ABSTRACT

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Electric bicycles, or e-bikes, are an emerging alternative transportation mode with the potential to increase cycling accessibility and overcome barriers associated with conventional cycling. However, research on implications of e-bikes for the transport system remains limited, particularly in the Brazilian context. As such, this research aims to evaluate the impact of e-bikes on accessibility and spatial equity within Brazilian cities.

The study will consist of four components. The first will analyze how e-bikes can increase accessibility to jobs and other destinations in São Paulo, considering physical effort constraints. Accessibility will be measured using a 2-step floating catchment area method with impedance functions for both time and physical effort. Impacts will be examined across population groups and regions using equity metrics.

The second study will investigate the potential of shared e-bikes as access/egress modes for public transit trips to reduce inequalities in job accessibility in São Paulo. Accessibility will be modeled using a gravity-based 2SFCA method incorporating competition effects. Tembici, a Brazilian bike sharing company, will provide data, allowing us to evaluate integration of existing e-bike stations with public transport. New optimal stations will be proposed. Equity will be evaluated through measures like Gini coefficients.

The third component will evaluate the potential of private and shared e-bikes as first/last mile modes to increase job accessibility via bike-and-ride systems in São Paulo. Accessibility will be modeled using GTFS data combined with uni/multimodal cycling models and algorithms for trip-mode selection. This will represent integration between cycling and transit networks.

The fourth study will assess the contribution of shared e-bikes towards the development of 15-minute cities in São Paulo and Rio de Janeiro. It will evaluate coverage of essential services by current systems and propose new stations to maximize coverage. Comparison between the two cities will provide insights into different urban contexts. Equity analysis will also be conducted using spatial statistical methods.

The research will rely on data from OpenStreetMap for road networks, Copernicus for elevation, IPEA (Institute for Applied Economic Research) for opportunities, GTFS for transit networks, and the operator Tembici for e-bike usage. The geographical scope encompasses São Paulo and Rio de Janeiro, allowing for comparison between Brazil's two biggest cities with differing characteristics.

E-bike speeds will be modeled based on slope, using existing methods from European contexts. Physical effort will be determined through metabolic power models validated by previous empirical studies. Accessibility will be measured considering time budget and physical capability constraints through enhancements to conventional cumulative opportunity and gravity-based methods.

This PhD project uses innovative techniques to study the potential of e-bikes in Brazil. The research aims to show that e-bikes can increase cycling mode share, accessibility, and spatial equity. It will develop new methods for measuring accessibility and equity impacts of e-bikes, provide empirical evidence regarding e-bikes' role in overcoming cycling barriers, and identify optimal strategies for planning and implementation of e-bike systems. The results will aid transport planners and policymakers in leveraging e-bikes for sustainable development. The work will make significant contributions to both academic