanliness of the vehicle, Taxi fare
Influences on Travel Behavior	
Have you ever had an unpleasant experience related to sexual harassment while using a taxi?	Never, Rarely, Sometimes, Often, Many times
Have you ever had an unpleasant touch or feeling from the behavior of the driver or other passengers while using a taxi?	Never, Rarely, Sometimes, Often, Many times
Have you ever witnessed any sexual harassment or inappropriate behavior toward other passengers while using a taxi?	Never, Rarely, Sometimes, Often, Many times
Have you ever heard of people experiencing sexual harassment or inappropriate behavior from the driver or other passengers while using a taxi?	Never, Rarely, Sometimes, Often, Many times
Have you ever read or heard anything about sexual harassment in taxis through media or newspapers?	Never, Rarely, Sometimes, Often, Many times
Have you ever been robbed or witnessed a robbery while using a taxi?	Never, Rarely, Sometimes, Often, Many times
Do you care about the social class of other passengers while using a taxi?	Never, rarely, sometimes, often, very frequently
Have you ever hesitated to use a taxi due to concerns about how others perceive you socially?	Never, rarely, sometimes, often, very frequently
How often do you go to a religious place (like mosque, etc.)?	Never, rarely, several times a year, monthly, weekly or more
How often do you engage in private religious activities, such as praying, meditation, etc.?	Never, once a month, once a week, several times a week, daily
Do family restrictions directly affect your decisions about how to travel?	Yes, always; Yes, most of the time; Yes, sometimes; Rarely; No, never
Do you consider your family's advice or guidance when deciding on your mode of transportation?	Yes, always; Yes, most of the time; Yes, sometimes; Rarely; No, never
Views on Proposed Solutions	
Do you think pink transportation adequately addresses security concerns?	Yes, No
Have you ever downloaded or purchased a security app?	Yes, No
Do you have privacy concerns when using such apps?	Yes, No
What is your preferred method of dealing with any security issues in a taxi?	Contacting an acquaintance, reporting to the police, direct phone call to the transportation provider, using security apps and reporting anonymously, using security apps with personal or anonymous reporting options

(continued on next page)

Table 5 (continued).

Questions	Options
How willing are you to pay more for a taxi that implements enhanced security measures, such as vehicle tracking and driver identity verification? Please indicate your willingness to pay as a percentage increase from the standard fare.	<10%, 11%–20%, 21%–30%, More than 30%, I am not willing to pay more for increased security
Please rate the importance of each topic on a scale of 1–5, where 1 means 'not important' and 5 means 'very important'.	Sending your location or taxi information to trusted contacts while using a taxi, Implementing real-time driver tracking to increase security, Implementing surveillance features like in-taxi cameras to enhance safety and monitoring during trips.

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