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PERCEPTION, REGULATION, USE AND MOBILITY OF LIGHT ELECTRIC VEHICLES FOR URBAN PERSONAL MOBILITY (VLMPU) IN COLOMBIA

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ABSTRACT

Over the past few years, a novel form of transportation has appeared globally: the electric personal mobility vehicle (EMPV). Thus, this kind of vehicle is vital for enabling people's movement. Furthermore, the introduction of these new transportation systems enables the enhancement of urban transit networks, leading to a decrease in environmental pollution, a major concern in Colombia. Nevertheless, their growth has prompted governments and authorities to establish regulations and control measures to reduce the occurrence of accidents involving other road users. Thus, the aim was to create rules for the usage and functioning of electric personal mobility vehicles (EMPV) in Colombia. The research approach utilized a non-experimental, descriptive design, which is essential for grasping the circumstances surrounding the phenomenon. The research

group comprised 7.9 million individuals aged 18 to 70 years in Bogotá, encompassing both genders, along with 667 persons who were registered in Bogotá's transportation system. A census was carried out to identify the users and vendors, due to the population's relatively recent emergence. In this matter of ideas, three groups were chosen for the study: 384 members of the general public, 191 transit workers from Bogotá, 70 vendors, and 90 users. Data was gathered through a review of documents and the administration of a survey. The findings of the study indicate that 91% of individuals utilize these vehicles on a regular basis, whether on a daily or weekly schedule, highlighting their essential role in transportation.

KEYWORDS: Regulations, Traffic, Mobility, Road Safety, Users, Road Actors.

1. INTRODUCTION

In recent decades, society has evolved dramatically, and with it, urban mobility systems. This is a response to urban growth, which has brought with it traffic congestion and the environmental challenges associated with traditional motorized transport. In this context, electric micromobility has become a solution for reducing polluting emissions, as well as being efficient for short trips and commutes, thus diversifying personal transportation options. Within this landscape, electric personal urban mobility vehicles (EPMVs), such as scooters, Segways, electric skateboards, hoverboards, and unicycles, have increased their presence in cities worldwide.

The creation of new mobility systems in the world's major cities helps reduce pollution. In recent years, a new range of personal mobility devices has emerged: the Segway, skateboard, unicycle, hoverboard, scooter, and skateboard. These electric personal mobility vehicles (EMPVs) have become a transportation alternative worldwide. (Rece, 2023). However, their growth and innovation have led to their spread across the globe, prompting governments to attempt to regulate their use.

International studies have shown how the lack of clear rules on speed, responsibilities, and safety equipment for low-mobility motor vehicles (LMMVs) has increased legal confusion and accidents, affecting both drivers and pedestrians (Eccarius and Cheng, 2020). For this reason, several countries have worked to create regulations to address the problems associated with the use of LMMVs, trying to find a balance between road safety, urban life, and technological advancement. Examples of this come from experiences in North America, Asia, and Europe. There, a trend has emerged regarding maximum speed limits for these vehicles, as well as defining the areas where they can operate, requiring personal protective equipment, and creating specialized divisions for the control and supervision of electric micromobility (Decree 970, 2020; McKenzie, 2019). However, this information has revealed that the implementation of fragmented or generalized regulations tends to create problems in terms of compliance. This is because local realities and the perceptions of the actors involved must be considered in order to develop informed regulatory approaches and avoid generating social resistance.

The growth of single-person vehicles in Bogotá has been significant over the past two years; these vehicles are used on urban roads and pedestrian zones with little traffic regulation by the authorities (Vélez, 2024; García et al., 2023). This situation poses a risk to pedestrians because there are no clear controls based on national laws, such as speed limits, designated driving areas, road safety rules, coexistence with other road users, and potential fines (Ministry of Transportation, 2024). According to Riggs et al. (2021), the lack of objective regulations for single-person vehicles increases the risk of traffic accidents involving other road users.

Meanwhile, the limited evidence in Latin American contexts prevents the simultaneous integration of the different road actors, merchants and traffic authorities, despite the growing academic interest in micromobility, which highlights the significant gap in the design of public policies that lack effectiveness in their regulation, an aspect that depends directly on legal and technical criteria, as well as a certain social ignorance about the regulations.

The regulation of light electric vehicles for urban personal mobility (LEPMVs) transcends the strictly technical and regulatory sphere. More than a mere legal adjustment in response to the emergence of new technologies, it constitutes a process of cultural reconfiguration of urban space and the forms of social interaction that occur within it.

Now, following a critical perspective, it has been identified that the proliferation of VLPUs shows many of the structural tensions related with innovation and institutional capacity. Moreover, the social adoption of those important technological advances, are having a rapid progress that tends to develop reactively. This gap generates scenarios of regulatory ambiguity that impact the legitimacy of public authority and weaken urban governance (World Health Organization, 2023). Therefore, regulation is not merely a legal response, but a mechanism for building or eroding institutional trust.

Additionally, the expansion of high-speed, low-emission zones (HSLUVs) challenges the notion of civic culture. The coexistence of pedestrians, cyclists, motorized transport, and electric vehicles occurs within infrastructures designed according to previous mobility models (National Traffic Code 769, 2002). This overlap of uses reveals that the conflict lies not only in the absence of regulations but also in the coexistence of different logics surrounding the right to public space. In this scenario, civic culture ceases to be a complementary component of regulation and becomes a structural element of its effectiveness; without the social internalization of norms, any regulatory framework tends to become a mere formality without real impact (Resolution 160, 2017).

Then, looking towards an urban perspective, the regulating micromobility has shown he importance of applying a collaborative and multi-level approach, where it doesn't supply only with a matter of setting different speed limits, but also with the integration of urban planning policies, the necessity of having a road safety education and environmental initiatives that would represent a high advance (Law 1964, 2019). Furthermore, trying to develop a transformation in the public space is not as easy, as it faces many challenges like the domination by the automobiles. However, the transitions do not seem to be neutral, it can better generate a process representing exclusion and inequality.

It could be confirmed that building a sustainable citizenry is not only based on the new technologies, but also of the environmental effects that this has represented. Therefore, sustainability is one of the most important topics to consider, due to the shared responsibility of ethics and sharing a common space (Asocapitales, 2023). As a consequence, the regulation must be understood as part of a broader cultural transition toward urban models where innovation, safety and equity are integrated in a coherent and socially legitimate way.

For that reason, this study aims to examine the use, perception, and current regulations surrounding the mobility of high-speed vehicles (HSVs) in Colombia. Additionally, its purpose is to provide empirical evidence to support the development of a comprehensive regulatory framework focused on improving road safety, coexistence in public spaces, and environmental sustainability (Law 15071, 2024; Law 2486, 2025). The study will employ a mixed-methods approach, which will facilitate academic and regulatory debate on the implementation of HLVs in different urban mobility systems. This will provide relevant support for decision-making in the Colombian context and in other countries with similar characteristics.

2. LITERATURE REVIEW / THEORETICAL FRAMEWORK

2.1. International Regulation of Micromobility

Studies by Eccarius and Cheng (2020) on micromobility in Taiwan, as an alternative and sustainable urban transport option, have shown a significant increase, which has led to regulatory challenges. Meanwhile, in Spain, the rise of electric personal vehicles has driven growth in major cities, prompting the government to establish regulations through Decree 970 (2020) for their control and regulation. In Germany, research by Siegfried et al. (2021) on electric scooter mobility as an alternative transport option has shown an increase in the last year, highlighting the challenges of regulation and traffic management on main roads. For their part, McKenzie's (2019) studies in Washington, DC, on individual micromobility have focused on the challenges of regulation, understanding and analyzing the behavior of users and the platforms that provide these services.

In Colombia, especially in Bogotá, the number of personal mobility vehicles (PMVs) has grown significantly in the last two years. These vehicles circulate on urban roads and pedestrian areas without mobility regulations, interacting with pedestrians, cyclists, and motorized vehicles (Velez, 2024; García et al., 2023). This situation has led to legal uncertainty due to the lack of specific regulations within the country's legal framework, such as speed limits, designated areas for their circulation, safety standards and measures, interaction with other road users, and potential penalties (Ministry of Transportation, 2024). The lack of objective regulations on PMV use increases the risk of traffic accidents with other road users (Riggs et al., 2021).

From a theoretical perspective, this study seeks to propose ideas based on international experiences regarding sustainable urban mobility (Mishra et al., 2023). Simultaneously, it aims to contribute to the academic and legal discussion on the integration of new modes of individual electric transport in cities, addressing the tensions between technological innovation, mobility, and the development of regulatory frameworks for mobility and road safety in accordance with urban planning, thereby achieving a better understanding of users' needs and challenges (Akin and Sicheng, 2022). Methodologically, as suggested by Ibáñez (2022), it supports the study of personal electric vehicle mobility in cities throughout the country from both social and legal perspectives, proposing regulations for urban personal electric vehicles and evaluating their relevance and effectiveness in the regulation and management of mobility.

Recently, the urban mobility has transformed due to the emergency of adopting to new alternatives for transportation, such as the electric scooters and different other modes of transportation, which has made an important advance in movements, motivating even governments, academics and citizens, due to the high impact it could represent towards sustainability. Studies by Bodansk et al. (2022) on the legalization of electric scooters in the United Kingdom aimed to determine the injury rate in a pilot program and establish control and

regulatory measures for the authorities. Meanwhile, Haworth et al. (2022) conducted a study in downtown Brisbane, Australia, on electric scooter users to identify their travel patterns, violations, risks, and interactions with pedestrians, and Dozza et al. (2022) compared the mobility of electric scooters, bicycles, and pedestrians to measure their level of integration and the dangers associated with sharing the same sidewalk.

Ting et al. (2020) in Singapore analyzed the number of hospitalizations due to accidents and serious injuries involving personal mobility devices (PMDs) to enforce traffic laws. They considered the technical and mechanical structure of these devices, given the nature of the accidents, and determined that they are vehicles with one or two wheels, electric motors up to 100 VDC and up to 240 VAC, and a maximum speed of 6 to 25 km/h. Similarly, the Spanish Ministry of the Interior (2022) defined the characteristics and specifications of PMDs. These vehicles also have one or two wheels, electric motors up to 100 VDC and up to 240 VAC, and a maximum speed of 6 to 25 km/h. Likewise, in Germany, the Federal Ministry of Justice and Consumer Protection (2019) defined by decree the types of vehicles permitted: electric scooters, Segways, monowheels, and hoverboards or electric skateboards. and specified a minimum age of 14 years for driving, with a maximum speed of 20 km/h.

Similarly, Australia's Road Traffic Act of 1960 regulates the use of scooters, as does Article 3 of the Austrian Traffic Regulations, which stipulates that a 12-year-old child may only use an electric scooter on public transport. Likewise, Luxembourg, through government measures (2021), addresses the use of personal electric microvehicles (PEMs) in its traffic code. Particularly, this adds specific advantages, like differences in terms of seats, where, for instance, scooters are unicycles. And the motor cannot exceed 0.25 kW of power, the rated speed cannot exceed 6–25 km/h, and the length cannot exceed 1.5 m.

In this continent, there are countries like United States, where, as Navee (2025) points out, have implement advances in the speed's limits and the mandatory helmet usage since the 1970s, due to the raise of the skateboards. In those terms, the local authorities decided also to empower the regulations of the usage of vehicles, making sure that the pedestrian zones were fully respected. As well as in Mexico, where the Secretariat of Parliamentary Services (2022) affirms that the maximum speed limit can be measured for only 25 kilometers per hour for bicycles, unicycles, tricycles, quadricycles, roller skates, skateboards, and motorized scooters, including those used by people with disabilities.

As another example is consider Brazilian government, which through Law 14-861 (2024), has mentioned the new advances for the traffic code, clarifying the requirements for those new electric vehicles, which include a ban on transporting children under 10 years old, that could represent an infraction. As well as Argentina with the National Road Safety Agency (ANSV) (2020), that has exposed that it must be a maximum speed of 30 km/h while using electric vehicles, and the importance of making use of the corresponding lights and reflective accessories.

And in Colombia has been presented a new Resolution (160 0f 1017), where were stablished regulations for the correct transportation of mopeds, tricycles and quadricycles. For instance, in Medellin, there has been launched a circular establishing the regulations for electric scooters, affirming that there is a limit of speed corresponding of 20 kilometers per hour, with the mandatory usage of helmet and all the protection accessories, and also a restriction of circulation after 6:00 p.m. In a similar way has done it Bogota, by announcing the Resolution 209 of 2019, clarifying the share of use of bicycles and scooters between 5:00 a.m. and 10:00 p.m., prioritizing the requirement of having liability insurance, both contractual and extra-contractual, to protect all parties involved.

In addition, it is mentioned the importance of following Circular 006 (2018) in terms of the recommendations it offers to the basic rules. Those include the speed must not exceed 20 km/h, and each scooter must have the protection accessories, including a GPS. And that for including what government announced by the Law 2486 (2025), specifically in the Article 2 where is mentioned the definition of light electric through the urban personal mobility vehicles in Colombia, but also including a rule clarifying a period of no more of one year to issue regulations to determine certain specifications (Ministry of Transit and Transportation, 2025).

2.2. Light Electric Vehicles for Urban Personal Mobility (VLMPU).

For over the past 5 years have been presented different changes for urban mobility, especially due to the introduction of Light Electric Personal Mobility Vehicles (LEPMVs), which include within it scooters, e-scooters and segways. These devices have become popular due to their potential to improve urban mobility. They allow for faster and more affordable travel due to their low cost. They also represent sustainable alternatives to congestion and fuel

consumption in automobiles (Beck et al., 2021). However, the rise of these devices has outpaced the regulations of most countries, leaving legal loopholes that increase accidents, especially in corridors with high concentrations of pedestrians and cyclists (Delmas et al., 2022). Meanwhile, in Europe, and particularly in Spain, the regulation of LEPMVs has begun to be implemented in a fragmented manner, with regulations implemented by each municipality. This demonstrates the urgent need to regulate the mobility of VLMPUs, reduce accidents, and improve sustainability and coexistence among different road users.

2.3. Types Of Light Urban Personal Mobility Vehicles

Light electric vehicles for urban personal mobility (LEPMVs) are a new type of transportation that has radically transformed micromobility in cities during the first half of the 21st century. Studies indicate that LEPMVs can be single- or multi-wheeled, powered by an electric motor, and reach speeds of between 6 and 25 km/h (Sánchez et al., 2025). They are categorized as microvehicles by the ANLA (2019) because they are zero-emission vehicles, as their functionality relies on an electric motor, as shown in the examples.

2.4. Electric Scooters (E-Scooters)

This vehicle is characterized by having handlebars, lacking a seat, and reaching a maximum speed of 25 km/h. Currently, scooters are one of the most widely used vehicles for urban mobility (Lázaro, 2022). In recent years, they have proliferated in various countries, such as Colombia; likewise, regulations in many countries stipulate that these vehicles cannot exceed 25 km/h and must be used by only one person (Hishikawa & Asano, 2022). Its basic structure consists of a rectangular platform where the rider sits, attached to two 203.2 mm wheels (one front and one rear), handlebars, and a propulsion system. The vehicle is powered by a motor located in one of the wheels or within the chassis.

Por otro lado, Biyik et al. (2026) desarrolló un scooter eléctrico híbrido, que integra una pila de combustible PEM de 3-kW y una batería de iones de litio de 50,4 V y 19,2 Ah a través de un convertidor bidireccional completamente activo y un sistema de gestión de energía, bajo el ciclo WMTC, logrando una autonomía de aproximadamente 300 km, lo que representa una mejora del 354-357 % en comparación con el modo eléctrico actual. Asimismo, Unal & Biyik (2024) crearon una batería de combustible PEM basada en hidrogeno, durante el proceso químico que resulta, las moléculas de hidrógeno producen electricidad y el único subproducto es agua, por tanto, se proyecta una solución al calentamiento global, contaminación del aire y el cambio climático, con un valor de cero emisiones

2.5. Segway (Segway Pt Personal Transportation)

Its structure consists of two lateral wheels, one on each side, and a handlebar, forming a mobile platform (Jiao, 2021). This type of tourist transportation has gained popularity in many cities. Moreover, this device could incorporate itself by a gyroscopic technology for detecting mistakes that could affect user's balance, allowing the intuitive control through body tilt, like leaning forward generating acceleration, braking and the lateral movements of handlebar control the direction (Braun et al., 2024).

Adisionalmente, Jin et al. (2025) Generaron un sistema de carga para el scooter, mediante un modelo de decisión integrado (MDI) que realiza decisiones de enrutamiento para la recarga de los scooteres eléctricos, utilizando vehículos con capacidad de carga en ruta, sin tener que parar el vehículo, teniendo una eficiencia entre 20 y 30 minutos más rápido que la carga normal. Unal & Biyik (2024) propusieron un modelo de simulación de patinete que emplea una pila de combustible, considerada la fuente de energía del futuro, en lugar de una batería. Además, se diseñó un modelo de patinete con recuperación regenerativa, y se ha observado que un scooter diseñado con pila de combustible puede ofrecer un incremento de más del 120 % en la autonomía en comparación con un scooter eléctrico normal.

En contexto, Sahin et al. (2025) diseñaron una fuente de energía híbrida que integra una pila de combustible y una batería, simulada en Matlab/Simulink, con un motor de corriente continua sin escobillas que propulsa un vehículo eléctrico liviano. El consumo de combustible del vehículo simulado fue de 1,03 gH_2 / km o 0,39 Lge/100 km, lo que equivale al consumo de gasolina; el motor fue controlado con éxito manteniendo la velocidad con una eficiencia es del 41,4%.

2.6. Electric Scooter

These devices are recognized due to the characteristics they have, like greater durability, load capacity and resistance of heave use. Then, as it doesn't have the necessity to exceed 25 km/h, it could be a discrepancy to identify as the robust and durable specifications it offers. Nevertheless, it is also

modern as it has a reinforced chassis and larger and better wheels. And as Kheder & Albaghli (2025) affirms, the different characteristics it has could optimize shock absorption and the incorporation of a rear suspension system, which brings guarantee of greater stability.

Por su parte, Janikian et al. (2024) señala que los patinetes eléctricos son vehículos electromecánicos que se usan de pie, sin ninguna base fija, que incluye motor y puede ser utilizado por empresas de transporte alquilado o comprado. Los usuarios pueden desbloquear un patinete eléctrico mediante una aplicación que se encuentra en su smartphone provista por la empresa de alquiler, firmar un contrato por el uso, aceptación de responsabilidad y pagar por el tiempo que lo utiliza. Por otro lado, en búsqueda de estrategias para la reducción de siniestros viales de los usuarios, Bassatet al.(2021) proponen un diseño e implementación de señales ergonómicas para los usuarios de los vehículos en uso y movilización, con la finalidad de evitar accidentes con los demás actores viales, de manera que sea uniforme en todos los países, puesto que el uso de los vehículos se ha proliferado en todo el mundo como un medio de trasporte versátil.

2..7 Electric Unicycles

It consists of a single wheel and two side platforms where the user places their feet for propulsion, and have the particularity of lacking handlebars, a seat, or other handholds (Mihályi et al., 2024). By the contrary, these devices use a gyroscopic system that could ensure dynamic balance, allowing the user to regulate speed and the direction through slight changes in body weight and foot position on the side platforms. Therefore Varela (2020) emphasizes that electric unicycles offer significant advantages like extreme profitability, energy storage capacity and efficiency.

Por su parte, Mihályi et al. (2024) han creado un modelo para la dinámica del uso de un monociclo eléctrico (EUC) operado por el cuerpo de un individuo con total dependencia para el desplazamiento; logrando datos experimentales de diversas maniobras a través de un sistema de captura de movimiento de alta precisión para la identificación de parámetros eficientes de movilidad; comprobando que el modelo reproduce con exactitud la dinámica longitudinal mediante los movimientos del cuerpo de la persona, incluso en maniobras que requieren movimiento lateral teniendo estabilidad y sincronización en los desplazamientos.

2.8. Hoverboards (Self-Balancing Boards)

Are recognized as the electric balance boards or scooters, which are known of the most adaptable means of transport, mainly between 2015 and 2018. But the design lacks handlebars and they are operated by leaning the body onto a platform with a flat central base, that could connect (McIlvain et al., 2019). The user stands with one foot on each side section, and the gyroscopic system detects changes in pressure and tilt angle to initiate movement: pressing the toes propels forward, pressing the heels reverses the movement, and pressing both feet changes direction (Cody et al., 2019). Their size, ease of use, light weight, and control system have made them a popular choice for short trips in flat urban environments, university campuses, and recreational spaces.

2.9. VLMPU For the Transport of Goods and Services

This specialized category has emerged in response to the growing demands for sustainable urban logistics and services in large companies for personal transportation, as well as for the transport of goods and other services. These vehicles must have yellow reflectors on the sides and red reflectors on the edges and corners of the load to allow for easy identification of the signage and to clearly distinguish other road users in low light and visibility conditions (Marincek et al., 2024). Three- or four-wheeled models are available for greater stability, with load platforms ranging from 50 to 200 kilograms, reinforced suspension systems, more powerful engines within regulatory limits, and safety features such as parking brakes, perimeter load lights, and reversing warning signals (Carracedo & Mostofi, 2022).

2.10. Safety Equipment

The correct use of personal protective equipment (PPE), including helmets, gloves, reflective vests, and front/rear lights, is essential to limit the risk of serious injury to users of light electric urban personal mobility vehicles (LEMVs), given that they share road space with other users, thus exposing themselves to collisions and falls (Mishra et al., 2023). International recommendations for micromobility state that certified helmets and reflective clothing decrease the likelihood of head injuries and improve user visibility, promoting safety in urban environments (International Transport Forum, 2024; Almohammad et al., 2025). It should also be considered that PPE protects the areas of the body most susceptible to direct impacts. Furthermore, it aids in the user's identification by other road users in

low-light or high-traffic situations. Therefore, it contributes to reducing the likelihood of accidents, especially collisions. Consequently, the configuration, certification and use of personal protective equipment (PPE) are undoubtedly benchmarks for safe and sustainable personal mobility.

2.11. Knowledge Of the Regulations

Several studies have shown that users of light electric urban personal mobility vehicles (LEMVs) often have a fairly limited understanding of the regulations governing their use, both internationally and locally. For example, research conducted in Valencia, Spain, revealed that even after local awareness campaigns, average scores for knowledge of micromobility regulations were low, between 4 and 5 out of 10 (Fonseca et al., 2025), in areas such as understanding specific rules, speed limits, parking, and the use of safety equipment, despite the existence of clear municipal ordinances. For that reason, the gaps are not only present in Europe, as there exist many users that confuse basic legal aspects or are unaware of their obligations, increasing the likelihood of non-compliance and the risks to read safety (Domínguez, 2020). And this joins with the limited knowledge about VLMPU regulations (Franco et al., 2024).

2.12. Education And Culture in Road Safety

The importance of road safety and awareness need to be mentioned as this represents the promotion of safe behavior among all road users and could reduce traffic accidents. It not only is based on following rules, but about representing values and attitudes of respect, responsibility and prevention in our society (European Commission, 2020). Then, the National Road Safety Plan aims people to develop cognitive and motivational skills. Those skills could make easier the decision making, for reducing risky behaviors and promoting a culture of mutual respect through routes (Ministry of Education, 2013).

2.13. Urban And Rural Traffic Signs

There are multiple traffic signs, in urban and rural areas for ensuring road safety. Moreover, the signs have a clear design each, for being fully understood, for showing warning and restrictions necessary for safe and orderly driving are communicated. But in cities these signs are more important than in rural parts, and they have specifications like pedestrians, cyclists, motorcycles, private cars and public transport for trying to reduce accidents. On the contrary, rural areas as it has also particularities about warning, but those are different as include animal crossings and high and low speeds due to topography (World Health Organization, 2023). Several international studies have demonstrated that visible, understandable, and well-maintained signage can significantly reduce accidents and improve risk perception among drivers, especially when it conforms to standardized technical manuals (Federal Highway, 2009).

2.14. Road Safety

This is considered as a pillar for social and economic development, and it wants to minimize traffic accidents, injuries and deaths. Plenty of the road accidents end in the cause of death, especially among young people, making it necessary to promote a prehensive road safety policy (World Health Organization, 2023). Similarly, the safe systems approach promoted by international organizations emphasizes that road safety depends not only on individual behavior but also on the shared responsibility of road users, authorities, and transportation system designers to minimize human error and its consequences (Cedeño et al., 2023). In this context, strengthening road safety not only helps save lives but also improves mobility in both urban and rural areas, maintaining a more sustainable and equitable transportation system.

2.15. User Responsibilities and Rights

Urban personal mobility vehicles have transformed the modern world thanks to their ease of use and zero emissions of polluting gases into the atmosphere (Ministry of the Environment and Sustainable Development, 2020). However, regulatory problems have arisen regarding their use and the provision of personal protective equipment, as observed in some Spanish cities, due to their exponential increase (Directorate General of Traffic, 2022). At the same time, accident reports in Spain, such as the one by Megías (2023), which recorded 8 deaths, 97 hospitalizations, and 1,097 injuries, demonstrate the road safety problem posed by these vehicles, as the driver is responsible for damages and injuries to third parties.

2.16. Road Safety and Civic Culture

Studies on injuries caused by the use of light electric vehicles for urban personal mobility highlight serious injuries (Serra et al., 2021). This is due to the lack of personal protective equipment (PPE), such as helmets, and protective gear for the upper and lower extremities, which increases the severity of accidents (Laverdet et al., 2023), due to

recklessness and traffic violations, such as speeding, driving under the influence of alcohol, and driving against traffic (Mehranfar and Jones, 2024).

2.17. Environmental Impact and Public Space

Light electric personal mobility vehicles (LEMVVs), such as electric scooters and e-scooters, benefit the environment by not emitting pollutants, saving energy, and reducing noise in cities. According to international studies, electric micromobility contributes to the fight against climate change by reducing CO_2 emissions and improving air quality (International Transport Forum, 2024). Furthermore, the use of lighter and electric modes of transport contributes to the development of healthier cities by reducing air and noise pollution, with a direct impact on public health and sustainability (European Environment Agency, 2023).

2.18. Control Of Public Space

Cedeño et al. (2023) y Delmas et al. (2022) mentions that supervision is necessary for maintaining public order, where there exist unauthorized spaces, where there are many vehicles that could occupy sidewalks, pedestrian zones where are caused conflicts and more. The control is fundamental for ensuring regulated coexistence. From another perspective, the International Transport Forum (2024) proposes that regulating and controlling public space (parking, permitted circulation areas, and operating limits) is key to maximizing the benefits of micromobility and minimizing its negative impacts. Additionally, the World Health Organization (2023) emphasizes that institutional control with appropriate sanctions and road safety education is essential for a safe mobility system that reduces accidents and protects the most vulnerable users, such as pedestrians and people with reduced mobility (World Commission on Environment and Development, 1987). In this sense, control of public space strengthens the legitimacy of the State and enables safer, fairer, and more sustainable urban mobility.

2.19. Citizen Behavior in the Use of Vlmpus

Vehicle use and citizen behavior in public spaces influence road safety and its management, as well as accident prevention and coexistence with other road users (Ministry of Transport, 2024; Resolution 160, 2017). On public roads, speeding and underutilization of protective equipment are most frequently associated with a lack of knowledge of traffic regulations and a poor road safety culture (Gangadharaiah et al., 2023).

In Colombia, risky behaviors among users of alternative transportation are linked to a lack of education and consistent enforcement of road safety regulations. This necessitates strengthening civic culture strategies to promote self-regulation, respect for traffic laws, and the protection of the most vulnerable users (Ministry of Education, 2013; Presidency of the Republic of Colombia, 2022). Therefore, modifying citizen behavior is essential for the safe and sustainable integration of multimodal transportation vehicles into urban mobility.

3. METHODOLOGY

The research methodology was based on a non-experimental design, as no variables were changed. The study was made in a real-life context, using documents that accomplish with global standards for regulating light electric personal mobility vehicles (Creswell, 2017; Hernández & Mendoza, 2020). For the methodological process, the study sought to identify and characterize the current regulatory framework for the use of these devices (Sáiz & Escolar, 2021). Moreover, it is used a mixed-methods approach for understanding and describing the complexities of different groups, so that the data was analyzed to identify patterns and trends (Plano & Ivankova, 2016), and the opinions were captured through a semi-structures survey using stratified probability sampling (DANE, 2018).

Qualitatively, balanced rating scales with open-ended and closed-ended questions were applied through surveys of authorities, merchants, and users, employing a purposive/expert nonprobability sampling method (Hernández & Mendoza, 2020; Regnault et al., 2018) to determine the level of acceptance of the regulatory measures. An analysis of national and international documents containing primary and secondary data was conducted (Jabal et al., 2024), focusing on global vehicle control and regulation standards through the inductive-analytical method, which requires examining each specific case and situation before making generalizations (Merria and Tisdell, 2019).

The target population for the study consisted of 40 international and national regulatory documents; 7.9 million people in Bogotá; users and dealers of light personal mobility vehicles (LPMVs); and officials from the Bogotá Metropolitan Transit Authority (Asocapitales, 2023). A subset of the total population was selected using the finite sampling formula, grouping the samples as follows: n = 40; population, n = 384 inhabitants aged 18 to 70; Bogotá Transit Authority, n = 191; representatives of city dealers, n = 70; and finally, n = 90 LPMV users. Sampling was

conducted randomly, based on convenience and opportunity, due to the study's conditions. Priority was given to using data collection instruments in high-traffic areas and during peak hours for these vehicles, on Bogotá's main streets and bike paths. This option was chosen because there is no official census of owners and users of Light Urban Personal Mobility Vehicles (VLMPU). Therefore, probabilistic methods were discarded, as they are not very feasible (Hernández & Mendoza, 2020).

At the same time, regarding the merchants, a census sampling method was used, as mentioned by Arias (2012) and Hernández et al. (2014), who state that when the population is less than one hundred, a census can be conducted because it is manageable enough to study it in its entirety, aiming to encompass the entire population of legally identifiable businesses (Ruiz & Contreras, 2021). To calculate technical validity, the formula of Cochran (1977) and Bernal (2010) for small populations was considered. The formula shows that it is a 95% confidence level and a 5% margin of error within a sample of 59 people. However, for a significant representation of the findings, the research team aimed to include 90 users of light urban personal mobility vehicles and 70 representatives of establishments that sell these types of vehicles.

For the selection of instruments, a strategy was adopted that combined three data collection instruments. These instruments were reviewed and evaluated by three experts in the field: a methodologist, a specialist in traffic law and regulations, and a sociologist specializing in social research. To address the technical, documentary, and legal perspectives of the research, the documentary analysis instrument developed by Marcelino et al. (2024) and Arias (2023) was used to analyze the regulations and documents related to the regulation of light electric vehicles for urban personal mobility (LEPMVs). Secondly, a ten-item semi-structured survey was administered to traffic officers to obtain detailed information on regulatory gaps in the use and control of these vehicles (Babativa et al., 2024). Simultaneously, to determine the public's perception of the use, regulation by the authorities, user habits, and the purchase and sale of these vehicles, an eight-item semi-structured interview was conducted. This was done for the systematic and homogeneous collection of qualitative data (Arias, 2012; Siegfried & Martin, 2021). The instruments were used to identify valuable data and information in the study.

4. RESULTS AND DISCUSSION

In the last decade, according to the documents consulted, light electric personal mobility vehicles (LEMVs), such as electric scooters, e-scooters, Segways, and electric hoverboards, have become established as a transportation option for short trips in cities. This trend is due to the convergence of technological, economic, and cultural factors that have made these modes of transport more viable and affordable. However, the proliferation of these new vehicles has outpaced the adaptation of regulations, infrastructure, and planned responses regarding safety, road coexistence, and urban planning (Badia & Jeneliusb, 2023). Studies such as those by the Mapfre Foundation (2023) and Burford et al. Studies (2024) have shown that accidents and injuries related to micromobility increased between 2018 and 2024. To reduce accidents, some countries have implemented restrictions such as speed limits, mandatory helmets, bans on riding on sidewalks, legal frameworks, and assigning responsibility to local governments (Yannis & Petraki, 2024; Polis Network, 2023). This has led governments and authorities to establish control laws for users and vehicles, as is the case in Colombia.

4.1. User Perspective

According to Badia & Jeneliusb (2023), the behavior of some users of high-speed, low-impact, and low-impact vehicles (HLMPU) causes problems in public traffic with other road users. These users travel on sidewalks, pedestrian areas, bike paths, and main roads without protection, generating conflicts. Furthermore, the lack of information campaigns has limited the dissemination of information about designated spaces, limitations, and traffic routes (Burford et al., 2024; Cloud et al., 2023).

Another situation that is evident regarding vehicular traffic is the lack of spaces/places for single-person vehicles (Polis Network, 2023). From another perspective, single-person vehicles are an alternative for sustainable and safe urban mobility, but they require a regulatory framework that regulates infrastructure, designs and educates on road safety in Colombia, such as Law 2486 (2025), a great step forward in recognizing and regulating them, but it is still necessary to define techniques, build responsibility matrices and coordinate national, departmental and local policies and interventions for mobility and integration with other road actors.

Por lo tanto, es imprescindible la coordinación entre el gobierno nacional y las entidades estatales para implementar políticas públicas que regulen y gestionen la movilidad y el control de los vehículos, abarcando desde las grandes ciudades hasta los

municipios más pequeños, a través de normativas que regulen el tránsito en las vías y prevengan accidentes a partir de factores individuales, sociales y físicos (Montoya et al., 2020).

The importance of these results lies in the fact that the government must not only legislate on behavior but also plan interventions in the road network and promote road coexistence (Bodansky et al., 2022). This data is not just numbers; it represents the technical voice of micromobility users. Ignoring these results would lead to regulations far removed from their objective. Conversely, incorporating them ensures that control regulations are an instrument for saving lives, improving travel times, and fostering a sustainable and orderly transportation model in the country.

In line with the above, the data obtained in the study on the gender distribution of personal mobility vehicle users shows a continued male dominance of 73%, compared to only 27% for women. This 46-percentage-point gap demonstrates that men are more technologically empowered in terms of mobility than women; however, women are increasingly motivated by new mobility options, as McKenzie (2019) points out, due to their functionality and ease of use.

On the other hand, regarding the highest concentration and volume of vehicular traffic, the Fontibón district stands out with 11%, followed by Chapinero, Kennedy, and Teusaquillo with 10% each, Santa Fe with 9%, and Usaquén, Bosa, Suba, and Puente Aranda with 7%. This represents 78% of the total sample in just nine high-traffic commercial and residential areas across nine districts of Bogotá. In contrast, the other districts show little to no traffic (between 0% and 4%), revealing a 22-percentage-point adoption gap in the sample. However, further research is needed in the city's other districts to better understand vehicle use, data that aligns with Navarro's (2020) research on urban mobility. In terms of motivation and mobility, the sample shows remarkable utility, since 38% use it to travel to work and to their places of study, while 20% do so to avoid congestion and save time, 11% for cost savings, 10% to contribute to the environment and 8% for comfort and practicality, results similar to studies of the World Commission on Environment and Development (1987) and Varela (2020).

Conversely, 4% use them for courier or delivery services, and 8% for recreational and sporting activities. This reveals an 80-percentage point difference between daily personal use and work-related use; in other words, the majority of users perceive these vehicles as an efficient alternative to traditional transportation for fulfilling their daily work responsibilities.

Regarding the frequency of use of light personal mobility vehicles (LPMVs), the "several times a week" category is the most common, at 67%, followed by daily use, which represents 24%. On the opposite side, 7% use them from time to time, while just 2% use them infrequently, underscoring a 91-percentage point gap between those who use them frequently and those who use them all the time. Therefore, 91% of participants report that they regularly utilize these vehicles, either daily or weekly, as essential and lasting elements of urban transportation. This information is consistent with the study by Montoya and Rátiva (2020), which emphasizes the importance of strong regulations to ensure their safe and reliable use on public roadways.

Regarding transportation infrastructure, roads (regular lanes) are the most used, at 34%; followed by bike lanes at 21% and pedestrian sidewalks at 12%; transit through pedestrian commercial areas represents 6%. This represents a difference of 27 percentage points with respect to the most crowded spaces, meaning that almost a quarter of the journeys made on pedestrian sidewalks demonstrate a direct conflict with pedestrian safety, data that agrees with studies by Hishikawa and Asano (2022).

Regarding knowledge of regulations on the transportation of personal urban mobility vehicles (VLMPU) in Colombia, the situation is uncertain; 31.1% of respondents claim to have a thorough understanding of the regulations, while 2.2% admit to being unaware of them. Additionally, there is a 29-percentage point gap between those who are well-informed and those who have no idea about the regulations. This situation is further complicated by the fact that 30% are aware of some regulations, 23.3% are unsure of what they have heard, and 13.3% are unaware of them. In short, almost 38.8% of users are completely unaware of the traffic regulations applicable to the regulation of personal urban mobility electric vehicles, data that aligns with information from Liebre Naranja (2025).

Concerning the understanding of existing VLMPU regulations, the survey indicates that respondents hold notably varied viewpoints. Thirty-four percent perceive the regulations as clear and adequate, whereas thirty-two percent view them as clear yet inadequate; twenty percent believe the regulations are present but unclear. In a different context, the smallest percentages relate to individuals who think there are no sufficient regulations (7%) and those who question their presence (7%). This results in a 27-percentage-point discrepancy

compared to the prevailing opinion; namely, while most users find the legal framework to be clear, 66% of them call for stronger or clearer regulations, as noted in Law 2486 (2025) and the work of Chiu and Ho (2025).

In this matter of ideas, concerning sanctions, the findings indicate that traffic police mainly concentrate on education and issuing warnings. Nevertheless, 66% of individuals state they have never faced any sanctions, while 24% have solely received verbal warnings, and 9% have undergone educational training. In contrast, strict coercive measures are nearly absent, as only 1% of offenders have been issued citations or fines; this highlights a 90-percentage point disparity between the lack of sanctions and the financial penalties outlined by Law 15071 (2024). In simpler terms, the traffic authority favors a proactive and instructive strategy instead of a punitive one.

Additionally, the coexistence in public areas, a significant level of self-reflection is noted among operators of VLMPU (Vehicle-Low-Mobility Public Transportation), with the most frequent assessment being "fair" (31%), followed by a view of responsible conduct (24%). Similarly, the "irresponsible" option receives the least support, at only 10%, representing a 20-percentage point difference from the majority opinion. Consequently, a weakness in road responsibility is evident; while 44% of opinions are positive (responsible), a relative majority (55%) rates behavior as fair or irresponsible, data similar to those found in research conducted by the Ministry of Transportation (2024) and the Ministry of Education (2013).

Regarding corrective measures, users prefer technical training to financial penalties. In fact, 37% consider mandatory road safety courses the most appropriate sanction, while 28% support fines that vary according to the severity of the infraction, 17% support educational sanctions, 10% support community service and temporary vehicle impoundment, and finally, only 2% support two options: those who believe there should be no sanctions. This data is based on regulations from the Spanish Ministry of Transport (2024) and the Ministry of the Interior (2022). This shows a 35-point difference between the educational option and the elimination of sanctions. This translates into strong public support, at 98%, for regulations focused on road safety education as a method of enforcement.

Regarding the need for legal regulation, 38% of respondents consider it very necessary, while 31% consider it extremely necessary and 21% moderately necessary. Opposition or indifference is very low: only 3% state that it is not necessary and 7% that it is somewhat necessary; this reveals a 30-percentage point difference from the majority opinion. Consequently, there is a 70% consensus among users who demand regulatory intervention, which provides strong social and political support for advancing the consolidation of regulations governing the mobility of light electric vehicles in the country, in accordance with Law 2486 (2025) and the National Traffic Code 769 (2002).

Regarding international experiences, it is evident that users are quite open to successful global models for regulating high-speed, low-volume, and low-emission vehicles (VLMPU). Indeed, 32% of individuals report being aware of certain experiences from other nations, 28% have heard about them but lack detailed knowledge, while 21% indicate that they are familiar with several, and 13% are unaware of any. This indicates that 53% of those surveyed are knowledgeable about external regulatory practices. Consequently, a lack of interest is fairly minimal, as only 6% indicate that they do not care about the experiences of other nations, which represents a difference of 26 percentage points when compared to individuals with some level of awareness. In other words, as stated by Franco and others. According to the findings of 2024, there is a favorable environment for implementing best practices within the local setting. This is particularly true as over half of the users are aware of international examples, which aids in the acceptance of regulations that conform to global standards for safe and effective urban mobility.

In terms of the most significant elements for regulation, speed emerges as the most critical factor, accounting for 23%, followed by the ban on driving while under the influence of alcohol or drugs, representing 16%, and the compulsory use of safety gear, which constitutes 13%. Other factors concerning enforcement, including administrative and technical responsibilities, specialized training or licensing, and restrictions on engine power, are viewed as less important, with significance levels between 2% and 10%. This results in a difference of 21 percentage points when compared to speed regulation. This indicates that individuals think rules should concentrate on managing speed, ensuring sobriety, and using personal protective gear, as set forth by the regulations of the Ministry of Transport (2024) and the Ministry of Education (2013), to promote safer interactions among those who use roads.

Users generally hold a favorable and united view regarding the effect of personal mobility vehicles

(PMVs) on environmental sustainability. 62. 2% of individuals think that these devices help in protecting the environment, whereas 30% perceive their impact as moderate. Critical viewpoints are limited: 3. 3% believe they assist very little, 1. 1% assert that they do not assist at all, and 3. 3% perceive a negative impact. This creates a difference of 61 percentage points between the majority favorable opinion and skepticism. This means that almost everyone supports the use of PMVs, with 92.2% of the people in the sample, results that coincide with the research by García et al. (2023), which identifies them as a key tool for sustainable mobility in communities.

Regarding compliance with regulations, 57% of respondents declared themselves fully willing to meet the requirements, provided they guarantee improved road safety and coexistence, supported by 37% who conditioned their willingness on the type of requirements established by the authorities. In contrast, direct resistance is minimal, with only 4% responding outright no. This highlights a 53-percentage point difference compared to the willingness to fully comply. That is, to adhere to the regulations established by the Ministry of Transportation (2024), Law 2486 (2025), and the National Traffic Code 769 (2002). Therefore, there is 94% community support among users for the control regulations, which encourages the traffic authority to implement more effective safety measures.

Concerning user assistance for the enforcement of rules related to light electric vehicles intended for urban personal mobility (VLMPU), there is a clear demonstration of social responsibility, as 63% of individuals are in favor of its implementation, 26% are very inclined to support it, and 9% show moderate willingness. This indicates that 98% of the entire population sample supports this, in line with ANLA regulations (2019). In comparison, opposition is low, with merely 2% expressing their hesitation. In conclusion, there exists a difference of 61 percentage points between overall support and opposition. This shows that most people see the regulation not as a restriction, but as an important shared advantage for the mobility of road users. This adheres to the requirements set forth in the National Traffic Code 769 (2002).

4.2. Perception Of the General Population

The findings from surveys carried out among the residents of Bogotá about the regulation of light electric vehicles for city personal transportation are essential for comprehending how individuals view their usage, along with the related risks and advantages (Franco et al., 2024). This information shows how well people understand the rules, along with their major worries about road safety and what the community expects from these regulations.

Additionally, public perception indicates that their usage is a prominent aspect of daily life. 29.2% of those surveyed indicated that they observed them every day, 20.1% stated that they noticed them multiple times each day, and 22.1% mentioned that they saw them occasionally or infrequently. In comparison, merely 7% of the population reported that they never encounter them, indicating a difference of 22 percentage points between the individuals who observe them every day and those who do not. As a result, the existence of vehicles in public areas is no longer a rare event but has turned into a common experience for nearly one-third of the population (National Road Safety Agency, 2020). This highlights the necessity of creating regulations since citizens continuously notice their interaction with the environment.

Moreover, the understanding of current regulations among the surveyed individuals indicates that the knowledge is largely scattered and largely shallow. Specifically, 29% of the population asserts that they are aware of certain regulations, yet only 24% report that they possess a comprehensive understanding of them. Additionally, 27% have some awareness of regulations but lack certainty, while 19% do not know any regulations, with 8% being completely unaware and 11% not even recognizing that such regulations exist. This underscores a difference of 32 percentage points between limited knowledge and complete unawareness of the regulations. As a result, nearly half of the population, which constitutes 46%, engages with or utilizes these vehicles without a sufficient understanding of the legal framework (National Traffic Code 769,2002 and ProBogotá, 2025).

In the same way, concerning the primary risk linked to vehicles, the survey indicates that the public's foremost worry is engaging with dense traffic. Twenty-nine percent of individuals believe that traveling on roads with typical traffic patterns poses the highest level of risk. This is succeeded by elements like accidents caused by negligence (23%), excessive speeding (18%), and crashes involving other vehicles (17%). In comparison, the risk associated with pedestrian traffic is regarded as the least significant, at merely 11%, which indicates an 18-percentage point distinction when compared to the risk involved in sharing the road with motor vehicles. Therefore, the community views traveling

by motorcycle, car, bus, and large vehicles as the most significant road hazard, a perspective that aligns with the Ministry of Transportation (2024), Decree No. 2822 (1998) and Decree No. 970 (2020).

Concerning the public's view of VLMPU user actions, perspectives are notably varied, with a general inclination toward negative assessments. The rating that is most frequently given is "fair," which is the opinion of 28% of individuals. Including the unfavorable views, it is noted that 29% of individuals assess the behavior as irresponsible or highly irresponsible; nevertheless, 44% hold a more favorable perspective: 25% deem it responsible and 19% regard it as very responsible. This indicates that there exists a 14-percentage point disparity between individuals who express approval of the behavior and those who criticize it when combining the "fair" and "irresponsible" categories (National Traffic Code 769, 2002), indicating that more than half of the citizens perceive deficiencies in the mobility system.

Conversely, concerning citizens' views on the effect of light electric vehicles for urban personal mobility (LEPMs), the survey indicates a mostly positive perspective. Specifically, 32% of people think these vehicles greatly enhance urban mobility, while 26% perceive a moderate improvement. In contrast, 18% feel it slightly worsens mobility, and 17% believe it has no effect. These findings are consistent with the research conducted by Eccarius and Cheng (2020).

Critical opinions are less frequent, with only 7% considering that mobility significantly worsens, demonstrating a 35-percentage point difference compared to the most positive opinions. However, 58% of citizens support the idea that LEPMs are a solution for urban transport (Akin & Sicheng, 2022). The combined categories of significant and moderate improvement provide a solid basis of social support for the implementation of the regulation. This reduces the perceived negative impact to 24% among the surveyed population.

Therefore, the public perceives the need for a legal framework for high-value, low-impact, and low-impact (VLMPU) activities as a major social demand, with 54% of citizens believing they should be regulated. This need for regulation is reinforced by 10% who consider it necessary and 25% who consider it moderately necessary, totaling 64% in favor of consolidating the regulations (Law 2486, 2025). In contrast, only 4% believe it is unnecessary. This represents a 50-percentage-point difference compared to the main demand for regulation; that is, there is social support for developing the regulatory framework due to the lack of existing regulations.

Regarding respondents' knowledge of international regulatory experiences, the data show a certain level of awareness and interest in learning about other models. In fact, 31% of citizens stated they had heard of such experiences, but lacked specific details. This awareness is further reinforced by the 24% who were familiar with some experiences and 20% with many, totaling 44% who know of at least one international experience; meanwhile, 23% were unaware of any. However, disinterest is minimal: only 3% expressed no interest in what is happening in other countries, a difference of 28 percentage points compared to those with partial knowledge. This suggests a predisposition to implement regulations based on international standards (Eccarius & Cheng, 2020; Gangadharaiah et al., 2023), given that the majority of citizens consider or recognize the importance of external benchmarks for regulating micromobility in Colombia.

In the order of priority for mandatory regulations, maximum speed ranks first at 33%, followed by mandatory safety devices for road users at 34%, and finally the allocation of road space at 28%. Administrative and technical requirements are considered less important, with driver's license regulations receiving the lowest weighting and vehicle technical requirements at only 2% each; this represents a 30-percentage point difference compared to the top priorities (speed and safety features) (Sánchez et al., 2025). Ultimately, citizens demand a law that protects road users and third parties through speed control and protective equipment, with the aim of ensuring responsible coexistence on the roads.

Regarding the needs for safe mobility, the public's need for improved road conditions is evident at 37%; followed by dedicated bike lanes for personal mobility vehicles at 24%; exclusive parking areas at 14%; public electric vehicle charging stations at 13%; and signage at 11%, 24 percentage points higher than the need for road repairs. In summary, the public indicates that the poor condition of the road network is the main factor threatening safety, as indicated by ANLA regulations (2019) and Decrees Nos. 282 (1998) and 970 (2020), as well as the Highway Law (1960). This suggests that any regulation must be accompanied by investment in road infrastructure and lane markings to reduce conflicts between users.

Regarding institutional leadership for controlling high-value, low-impact, and low-impact (VLMPU) infrastructure, it is specified that most people prefer centralized management. Citizens think that VLMPU positively affects environmental sustainability in

Colombia. When we compare this data with the lowest percentages, a significant difference becomes clear. The Ministry of Transportation is allocated the largest share at 41%, while the Secretariats of Mobility receive 5%, the National Police obtain 7%, and municipal governments are assigned 14%. When looking at the least favored choices, the contrast becomes even greater, with only 3% of the population viewing a new specialized agency as a realistic option, marking a 39-percentage point gap between the top national authority and the establishment of new agencies. This shows an agreement on enhancing the current institutions within a national structure (Fonseca et al., 2025; Navee, 2025; and Law 14861, 2024) and guaranteeing the enforcement of laws across the nation.

The primary category shows that their contributions are moderate (40%), significant (34%), and minimal (16%). The public believes that light and medium-power vehicles (LMVs) positively affect Colombia's environmental sustainability. Evaluating these numbers against the lower percentages shows a notable distinction. Only 3% regard these vehicles as detrimental, and 6% think they offer no benefits. Consequently, there exists a difference of 37 percentage points between the predominant positive view and the rejection concerning the environment, indicating a 74% agreement in society supporting LMVs as beneficial to ecological efforts. These findings align with the research conducted by Yan and Shen (2023) as well as Delmas et al. (2022) and Quesada (2023) offer a crucial foundation for encouraging clean and sustainable regulations in the nation

4.3. VLMPU Traders' Perception

Concerning dealers of electric personal mobility vehicles (EMPVs), their contributions are crucial for comprehending the market, marketing techniques, experience, regulations, and financial benefits for consumers (International Transport Forum, 2024). This data helps us grasp the perspectives, requirements, and existing deficiencies related to current regulations, driving skills, the technology used, different brands and models, as well as the accessibility of obtaining them. The results aid in developing regulations, enhancing the market, and encouraging safe and sustainable transportation, in line with road safety and harmony within the nation (Arafat et al., 2020).

As per the findings on vehicle sales, electric scooters dominate the Colombian VLMPU market with a share of 31%, highlighting their strong demand and establishing them as the main mode of urban micromobility. Electric bicycles rank second, accounting for 20%. This indicates an increasing inclination towards more sustainable and reachable types of transportation, as evidenced by research conducted by Arafat et al. Sure! Please provide the text that you would like me to rephrase for you. According to Badia and Jeneliusb (2023), hoverboards account for 11% of the market, electric unicycles make up 3%, and Segways or self-balancing vehicles comprise 1%, making the latter the least sold among these options. The most favored vehicles were selected due to their quality, innovation, accessibility, and cost-effectiveness.

4.4. Mobility And Innovation of New Models.

Concerning the categories of personal mobility vehicles (PMVs) and their features, electric scooters (e-scooters) received the highest figures in terms of specific factors, including restricted speed (28. 6%), convenient charging (28. 6%), and small, lightweight design (22. 9%). Conversely, the lowest percentages were found for Segways, especially in characteristics such as dimensions (4.3%) and brand (1.4%). This indicates that they have a smaller market presence and less technical consolidation (National Road Safety Agency, 2020). As for the factors that most influence the purchase decision, price represents 29%, followed by battery range (21%) and maximum speed (19%). These vehicles are more standardized and better suited to urban mobility, as indicated by Apollo (2024).

Conversely, the least influential features are the incorporated technology and after-sales service, at only 1%, demonstrating that they are not as relevant as usage needs (Bogotá Chamber of Commerce, 2024). Meanwhile, aesthetic design (11%) and portability/weight (9%) are considered important, indicating that the VLMPU market values availability and efficiency more than technology.

Sin embargo, en los grandes países industrializados, particularmente como los Estados Unidos, Alemania, Japón y Corea del Sur, la industria automotriz continúa avanzando en una marcha sostenida de innovación, a través de una propuesta continua de mejora de calidad y eficiencia energética y el cuidado del medio ambiente; por tanto, han propuesto prototipos con sistemas de movilidad inteligentes y de alta resistencia con fuentes de energía alternativas; como los vehículos unipersonales de auto-recarga a través de medios regenerativos, las baterías de hidrógeno y las celdas de combustible, que persiguen solventar las carencias de autonomía y los tiempos de recarga que tienen los scooters actuales (Mihályi et al., 2024; Sahin

et al., 2025 y Unal & Biyik., 2024). Todo corresponde a una visión estratégica orientada a la creación de un vehículo versátil, apto para diferentes situaciones y necesidades del usuario, orientada a la sostenibilidad, la eficiencia en el uso personal. También está articulado con tendencias globales como la digitalización, la conducción autónoma y la integración de las infraestructuras inteligentes creando un ecosistema de movilidad más seguro para la comunidad

Regarding the technical specifications of the best-selling models, the electric scooter boasts the highest values in functional measurements such as folded length (100-120 cm, 47%), length (50-70 cm, 5%), and platform width (20 cm, 47%), corroborating its design for frequent urban use, as indicated by studies by Cloud et al. (2023). Conversely, the electric unicycle is the least popular due to its complexity of handling. In contrast, the hoverboard, weighing 10-30 kg, is very well received (63%), unlike the scooter, which is lighter at 8-15 kg. This indicates that the market prefers dimensionally stable models with a moderate weight, as described by McIlvain et al. (2019), which allow for safer and more versatile use in urban environments, are foldable, and offer longer battery life.

Regarding the best-selling vehicle battery, the lithium-ion (Li-ion) battery is the most popular option at 47%, due to its efficiency, long lifespan, and excellent performance. The lithium-polymer battery is the second most popular at 33%, confirming the market trend toward lighter and faster-charging technologies (Kheder and Albaghli, 2025). Conversely, lead-acid batteries (11%) and other technologies (9%) are the least used, presenting disadvantages in terms of weight, range, and lifespan, according to research by Asrori et al. (2024). The technical configuration of the battery system and the range of light electric personal mobility vehicles (LEMVs) reflect a technological standard. Voltage (V) is the most influential characteristic, representing 51% of the specifications shared by suppliers. Compared to the lowest data, the difference is considerable in amp-hours at 21%, which means the VLMPU market is shifting towards modern, efficient batteries.

Regarding vehicle efficiency, range, and battery life in kilometers, 47% of retailers highlighted it as the performance metric most valued by mobility users. With respect to battery life, 33% indicated that users prioritize charge duration, while 14% focused on charging time, data that aligns with studies by Puradannavar et al. (2023). Comparing the highest and lowest percentages shows that suppliers prefer to sell vehicles with batteries in good condition and shorter charging times, given weather and location conditions. This demonstrates that users are more interested in a long-lasting battery for extended journeys.

De otro lado, los vehículos eléctrico livianos de movilidad personal urbanos en los últimos 4 años han pasado por una transformación impresionante en cuanto a baterías y eficiencia operativa. La capacidad promedio de las baterías ha aumentado de 250 Wh en 2020 a más de 500 Wh en 2024, lo que permite que algunos modelos de alta gama ofrezcan autonomías superiores a los 100 km por carga (Market Growth Reports, 2024). Además, las mejoras en la tecnología de iones de litio han proporcionado una mayor densidad de energía, velocidades de carga más rápidas y una vida útil más larga, haciendo que los scooters sean más confiables y económicos para el uso diario (GM Insights, 2024).

Regarding the importance of international safety certifications for battery systems, 66% of retailers stated that their systems are good, and 34% indicated they are in the certification process, highlighting its importance, as noted by Apollo (2024). On the other hand, concerning reported battery incidents, 20% of retailers reported problems, while 80% did not, findings that align with the study by Asrori et al. (2024). In summary, there is a 32-percentage point difference between systems that are already certified and those that are recently certified, but with a trend toward real improvement. Regarding battery incidents, the difference is only 20 percentage points relative to the fact that technical failures are minimal.

In terms of power and speed for very long-haul motors (VLMPUs), the market is fairly balanced in terms of rated power and performance, with each holding a 50% market share. This is followed by brushed motors at 31%, with other technologies making up 21%. Nevertheless, there exists a 26-point disparity between the leading brushless technology and the less prevalent alternatives, reflecting the industry's inclination toward more efficient and low-maintenance motors. This is evidenced by comparative research on electric motors for solo vehicles conducted by Qijie (2024) and Bachiri et al. Sure! Please provide the text that you would like me to rephrase.

Concerning speed regulation, 93% of business proprietors reported that a top speed of 20 to 25 km/h is sufficient, as highlighted by Cañabate (2019). This stands in stark contrast to the lowest percentage, where merely 7% believe this range is insufficient for sharing the roadway with other users. This shows a difference of 86 percentage points between approval

and rejection, suggesting nearly complete agreement on this speed limit as a safety measure. This validates the authorized speed limit for mixed traffic in accordance with national laws (Badia and Jeneliusb, 2023).

According to the merchants surveyed, regarding the use of (VLMPU) on urban roads and bike paths, some indicated that 43% prefer 30 km/h, 26% 25 km/h, 13% 20 km/h, and 9% between 10 and 20 km/h. Compared to the less frequently chosen options, there is a dispersion in safety preferences, with a 17 percentage point difference between the highest recommendation of 30 km/h and the most conservative of 25 km/h. Therefore, the most common speed for their commutes is between 25 and 30 km/h, data that aligns with studies by Yan and Shen (2023).

On the other hand, regarding vehicle braking systems, the front mechanical brake was identified as having the greatest impact, at 41%; followed by the rear mechanical disc brake, at 31%; regenerative electronic brakes, at 11%; and foot/fender brakes, at 9%. Dual braking systems represent only 7%. This 32-percentage-point difference between the most common system and the advanced dual braking system indicates that users are unaware of the importance of vehicle brakes. However, the market continues to rely primarily on conventional mechanical disc brakes at 72%, data that coincides with the research by Lyubenov et al. (2023). Furthermore, the results from users, retailers, and authorities recommend a 5.5m distance between vehicles to avoid conflicts and serious consequences for other road users, as suggested in the study by Elsagheer et al. (2022).

Regarding the type of lighting for VLMPUs (Vehicle Light and Mobile Units), the sample indicates a preference for LED headlights (37%), rear lights (26%), side reflectors (24%), and turn signals (10%); 3% state that a lighting system is not necessary. Comparing the data, headlights and rear lights are essential for safe driving, especially at night. The 24% difference between the highest and lowest ratings highlights the importance of reflective elements; that is, from a commercial perspective, headlights and rear lights, as well as reflective materials, are crucial for road use, as Fernández (2024) indicates, to reduce the risk of collisions during nighttime driving and in low-visibility conditions.

Regarding the structure and safety features of the (VLMPU), some retailers, representing 33% of the market, mentioned that they include suspension, run-flat tires, a bell or horn, an anti-theft alarm/GPS system, front and rear mudguards, an automatic shut-off system, and IP30 water resistance. This indicates that the vehicle's structural safety is fundamental, according to the International Transport Forum (2024), as a key element in vehicle safety for users.

Regarding personal protective equipment (PPE), 93% of respondents indicated that it is provided at the point of sale. They highlighted head and upper and lower limb protection as the top priorities. On the other hand, 7% reported not providing any PPE; however, they did recommend places to purchase it. It is also worth noting that the PPE kits that stores provide to customers typically include a helmet, knee pads, a reflective vest, elbow pads, and gloves without technical safety specifications, results that align with studies by Gangadharaiah et al. (2023). Comparing these results with PPE usage reveals a significant lack of protection for users. Gloves account for only 4% of usage, elbow pads 7%, and helmets 39%. This highlights a 35-percentage point difference between helmet use and hand and arm protection. This suggests a safety approach focused on high-risk injuries. The protection should be uniform throughout the user's body, as mentioned by Hishikawa and Asano (2022).

Regarding the type of technology incorporated into vehicles, retailers indicated that the most prominent option is mobile applications at 51%. This is followed by Bluetooth at 20%, integrated GPS at 14%, and IoT (Internet of Things) systems at 9%. Meanwhile, 6% consider technological use in vehicles to be less important. Comparing the data reveals a 46-percentage point gap between the demand for mobile applications and their non-use. However, there is a stronger trend toward the use of technology in vehicles, with 94% agreement.

Concerning the demographics of VLMPU purchasers and users in Colombia, young individuals aged 15 to 25 make up the majority, accounting for 49%, while those aged 26 to 35 represent 34%. When examining these results alongside older age categories, a clear generational difference is evident, as individuals aged 46 to 55 and those above 55 each account for merely 4%. This shows a difference of 45 percentage points between the main group of young adults and older purchasers, suggesting that 83% of the market is held by young adults, based on research by Yannis and Petraki (2024) as well as Dozza et al. (2022).

Concerning awareness and safety in buying a light electric vehicle for personal use in urban areas of Colombia, there is a clear dedication from vendors. In particular, users obtain face-to-face training (40%),

comprehensive user guides (31%), and instructional videos (11%). When comparing these results to the lowest statistics, it is observed that merely 9% do not provide any training, while an additional 9% offer only fundamental alerts. This represents a 31-percentage-point difference between the most prominent educational support and its complete absence, reflecting an 82% market consensus that values user training to ensure safe driving. This establishes a standard of shared responsibility with the authorities, data that aligns with studies by Burford et al. (2024) on injury and fatality prevention.

Finally, the population sample proposes an estimated timeframe of six months for the transition and implementation of the VLMPU regulation, with 47% support. Thirty percent indicated a two-year timeframe, 21% more than two years, and 1% one year. Comparing the data with the longer timeframes reveals a difference of 46, 29, and 20 percentage points between the first and second year. This demonstrates a 46-percentage-point gap between the need for a swift change and the resistance to waiting a year. This indicates that the majority of the population sample prefers a faster implementation of the regulation. This aligns with studies by the World Health Organization (2023) and Law 2486 (2025) regarding the importance and urgency of establishing controls on personal mobility vehicles.

4.5. Analysis And Triangulation of Results

The study's results confirm that the steady growth of VLMPUs in Colombia is due to a global trend of urban mobility transformation, driven by the search for more flexible, sustainable, and efficient transportation alternatives compared to traditional motorized transport (Beck et al. 2021; ANLA, 2019). This situation shows that the findings reported match specific contexts in Europe, North America, and Asia, where electric micromobility has significantly progressed, becoming an important choice for short-distance travel, especially in crowded urban regions (European Commission, 2020).

A comparison shows that one similarity between Colombia and the global situation is the difference between the quick acceptance of light electric personal mobility vehicles (LEMVs) and the insufficient development and execution of regulations (Bodansky et al., 2022). Studies carried out in nations like the United States, Germany, and Spain have shown that the absence of clear and understandable initial regulations has led to disputes regarding the use of public areas, challenges in enforcing effective penalties, and a notable rise in traffic accidents (Arafat et al., 2020; Decree No. (1428, 2003; Ibáñez, 2022). Likewise, the findings from this research show that, even though there is strong social support for the use of LEMVs, a substantial amount of regulatory unawareness continues to exist, and both users and the wider community hold a belief in the insufficiency of regulations (Ministry of Transit and Transportation, 2025).

Nonetheless, in the context of Colombia, some significant differences are evident when compared to global experiences. For instance, several countries in Europe have concentrated on a more technical and administrative strategy, emphasizing the creation of standards, requirements, and regulations for traffic, as highlighted by the Spanish Ministry of the Interior (2022; Decree No. (2822, 1998). In comparison, Colombia is experiencing an increasing social demand for educational and preventive regulations, as noted by the Ministry of Education (2013). Because of the differences in their methods, cities such as Singapore and Brisbane prioritize road safety education, supporting it with regulations and awareness campaigns. In contrast, other countries in continental Europe enforce models that emphasize penalties.

In the same way, this global comparison shows that there are commonalities in how regulatory factors are prioritized, which corresponds with findings from earlier research (Lazaro, 2022). The individuals involved in this research are knowledgeable about the key regulations, including the ban on operating a vehicle while impaired by alcohol or drugs, the obligation to wear personal protective gear, and the established speed limits (Law 2486, 2025; Traffic and Transportation Code 769, 2002). This focus aligns with global research that recognizes specific key elements and causes related to incidents involving electric micromobility (Haworth et al., 2022). Nonetheless, in contrast to other nations that necessitate intricate licenses or registrations, the findings of the study indicate that, within the context of Colombia, such obligations have been regarded as less important. This viewpoint highlights the importance of creating regulatory models that align with the social and institutional context.

Conversely, the administration of public areas and road facilities are elements that must be considered in this discussion. Global studies indicate that in order for the management of high-speed, low-traffic, low-impact (VLMPU) areas to succeed, it is essential to have separate infrastructure, proper upkeep of the road network, and unambiguous signage (Hishikawa et al., 2022; Law 14861, 2024). Thus, the findings of the research indicate that

Colombian society views the absence of dedicated spaces and the inadequate state of the road infrastructure as significant risk factors. This observation aligns with findings from studies carried out in other cities across Latin America and Europe (Ruiz et al., 2021; Szemere et al., 2024). Consequently, it is recommended that regulatory frameworks alone are inadequate without investment in necessary infrastructure and cohesive urban planning.

This research, which combines important findings about the regulation of light electric vehicles for urban personal transportation (LEPMVs), relies on feedback from citizens, users, retailers, and pertinent documents to offer a thorough view that forms a critical foundation for developing regulatory structures in Colombia. The presence of these vehicles in Bogotá has changed from a new occurrence to a crucial element of everyday city life. These findings are comparable to those reported in research conducted by the Mayor's Office of Bogotá (2023) and the Bogotá Chamber of Commerce (2024), which show that 29% of the overall population engages with them on a regular basis. This level of visibility corresponds to user habits, as 91% of individuals use these devices frequently (either daily or weekly), reinforcing their role as a vital form of transportation.

Although, when viewed from a demographic standpoint, a significant difference in gender is evident: 73% of the users are male, whereas only 27% are female. This implies that there might be variations in how technology is perceived or in views on road safety depending on one's gender. In a similar vein, retailers have reported that the predominant user demographic consists of young adults aged 15 to 35 years, representing 83% of the market. This suggests that road safety education programs ought to concentrate on this particular group. Moreover, comparable research, including those carried out by Szemere et al. The findings of Bucsky (2020) in Budapest, Hungary, and Spain, align with the results of this study, similar to the situation in Bogotá, where 38% of individuals utilize this type of transportation for work or educational purposes.

It is essential for all parties engaged in enforcing the regulations to have a legal framework in place. Sixty-four percent of the general population, sixty-nine percent of users, and one hundred percent of the reviewed documents concur that certain regulations are essential. It is important to mention that 46% and 40% of users, respectively, engage with these vehicles without fully comprehending the existing regulations, as stated by Cañabate (2019). As a result, 82% of dealers offer instruction on how to use and operate these vehicles to buyers and clarify the manual during the purchase process, acknowledging that training is essential for safe and efficient usage, as noted by Apollo (2024). Nonetheless, there are still weaknesses in traffic management, as 52% of users believe that the existing rules are inadequate.

External references, including Arafat et al. The authors (2020) assert that the lack of governance in micromobility leads to safety issues that can only be addressed through regulations that not only ban certain practices but also provide education. This corresponds with user accounts in Bogotá and the analysis of documents, which suggests that 37% of users prefer compulsory road safety courses rather than financial penalties. Additionally, it emphasizes a gap between how things are viewed and what is actually true. Most individuals (29%) perceive driving on roads with typical traffic as the highest risk, worried that accidents involving large vehicles may occur, which aligns with the findings from research conducted by Hishikawa and Asano (2022). However, users report that the roads are the area they utilize the most (34%), followed by bike paths and sidewalks (21%). This sharing of common areas creates tensions since over half of the population, specifically 55%, considers the conduct of users to be average or irresponsible. These findings align with the research conducted by Castillo and Orozco (2024).

Regarding vehicle safety and brakes, dealers indicate that 72% of the cars sold are equipped with mechanical disc brakes. 37% incorporate LED lighting in the front to optimize visibility, according to studies by Velez (2024) and Navarro (2020). This aligns with the structure and condition of the road network, prioritizing accident prevention (37% according to the sample) as the most crucial investment for safety, data that is similar to studies by the National Road Safety Agency (2020). Consequently, the risk of death for those using micromobility is intertwined with the human factor, the technology and mechanics, and the road network, according to research by the International Transport Forum (2020). Another safety factor on the roads is conflicts between road users, which validates the 11% of users concerned about the use of shared roads.

From a business viewpoint, the most popular VLMPUs are electric scooters, accounting for 47%, and skateboards, making up 21%. The effectiveness of these models relies on their low cost (29%), long battery life (21%), compact dimensions, and user-friendly design. In technical language, lithium-ion

batteries (47%) and brushless motors (47%) are employed, as research by McKenzie (2019) and Apollo (2024) indicates that these technologies are effective and need little maintenance.

Conversely, concerning speed, 93% of merchants and users recommend a top speed of 20 to 30 km/h in shared areas. This underscores the necessity for a national guideline and the implementation of speed limits to avoid hazardous situations for users and other road participants. This information is consistent with Law 15071 (2024), Law 2486 (2025), and the Ministry of Transportation (2024). Concerning the significance of personal protective equipment, 93% of merchants, users, the general public, and analyzed documents recognized helmets, knee pads, elbow pads, and reflective components as essential elements for personal safety while traveling in vehicles. These are regarded as a priority within the regulatory framework, data that corresponds with the findings of Eccarius and Cheng (2020).

Concerning the management of personal urban mobility vehicles (PMVs), the information indicates that most individuals favor centralized oversight. Forty-one percent of individuals think that the Ministry of Transportation ought to take charge of this process. Conversely, 74% are against the establishment of new agencies. Regarding legal standardization, 89% of participants endorse a safety law, a result that aligns with Decree 970 (2020), as noted by Elsagheer et al. (2022), and Fonseca and colleagues. (2025). At the same time, there is agreement on the positive effects for the environment, with 74% of the public and 92% of users considering PMVs to be a sustainable option for transportation. This changes traffic regulation into a government policy for reducing carbon emissions, as mentioned by Vélez (2024) and García et al. Certainly! Please provide the text you would like me to rephrase, and I'll assist you with the task.

En contraste, con la implementación de políticas públicas que no solo sean punitivas, sino que también faciliten la interacción de las comunidades en la participación y el uso de nuevos sistemas alternativos de movilidad, especialmente en el caso de transporte unipersonal, se puede alcanzar una disminución en la emisión de gases de efecto invernadero, lo que a su vez reduce la contaminación y mejora la salud pública de las comunidades más afectadas (Moreno et al., 2025).

6. CONCLUSIONS

The management of light electric vehicles for urban personal transport in Colombia is a vital social need; thus, this research was undertaken to grasp the views of the community and officials about a suggested regulation. According to the results gathered, there is a strong level of community backing and accompanying documentation, especially regarding speed limits, with a suggested maximum speed of 20 to 25 km/h. The use of personal protective equipment (PPE) is a topic of concern, as 93% of the community has shown their support for it. Moreover, the regulation must incorporate legal rules that align with actual market conditions (including vehicle types/models and braking systems as a safety feature) and the needs of the community.

The present condition of urban personal mobility vehicle traffic in Colombia shows shortcomings in technology and road safety. This is shown by the rise in the number of vehicles, caused by the absence of uniform regulations, required vehicle checks, poor signage and lighting, and a lack of personal safety gear. These shortcomings support the need for stricter regulations to ensure safety by mandating the use of safety equipment for all users, most of whom (83%) are young individuals aged 15 to 35.

It is essential to standardize the technical parts of light electric vehicles for urban personal mobility (VLMPU) that are currently available in the market. This standardization should take into account their use and adaptation to the Colombian context based on international models. To ensure effectiveness, it is essential to depend on proper documentation and refer to the international legal framework. This will facilitate the swift acceptance of quality standards for developing regulations in Colombia.

The data gathered for the regulatory system for VLMPU (Vehicles with Maximum Speed Limits) should rely on pertinent international examples and standards that are suitable for the context of Colombia. Consequently, the suggested regulations ought to concentrate on guaranteeing that users can obtain personal protective equipment (PPE) that adheres to basic safety standards, maximum velocity limits, and quality certifications from vendors. This requires finding a balance between the effectiveness of the transportation method and the duty of users to ensure the safety of all individuals using the roads, fostering shared accountability among businesses, users, the public, and traffic authorities. From a public policy standpoint, the findings indicate the necessity to create regulations that link national guidelines with local operational abilities. This can be achieved through strategies focused on road safety education, engaging citizen participation, ensuring effective institutional oversight, and fostering adaptive urban planning. These rules must be

founded on the principles of fairness in public areas and safeguarding the most at-risk road users. Additionally, they should be embraced by society, steering clear of solely punitive approaches, since such methods may result in pushback or inadequate adherence. The success of regulations will rely on the alignment of official rules, the ability of institutions, and the involvement of citizens. This will create a cooperative governance structure that supports the shift to multimodal transportation systems.

Por su parte, a través de la integración y la participación de los ciudadanos en el desarrollo de políticas públicas, no solo se asegura el cumplimiento y la implementación de las normativas, sino que, por el contrario, se convierten en participantes y observadores ciudadanos, en un ambiente de convivencia y armonía social, contribuyendo a la innovación en la movilidad sostenible y eficiencia en la movilidad urbana en todo el territorio colombiano

6.1. Contributions To the Scholarly Discussion

This research adds to the conversation regarding micromobility in Latin American settings, where practical evidence remains scarce. In contrast to primarily descriptive studies or those centered on European nations, this research combines citizen perceptions, regulatory assessments, and an institutional approach. It presents an interdisciplinary viewpoint that connects mobility, urban governance, and civic culture, as well as discussions on regulation, technological advancements, road safety, social equity, and the development of sustainable citizenship. This offers conceptual frameworks that can be relevant to other nations with similar urban characteristics.

6.2. Study Limitations

The primary limitation is the cross-sectional design used in this study, which hinders the ability to determine causal relationships or to examine how the phenomenon changes over time. The sample comprises a variety of participants, including the general public, users, and merchants.

6.3. Future Areas of Study

In light of these findings, it is suggested that upcoming research should concentrate on:

1. Carry out long-term studies to evaluate the effects of new regulations after they are put into effect.
2. Create comparative studies between cities in Colombia and other Latin American cities to recognize unique patterns of governance in micromobility.
3. Include quantitative methods that enable the examination of relationships between variables, including normative knowledge, driving behavior, and accident rates.
4. To explore further qualitative research on the use of public spaces and the understanding of social justice in situations related to mobility.

Overall, the management of VLMPU should be viewed not merely as a legal issue, but also as a process of cultural and institutional change that shapes the connection among citizens, technology, and urban areas. Its correct execution can greatly aid in creating safer, more sustainable, and socially inclusive urban areas.

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