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Health on the Way to School: A Comparison of High-Risk Behaviors Among Students Across Different Modes of School Transportation

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A B S T R A C T

Objective: The manner in which students commute to school and its psychological implications have received limited attention from parents and psychologists. Although observational learning (modeling) during students' daily journeys to and from school plays a significant role in shaping their behaviors and everyday learning experiences, relatively little research has been conducted in this area. The present study aimed to examine the tendency toward high-risk behaviors among secondary school students across different modes of school transportation.

Methods and Materials: The present research employed an ex post facto (causal-comparative) design. The sample consisted of 360 students, including 180 female and 180 male students. Participants were selected using a combination of cluster and stratified sampling methods. Data were collected using the Iranian Adolescents Risk-Taking Scale (IARS) developed by Zadeh Mohammadi et al. (2011).

Findings: The results of multivariate analysis of variance (MANOVA) indicated a statistically significant difference between school transportation methods and students' tendencies toward high-risk behaviors. Except for two cases in which female students demonstrated higher mean scores than males on tendencies toward high-risk behaviors, male students generally exhibited higher mean scores across different school transportation methods. Female students reported higher mean scores for sexual relationships and sexual behaviors in the active transportation group compared to male students. Furthermore, female students demonstrated higher mean scores for relationships with the opposite sex in the family transportation group than their male counterparts. In addition, the mean tendency toward substance use was higher among students who used public transportation.

Conclusion: Although students' commuting patterns constitute an important component of their daily activities, peer and community modeling—whether positive or negative—also represents an inseparable aspect of every culture and remains a recurring concern for parents. Therefore, greater attention should be paid to this issue and its psychological effects on both female and male students.

Keywords: *High-risk behaviors, transportation, students, school route.*

1. Introduction

Adolescence is a critical developmental period characterized by substantial biological, cognitive, emotional, and social changes that influence health-related decision-making and behavioral patterns. During this stage, young people become increasingly exposed to environmental, peer, and societal influences that may either promote healthy development or increase vulnerability to

risk-taking behaviors. High-risk behaviors, including substance use, alcohol consumption, smoking, aggressive conduct, risky sexual behaviors, and other forms of delinquency, represent major public health concerns because of their immediate and long-term consequences for physical, psychological, educational, and social well-being (Champion et al., 2019; Kordi Haji et al., 2022). Understanding the contextual factors that contribute to the development of these behaviors is therefore essential for designing effective preventive interventions and promoting healthy adolescent development.

Schools constitute one of the most influential social environments in adolescents' lives. Considerable research has examined the role of school climate, educational experiences, peer relationships, and family involvement in shaping adolescent behavior. However, the daily journey between home and school has received comparatively less attention despite representing a significant component of students' everyday experiences (Chang et al., 2024; Ross et al., 2020). The school commute is more than a transportation activity; it is a social and developmental context in which adolescents interact with peers, observe social norms, encounter environmental stimuli, and experience varying degrees of supervision and independence. Consequently, transportation modes may influence students' exposure to opportunities, risks, and social learning experiences that contribute to behavioral outcomes.

Social learning and ecological perspectives suggest that adolescents acquire attitudes and behaviors through observation and interaction with their surrounding environments. Exposure to peers, community members, and environmental conditions during daily travel may facilitate the acquisition of both adaptive and maladaptive behaviors. Research on bullying, harassment, and peer victimization indicates that social environments beyond the classroom can significantly affect adolescent adjustment and behavioral development (Sahin-Ilkorkor & Brubaker, 2025). Similarly, transportation settings may create opportunities for positive social engagement or, alternatively, expose students to behaviors and situations associated with increased risk-taking tendencies.

Transportation to school occurs through a variety of modes, including family transportation, school bus services, public transportation, and active transportation such as walking and cycling. Each transportation mode differs substantially in terms of adult supervision, peer interaction, independence, environmental exposure, and perceived safety. Recent transportation research has emphasized that school transportation systems are important determinants of student safety and well-being (Chang et al., 2024). Furthermore, concerns regarding the safety and effectiveness of school transportation have expanded to include psychological and social outcomes in addition to traditional traffic-related considerations (Chan et al., 2024).

Active transportation, particularly walking and cycling to school, has received considerable attention because of its potential health benefits. Numerous studies have demonstrated that active commuting contributes to higher levels of physical activity among children and adolescents, thereby supporting cardiovascular health, weight management, and overall physical well-being (Poitras et al., 2016; Yang et al., 2019). Evidence also suggests that physical activity positively influences cognitive functioning, attention, academic performance, and psychological health (Cox, 2016; Khan & Hillman, 2014). Acute and regular physical activity have been associated with improvements in mood, neurocognitive functioning, and emotional regulation (Basso & Suzuki, 2016). Moreover, active school travel has been linked to greater happiness, positive emotions, and enhanced subjective well-being among students (Ramanathan et al., 2014; Westman et al., 2017).

The environmental and social characteristics associated with active transportation may also contribute to broader developmental outcomes. Studies have reported that adolescents who engage in active commuting often demonstrate increased independence, self-confidence, and community engagement (Loo et al., 2019; Mandic et al., 2015). Urban design factors, including green spaces and pedestrian-friendly environments, have been shown to support active transportation and contribute to healthier developmental outcomes among school-aged children (Yang et al., 2019). Educational and community-based initiatives designed to promote active commuting have likewise demonstrated promising effects on students' physical activity behaviors and health outcomes (Coombes & Jones, 2016; Schonbach et al., 2019).

Despite these benefits, active transportation is not without challenges. Parents frequently express concerns regarding traffic hazards, personal security, environmental conditions, and social risks associated with independent travel to school (Aranda-Balboa et al., 2020; Huertas-Delgado et al., 2017). Such concerns may influence transportation decisions and shape adolescents' exposure to different social environments during their commute. Consequently, transportation mode may function as a complex ecological factor that

simultaneously influences health promotion and risk exposure.

Public transportation presents a different set of opportunities and challenges. Compared with family transportation or school bus services, public transportation often provides adolescents with greater independence and less direct adult supervision. While this autonomy may foster responsibility and self-efficacy, it may also increase exposure to environmental risks and problematic social influences. Research has documented associations between public transportation use, exposure to community violence, and adverse educational outcomes such as absenteeism (Burdick-Will et al., 2019; Stein & Grigg, 2019). Students who regularly use public transportation may encounter situations that expose them to antisocial behaviors, unsafe environments, or social pressures that influence risk-taking tendencies.

Particularly concerning are findings regarding harassment and victimization in public transportation settings. International evidence indicates that women and girls frequently experience sexual harassment, intimidation, and unwanted attention while using public transit systems (Gekoski et al., 2017). Such experiences may influence psychological well-being, perceptions of safety, and behavioral responses among adolescents. Exposure to these conditions during formative developmental years may have implications for attitudes toward relationships, social interactions, and broader psychosocial adjustment.

School transportation services occupy an intermediate position between public transportation and family transportation. School buses generally provide structured transportation with varying levels of supervision and safety regulations. Research has increasingly focused on factors associated with safe and effective school transportation, particularly for vulnerable student populations (Chan et al., 2024). Nevertheless, school transportation environments remain important social settings in which peer interactions occur and behavioral norms may be reinforced. The quality of supervision, peer culture, and transportation policies may therefore influence students' behavioral experiences during daily commutes.

Family transportation is often perceived as the safest mode of school travel because it typically involves direct parental supervision and monitoring. Family involvement has consistently been identified as a protective factor against numerous adolescent risk behaviors. Transportation provided by parents may limit exposure to potentially risky social environments while simultaneously creating opportunities for communication and emotional support. Research has demonstrated that supportive family involvement contributes to healthier developmental outcomes and improved psychosocial adjustment among adolescents (Allen et al., 2018; Graham et al., 2014). However, reliance on family transportation may also reduce opportunities for independent mobility and peer interaction, highlighting the complexity of transportation-related developmental experiences.

The relationship between transportation and adolescent behavior can also be understood within broader socioecological frameworks. Students' transportation experiences are shaped by interactions among individual, family, school, community, and environmental factors. These multiple influences contribute to behavioral outcomes through pathways involving social learning, peer influence, perceived safety, physical activity, emotional well-being, and environmental exposure. Research examining travel behavior interventions has shown that educational and environmental modifications can influence both transportation choices and associated developmental outcomes (Humberto et al., 2021). Similarly, systematic reviews of physical activity promotion have emphasized the importance of considering multiple ecological contexts when evaluating adolescent health behaviors (Messing et al., 2019).

Recent evidence further suggests that mobility patterns may have implications for mental health and psychological functioning. Active mobility has been associated with improved mental health outcomes, reduced psychological distress, and enhanced well-being across diverse populations (Scrivano et al., 2023). Given the established relationships between mental health, social functioning, and risk-taking behavior, transportation experiences may indirectly influence adolescents' propensity to engage in high-risk activities. Furthermore, school-based prevention efforts targeting lifestyle risk behaviors increasingly recognize the importance of environmental and contextual determinants of adolescent behavior (Champion et al., 2019; Mairena Carrellan et al., 2025).

Although a growing body of literature has examined transportation safety, physical activity, mental health, and educational outcomes, relatively little research has directly investigated the relationship between school transportation modes and tendencies toward high-risk behaviors among adolescents. Existing studies have largely focused on physical health, transportation accessibility, attendance, and safety concerns, leaving important questions regarding

psychological and behavioral outcomes insufficiently addressed (Chang et al., 2024; Ross et al., 2020). Moreover, potential gender differences in the relationship between transportation modes and high-risk behaviors remain poorly understood despite evidence that males and females may experience transportation environments differently (Gekoski et al., 2017; Sahin-Ilkorkor & Brubaker, 2025).

Given the developmental significance of adolescence, the pervasive influence of daily transportation experiences, and the limited empirical evidence linking transportation modes to high-risk behaviors, further investigation is warranted. Understanding whether different transportation methods are associated with distinct patterns of risk-taking behavior may provide valuable insights for educators, psychologists, parents, policymakers, and transportation planners seeking to promote adolescent health and safety.

Therefore, the present study aimed to examine differences in tendencies toward high-risk behaviors among male and female secondary school students across different modes of transportation to school.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a descriptive causal-comparative (ex post facto) research design to investigate differences in students' tendencies toward high-risk behaviors across various modes of transportation to school. The target population consisted of all male and female high school students enrolled in the second cycle of secondary education in District Two of Zahedan, Iran, during the 2024–2025 academic year. The participants were between 16 and 18 years of age. Given the large size and geographical dispersion of the study population, a combination of cluster and stratified sampling procedures was utilized. Cluster sampling was employed to facilitate access to schools and students across the district, while stratified sampling was used to ensure proportional representation of both genders. After identifying the selected school clusters, questionnaires were distributed among students who met the inclusion criteria. Demographic variables were controlled during the sampling process to increase the comparability of the groups. The final sample comprised 360 students, including 180 female and 180 male students. These participants represented different school transportation modes, including family transportation, public transportation, school transportation services, and active transportation methods. The collected data were subsequently analyzed to examine differences in students' tendencies toward high-risk behaviors according to their mode of transportation to school.

2.2. Measures

Data were collected using the Iranian Adolescents Risk-Taking Scale (IARS), developed by Zadeh Mohammadi and colleagues in 2011. The IARS is a standardized self-report instrument specifically designed to assess various dimensions of high-risk behaviors among Iranian adolescents. The scale consists of several subscales that evaluate tendencies toward risky driving behaviors, violence and aggression, cigarette smoking, substance and drug use, alcohol consumption, sexual behaviors and relationships, and relationships with the opposite sex. Participants are asked to indicate the extent to which they engage in or are inclined toward specific risk-related behaviors using a Likert-type response format. Higher scores on the scale indicate a greater tendency toward engaging in high-risk behaviors. Previous psychometric evaluations have demonstrated satisfactory validity and reliability of the instrument among Iranian adolescent populations. Evidence for content validity, construct validity, and internal consistency has been reported in earlier studies, indicating that the IARS is an appropriate and reliable measure for assessing risk-taking tendencies in adolescent samples. In the present study, the questionnaire was administered collectively in school settings under standardized conditions, and participants completed the instrument anonymously to enhance the accuracy and honesty of their responses.

2.3. Data Analysis

The collected data were analyzed using statistical procedures appropriate for causal-comparative research. Initially, descriptive statistics, including means and standard deviations, were calculated to summarize participants' demographic characteristics and scores on the high-risk behavior dimensions. Prior to conducting inferential analyses, the assumptions underlying multivariate statistical procedures were examined. To investigate differences in students' tendencies toward high-risk behaviors across various modes of school transportation and gender groups, Multivariate Analysis of Variance (MANOVA) was employed. This statistical technique allowed for the simultaneous examination of multiple dependent variables related to high-risk behaviors while accounting for the effects of transportation mode and gender. Statistical

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analyses were performed using appropriate statistical software, and significance levels were evaluated at the conventional alpha level of 0.05. The results of these analyses were used to determine whether meaningful differences existed in the prevalence and tendency toward high-risk behaviors among students using different transportation methods to travel to and from school.

3. Findings and Results

Data were collected from 360 students. The descriptive characteristics of the participants included gender, age, mode of transportation to school, family income status, and preferred mode of transportation to school. A summary of the demographic characteristics of the participants is presented in Table 1.

Table 1

Descriptive Characteristics of the Students (N = 360)

Variable	Category	n	%
Sex	Male	180	50.0
	Female	180	50.0
Educational Level	High School	360	100.0
	Illiterate	0	0.0
	Primary School	0	0.0
	Middle School	0	0.0
	Diploma	0	0.0
Age	15–18 years	360	100.0
Mode of Transportation to School	Family Transportation	90	25.0
	Active Transportation (Walking or Cycling)	90	25.0
	School Service	90	25.0
	Public Transportation	90	25.0

The results of the multivariate analysis of variance (MANOVA) indicated that there were statistically significant differences between modes of transportation to school and tendencies toward high-risk behaviors among male and female students. With the exception of two dimensions in which female students exhibited higher tendencies toward high-risk behaviors than male students, the remaining dimensions showed higher mean scores among male students across different transportation methods. Female students demonstrated higher mean scores for sexual relationships and sexual behaviors within the active transportation group. Similarly, female students reported higher mean scores for relationships with the opposite sex in the family transportation group than male students. The detailed results are presented in Table 2.

Table 2

Results of Multivariate Analysis of Variance for High-Risk Behaviors Across Different Modes of Transportation

Variable	Family Transportation M (SD)	Active Transportation M (SD)	School Service M (SD)	Public Transportation M (SD)	Sum of Squares	df	Mean Square	F	p
Drug Use Tendency	15.3 (2.69)	15.8 (2.77)	16.4 (2.86)	16.8 (3.04)	109.09	359	185.50	7.50	< .001
Alcohol Use Tendency	12.6 (2.71)	13.3 (3.00)	12.6 (2.95)	13.3 (2.84)	47.90	359	200.30	3.50	< .001
Cigarette Smoking Tendency	10.7 (2.45)	11.6 (2.67)	11.5 (2.53)	11.3 (2.54)	42.03	359	200.40	5.10	< .001
Tendency Toward Violence	13.7 (2.97)	15.2 (2.51)	14.5 (3.00)	15.0 (3.04)	109.50	359	237.70	9.02	.001
Sexual Relationships and Behaviors	13.3 (1.41)	13.4 (1.17)	12.9 (1.29)	13.1 (1.54)	15.88	359	10.20	3.07	< .001
Tendency Toward Relationships With the Opposite Sex	12.5 (1.78)	14.7 (0.85)	12.2 (1.94)	12.5 (1.87)	378.90	359	70.60	50.40	< .001
Dangerous Driving Tendency	13.1 (1.62)	12.8 (1.93)	12.6 (2.33)	12.7 (2.42)	12.09	359			

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As shown in Table 2, statistically significant differences were observed among transportation modes in most dimensions of high-risk behaviors. Students using public transportation reported the highest mean scores for drug use tendency, while students using active transportation demonstrated the highest mean scores for tendencies toward relationships with the opposite sex and violent behaviors. Family transportation was generally associated with lower levels of several high-risk behavior dimensions. The largest effect was observed for the tendency toward relationships with the opposite sex ($F = 50.40$, $p < .001$), indicating substantial variation across transportation methods. In contrast, dangerous driving tendency demonstrated the weakest effect ($F = 1.52$, $p = .050$), suggesting only marginal differences among transportation groups.

4. Discussion

The present study aimed to examine differences in tendencies toward high-risk behaviors among secondary school students across different modes of transportation to school. The findings revealed significant differences in several dimensions of high-risk behaviors according to transportation mode. In general, students who used public transportation demonstrated higher tendencies toward substance use, while students who relied on active transportation reported higher scores in some interpersonal and behavioral domains. Furthermore, male students generally exhibited higher tendencies toward high-risk behaviors than female students, although female students scored higher in specific dimensions, including sexual relationships and behaviors within the active transportation group and relationships with the opposite sex among those transported by family members. These findings suggest that the daily transportation environment constitutes an important developmental context that may influence adolescents' behavioral tendencies and psychosocial experiences.

One of the most notable findings of the study was the higher tendency toward drug use among students who used public transportation. This result can be interpreted through social-ecological and social learning perspectives, which emphasize the influence of environmental exposure and observational learning on adolescent behavior. Public transportation environments often involve less adult supervision, greater exposure to diverse social groups, and increased opportunities for unsupervised peer interaction. Adolescents using public transportation may therefore encounter situations in which substance-related behaviors are more visible or socially normalized. Previous studies have demonstrated that transportation contexts can influence educational and behavioral outcomes through exposure to environmental risks and social stressors (Burdick-Will et al., 2019; Stein & Grigg, 2019). Furthermore, research examining risk behaviors among adolescents has consistently highlighted the role of environmental and social influences in the initiation and maintenance of substance use and other forms of delinquent behavior (Kordi Haji et al., 2022). The present findings extend this literature by suggesting that transportation environments may represent an overlooked context in which adolescents encounter risk-promoting influences.

The results also indicated that students using active transportation reported relatively high scores in several behavioral domains, including tendencies toward violence and relationships with the opposite sex. At first glance, these findings may appear inconsistent with the substantial body of evidence highlighting the benefits of active commuting. Numerous studies have shown that walking and cycling to school contribute to improved physical health, enhanced psychological well-being, greater happiness, and stronger cognitive functioning (Basso & Suzuki, 2016; Cox, 2016; Ramanathan et al., 2014; Scrivano et al., 2023). Active transportation has additionally been associated with healthier body weight, greater physical fitness, and increased social engagement (Galvez Casas et al., 2015; Yang et al., 2019). However, the present findings suggest that active transportation may simultaneously expose adolescents to broader social environments in which peer interactions occur without direct adult supervision. Consequently, while active transportation provides substantial health benefits, it may also increase opportunities for social experimentation, peer influence, and engagement in behaviors that emerge during adolescence. This interpretation is consistent with studies emphasizing the complex interplay between environmental opportunities and adolescent developmental processes (Huertas-Delgado et al., 2017; Mandic et al., 2015).

Another important finding was the relatively high tendency toward relationships with the opposite sex among students engaging in active transportation. Adolescence is characterized by increasing interest in social and romantic relationships, and transportation routes may provide opportunities for interaction that are less available in more structured transportation contexts. Students who walk or cycle to school often travel with peers, spend more time in

public spaces, and experience greater independence compared with those transported by family members or school buses. Such circumstances may facilitate social interactions and relationship formation. Although healthy social development is a normal aspect of adolescence, unsupervised environments may also increase exposure to situations involving risky interpersonal behaviors. Previous reviews examining adolescent risk and protective factors have emphasized the role of peer contexts and social environments in shaping behavioral outcomes (Sahin-Ilkorkor & Brubaker, 2025). The current findings support the notion that transportation settings may function as meaningful social contexts that influence adolescents' interpersonal experiences.

The finding that female students in the active transportation group reported higher tendencies toward sexual relationships and behaviors than male students deserves particular attention. This result may reflect gender-specific social experiences associated with independent mobility and peer interaction. While traditional assumptions often portray male adolescents as more likely to engage in risk-taking behaviors, contemporary evidence suggests that contextual factors can influence behavioral patterns differently across genders. Transportation environments may expose girls and boys to distinct social expectations, opportunities, and pressures. Moreover, studies examining harassment and gendered experiences in public spaces have shown that girls often navigate transportation environments differently from boys, which may shape their social interactions and behavioral attitudes (Gekoski et al., 2017). Although the present study did not directly investigate these mechanisms, the observed gender differences highlight the importance of considering transportation experiences through a gender-sensitive lens.

The results additionally showed that female students transported by family members reported higher tendencies toward relationships with the opposite sex than male students in the same transportation category. This finding may initially appear counterintuitive because family transportation is typically considered a protective factor due to greater parental supervision. Nevertheless, parental involvement and supervision do not necessarily eliminate adolescents' interest in social and romantic relationships. Rather, family transportation may coexist with other social opportunities that facilitate relationship formation. Research has consistently demonstrated that family support contributes to positive psychosocial development and serves as a protective factor against numerous forms of high-risk behavior (Allen et al., 2018; Graham et al., 2014). Therefore, the higher scores observed in this domain should not necessarily be interpreted as indicating problematic behavior but may instead reflect developmental differences in social orientation and interpersonal interests.

The present findings further revealed that male students generally exhibited higher levels of high-risk behavioral tendencies across most transportation categories. This pattern is consistent with extensive literature indicating that adolescent males tend to report greater involvement in behaviors such as substance use, aggression, risky driving, and delinquency (Kordi Haji et al., 2022). Developmental theories suggest that males are often socialized toward greater sensation-seeking, autonomy, and risk-taking, which may increase vulnerability to certain forms of problematic behavior. Environmental contexts such as transportation settings may amplify these tendencies by providing opportunities for peer reinforcement and behavioral modeling. The consistency between the present findings and previous research strengthens confidence in the observed gender differences and highlights the need for prevention strategies that acknowledge gender-specific risk profiles.

The elevated levels of violent behavior observed among students using active transportation also merit discussion. Walking or cycling to school often requires navigating public spaces and interacting with peers in relatively unstructured environments. Such conditions may increase exposure to interpersonal conflicts, territorial disputes, bullying, or aggressive peer dynamics. Previous research has demonstrated that transportation routes can expose students to violence and crime, with important implications for educational and psychological outcomes (Burdick-Will et al., 2019). Similarly, studies examining school-related social environments have identified peer interactions as significant predictors of aggressive behavior and psychosocial adjustment (Sahin-Ilkorkor & Brubaker, 2025). The current findings suggest that transportation routes themselves may represent important locations in which these social processes unfold.

The broader implications of the study emphasize that school transportation should not be viewed solely as a logistical or infrastructural issue. Rather, transportation modes represent distinct social and developmental environments that may influence adolescents' psychological experiences, social interactions, and behavioral tendencies. Contemporary transportation research increasingly recognizes that student transportation affects not only physical safety but also educational engagement, emotional

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well-being, and developmental outcomes (Chan et al., 2024; Chang et al., 2024). Evidence concerning absenteeism, school participation, and transportation accessibility further demonstrates the far-reaching effects of transportation systems on students' lives (Ross et al., 2020; Stein & Grigg, 2019). The present study contributes to this growing body of literature by highlighting associations between transportation modes and high-risk behavioral tendencies.

At the same time, it is important to acknowledge that transportation modes may reflect broader social, familial, and environmental characteristics. For example, families selecting active transportation may differ from those using family vehicles or public transportation in terms of socioeconomic status, neighborhood characteristics, parental attitudes, or community resources. Previous research has shown that environmental and social factors strongly influence transportation choices and adolescent experiences (Aranda-Balboa et al., 2020; Humberto et al., 2021). Consequently, transportation mode should be understood as one component of a larger ecological system influencing adolescent behavior.

5. Conclusion

Overall, the findings support the view that adolescents' journeys to and from school constitute meaningful developmental experiences. Transportation environments may shape opportunities for physical activity, social interaction, peer influence, environmental exposure, and behavioral learning. While active transportation offers substantial physical and psychological benefits (Messing et al., 2019; Poitras et al., 2016), and family transportation may provide protective supervision, each transportation mode also presents unique challenges and opportunities. Therefore, a comprehensive understanding of adolescent well-being requires consideration of the transportation contexts in which daily developmental experiences occur.

6. Limitations & Suggestions

Several limitations should be considered when interpreting the findings of this study. First, the causal-comparative design does not permit causal conclusions regarding the relationship between transportation modes and high-risk behaviors. Second, all data were collected through self-report questionnaires, which may be subject to social desirability bias, recall bias, and response inaccuracies. Third, the study was conducted in a single educational district, which may limit the generalizability of the findings to other geographical regions and cultural contexts. Fourth, potentially important variables such as parental monitoring, peer group characteristics, neighborhood safety, and socioeconomic status were not examined directly. Finally, the study focused on behavioral tendencies rather than actual behavioral engagement, which may have influenced the interpretation of the results.

Future studies should employ longitudinal designs to examine how transportation experiences influence the development of high-risk behaviors over time. Researchers are encouraged to investigate mediating and moderating variables such as parental supervision, peer influence, school climate, neighborhood safety, and socioeconomic conditions. Qualitative studies may provide deeper insights into adolescents' lived experiences during their journeys to and from school. Comparative investigations involving different cities, regions, and cultural contexts would further enhance understanding of transportation-related influences on adolescent development. Future research should also examine protective factors that may reduce risk exposure within various transportation environments and explore gender-specific mechanisms underlying the observed differences.

Educational authorities, school administrators, transportation planners, and parents should recognize school transportation as an important developmental context rather than merely a means of travel. Programs designed to enhance supervision, safety, and positive peer interactions during school commutes may contribute to reducing adolescents' vulnerability to high-risk behaviors. Schools can collaborate with families and transportation providers to establish monitoring systems and promote safe commuting practices. Educational campaigns focusing on risk awareness, healthy social relationships, and responsible behavior during school travel may also prove beneficial. Furthermore, creating safer transportation environments and strengthening communication among students, parents, schools, and transportation personnel may foster healthier developmental outcomes and support adolescents' overall well-being.

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Declaration of Interest

The authors of this article declared no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this article.

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