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Methodology for using the Microscale Audit of Pedestrian Streetscapes-MAPS in the city of São Paulo

Metodologia de utilização do Microscale Audit of Pedestrian Streetscapes-MAPS na cidade de São Paulo

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ABSTRACT

The Microscale Audit of Pedestrian Streetscapes-Global (MAPS Global) is an international instrument that aims to characterize the variability of pedestrian environments related to physical activity at the microscale level, being a reliable tool that allows comparisons between locations with different contexts. In this regard, the objective of the present study is to describe the methodological process adopted in the Health Survey of São Paulo or Inquérito de Saúde de São Paulo (ISA) in portuguese – Physical Activity and Environment survey for the microscale environment assessment with the MAPS-Global instrument. The use of the method in São Paulo city involved several steps and adaptations relevant to the context of the study, such as: meetings with the group responsible for the validation of the method in Brazil, training of researchers for data collection, review of sections and questions and instrument hosting on Google forms, georeferencing of households and preparation of routes, training and certification of evaluators, and data collection procedures. The environment audit presented challenges, even though it was an exclusively online process, 25 months were required for all the stages development since the audit involved a considerable sample of 1,434 subjects, an increased evaluation coverage in cross-segment sections, and a team of seven evaluators. For future data collection it is suggested to consider the time available for auditing, the size of the team for the selected sample, as well as the possibility of adapting the instrument, such as the inclusion or removal of items according to the local context or reality of the study.

Keywords: Physical activity; Built environment; Cohort

RESUMO

O Microscale Audit of Pedestrian Streetscapes-Global (MAPS-Global) é um instrumento internacional que visa caracterizar a variabilidade de ambientes de pedestres relacionados à atividade física ao nível de microescala, sendo uma ferramenta confiável que permite comparações entre locais com diferentes contextos. Neste sentido, o objetivo do presente estudo é descrever o processo metodológico adotado na pesquisa Inquérito de Saúde de São Paulo (ISA) - Atividade Física e Ambiente para a avaliação da microescala do ambiente com o instrumento MAPS-Global. A utilização do método na cidade de São Paulo envolveu diversas etapas e adaptações relevantes para o contexto do estudo, inicialmente foram realizadas reuniões com o grupo responsável por validar o método no Brasil, treinamento dos pesquisadores para coletas de dados, revisão dos blocos e questões, hospedagem do instrumento no Google forms, georreferenciamento dos domicílios, elaboração das rotas, treinamento e certificação dos avaliadores e procedimentos de coletas de dados. A auditagem do ambiente apresentou desafios, mesmo se tratando de um processo exclusivamente online, foram necessários 25 meses para o desenvolvimento de todas as etapas do estudo, pois a avaliação envolveu 1.434 sujeitos, aumento da cobertura da avaliação nas seções dos segmentos e cruzamentos e uma equipe de sete avaliadores. Sugere-se para coletas futuras que seja observado o tempo disponível para auditagem, o tamanho da equipe para a amostra selecionada, bem como a possibilidade realizar adaptações no instrumento como a inclusão ou retirada de itens conforme contexto ou realidade local do estudo.

Palavras-chave*: Atividade física; Ambiente construído; Coorte.*

Introduction

Environmental characteristics, such as parks, squares, street connectivity, a variety of destinations, bike paths, train and subway stations, aesthetic conditions, and urban landscape, are associated with higher levels of physical activity, particularly in the context of leisure and commuting[1–4]. Despite the existing evidence, associations involving environmental characteristics tend to vary considerably[5]. In part, this complexity arises from the challenge of assessing the characteristics of the environment at various scales[6].

The macroscale includes composite or aggregated measures in larger areas, such as census tracts, neighborhoods, or entire regions. These measures can include access to specific land uses and common destinations[7]. The microscale includes characteristics from street segments, which can change more quickly and at a lower cost. These characteristics include the presence and quality of sidewalks, road structure, aesthetic features, and the urban landscape[8–10]. Even with all these characteristics that are involved in its evaluation, the type and scale of the measure have direct implications for understanding how the environment can affect behavior. Additionally, the measure may have greater or lesser relevance depending on the dimensions and contexts of physical activity, as well as the characteristics of the population[5].

Most studies involving the built environment indicate that there is a relationship among factors at the macro-scale level. However, these aspects may not fully represent the environment where people live[7]. In this sense, it becomes relevant to evaluate microscale aspects that can influence walking, such as the quality of the sidewalks, the presence of garbage and obstructions, lighting, crosswalks, and traffic lights. These variables directly impact comfort and safety, and consequently, can also influence physical activity[5,10].

Based on this need, the International Physical Activity and Environment Network (IPEN) developed the MAPS-global instrument, which evaluates conceptually relevant attributes for physical activity. This instrument allows for comparisons between places with different microscale contexts. In 2018, data on development and reliability from five countries, including Brazil indicated that the instrument is a reliable tool that can be used to assess residential and commercial areas[11].

Although MAPS-Global has proven to be reliable for environmental assessments at the microscale level, it still presents challenges. It is a lengthy instrument that is not widely used in Brazil, and it includes subjective assessment items that require technical knowledge. For its use in the city of São Paulo, adaptations were made to the instrument. These adaptations included the inclusion of questions, training of evaluators, preparation of routes through georeferencing, and the use of an online form platform for data collection and storage. In this sense, the objective of the present study is to describe the methodological process adopted in the ISA-Physical Activity and Environment study for evaluating the microscale of the environment using the MAPS Global instrument.

Methods

This study focuses on a cohort with the primary objective of analyzing the potential impacts of the built environment on physical activity, both in leisure time and active of transportation. The study also aims to investigate secondary outcomes such as obesity, mental and cardiovascular diseases. The complete protocol is described in the article published by Florindo et al.[12].

Briefly, in the baseline (2014/2015), a total of 4,042 people aged 12 years old or older were evaluated throughout the city of São Paulo through household interviews conducted in 2,603 households. Between 2020 and 2021, the second evaluation was conducted by telephone survey because the COVID-19 pandemic. All individuals who were 18 years old at the second interview were eligible, including adolescents who reached adulthood. The final longitudinal sample consisted of 1,434 adults living in 1,110 households, as shown in Figure 1 (red dots). The research was approved by the Research Ethics Committees of the School of Arts, Sciences, and Humanities of the University of São Paulo and the Municipal Health Department of São Paulo. It was conducted by telephone survey because the COVID-19 pandemic.

MAPS-Global is an international instrument that originated in the United States and has already undergone several validation studies in other countries[10,11,13]. It was recently validated for use on online platforms, such as Google Earth[1,14].

The instrument is organized into four sections: routes, street segments, intersections, and dead ends. The route section is divided into three main categories: 1- residential and mixed-use land, which assesses the concentration of family homes and commercial establishments, as well as the diversity of urban infrastructure available for accessing services such as shops, restaurants, and facilities for physical activity, among others; 2- street usage, which evaluates the availability of pedestrian infrastructure, public transportation options, and urban furniture; and 3- aesthetics and social environment, which considers the quality of landscaping and gardening, as well as the preservation attributes of residences and streets. The routes are understood as paths to be taken from the participant's home towards the center with the highest commercial density (Figure 2A).

The segments section evaluates in more detail the sections of streets that start and end between two intersections or with a change of address (Figure 2B). It considers characteristics such as the quality, width,

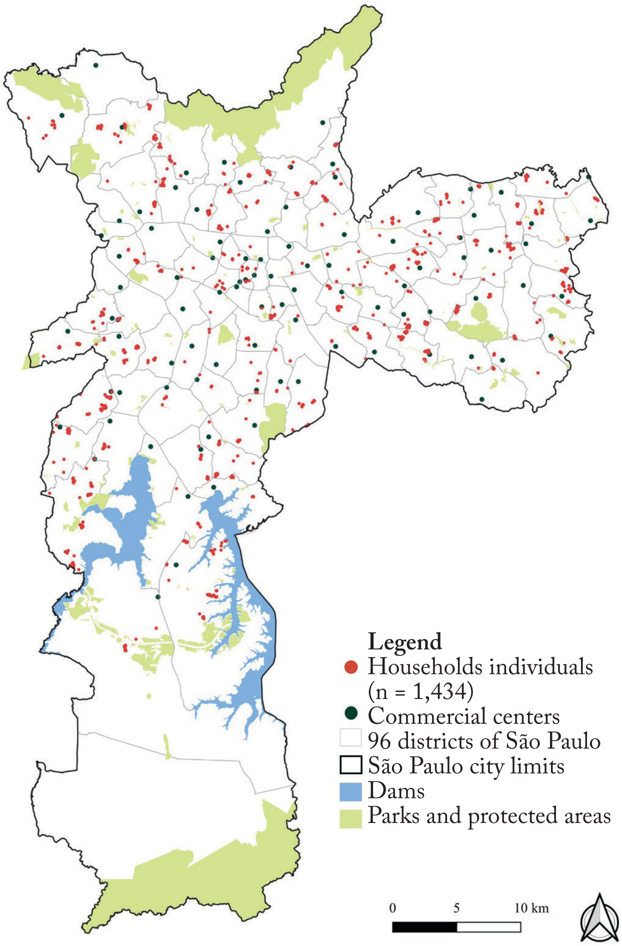

Figure 1 – Sample of households individuals (n = 1,434), comercial centers and city districts, ISA-Physical Activity and Environment survey, São Paulo, 2022.

slopes, and obstructions of the sidewalks, tree cover, number of vehicle lanes, and other factors that may affect pedestrian safety and experience. The intersection section evaluates traffic control measures such as traffic lights, crosswalks, and bicycle signs, as well as accessibility. It is characterized as the location where pedestrians cross the street (Figure 2). More details about each scale and composition of the scores can be found on website https://www.drjimsallis.com/maps.

Experiments using MAPS-Global in Brazil began in 2014 as part of the IPEN/Adolescents project (ESPAÇOS/Adolescentes, the name used locally). The project was coordinated and executed by the in Physical Activity and Quality of Life Research Group – GPAQ at the Pontifical Catholic University of Paraná[11] in the city of Curitiba, Paraná.

In the first part of this project[11], the validation process and the agreement between evaluators and three GPAQ members were carried out. For the context of Brazil, in the routes section, items related to trade and services were added, such as grocery stores, walking trails, outdoor gyms, and sports courts. The agreement process involved 68 routes in census tracts with varying levels of walkability and income characteristics. These routes were previoulsy selected and designed by the San Diego (USA) team of the IPEN-Adolescents project. In the case of Brazil, the dead-end street section was not included due to differences in conceptual and comparison characteristics. The routes started next to the participant's residence in the street segment, with evaluation of both sides, the segments were evaluated only on one side and the intersections considering only the intersection control and the crossing point for the next segments.

In 2016, a new phase of the project was conducted to develop association studies using online assessments. This phase involved a larger sample size and included valid data from accelerometers (n = 356), commercial routes (n = 55) and public squares or parks (n = 56)[15]. Routes were manually drawn by local researchers to the nearest shopping center identified using Google Earth Pro® software. Six evaluators were trained in three stages: theoretical, using images, and practical training.

Some considerations were made regarding the study procedures in Curitiba. First, data collection utilized applications such as QuickTap and Qualtrics, which streamline the process of collecting and managing typing errors. Second, the sampling characteristics of the project must be taken into account in order to avoid researchers' selection bias towards the environmental characteristics of the routes. Although there was a lack of image updates in certain areas of the city of Curitiba between 2014 and 2016, the use of Google Street View proved to be sufficient for gathering audit information about the environment.

The script for using MAPS in ISA-Physical Activity and Environment Study followed the following chronological order: 1) Meeting with the GPAQ and training a researcher from the Physical Activity Epidemiology Group at the University of São Paulo (GEPAF-USP) to collect the data from São Paulo; 2) Reviewing the instrument, preparing the electronic form, and hosting it in Google Forms; 3) Georeferencing participants' homes and creating routes; 4) Training evaluators with reliability analysis; and 5) Conducting data collection procedures (Figure 3). For data collection, we used a sample of 1,067 households that remained unchanged between the two collection waves (2014/2015; 2020/2021). Additionally, we included another 138

Figure 2 – View of routes, segments and intersections georeferenced and located in the Google Earth, São Paulo, 2022

households, corresponding to subjects who moved between the two evaluation times. In total, we collected data from 1,205 households.

Considering that the environment of the city of São Paulo has different characteristics from the country in which the method was created, as well as from the city of Curitiba-PR, some adaptations were made throughout the planning process: 1) Increase in the evaluation coverage of the segment section, considering both sides of the streets from the starting point. This includes items such as the presence of parking lots and the quality of the sidewalks. The instrument previously only considered the participant's side of the house; 2) In the intersections section, evaluation of all crossing possibilities, not just one as the method proposes. This is done in order to verify aspects related to traffic control for a safe crossing; 3) Insertion in the route section of the following elements: a) Presence of public health services (hospitals and primary health care units); b) Gyms for physical exercise practices; c) Educational institutions (universities and schools); d) Bus lanes; e) Staircases; f) Alleys. The scores followed the original structure of the instrument, taking into account the number of items along the route (0, 1, 2, 3, 4, or 5+). The presence of staircases and alleys will be evaluated as negative aspects in the environment. In the segment section, the presence of vacant lots (with or without weeds) was added because it is considered a common feature that can generate a feeling of insecurity for pedestrians.

Three forms were created for the data collection and storage process, with each form corresponding to a section of the instrument on the Google Forms platform. A specific manual was prepared based on the one produced by GPAQ, as well as training videos. The materials are available on the GEPAF-USP website at http://www.each.usp.br/gepaf/?cat=11&lang=pt.

The ArcGIS Desktop software, version 10.8.1.14362 was used to prepare the routes. The original MAPS methodology recommends that the route should start at people's homes and end at the nearest shopping center, provided that it is at least 400 meters and no more than 725 meters away from the residences. In cases where the route, which has traveled less than 400 meters, reaches the shopping center, it must be extended in the same direction (for example, from north to south) until it reaches 400 meters. At the other extreme, if it does not reach the shopping center even after traveling 725 meters, it must be closed. These distances are based on walking distances, which can be covered in approximately 10 minutes[16].

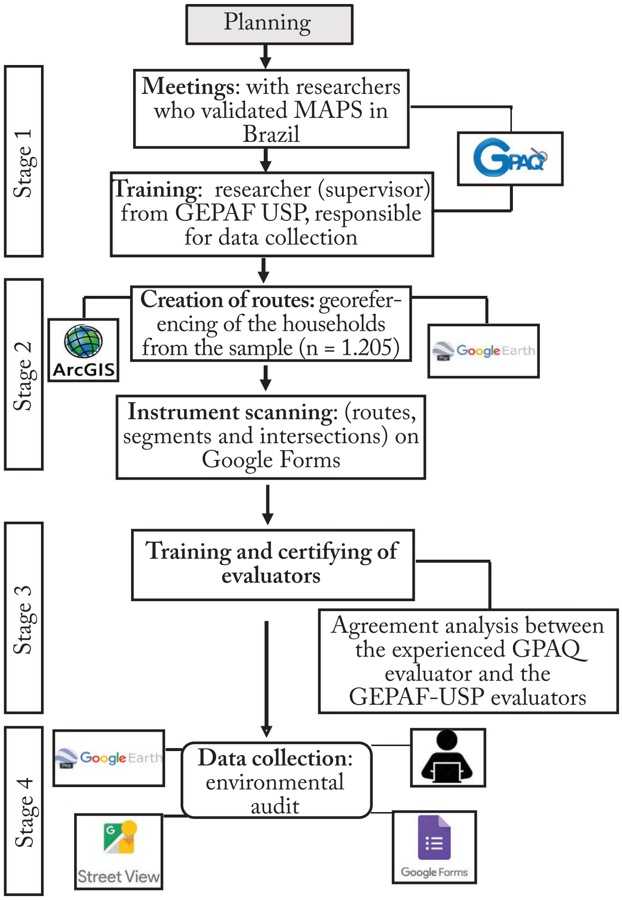

Figure 3 – Flowchart of the steps of the MAPS methodology in the ISA-Physical Activity and Environment study

It was necessary to georeference the subjects' residences, and the addresses were considered as the starting points of the routes. Shopping centers were designated for each of the 96 districts that comprise the city of São Paulo. As the definition of shopping centers was subjective, it was determined that the target shopping center would be the region with the highest concentration of registrations in the National Registry of Legal Entities (CNPJ), obtained through the Urban Property Tax (IPTU). Thus, all 794,968 CNPJ records in the city were georeferenced. For each district, a spatial marker indicating the commercial center was created.

Subsequently, the routes connecting the subjects' residence (incident) and the nearest shopping center (facility) were traced using the Closest Facility tool of the ArcGIS Network Analysis package. Finally, the routes were converted to Keyhole Markup Language (KML) format using the conversion tool, allowing them to be opened on the Google Earth platform (Figure 2).

Initially, the first evaluator from GEPAF-USP underwent a 40-hour training session with an experienced evaluator from GPAQ. From this training, the evaluator was responsible for MAPS-global, including training new evaluators who joined. In addition to preparing instructional videos and conducting meetings with the person in charge, all evaluators underwent training that included evaluating five surveys of routes, segments, and intersections. For the certification process of the evaluators, the method proposes a 95% agreement, but due to the subjective nature of certain items and elements that involve quality judgment, a minimum agreement of 90% has been established for the certification of new evaluators in all sections of the MAPS questionnaire.

The study team consisted of a geoprocessing specialist, a supervisor, and six evaluators. The supervisor had multiple roles, including being an evaluator. In addition to evaluating, the supervisor was responsible for: 1) Training new evaluators; 2) Distributing and auditing routes; and 3) Organizing the database. On average, blocks with 10 routes were sent. Regarding the organization of data, the supervisor periodically backs up responses to avoid any potential losses. Excel spreadsheets are created to monitor the distribution of routes and prepare reports. Initially, the routes shared by several individuals from the sample who lived in the same household or in a nearby household were distributed among the evaluators. This allowed each route, or some part of the route, to be audited only once.

Data collection lasted for 25 months (December 2020 to January 2023) and 1,434 routes, 11,201 segments, and 10,857 crossings were audited. Routes took an average of 25.8 minutes (sd = 17.4 minutes) to complete, with a minimum of three and a maximum of 87 minutes. Segments took an average of 8.9 minutes (sd = 4.4 minutes), with a minimum of one and a maximum of 46.2 minutes. Crossings took an average of 4.3 minutes (sd = 2.8 minutes), with a minimum of one and a maximum of 48 minutes. Image dates for each Google Street View route ranged from January 2010 (oldest) to May 2022 (most recent).

Discussion

The objective of this study was to report the methodological processes adopted to carry out data collection using the MAPS-Global instrument in the ISA-Physical Activity and Environment study. It also aims to highlight the difficulties encountered during the process and provide suggestions for future data collections using this method.

With online data collection, it is possible to audit a large number of routes in the city of São Paulo, which is one of the advantages of using virtual tools[11,18]. It is noteworthy that the auditing time for each section of MAPS-Global was similar to the times reported in other studies that utilized the same tool[11,18]. It is also important to highlight the saving of time and resources[19]. Initially on-site auditing instruments would have been used. However, due to the COVID-19 pandemic, the chosen built environment assessment had to be transferred to an online format using Google Earth. This made it possible to utilize the resource for conducting telephone interviews with participants in the second phase of the study.

MAPS-Global is a lengthy instrument with items that may pose challenges in assessment due to the subjective nature of elements like aesthetics and road width. As a result, constant training and supervision are necessary throughout the entire process[11]. It is suggested that other studies consider certifying evaluators by sections of the instrument rather than the general agreement. Certification by section can make it easier to include new evaluators, preventing delays and exclusion of possible evaluators from the collection process. Another important aspect is the collection and organization of data. It was decided to use Google Forms. However, this tool does not automatically fill in the duplicated routes, which increased the time required for organizing the data.

There are important strengths to this study, such as the evaluation of both sides of the routes, since there are still few studies that have used MAPS in this way, especially in longitudinal investigations using auditing techniques that assess the variability of environments on a microscale. This is particularly relevant in countries like Brazil and in cities like São Paulo, which have many environmental[20] inequities, high population density, income inequality, an accelerated urbanization process, and numerous changes in the built environment[21,22]. Newly published data from the ISA-Physical Activity and Environment study in São Paulo between 2015 and 2020 revealed disparities in the distribution of facilities in the built environment. For instance, bicycle paths, large public transportation stations, and squares were more common in high-income regions[23], findings emphasize the importance of expanding objective assessments through auditing. By considering these aggregate measures, we can gain a better understanding of the environment in which people live and examine its relationship with various types of physical activity practices.

The sample audited for this study is well distributed across the regions of São Paulo and may demonstrate the variability of environments. Also, because it involves an audit with constant updates of images by Google, the research has the potential to conduct longitudinal monitoring of the microenvironment, which represents an innovative aspect in the research area.

Finally, it should be noted that the audit of the environment in the city of São Paulo presented several challenges. Despite being conducted exclusively online, it involved complex and time-consuming data collection. The training and certification stages for the evaluators alone took more than two years. Additionally, the data collection process was lengthy due to factors such as the large sample size, inclusion of audits on both sides of the street in the segment section, evaluation of all possible crossings in the intersection section, and the need for a qualified team to carry out the audits. It is recommended that for future data collections, careful attention be given to the time allocated for auditing the environment and the size of the team for the selected sample. This is because a larger number of evaluators will result in a shorter collection time, as well as the opportunity to make adjustments to the instrument. These adjustments may include the inclusion or removal of items that are not applicable to the study's context or local reality.

Conflict of interest

The authors declare no conflict of interest.

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Author contributions

Oliveira ES and Paula IVS participated in the manuscript design, writing and relevant critical review of the intellectual content; Silva AAP participated in writing the manuscript and relevant critical review of the intellectual content; Hino AAF and Teixeira IP participated in the writing and relevant critical review of the intellectual content; Prado RCR, Lacerda JC and Oliveira LF participated in writing the manuscript; Florindo AA participated in the design of the manuscript and final approval of the version to be published.

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