

A Comprehensive Assessment of Motorcycle Helmet Use in Ecuadorian Cities with Below-Average Motorized Vehicle Registration Rates

Javier Vásquez-Monteros, Danilo Pacheco, Juan Regalado, Yasmany García-Ramírez

Universidad Técnica Particular de Loja

San Cayetano, Loja, Ecuador

cjvasquez23@utpl.edu.ec; dfpacheco5@utpl.edu.ec; jpregalado@utpl.edu.ec; ydgarcia1@utpl.edu.ec

Abstract - Motorcycle helmet use is critical for road safety, particularly in regions with varying motorized vehicle registration rates. Ecuadorian cities Loja and Zamora-Chinchipe, with rates below the national average, present a unique context for understanding helmet usage patterns. The anticipated population growth and increased motorcycle usage in these cities underscore the need for a baseline assessment of helmet practices, considering the potential safety implications. This study aims to comprehensively assess motorcycle helmet use in Loja and Zamora-Chinchipe, focusing on participant surveys and observational data to provide insights into age demographics, reasons for motorcycle usage, brand and type preferences, replacement patterns, factors influencing helmet choice, perceptions of helmet importance, purchase locations, awareness of helmet certification, usage of additional protective measures, and adherence to safety guidelines. Data is collected through surveys and observational inspections, with a sample size calculated based on registered motorcycles. The survey covers diverse aspects, including participant demographics, motorcycle usage, helmet preferences, and safety awareness. Observational data is collected by researchers inspecting helmets for various conditions. Key findings include a significant presence of younger riders, varied reasons for motorcycle usage, dominant preferences for the ICH brand and full-face helmets, and distinct factors influencing helmet choice. Varied turnover rates, emphasis on price/brand, and awareness gaps on certified helmets suggest region-specific strategies. Low adherence to safety guidelines highlights the need for urgent and targeted interventions. The study concludes that tailored safety campaigns considering regional nuances, collaboration with prominent helmet brands, educational initiatives addressing certification awareness and sizing, and continuous monitoring and interventions are essential for enhancing road safety awareness and compliance in Loja and Zamora-Chinchipe.

Keywords: Motorcycle helmet use, Road safety, Ecuadorian cities, Helmet preferences, Safety campaigns.

1. Introduction

Motorcycle helmet use is a critical component of global road safety, as evidenced by the staggering toll of over 1.3 million fatalities annually from road traffic collisions worldwide [1]. Helmets play a pivotal role in safeguarding riders from injuries such as traumatic brain injury and concussion [2]. However, riders of motorized two- and three-wheelers face heightened vulnerability to injuries and fatalities, particularly in regions where such crashes rank among the leading causes of mortality and disability [3]. This global concern has prompted initiatives like the Global Road Safety Partnership, which has set an ambitious target of achieving nearly 100% motorcycle helmet usage by 2030, underscoring its importance among the twelve road safety targets [4].

Despite the critical role helmets play, studies reveal risky driving behaviors among motorcyclists, including unauthorized overtaking, inappropriate speed, non-compliance with traffic regulations, riding under the influence, and notably, not using helmets [5]. The primary drivers of this non-compliance are the attitudes and behaviors of riders [6]. Various obstacles to helmet use include perceptions of ineffectiveness, peer pressure, insufficient information, high costs, inconvenience, style concerns, weight, and discomfort [7], [8].

To address these challenges and achieve widespread helmet usage, proven strategies such as the effectiveness of full-face helmets and proper fastening in reducing head and facial injuries should be emphasized [9]. Countries like Thailand have identified increasing helmet usage as a strategic measure to mitigate road traffic deaths, particularly among motorcycle users [10]. Successful initiatives like the Global Helmet Vaccine Initiative in Vietnam, Cambodia, and Uganda demonstrate the impact of targeted programs, improved accessibility, public awareness campaigns, institutional policies, and robust monitoring and evaluation [11]. Additionally, community road safety meetings have been associated with increased self-

reported helmet usage [12], and regulations exist for motorcycle helmets, requiring manufacturers to certify compliance [13].

The analysis of helmet use gains heightened importance in the wake of a substantial surge in motorcycle numbers post-CoViD-19, especially among delivery personnel [14]. While motorcycles are seen as a means to navigate traffic, the widespread use raises concerns about heightened urban congestion [15]. In Ecuador, urban motorcyclists have increased [16], yet few studies offer a baseline for potential control measures, regulatory changes, or improved traffic education. This study addresses low motorization cities like Loja and Zamora-Chinchipe, offering insights before they experience higher motorization rates. It assesses helmet use through participant surveys and observational data, covering demographics, usage patterns, brand preferences, replacement habits, influencing factors, perceptions, purchase locations, certification awareness, additional protective measures, and safety guideline adherence. The aim is to provide a comprehensive understanding of motorcycle helmet use in these regions and pave the way for targeted interventions to enhance road safety awareness and compliance.

2. Materials and Methods

2.1. Settings and Study Design

Ecuador has a motorized vehicle registration rate of 143 vehicles per 100,000 inhabitants [17]. Considering the expected ongoing population growth in Ecuador [18], an increase in motorized vehicles, and consequently, motorcycles is anticipated. This study specifically targets cities below the average rate, aiming to establish a baseline assessment before potential population growth occurs. Loja and Zamora-Chinchipe, with rates of 135 and 103, respectively, were selected for this purpose [17]. The capital cities within these provinces with the highest population concentration, are of particular interest. Notably, Loja and Zamora-Chinchipe exhibit accident rates per registered vehicle of 7.2 and 3.8, respectively, both below the national average of 8.4 [17].

Participants are initially questioned about general aspects of motorcycle helmet use. Subsequently, researchers observe participants' helmet usage, inspect the helmets, and document their findings. This study is characterized as observational and descriptive, as it aims to portray the attitudes, behaviors, perceptions of individuals regarding helmet use, and, inspector collected data through observation without directly intervening in the situation.

2.2. Sample Selections

To calculate the sample size, we estimated the number of evaluations in each city using the number of registered motorcycles, with a 99% confidence level, a probability of success or failure set at 50%, and a margin of error of 10%. In 2021, the city of Loja had 4744 registered motorcycles, and the city of Zamora-Chinchipe had 649 registered motorcycles for the same year [16].

2.3. Data collection instrument

The data collection instrument was a survey designed for participants, encompassing both general and specific information about helmet usage. All questions were closed-ended, outlined in Table 1. Furthermore, inspection questions were administered by a researcher-inspector (see Table 2). Generally, in a true or false format, these questions were recorded based on the researcher's observation.

2.4. Data collection procedure and analysis

Data collection occurred at locations commonly visited by motorcyclists, including commercial establishments specializing in motorcycle products, strategic stops made by motorcycle drivers, and visits to places popular among motorcyclists such as repair shops, accessory stores, helmet and motorcycle parts shops, shopping malls, bus terminals, and selected parking lots. This process continued until the minimum required sample size was reached.

After collecting the data, any inconsistent or erroneous information was eliminated. The refined dataset was then organized into a spreadsheet, and descriptive statistics were applied to analyze the responses from both groups, covering both the first and second parts of the study.

3. Results

3.1. Participant responses

After applying the equation to calculate the sample size, it was determined that 161 and 133 participants were needed for the cities of Loja and Zamora Chinchipe, respectively. This requirement was satisfactorily met in the study. The information processing resulted in the display of answers provided by the participants from both cities in Table 1.

Table 1: Descriptive statistics of survey responses in this study.

Questions	Options	Loja	Zamora Chinchipe
How old are you?	A. 16-20 B. 21-29 C. 30-39 D. 40 or more.	17% 39% 21% 23%	10% 59% 19% 12%
What is the main reason for using your motorcycle?	A. Main means of transportation B. I use it for work C. Recreational use	56% 38% 6%	49% 21% 30%
Can you specify the brand of your motorcycle helmet?	A. Moxal B. ICH C. HRO D. AGV E. Other such as Shaft, Pro Tork, Safelead, Pirel, among others.	12% 37% 5% 3% 43%	14% 38% 3% 7% 38%
Which type of motorcycle helmet do you use?	A. Full-face B. Open-face C. Off-road, D. Tropical E. Modular/Flip-up, F. Half-helmet.	45% 12% 3% 3% 35% 2%	34% 8% 8% 5% 45% 0%
How long have you been using your current helmet?	A. Less than one year B. Between one and two years C. Two years or more	7% 65% 28%	56% 29% 15%
What is the primary reason you find important when choosing a helmet?	A. Design/color B. Price C. Brand D. Certification E. Other	9% 50% 26% 9% 6%	23% 69% 6% 2% 23%
In your opinion, why is using a helmet important?	A. For safety B. To avoid penalties	69% 31%	74% 26%
Where did you purchase your helmet?	A. Motorcycle and accessories store B. Online stores C. Other non-specialized businesses.	73% 9% 18%	72% 14% 14%
Are you aware of the difference between a regular helmet and a certified helmet?	A. Yes B. No	60% 40%	47% 53%
Besides wearing a safety helmet, do you use any other protective measures?	A. Gloves B. Boots C. Knee and elbow protection D. Reflective clothing E. None	29% 4% 2% 4% 62%	22% 11% 6% 11% 50%

In Loja, the majority of participants (39%) fall within the 21-29 age group, while in Zamora Chinchipe, the highest percentage is also in the 21-29 age group (59%). Both cities demonstrate a notable presence of younger participants, the 16-20 and 21-29 age groups collectively constituting a significant portion of respondents in both locations. Loja has a more evenly distributed age representation across the provided options, whereas Zamora Chinchipe exhibits a higher concentration in the 21-29 age group.

The primary reason for motorcycle usage in Loja is transportation, with 56% of respondents indicating it as their main means of commuting. In Zamora Chinchipe, transportation remains the leading motive (49%), although there's a noticeable decline compared to Loja. Work-related use is substantial in Loja (38%), suggesting widespread professional utilization of motorcycles. Zamora Chinchipe also shows work-related usage (21%), albeit to a lesser extent. Recreational use is minimal in Loja (6%), indicating a prevalent perception of motorcycles as practical transportation rather than leisure vehicles. In contrast, Zamora Chinchipe sees a significant portion (30%) using motorcycles for recreation. These disparities suggest the need for tailored transportation planning and safety interventions in each region. Safety campaigns in Zamora Chinchipe, where recreational use is more prevalent, might benefit from addressing a broader range of scenarios beyond daily commuting.

The primary helmet choice in both Loja and Zamora Chinchipe is ICH, with 37% and 38% usage, respectively, indicating widespread popularity. In Loja, there's additional diversity, with 43% opting for "Other" brands. Zamora Chinchipe also shows substantial usage of "Other" brands, though slightly lower at 38%. Both cities exhibit lower percentages for Moxal, HRO, and AGV, indicating a smaller market share. Considering the dominance of ICH, potential safety campaigns could benefit from collaboration or endorsements with this brand.

Full-face helmets dominate in Loja, with 45% of respondents favoring this option, highlighting a strong inclination toward this type. In Zamora Chinchipe, full-face helmets still lead (34%), albeit with a slightly lower percentage than in Loja, indicating subtle variations in helmet preferences between the two cities. Notably, modular/flip-up helmets enjoy significant popularity in Loja (35%), signifying broad acceptance and catering to riders valuing versatility. Zamora Chinchipe exhibits an even stronger preference for modular/flip-up helmets (45%), reinforcing a penchant for helmets offering both full-face and open-face configurations. Open-face helmets have a moderate presence in Loja (12%), with slightly lower usage in Zamora Chinchipe (8%), suggesting a regional preference for more enclosed designs. Half-helmets are minimally used in both cities, accounting for only 2% of respondents in Loja and none in Zamora Chinchipe. Understanding these helmet preferences is pivotal for tailoring effective safety campaigns that highlight the features and benefits of the most commonly chosen types.

A significant proportion of respondents in Loja (65%) have been using their current helmets for between one and two years, indicating a high turnover or replacement rate. In contrast, the majority in Zamora Chinchipe (56%) have used their helmets for less than a year, suggesting a higher prevalence of recently acquired helmets. In Loja, a substantial segment (28%) has used helmets for two years or more, pointing to a mix of frequent replacements and prolonged usage. In Zamora Chinchipe, a smaller percentage (15%) has helmets for two years or more, indicating a lower prevalence of long-term usage compared to Loja. The higher percentage of prolonged helmet usage in Loja may signify a distinct replacement pattern or a greater emphasis on durability. Conversely, the higher percentage of recent helmet acquisitions in Zamora Chinchipe suggests a trend of more frequent replacements or a focus on staying current with safety features. Safety campaigns in Loja could stress regular replacements, particularly for those using helmets for an extended period, while initiatives in Zamora Chinchipe could highlight the safety advancements in newer helmet models.

A majority of respondents in Loja (50%) prioritize price when choosing a helmet, indicating the pivotal role cost plays in the decision-making process for motorcyclists in the region. In Zamora Chinchipe, this emphasis on price is even higher, with 69% of respondents considering it their primary consideration, revealing a pronounced sensitivity to affordability in helmet selection. In Loja, a notable percentage (26%) values brand as an important factor, reflecting the significance of reputation and trust associated with specific helmet brands. However, in Zamora Chinchipe, the emphasis on brand is much lower, with only 6% of respondents prioritizing it. Design/color is considered important by a small percentage (9%) of respondents in Loja, while Zamora Chinchipe shows a higher percentage (23%), indicating a

relatively greater emphasis on the visual aspects of helmets in this region. Certification is a less emphasized factor in both cities, with 9% of respondents in Loja and 2% in Zamora Chinchipe considering it a primary factor. A small percentage (6%) of respondents in Loja and a higher percentage (23%) in Zamora Chinchipe consider factors not listed. Campaigns in Loja could leverage awareness of brand importance, emphasizing reputable brands and their safety features, while Zamora Chinchipe may benefit from campaigns highlighting the safety features of helmets, given the lower emphasis on certification.

A substantial majority of respondents in Loja (69%) and an even higher percentage in Zamora Chinchipe (74%) recognize the paramount importance of using helmets for safety. Additionally, a notable percentage in Loja (31%) acknowledges the legal aspect of helmet usage, indicating an awareness of associated penalties. In Zamora Chinchipe, a slightly lower percentage (26%) emphasizes avoiding penalties, suggesting a relatively lower focus on legal consequences compared to safety considerations. These findings highlight the opportunity for safety awareness campaigns in both cities, emphasizing the protective role of helmets. In Loja, campaigns could address both safety and legal compliance, aligning with the dual motivations identified. In Zamora Chinchipe, while safety remains paramount, reinforcing the legal aspects could ensure continued compliance with helmet regulations.

In Loja, a significant majority of respondents (73%) favor purchasing helmets from motorcycle and accessories stores, indicating a strong reliance on specialized outlets catering to motorcyclists' needs. Similarly, Zamora Chinchipe exhibits a comparable trend, with 72% of respondents preferring motorcycle and accessories stores for helmet purchases. A smaller percentage in Loja (9%) opts for online stores. Conversely, in Zamora Chinchipe, a slightly higher percentage (14%) selects online stores, indicating a slightly greater acceptance of online platforms for helmet purchases. Additionally, approximately 18% of respondents in Loja and 14% in Zamora Chinchipe purchase helmets from other non-specialized businesses.

In Loja, a majority of respondents (60%) demonstrate an understanding of the distinction between regular and certified helmets, reflecting a commendable awareness of helmet certification for safety. In Zamora Chinchipe, though slightly less, a significant proportion (47%) still exhibits knowledge of this difference, indicating substantial awareness in the region. The percentages of respondents lacking awareness (40% in Loja and 53% in Zamora Chinchipe) present an educational opportunity for campaigns aimed at enhancing knowledge about helmet certification. Initiatives focused on elucidating the benefits and safety aspects of certified helmets could effectively boost awareness in both cities. Recommendations include designing educational campaigns to underscore the importance of helmet certification in ensuring safety during motorcycle use, fostering collaboration with local authorities, helmet vendors, and safety organizations to amplify the impact of awareness initiatives.

The majority of respondents in Loja (62%) and a significant portion in Zamora Chinchipe (50%) primarily rely on safety helmets without using additional protective measures. This shared pattern indicates helmets as the primary protective measure in both cities. In Loja, about 29% report using gloves, showing some awareness of hand protection. In Zamora Chinchipe, a slightly lower percentage (22%) mentions glove usage. Boots are used by 4% in Loja, indicating less common usage compared to gloves. In Zamora Chinchipe, a higher percentage (11%) uses boots, suggesting a greater inclination towards protective footwear. The use of knee and elbow protection is relatively low in both cities. Awareness campaigns highlighting gloves, boots, and other measures could be effective in both cities, with tailored initiatives addressing specific needs for increased adoption.

3.1. Inspector reports

The inspector-reported data for both cities is summarized in Table 2. In Loja, a notable 60% of the helmets have their outer covers in good condition. In Zamora Chinchipe, a slightly lower majority (51%) has the outer cover in good condition, indicating a relatively larger group that might need to address their helmet covers. For motorcyclist with helmets with less favorable conditions, targeted awareness campaigns emphasizing regular helmet maintenance are recommended.

In Loja, a significant majority (75%) has their helmet retention system (strap) in good condition. However, the 25% with less favorable conditions suggest a small portion may need attention to their helmet straps. In Zamora Chinchipe, an even higher percentage (79%) reported good conditions for helmet retention systems. Nonetheless, the 21% with less favorable conditions signal a small proportion requiring attention to their helmet straps.

Table 2: Descriptive statistics of survey responses in this study.

Questions	Options	Loja	Zamora Chinchipe
Is the outer cover of your helmet in good condition?	A. Yes B. No	60% 40%	49% 51%
Is the retention system (strap) of your helmet in good condition?	A. Yes B. No	75% 25%	79% 21%
Is the interior foam of your helmet in good condition?	A. Yes B. No	61% 39%	80% 20%
Is the face shield (visor) of your helmet in good condition?	A. Yes B. No C. N/A	50% 34% 16%	59% 34% 7%
Does your helmet have certification showing approval by DOT, ECE 2205, or NTC?	A. DOT B. ECE 2205 C. DOT-ECE-2205 D. None	58% 5% 3% 34%	58% 3% 7% 32%
Is the size of your helmet suitable for you?	A. Yes B. No	59% 41%	77% 23%
Do you use your helmet appropriately according to safety guidelines?	A. Yes B. No	38% 62%	25% 75%
N/A: Not available			

In Loja, 61% of helmets exhibited good interior foam conditions, while 39% showed less favorable conditions. Zamora Chinchipe had a higher percentage, with 80% of helmets in good condition and 20% having less favorable conditions. This highlights maintenance variability between the cities, suggesting a need for focused campaigns in Loja and the reinforcement of good practices in Zamora Chinchipe.

In Loja, 50% of the helmets had a good condition face shield, while 34% showed less favorable conditions. Additionally, 16% of helmets in Loja lacked visors, offering insights for vendors. In Zamora Chinchipe, a commendable 59% of helmets maintained their visors well, aligning with practices in Loja. Only 7% had helmets without visors in Zamora Chinchipe. There's an opportunity for targeted campaigns in Loja and a focus on reinforcing good practices in Zamora Chinchipe, emphasizing the benefits of a well-maintained face shield.

In Loja, 58% of the helmets had DOT certification, meeting United States safety standards. Additionally, 5% had ECE 2205 certification, and 3% had DOT-ECE-2205 dual certification. However, 34% of helmets lacked certification. In Zamora Chinchipe, a consistent 58% had DOT certification, 3% had ECE 2205 certification, and 7% had DOT-ECE-2205 dual certification. Conversely, 32% of helmets in Zamora Chinchipe lacked certification, highlighting an opportunity for awareness campaigns on the importance of certified helmets. While both cities display high awareness of DOT certification, the significant percentage of helmets without certification emphasizes the need for educational campaigns to stress the importance of choosing certified helmets for safety. The variability in certification types suggests a willingness among some respondents to opt for helmets meeting multiple safety standards, indicating a potential area for further exploration and promotion through awareness initiatives.

In Loja, 59% of helmets were found to be appropriately sized for the head, while 41% were not. In Zamora Chinchipe, an even higher percentage (77%) of helmets matched the head size, but 23% did not. This underscores the continuous effort required to ensure proper helmet sizing. Targeted education campaigns focusing on the selection of properly fitting helmets could contribute to improved overall satisfaction and increased safety awareness.

In Loja, a significant 62% of respondents do not use their helmets appropriately, suggesting that a considerable number of motorcyclists might not be following recommended safety practices. With only 38% demonstrating proper adherence, there's a need for targeted initiatives to raise awareness about the importance of using helmets in line with safety guidelines. In Zamora Chinchipe, adherence is even lower, with 75% improperly using the helmet, highlighting a critical issue that demands attention. Urgent interventions are required, as only 25% exhibit proper adherence in

Zamora Chinchipe, stressing the need for compliance with safety guidelines and improving overall road safety. The findings reveal a troubling trend of low adherence to safety guidelines in both cities, emphasizing the necessity for targeted interventions, comprehensive public awareness campaigns, collaboration with authorities, and tailored educational programs to promote proper helmet usage.

4. Conclusion

This study, assessing motorcycle helmet use in Ecuadorian cities Loja and Zamora-Chinchipe, establishes a baseline in regions with below-average motorized vehicle registration rates. Key insights reveal a significant presence of younger riders, varied reasons for motorcycle usage, a preference for the ICH brand and full-face helmets, and distinct factors influencing helmet choice. The main conclusions drawn from this study are as follows:

1. **Tailoring Interventions to Regional Disparities:** The observed variations in helmet use underscore the importance of tailoring interventions to address regional disparities. Strategies must consider the unique characteristics, demographics, and cultural nuances of each city to maximize the impact of safety campaigns.
2. **Age-Targeted Safety Campaigns:** The substantial presence of younger riders necessitates age-targeted safety campaigns. Engaging with this demographic through innovative and relatable messaging can enhance awareness and promote responsible riding behaviors.
3. **Opportunity for Brand Collaboration:** The dominance of the ICH brand suggests an opportunity for collaboration to amplify the impact of safety campaigns. Partnerships with well-recognized brands can positively influence riders' perceptions and preferences, contributing to increased helmet use.
4. **Importance of Educational Initiatives:** Knowledge gaps regarding helmet certification and sizing indicate the importance of educational initiatives. Campaigns focusing on these aspects can empower riders with information, influencing their choices and contributing to improved safety practices.
5. **Addressing Low Adherence to Safety Guidelines:** The concerning trend of low adherence to safety guidelines necessitates targeted interventions. Strategies should address the root causes of non-compliance, emphasizing the importance of following safety regulations to reduce the risk of injuries and fatalities.
6. **Policy Implications and Regional Regulations:** The study's findings carry potential policy implications, especially considering the unique circumstances of Loja and Zamora-Chinchipe. Policymakers may explore the development of regional regulations informed by the study, aiming to enhance road safety and promote responsible motorcycle riding.
7. **Ongoing Monitoring and Commitment:** Ongoing monitoring and intervention efforts are crucial, particularly in areas identified for improvement, such as helmet conditions and overall safety awareness. A sustained commitment to enhancing road safety will contribute to a lasting impact on motorcycle helmet use and compliance.

While the study provides valuable insights into two specific cities, generalizability should be approached cautiously. Future research exploring similar regions with low motorization rates could expand the understanding of evolving trends in motorcycle helmet use and road safety practices. This article's significance lies in providing crucial insights into motorcycle helmet usage patterns, preferences, and safety practices in Ecuadorian cities, offering a foundation for tailored safety campaigns and interventions to enhance road safety awareness and compliance.

Acknowledgements

The authors express their gratitude to ChatGPT 3.5, an advanced language model developed by OpenAI, for its linguistic expertise in creating a clear and precise English version.

References

- [1] WHO, "Road traffic injuries." Accessed: Apr. 11, 2023. [Online]. Available: https://www.who.int/health-topics/road-safety#tab=tab_1
- [2] M. Wumbei, "Noncompliance with Regulations on the Use of Safety Helmets by Motorcyclists in Tamale, Ghana [Doctoral dissertation]," Walden University, 2021. Accessed: Apr. 12, 2023. [Online]. Available: <https://www.proquest.com/docview/2557525361?pq-origsite=gscholar&fromopenview=true>

- [3] B. Sharma, "Motorized two-wheeler crash injuries and the role of helmet-use in their prevention: An overview," *Journal of Indian Academy of Forensic Medicine*, 2008.
- [4] WHO, "Global status report on road safety 2018," Global report. Accessed: Jan. 15, 2024. [Online]. Available: <https://www.who.int/publications/i/item/9789241565684>
- [5] K. Hassanzadeh, S. Salarilak, H. Sadeghi-Bazargani, and M. Golestani, "Motorcyclist risky riding behaviors and its predictors in an Iranian population," *J Inj Violence Res*, vol. 12, no. 2, p. 161, 2020, doi: 10.5249/jivr.vol112i2.161.
- [6] P. Kitson, B. Asamoah, N. Kombonaah, and E. A. Atiemo, "Understanding Why Motorcycle Riders Do Not Comply with Traffic Control Signals in the WA Municipality in Ghana," *Research on Humanities and Social Sciences*, vol. 9, no. 14, 2019, doi: 10.7176/rhss.
- [7] E. Germeni, C. Lionis, B. Davou, and E. T. Petridou, "Understanding reasons for non-compliance in motorcycle helmet use among adolescents in Greece," *Injury Prevention*, vol. 15, no. 1, pp. 19–23, Feb. 2009, doi: 10.1136/ip.2008.019356.
- [8] J. Faryabi, M. Rajabi, and S. Alirezaee, "Evaluation of the Use and Reasons for Not Using a Helmet by Motorcyclists Admitted to the Emergency Ward of Shahid Bahonar Hospital in Kerman," *Arch Trauma Res*, vol. 3, no. 3, p. 19122, Sep. 2014, doi: 10.5812/atr.19122.
- [9] C. Lucci, S. Piantini, G. Savino, and M. Pierini, "Motorcycle helmet selection and usage for improved safety: A systematic review on the protective effects of helmet type and fastening," *Traffic Inj Prev*, vol. 22, no. 4, pp. 301–306, 2021, doi: 10.1080/15389588.2021.1894640.
- [10] A. Nishi *et al.*, "Motorcycle helmet use to reduce road traffic deaths in Thailand," *Bull World Health Organ*, vol. 96, pp. 514–514A, 2018, doi: 10.2471/BLT.18.215509.
- [11] G. Craft *et al.*, "A Comprehensive Approach to Motorcycle-Related Head Injury Prevention: Experiences from the Field in Vietnam, Cambodia, and Uganda," *International Journal of Environmental Research and Public Health* 2017, Vol. 14, Page 1486, vol. 14, no. 12, p. 1486, Nov. 2017, doi: 10.3390/IJERPH14121486.
- [12] S. Phimha, A. Rittitit, N. Prasit, N. Nilnate, and P. Bouphan, "Participation in Community-Based Road Safety Program Associated with Motorcycle Helmet Use in Udon Thani Province, Thailand," *Medico Legal Update*, vol. 20, no. 4, pp. 1270–1274, Nov. 2020, doi: 10.37506/MLU.V20I4.2003.
- [13] NHTSA, "Importation and Certification FAQs." Accessed: Apr. 12, 2023. [Online]. Available: <https://www.nhtsa.gov/importing-vehicle/importation-and-certification-faqs-0>
- [14] H. Qin, Y. Wei, Q. Zhang, and L. Ma, "An observational study on the risk behaviors of electric bicycle riders performing meal delivery at urban intersections in China," *Transp Res Part F Traffic Psychol Behav*, vol. 79, pp. 107–117, May 2021, doi: 10.1016/j.trf.2021.04.010.
- [15] D. Dissanayake and T. Morikawa, "Household Travel Behavior in Developing Countries: Nested Logit Model of Vehicle Ownership, Mode Choice, and Trip Chaining," *Transportation Research Record: Journal of the Transportation Research Board*, no. 1805, pp. 45–52, Jan. 2002, doi: 10.3141/1805-06.
- [16] Instituto Nacional de Estadística y Censos, "Estadísticas de Transporte (ESTRA)." Accessed: Jan. 14, 2024. [Online]. Available: https://www.ecuadorencifras.gob.ec/documentos/web-inec/Estadisticas_Economicas/Estadistica%20de%20Transporte/ESTRA_2021/2021_METODOLOG%C3%8DA_ESTRA.pdf
- [17] Instituto Nacional de Estadística y Censos, "Anuario de estadísticas de transporte 2021," Anuario. Accessed: Jan. 14, 2024. [Online]. Available: https://www.ecuadorencifras.gob.ec/documentos/web-inec/Estadisticas_Economicas/Estadistica%20de%20Transporte/ESTRA_2021/2021_ESTRA_PPT.pdf
- [18] INEC, "Proyecciones poblacionales." [Online]. Available: <https://www.ecuadorencifras.gob.ec/proyecciones-poblacionales/>