

# Challenges and opportunities of urban mobility in Latin America: strategies toward sustainable development

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## Abstract

Urban mobility in Latin America is a relevant area of research because of the negative effects of vehicular pollution on human health and the environment. In recent years, mobility patterns have shifted globally as a result of technological advancements and growing environmental awareness. Accordingly, this study aims to identify emerging trends in sustainable urban mobility in the region through bibliometric analysis, text mining, and content analysis. The findings indicate that early studies primarily focused on transport development, congestion, and pollution. However, more recent research has incorporated sustainable approaches, emphasizing public transportation, the use of electric vehicles, and their connection to social inclusion, particularly among low-income workers. Additionally, the COVID-19 pandemic had a notable impact by promoting the creation of bicycle lanes and the expansion of sidewalks to facilitate social distancing, thereby reshaping urban dynamics in several Latin American cities.

*Keywords:* sustainable mobility; urban mobility; urban transport; sustainable development; climate change.

# Desafíos y oportunidades de la movilidad urbana en América Latina: estrategias hacia el desarrollo sostenible

## Resumen

La movilidad urbana en América Latina es un campo de investigación relevante debido a los efectos negativos de la contaminación vehicular sobre la salud y el medio ambiente. En los últimos años, los patrones de movilidad han cambiado globalmente por avances tecnológicos y una mayor conciencia ambiental. Por ello, esta investigación busca identificar tendencias emergentes en movilidad urbana sostenible en la región, utilizando análisis bibliométrico, minería de texto y análisis de contenido. Los hallazgos muestran que los estudios iniciales se enfocaban en el desarrollo del transporte, la congestión y la contaminación. No obstante, investigaciones recientes incorporan enfoques sostenibles, destacando el transporte público, el uso de vehículos eléctricos y su relación con la inclusión social, especialmente entre trabajadores de bajos ingresos. Además, la pandemia de COVID-19 influyó notablemente, promoviendo la creación de carriles para bicicletas y la ampliación de aceras para facilitar el distanciamiento social, transformando así la dinámica urbana en varias ciudades latinoamericanas.

*Palabras clave:* movilidad sostenible; movilidad urbana; transporte urbano; desarrollo sostenible; cambio climático.

## 1. Introduction

Mobility patterns have changed significantly each year worldwide due to continuous improvements in transportation technologies and growing environmental awareness regarding the protection of the planet. Urban mobility is one of the primary challenges that contemporary cities must confront. It is crucial to recognize that mobility is essential

for economic, cultural development, and knowledge management in both developed and developing countries, and Latin American countries are not immune to these challenges [1].

The need to promote sustainability and sustainable mobility in Latin America has been widely acknowledged by the Economic Commission for Latin America and the Caribbean, which has conducted comprehensive analyses



and generated valuable reports on the subject over the past 15 years to raise public awareness about the importance of sustainable mobility [2]. Urban transportation planning and the promotion of environmentally friendly transport modes have been highlighted in the reviewed literature as tools for developing more coordinated transportation policies and advancing sustainable urban development, with sustainable mobility being a fundamental requirement [3].

This study aims to identify influential actors who have played a decisive role in the evolution of urban and sustainable mobility in Latin America. Additionally, it seeks to identify new thematic trends and patterns in urban mobility, as well as to explore new mobility alternatives, such as the use of bicycles and electric vehicles, to counteract high levels of air pollution. Overall, this research examined the development of the literature on sustainable urban mobility in Latin America and identified emerging trends and potential future directions in this field.

## 2. Methodology

To examine the existing literature on sustainable mobility in Latin America, this research adopted a mixed-methods approach that combined quantitative and qualitative analyses, focusing on a literature review [4]. The following sections describe the steps taken, search strategies employed, and data analysis techniques.

### 2.1 Search strategy and selection criteria

The research focused on identifying original articles, review papers, and conference proceedings related to sustainable urban mobility in Latin America, published between 2005 and May 2025. Keywords such as “urban mobility”, “sustainable mobility”, and “Latin America”, including the countries within the region, were used for document retrieval and selection. Although the research did not restrict its search to any specific language, it was observed that 78.5% of the 438 documents were written in English, 20% in Spanish, and 5.7% in Portuguese.

### 2.2 Data processing and analysis

This research employed three data analysis techniques along with statistical analyses to explore the evolution of the research field related to sustainable mobility in Latin America. The methodology includes bibliometric analysis, text mining, and content analysis.

This study used a bibliometric analysis approach involving mathematical tools to investigate research perspectives in terms of trends and research sources. The statistical examination of articles, documents, authors, institutions, and countries plays a crucial role in quickly understanding the evolution of the literature over time. Additionally, citation analysis can reveal critical details about the literature and influential researchers, facilitating comprehension of research perspectives and trends within a specific knowledge area [5].

According to Yu et al. [6], bibliometric analysis aids in detecting internal relationships in the literature and

identifying central citations and key knowledge clusters. Consequently, a bibliometric analysis of the literature from Scopus on sustainable mobility in Latin America was conducted to determine the detailed characteristics of the literature and identify research trends and innovative perspectives.

Text mining, which is defined as the process of extracting relevant information from a set of documents, was employed to explore text patterns and semantic structures that better explain complex data [6,7]. Similarly, content analysis was used as a qualitative method to provide additional detailed insights regarding the quantitative findings and to identify the most influential published documents in the field of sustainable mobility in Latin America, aiming to uncover common patterns.

This research employed two software tools for data analysis. For the bibliometric and scientometric analysis, Bibliometrix was used—an essential tool for simultaneously analyzing and mapping bibliographic data [8]. Similarly, VOSviewer was utilized to construct network maps and visually explore different perspectives, thereby simplifying the interpretation of the bibliometric analysis results. [9].

## 3. Results

### 3.1 Evolution of the literature over time

This research explored the literature by analyzing articles published between 2005 and May 2025, identifying influential authors, representative countries, and relevant journals, resulting in 438 documents. The evolution of scientific output on urban and sustainable mobility is presented in Fig. 1. It was noted that before 2005, only four documents were found that lacked relevant information for the analysis or were not directly related to the research topic, leading to their exclusion.

The results indicate a significant increase in the number of articles published in the last five years, representing more than 70% of the total. 2023 had the highest number of articles published, with a total of 71 documents. In terms of citations, 2024 had the highest number, with a total of 1,124. This suggests a correlation between the number of citations and the number of articles published during the period 2019 to

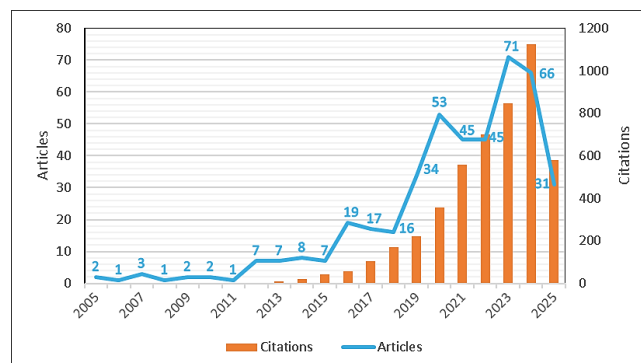


Figure 1. Evolution of literary production and scientific citations. Source: Own elaboration based on Scopus and WoS data.

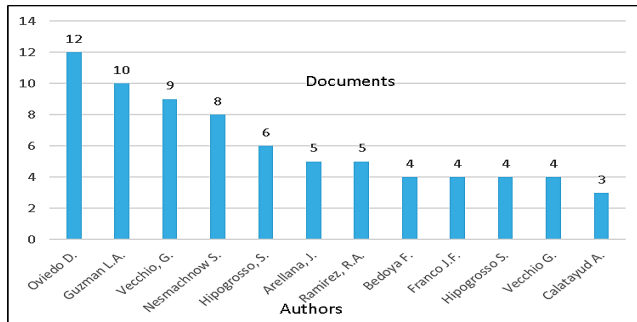


Figure 2. Influential researchers.  
Source: Own elaboration based on Scopus and WoS data.

2024. Based on this trend, it can be inferred that the field of urban and sustainable mobility in Latin America will continue to expand in the coming years, increasing the number of researchers interested in the topic.

### 3.2 Influential researchers

During the period 2005 to 2025, twelve influential researchers who produced quality articles on urban and sustainable mobility in Latin America were identified. The most influential author was Oviedo Daniel Ricardo from University College London in the United Kingdom, with twelve publications indexed in Scopus; in second place was Guzman LA from the Universidad de los Andes in Colombia, with ten publications; in third place was Vecchio Giovanni from Pontificia Universidad Católica de Chile, with nine indexed publications in Scopus in the field of research. The most influential researchers are shown in Fig. 2.

### 3.3 Influential institutions

This research identified the ten most influential institutions based on the first author’s affiliation data. The Pontificia Universidad Católica de Chile has 25 articles with lead authors. Likewise, Universidad de los Andes in Colombia has 19 articles related to research on urban and sustainable mobility in Latin America. Curiously, among the 10 most relevant institutions is University College London, which has 18 publications. It can also be said that of the ten most influential institutions shown in Fig. 90% of them are in Latin America; which indicates great interest in this field of research.

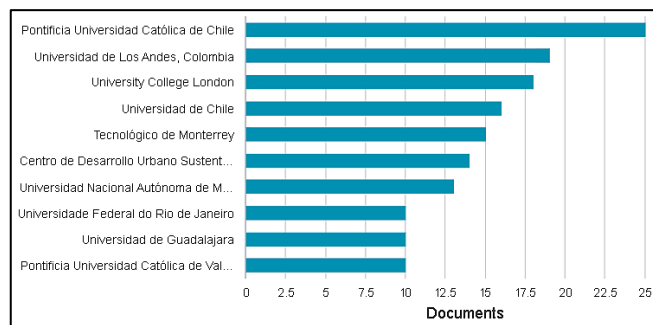


Figure 3. Institutions with more published documents.  
Source: Own elaboration based on Scopus and WoS data.

### 3.4 Influential countries

By 2025, 45 countries were identified with published articles related to urban and sustainable mobility in Latin America. Figure 4 shows the 10 countries with the highest number of publications. Among them, Mexico and Chile occupy first and second place, respectively, with 90 and 76 publications, respectively. Additionally, Colombia, Brazil, Spain, and Ecuador are among the top five countries. Notably, countries in Latin America without publications in this area include Guatemala, Cuba, Venezuela, and Nicaragua. Additionally, the results indicate that 3 articles from the sample have an undefined country affiliation.

### 3.5 Analysis of research areas

This research identified several domains within the field of urban and sustainable mobility in Latin America through keyword cluster analysis. Keywords serve as a primary representation of the information contained in an article, allowing for an understanding of the scope of the research topic through analysis. Specifically, the VOSviewer software was used to examine keywords in the 438 selected articles. The main keywords were chosen based on a threshold of eight occurrences, resulting in 79 relevant keywords from an initial count of 1,390. However, not all keywords were related to the study topic, leading to refinement that yielded 40 relevant keywords.

Following this analysis, it was observed that the keywords “urban mobility”, “sustainable mobility”, and “mobility” occurred 133, 70, and 60 times, respectively. The results are presented in Fig. 5 reveal the identification of five different keyword clusters in the 438 documents analyzed. The clusters related to urban and sustainable mobility research in Latin America are identified as “urban mobility”, “sustainable mobility”, “sustainability”, “accessibility”, and “urban transport”. Furthermore, a strong interdependence among several research clusters was observed. For example, the red cluster represents sustainable mobility and includes keywords such as “electromobility”, “climate change”, electric vehicles “greenhouse gases”, among others.

The first cluster (blue) could be termed sustainable urban transport, as it primarily includes keywords such as public transportation, bicycles, and traffic congestion. The third cluster, identified in green, focuses on mobility and sustainability and includes terms such as transportation policy, cycle transport, accessibility, and COVID-19. A strong relationship and dependency between this cluster and others was noted.

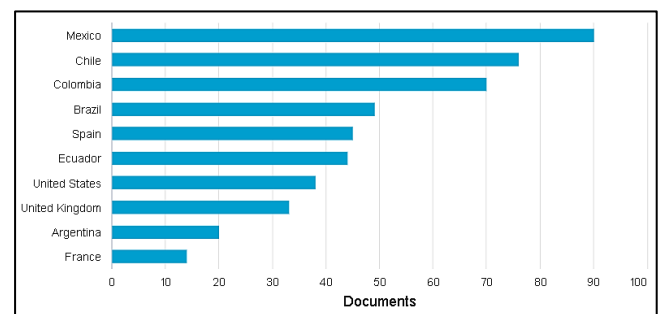


Figure 4. Countries with the most published documents.  
Source: Own elaboration based on Scopus and WoS data.





and rail systems in Lima, aimed at reducing accessibility disparities between low-income communities and other urban areas [18]. Despite these efforts, research indicates that these investments have not always effectively improved accessibility and have failed to alleviate inequalities related to public transportation. Research conducted in various Colombian cities has shown a direct relationship between access to transportation and social inclusion, especially for domestic workers who primarily rely on public transport due to their identity, gender, and low incomes [19]; Also, according to Rodríguez et al, bicycle-sharing systems in Santander (Spain) and Cartagena (Colombia) offer an efficient urban mobility solution for young women by reducing traffic congestion and improving health [20].

On the other hand, according to Montoya Robledo and Escovar Álvarez, “some studies in Latin American cities reveal that women feel safer using bicycles than walking or using public transport at night” [21] (p. 401). A study conducted by Rivero et al. in the city of Bahía Blanca (Argentina) revealed that active mobility is primarily used by men, city center residents, bicycle users, and people without cars for short leisure trips, while public transport is preferred by women, students, workers, and young people for longer, less frequent trips [22].

The criteria defining transportation systems in Latin America have evolved in recent years, shifting from a focus on speed and reduced travel times to emphasizing reliability, environmental impact, accessibility, and social equity. This change, illustrated by examples in European countries like France's LOTI Transport Act (1982) and policies from the United Kingdom's Department for Transport, incorporates accessibility as an essential element of affordable, high-quality mobility. Major cities in Latin America and other regions follow this trend, including equity and social inclusion in transportation planning [23]. However, many Latin American cities lack specific and robust tools to assess how transport projects impact accessibility and social inclusion, especially for poorer and more disadvantaged populations.

Similarly, the literature has developed several survey methods to investigate associations between cultural habits and inclusive means of transport used by populations, as seen in Barranquilla, Colombia. Research by Reniz Acosta et al. [24] highlighted the need to implement programs that encourage the use of inclusive transportation options, such as bicycles, while ensuring the necessary infrastructure and safety for active population participation in daily mobility. Coello- Salcedo et al. [25] comparatively analyzed the perceptions and operating parameters of mechanical and electric bicycles in the city of Cuenca, Ecuador. The results showed that electric bicycles were rated more highly by users, highlighting the greater enjoyment of the ride and their widespread recommendation, supported by better speed and acceleration data.

Lastly, the rapid urban expansion in cities such as Bogotá and Cali in Colombia, combined with informal peripheral urbanization and a centralized labor market, has affected the mobility of both high- and low-income residents alike [26]. In South American countries, transportation planning must address infrastructure deficits and connectivity gaps while

reducing social, spatial, economic, and environmental inequalities [18,23]. The findings highlight the need to implement transportation policies that promote equitable access to enable social and economic participation, in line with the Sustainable Development Goals (SDGs); especially as part of the SDG 11 targets “sustainable cities and communities” and the United Nations New Urban Agenda on access to transportation for low-income populations. The capabilities approach, focused on individuals' freedom to pursue valuable opportunities, offers a useful perspective to address sustainable mobility challenges, as access to transportation enhances material assets, social connections, and opportunities, supporting broader human and social capital beyond work and education [18]. In Latin America, such access is a central objective of urban mobility policies in pursuit of sustainability.

#### ***4.3 Urban mobility and its related factors during the COVID-19 pandemic***

According to the literature, the COVID-19 pandemic has significantly impacted mobility, especially in public transport, due to the risk of contagion and social distancing measures implemented by authorities [27]. Following the World Health Organization's declaration of COVID-19 as a pandemic on March 11, 2020, many governments adopted drastic measures to slow the virus's spread, including restrictions on urban mobility and public space closures [28]. These measures resulted in changes in travel behavior, and Latin America was no exception to this trend.

The necessity for physical distancing during the COVID-19 pandemic has impacted sustainable mobility initiatives. Cities in Europe and Latin America have implemented temporary changes in public spaces, such as creating bike lanes and widening sidewalks to facilitate mobility while ensuring physical distance [29]. Additionally, there has been a shift in people's inclination toward walking in urban green spaces, distancing them from crowded locations [30].

Overall, the reviewed literature indicates that most articles related to COVID-19 focused on restrictions on people's mobility and their relationship to decreasing virus transmission cases after authorities implemented health measures in Latin American cities [31].

#### ***4.4 Urban transport and the synergies between environmental and health***

One of the most researched topics regarding sustainable urban mobility in Latin America relates to air pollution, which has become a critical concern in cities and leads to numerous deaths each year [32]. According to the World Health Organization (WHO), approximately 99% of the global population breathes air that exceeds quality limits, with developing countries facing the harshest exposures. Both ambient and household air pollution are responsible for approximately 7 million deaths annually [33].

Ochoa-Covarrubias et al. (2021) stated that air pollution is caused by the presence of particulate matter and gases that pose risks to human health and other living organisms [32]. The WHO identifies particulate matter (PM), carbon

monoxide (CO), carbon dioxide (CO<sub>2</sub>), ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>) as the most concerning pollutants for public health [33].

In 2023, Bedoya-Maya et al. reported that “road traffic is one of the critical contributors to high levels of CO<sub>2</sub> and NO<sub>2</sub> in the air” [11] (p. 1). The literature maintains that these pollution levels are linked to health issues primarily affecting the lungs, larynx, pharynx, and eyes [11]. According to Higgins et al. [34], this type of pollution is significant in large urban centers, and it is driven by the increasing number of vehicles on the streets, which increases traffic congestion and pollution.

According to the United Nations Human Settlements Programme, Latin America and the Caribbean are the most urbanized regions in the world, with about 80% of its population concentrated in cities [35]. If this growth trend continues, by 2025, approximately 100 million people will reside in just six megacities [36]. Research by Grassi et al. [37] found that urban traffic has adversely affected the environment and human health in populated areas, with around 80% of atmospheric pollutants coming from mobile sources. Other authors, such as Huerta and Fuentes [38], have identified additional factors associated with urban mobility in a study conducted with users of the Metrobús in Mexico City. They found that certain aspects, such as travel time, crowding during peak hours, and comfort, significantly influenced the quality of life for those using public transportation to commute to work.

In 2024, Quezada et al. showed how women in Santiago, Chile engage with electric mobility in the context of carbon neutrality and the importance of inclusive policies to reduce inequalities and improve environment with electric the mobility [39].

Lastly, some authors express concern over the disposal and recycling of end-of-life vehicles (ELVs), as these vehicles are considered a significant category of hazardous waste. They pointed out that poor management of ELVs contributes to various environmental issues, including groundwater contamination and soil pollution by heavy metals [5,40].

#### ***4.5 Considering electric and hybrid vehicles as sustainable mobility alternatives***

Electric and hybrid vehicles have emerged as key factors in combating climate change [41]. However, their high purchase prices have created social inequities, leaving many communities excluded from public policy promoting green economies and climate change mitigation [42,43]. Lastly, the literature indicates persistent mobility differences between gender and socioeconomic groups, which are influenced by the economic landscape of cities and the spatial distribution of job opportunities and salaries [44].

#### **5. Future trends and research directions**

Urban and sustainable mobility in Latin America encompasses various facets involving different components throughout the mobility process. Strengthening and promoting environmentally friendly mobility systems has

become a primary concern for Latin American governments and researchers alike. Researchers are advocating for and investigating new transportation alternatives to address air pollution, particularly diesel- and gasoline-powered vehicles.

Electric vehicles are emerging as a significant alternative for both public and private transport, helping to reduce pollution levels in urban areas. Literature indicates that bicycles also play a crucial role in mobility across several Latin American cities, serving as an entirely eco-friendly mode of transport for short to medium distances without emitting harmful gases.

In the future, the quest for new mobility alternatives is likely to inspire researchers to raise awareness among citizens about adopting innovative transportation methods and technologies that minimize greenhouse gas emissions. The authors will also highlight the health and environmental detriment of fossil fuel-based vehicles, thereby discouraging their use and promoting more sustainable and economical alternatives. This direction presents a promising avenue for future research, particularly in the context of combating climate change.

It is essential to review literature from not only Latin America but also from countries such as the United States, the United Kingdom, and various European nations. Such comparisons can guide future researchers toward identifying potential directions for urban and sustainable mobility research. Furthermore, there is a clear lack of public management from governments to support new transportation systems in populated areas; thus, governments should encourage and promote mobility alternatives that target global warming.

The recent COVID-19 pandemic undoubtedly triggered significant changes in urban-transport modes and models, prompting many individuals and organizations to seek and adopt new mobility alternatives, particularly through increased bicycle and electric motorcycle use. These shifts present shared benefits for health and environmental mobility in urban centers, warranting thorough investigation in future studies. Several researchers have already begun discussing new lessons in mobility during pandemic situations and the transition toward safer, more environmentally sustainable mobility alternatives.

#### **6. Conclusions**

The findings revealed a significant increase in the number of published articles over the past five years. Mexico and Colombia have emerged as leading producers of influential urban and sustainable mobility in Latin America.

The institutions with the highest number of publications related to urban and sustainable mobility in Latin America are the Pontificia Universidad Católica de Chile, the Universidad de los Andes in Colombia, and the University College London in England. The results also show interrelations between different research groups in Latin America and the United Kingdom.

Differences were found between gender groups and socioeconomic strata in terms of the use of urban mobility systems. These differences are influenced by the spatial distribution of job opportunities and are more noticeable in

the most disadvantaged social classes.

The findings also indicate that most existing research has focused on local and specific scenarios within the field of mobility, highlighting the need for more comprehensive studies that incorporate global perspectives, alternatives, and technologies to improve urban mobility and sustainability in Latin America. Additionally, it was noted that existing literature tends to prioritize material and economic perspectives over the social aspect in urban mobility research, underscoring the importance of raising social awareness to promote the use of less polluting, environmentally friendly vehicles in pursuit of a sustainable future for all.

Finally, the study found that electric vehicles, electric bicycles, and scooters are key factors in combating climate change. However, although they offer potential benefits for public health and the environment, electric bicycles have also created a social inequality gap due to their high purchase prices, excluding many families from public policies that support green economies.

## References

- [1] Recasens-Alsina, M., Challenges for sustainable urban mobility in Barcelona. *Ciudad y Territorio, Estudios Territoriales*, 52(204), pp. 236-276, 2020.
- [2] Vasconcellos, E., Contribuciones a un gran impulso ambiental para América Latina y el Caribe: movilidad urbana sostenible. [en línea]. 2019. Disponible en: <https://repositorio.cepal.org/handle/11362/44668>
- [3] Næss Strand, P., and Næss Strand A., Oslo's Farewell to Urban Sprawl. *European Planning Studies*. 19(1), pp. 113-139, 2011. DOI: <https://doi.org/10.1080/09654313.2011.530395>
- [4] Ñaupás, H., Mejía, E., Novoa-Ramírez, E. and Paucar-Villagómez, A., Metodología de la investigación cuantitativa - cualitativa y redacción de la investigación, 4ª edición, Ediciones de la U, 2014.
- [5] Pilkington, A., and Meredith, J., The evolution of the intellectual structure of operations management-1980-2006: A citation/co-citation analysis. *Journal of Operations Management*, 27(3), pp. 185-202, 2009. DOI: <https://doi.org/10.1016/J.JOM.2008.08.001>
- [6] Yu, Z., Khan, S., Zia-ul-haq H., Tanveer, M., Sajid, M., and Ahmed S., A bibliometric analysis of end-of-life vehicles related research: exploring a path to environmental sustainability. *Sustainability*, 14(14), pp. 1-21, 2022. DOI: <https://doi.org/10.3390/su14148484>
- [7] Gulo, C., Rúbio, T., Tabassum, S., and Pradot, S., Mining scientific articles powered by machine learning techniques. *Open Access Series in Informatics, (ICCSW 2015)*, pp. 21-28, 2015. DOI: <https://doi.org/10.4230/OASISs.ICCSW.2015.21>
- [8] Dervisu, H., Bibliometric analysis using bibliometrix an R package. *Journal of Scientometric Research*. 8(3), pp. 156-160, 2019. DOI: <https://doi.org/10.5530/JSCIREs.8.3.32>
- [9] Van Eck, N., and Waltman, L., Manual for VOSviewer version 1.5.2, Leiden Univeristy. [online]. 2023, pp. 1-28. Available at: [https://www.vosviewer.com/documentation/Manual\\_VOSviewer\\_1.5.4.pdf](https://www.vosviewer.com/documentation/Manual_VOSviewer_1.5.4.pdf)
- [10] De Oliveira, G. L., Lima, L., Silva, I., Ribeiro-Dantas, M.D., Monteiro, H., and Endo, P.T., Evaluating social distancing measures and their association with the covid-19 pandemic in South America. *International Journal of Geo-Information*. 10(3), art. 30121, 2021. DOI: <https://doi.org/10.3390/ijgi10030121>
- [11] Bedoya-Maya, F., Calatayud, A., and González Mejía, V., Estimating the effect of road congestion on air quality in Latin America. *Transportation Research Part D: Transport and Environment*. 113, art. 103510, 2022. DOI: <https://doi.org/10.1016/j.trd.2022.103510>
- [12] Asprilla-Lara, Y., Mosquera-Palacios, D.J., and González-Pérez, M.G., Sustainable mobility in cities of the XXI century: road perspectives in Bogotá-Colombia and Guadalajara-México. *Ciudad y Territorio Estudios Territoriales*, 54(212), pp. 429-442; 2022. DOI: <https://doi.org/10.37230/CyTET.2022.212.8>
- [13] Bermúdez-Hernández, J., Cardona-Acevedo, S., Valencia-Arias, A., Palacios-Moya, L., and Dioses-Lescano, N., Behavioural factors for users of bicycles as a transport alternative: a case study. *Sustainability*. 14(24), art. 16815, 2022. DOI: <https://doi.org/10.3390/su142416815>
- [14] Gonzalez-Calderon, C.A., Posada-Henao, J.J., Granada-Muñoz, C.A., Moreno-Palacio, D.P., and Arcila-Mena, G., Cargo bicycles as an alternative to make sustainable last-mile deliveries in Medellín, Colombia. *Case Studies on Transport Policy*. 10(2), pp. 1172-1187, 2022. DOI: <https://doi.org/10.1016/j.cstp.2022.04.006>
- [15] Hipogrosso, S., and Nesmachnow, S., Assessment of sustainable mobility initiatives developed in monteideo, Uruguay. *Smart Cities*, 3(2), pp. 479-510, 2020. DOI: <https://doi.org/10.3390/smartcities3020026>
- [16] Binatti, G., Batalha, Y., De Castro, J., and De Sousa Oliveira, M., Latin American bike sharing ecosystem overview: from data collection to implementation model portraits. *Revista Brasileira de Gestão Urbana*. 14, pp. 1-16, 2022. DOI: <https://doi.org/10.1590/2175-3369.014.E20210066>
- [17] Mix, R., Hurtubia, R., and Raveau, S., Optimal location of bike-sharing stations: a built environment and accessibility approach. *Transportation Research Part A: Policy and Practice*. 160, pp. 126-142, 2023. DOI: <https://doi.org/10.1016/j.tra.2022.03.022>
- [18] Oviedo, D., and Guzman, L.A., Revisiting accessibility in a context of sustainable transport: capabilities and inequalities in Bogotá. *Sustainability*. 12(11), art. 14464, 2020. DOI: <https://doi.org/10.3390/su12114464>
- [19] Bocarejo, J.P., Portilla, I.J., Velásquez, J.M., Cruz, M.N., Peña, A., and Oviedo, D.R., An innovative transit system and its impact on low-income users: the case of the Metrocable in Medellín. *Journal of Transport Geography*. 39, pp. 49-61, 2014. DOI: <https://doi.org/10.1016/j.jtrangeo.2014.06.018>
- [20] Rodríguez, A., Delgado-Lindeman, M., Sipone, S., and dell'Olio, L., Gender dynamics in electric bike-sharing: Insights on usage and fare structures. *Research in Transportation Economics*. 111, art. 101561, 2025. DOI: <https://doi.org/10.1016/j.retrec.2025.101561>
- [21] Montoya-Robledo, V., and Escovar-Álvarez, G., Domestic workers' commutes in Bogotá: transportation, gender and social exclusion. *Transportation Research Part A: Policy and Practice*. 139(8), pp. 400-411, 2020. DOI: <https://doi.org/10.1016/j.tra.2020.07.019>
- [22] Rivero, M.A., Pesce, G., and Pedroni, F., Urban mobility decisions in the city of Bahía Blanca (Argentina): How to contribute to sustainable development. *Investigaciones Geográficas*. 83, pp. 197-217, 2025. DOI: <https://doi.org/10.14198/INGEO.27615>
- [23] Bocarejo, J.P., and Oviedo, D.R., Transport accessibility and social inequities: a tool for identification of mobility needs and evaluation of transport investments. *Journal of Transport Geography*. 24, pp. 142-154, 2012. DOI: <https://doi.org/10.1016/j.jtrangeo.2011.12.004>
- [24] Reniz-Acosta, K.P., Fábregas, C.J., Vidarte, J., Claros-Rodado, A., and Nuñez-Bravo, N., Healthy culture and inclusive means of transport in the city of Barranquilla / Colombia | Cultura saludable y medios de transporte incluyentes en la ciudad de Barranquilla/Colombia. *Espacios*. 39(16), 2018.
- [25] Coello-Salcedo, M.F., Mendoza-Vázquez, I.A., Coello-Salcedo, B.M., and Romero-González, J.A., Comparison of mechanical bicycle and e-bike in the public bicycle-sharing system of Cuenca-Ecuador. *Revista Facultad de Ingeniería*. 114, pp. 19-31, 2025. DOI: <https://doi.org/10.17533/udea.redin.20240937>
- [26] Jaramillo, C., Lizárraga, C., and Grindlay, A., Spatial disparity in transport social needs and public transport provision in Santiago de Cali (Colombia). *Journal of Transport Geography*. 24, pp. 340-357, 2012. DOI: <https://doi.org/10.1016/J.JTRANGEO.2012.04.014>
- [27] Trejo, J.R., De la Llata-Gómez, R., and Biosca, S.A., Variables explaining the modal shift in public transport use due to COVID-19 in an urban environment in Queretaro. *Investigaciones Geográficas*. 109, pp. 1-16, 2022. DOI: <https://doi.org/10.14350/ig.60590>
- [28] Kellermann, R., Sívizaca-Conde, D., Rößler, D., Kliewer, N., and Dienel, H.L., Mobility in pandemic times: exploring changes and long-term effects of COVID-19 on urban mobility behavior. *Transportation Research Interdisciplinary Perspectives*. 15(3), art. 100668, 2022. DOI: <https://doi.org/10.1016/j.trip.2022.100668>

- [29] Vecchio, G., Tiznado-Aitken, I., and Mora-Vega, R., Pandemic-related streets transformations: accelerating sustainable mobility transitions in Latin America. *Case Studies on Transport Policy*. 9(4), pp. 1825-1835, 2021. DOI: <https://doi.org/10.1016/j.cstp.2021.10.002>
- [30] Sainz-Santamaria, J., Moctezuma, D., Martinez-Cruz, A.L., Téllez, E.S., Graff, M., and Miranda-Jiménez, S., Contesting views on mobility restrictions in urban green spaces amid COVID-19 - Insights from Twitter in Latin America and Spain. *Cities*. 132, art. 104094, 2023. DOI: <https://doi.org/10.1016/j.cities.2022.104094>
- [31] Paternina-Caicedo, A., Alvis-Guzmán, N., Duenás, C., Narvaez, J., Smith, A.D., and De La Hoz-Restrepo, F., Impact of mobility restrictions on the dynamics of transmission of COVID-19 in Colombian cities. *International Health*. 14(3), pp. 332-335, 2023. DOI: <https://doi.org/10.1093/inthealth/ihab064>
- [32] Ochoa-Covarrubias, G., González-Figueroa, C., Dealba-Martínez, H., and Grindlay, A.L., Air quality and active transportation modes: a spatiotemporal concurrence analysis in Guadalajara, Mexico; *Sustainability*. 13(24), art. 13904, 2021. DOI: <https://doi.org/10.3390/su132413904>
- [33] Air pollution, [online]. 2022. [accessed Mar. 15, 2022]. Available at: [https://www.who.int/westernpacific/health-topics/air-pollution#tab=tab\\_1](https://www.who.int/westernpacific/health-topics/air-pollution#tab=tab_1)
- [34] Higgins, C.D., Adams, M.D., Réquia, W.J., and Mohamed, M., Accessibility, air pollution, and congestion: capturing spatial trade-offs from agglomeration in the property market. *Land Use Policy*. 84, pp. 177-191, 2019. DOI: <https://doi.org/10.1016/j.LANDUSEPOL.2019.03.002>
- [35] UN Habitat. The state of the world's cities 2006/2007: The Millennium Development Goals and urban sustainability, 2006.
- [36] Cahill, M., Housing and urban development, in *The Environment and Social Policy*. pp. 92-112, 2018.
- [37] Grassi, Y.S., Brignole, N.B., and Díaz, M.F., Pandemic impact on air pollution and mobility in a Latin American medium-size city. *International Journal of Environmental Studies*. 79(4), pp. 624-650. DOI: <https://doi.org/10.1080/00207233.2021.1941662>
- [38] Huerta, G.C. and Fuentes Flores, C.M., Smart mobility in the creation of public value for Metrobus users in Mexico City. *Revista de Urbanismo*, 46, pp. 40-56; 2022. DOI: <https://doi.org/10.5354/0717-5051.2022.64500>
- [39] Quezada, C.R., Vecchio, G., and Waintrub, N., Women's attitudes towards electromobility. *Revista de Urbanismo*, 51, 2024. DOI: <https://doi.org/10.5354/0717-5051.2024.75881>
- [40] Nwachukwu, M.A., Feng, H., and Achilike, K., Integrated studies for automobile wastes management in developing countries. In the concept of environmentally friendly mechanic village. *Environmental Monitoring and Assessment*. 178, pp. 581-593, 2011. DOI: <https://doi.org/10.1007/s10661-010-1714-y>
- [41] Barkenbus, J.N., Prospects for electric vehicles. *Sustainability*. 12(14), pp. 1-13, 2020. DOI: <https://doi.org/10.3390/su12145813>
- [42] Requia, W.J., Mohamed, M., Higgins, C.D., Arain, A. and Ferguson M., ¿How clean are electric vehicles? Evidence-based review of the effects of electric mobility on air pollutants, greenhouse gas emissions and human health. *Atmospheric Environment*. 185(4), pp. 64-77, 2018. DOI: <https://doi.org/10.1016/j.atmosenv.2018.04.040>
- [43] Vecchio, G., Tiznado-Aitken, I., and Hurtubia, R., Transport and equity in Latin America: a critical review of socially oriented accessibility assessments. *Transport Reviews*. 40(3), pp. 354-381, 2020. DOI: <https://doi.org/10.1080/01441647.2020.1711828>
- [44] Da Silva, A.C., and Pizzolato, N.D., Using electric vehicles for freight transport purposes and challenges to do an implementation in Brazil. *Ambiente & Sociedade*. 25, 2022. DOI: <https://doi.org/10.1590/1809-4422ASOC20210183R2VU2022L3OA>

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