Research Paper

Walkability Index as a Strategic Planning Instrument for the Historic Center of Rio de Janeiro

Gustavo RIBEIRO, Royal Danish Academy, Denmark

Victor ANDRADE, Technical University of Denmark (DTU), Denmark

Abstract

This paper describes the design and application of a walkability index developed by the Institute for Transportation and Development Policy – Brazil – and the City of Rio de Janeiro, with two of the authors acting as external consultants in the period 2015 - 2017. The walkability index presented here was designed in the context of strategic planning and strategic interventions in the historic centre of Rio de Janeiro, which aimed at the improvement of conditions of liveability in that area. The authors present a discussion of the methodology and approach adopted in the development of this walkability index with reference to the work of authors who have investigated the benefits of active mobility and to other walkability indexes and methodologies for measuring the effects of active mobility. This walkability index embodies an attempt to balance the design of a method for the systematic measurement of variables concerning urban form (such as width of sidewalks and block size), use of urban spaces (through count of pedestrian circulation) and environmental conditions (such as noise levels) on the one hand, and the development of a strategic instrument in the urban transformation of the historic center of Rio de Janeiro on the other hand. The development of this walkability index coincided with the investment by the Municipality of Rio de Janeiro on new transport infrastructure in the form of a light-rail system linking the historic centre with surrounding areas such as the newly redeveloped port and Santos Dumont Airport. At the same period, the programme *Centro para Todos* (Centre for All) was implemented by the Rio de Janeiro World Heritage Institute (IRPH) – with a focus on the improvement of conditions of the centre from the point of view of physical infrastructure (involving for instance the upgrading of sidewalks) and public safety and in view of boosting the residential use of the Rio de Janeiro's historic city centre. In this context, this walkability index was developed to highlight spatial conditions of Rio de Janeiro's historic centre that were estimated to have a relevant impact on pedestrian use. The authors present a reflection on the application of this walkability index in the formation of current urban policies such the 'Reviver Centro' programme.

Keywords

Walkability Index, Urban Policy, Strategic Planning

1. Introduction

1.1. Shift in Urban Policies in Rio de Janeiro

The Rio de Janeiro walkability index discussed in this paper was developed within the context of a major shift in urban policy towards revitalizing the historic center of Rio de Janeiro with a primary aim to recuperate many derelict buildings worth preservation and increase residential uses.

This shift was notably marked by the implementation of the programme “Centre for All” (Centro para Todos) (Prefeitura do Rio de Janeiro, 2015), which comprised a detailed mapping of land use and the condition of preservation of individual buildings in the historic center. The “Centre for All” programme was implemented in parallel with other important initiatives, notably:

(1) *Porto Maravilha Urban Regeneration Project*: a land value capture initiative involving the sale of development rights to renew the former industrial harbor, implementing mixed-used development and new cultural buildings.

(2) Light Rail: linking the center with surrounding areas such as the newly redeveloped port and Santos Dumont Airport

We argue in this paper that the development of the Rio de Janeiro Walkability Index should be considered a strategic element of urban planning and transformation in the context of the above-mentioned urban policies and initiatives as part of an overall shift in the political focus in urban planning. In that way, the walkability index contributed by developing a new methodology to measure and analyze urban spaces from the point of view of pedestrian use and to provide recommendations for further development of the historic center based on such analysis.

1.2. The Historic Centre of Rio de Janeiro

The historic centre covers an area 572,31 hectares, and it has a unique architectural value which has experienced a gradual loss of residential uses and a shift to predominantly commercial and business uses throughout the twentieth century. Many historic buildings were left empty and underused and fell in disrepair.

The historic center of Rio de Janeiro had undergone a long and continuous process of decay that can be traced back to the beginning of the twentieth century when the wealthier segment of the population began to move in greater numbers to the neighborhoods in the south of the city, such as Botafogo, Flamengo, and Copacabana. In 2022, the population was 32,758, down from 41,142 in 2010.

In parallel with such demographic dynamics, the centre underwent an accelerated pace of modernization with the 1930 Revolution and the institution of Getulio Vargas’ *Estado Novo*, which brought about the replacement of the existing urban fabric by modern high-rise buildings, such as the Ministry of Education and Health (1936 – 1943) designed by Le Corbusier in collaboration with Oscar Niemeyer and Lucio Costa amongst other leading Brazilian architects at the time.

Whilst recognizing the architectural and cultural importance of the modern movement’s legacy for the city of Rio de Janeiro and internationally and the necessity of urban interventions of modernization of obsolete urban infrastructure, it is nonetheless important to point out that a valuable heritage of historic buildings dating from the nineteenth century and from previous centuries was destroyed or abandoned as part of that process. In connection with this trajectory of urban development, the historic center experienced a gradual loss of residential use throughout the twentieth century, which has further contributed to the decay of historic buildings and the historic urban fabric.

In the new millennium the City of Rio the Janeiro devised urban policies and legislation aimed at boosting residential use and at promoting the rehabilitation of the historic buildings and urban fabric. (Saelens & Handy, 2008, p. 550)

The guidelines by the City of Rio de Janeiro (Secretary of Housing) issued in 2003 for the development of housing programmes stressed the need for a holistic approach towards the historic heritage of Rio de Janeiro's centre that should include not only the architectural heritage, but also the unique local cultures of each neighbourhood. (Prefeitura da Cidade do Rio de Janeiro, Secretaria Municipal de Urbanismo, 2003, p. 1)

The focus on rehabilitating Rio de Janeiro's historic centre and increasing residential use gained further momentum with urban plans, such as the Plan for Sustainable Urban Development – *Plano Diretor de Desenvolvimento Urbano Sustentável do Município do Rio de Janeiro* (Prefeitura do Rio de Janeiro, 2011c), urban legislation (Prefeitura do Rio de Janeiro, 2011b) (Prefeitura do Rio de Janeiro, 2012a) (Prefeitura do Rio de Janeiro, 2012b) and strategic projects and initiatives by the Rio de Janeiro World Heritage Institute (IRPH) (Instituto Rio Patrimônio da Humanidade, 2013).

The residential population of the central area of Rio de Janeiro in 2010 was twenty-eight thousand inhabitants and the IRPH set at target to increase the population to one hundred thousand inhabitants by 2020. (Instituto Rio Patrimônio da Humanidade, 2013, p. 8)

1.3. Programme Centre for All

The programme Centre for All was an initiative for urban regeneration of the historic centre of Rio de Janeiro implemented by the IRPH comprising two main fronts of action: one institutional and another operational. At the institutional level, the goal was to promote a culture of coordination between the services of different agencies of the Municipality of Rio de Janeiro (Cet-Rio, Comlurb, Guarda Municipal, RioLuz, Seconserva, Ordem Pública (Seop), Secretaria de Desenvolvimento Social (SMDS), and IRPH). (O Dia, 2015). Representatives from each agency met periodically to devise and implement plans of action. At an operational level, the programme Centre for All focused on the improvement of the safety of the inhabitants and the improvement of conditions for pedestrians through maintenance of sidewalks, street cleaning and lighting of public spaces, amongst other initiatives. (Prefeitura do Rio de Janeiro, 2015)

IRPH divided the historic centre into eight areas (shown in Figure 1). The first area designated for implementing the programme was the neighbourhood around Tiradentes Square. In view of coordinating the work of the Walkability Index with that of the Programme Centre for All, the first area of application for the Walkability Index was the neighbourhood around Tiradentes Square.

Figure 1 Designated area to start the "Center for All" program and develop the Walkability Index application. Source: ITDP, 2018.

2. Walkability

The primary purpose of this Walkability Index has been to provide a tool for the Municipality of Rio de Janeiro (and other municipal governments in Brazil) to be used to assess the built environment from the point of view of walkability. The formulation of specific indicators dealing with aspects such as land use mix and physical quality of sidewalks has been based on a close dialogue with the key departments in the Municipality of Rio de Janeiro and on a review of academic literature (Vale, Saraiva and Pereira, 2015) (Saelens and Handy, 2008) (L. Frank & Engelke, P. 2001) (Saelens, Sallis and Frank, 2003) (Cervero and Duncan, 2003) (Forsyth *et al.*, 2008) (Brownson *et al.*, 2009) that has documented the relevance of these aspects as important components of walkability.

Authors, such as Cevero & Duncan in their study of active mobility in the San Francisco Bay Area have looked critically at indicators usually included in studies of active mobility and have concluded that "Although well-connected streets, small city blocks, mixed land uses, and close proximity to retail activities were shown to induce nonmotorized transport, various exogenous factors, such as topography, darkness, and rainfall, had far stronger influences." (Cervero and Duncan, 2003, p. 1482). In their comprehensive review of evidence on the built environment correlates with walking (including 13 reviews and 29 original studies), Saelens & Handy highlight in particular consistent associations between walking for transportation purposes and density, land use mix, and proximity of nonresidential destinations (Saelens and Handy, 2008, p. 563), whilst findings for route/network connectivity, parks and open space, and personal safety were, according to the authors, more equivocal (Saelens and Handy, 2008, p. 550). Furthermore, Saelens & Handy point to "evidence less consistently found a relation between transportation walking and pedestrian infrastructure, such as sidewalk presence and

condition, although pedestrian infrastructure was more consistently related to recreation walking" (Saelens and Handy, 2008, p. 550).

The elaboration of this Walkability Index was based on a selection of environmental factors that would be included as indicators, based both on a critical examination of walkability studies methodologies and academic reviews of walkability indexes and on the specific characteristics of the urban and institutional context of the city of Rio de Janeiro.

With those considerations in mind, this Walkability Index has sought to include a wide range of indicators dealing not only morphological urban features such as "dimension of urban blocks", but also "environmental" considerations such as "shade and shelter" that are particularly relevant in the case of the hot and wet summers of Rio de Janeiro, and "public security" such as "street lighting," amongst other categories.

3. The Rio de Janeiro Walkability Index

3.1 Background

According to the Brazilian Association for Public Transport (ANTP), in Brazilian cities with over sixty thousand inhabitants, 41% of all transport journeys are realized on foot, whilst 25% are realized by individual motorized vehicles and 28% on collective transport (ANTP, 2018). There is an urgent need to assess and qualify the built environment in Brazilian cities from the point of view of pedestrians and to produce knowledge that can inform the elaboration of urban policies, strategies, and planning. The elaboration of the Rio de Janeiro Walkability Index was motivated by that need.

The centre is the urban district in the City of Rio de Janeiro, where the highest percentage (26%) of jobs are located (Prefeitura do Rio de Janeiro, 2011a, p. 8). It is an urban district that pedestrians intensively use on a daily basis.

The first version of the Rio de Janeiro Walkability Index was launched in 2016 by the Institute for Transportation and Development Policy in partnership with IRPH. The Walkability Index was developed in 2015 through a close dialogue between the ITDP and IRPH. The proposed indicators were discussed and adjusted in parallel with a pilot application of the Index in the neighbourhood of Tiradentes Square. This pilot application of the Index preceded the implementation of the first phase of the programme Centre for All in Tiradentes Square (Prefeitura do Rio de Janeiro, 2015) and by identifying specific challenges (such as maintenance of sidewalks down to particular location of holes in pavement) it delivered relevant input for the implementation of the programme.

As the main partner at the Municipality of Rio de Janeiro in elaborating the Walkability Index, the Rio de Janeiro World Heritage Institute (IRPH) coordinated the involvement of other municipal secretaries and departments. The involved public agencies participated actively in elaborating indicators relevant to their area of responsibility. That process contributed towards anchoring the Walkability Index in the different levels of the local administration.

In the period from 2016 to 2017 the Walkability Index was discussed in different forums with professionals from the Municipality of Rio de Janeiro, academics, and civil society. And as a result of that process, the Index was revised to simplify the data collection, reconfigure some indicators and making it more easily applicable in other Brazilian cities.

3.2. Indicators

The Walkability Index was developed in 2015 through a close dialogue between the ITDP and IRPH. The proposed indicators were discussed and adjusted in parallel with a pilot application.

The indicators of the Walkability Index are grouped according to six different categories (Figure 2). Aiming at anchoring the Walkability Index at different institutional levels of public administration, the categories were

defined by the areas of responsibility of departments of the Municipality of Rio de Janeiro and given the integration of the application of indicators in the work planning, public administration, and infrastructure maintenance performed by these departments. By defining these six categories and the fifteen indicators in close dialogue with the relevant departments of the Municipality of Rio de Janeiro, the authors also aimed at anchoring the Walkability Index at different institutional levels of public administration.

Sidewalk focuses on the physical attributes of the sidewalk, namely the width and level of pavement maintenance.

Mobility measures access to public transportation through two indicators:

1. Dimension of urban blocks
2. Distance to station of transport of medium or high capacity[1]

Attraction comprises indicators for the assessment of visually accessible activity behind the facades, public activity in the streets during daytime and nighttime and land use:

3. Facades visually transparent
4. Facades visually active
5. Public activity during daytime and nighttime.
6. Mixed use

Traffic Safety includes indicators measuring the conditions of safety for pedestrians concerning motorized traffic in streets and street crossings and the standard of universal design:

7. Street Typology
8. Crossings

Public Security is one of the central challenges in boosting residential use. Two indicators are included that concern both the perception of security by pedestrians as well as lighting and pedestrian use viewed as factors that can have a preventive effect on criminal behavior in public spaces:

9. Street lighting
10. Pedestrian flow measured at the daytime and at nighttime

Environment comprises indicators that measure environmental comfort factors that can have an impact on walkability:

11. Shade and shelter
12. Noise pollution
13. Garbage collection

[1] ITDP. Tod standard. 3rd Ed., 2017. Available at: <https://www.itdp.org/wp-content/uploads/2014/03/TOD-2017-v3.pdf>.

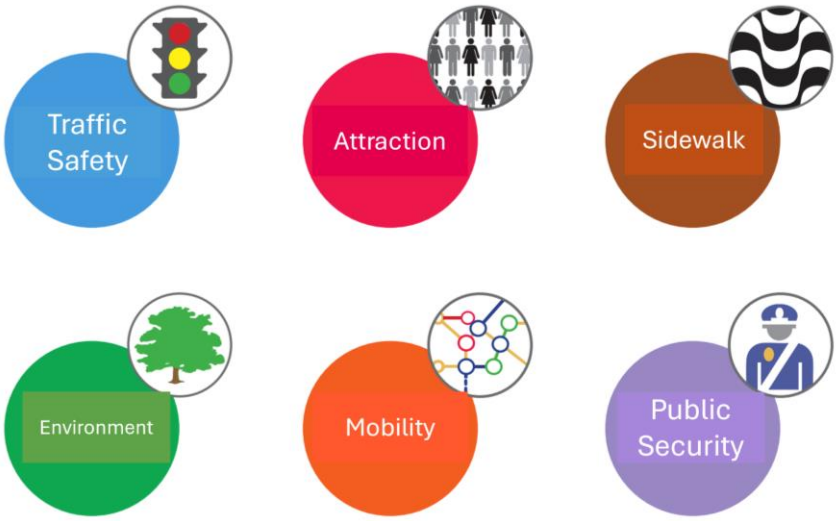

Figure 2 The six categories of the Walkability Index. Source: ITDP, 2018.

4. Methodology

4.1. Measurement

The Walkability Index was based on a methodology developed by ITDP and published in reports such as "Footpath design: A guide to creating footpaths that are safe, comfortable, and easy to use" (ITDP, 2013) and TOD Standard, 3rd edition (ITDP, 2017). Some indicators developed in connection with those guides are integrated in an adapted form in this Walkability Index. In addition, recent publications by WHO concerning traffic safety contributed towards the revision and refinement of some of the indicators (World Health Organization, 2017) (Global Road Safety Partnership *et al.*, 2008)

Furthermore, the structure of the Walkability Index, including the choice of indicators and definition of categories, was based on an assessment of its potential to be integrated into the daily activities of different departments and agencies of the City of Rio de Janeiro. Through a close dialogue with the different departments of the City of Rio de Janeiro, the following aspects were considered for the composition of the Walkability Index:

- Potential of inclusion of indicators already used by the Municipality of Rio de Janeiro
- Methodologies and protocols used by relevant departments and agencies of the Municipality of Rio de Janeiro in urban interventions and maintenance work.

The basic spatial unit of measurement used in the indicators of the Walkability Index is the *sidewalk segment* – defined as part of a sidewalk (sidelining a street) located between adjacent intersections of the pedestrian network - including non-motorized crossings – and considering only one side of the sidewalk (see figure 3).

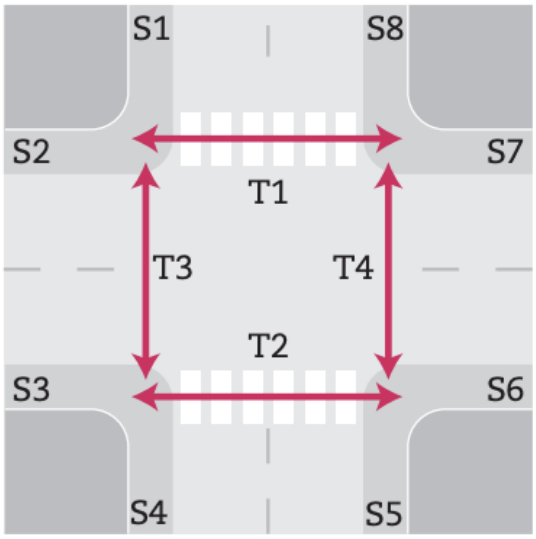

Figure 2 Sidewalk segments (S) and Crossing segments (T). Source: ITDP, 2018.

With particular indicators, such as *(5) Facades Visually Transparent (6) Facades Visually Active*, a spatial unit of measurement compatible with those indicators was chosen – in this case, the façade of an entire block corresponding to a sidewalk segment. In the case of the indicator (9) *Street Typology*, the measurement was applied for the segment of the street and used in scoring the opposite segments of the sidewalk alongside the street.

The application of the Walkability Index was based on three types of data:

- Primary data collected in field research (such as the width of the sidewalks).
- Secondary data collected from pre-existing documentation, aerial / satellite photographs, and georeferencing programmes (such as Google Earth).
- Secondary data collected from public agencies (such as road hierarchy).

5. Discussion

5.1. Walkability Index as a Planning Instrument

The application of this index is based on evaluating the aspects of the urban environment that favour or discourage walking, and the basic unit of analysis is the sidewalk segment. The idea behind the adoption of that scale of analysis is to promote an understanding pedestrian networks in the scale of the neighbourhood. Following that approach, this Walkability Index is recommended for areas of up to one square kilometre.

Studies of walkability on the city scale provide a different (and complementary) perspective and make comparative studies between different cities possible. The publication “Pedestrians First: Tools for a Walkable City” developed by ITDP includes indicators at territorial scales different from this Walkability Index (ITDP, 2018).

The distribution of indicators under different categories is not without some ambiguity. The same indicator could have been assigned to different categories, as is the case of the Dimension of the Blocks indicator: even though it figures under the category Mobility, it could also be placed under the Traffic Safety category (to the extent that large blocks can encourage people to drive at speeds inappropriate to pedestrian safety), or it could be placed under the category Public Safety (large blocks may inhibit the circulation of more vulnerable groups due to the risk of crimes such as rape, sexual harassment or robbery), or it could even belong to the category Attraction (because it is an element related to the built environment).

This limitation stems mainly from the effort to carry out a holistic assessment of the aspects that affect walkability, through several indicators grouped into six categories. The fifteen indicators in this Walkability Index have different attributes, making alignment and compliance with the content of each category more difficult. In some cases, the indicator measures data that are directly related to a phenomenon evaluated in the category and, in others, it registers attributes by proxy, as is the case of the indicators related to the Public Safety category: the Indicator Flow of Pedestrians and Illumination are proxies of the Public Safety phenomenon.

Finally, the categorization of indicators of walkability into categories follows the intention of providing a readable and easy-to-apply tool and minimizing conceptual and technical inconsistencies. Consequently, we chose the list of indicators that through pilot applications were considered to be essential for each category, regardless of the variations in the number of indicators under each category. The Road, Mobility, Road Safety and Public Safety categories have two indicators each, differing from the Environment category - with three indicators, and the Attraction category - with four indicators. The calculation methodology of the categories or the proposed final index considers the arithmetic mean of the indicators that compose them and, therefore, an indicator of the category Attraction or Environment will have weights smaller than the indicators of the other categories.

Redundancy between indicators arises as creating a prioritized comprehensive tool has resulted in partial overlaps between indicators. This is the case, for example, of the indicators Mixed Uses and Public Day and Night Use, which refer to the question of the uses of buildings. However, the Mixed Uses indicator aims to focus on the diversity aspects of use in buildings, while Daytime and Nighttime Public Use is restricted to buildings that have public daytime and/or nighttime use.

5.2. Application

The data collection method was determined to allow the application of the Walkability Index in cities where there is a lack of public data (relating mainly to local land use, traffic management and public service management), as well as contexts where the evaluation of an indicator is not accessible (as is the case of an alternative survey for the Illumination indicator, in cases of impossibility of measuring by light metre).

Some indicators are based on quantitative data from field research, (Street typology and Crossings), while other indicators are based on qualitative data that depend on on-site observation and registration, as in the category Pavement (Pavement and Width). It was sought to attenuate the researcher's bias through the criteria defined for data collection, however, the variation of the methods used inevitably confers to the Walkability Index a certain degree of subjectivity.

Auditing could have been used to calibrate some of the indicators further, for instance, in the case of indicators measuring the perception of security by pedestrians. Auditing could have been used to assess how the presence of lampposts in different segments of sidewalks affects pedestrians' perception of security. Auditing could have been used to further specify the threshold of perception of public safety based on the number of people in a street.

6. Conclusion

A central argument of this paper is that a key contribution of the Rio de Janeiro Walkability Index to urban planning is its role in documenting, mapping and describing urban spaces in the historic centre through the development of a novel methodology with a focus on pedestrian use. Through a systematic and detailed approach to the development of indicators focussing on urban form (such as width of sidewalks and block size), use of urban spaces (through count of pedestrian circulation) and environmental conditions (such as noise levels) the Rio de Janeiro Walkability Index can be considered as strategic instrument of urban transformation. The development of the Walkability Index has concurred with other urban policies to promote a shift at a discursive

level and at the level of concrete interventions. In that sense, this Walkability Index can be seen as playing a key strategic role in the urban transformation of the Rio de Janeiro Historic Centre.

Strategic urban leadership has played a central role in developing policies promoting the rehabilitation of the historic centre through the administration of mayor Eduardo Paes. The work with Rio de Janeiro Walkability Index was initiated as a partnership between ITDP and the Municipality of Rio de Janeiro under Eduardo Paes leadership in parallel with other key policies and interventions, such as the programme Center for All, the implementation of a light-rail system and the Porto Maravilha programme. In the subsequent administration without Eduardo Paes at the helm, there was very limited further development of those policies. And with Eduardo Paes return as the mayor of Rio de Janeiro, the 'Reviver Centro' plan has been implemented with a focus on urban, cultural, social and economic revitalization of the historic centre. The 'Reviver Centro' plan and adopts a land value capture model with transfer of development rights to stimulate the increase in residential land use is a central component of the plan and rehabilitation of public spaces is one of the main aims of the plan.

The municipality has passed new legislation focusing on walkability, notably with a focus on tax incentives to promote the reoccupation of derelict buildings. In addition, the current Strategic Plan defines the city centre as a priority for redevelopment. The implementation of such urban policy and legislation elements highlights the importance of long-term strategic urban leadership, and in the context of this paper, it highlights the importance of conceiving the development of a walkability index of one initiative amongst several others for the promotion of shift towards pedestrian-centered urban planning.

At an institutional level, it is important to highlight the close partnership between the Institute for Transportation and Development Policy (ITDP Brazil) and the Municipality of Rio de Janeiro. Such partnership promoted a close dialogue and collaboration in developing the Walkability Index, designing each indicator, and implementing it in selected areas of the Rio de Janeiro historic centre. A key argument in this paper is that beyond a consideration of the extent to which methodical components of the Walkability Index have been adopted in urban planning practice at the Rio Municipality, the Walkability Index should be considered as a strategic element in the context of other plans and initiatives (such as Centre for All, Porto Maravilha, and Reviver Centro) towards a paradigm shift in policy making

7. References

ANTP (2018) 'Sistema de Informações da Mobilidade Urbana da Associação Nacional de Transportes Público - Simob/ANTP Relatório geral 2016'. Available at: http://www.antp.org.br/sistema-de-informacoes-da-mobilidade/apresentacao.html.

Brownson, R.C. *et al.* (2009) 'Measuring the built environment for physical activity: state of the science', *American Journal of Preventive Medicine*, 36(4 Suppl), pp. S99-123.e12. Available at: https://doi.org/10.1016/j.amepre.2009.01.005.

Cervero, R. and Duncan, M. (2003) 'Walking, Bicycling, and Urban Landscapes: Evidence From the San Francisco Bay Area', *American Journal of Public Health*, 93(9), pp. 1478–1483.

Forsyth, A. *et al.* (2008) 'Design and destinations: Factors influencing walking and total physical activity', *Urban Studies*, 45(9), pp. 1973–1996. Available at: https://doi.org/10.1177/0042098008093386.

Frank, L. and Engelke, P. (2001) 'The Built Environment and Human Activity Patterns: Exploring the Impacts of Urban Form on Public Health', *Journal of Planning Literature*, 16, pp. 202–218. Available at: https://doi.org/10.1177/08854120122093339.

Global Road Safety Partnership *et al.* (2008) *Speed management: a road safety manual for decision-makers and practitiioners.* Geneva: Global Road Safety Partnership. Available at: http://www.grsproadsafety.org/themes/default/pdfs/Speed%20management%20manual.pdf (Accessed: 15 June 2019).

Instituto Rio Patrimônio da Humanidade (2013) *Projeto Vazios Urbanos*. Prefeitura da Cidade do Rio de Janeiro, Gabinete do Prefeito. Available at: http://www.rio.rj.gov.br/dlstatic/10112/5333332/4139324/24VaziosUrbanosIRPH082014.pdf (Accessed: 6 December 2019).

ITDP (2013) *Footpath Design: A guide to creating footpaths*. Available at: https://www.itdp.org/2014/03/26/footpath-design-a-guide-to-creating-footpaths/ (Accessed: 15 June 2019).

ITDP (2017) *TOD Standard*. Available at: https://www.itdp.org/2017/06/23/tod-standard/ (Accessed: 15 June 2019).

ITDP (2018) *Pedestrians First: Tools for a Walkable City*. Available at: https://www.itdp.org/publication/walkability-tool/ (Accessed: 16 June 2019).

O Dia (2015) 'Centro é dividido em oito regiões para revitalização', *O Dia*, 15 August. Available at: https://odia.ig.com.br/_conteudo/noticia/rio-de-janeiro/2015-08-16/centro-e-dividido-em-oito-regioes-para-revitalizacao.html.

Prefeitura da Cidade do Rio de Janeiro, Secretaria Municipal de Urbanismo (2003) *A retomada do Centro da Cidade - Macrofunção Habitar o Centro/Prefeitura da Cidade do Rio de Janeiro*. 20030601. Rio de Janeiro: Prefeitura da Cidade do Rio de Janeiro, Secretaria Municipal de Urbanismo, Instituto Municipal de Urbanismo Pereira Passos. Available at: http://portalgeo.rio.rj.gov.br/estudoscariocas/download/2347_A%20retomada%20do%20Centro%20da%20cidade%20-%20Macrofunção%20Habitar%20o%20Centro.pdf.

Prefeitura do Rio de Janeiro (2011a) *Distribuição dos empregos formais na cidade do Rio de Janeiro em 2008: uma análise espacial*. Rio de Janeiro. Available at: http://portalgeo.rio.rj.gov.br/estudoscariocas/download/2938_Distribuição%20dos%20empregos%20na%20cidade%20do%20Rio%20de%20Janeiro%20em%202008.pdf (Accessed: 13 June 2019).

Prefeitura do Rio de Janeiro (2011b) *Lei complementar nº 111 de 1º de fevereiro de 2011. Dispõe sobre a Política Urbana e Ambiental do Município, institui o Plano Diretor de Desenvolvimento Urbano Sustentável do Município do Rio de Janeiro e dá outras providências.* Rio de Janeiro.

Prefeitura do Rio de Janeiro (2011c) *Plano Diretor de Desenvolvimento Urbano Sustentável do Município do Rio de Janeiro*. Rio de Janeiro.

Prefeitura do Rio de Janeiro (2012a) *Decreto no 35.646 de 16 de maio de 2012. Estabelece as diretrizes para outorga de uso a terceiros de próprios municipais sem destinação pública específica e em mau estado de conservação.* Rio de Janeiro.

Prefeitura do Rio de Janeiro (2012b) *Decreto no 35.648 de 16 de maio de 2012. Dispõe sobre o procedimento de arrecadação dos imóveis urbanos abandonados.* Rio de Janeiro.

Prefeitura do Rio de Janeiro (2015) 'Programa Centro para Todos entra na segunda etapa', 17 August. Available at: http://www.rio.rj.gov.br/web/irph/exibeconteudo?id=5529919.

Saelens, B.E. and Handy, S.L. (2008) 'Built environment correlates of walking: a review', *Medicine and Science in Sports and Exercise*, 40(7 Suppl), pp. S550-566. Available at: https://doi.org/10.1249/MSS.0b013e31817c67a4.

Saelens, B.E., Sallis, J.F. and Frank, L.D. (2003) 'Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures', *Annals of Behavioral Medicine*, 25(2), pp. 80–91. Available at: https://doi.org/10.1207/S15324796ABM2502_03.

Vale, D., Saraiva, M. and Pereira, M. (2015) 'Active accessibility: A review of operational measures of walking and cycling accessibility', *Journal of Transport and Land Use*, 9, pp. 1–27.

World Health Organization (2017) *Managing speed*. Geneva. Available at: http://www.who.int/violence_injury_prevention/publications/road_traffic/managing-speed/en/ (Accessed: 15 June 2019).