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# Governing Road Safety In Urban South Asia: Public Perceptions And Policy Strategies For Animal–Vehicle Collisions In Lahore, Pakistan

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**Abstract**

Animal-vehicle collisions (AVCs) represent a significant yet understudied challenge in rapidly urbanizing cities of the Global South, where free-roaming domestic animals compound traffic safety risks. While extensive research exists on wildlife-vehicle collisions in developed nations, little attention has been given to urban AVC dynamics in South Asian contexts. Therefore, this study aims to explore public perceptions of AVCs and evaluate preferred prevention strategies in Lahore, Pakistan, where free-roaming livestock and stray animals significantly impact traffic safety. Using a structured questionnaire survey administered to 575 respondents, the research indicate that vehicle speed emerges as the most critical factor, particularly among respondents aged 31-40 years, while poor lighting and lack of signage are widely recognized as contributing elements to AVCs. Female participants indicated stronger support for regulatory measures such as speed enforcement, and male respondents supported infrastructural solutions, i.e., fencing to mitigate AVCs. To reduce AVCs, educational attainment significantly influences preferences, as highly educated respondents prioritize awareness campaigns while those with primary education emphasize practical roadside maintenance. These findings provide empirical evidence to guide the development of context-sensitive prevention strategies in South Asian cities, suggesting the need for integrated approaches that combine infrastructure improvements, public education initiatives, and policy reforms.

**Keywords:** Animal-Vehicle Collisions (AVCs), Traffic Safety, Free-Roaming Animals, Urban Transportation, Road Infrastructure.

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## Introduction

### Introduction

Animal-vehicle collisions (AVCs) represent a major and increasing global issue with millions of animals dying on the road each year (Hill et al., 2019; Lind Hansen et al., 2024). Rapid urbanization and the expansion of road networks into peri-urban and rural areas have increased conflicts between animals and vehicles.(Wu et al., 2024). There are also very many traffic accidents involving domestic animals (Carvalho-Roel et al., 2019) Apart from the ecological impact, AVCs pose serious a threat to human safety and generates substantial socioeconomic loss due to injuries and property damage(Canal et al., 2018). For instance, in Europe alone vehicle killing of birds and mammals is estimated to amount to 194 million and 29 million respectively (Grilo et al., 2020), In Australia, approximately five million frogs and reptiles die on roads every year. Roads are therefore a major threat to both endangered and common species due to the added mortality from vehicular collisions (Chen & Koprowski, 2011). AVCs also kill wildlife in large numbers due to roads (Kioko et al., 2015). In South Asia, including Pakistan and India, road related animal mortalities are estimated to range from hundreds of thousands to millions annually (Azam et al., 2023). Irrespective of this fact, AVCs are a black hole in the minds of the society that is not given enough attention through the media (Kioko et al., 2015).These incidents reflect broader systemic issues related to urban animal management, traffic control, and infrastructure planning. While vehicle damages are often repairable, the loss of human lives and animals carries irreversible consequences. AVCs, whether because of wildlife, livestock, or stray animals, have emerged as a key area of research in road safety studies (Jantan et al., 2021). Roadkill is a major source of amphibian mortality and may contribute to their global decline (Glista, 2007). It is necessary to create awareness about this problem among the drivers and passengers (Dasoler & Gonçalves, 2023).

In developed countries such as the United States, Canada, and Australia, extensive research and infrastructure investments have focused on reducing wildlife-vehicle collisions (Bhatti et al., 2026). But in developing countries the nature of AVCs is very different. But in most nations roadkill studies are virtually non-existent (Schwartz et al., 2020). In South Asian urban centers, the issue is compounded by the presence of freely roaming livestock and stray animals, including cattle, donkeys, goats, and dogs (Kazmi et al., 2026). Existing studies primarily focus on wildlife-related collisions, leaving a critical gap in understanding the urban dynamics of AVCs (Azam et al., 2023). Moreover, animal collisions often go underreported, further obscuring the scope of the issue. Lahore is the second-largest city of Pakistan with over 11 million residents (Pakistan Bureau of Statistics [PBS], 2023). Animals have been observed roaming freely on roads, contributing to sudden accidents that lead to traffic disruptions, injuries, fatalities, and financial losses (Khan et al., 2026). Collision is not by chance and is determined by other factors such as road geometry, traffic volume, land cover and season of the year (Mohammadi et al., 2023).This study aims to address the lack of empirical data on urban AVCs in Lahore and provide context-specific insights to inform policies, infrastructure improvements, and public safety strategies to mitigate such collisions. the toll of animal lives taken by traffic has likely increased accordingly.(Hels & Buchwald, 2001)

## Scope of the Study

This study focuses on urban zones of Lahore, using a mixed-methods approach. A survey of around 500 participants, including drivers, pedestrians, and residents, was conducted, with data stratified by age, gender, and occupation. The goal was to capture diverse perspectives on animal-vehicle collisions (AVCs) and provide policymakers, urban planners, and animal welfare agencies with practical insights. The study aims to promote road safety, reduce economic losses, and support sustainable coexistence between humans and animals in rapidly urbanizing cities.

## Literature Review:

The literature review examines international findings, Pakistan specific studies, socio-cultural, seasonal, and legal factors that collectively shape the occurrence and mitigation of AVCs in urban settings.

### Global Perspective on Animal Vehicle Collisions (AVCs)

Mitigation of wildlife in developed countries has also been achieved with success through wildlife crossings, fencing and road sensors (Clevenger et al., 2001) For instance, Banff National Park in Canada witnessed a 96% reduction in elk vehicle collisions following the installation of wildlife crossings. Seasonal and temporal patterns are also prominent in AVC occurrences.(Gálvez, 2021) AVCs tend to occur more frequently where it is dark and not lit and where there is no unfavorable weather condition (Bhatti et al., 2023). Various factors have been identified as contributing to AVC, along with the nature of the road, traffic speed, and traffic volume (Bennett et al., 2011; Santos et al., 2011). Roadkill is not uniformly spread across roads, but is more likely to occur where there are hotspot where environmental and road conditions enhances the frequency of the affected organisms (Filius et al., 2020). The research by (Wang, 2013) suggests that amphibians and small-sized mammals should have wildlife crossing structures built to minimize road mortalities and implementing traffic control strategies to reduce death of amphibian species (Khan et al., 2026). Globally, studies have shown that the AVCs' crash rates are more likely to rise with a posted speed limit of more than 60 mph (Roy & Ksaibati, 2021).Thus human behavior also contributes to the AVC incidents. However, basic interventions like speed regulation and warning signage and targeted driver awareness campaigns have been found to effectively reduce the incidents of such collisions.(Balčiauskas et al., 2025; Borza et al., 2023; Rehman et al., 2023)

Speed limit has a positive correlation with increased likelihood of an AVC caused by an animal crossing the road (Khan et al., 2026). Consistent with international evidence, higher posted speeds are associated with a greater likelihood of AVCs. Scenario testing shows that a 10 mph reduction lowers expected collisions, particularly in urban areas (Gurumurthy et al., 2022).

Technological innovation plays a growing role. Animal detection systems and AI-driven vehicle sensors have demonstrated collision reductions of up to 50% in pilot projects across the U.S. and Europe. The development of predictive models that integrate roadkill data with traffic, environmental, and animal movement datasets may help identify hotspots and guide mitigation(Laube et al., 2023). Key predictors of AVCs included

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roadway curvature, traffic volume, speed limits, proximity to water bodies, and vegetation cover(Rahman et al., 2023). Installing wildlife passages, fencing, and speed-control measures in high-risk areas significantly reduces AVC occurrence(Wu et al., 2024). In India, similar technologies have been adapted to local needs, preventing collisions with large animals like elephants and cattle (Bhatti et al., 2025). (Sharma & Shah, 2017). Best countermeasures to minimize the number of AVC as the speed limit should be lowered at night so that drivers are warned by indicating signs drivers will have the opportunity to know when an animal is approaching, and there are physical control mechanisms, that might include building overpasses and underpasses, fencing, and at-grade crossings, might work (Mccollister & Van Manen, 2010). Another solution to the problem of reducing the AVCs could be a driver education and awareness program (Roy & Ksaibati, 2021).

Combining systematic surveys with citizen science data and opportunistic records provides a more complete picture of roadkill risk.(Laube et al., 2023) Raising awareness through public education, social media, and community outreach programs can foster empathy towards animals and encourage responsible behavior.(Farwa Naqvi, 2024). Crowdsourced data and community reporting were essential in improving AVC detection and mapping (Balčiauskas et al., 2025). Urban planners can integrate smart design features such as wildlife crossings, speed-calming measures, and buffer zones to sustainably address the issue within growing cities. Public acceptance is highest for measures that improve safety without adding significant travel time (Villamagna & Laflamme, 2024)

**Contextual Overview: Pakistan**

Pakistan remains largely underrepresented in the global discourse on AVC, despite its rapidly expanding road networks and increasing vehicular traffic, particularly in urban and peri-urban areas such as Lahore. While numerous international studies have examined the ecological impacts of roadkill, documented research from Pakistan is scarce. To date, only a handful of localized efforts have attempted to record such incidents, often in fragmented or anecdotal forms, and typically without the application of robust statistical analysis.

In South Asian context, particularly in major cities of Pakistan, animal-vehicle collisions (AVCs) are primarily associated with stray or domesticated animals rather than wildlife. In densely populated cities like Lahore and Karachi anecdotal evidence and media reports frequently document how stray dogs, donkeys and cows disrupt urban mobility and pose a significant road safety concern.

One of the most comprehensive datasets comes from the Pothwar Plateau (north of Lahore), which recorded 392 car cases in just two years on a single section (2010–2012), with approximately 72% mammals (e.g., jackals, dogs, wild cats), underscoring substantial vertebrate exposure on major corridors serving Lahore (Akrim et al., 2019).

On the Lahore–Islamabad Motorway (M-2), studies have documented high numbers of vertebrate roadkill, with mammals such as jackals, wild cats, and domestic dogs being most affected. These studies highlight motorway sections with particularly high collision rates (black spots), although they often focus on traffic safety rather than wildlife impacts (Hasan, 2022). Beyond motorways, provincial case studies exist but remain

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piecemeal. for example, a 5-month survey on Bhalwal Road (Sargodha District, central Punjab) tallied 242 roadkill's across mammals, birds, reptiles and amphibians and included basic inferential analysis linking mortality to traffic intensity, yet its insights are site-specific and difficult to generalize to the Lahore metropolis. (Munir et al., 2023) According to the Ayesha Chundrigar Foundation (as cited in The Express Tribune, 2025), based in Karachi, they receive about 30 to 40 injured animals every day, most of which are victims of vehicle collisions, including not only dogs and cats, but also birds, donkeys, and cows (Nida M Azeem, 2025).

Much of the available evidence is based on incidental observations rather than systematic monitoring, leaving significant gaps in understanding the scale, species composition, and ecological consequences of animal vehicle collisions in the region.

**Cultural and Religious Practices Exacerbating AVCs in Pakistan**

Cultural and religious traditions also contribute to the frequency of AVCs. A distinctive cultural practice that increases the danger of AVCs in Lahore the siting of sadqa (charitable) meat beside roadways, particularly along the Lahore Canal and the banks of the Ravi River. Many residents, motivated by religious beliefs and traditions, dispose of sacrificial meat in open areas to feed stray dogs and birds. While this act is well-intentioned, it unintentionally attracts large numbers of scavenging birds, leading to an increase in bird-vehicle collisions and driver distractions. AVC is not only an animal welfare issue but also a major human safety concern, often leading to severe injuries or fatalities.

**Seasonal Surge in Animal Movement: Eid-ul-Azha**

Additionally, the annual Islamic festival of Eid al-Adha introduces a temporary yet significant risk factor. In Lahore alone, more than 0.77 million animals enter the city in the weeks preceding the festival in 2024 (Usman Aleem, 2024). Temporary livestock markets are established near major roads, and many households keep sacrificial animals in residential areas, leading to unrestrained animal movement on public streets. Furthermore, during transportation, animals are sometimes thrown from vehicles and struck by oncoming traffic, highlighting the need for greater awareness and action to mitigate these tragic consequences.(Farwa Naqvi, 2024)

**Legal Framework and Institutional Gaps**

Despite their scale, AVCs are still poorly integrated into transport planning and biodiversity policies at national and regional levels (Torres et al., 2025) Another common but often overlooked cause of AVCs in urban centers such as Lahore is the improper disposal of partially consumed food wrappers. These leftovers attract stray animals, particularly dogs, to roadsides, where they are at risk of being struck by fast-moving vehicles. This issue highlights the need for integrated strategies involving urban planning, technology, and public awareness to ensure road safety for both humans and animals.

**Methodology**

**Study area**

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Lahore, the capital of Punjab and the second-largest city of Pakistan, is home to over 13 million people according to the 2023 census. Beyond its size, Lahore plays an outsized economic role, contributing about 11.5% of Pakistan's GDP and nearly one-fifth of Punjab's provincial economy (Tahir, 2017). The city's rapid growth has gone hand in hand with a surge in vehicles, with more than five million registered on its roads by early 2024 not surprisingly, this has made Lahore one of the most congested and overburdened urban centers in Pakistan, where traffic density, weak regulation, and shared use of roads are constant challenges. These realities, combined with the presence of stray dogs, cows, and donkeys, and seasonal factors like Eid al-Adha, create conditions where AVCs are both frequent and overlooked. Given its scale and complexity, Lahore offers a critical lens for understanding the hidden costs of AVCs in South Asian megacities.

**Questionnaire Design**

To collect relevant data, a comprehensive questionnaire was developed, consisting of the following sections: The questionnaire was designed with four focused sections. The first gathered demographic information such as age, gender, occupation, and driving experience. The second used a Likert scale to assess driving habits and awareness of animal crossings. The third explored potential causes of animal-vehicle collisions, including speeding, poor lighting, lack of signage, and animal behavior. The final section collected opinions on possible solutions, such as installing animal crossings, improving signage, or raising public awareness.

Survey and Data Collection

Data were collected using both online and manual surveys. Online surveys were distributed through social media platforms, particularly WhatsApp, targeting drivers of various vehicle types, including cars, motorcycles, and others within Lahore. In addition, manual surveys were carried out in high-traffic zones and peri-urban areas, where the likelihood of animal-vehicle collisions is comparatively higher. Online Surveys were distributed through social media platforms (WhatsApp), targeting drivers of all categories (car, motorcycle, etc.) within Lahore.

Analytical Approach.

Demographic analysis

The survey included a total of 575 respondents, with balanced representation in terms of gender, 49.9% male (n = 287) and 49.9% female (n = 287), while 0.2% (n = 1) preferred not to disclose their gender.

In terms of age distribution, the majority of participants were between 20–30 years old (51.0%, n = 293), followed by those under 20 (43.3%, n = 249). A smaller proportion belonged to the 31–40 age group (4.9%, n = 28), and only 0.9% (n = 5) were above 40 years of age. Regarding educational background, most of them had a bachelor degree (61.0%, n = 351), those with an intermediate came next or college-level education (32.7%, n = 188). Participants with a master's degree accounted for 1.4% (n = 8), while 4.9% (n = 28) had only primary or secondary education. Vehicle ownership data revealed that motorbike users formed the largest group (40.5%, n = 233), followed by car users (34.6%, n = 199). Other vehicle users (including rickshaws and delivery vehicles) made up 10.4% (n = 60), while bus users constituted 10.3% (n = 59). Notably, 4.2% (n = 24) of respondents reported not owning or using any vehicle.

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| Frequencies of Education Status | | |
|---|---|---|
| Education Status | Counts | % of Total |
| Master’s degree | 8 | 1.40% |
| Bachelor’s degree | 351 | 61.00% |
| Intermediate/College | 188 | 32.70% |
| Primary/ Secondary | 28 | 4.90% |
| Frequencies of Vehicle Type | | |
| Vehicle Type | Counts | % of Total |
| No Vehicle | 24 | 4.20% |
| Motorbike | 233 | 40.50% |
| car | 199 | 34.60% |
| Bus | 59 | 10.30% |
| Other | 60 | 10.40% |
| Frequencies of Age | | |
| Age | Counts | % of Total |
| 20-30 | 293 | 51.00% |
| under 20 | 249 | 43.30% |
| 31-40 | 28 | 4.90% |
| above 40 | 5 | 0.90% |
| Frequencies of Gender | | |
| Gender | Counts | % of Total |
| Male | 287 | 49.90% |
| Female | 287 | 49.90% |
| Prefer not to say | 1 | 0.20% |

Table 1_Demographic analysis

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**Weighted Average Analysis**

To quantitatively assess the perceived significance of various factors contributing to animal-vehicle collisions, a weighted average analysis was conducted based on responses to 5-point Likert scale questions. Each response option was assigned a custom weight to reflect increasing levels of agreement. Ranges are 0.2 Strongly Disagree, 0.4 Disagree, 0.6 Neutral, 0.8 Agree and 1.0 Strongly Agree. The weighted average score for each factor was calculated using the formula:

Weighted Average = (Σ (Custom Weight × Response Frequency)) / Total Responses.

Interpretation of results was based on a defined scale: Ranges are 0.2 Strongly Disagree, 0.4 Disagree, 0.6 Neutral, 0.8 Agree and 1.0 Strongly Agree. This analysis was further disaggregated by demographic categories such as age, gender, and vehicle type to identify variations in perception across respondent groups. A group wise analysis based on age categories was conducted to identify variations in the perceived significance of factors contributing to animal-vehicle collisions. Weighted average scores were calculated for each factor across four age groups.

Participants aged 31–40 considered vehicle speed the most critical factor (0.82), while younger groups (under 20 and 20–30) rated it lower at 0.69. Poor lighting and roadside litter were consistently rated high across all ages, with the strongest agreement among respondents over 40 (0.80). Perceptions of bad weather as a contributing factor also rose with age, reaching 0.80 in the oldest group. In contrast, intentional driver behavior was generally seen as less influential, particularly by older respondents (0.40). Overall, the results suggest that older individuals place greater emphasis on environmental and situational risks such as poor lighting and weather, whereas younger respondents tend to underestimate these factors and assign less importance to vehicle speed.

| Group analysis by Age | | | | |
|---|---|---|---|---|
| | Under 20 | 20-30 | 31-40 | above 40 |
| Vehicle Speed | 0.69 | 0.69 | 0.82 | 0.73 |
| Litter On Road Side | 0.79 | 0.71 | 0.76 | 0.80 |
| Intentional By the Driver | 0.55 | 0.55 | 0.63 | 0.40 |
| Animal Behavior | 0.61 | 0.52 | 0.61 | 0.60 |
| Bad Weather Conditions | 0.60 | 0.57 | 0.70 | 0.80 |
| Poor Lighting/Darkness | 0.75 | 0.74 | 0.80 | 0.80 |

Table 2_ Age group analysis

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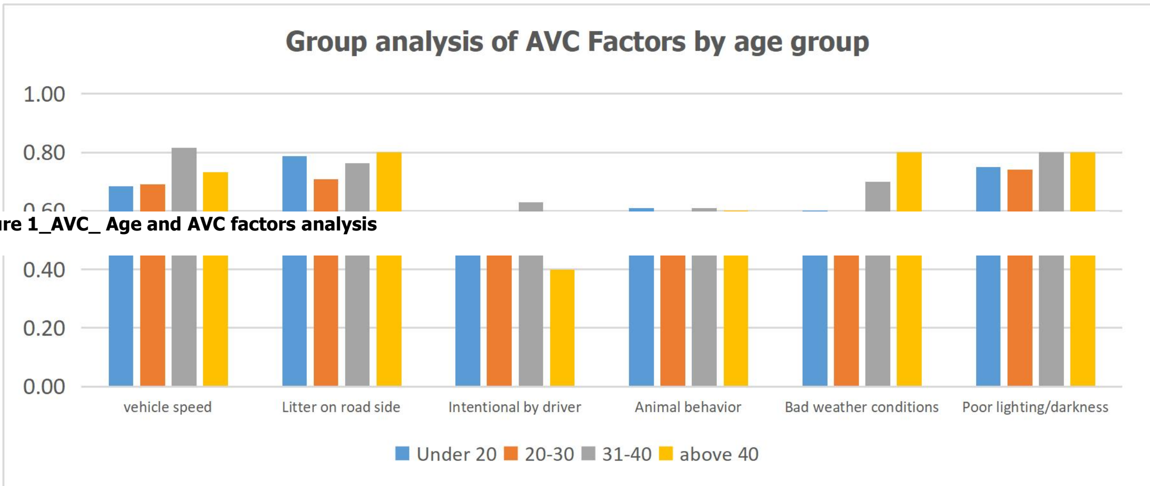


**Figure 1_AVC_ Age and AVC factors analysis**

The analysis suggests some interesting gender differences in how animal–vehicle collision (AVC) risks are perceived. Female respondents generally rated most factors a little higher than males, showing greater concern about issues such as vehicle speed (0.751 vs. 0.682) and poor lighting (0.761 vs. 0.734). This points to a stronger sensitivity among women to external and environmental conditions that can increase accident risk. Male participants, on the other hand, placed more weight on intentional driver behavior (0.606 vs. 0.499), which may reflect a tendency to see driver accountability as more central. One respondent chose not to disclose gender and rated nearly all factors very highly, though given that this was a single case, it has little statistical value. Overall, while the differences are not extreme, the findings suggest that women are more cautious about environmental risks, whereas men emphasize the role of driver decisions, an observation that could help shape more targeted safety measures and awareness campaigns.

| Group analysis by Gender | | | |
|---|---|---|---|
| Factors | Male | Female | prefer not to say |
| vehicle speed | 0.682 | 0.751 | 1 |
| Litter on the roadside | 0.74 | 0.72 | 1 |
| Intentional by the driver | 0.606 | 0.499 | 0.2 |
| Animal behavior | 0.5902 | 0.5523 | 0.8 |
| Bad weather conditions | 0.5902 | 0.593 | 0.8 |
| Poor lighting/darkness | 0.734 | 0.761 | 0.8 |

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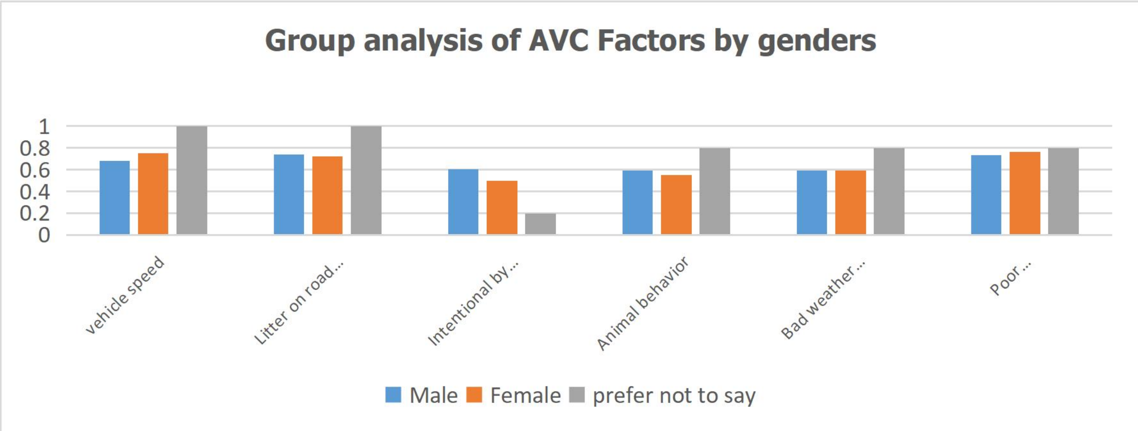


Table 3_Perceived AVC factors by gender.

**Figure 2_Gender and AVC analysis**

Perceptions of AVC factors also varied with education level. Respondents with a master's degree rated most risks higher than others, especially vehicle speed, animal behavior, and poor lighting (all 0.80), highlighting strong awareness of these issues. Bachelor's degree holders gave more moderate ratings, with speed (0.70) and poor lighting (0.72) standing out. Those with intermediate or college-level education emphasized litter on the roadside (0.76) but rated animal behavior lower (0.50). Interestingly, participants with only primary or secondary education viewed litter (0.85), speed (0.77), and poor lighting (0.77) as key concerns, pointing to heightened sensitivity to environmental and visibility factors. Notably, the lowest score for intentional driver behavior (0.375) came from the master's group, suggesting less emphasis on driver intent compared to other groups.

| Analysis of the group based on the level of education | | | | |
|---|---|---|---|---|
| | Master's Degree | Bachelor's Degree | Intermediate/ College | Primary/Secondary |
| Vehicle Speed | 0.8 | 0.7 | 0.74 | 0.77 |
| Litter On the Roadside | 0.75 | 0.71 | 0.76 | 0.85 |
| Intentional By the Driver | 0.375 | 0.56 | 0.54 | 0.61 |
| Animal Behavior | 0.8 | 0.61 | 0.5 | 0.47 |
| Bad Weather Conditions | 0.675 | 0.589 | 0.581 | 0.679 |
| Poor Lighting/Darkness | 0.8 | 0.72 | 0.8 | 0.77 |

Table 4_Perceived AVC factors by education level

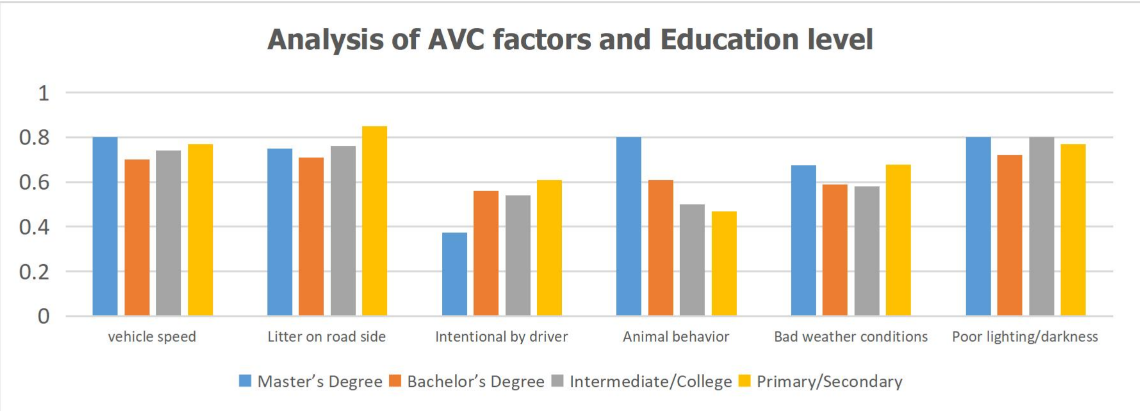


**Figure 3_ Education level and AVC analysis**

**Mitigation Strategies**

In addition to analyzing perceived causes of animal-vehicle collisions, the same weighted average method was applied to evaluate the effectiveness of proposed mitigation strategies. A group analysis by age was conducted to examine variations in the perceived effectiveness of different strategies for reducing animal-vehicle collisions.

A group analysis by Age Groups

Across all age groups, roadside maintenance (e.g., keeping roadsides clear) was consistently rated highly, with the highest score from the above 40 group (1.0) and substantial agreement among under 20 (0.817) and 31–40 (0.871) age groups. The 31–40 age group generally expressed the strongest support across most strategies, notably for awareness campaigns (0.914), increased responsibility on animal management services (0.879), and speed limit enforcement (0.843), suggesting heightened concern and awareness in this demographic. Physical infrastructure measures such as fencing and wildlife crossings were also rated highly across all groups (0.736–0.8), indicating broad support for structural interventions. On the other hand, technological innovations and scientific research received slightly lower ratings, particularly among respondents above 40 (0.6), possibly reflecting generational differences in trust toward modern solutions.

| Weighted Average Scores of Mitigation Strategies by Age Group | | | | |
|---|---|---|---|---|
| | Under 20 | 20-30 | 31-40 | above 40 |
| Increased responsibility on animal management services | 0.772 | 0.742 | 0.879 | 0.6 |
| Physical structures (e.g., fences, wildlife crossings) | 0.736 | 0.792 | 0.793 | 0.8 |
| Awareness campaigns for animal vehicle collision prevention (e. | 0.735 | 0.719 | 0.914 | 0.8 |
| Enhanced driving education on safe driving near animals | 0.745 | 0.764 | 0.8 | 0.6 |
| Technological innovations (e.g., animal detection systems) | 0.689 | 0.715 | 0.757 | 0.6 |
| Roadside maintenance (e.g., keeping roadsides clear) | 0.817 | 0.793 | 0.871 | 1 |
| Introduction and enforcement of speed limits in 4-risk areas | 0.772 | 0.773 | 0.843 | 0.6 |
| Traffic speed reduction in areas with high animal activity | 0.803 | 0.725 | 0.764 | 0.8 |
| Increased scientific research on animal vehicle collision prevention | 0.696 | 0.718 | 0.721 | 0.6 |

Table 5_Age-wise preferences for AVC mitigation strategies

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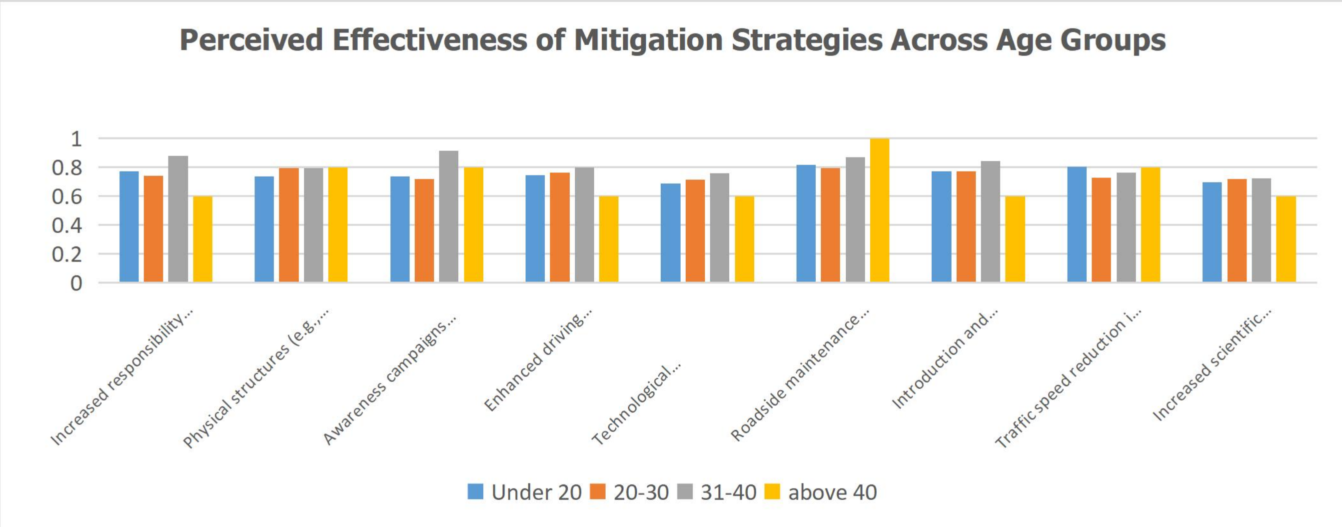


**Figure 4_mitigation strategies across the age groups**

**Age-Group Analysis of Mitigation Strategies by gender**

Roadside maintenance was rated highly across all age groups, with the strongest support from respondents over 40 (1.0) and solid agreement among younger groups (0.817–0.871). The 31–40 group consistently showed the highest concern, strongly supporting awareness campaigns (0.914), greater responsibility for animal management services (0.879), and speed limit enforcement (0.843). Structural measures such as fencing and wildlife crossings also received broad approval (0.736–0.8). In contrast, technological solutions and scientific research were rated lower, particularly by respondents above 40 (0.6), suggesting less trust in modern interventions among older participants.

| Perceived Effectiveness of Animal-Vehicle Collision Prevention Measures by Gender | | | |
|---|---|---|---|
| | Male | Female | prefer not to say |
| Increased responsibility on animal management services | 0.713 | 0.808 | 0.8 |
| Physical structures (e.g., fences, wildlife crossings) | 0.755 | 0.78 | 0.8 |
| Awareness campaigns for animal vehicle collision prevention (e. | 0.741 | 0.731 | 0.8 |
| Enhanced driving education on safe driving near animals | 0.752 | 0.761 | 0.8 |
| Technological innovations (e.g., animal detection systems) | 0.713 | 0.697 | 0.8 |

| | | | |
|---|---|---|---|
| Roadside maintenance (e.g., keeping roadsides clear) | 0.78 | 0.755 | 1 |
| Introduction and enforcement of speed limits in 4-risk areas | 0.715 | 0.758 | 0.8 |
| Traffic speed reduction in areas with 4 animal activities | 0.792 | 0.734 | 0.8 |
| Increased scientific research on animal vehicle collision prevention | 0.674 | 0.728 | 0.8 |

Table 6_Gender-wise preferences for AVC mitigation strategies.

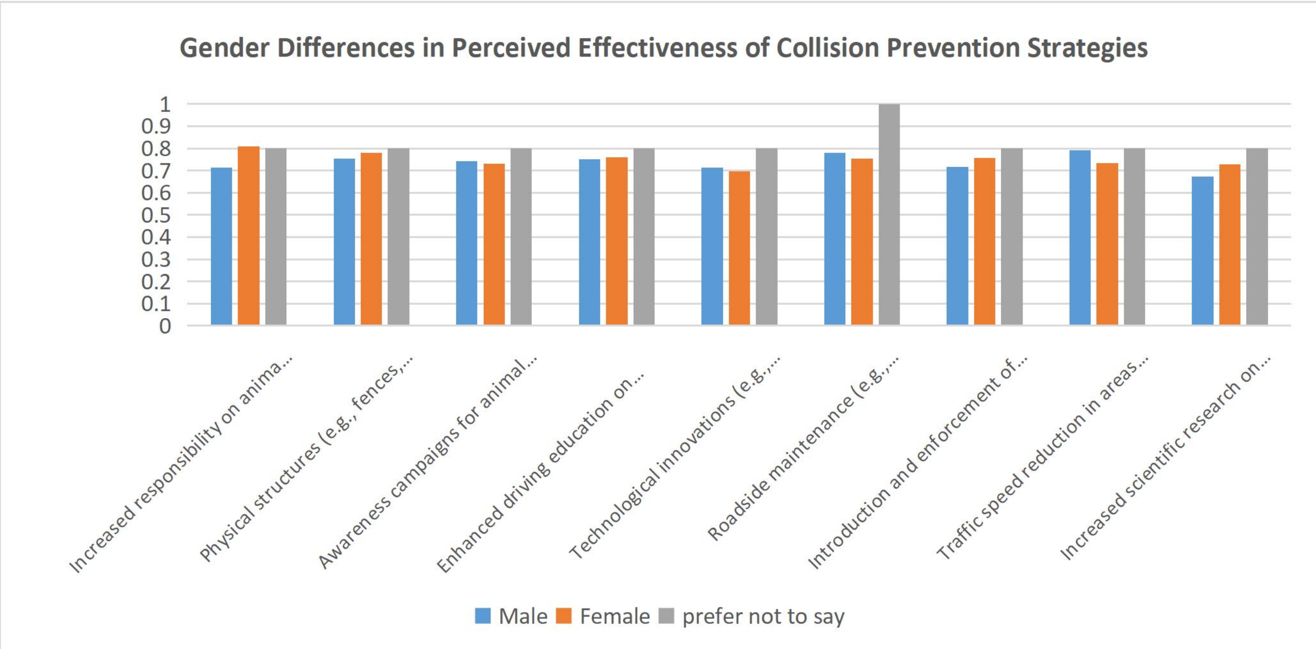


**Figure 5_ mitigation strategies across the genders**

| |
|---|
| Ratings of Animal Vehicle Collision Prevention Measures by Respondents Education Level |

| | Master's Degree | Bachelor's Degree | Intermediate/College | Primary/Secondary |
|---|---|---|---|---|
| Increased responsibility for animal management services | 0.775 | 0.752 | 0.771 | 0.786 |
| Physical structures (e.g., fences, wildlife crossings) | 0.775 | 0.752 | 0.771 | 0.786 |
| Awareness campaigns for animal-vehicle collision prevention | 0.975 | 0.711 | 0.787 | 0.643 |
| Enhanced driving education on safe driving near animals | 0.925 | 0.713 | 0.809 | 0.9 |
| Technological innovations (e.g., animal detection systems) | 0.75 | 0.706 | 0.688 | 0.786 |
| Roadside maintenance (e.g., keeping roadsides clear) | 0.75 | 0.796 | 0.828 | 0.857 |
| Introduction and enforcement of speed limits in 4-risk areas | 0.8 | 0.783 | 0.771 | 0.686 |
| Traffic speed reduction in areas with 4 animal activities | 0.775 | 0.745 | 0.782 | 0.821 |
| Increased scientific research on animal vehicle collision prevention | 0.75 | 0.73 | 0.65 | 0.72 |

**A group analysis by Education Level**

An education-based analysis was conducted to explore differences in perceptions of various animal-vehicle collision prevention strategies. Respondents with a Master's degree rated awareness campaigns (0.975) and enhanced driving education (0.925) significantly higher than other groups, suggesting a strong emphasis on informational and behavioral interventions among highly educated individuals. Conversely, respondents with primary or secondary education showed higher appreciation for practical and infrastructural measures, such as roadside maintenance (0.857), traffic speed reduction (0.821), and physical structures like fences and wildlife crossings (0.786). While technological innovations received relatively consistent support across education levels (0.688–0.786), scientific research was rated lowest by those with intermediate/college education (0.65), indicating potential skepticism or limited engagement with research-driven approaches in this group.

Table 7_education and preferences for AVC mitigation strategies.

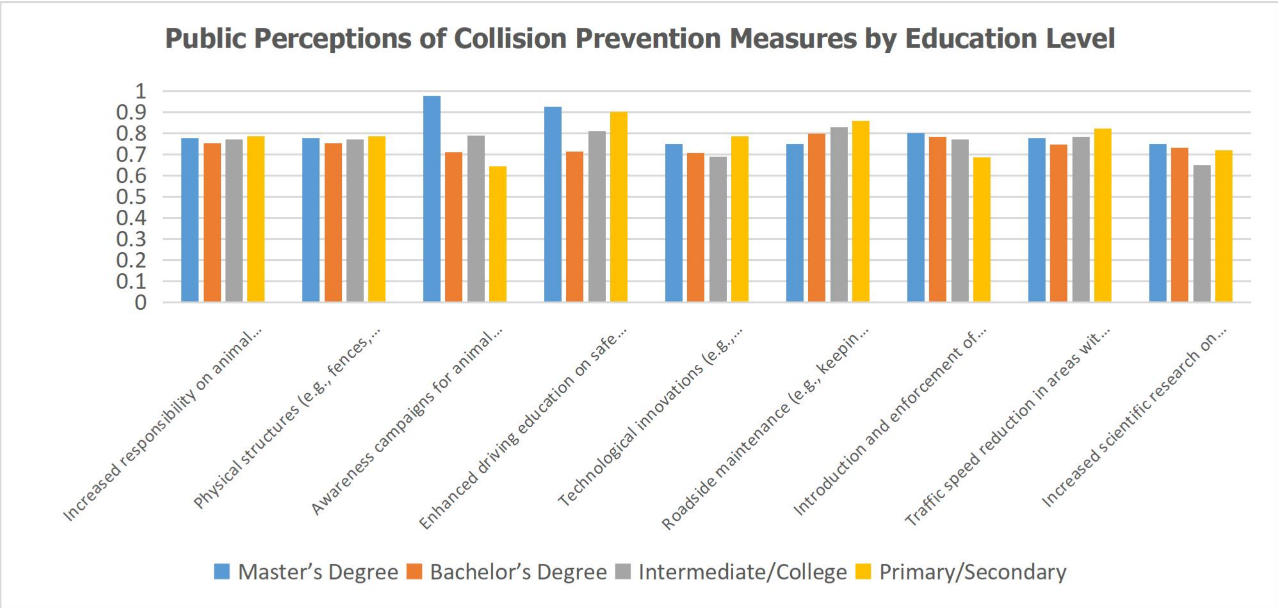


**Figure 6_prevetive measures and education level**

**Results :**

Perceptions of Animal Vehicle Collision Causes by Age

The study highlighted the clear age-related differences in the perception of factors contributing to animal vehicle collisions. Respondents aged 31-40 and those over 40 were more concerned about environmental circumstances, such as poor lighting (0.80) and severe weather (0.80), as well as a greater appreciation for vehicle speed (0.82 and 0.73, respectively) as an important aspect. Younger respondents (under 30) rated these characteristics as having a lower priority, particularly intentional behavior while driving and animal behavior.

Gender Differences in Perceptions of Animal Vehicle Collision

Gender based study revealed that female respondents ranked risk variables higher than males, such as vehicle speed (0.751) and insufficient lighting (0.761), indicating that they are more sensitive to environmental challenges. In contrast, male respondents prioritized intentional driver behavior (0.606), indicating a possible greater confidence in individual accountability.

The study finds small gender variations in recommended collision prevention measures, with females favoring regulatory and management approaches and males leaning slightly toward structural alternatives. Non disclosing respondents expressed generally positive feedback, emphasizing the significance of inclusive and gender sensitive planning.

Education Level and Risk Awareness

Educational background was a significant factor in shaping the perceptions. Master's students agreed strongly on systemic causes such as vehicle speed (0.80), animal behavior (0.80), and poor lighting (0.80), whereas respondents with lower education levels were more focused on real, visible issues such as roadside litter (0.85) and poor lighting (0.77). Results may indicate a deeper systemic or structural understanding of the causes of

AVC among highly educated participants. This study indicates that individuals' backgrounds in education influence how they interpret and prioritize the causes of animal-vehicle incidents.

Mitigation Strategy Preferences by Age

When it comes to preventive measures, respondents aged from 31-40 rated the majority of strategies as the most effective, particularly awareness campaigns (0.914), animal management responsibilities (0.879), and speed limit enforcement. The oldest age group (over 40) demonstrated significant support for physical infrastructure (0.80) and roadside maintenance (1.0) and reviewed technological interventions lower (0.60). These findings reveal age-related preferences in mitigation options, with younger and middle-aged respondents favoring educational and technological initiatives, whereas older participants prefer practical and environmental approaches. The study reveals age related changes in strategy preferences, with all groups prioritizing roadside maintenance and infrastructure. Middle aged respondents prefer more comprehensive interventions, but elderly adults prefer practical, low technology solutions to technology alternatives.

Mitigation Preferences by Gender

The study found that overall, all genders were largely supportive of the recommended steps to decrease ACV. Female participants prioritized stricter regulation of animals (0.808) and enforcing speed restrictions in potentially hazardous areas (0.758). Male respondents favored practical, infrastructure related solutions, with roadway maintenance getting the highest score (0.78). Interestingly, individuals who did not reveal their gender scored every technique very highly (0.8 to 1.0), indicating more consistent approval across all categories. These differences suggest that gender influences how people perceive strategies for prevention.

Educational Differences in Strategy Support

Respondents with higher education, particularly those with a Master's degree, reported considerable support for awareness campaigns (0.975) and enhanced driving education (0.925), indicating a preference for knowledge based on behavior changing initiatives. Individuals with lesser levels of education, on the other hand, prioritized practical actions such as roadside maintenance (0.857) and limiting traffic speed in areas with high animal activity (0.821). These findings indicate that educational background may influence how different groups view the efficiency of various mitigation strategies.

**Discussion**

This study sheds light on how people in Lahore understand and respond to the issue of animal–vehicle collisions (AVCs), adding much-needed evidence from a South Asian city where free-roaming livestock and stray animals remain a daily reality. The results reveal that age, gender, and education are not just background variables but critical factors shaping perceptions of both causes and solutions.

Age emerged as a particularly strong differentiator. Respondents over 30 years of age were more attentive to environmental hazards such as poor lighting and severe weather, while younger participants tended to focus more on driver behavior. This finding is consistent with research showing that older drivers, through accumulated experience, are more attuned to external risks (Sullivan, 2011; Wilkins et al., 2019). In practice, this suggests that prevention efforts in Pakistan may benefit from tailoring road-safety campaigns by age group, with younger drivers receiving more education about situational risks that they may underestimate.

Gender differences were also evident. Female respondents favored regulatory measures such as speed enforcement, while male respondents were more supportive of structural solutions like fencing and road design improvements. These results mirror international studies, where women often prefer governance and enforcement approaches, while men lean toward engineering solutions (Torres et al., 2025). For city planners in Lahore, this indicates the importance of designing gender-sensitive policies that speak to these distinct perspectives, ensuring broader public acceptance.

Education added another layer of complexity. Participants with higher education levels recognized systemic causes such as animal behavior and inadequate traffic control and expressed strong support for awareness campaigns and driver training. By contrast, those with less formal education emphasized visible and immediate concerns such as litter, poor lighting, and roadside conditions, and preferred tangible solutions like better maintenance and speed reduction. Similar education-linked differences in risk interpretation have been reported elsewhere (Besharatian & Dorafshan, 2025). This suggests that AVC campaigns in Pakistan should not only address infrastructure but also use different communication strategies depending on the target audience's educational background.

When these findings are considered together, they make it clear that a "one-size-fits-all" approach will not work for AVC prevention in urban Pakistan. Instead, what is needed is an integrated strategy that combines infrastructure upgrades (lighting, fencing, and signage), stronger speed enforcement in high-risk areas, and age- and education-sensitive public awareness initiatives. Framing these interventions in terms of animal welfare and biodiversity could further increase public engagement, as highlighted in recent studies(Cherry et al., 2019).

Global evidence shows that such multifaceted approaches are highly effective. For example, meta-analyses demonstrate that roadkill mitigation reduces AVCs by around 40%, and that fencing paired with wildlife crossings can cut large-mammal collisions by as much as 80–90% (Rytwinski et al., 2016; Ament et al., 2021). While Lahore faces unique challenges—including unregulated livestock movement and infrastructural gaps—these lessons from other regions point to the benefits of combining engineering, regulation, and education within a culturally grounded framework. If implemented thoughtfully, such strategies could make Pakistani roads safer for both people and animals, while supporting more sustainable forms of urban mobility.

**Conclusion**

Animal-vehicle collisions (AVCs) in urban areas is a growing and under recognized challenge in the rapidly expanding and transforming cities of the Global South. This study contributes to fulfilling this research gap by examining public perceptions of AVC causes and mitigation strategies in Lahore, Pakistan, which is a city where freely roaming domestic and stray animals coexist with increasingly congested urban traffic systems. Through an analysis of responses from a diverse sample of 575 individuals, the findings underscore the ways in which demographic characteristics, particularly age, gender, and educational background shaped both the understanding of AVC risks and preferences for prevention measures.

Nonetheless, the study is not without limitations. The reliance on self-reported survey data introduces the possibility of subjective bias and may not fully capture the complexity of on ground conditions or actual behavior during AVC incidents. The absence of empirical accident data or spatial mapping limits the study's ability to correlate perceptions with real collision patterns. Furthermore, the focus on a single urban center restricts the generalizability of the findings to other South Asian contexts, where socio cultural and infrastructural dynamics may differ. Moreover, there is a need for longitudinal investigations to assess how public attitudes evolve in response to awareness campaigns, policy changes, or infrastructural developments.

Ultimately, addressing AVCs in urban Pakistan and similar settings requires more than technical fixes. It calls for empathetic, inclusive planning that respects local realities, interacts with the social mind and acknowledges co-existence of humanity and animal life in the shared urban space.

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