Universidade Estadual de Londrina

MONICA CRISTINA NISHIKAWA MOTOMURA

WALKABLE SPACES:

CORRELATION BETWEEN BUILT ENVIRONMENT, SOCIAL CAPITAL AND SELF-RATED HEALTH IN CAMBÉ - PARANÁ - BRAZIL

Londrina
2017

MONICA CRISTINA NISHIKAWA MOTOMURA

WALKABLE SPACES:

CORRELATION BETWEEN BUILT ENVIRONMENT, SOCIAL CAPITAL AND SELF-RATED HEALTH IN CAMBÉ - PARANÁ - BRAZIL

Research submitted for the fulfilment of the requirements for the Master's Degree in Architecture and Urbanism from the Associated Master Program in Architecture and Urbanism from State University of Londrina and State University of Maringá.

Advisor: Prof. Dr. Milena Kanashiro
Co-advisor: Prof Dr. Mathias Roberto Loch

Londrina
2017

Ficha de identificação da obra elaborada pelo autor, através do Programa de Geração Automática do Sistema de Bibliotecas da UEL

Motomura, Monica Cristina.
Walkable spaces : correlation between built environment, social capital and self-rated health in Cambé – Paraná – Brazil / Monica Cristina Motomura. - Londrina, 2017.
168 f. : il.

Orientador: Milena Kanashiro.
Coorientador: Mathias Roberto Loch.
Dissertação (Mestrado em Arquitetura e Urbanismo) - Universidade Estadual de Londrina, Centro de Tecnologia e Urbanismo, Programa de Pós-Graduação em Arquitetura e Urbanismo, 2017.
Inclui bibliografia.

1. Walkability - Tese. 2. Self-rated health - Tese. 3. Built environment - Tese. 4. Social capital - Tese. I. Kanashiro, Milena. II. Loch, Mathias Roberto. III. Universidade Estadual de Londrina. Centro de Tecnologia e Urbanismo. Programa de Pós-Graduação em Arquitetura e Urbanismo. IV. Título.

UNIVERSIDADE ESTADUAL DE LONDRINA
CENTRO DE TECNOLOGIA E URBANISMO

"WALKABLE SPACES: CORRELATION BETWEEN BUILT ENVIRONMENT, SOCIAL CAPITAL AND SELF-RATED HEALTH IN CAMBÉ - PARANÁ - BRAZIL"

Autora: Monica Cristina Nishikawa Motomura
Orientadora: Profª Drª Milena Kanashiro
Co-orientador: Prof. Dr. Mathias Loch

TITULAÇÃO: Mestre em Arquitetura e Urbanismo

APROVADA em 14 de março de 2017.

Prof. Dr. Romulo Celso Krafta

Prof. Dr. Renato Leão Rego

Prof. Dr. Geraint Ellis

Profª Drª Milena Kanashiro
(Orientadora)

MONICA CRISTINA NISHIKAWA MOTOMURA

WALKABLE SPACES: CORRELATION BETWEEN BUILT ENVIRONMENT, SOCIAL CAPITAL AND SELF-RATED HEALTH IN CAMBÉ - PARANÁ - BRAZIL

Research submitted for the fulfilment of the requirements for the Master's Degree in Architecture and Urbanism from the Associated Master Program in Architecture and Urbanism from State University of Londrina and State University of Maringá.

Advisor: Prof. Dr. Milena Kanashiro
Co-advisor: Prof. Dr. Mathias Roberto Loch

Londrina, 14th March, 2017.

FINAL BOARD EXAMINATION

Prof. Dr. Romulo Celso Krafta
Federal University of Rio Grande do Sul

Prof. Dr. Renato Leão Rego
State University of Maringá

Prof. Phd Geraint Ellis
Queen's University Belfast

Prof. Dr. Milena Kanashiro
State University of Londrina

To my family.

ACKNOWLEDGMENT

To the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES) for the scholarship that allowed me to dedicate myself entirely to this research.

To my advisor Professor Milena Kanashiro and my co-advisor Professor Mathias Loch. Thank you for the lessons, all the support, the extreme dedication to the development of this research and especially for believing in me.

To Professor Geraint Ellis, Professor Romulo Krafta and Professor Renato Leão Rego. Thank you for participating in the preliminary board and final board examinations and for contributing to this research.

To the State University of Londrina (UEL) and the Master Program in Architecture and Urbanism from the Department of Architecture and Urbanism. Thank you for contributing to my academic education.

To Cambé Townhall for providing the material for this research.

To Larissa Fontoura, Adriane Fernanda, Natália Tamanaka and Ana Castro for all the help and support for the development of this research.

To my family and friends who have been by my side during this stage of my life.

“SICINIUS

What is the city but the people?

CITIZENS

True. The people are the city”

The Tragedy of Coriolanus

William Shakespeare (1608, Scene I, Act III)

MOTOMURA, Monica Cristina Nishikawa. **Walkable spaces: correlation between built environment, social capital and self-rated health in Cambé – Paraná – Brazil**. 2017. 168 p. Dissertation (Master's Degree Dissertation) – State University of Londrina, Londrina, 2017.

ABSTRACT

The increase of health problems, such as chronic non-communicable diseases (NCDs) including heart diseases and obesity, are of a big concern for the current society. These chronic non-communicable diseases are strongly related to physical inactivity. Therefore, many researchers have been exploring the correlation between physical activity and the built environment, associating health with urban planning studies. Through an exploratory process, Loch (2013) correlated social capital with health in the VIGICARDIO study conducted in 2011 in Cambé, Paraná, Brazil. This research introduces built environment components to understand walkable spaces and aims to verify if the relationship between social capital and self-rated health can vary according to walkability levels in Cambé-PR. A walkability index was constructed based on the methodology of Frank et al. (2010a), which systematizes four built environment variables: net residential density, retail floor area ratio, intersection density and land use mix. This research explores the possibility of using social capital and walkable environments as a strategy to promote self-rated health. The results show that social capital is positively associated with self-rated health and that living in areas with higher walkability levels and within denser areas, can also relate to better self-rated health outcomes. This research contributes to the discussions about walkability and social capital within built environment organizations, and supports urban planning as a tool that assists in constructing a healthier city.

Key-words: Walkability. Health. Self-rated Health. Built environment. Social Capital.

MOTOMURA, Monica Cristina Nishikawa. **Walkable spaces: correlation between built environment, social capital and self-rated health in Cambé – Paraná – Brazil**. 2017. 168f. Dissertação (Dissertação de Mestrado) – Universidade Estadual de Londrina, Londrina, 2017.

RESUMO

Considerando o aumento de problemas de saúde relacionados com a inatividade física e com doenças crônicas não transmissíveis, tais como doenças cardíacas e obesidade, muitas pesquisas fazem a correlação entre o ambiente construído e a atividade física, incluindo ocaminhar. Essas questões associam a saúde com o planeja mento urbano. Por meio de um processo exploratório, Loch (2013) associa o capital social à saúde, a partir dos dados do estudo VIGICARDIO realizado em 2011, na cidade de Cambé, Paraná, Brasil. Essa pesquisa introduz os componentes do ambiente construído para entender espaços caminháveis e tem como objetivo verificar se a relação entre capital social e auto percepção de saúde se altera de acordo com o nível de caminhabilidade em Cambé. Um índice de caminhabilidade foi construído baseado na metodologia de Frank et al. (2010a), que sistematiza quatro variáveis do ambiente construído: densidade residencial, relação da área construída comercial e o terreno destinado a esse uso, densidade de cruzamentos e a variação do uso do solo. Nessa pesquisa, a auto percepção de saúde está relacionada à caminhabilidade, sendo que essa associação é relevante para compreender se ambientes caminháveis podem ser uma estratégia para promover uma auto percepção de saúde positiva, considerando também o capital social. Os resultados dessa pesquisa apontam que, de forma geral, o capital social está positivamente associado a auto percepção de saúde; a auto percepção de saúde é mais positiva em áreas mais caminháveis e com maior densidade populacional. Essa pesquisa contribui para compreender o deslocamento a pé e as discussões de capital social nas estratégias de organização dos espaços construídos para dar suporte a uma vida mais saudável.

Palavras-chave: Caminhabilidade. Saúde. Autopercepção de Saúde. Ambiente construído. Capital Social.

FIGURE INDEX

TABLE INDEX

BOARD INDEX

CHART INDEX

SUMMARY

1 INTRODUCTION

1.1 Research Problem

Chronic non-communicable diseases (NCD) represent a global problem (BROWNSON et al., 2009) related to public health in rich and poor countries (MALTA et al., 2009). In 2014, the total number of deaths in the world was 1.318.000, and it was estimated that 74% of these deaths were caused by NCDs (WHO, 2014a).

In Brazil, chronic non-communicable diseases represent a major concern in public health especially after the epidemiological transition that occurred in the second half of the 20th century (LOCH, 2013). According to the World Health Organization (WHO), cardiovascular diseases, cancer, chronic respiratory diseases and diabetes are considered the main types of non-communicable diseases. The susceptibility to these diseases increase due to physical inactivity (WHO, 2003). Aging and obesity are also factors connected to NCDs, and are closely related to behaviour issues included in the lifestyle of people (LOCH, 2013).

Although it is not completely understood how to increase physical activity behaviours (ELLIS et al., 2015) there is a growing comprehension of how the built environment can influence physical activity (SALLIS; BAUMAN; PRATT, 1998; HUMPEL et al., 2002; DING; GEBEL, 2012). There is a consensus that interventions in the environment will be needed in order to make expressive changes in the physical activity context (SALLIS et al., 2012).

Physical activity has been related to social capital (KIM et al., 2006; WEN; BROWNING; CAGNEY, 2007; MUMMERY et al., 2008; LEGH-JONES; MOORE, 2012) and built environment (CERVERO; KOCKELMAN, 1997; SUMINSKI et al., 2005; BERKE et al., 2007; CERIN et al., 2007; OWEN et al., 2007; BENTLEY; JOLLEY; KAVANAGH, 2010; KING et al., 2011; LOTFI; KOOHSARI, 2011; WITTEN et al., 2012; SUGIYAMA et al., 2015; CAUWENBERG et al., 2016). Social relationships are associated to health and can discourage negative behaviours. Therefore, the built environment can play an important role for supporting social and healthier behaviours.

Despite international efforts in implementing public policies to improve health in many countries all over the world, it is understood that human behaviour is related to enhancing health. The ecological model approach seeks to understand human behaviour changes that could lead to a healthier lifestyle. The main concept of ecological models is that

behaviour has different levels of influence, which can be changed through different forms of intervention (SALLIS; OWEN; FISCHER, 2008).

Therefore, healthy behaviours are connected with social interactions and community ties which are key elements of social capital (LEYDEN, 2003), and that may be related to ties in different contexts (HELLIWELL; PUTNAM, 2004). For example, particular social aspects can influence health habits (CASSEL, 1976) and understanding the role of social capital in communities can improve public health (LEYDEN, 2003).

Social capital can contribute to positive self-rated health outcomes (SUBRAMANIAN; KIM; KAWACHI, 2002; NIEMINEM et al, 2010; MOORE et al., 2011; HAN; KIM; LEE, 2012; WAVERIJN et al., 2014; LAU; ATAGUBA, 2015). Self-rated health is an important predictor in epidemiological studies associated to healthy behaviours and outcomes including obesity, access to medical care, physical activity, nutrition, smoking and alcohol consumption (LOCH, 2013). In this sense, self-rated health is related to the perception of one's own health condition that can lead, when positive, to healthier behaviours.

Thus, self-rated health also encompasses physical activity, which in this research was related to walkability. This association is relevant as an effort to comprehend if walkable environments might be a strategy to promote positive self-rated health.

Some research have showed how physical attributes can affect walkability through case studies (BROWNSON et al., 2009; LESLIE et al., 2005; LOVASI et al., 2008; SAELENS; SALLIS; FRANK, 2003; SAELENS et al., 2003; SOUTHWORTH, 2005; WOOD; FRANK; GILES-CORTI, 2010; FRANK et al., 2012). Considering the characteristics of walkable environments, interaction and proximity are elements that increase social capital in certain physical environments (CABRERA; NAJARIAN, 2013). Pedestrian oriented and mixed-use neighbourhoods are more likely to present these two characteristics (TALEN, 1999). In this sense, walkable spaces can support not only healthier behaviours, such as physical activity, but also social capital improvements.

However, even if this correlation is being addressed effectively through numerous studies, few of them relate these two dimensions – built environment and health - with social capital (WOOD; FRANK; GILES-CORTI, 2010). Besides, more researches are needed to assess the variables of the built environment in relation to objectives and perceptions data for a more accurate understanding of the influence of space in human behaviour (SAELENS; SALLIS, 2002).

There was an opportunity to investigate the exploratory process of existing data from Loch (2013), which linked social capital and health, by introducing a new element in this study: the built environment. In that way, social capital and health can be inserted into urban planning discussions. This interdisciplinary approach offers an opportunity to the health field: to study how transport investments and decisions over land use can impact quality of life (FRANK et al., e 2010a).

The methodological strategy of this research is to associate social capital and self-rated health correlations from the VIGICARDIO database, based on Loch (2013), according to walkability levels. A Walkability Index (FRANK et al., 2010a) was applied in Cambé-PR, based on the census tracts. The index involves four built environment variables: (1) net residential density; (2) retail floor area ratio; (3) intersection density and (4) land use mix. Social capital and self-rated health data were statistically organized by binary logistic regression to analyse the correlations between the variables, which were then arranged by walkability levels. The methodology adopted was Correlational Research in order to clarify patterns of relationship between two or more variables in a phenomenon (GROAT; WANG, 2002) and the methodological strategy was the Case Study, which can be used when it is necessary to deal with contextual issues in the phenomenon of study (YIN, 2001).

1.2 Research Objectives

The primary objective of this research is to verify if the relationship between social capital and self-rated health varies according to the walkability levels in Cambé (Paraná State, Brazil). There is an assumption based on the results from Loch (2013) that social capital can contribute to positive self-rated health in Cambé and can increase healthier behaviours, including physical activity.

The specific aims of the research are to:

- Analyse the urban morphology of Cambé and how it relates to walkability;
- Comprehend which walkability index variables influence the association between social capital and self-rated health;

1.3 Significance of the study

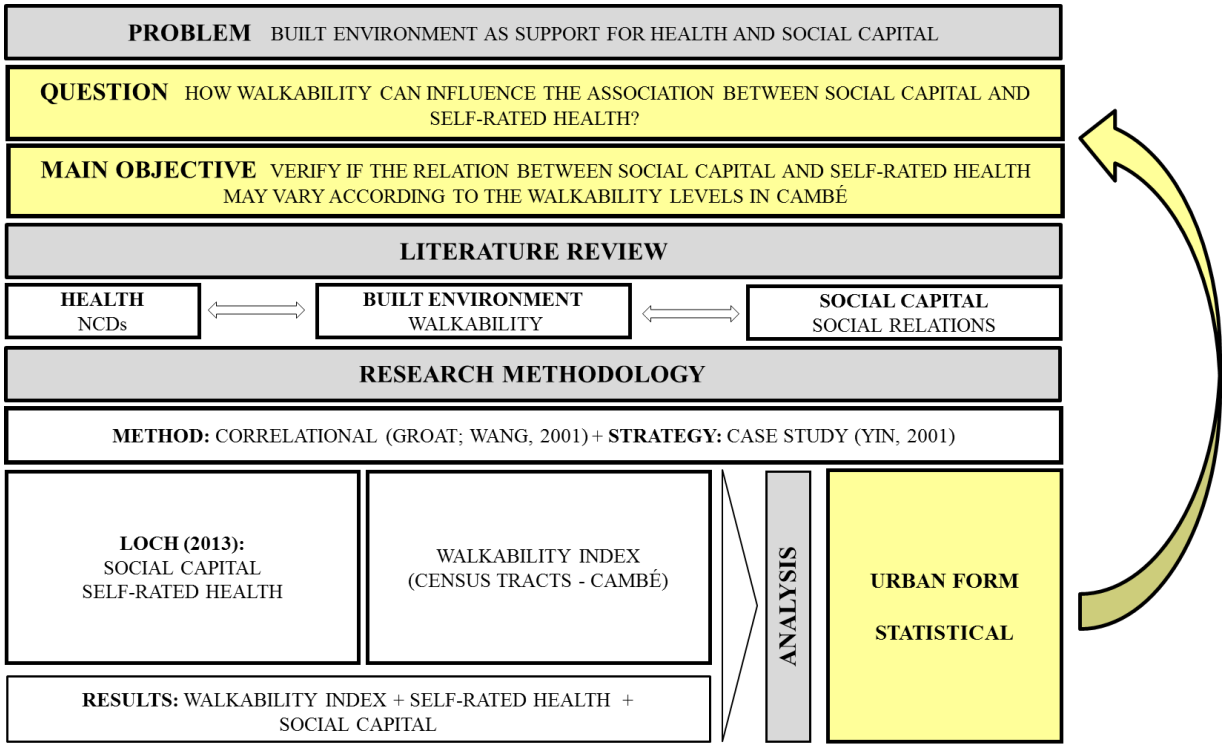
Although there are still several questions about the association between social capital, health and the built environment, as well as concerns about how it influences human behaviours, some findings of this research may indicate:

- An evidence on how an instrument to measure walkability can be applied especially in a developing economy country (WESP, 2014), such as Brazil. Many walkability indexes have been applied in developed countries, which do not reflect Brazilian urban environment and economic context that reflect high levels of social inequality;
- An empirical indication that demonstrates how social capital, self-rated health and walkability can be understood in a Brazilian small town;
- A better understanding of the Brazilian built environment characteristics related to walkability;

1.4 Research Outline

To reach the research objectives, this dissertation consists of six chapters. The first chapter of introduction shows a general overview of the research, with objectives and significance of the study in addition to the outline of the research structure. The second chapter of literature review points out main concepts, contexts and associations between built environment, health and social capital. The third chapter shows a framework of research methods and procedures, explaining how correlational variables and the walkability index were systematized in this research for Cambé-PR case study. The fourth chapter presents the results and analysis and finally the fifth and sixth chapters set the discussions and conclusions of this study. The following outline shows the development of the research (Figure 1).

Figure 1 - Research outline



Source: Organized by the author (2017)

2 LITERATURE REVIEW

2.1 Health: Non-communicable diseases

Chronic non-communicable diseases (NCD) represent a threat to health and human development in the world and in Brazil it is the main problem within health disorders (SCHMIDT et al., 2011). According to the World Health Organization, cardiovascular diseases, cancer, chronic respiratory diseases and diabetes are considered the main types of non-communicable diseases and they may be aggravated by aging once this factor is also connected with NCDs (LOCH, 2013). In 2014, the total number of deaths in the world was 1.318.000 and estimated 74% were caused by NCDs (WHO, 2014a). Furthermore, they constitute a serious problem of public health in rich and poor countries (MALTA et al., 2009). Deaths of people aging under 70 years old that were caused by NCDs represented 48% in low and middle income countries, and 28% in high-income countries and these numbers overall may increase from 38 million in 2012 to 52 million by 2030 (WHO, 2014b).

Obesity is also associated with non-communicable diseases, once it can enlarge the rates of diabetes, hypertension, coronary heart disease, stroke, types of cancers and other diseases (WHO, 2014b). In this sense, obesity is not isolated in relation to other diseases (HASLAM, 2007). Among adults aging 18 and older, 39% were overweight in 2014 and these rates doubled since 1980 (WHO, 2014b). Obesity is a condition in which its possible causes and treatment are well known such as diets, physical activity, use of drugs and surgery (HASLAM, 2007). This suggests that life conditions influence obesity (MALTA et al., 2009).

Physical inactivity has been a health problem globally (BROWNSON et al., 2009) and it plays a big role in the increase of incidence of NCDs including heart diseases, diabetes, types of cancer, osteoporosis, psychological disorders and obesity (WHO, 2003; BUTLAND et al., 2007; PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE, 2008). Active people, including men and women, present 30% lower risk of dying and present higher levels of health-related fitness in comparison to inactive ones. In addition, active people are also less likely to develop disabling medical conditions and present lower rates of chronic diseases (PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE, 2008). In the United States, more than 60% of the adult population does not practice the amount of physical activity recommended per day (MOUDON; LEE, 2003). In this sense, physical activity can be

an active tool for prevention, treatment and rehabilitation programmes of chronic diseases (PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE, 2008).

Although it is not completely understood how to increase physical activity behaviours (ELLIS et al., 2015) there is a growing comprehension of how the built environment influence physical activity (SALLIS; BAUMAN; PRATT, 1998; HUMPEL et al., 2002; DING; GEBEL, 2012). There is also a consensus that to make expressive changes in the physical activity context, interventions in the environment will be needed (SALLIS et al., 2012). Promotion of good health in the urban environment has been discussed since the 19th century when cities, especially in Europe and North America, faced a fast growth descendant from the Industrialization process (KENZER, 1999).

Health outcomes can also be related to self-rated health, which is an important health predictor in epidemiological studies and it is associated with healthy behaviours and outcomes including obesity, access to medical care, physical activity, nutrition, smoking and alcohol consumption (LOCH, 2013). Self-rated health data collection is easy and shows an important information regarding health in a subjective or perceptive way (REICHERT; LOCH; CAPILHEIRA, 2012).

The urban conception and the way cities are designed carry out public health consequences in relation to the built environment expressed as "the physical structures and elements of the human made environments in which we live, work, travel, and play" (FRANK; ENGELKE, 2005, p. 194). However, the connection between built environment and physical activity is rarely inserted in urban planning actions, although there is a forthcoming frame of research in this area (HANDY et al., 2002). The built environment is an important factor among many others which can be modified to support and influence health (FRANK et al., 2012; FITZPATRICK; LaGORY, 2000).

2.2 Walkability: built environment and health

Walking for different purposes – for errands or recreational - can be part of a global strategy to promote physical activity and to increase positive levels of public health (FRANK et al., 2012). Walkable environments can allow individuals to have an active lifestyle and to avoid diseases such as obesity, diabetes, cardiovascular diseases and types of cancer (EYRE et al., 2004). The lack of physical activity and obesity rates are increasing and these conditions are the main causes of disability and death (FRANK et al., 2012).

Besides contributing to a better health, walkability plays an important role within the sustainable mobility concept, since it reduces energy consumption of motorized transportation. It also helps to minimize environmental impacts, as walking demands fewer resources than other means of transportation, it is cheap, more silent, and a non-polluting way of displacement (ROGERS; GARDNER; CARLSON, 2013; GEHL, 2013).

Since the beginning of the last century, the dangers of traffic and the role of streets have been the main subject for discussion in modern planning (APPLEYARD, 1981).

> "In the twentieth century streets are cleaner than they used to be. They are better paved, too. But the paving has encouraged the intrusion of a new menace – the motorized vehicle. Today, traffic and its by-products have steadily and inexorably invaded the streets of our cities."
> (APPLEYARD, 1981, p.3)

Walkability was an essential factor in cities during the pre-automobile era. The city of Boston (MA) in the United States, prior to the 19th century, was developed in an area of approximately 3.2 km², where each point of the city was accessible by a walkable distance of about 1600 meters or 30 minutes. Currently, even after all its development, the city centre retains the character of a walkable space (SOUTHWORTH, 2005). Recently, the Neo-traditional Development (NTD) (LUND, 2002), has been rescuing the concept of planning "traditional neighbourhoods", which are characterized by high density, diverse typologies, trade and employment concentration, pedestrian oriented spaces, open public spaces and road connectivity. These characteristics resemble urban areas prior World War II (FRANK, 2000) and enables the designation of walkability to these traditional areas (LEYDEN, 2003; SAELENS; SALLIS; FRANK, 2003). To be traditional is to enable people to make travel choices, besides the motorized option, by setting up walkable configurations to the built environment while considering walkable distances for residents (FRANK, 2000).

One of the big benefits of walking is that it can be inserted in the daily activities of individuals (GEHL, 2013), who can align their daily needs to the quantity and quality of destinations (FARR, 2013). Walking can be considered an influential matter related to lifestyle choice (DU TOIT et al., 2007). Neighbourhood design may not only affect the amount of transportation choices provided (FRANK, 2000; TRANSPORTATION RESEARCH BOARD, 2005; HOEHNER et al., 2005), but also influences travel behaviour. Therefore, it is necessary to build up measures analysing various layers of the physical environment (HANDY et al., 2002). These measures are connected to travelling modes and

routes (CERVERO; KOCKELMAN, 1997), frequency and length of trips (HANDY et al., 2002) and walkability: land use mix, density and intensity, street connectivity, street scale, aesthetics, and regional structures.

Researches involving health behaviour and urban planning point out different patterns of associations between the built environment and physical activity. Some studies show reviews of papers related to these associations (Board 1) and others include socioeconomic and demographic characteristics as confounding variables (Board 2). So far, these researches have been developed in a limited way (OWEN et al., 2004), and this shows the need for more studies related to the built environment, especially those concerning specific physical activity contexts (DE BOURDEAUDHUIJ; SALLIS; SAELENS, 2003; CERVERO; KOCKELMAN, 1997).

Board 1 – Review papers about the relationship of built environment and physical activity

AUTHOR(S)	RESEARCH	MAIN CONCLUSIONS/DISCUSSIONS
SAELENS; SALLIS; FRANK (2003)	Transportation and urban planning investigations of environmental variables in relation to non-motorized transport and physical activity	Interdisciplinary approaches should be considered into consideration when dealing to improve understanding of the relation between built environment, physical activity and health.
SRINIVASAN; O'FALLON; DEARRY (2003)	Recommendations, based in the National Institute of Environmental Health Sciences (NIEHS) conference, for research and policy approaches in addition to concepts and definitions	Research on the relationship between built environment and health need to be improved and demands further comprehension, including methods and measures to analyse this relation
SAELENS; HANDY (2010)	Review of the evidence on the built environment correlates with walking	Positive relations between walking for transportation and density, distance to non-residential destinations, and land use mix were pointed out; Recreational walking is still not clear among studies
DURAND et al. (2011)	Compilation of existing built environment research in relation to the smart growth planning and its association with physical activity and body mass	The built environment associated with smart growth planning can improve physical activity
DING; GEBEL (2012)	Review of review papers about the relationship between built environment and physical activity and obesity	Conceptual and statistical models taking into consideration moderators and mediators, built environment objective and perceived measures and causal understanding should be better analysed in future studies
GRASSER et al. (2013)	Review of GIS-based measures of walkability in urban and suburban neighbourhoods consistently associated with active transportation and weight- related measures in adults	Population density, intersection density and walkability indexes were associated to walking, and these features are suitable for GIS walkability measuring process, especially related to transport
HARRIS et al. (2013)	Analysis of the development of researches about physical activity and built environment to identify gaps in this relation	Studies about built environment and physical activity associations are still in the discovery phase, suggesting that more research is necessary

Source: Organized by the author (2017)

Board 2 - Papers examining the association between built environment measures and physical activity moderated by confounding variables

AUTHOR(S)	RESEARCH	BUILT ENVIRONMENT	CONFOUNDERS	MAIN CONCLUSIONS/DISCUSSIONS
CERVERO; KOCKELMAN (1997)	Influence of the 3D's on trip frequency and mode choice of residents in San Francisco's Bay Area	3D's: Density, diversity and design	Age, gender, employment, race and ethnicity, number of members; number of persons under 5 years of age, vehicle ownership, income, housing tenure	Compact, mixed-use, pedestrian-friendly designs are related to walkability. There are some elasticities in the three dimensions of the built environment, but in combination they present more impact
HANDY et al. (2002)	Review of urban planning concepts toward the relationship between built environment and active travel	Density and intensity, land use mix, street connectivity, street scale, aesthetic qualities, regional structure	Sociodemographic variables can influence the relation between the built environment and travel behaviour	Walking and bicycling are more related to leisure than to travel. Human behaviour should be understood first than objective conditions that predict physical activity
SUMINSKI et al (2005)	Relationship between physical environment and walking of U.S. adults	Functional (construction/integrity of neighbourhood sidewalks and streets), safety (traffic volume and speed, lighting, and crime), aesthetic (cleanliness and views of buildings and scenery), destinations (e.g. shops, parks, work, or schools)	Ethnic background, educational attainment, age, dog ownership and gender	Environmental characteristics were related to walking in different ways for men and women. For women, safety and more destinations in their neighbourhood improved walking for exercise, walking a dog and walking for transport
FRANK et al. (2006)	Association between a single walkability index and health outcomes in King County, Washington	Land use mix, street connectivity, net residential density and retail floor area ratio (walkability index)	Gender, age, education, ethnicity, annual household income, children under 18	Walkability is associated with transport, body mass index reduction and fewer vehicle miles travelled, which also reduces the environment impacts and the prevalence of chronic diseases

KRIZEK; JOHNSON (2006)	Effect of household proximity to retail and bicycle facilities in relation to walking and cycling in Twin Cities, U.S.	Cycling: proximity of survey participants' homes to bicycle facilities; Walking: proximity to neighbourhood retail	Age, gender, education, employment, household size, children under 18 years old, household income, number of bicycles and vehicles per person	Bicycling and walking are related to proximity and destinations, factors that should be included in the planning policies
LEE; MOUDON (2006)	Relationship between physical environment and walking through the 3D+R in King County, Washington	3D+R: Destinations, distance, density, and route (land use and transportation infrastructure characteristics)	Demographic and household characteristics	Walkability analysis benefits from smaller scale data and spatial units and buffer sizes might be adaptable depending on the context. Observable environmental variables can be effective and turn the collection of data simpler, and specific approaches for walkability may be more suitable
BERKE et al. (2007)	Association between walkable neighbourhoods and more activity and less obesity in older men and women	Walkability score: distance, residential density, land use mix, accessibility (walkability index)	Age, income, education, living alone, living in same home at least 2 years	Neighbourhood walkability score results are related to the increase of walking for exercise in men and women. Types of land use and distances and residential density might be strongly related to physical activity in older adults
CERIN et al. (2007)	Associations between access to destinations and walking for transport in Adelaide, Australia	Land use mix, proximity of destinations	Age, gender, educational attainment, marital status, annual household income before taxes, employment status, ethnicity, number of children under 18 years in the household, children’s age and household size	Destinations in the neighbourhood can contribute to a more active lifestyle in its residents, fact that can be enhanced by improving this accessibility and public transport and encouraging walking

OWEN et al. (2007)	Objectively neighbourhood walkability attributes in relation to adults' walking for transport in Adelaide, Australia	Dwelling density, street connectivity, land-use mix, and, net retail area (walkability index)	Age, gender, education, children in household, household income (individual and census district levels)	Walking for transport is strongly related to street connectivity and proximity to retail and commercial destinations when considering week frequency
CERVERO et al., (2009)	Built environment in relation to walking and bike lane attendance in Bogotá	5D's: Density, diversity, design, destination accessibility and distance to transit	Individual level: age, gender; Household level: socioeconomic status and car ownership	Walking and cycling were only related to street design and regulation of streets. Density, diversity, destination accessibility and distance to transit were not related to induce travel demand, because in Bogotá, compact neighbourhoods are commonplace
SALLIS et al. (2009)	Associations of neighbourhood built environment and median income in relation to health outcomes	Net residential density, retail floor area ratio, intersection density, land use mix (walkability index)	Income, gender, age, education, ethnicity, number of motor vehicles/adults in household, marital status, number of people in household and years at current address	Lower-income adults have worst weight status, less quality of life, neighbourhood satisfaction and social cohesion, walk less for transport and when living in high walkable areas they have slightly poorer mental health
BENTLEY; JOLLEY; KAVANAGH (2010)	Objectively measured features of local environments in relation to time spent walking in Melbourne, Australia	Functionality, safety, destinations and aesthetics	Sex, gender, education, income, household composition, occupation	Design (increasing track length, fewer buildings with driveways), safety (decreasing distance of the path from the road), variety of destinations and commercial views are related to walking. Setting specific measures of the built environment might improve the outcomes
KING et al. (2011)	Relations of objectively measured neighbourhood design, mobility impairment, and physical activity and body weight in Seattle-King County, Washington and Baltimore-Washington DC	Net residential density, retail floor area ratio, intersection density, land use mix (walkability index)	Gender, age, education, race/ethnicity, number of motor vehicles/adults in household, marital status, number of people living in household and years at current address	People living in more walkable neighbourhoods were more likely to walk for transport and to do moderate to vigorous physical activity and to present lower body weight independently of income or mobility disability

LOTFI; KOOHSARI (2011)	Objective measures of the built environment in relation to walking in neighbourhoods of Tehran, Iran	Net residential density, retail floor area ratio, intersection density, land use mix (walkability index)	Social vulnerability (population, housing, socioeconomic status, and physical distance)	Levels of walking, is associated to the level of the neighbourhoods' walkability index, independently of social vulnerability. Elderly people living in high-walkable neighbourhoods walk more frequently than those who live in low-walkable neighbourhoods, regardless of their socioeconomic status
WITTEN et al. (2012)	Associations of objectively characteristics of the neighbourhood built environment with residents' self-reported physical activity (transport, leisure, and walking) and accelerometer-derived measures	Destination access, street connectivity, dwelling density, land-use mix and streetscape quality	Age, ethnicity, sex, qualifications, marital status, household income, employment, car access, neighbourhood deprivation and neighbourhood preferences	Street connectivity, destination accessibility, and dwelling density were related to transport and leisure physical activity, even controlling for preference of living in more or less walkable areas
HINO et al. (2013)	Association between features of the built environment and levels of walking and cycling for transport in Curitiba, Brazil	Accessibility, density of public transport, traffic safety, land use mix, street patterns and terrain slopes	Gender, age, education, marital status, car ownership, income	Cycling and walking for transport were higher in Recife, where there are the lowest human development index, higher crime rate, population density, unemployment rate and social inequality. Physical activity for transport might be related to necessity even with no safe circumstances, which means that demographic and economic issues can affect physical activity
REIS et al. (2013)	Association between walkability and physical activity outcomes, and the effect of income on this relationship among adults in Curitiba, Brazil	Residential density, intersection density, and land-use mix (walkability index)	Income, age, gender; years of education, marital status, children in the household, number of cars in household and time living in the neighbourhood	Walkability is related to physical activity for leisure and for transport. Urbanization process might interfere in the physical activity outcomes in developing countries

VELÁSQUEZ-MELÉNDEZ; MENDEZ; PADEZ (2013)	Associations between built environment and excess weight in the urban population of Belo Horizonte, Brazil	Parks, squares, locations for physical exercise, population density, and food stores	Gender, age, skin colour, conjugal status, education, income, population density	Living in neighbourhoods with higher population density was associated with lower prevalence of excess weight, even after adjusting for gender, age, and conjugal status. Presence of parks, squares, and locations were related to physical exercise in the neighbourhood
SUGIYAMA et al. (2015)	Associations of objective and subjective environmental attributes with walking for recreation in Adelaide, Australia	Objective: residential density, intersection density, land use mix and net retail area ratio; Subjective: access to destinations, aesthetics, walking infrastructure, traffic/barriers not a problem, crime safety	Age, gender, educational attainment, work status, marital status and annual household income	Residents of low SES areas had lower perceptions in neighbourhood aesthetics, traffic/barriers, and safety from crime, which decrease rates of recreational walking
CAUWENBERG et al. (2016)	Mediating effect of physical activity in the relation between walkability with health among Flemish adults	Residential density, street connectivity and land use mix diversity (walkability index)	Age, gender, educational level, marital status, number of motorized vehicles in the household, years living at the current address, residential self-selection, income	High walkable neighbourhoods are positively related to health (BMI and waist circumference) among older adults living in low income neighbourhoods with higher levels of moderate-to-vigorous physical activity and walking for transport

Source: Organized by the author (2017)

Health issues considered in the urban context have been a relevant topic in many projects especially the “Healthy Cities” from the World Health Organization (WHO) (NOGUEIRA; REMOALDO, 2010). Such programme is global and enlists local governments to achieve the health development by associating political, institutional and planning projects. The concept of “healthy cities” is interdisciplinary and involves sociology, urban geography, city planning, ecology, politics, economics, philosophy and many other areas including public health. It can be understood under different points of view depending on the person, the culture and the context (HANCOCK; DUHL, 1988). Healthy cities aim to provide healthy conditions to their population and better quality of life by enabling people to fully develop their potential (NOGUEIRA; REMOALDO, 2010).

> “A healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and in developing to their maximum potential.” (HANCOCK; DUHL, 1988, p. 24)

2.3 Social capital

The concept of social capital has its origins in social sciences studies, and it is becoming increasingly popular within many other subjects. The idea of social capital was first presented in sociology during the 19th century by Durkheim, Marx and Simmel. Although, sociologists do not consider it a new concept (PORTES, 2000), since the idea of social capital precedes the use of the word itself (LOCH, 2013). The first time the term "social capital" was used dates back more than 80 years ago in the writings of Lyda J. Hanifan, who was a superintendent of schools in West Virginia (WOOLCOCK; NARAYAN, 2000).

> “In the use of the phrase social capital I make no reference to the usual acceptation of the term capital, except in a figurative sense. I do not refer to real estate, or to personal property or to cold cash, but rather to that in life which tends to make these tangible substances count for most in the daily lives of a people, namely, goodwill, fellowship, mutual sympathy and social intercourse among a group of individuals and families who make up a social unit, the rural community, whose logical center is the school. In community building as in business organization and expansion there must be an accumulation of capital before constructive work can be done. (…).” (HANIFAN, 1916, p. 130)

The term was not used for subsequent years, but was adopted by several other authors, including Jane Jacobs (1961) in her critique of cities and Glenn Loury (1977) in his political approach (CANADIAN GOVERNMENT, 2003). Although, there is a consensus that the most important contributions to the meaning of social capital came from Pierre Bourdieu in France, and from James Coleman and Robert Putnam in the United States (Board 3). Bourdieu developed his concept between 1970 and 1980 but it did not attract much attention at that time. Coleman, with his social and economic vision, and Putnam who attracted more publicity, were responsible for the debate in the United States (FIELD, 2003).

Board 3 - Definitions of social capital by author

AUTHOR	DEFINITION
PIERRE BOURDIEU (1980)	Durable network of relations more or less institutionalized that is linked to a group of agents with characteristics in common and lasting connections. This network comes from social investment and to measure individual social capital ratio its extension is taken into account
JAMES COLEMAN (1988)	Social capital can have many forms and integrates through changes employed in human relationships that facilitate certain actions between people and it is part of the social structure. As an example, a group having greater trust between the members has a greater ability to reach targets in common than a group that does not emanate reliability
ROBERT PUTNAM (1995)	Social organization in the form of networks, norms and mutual trust within a group that facilitate cooperation for achieving a common benefit. Social capital levels can be detected by the amount of voluntary associations, trust between people and how people help each other. As an example, a community with high levels of social capital is more likely to have effective civic institutions and therefore may have greater prosperity

Source: Organized by the author (2017)

Social capital differs from other forms of capital. Just as physical capital is created to transform materials and tools to facilitate the production, human capital is created to transform people so that they have the capacity and ability to act in new ways. In this sense, social capital is created when the relationships between people change in order to facilitate certain actions. Therefore, this is a less tangible concept since it is based on social relations (COLEMAN, 1990). However, there is a debate if it is whether or not a form of capital (CANADIAN GOVERNMENT, 2003). According to Adler; Kwon (2009), social capital can be considered as capital, as well as physical and human capital. Social capital is potentially a long-term factor that requires costs to be produced and acquired, and involves time and effort. Social capital can also be invested to ensure future benefits, but unlike other forms of capital, the investment is not quantitative (ADLER; KWON, 2009).

More than providing a definition and the essential aspects of social capital and its effects, Ferlander (2007) conducts concepts of levels and forms of social capital, which can be developed in an individual or collective way, although both can be considered at the same time. For example, through social networks, which can be weak or strong, horizontal or vertical and formal or informal, it is possible to create: (1) bonding ties, which are relations likely to be developed in local groups (PRETTY, 2003) and in mighty closed groups (MATOS, 2009) between people with the same objectives; (2) bridging ties, which are relations between people or groups with different views that may be influenced by outer systems (PRETTY, 2003) or (3) linking ties, which are relations between people with different hierarchy positions (FERLANDER, 2007) (Board 4).

Board 4 - Forms of social capital

LEVELS OF DIRECTION AND FORMALITY TIES		**LEVELS OF DIVERSITY AND STRENGTH TIES**	
HORIZONTAL	**Formal** (voluntary associations) **Informal** (family, relatives, friends, neighbours and colleagues)	**BONDING**	**Strong** (social class or religion) **Weak** (members with same characteristics within voluntary y associations)
		BRIDGING	**Strong** (age, gender or ethnicity) **Weak** (members with different characteristics within voluntary associations)
VERTICAL	**Formal** (church, work hierarchies and network ties between citizens and civil servants) **Informal** (criminal networks, clan relations and street gangs)	**LINKING**	**Strong** (work colleagues) **Weak** (distant colleagues or ties between citizens and civil servants)

Source: Ferlander (2007); Organized by the author (2017)

Bonding ties are connected with the concept of homophily, which unwinds in the idea that similarities can generate more connections.

> "Homophily is the principle that a contact between similar people occurs at a higher rate than among dissimilar people. The pervasive fact of homophily means that cultural, behavioral, genetic, or material information that flows through networks will tend to be localized (…)."
> (MCPHERSON; SMITH-LOVIN; COOK, 2001, p. 416)

Neighbourhood residents with same characteristics including age, gender, race, education or socioeconomic status are more inclined to create a social tie in comparison

to people who are different from each other (CABRERA; NAJARIAN, 2015). On the other hand, homophily can also make interactions between diverse individuals shortened, which can cause segregation of a network in a wider approach (YUAN; GAY, 2006).

Bridging ties are more related to weak ties as proposed by Granovetter (1973) in his study. He argues that under bridge relations, it is possible to create interactions in micro and macro scales resulting in a large-scale pattern that returns into small groups. In this concept, weak ties are important to the interaction of individuals in a community. Friedkin (1982) also states that weak ties are essential to information flow, because people are more willing to keep more weak ties than strong ones, even though both ties are positive in their particular way in relation to information flow.

Social interactions and community life are key elements of the broader concept of social capital (LEYDEN, 2003). Societies, which develop the culture of reciprocity and interpersonal trust, are more likely to prosper and to achieve common well-being (D'ARAUJO, 2003). The main idea of social capital is straightforward when establishing that social relationships have value (ROGERS; GARDNER; CARLSON, 2013). Social capital may be related to family or friendship ties within workplaces, church, associations, community or even on the internet (HELLIWELL; PUTNAM, 2004). Because strategies are needed to create oriented social relations (PORTES, 2000), social capital can be generated according to changes in lifestyle (PUTNAM, 1993). Jane Jacobs in her book "The Death and Life of Great American Cities", originally published in 1961, says that through contact with people it is possible to create a public identity and also create a network of trust and mutual support. The absence of contacts may be a disaster for the streets (JACOBS, 2011).

Social capital can also be negative within certain groups and in some cases may generate inequalities, exclusion or prejudice among people (LOCH, 2013). Portes (2000) consider that social relations are not a natural practice and therefore well-oriented strategies need to be built in order to be a source of trust. It is possible to state that habits can be modified to generate greater social capital (PUTNAM, 1993), which is not something already built, but a result of many positive or negative relations (MATOS, 2009). Being positive or negative depend on the context, since a specific social interaction can be good in certain situations, but also negative in others (MATOS, 2009).

2.3.1 Social capital and health

Certain social aspects can influence health habits (CASSEL, 1976). Since the introduction of social capital in the discussions of public health (KAWACHI et al., 1997), new insights have enabled mechanisms that can influence health (GIORDANO et al., 2013). Understanding social capital rates in communities may be a relevant factor to improve public health issues (LEYDEN, 2003).

Kawachi and Berkman (2000) explored a different concept of social capital and health, by considering three main points that support the idea of social capital affecting individual health: (1) influence on healthy behaviours; (2) access to services and facilities and (3) influence on the psychological process. Some social capital factors related to health within a neighbourhood or locality are connected to the collective level. First, promoting rapid information diffusion enhancing the probability that people will adopt healthy behaviours in a more sociable environment (ROGERS, 1983). Second, exerting social control over negative behaviour, also mentioned by Ueshima et al. (2010, p. 1) as a "diffusion of healthy norms".

There are growing evidences that social capital benefits health and the well-being of individuals. The literature review papers show this association (Board 5).

Board 5 - Review papers about the relationship of social capital and health

AUTHOR(S)	RESEARCH	MAIN CONCLUSIONS/DISCUSSIONS
ISLAM et al. (2006)	Social capital and health association literature across countries taking into consideration the economic egalitarian as an influential aspect	Individual level social capital is more vigorous than area level to explain health relations
MCNEILL; KREUTER; SUBRAMANIAN (2006)	Identification of five social environment extensions (social support and social networks, socioeconomic position and income inequality, racial discrimination, social cohesion and social capital, and neighbourhood factors) in relation to physical activity rising different outcomes between them	Research on social environmental influences on physical activity is still growing. Little is known about the relative importance of these five dimensions of the social environment on physical activity
AGAMPODI et al. (2015)	Identify the methods used to measure social capital in low and middle-income countries	It is necessary to adapt and validate some tools once many of them were applied in high income contexts

POWELL et al. (2015)	Social networks measures that connects and influence overweight and obesity	Social aspects need to gain attention towards healthy behaviour
SUGLIA et al. (2016)	Social environments and obesity	Neighbourhood social environment may play an important role in the prevention of obesity, however, more research about how social networks play a role in the health behavioural issues are necessary

Source: Organized by the author (2017)

For both, the individual and collective levels, the socioeconomic status plays an important role towards the correlation between social capital and health. Socioeconomic factors tend to gather characteristics in a specific group of analysis, which can be approximated to the social capital forms, which consists of being formal, informal, weak or strong. In relation to the individual level, there are many variables of social capital, which are pertinent to health such as socioeconomic status (LINDSTRÖM, HANSON, ÖSTERGREN, 2001). Mortality rates can be related to income differences (WILKERSON, 1997), since greater disparity between rich and poor population affect the disintegration of the social structure (KAWACHI et al., 1997). However, social capital can play an important role when considered as a mediator between income inequality and health related quality of life (KIM, KAWACHI, 2007). The more compact and homogeneous a society is, in relation to income, race and religion, the more it improves trust perceptions (ALESINA; LA FERRARA, 2000). Studies have been showing that individual characteristics used as confounding variables are relevant to the association between social capital and health (Board 6).

Board 6 - Papers examining the association between social capital and health moderated by confounding variables

AUTHOR(S)	RESEARCH	SOCIAL CAPITAL	CONFOUNDERS	MAIN CONCLUSIONS/DISCUSSIONS
KIM et al. (2006)	Relations between US state and county levels social capital and obesity and leisure-time physical inactivity	Participation in organizations/community, meetings attended, volunteer work, trust, honesty, visiting friends etc.	Age, gender, race/ethnicity, marital, educational attainment and income	Social capital in the state level presented lower odds of obesity and physical inactivity. For state level, social capital (civic and political participation) was less strong in comparison with county level, what suggests that social capital might be more positive for local environments
WEN; BROWNING; CAGNEY (2007)	Relationship between neighbourhood socioeconomic status and social capital on physical activity in Chicago, U.S.	Trust and norms of reciprocity	Individual level: age, gender, race/ethnicity, marital status, education and annual household income; neighbourhood-level: deprivation index	Neighbourhood socioeconomic status and social capital are relevant to physical activity outcomes, over individual characteristics. Neighbourhoods effects are more influential for women and results suggests that neighbourhood level SES may be the key to promote physical activity
MUMMERY et al. (2008)	Associations between social capital and physical inactivity in Queensland, Australia adults	Social networks and support, and social participation	Age, gender, education and household income	Physical inactive is related to lower social capital scores in comparison to those who do physical activity. However, gender, age, income or educational groupings did not show any significance
LEGH-JONES; MOORE (2012)	Association between network capital and physical inactivity in Montreal Metropolitan Area, Canada	Person's ties to others working in specific types of occupations	Gender, household income, educational attainment, age and self-rated health	Younger age groups and men were less likely to be inactive. Higher education, self-reported health and social capital, except trust, were related to physical activity

LUCUMÍ et al. (2015)	Relationship between levels of cognitive social capital and health-related quality of life in Bogotá, Colombia	Trust	Age, gender, educational attainment, living arrangements and proximity to family members	There are positive associations between cognitive social capital and physical and mental health, and a higher score of physical health among older adults living in high socioeconomic neighbourhoods. In addition, better physical health was associated with shared common values and a sense of fairness and that people living in more socioeconomically advantaged neighbourhoods have more mental health benefits from having a high perception of fairness. Results of the research are associated to the income inequality of Colombia

Source: Organized by the author (2017)

Self-rated health can also be associated to social capital (SUBRAMANIAN; KIM; KAWACHI, 2002; KAVANAGH; TURRELL; SUBRAMANIAN, 2006; KIM; KAWACHI, 2006; POORTINGA, 2006; NIEMINEN et al., 2010; MOORE et al., 2011; AHNQUIST; WAMALA; LINDSTROM, 2012; HAN; KIM; LEE, 2012; KISHIMOTO et al., 2013; NIEMINEN et al., 2013; WAVERIJN et al., 2014; LAU; ATAGUBA, 2015).

Collective or individual social capital are both related to positive self-rated health (NIEMINEN et al., 2010). In an individual context, social capital may emerge in specific groups or actors (KAWACHI et al., 1997). In a collective way, which is based on the level of social capital of residents of a geographical scale such as neighbourhoods (WAVERIJN et al., 2014), social capital is not exclusive and in the general conditions can benefit people who do not invest in individual social capital (COLEMAN, 1988).

The collective level of social capital can be represented by bonding and bridging ties, which are both related to health, although in different manners. In this context, social capital might be relevant for people with chronic diseases, who are less likely to participate in their neighbourhood because of their health limitations (WAVERIJN et al., 2014). For example, in Japan, Kishimoto et al. (2013) concluded that, for a population aged 65 years old or more, bonding and bridging social capital are inversely associated with poor self-rated health for Japanese men. These findings were met after adjusting for socioeconomic variables, habits, overweight and personality. On the other hand, only bonding patterns were related to self-rated health for Japanese women.

Kim; Subramanian; Kawachi (2006) also categorize different outcomes when considering bonding and bridging social capital among 40 U.S. communities regulated by SES. Fair or poor self-rated health on the contrary are related to bridging social capital and to individual level measures, which are connected to bonding social capital and trust. In relation to ethnicity, bonding social capital is more consistently and contrarily associated with fair or poor self-rated among white people.

The number of researches showing the influence of social capital in self-rated health has been growing, since self-rated health is intrinsically related to health behaviour outcomes including physical activity, and has been explored in many epidemiological studies (Board 7).

Board 7 - Papers examining the association between social capital and self-rated health

AUTHOR(S)	RESEARCH	SOCIAL CAPITAL	CONFOUNDERS	MAIN CONCLUSIONS/DISCUSSIONS
SUBRAMANIAN; KIM; KAWACHI (2002)	Investigation of the association between contextual and individual level social trust with self-rated health in the U.S.A.	Trust	Age, gender, ethnicity/race, marital status, education and income	In a contextual direction, trust and self-rated health are positively related, but when controlling for individual trust perception, this relation became insignificantly. This fact shows that the association between self-rated health and trust are more complex
KAVANAGH; TURRELL; SUBRAMANIAN (2006)	Evaluate the relation between social capital and self-rated health, also considering area-based socioeconomic disadvantage in Tasmania, Australia	Social trust, trust in public and private institutions, neighbourhood integration, neighbourhood alienation, neighbourhood safety and political participation (all related to bonding, bridging and linking social capital)	Age, indigenous status, marital status, education, recent occupation, income and smoking status	Area SES has a strong relevance for self-rated health, when people living in deprived areas present fair or poor self-rated health. Social trust and political participation are related to positive self-rated health.
KIM; KAWACHI (2006)	Analyse the effect of grouped social capital with self-rated health in U.S.A.	Social trust, informal social interactions, formal group involvement, religious group involvement, giving and volunteering, diversity of friendship networks, electoral political participation and non-electoral political participation	Age, gender, race, marital status, education, income, proximity to core urban areas	Social capital is positively associated to self-rated health (at community and individual level) and each variable of social capital play a different role and gives a specific correlation with self-rated health. Also, living far from urban core areas presented strong health advantage
POORTINGA (2006)	Investigate the hypothesis that the association between social capital and health is mediated by people's health behaviours	Social support, social trust, civic participation	Age, gender, economic status, social class, household tenure, smoking, alcohol intake, and fruit/vegetable consumption	High levels of trust and those with a medium or high level of civic participation were less likely to report poor health. At the community level, social capital lowered the risk of reporting poor health. Controlling for smoking, alcohol intake, and fruit/vegetable consumption did not affect the association between social capital and self-rated health

NIEMINEN et al (2010)	Examine specific dimensions of social capital in relation to self-rated health and psychological well-being in Finland	Social support, social participation and trust/reciprocity	Age, gender, education, living arrangements, income, type of region, long-standing illness and functional capacity	All three social capital dimensions were associated with positive outcomes of self-rated health. Even after adjusting data, trust/reciprocity and social participation continues associated. Mainly, young age, higher education, higher income and the absence of long-standing illness and functional limitations were positively associated with positive self-rated health. Also, people living alone self-rated themselves with good health if they participate socially
MOORE et al. (2011)	Investigate the association of sociodemographic and social capital with core ties and self-rated health in Montreal, Canada	Trust, social participation and network social capital	Gender, income, education, employment, age, marital status, primary household language, birthplace and length of residence at current address	Extra-neighbourhood social capital with diversity and neighbourhood social participation were related to good self-rated health. For adults, a positive outcome of self-rated health was found in people's connections and access to resources outside their neighbourhood.
AHNQUIST; WAMALA; LINDSTROM (2012)	Associations between lack of economic capital and social capital with health outcomes in Sweden	Social participation, interpersonal and political/institutional trust	Age, country of birth, educational level, employment status, family status and long-term illness	Low social capital and economic capital (individual level) are independently associated with poor health outcomes, but when combined they worsen poor health for men and women. Social participation, were significantly associated with poor self-rated health for women and poor self-rated health and psychological distress for men.

HAN; KIM; LEE (2012)	Examine the relation between social capital and self-rated health, controlling for confounders at individual and area levels in Seoul, South Korea	Network resources and organizational participation	Area level: public assistance, female-headed households with children under poverty line, male-headed households with children under poverty line. Individual level: age, gender, perceived social class, employment, education, marital status, smoking and drinking	There was a low percentage of people reporting good health (38,5%). Individual level social capital is positively associated with self-rated health (network resources and organizational participation). Social capital concept were created in the western countries, but it showed an important role in justifying health outcomes in South Korea for individual level
KISHIMOTO et al. (2013)	Investigate the association between bonding and bridging social capital with self-rated health for men and women in Okayama, Japan	Social participation/ involvements (bonding or bridging social capital)	Age, education, smoking, frequency of alcohol consumption, overweight and living arrangements, type-D personality	For elderly men, both bonding and bridging social capital were associated with positive self-rated health. For elderly women, only bonding social capital. Men has more flexibility to construct social connections even after retirements (workplace = bonding; retirement = bridging). On the other hand, women are less flexible.
NIEMINEN et al. (2013)	How different dimensions of social capital and health behaviours are connected in Finland	Social support, social participation and networks, trust and reciprocity	Age, gender, education, income and living arrangements	High levels of social participation are related to healthier behaviours and it is the only social capital dimension that is clearly associated with health behaviours independently of sociodemographic variables. Social support, trust and reciprocity were independently associated with self-rated health and psychological well-being

WAVERIJN et al. (2014)	Investigate interactions effects on individual and neighbourhood social capital with changes over time in self-rated health of people with somatic chronic diseases in Netherlands	Individual: like neighbourhood, feel connected, know the neighbours, social interaction. Neighbourhood: contacts with neighbours	Individual: sex, age, education, income, employment, marital status, nature of the first diagnosed disease; number of chronic diseases, self-reported severity of the disability. Neighbourhood: income, urbanity, ethnic diversity	Individual and neighbourhood social capital at baseline presented a positive effect on changes in self-rated health of people with chronic diseases. In this context, neighbourhood social capital play an important role for people with chronic diseases, because of their disabilities
LAU; ATAGUBA (2015)	Examine the association between social capital and self-rated health in South Africa in a longitudinal study	Individual level: group participation, personalized trust and general trust and reciprocity and associational activity (household level. Neighbourhood: aggregating individual social capital	Individual: age, sex, race, marital status, education, employment, self-rated health, urban, obese, smoking and number of household members. Neighbourhood: deprivation index	Individual personalized trust, community service group membership and neighbourhood personalized trust were positively associated with self-rated health. In this study, socioeconomic conditions were significant and these factors should be taken into consideration for policy makers

Source: Organized by the author (2017)

For the promotion of health it is required that health policies are designed in a sustainable way and with the participation of society (SAPAG; KAWACHI, 2007). In this perspective, models and theories, which study human behaviour, can be considered (LOCH, 2013). Ecological models have increased their relevance and applicability in the last two decades, guiding approaches to change behaviours to decrease health problems. A multilevel ecological framework can anticipate physical activity behaviour through a complex correspondence between social, physical, and policy environmental aspects and human action, such as live, work and play and it is also necessary to orientate ecological models to specific contexts according to the type of behaviour that will be analysed (GILES-CORTI et al., 2005). In the United States, the reductions in tobacco use since 1960 were a result of integrated strategies that were linked to ecological models (SALLIS; OWEN; FISCHER, 2008). The main idea of ecological models is that one's behaviour has different levels of influence including intrapersonal, interpersonal, organizational, communal, physical space and policy. Ecological models help to better comprehend the determinants of healthy behaviours and can be used to develop forms of intervention aiming at changing behaviours at each level of influence (SALLIS; OWEN; FISCHER, 2008). In ecological models, more collective concepts are applied such as the social support, social determinants as well as the social capital one. In this context, social capital in relation to greater participation and social organization can influence people to act collectively to increase the chances to reach a collective purpose such as health (LOCH, 2013). Inside a collective-ecological dimension of society, it is necessary to understand social capital along with social cohesion when there are strong social ties, absence of conflicts, trust and reciprocity.

2.3.2 Social capital and the built environment: encompassing health

The neighbourhood is an important element for our identity and it has social meanings defining who we are and how we live (FITZPATRICK; LaGORY, 2000). Different types of built environments enable distinct ways for social capital to take course (DESIGN FOR HEALTH, 2008) and there is a premise that neighbourhood designs are related to social capital (Board 8).

Board 8 - Papers examining the association between social capital and the built environment

AUTHOR(S)	RESEARCH	BUILT ENVIRONMENT	SOCIAL CAPITAL	MAIN CONCLUSIONS/DISCUSSIONS
LEYDEN (2003)	Investigation of the hypothesis that pedestrian-oriented and mixed-use neighbourhoods encourage levels of social interaction in Galway, Republic of Ireland	Neighbourhood walkability: land use mix	Knowing the neighbours, political participation, trust or faith in people and social engagement	People living in walkable areas with mixed-use neighbourhoods are more likely to know their neighbours, to participate politically, to trust others, and to be involved socially
WOOD et al. (2008)	Relationship between social capital and the built environment, focusing in particular on the walkability of suburbs in Perth, Australia	Street network design and land use mix	Trust, concern, reciprocity, civic engagement, friendliness and networks	Higher suburb maintenance, proximity to shops, design, conventional street network, composition and quality of the built environment are associated with higher levels of social capital in the suburbs. In addition, social capital is positively associated with participation in local activities. Presence of children under 18 years at home, level of income, age group and dwelling type were associated to social capital. Gender and income are strong demographic predictors of feeling safe, which is related to social capital
MASON (2010)	Relationship between community design and trust in Boise, U.S.	Street design, sidewalks and open space	Trust	Income inequality is negatively related to trust, but street design, sidewalks, parks and open space can increase trust. An interesting outcome is that cul-de-sac design streets were positively associated with trust, in conjunction with being women and having a greater numbers of children. An explanation might be that cul-de-sac streets and parks, adults and children can interact. As a conclusion, community design can contribute to building trust even if the design cannot overcome income inequalities

ROGERS et al (2011)	Investigation of the generation and maintenance of social capital as an important component of quality of life that may be more effective in walkable communities in New Hampshire, U.S.	Destinations and walking distances	Trust, participation in community project, inviting friends at their homes, volunteer work, meeting attendance, affirmation that TV is the main form of entertainment	Social capital might be a mediator between walkability and quality of life. The number of destination in a walkable distance is strongly correlated to indicators of social capital
ROGERS et al (2012)	Relationship between select measures of social capital and self-perceived walkability in Manchester and Portsmouth, New Hampshire, U.S.	Accessibility and walking distances (walkability index)	Trust, working on a community project/volunteering, donating blood, attending a public meeting, a political meeting or rally, a club or organizational meeting, visiting the home of someone of a different neighbourhood, visiting the home of a community leader	Higher levels of social capital were related to individuals who perceived their neighbourhoods to be more walkable. Higher walkability were associated with higher levels of participation in community activities and trust, which is also related to education and years lived in home
WILKERSON et al. (2012)	Associations between features of the physical environment and neighbourliness in Portland, U.S.	Sidewalks, front porches, traffic-calming devices, bars on windows, and the presence of litter or graffiti	Interaction, trust, and reciprocity between neighbours	Reciprocity and trust of neighbours and knowing and being in contact with them increase when there are physical-environment attributes that provide semiprivate space for informal interaction: front porches, continuous sidewalks, and freedom from high-traffic streets, bars on windows and doors, and litter and graffiti

BJORNSTROM; RALSTON (2014)	Association between the built environment and perceived social cohesion affected by perceived danger in Los Angeles County	Commercial diversity, heavy traffic, sidewalks and trees	Partnership, solidarity, trust, relationships and sharing same values in neighbourhood	Danger moderated the effect of commercial diversity, sidewalks, and trees, and concentrated disadvantage moderated the coefficients on built variables (excepting trees) such that the magnitudes of their effects were stronger in high-disadvantage neighbourhoods. In high disadvantage neighbourhoods, there was a positive relationship between sidewalks and cohesion among those who felt safe and those who did not, but the positive relationship was not as strong for those who report that they live in a dangerous neighbourhood. Also, in these same neighbourhoods, the relationship between commercial diversity and perceived cohesion among those who perceive their neighbourhood to be safe was positive but it was negative among those who felt unsafe
FRENCH et al. (2014)	Relationship between neighbourhood built environment and sense of community in Perth, Australia	Land use mix, density, connectivity and commercial floor ratio	Neighbourhood Cohesion Index	Residents' perceptions of the neighbourhood were stronger predictors of sense of community than objective measures of the built environment. Walking for transport and for recreation and residential density were positively associated with sense of community. Positive perceptions of infrastructure for walking, neighbourhood aesthetics, and safety were all associated with greater sense of community
CABRERA; NAJARIAN (2015)	Relationship between the built environment and spatial bridging ties in Tucson, U.S.	Interaction in specific places of the neighbourhood	Social interactions/connections, trust, rating of community and reciprocity	Respondents who go to local shops and businesses, uses their porches and attend homeowners' association had more spatial bridging ties than those who did not

Source: Organized by the author (2017)

Opportunity for interactions and proximity are necessary factors to enhance social capital (CABRERA; NAJARIAN, 2013). Interactions between residents are possible once the social capital is higher and the built environment gives support for that. Social capital is part of an ecologic concept (LOCHNER; KAWACHI; KENNEDY, 1999) and it can occur where there is interaction (KAWACHI; SUBRAMANIAN; KIM, 2008). Pedestrian oriented and mixed used neighbourhoods are more likely to develop these characteristics and are called "traditional" ones. Being traditional is to be walkable and to let people accomplish daily actions without cars. In addition, walkability may encourage people "getting out and about", which is an encouragement for social interactions (FRENCH, et al., 2014), what is also defended by Jacobs (2011), who states that diverse commercial activities can make people go out to the streets and into their neighbourhoods, fact that can stimulate more familiarity, informal, social control and cohesion. Providing means and locations for people to interact, share information and connect to each other is achieved by walkability (ROGERS, et al., 2011).

This scenery contrasts with modern suburban neighbourhoods (TALEN, 1999) produced by the "urban sprawl". Urban sprawl is characterized by the rapid expansion of metropolitan areas. Attributes of urban sprawl – low density, dependence on motorized vehicles for transport, spatial segregation of different land uses, weakening the formation of groups – can be considered familiar nowadays (FRUMKIN, 2002). Social scientists have been increasingly claiming the negative consequences of urban sprawl (MASON, 2010), once the automobile dependence, which is a consequence of the urban sprawl, is prejudicial to the formation of social ties. On the other hand, social ties can emerge in less auto-dependent neighbourhoods or more pedestrian friendly areas (FREEMAN, 2001). People who live in traditional neighbourhoods develop higher levels of social relations than people who live in suburban areas (LUND, 2002) especially because in suburban areas with no attractive walking environment, less interaction is promoted. However, if environmental design with quality is planned in these suburban areas, socially supportive neighbourhoods can be created (WOOD et al., 2008).

Many studies pointed out the association of social capital and the built environment and some of them associate both factors with walkable environments. These relationships support the discussions of social capital and built environment in relation to health discussions (Board 9).

Board 9 – Papers examining the association between social capital, built environment and health

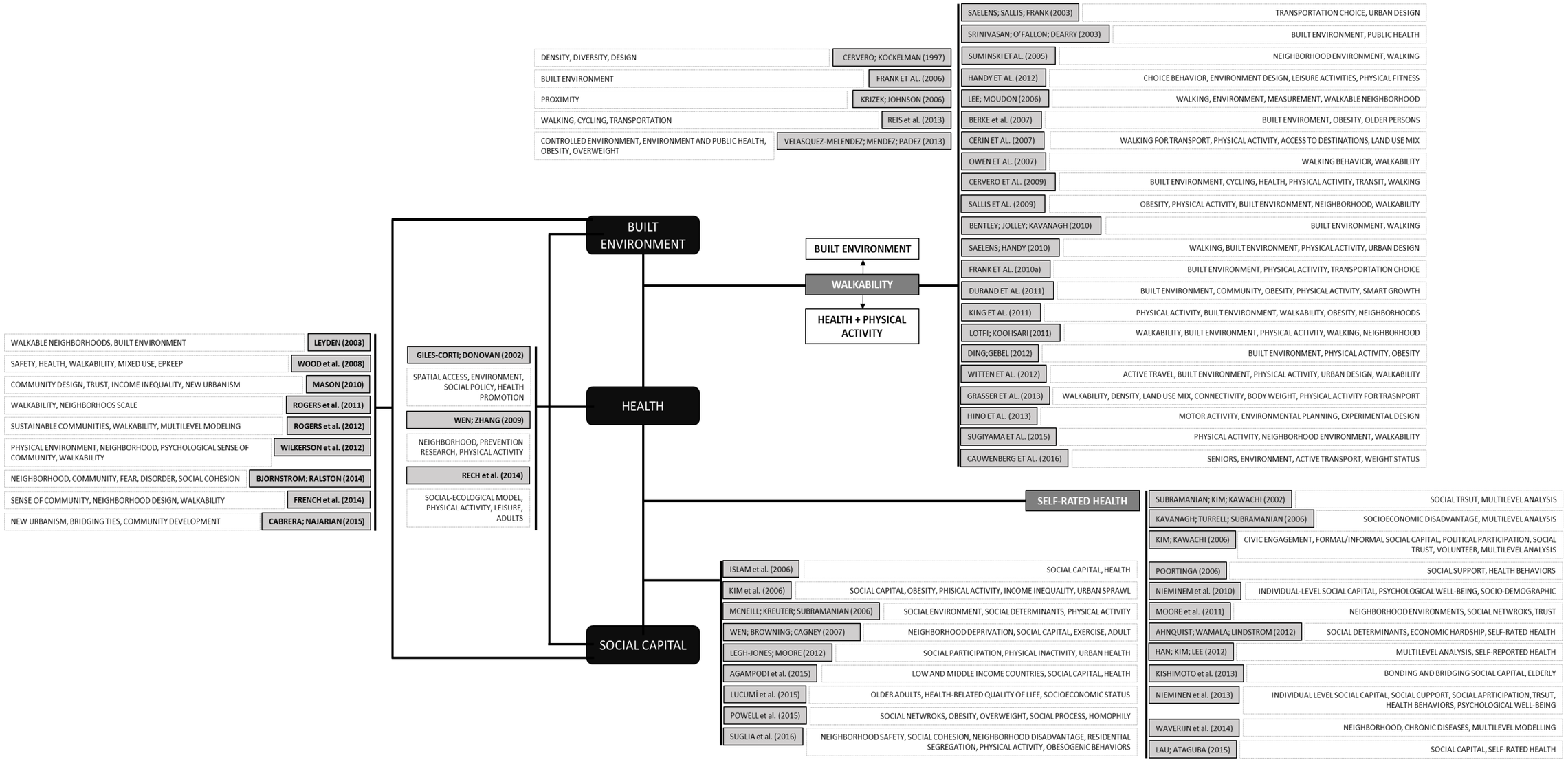
AUTHOR(S)	RESEARCH	BUILT ENVIRONMENT	SOCIAL CAPITAL	HEALTH	MAIN CONCLUSIONS/DISCUSSIONS
GILES-CORTI; DONOVAN (2002)	Relationship between individual and social environmental and physical environmental that provide recreational physical activity in Perth, Australia	Recreational facilities	Club membership, frequency of participation in physical activity by five significant others and frequency of a significant other doing physical activity with respondent	Exercise in recommended levels: activity index	Individual and social environmental determinants mediated physical environmental determinants of exercising as recommended. Access to recreational facilities are related to the achievement of recommended levels of physical activity. Individual and social environmental determinants appeared to be more important in directly determining whether recommended levels of activity were achieved.
WEN; ZHANG (2009)	Examine the contextual effects of neighbourhood built and social environments on exercise in Chicago, U.S.	Pedestrian injury rate, residential density, distance to subway or parks, land use mix and access to neighbourhood amenities	Neighbourhood social environment, socioeconomic status (neighbourhood-level affluence, poverty, education, the percent of female-headed households and the percent of households on public assistance) and social capital (neighbourly trust, norms of reciprocity and perceived violence)	Frequency of physical activity	Access to restaurants and bars and neighbourhood social environment were significantly associated with reporting regular exercise in the past year. The beneficial effect of neighbourhood social environment was significantly stronger for women
RECH et al. (2014)	Associations between intrapersonal, interpersonal, environmental factors and leisure-time walking and leisure-time physical activities in Curitiba, Brazil	Residential density, access to leisure facilities, aesthetics, and safety from crime in the neighbourhood level	Social support	Leisure-time walking and leisure-time physical activities, not including walking	Self-efficacy and enjoyment, social support from family and friends and favourable perceptions of the environment including neighbourhood safety from crimes, aesthetics and access to leisure facilities were positively associated with leisure-time walking and leisure-time physical activities. Safety from crime is associated with leisure-time physical activities only among older adults (≥40 years)

Source: Organized by the author (2017)

2.4 Literature review diagram

The literature review can be systematized in three main emphasis: health, social capital and built environment, especially involving concepts and definitions. The relationship between the groups are the most important approaches of this research. The scheme with authors and main keywords is demonstrated as following (Figure 2).

Figure 2 - Literature review diagram: authors and main keywords



Source: Organized by the author (2017)

3 METHODS

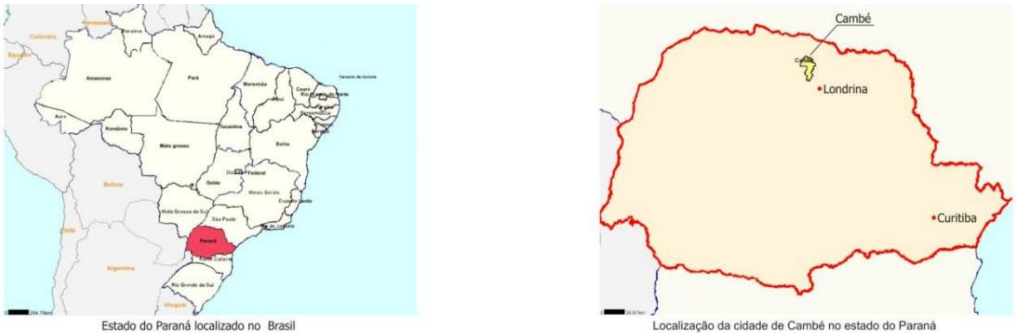
The main objective of this research is to comprehend if the relation between social capital and self-rated may vary according to the walkability levels in Cambé, Paraná, Brazil. The methodology adopted was Correlational Research in order to clarify patterns of relationship between two or more variables in a phenomenon (GROAT; WANG, 2002), including the walkability index, social capital and self-rated health variables. The methodology strategy used was Case Study (YIN, 2001), focusing on Cambé-PR.

3.1 Case study: Cambé, Paraná State, Brazil

Cambé is 494,692 km² and had an estimated population of 103.822 in 2015 (IBGE, 2015). Despite being located in Londrina Metropolitan Area, Cambé is a town (Figures 3 and 4). Its economy is focused on soy agriculture and the town has a significant industrial complex including mostly agribusiness and chemical industries (CAMBÉ. Townhall, 2016) and the Human Development Index (HDI) is 0,793 (medium) (UNDP Brazil, 2000). Cambé presents relevant sites such as the downtown sidewalk (Figure 5) and Zezão Park (Figure 6).

Cambé was chosen to be used as the strategy of the case study, because the urban area of the town, included in the urban perimeter (Figure 7), was already an object of study of the VIGICARDIO and the database containing social capital and health outcomes was available for this current research.

Figure 3 - Cambé location – Paraná State



Source: Cambé Master Plan (2008)[1]

[1] *apud* Cambé PLHIS (2012)

Figure 4 – Cambé - Location – Londrina Metropolitan area

Source: IBGE (Access in 11/07/2016)

Figure 5 – Downtown sidewalk in Cambé

Source: Registered by the author (2016)

Figure 6 – Zezão Park in Cambé

Source: Registered by the author (2016)

Figure 7 - Cambé urban perimeter

Source: Google Maps (Access in 2016); Organized by the author (2016)

3.2 Correlational variables

3.2.1 Social capital and physical activity

This research is based on the cross-sectional study of Loch (2013) of the 40 years old or more population of Cambé, Paraná State (Brazil) developed in 2011 (published in 2013). This is part of the project called VIGICARDIO – Cardiovascular diseases in Paraná State: mortality, risk profile, remedy therapy and complications (free translation of VIGICARDIO – *Doenças cardiovasculares no Estado do Paraná: mortalidade, perfil de risco, terapia medicamentosa e complicações*) (LOCH, 2013) and systematizes three main variables including: social capital, health behaviour and sociodemographic (Table 1).

Table 1 - Main variables groups from Loch (2013)

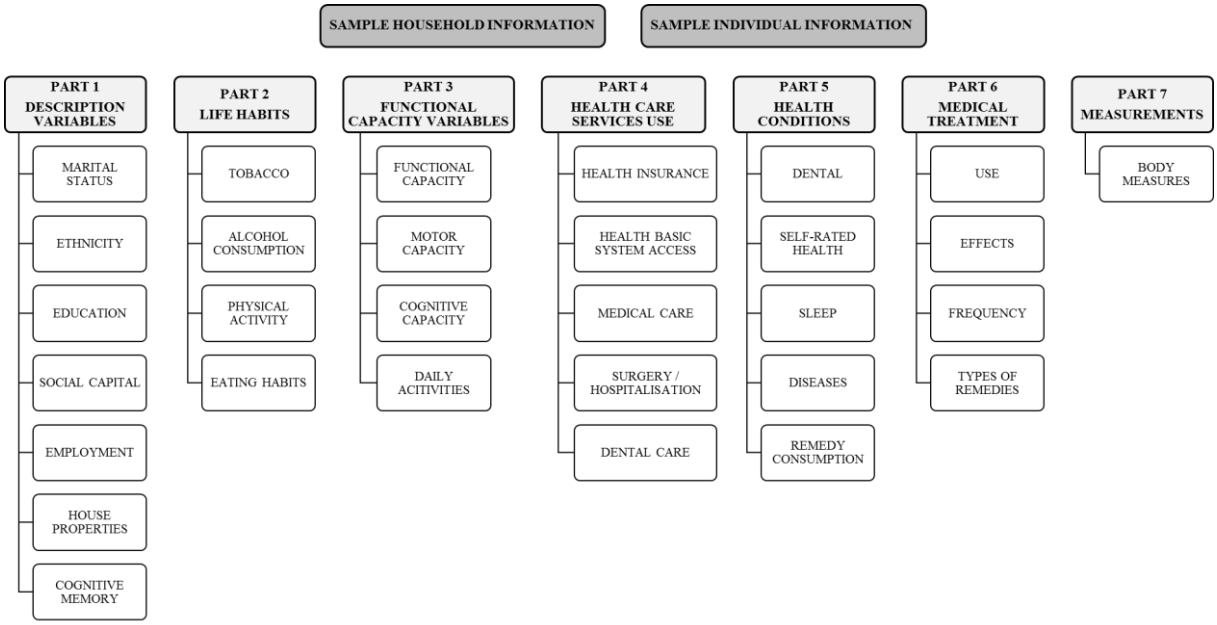
VIGICARDIO LOCH (2013)	**SOCIAL CAPITAL**	NUMBER OF FRIENDS
		BORROW YOU SOME MONEY WHEN NECESSARY
		TRUST IN PEOPLE IN YOUR NEIGHBORHOOD
		NEIGHBORHOOD SECURITY
		CIVIC/COMUNITARY PARTICIPATION
		SCORE SOCIAL CAPITAL
	HEALTH BEHAVIORS	LEISURE PHYSICAL INACTIVITY
		LOW FRUIT AND/OR VEGETABLES CONSUMPTION
		TOBACCO
		HEAVY ALCOHOL CONSUMPTION
		HEALTH RISK BEHAVIORS SIMULTANEITY
		SELF-RATED HEALTH
	DEMOGRAPHIC	GENDER
		AGE
		SOCIAL CLASS
		NUTRITIONAL STATE
		DISPLACEMENT DIFFICULTY
		HEALTH CARE SERVICES USE
		SELF-RATED HEALTH

Source: Organized by the author (2016)

Main variables (social capital, health behaviours and self-rated health) were attended by a questionnaire (Attach 1) organized into different and specific sections (Chart 1). From each part, it was possible to select the variables for the current study, which are: social capital in the neighbourhood level, self-rated health and confounders (Charts 2 and 3).

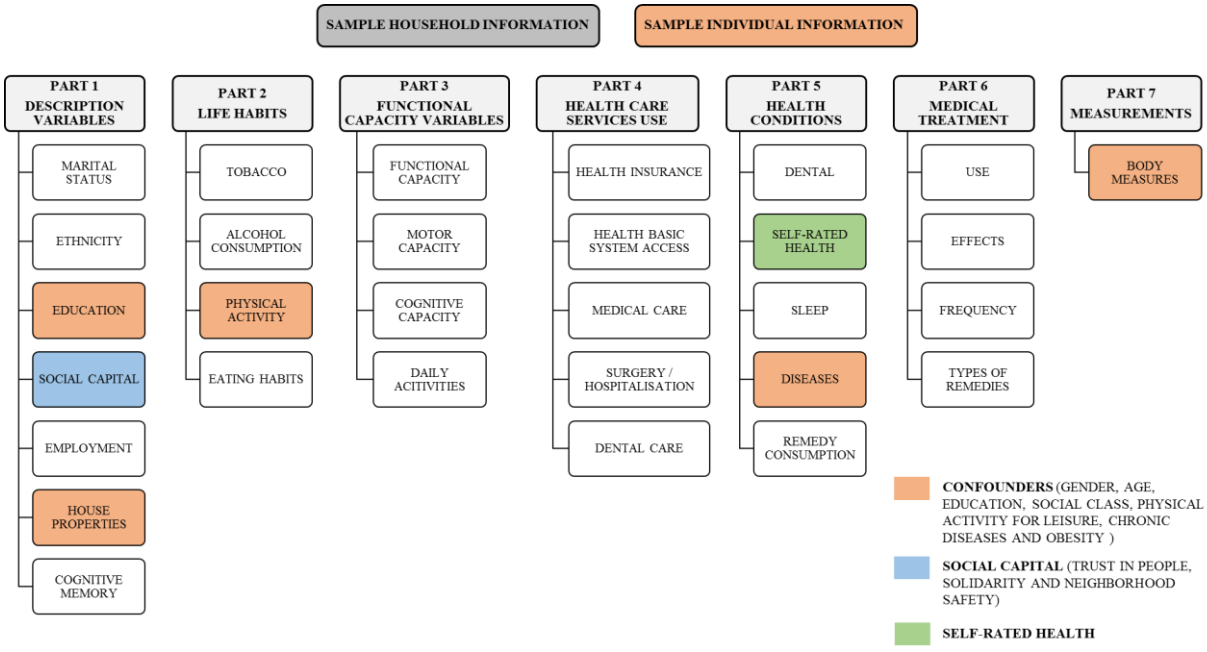
VIGICARDIO study was approved by the Research Ethics Committee Involving Humans from State University of Londrina (Attach 2).

Chart 1 - Questionnaire structure



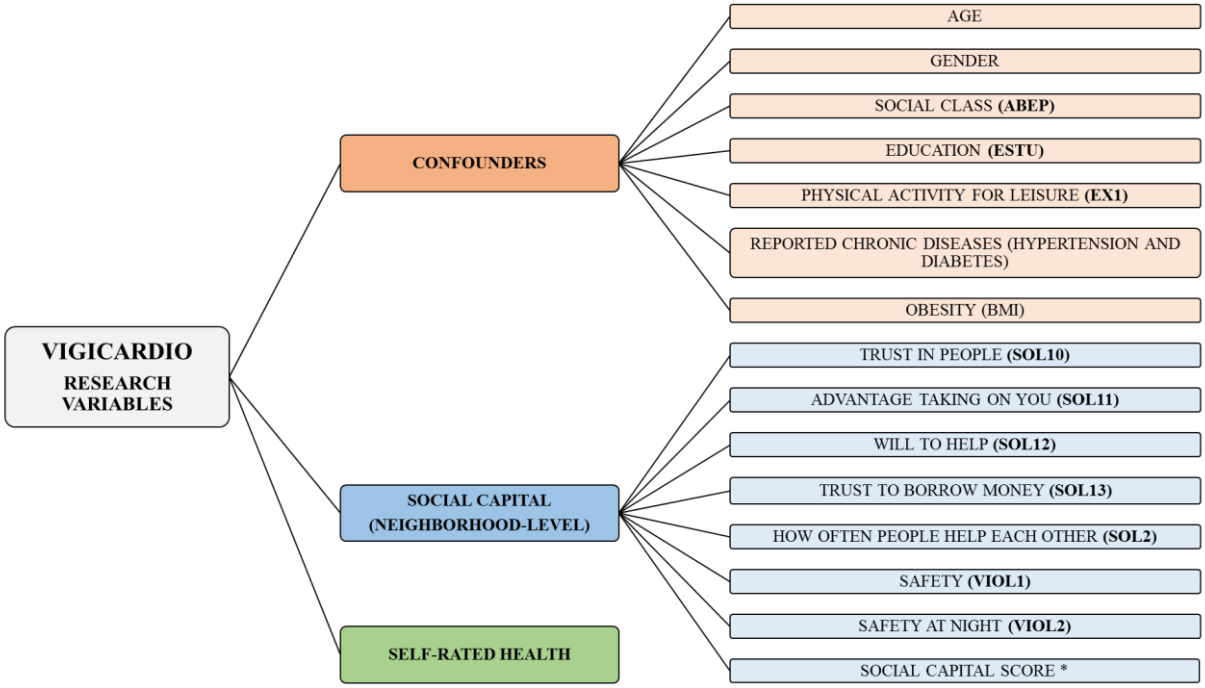
Source: Loch (2013); Organized by the author (2017)

Chart 2 - Variables used in the current study from the questionnaire structure



Source: Loch (2013); Organized by the author (2017)

Chart 3 - Variables used in the current study and the specific measures



*SOCIAL CAPITAL SCORE: sum of all variables

Source: Loch (2013); Organized by the author (2017)

Variables were organized according to positive and negative responses and were dichotomized or classified. Sociodemographic confounding variables were codified in categories starting from the most positive measure, going to the most negative one to each variable (e.g. men, people aging between 40 – 49, in high social class group who studied 9 or more years were considered as the positive outlines to be associated with high rates of social capital and healthy behaviour) (Board 10). Social capital answers of the questionnaire were compound by five intensity scales of agreement (positive) or disagreement (negative) and social capital score was obtained by the sum of all variables to which were given 1 point to positive and 0 point to negative behaviour outcomes (LOCH, 2013). Social capital variables were chosen when they were related to the neighbourhood or location context (Board 11); self-rated health replies were structured in yes (positive) or no (negative) (Board 12).

Board 10 - Variable details: demographic, clinical and behavioural

CONFOUNDERS	
GENDER	Male
	Female
AGE	40 – 49
	50 – 59
	60 and greater
ECONOMIC CLASS	A + B
	C
	D + E
EDUCATION	9 years and greater
	5 - 8 years
	0 - 4 years
PHYSICAL ACTIVITY FOR LEISURE	Active
	Inactive
REPORTED CHRONIC DISEASES	With diagnosed diseases
	Without diagnosed diseases
OBESITY	Normal
	Overweight
	Obese

Source: Loch (2013); Organized by the author (2016)

Board 11 - Variable classification and details: social capital

SOCIAL CAPITAL		
SOL10: You can trust most of the people who live in your neighbourhood/locality:	(1) Totally agree	Positive
	(2) Partly agree	
	(3) Neither agree nor disagree	Negative
	(4) Partly disagree	
	(5) Totally disagree	
SOL11: In your neighbourhood/locality it is necessary to be careful that someone will take advantage on you:	(1) Totally agree	Negative
	(2) Partly agree	
	(3) Neither agree nor disagree	Positive
	(4) Partly disagree	
	(5) Totally disagree	
SOL12: Most of the people in your neighbourhood/locality are willing to help you in case you need it:	(1) Totally agree	Positive
	(2) Partly agree	
	(3) Neither agree nor disagree	Negative
	(4) Partly disagree	
	(5) Totally disagree	

SOL13: In your neighbourhood/locality people usually do not trust each other to lend or borrow money:	(1) Totally agree	Negative
	(2) Partly agree	
	(3) Neither agree nor disagree	Positive
	(4) Partly disagree	
	(5) Totally disagree	
SOL2: Nowadays, how often do you say people in your neighbourhood/locality help each other?	(1) Always	Positive
	(2) Most of the time	
	(3) Sometimes	Negative
	(4) Rarely	
	(5) Never	
VIOL1: In your opinion, your neighbourhood is usually:	(1) Very peaceful	Positive
	(2) Moderately peaceful	
	(3) Neither peaceful nor violent	Negative
	(4) Moderately violent	
	(5) Very violent	
VIOL2: Regarding your safety, how do you feel when you walk alone at night?	(1) Moderately safe	Positive
	(2) Not so safe	
	(3) Neither safe nor unsafe	Negative
	(4) Moderately unsafe	
	(5) Very unsafe	
SOCIAL CAPITAL SCORE: sum of the variables results	Social capital responses	
	4 - 7 points	Positive
	0 - 3 points	Negative

Source: Loch (2013); Organized by the author (2016)

Board 12 - Variable classification and details: self-rated health

SELF-RATED HEALTH		
EST1: How do you classify your health condition?	(1) Very good	Positive
	(2) Good	
	(3) Regular	Negative
	(4) Bad	
	(5) Very bad	

Source: Loch (2013); Organized by the author (2016)

3.3 Walkability index: construction

Through an exploratory process of existing data from Loch (2013) that link social capital to health, there was a gap and an opportunity to investigate the introduction of the built environment in this association. In that way, it is possible to bring social capital and health to the urban planning area. This interdisciplinary approach can lead to a greater understanding

in the health field in the sphere of impacts of transport investments and decisions over land use involving the built environment and quality of life (FRANK et al., 2010a).

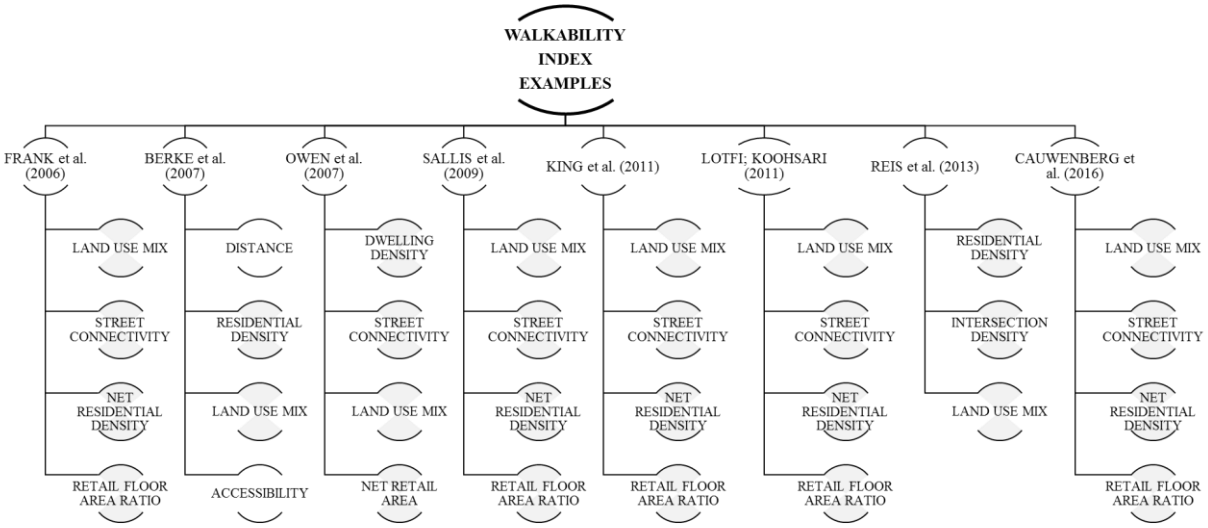
There is a growing interest in combining spatial objective attributes to create a composite index for application in empirical studies of the built environment (CERVERO; KOCKELMAN, 1997; FRANK et al., 2006; BERKE et al., 2007; OWEN et al., 2007; LOVASI et al. 2008; SALLIS et al., 2009; FRANK et al., 2010a; FRANK et al., 2010b; KING et al., 2011; LOTFI; KOOHSARI et al., 2011; HINO et al., 2012; REIS et al., 2013; CAUWENBERG et al., 2016). There is also a demand for understanding how particular attributes of the built environment can affect human behaviour involving physical activity, but many issues persist about how the interrelationship between them develop (HANDY ET AL., 2002; SAELENS; SALLIS; FRANK, 2003).

Many other authors have constructed walkability indexes considering a combination of different variables to examine the built environment in relation to active transportation (Chart 4). The application of walkability indexes are based on using reduction tools, like factor analysis, which can contribute to survey design purposes and explain travel choice and physical activity (FRANK et al., 2010a). The factor analysis is a statistical process that examines different variables measuring the same outcome and defines a smaller set of basic common dimensions called factors.

Furthermore, in respect to walkability indexes, it is important to consider the combination of built environment factors on active transport and physical activity in a geographical level (such as census tracts). This process is relevant for health research field, once other data resources are available, e.g. sociodemographic (FRANK et al., 2010a).

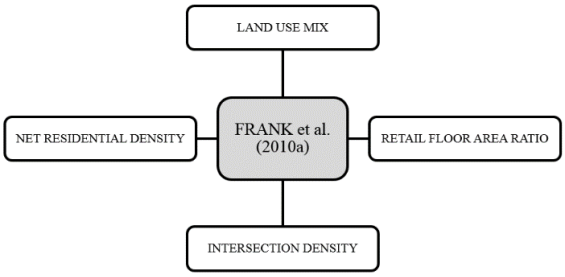
For this research, a Walkability Index was proposed to Cambé-PR, Brazil, through the development of a spatial patterning for walkability based on the walkability index organized by Frank et al. (2010a) (Chart 5).

Chart 4 - Walkability index structures



Source: Organized by the author (2016)

Chart 5 – Walkability Index choice



Source: Organized by the author (2016)

The index organized by Frank et al. (2010a) is part of the NQLS (Neighborhood Quality of Life Study) and it is associated with measurements of active transportation and physical activity. The built environment can influence transportation mode choices and studies involving characteristics of community design have gained attention (FRANK et al., 2010a). The geographical scale was considered for the index to create a "walkability surface" in each census tract group level and the characteristics to be analysed involve net residential density, retail floor area ratio, intersection density and land use mix (Board 13). For the construction of the index, digital maps were made on AutoCAD 2015 and

on ArcGIS 10.4 Free Version and for all calculation (Appendix 1) the programme used was Excel 2013.

Board 13 - Variables of the Walkability Index

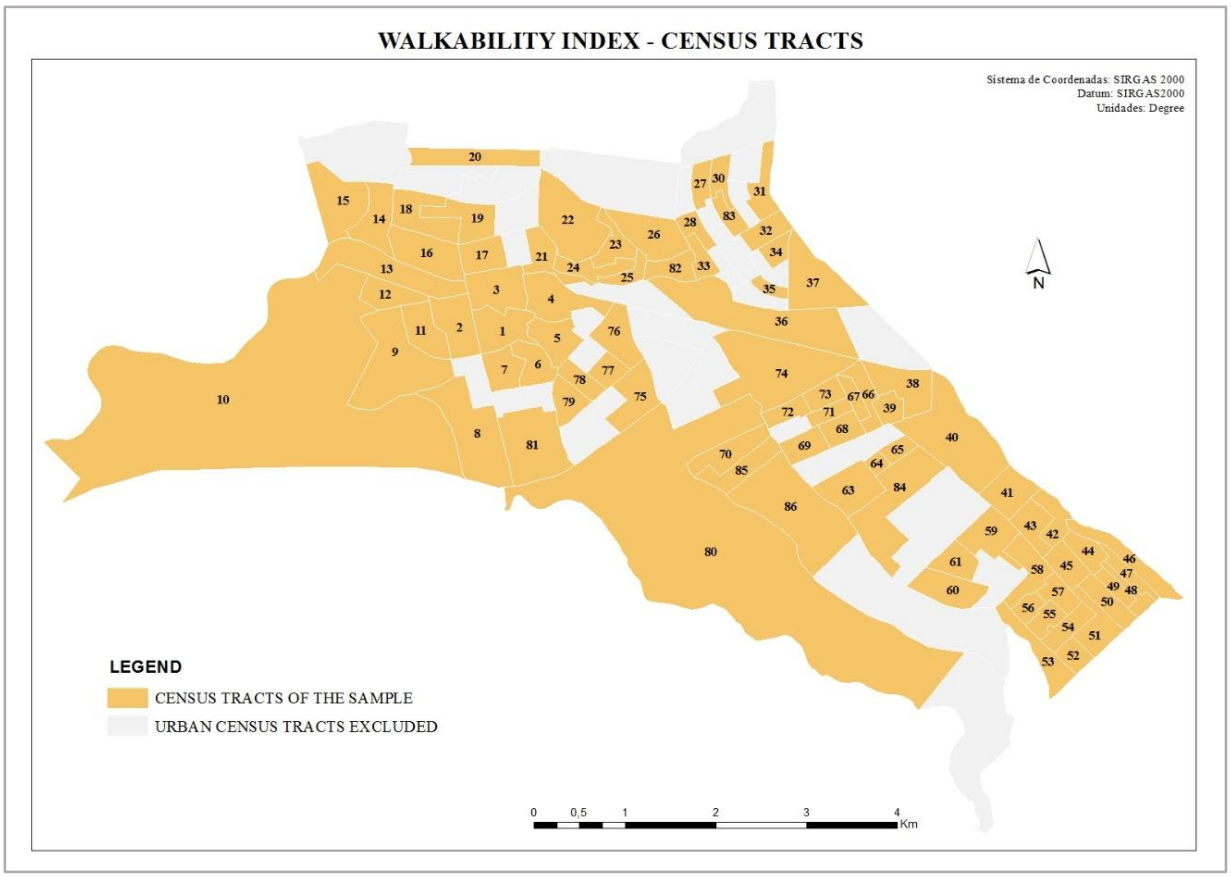
VARIABLE	DESCRIPTION
NET RESIDENTIAL DENSITY	The ratio of residential units to the land area established for residential use per census tract
RETAIL FLOOR AREA RATIO	The retail building floor area footprint divided by the retail land floor area footprint. This measure indicates the relation of how much area is intended to parking
INTERSECTION DENSITY	Related to connectivity of the street network. It is calculated by the ratio of the number of true intersections (three or more legs) to the land area of the census tract group
LAND USE MIX	Related to the diversity of the land use types in a block group classified in: residential, retail (excluding "big boxes"), entertainment (including restaurants), office and institutional (including schools and community institutions). Values vary between 0 (single use) and 1 (completely even distribution of floor area across the five uses)

Source: Frank et al. (2010a); Organized by the author (2016)

For the construction of the walkability index, firstly a map of the census tracts was organized according to the Brazilian Institute of Geography and Statistics (IBGE), which are the basis for setting up the index. This current study is based on Loch's (2013) research, which defined census tracts as samples, including only 84 census tracts in Cambé (1 to 86, excluding 29 and 62) that were considered for the index (Figure 8).

According to the index variables (Board 13), some criteria of data collection were defined in order to systematize the variables to format the walkability index for Cambé (Board 14).

Figure 8 - Census tracts of the sample



Source: IBGE (2010); Organized by the author (2016)

Board 14 - Criteria adopted for each variable of the walkability index

VARIABLE	CRITERIA FOR THE CONSTRUCTION OF THE WALKABILITY INDEX
a. INTERSECTION DENSITY	The types of intersections were collected in a digital map and those with 3 or more legs were selected. Intersections between two census tract were included in both. The number of intersections was divided by the area of the census tract (acres)
b. LAND USE MIX	The land use of Cambé was divided into 5 categories: residential, commercial, entertainment (including restaurants, bar, cafeterias, gym, leisure, country houses), service (including offices, clinics, small industries and factories) and institutional (including all townhall facilities, schools, institutions). Only the street level (ground floor) was considered as this level is associated with walking (SUNG et al., 2015) and urban vitality (JACOBS, 2011) (Figure 9). Google Street View was adopted to determine all the land uses
d. NET RESIDENTIAL DENSITY	Number of residences divided by the area of the census tract (acres). Google Street View was adopted to determine the residential use
c. RETAIL FLOOR AREA RATIO	In all the commercial areas or lots, in order to set the proportion, the built area and the determinant commercial use area were calculated. Google Street View was adopted to determine the commercial use

Source: Organized by the author (2016)

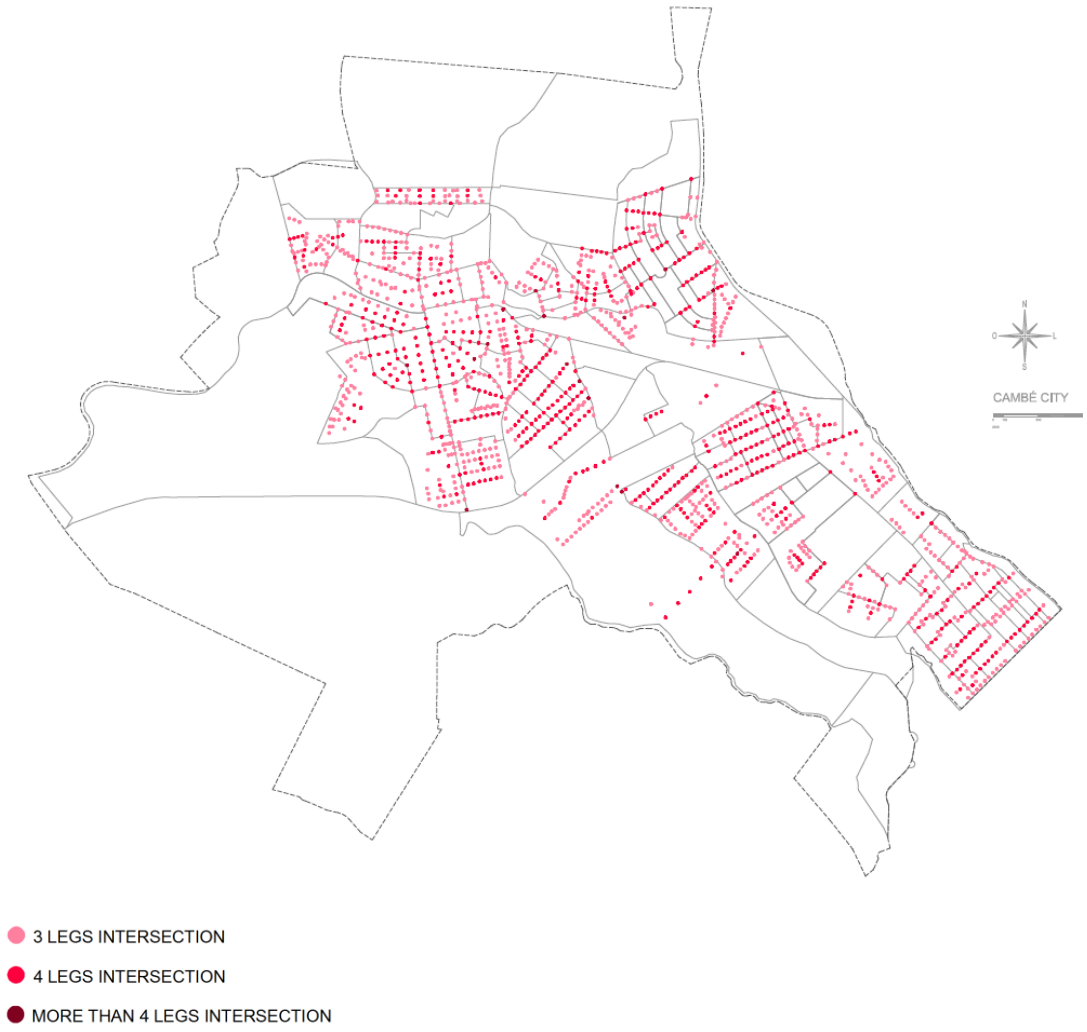
Figure 9 - Street level example

Source: Registered by the author (2016)

a. Intersection Density map

Using Cambé's digital map provided by Cambé's townhall in 2015, all base maps for the calculation of the index were made using AutoCAD 2015 Version. The first map elaborated was the Intersection density map. All intersections following the discretion of the index were set (Figure 10) and the density was calculated dividing the number of intersections in each census tract by its area in acre using the Excel 2013 Version. Acre is a unit used in many indexes, including the one developed by Frank et al. (2010a).

Figure 10 - Intersection density map



Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2016)

b. Land Use distribution map

In Brazilian cities, there is a significant presence of mixed lots (different land uses in the same lot), which is usually characterized by residential use with another one. For the construction of the index, in order to calculate the land use areas, a spatial distribution of the mixed lots was made for each census tract (Figure 11) to identify the cases and to divide each mixed lot. Satellite images from Google Earth and Google Street View were used as instruments for this stage, always combining same dates and years of the images from each instrument.

Figure 11 - Distribution of mixed lots in the census tracts

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2016)

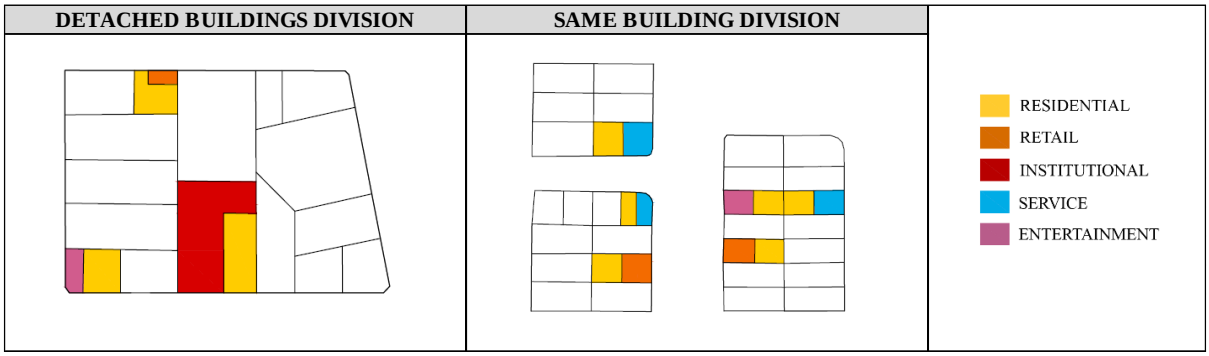
The mixed lots were mapped in Cambé, considering two basic typologies: separated or in the same building (see Appendix 2). By using Google Earth and Google Street View the distinction between them was based on the following conditions:

1) if the uses were located in detached buildings, it was possible to determine the area of each land use;

2) if the uses were inside the same building, the lot was divided in equal parts depending on the arrangement (horizontal or vertical).

Demonstration of the criteria adopted is shown in Figure 12 and illustrated by Figures 13 and 14.

Figure 12 - Mixed lots divisions



Source: Cambé Townhall (2015); Google Street View (2016); Organized by the author (2017)

Figure 13 - Mixed lots: detached buildings example

Source: Registered by the author (2016)

Figure 14 - Mixed lots: same building example

Source: Registered by the author (2016)

The land use mix were mapped (Figures 15), according to the walkability index criteria taking into consideration the adaptations needed for Cambé (Board 14), and was

attended by specific establishments (Board 15). In addition, each land use map is presented with their distribution isolated (Figures 16 to 20).

For the final land use mix value for each census tract, the total areas of each land use were counted in Acres and the entropy formula was used to measure how variable the land use mix is:

$$-\sum k = \left(\frac{pk \times \ln pk}{\ln N} \right)$$

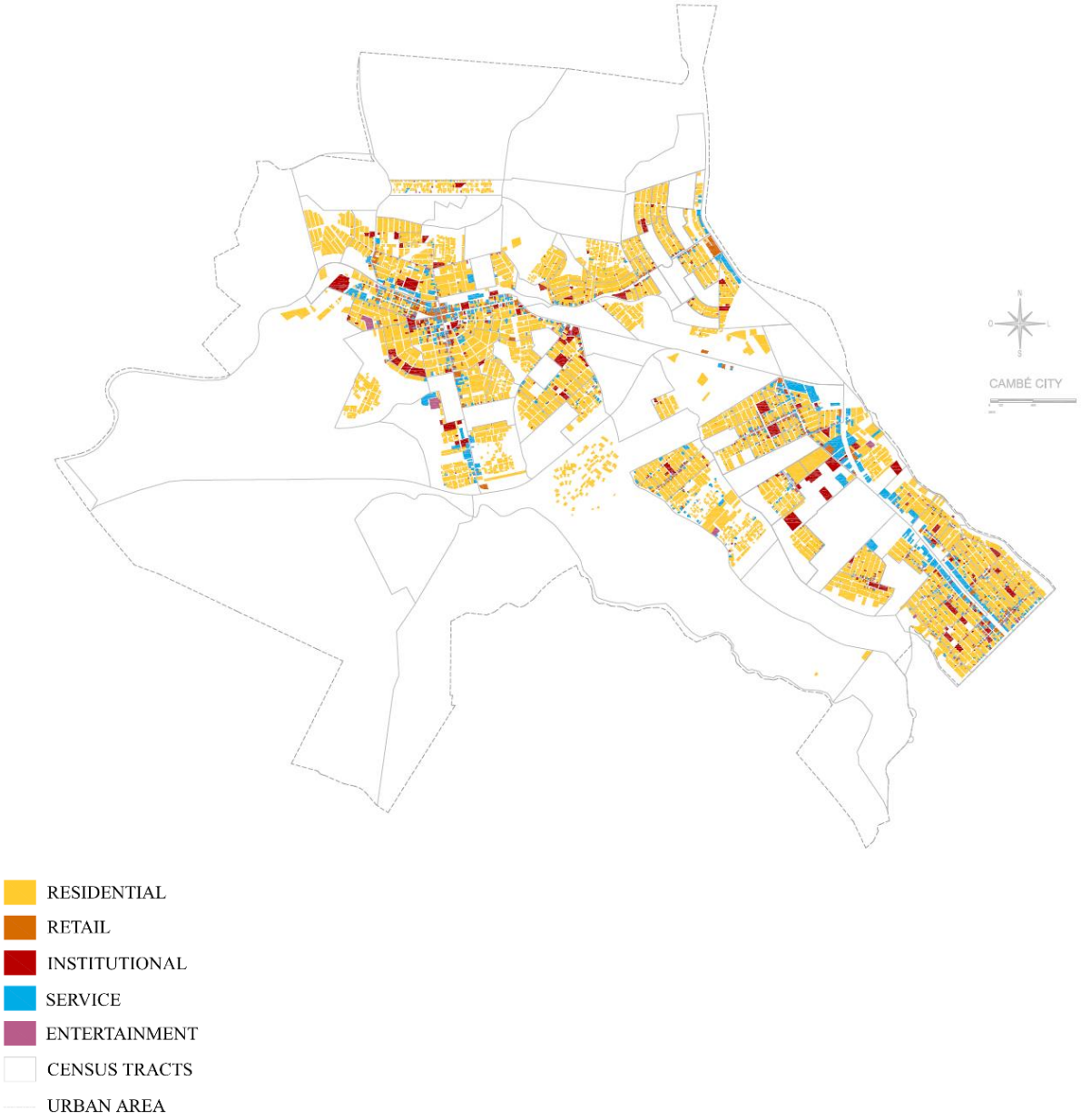
where k = categories of land use; p = proportion of the land use area within the census tract area; and ln = log (DUNCAN et al., 2010).

Board 15 - Examples of establishments for each land use category

LAND USE	WHAT ATTEND TO EACH USE?
RESIDENTIAL	Ground floor dwellings and tall residential buildings, considering the total number of dwellings
RETAIL	A place where the sale of goods to the public is for consumption and not for resale. E.g.: pharmacy, supermarket, bakery, clothes shop, etc.
SERVICE	A place supplying a payable public need. E.g.: medical care centre, pet shop, office, small factory or industry, etc.
INSTITUTIONAL	Every place that belongs to the government administration or every place where people gather usually for the same purpose. E.g.: townhall, court of law, public health care centre, public and private school, church, neighbourhood association, etc.
ENTERTAINMENT	Every place for leisure activities. E.g.: bar, restaurant, cafeteria, gym, club, country house, etc.

Source: Organized by the author (2016)

Figure 15 - Land use mix - Cambé



Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

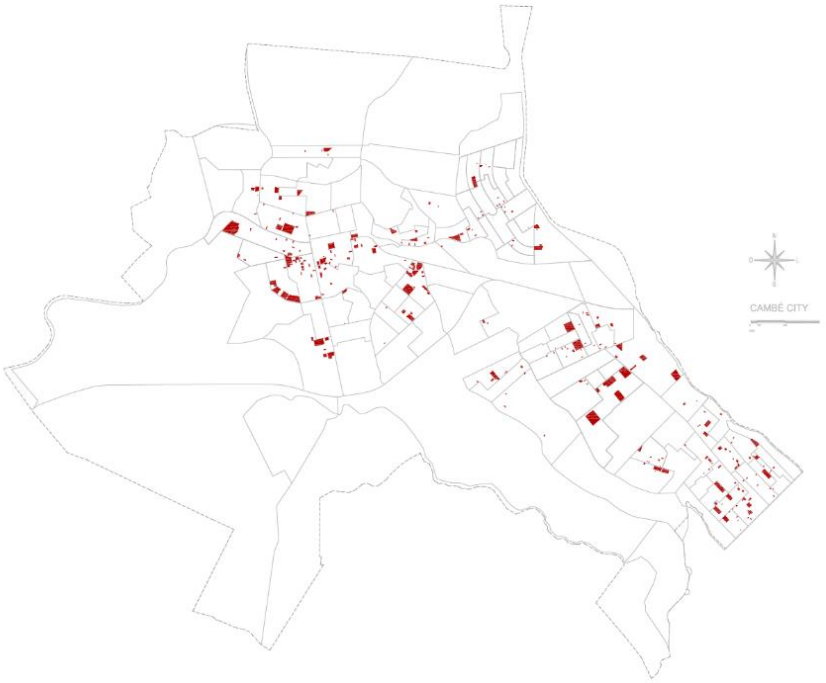
Figure 16 - Land use: RESIDENTIAL

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Figure 17 - Land use: RETAIL

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Figure 18 - Land use: INSTITUTIONAL



Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Figure 19 - Land use: SERVICE

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Figure 20 - Land use: ENTERTAINMENT

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

c. Net residential density map

After counting the dwellings in each census ward, the residential density was calculated. The number of dwellings per census tract was divided by the area, in acres, designated to residential use in each census tract (Figure 21).

Figure 21 - Dwelling distribution per census tract

Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

d. Retail floor area ratio

For the calculation of the retail floor area ratio, retail areas were isolated and the construction area was crosshatched. The ratio results from the division between the building area (acres) and the retail area (acres) for each census tract (Figure 22). These measures can demonstrate the void space inside the retail lots, guiding to more parking areas (FRANK et al., 2010a).

Figure 22 - Example blocks – calculation of retail floor area ratio

Source: Cambé Townhall (2015); Google Street View (2016); Organized by the author (2016)

All variables of the index were normalized by the "z score". The final walkability index, which resulted in the walkability index map, was calculated (Appendix 1) with the formula (FRANK et al., 2010a):

WALKABILITY INDEX = [(2 x z-score intersection density) + (z-score net residential density) + (z-score retail floor area ratio) + (z-score land use mix)]

4 RESULTS AND ANALYSIS

A map of the walkability index in Cambé was formatted using ArcGIS 10.4 Free Version. The objective of this part of the study was to discuss the correlations between the walkability index, social capital and self-rated health.

The first part of the analysis comprised the understanding of the spatial characteristics of the urban form of the higher and lower walkability census tracts in Cambé. The walkability index systematized four variables (intersection density, land use mix, residential density and retail floor area ratio) and the analysis pointed out issues associated with those variables after considering spatial arrangements of small-to-medium size Brazilian cities. Therefore, it was necessary to understand Cambé's historical issues and its urban development process.

In the second part, the association between the walkability index and population density was analysed by overlapping population density and the walkability index data.

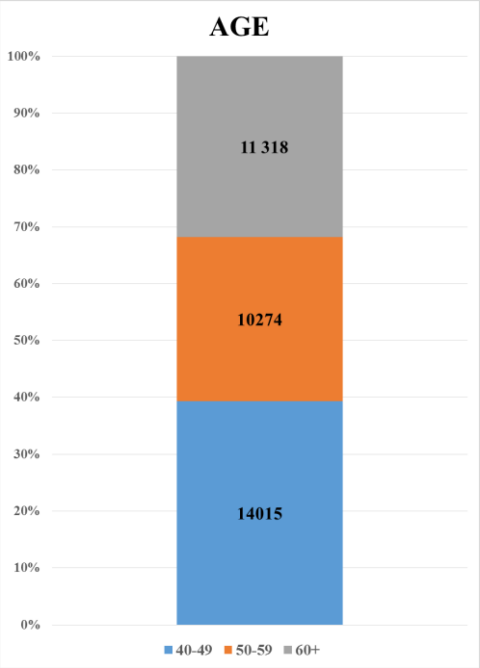
Finally, in the third part, the walkability index and VIGICARDIO database were correlated. It started with a descriptive data and lastly, correlations between social capital and self-rated health were stratified, according to population density and walkability levels.

4.1 Higher and lower walkability: urban form characteristics in Cambé

A map of the walkability index in Cambé was systematized using ArcGIS 10.4 Free Version, and it demonstrated the distribution of walkability classifications among the census tracts. Considering that there is not a significant heterogeneity in the distribution of people aging 40 years old or greater in Cambé (IBGE, 2010) (Figure 24) and considering the scale of the town, it was not necessary to stratify walkability in many groups. Therefore, the tertile classification was adopted.

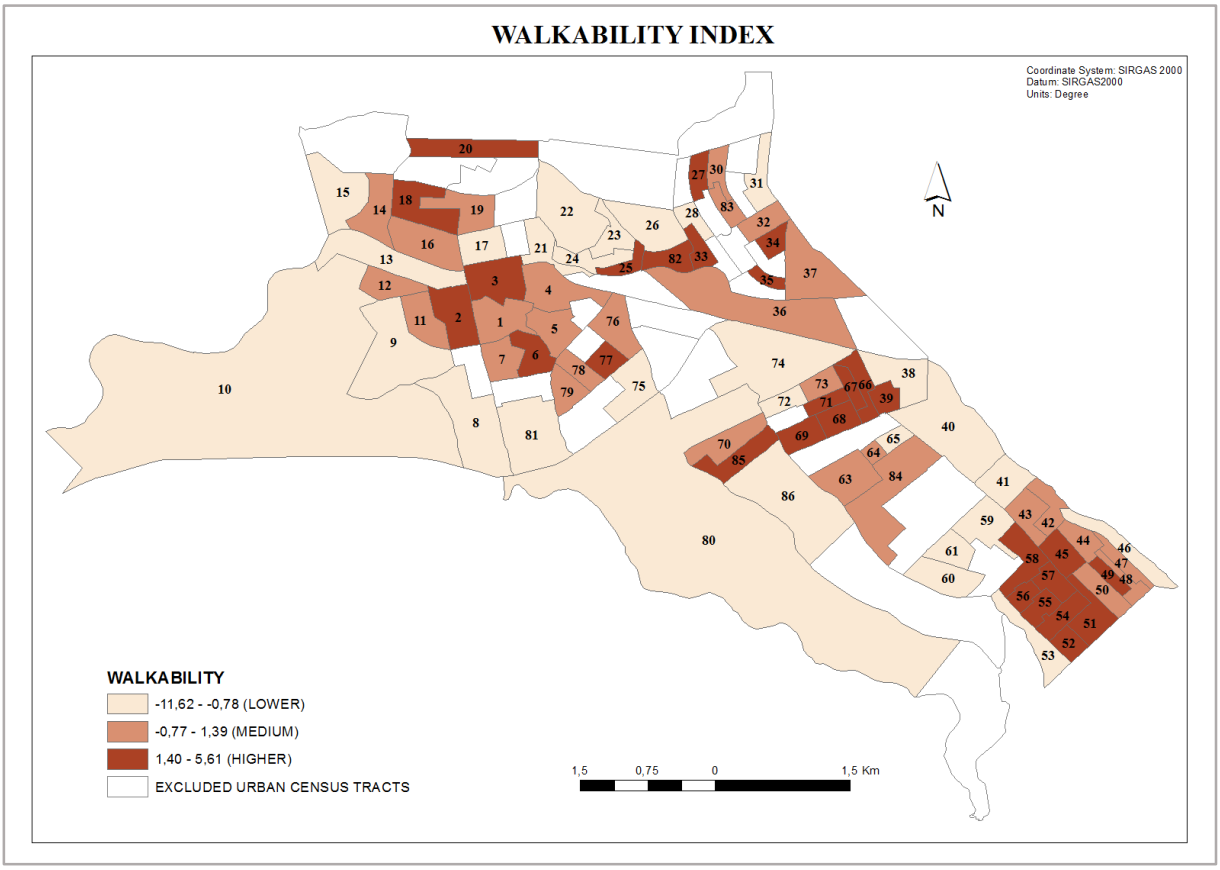
The walkability index map demonstrates three classes of walkability (Figure 24). The tertile distribution comprises 28 (twenty-eight) census tracts for each class: the main two edges (higher and lower walkability) and the transition between them (medium walkability) (Figure 23).

Figure 23 - Age distribution in Cambé



Source: IBGE (2010); Organized by the author (2016)

Figure 24 - Walkability index map (Tertiles)



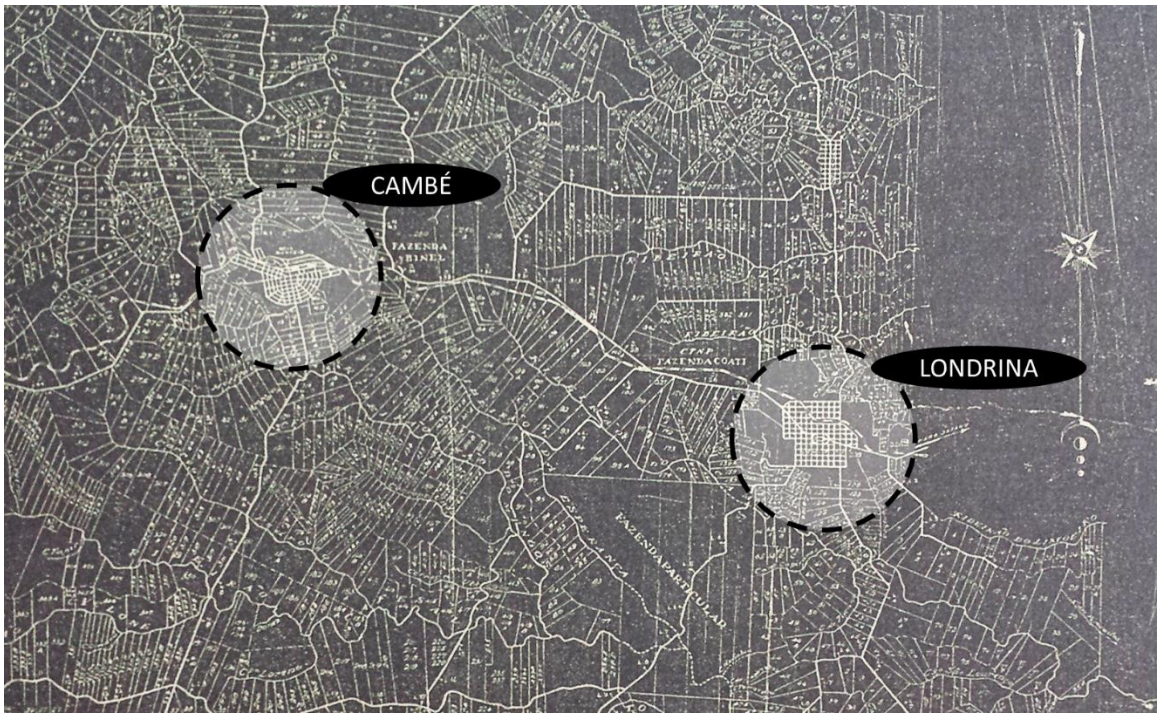
Source: IBGE (2010); Organized by the author (2017)

Most of the higher walkability level can be situated within census tracts' clusters and the lower walkability level is mainly situated in census tracts located in the outskirts of Cambé. These spatial characteristics are closely related to the process of the urban development.

Cambé can be considered a new town, since it was implemented in 1932 as part of the CTNP (*Companhia de Terras Norte do Paraná*), a subsidiary of Paraná Plantations Ltd Company, established in London, England. The CTNP was responsible for the colonization process of the North of Paraná region, where 63 cities were planned in a network of hierarchical urban centres, connected with a system of roads and railways (YAMAKI, 2003). The railway was a fundamental element for the colonization process since its construction was the element that attracted the creation and implementation of new cities in in the North of Paraná. In addition, it was also the structuring element which determined where cities would be situated, marking the landscape under construction (REGO, 2009).

The rural land subdivisions provided by the CTNP were based on small rural lots (YAMAKI, 2003; REGO, 2009), which surrounded the urban centres aiming the interests of the small producer, who at that time, cultivated mainly coffee (REGO, 2009) (Figure 25).

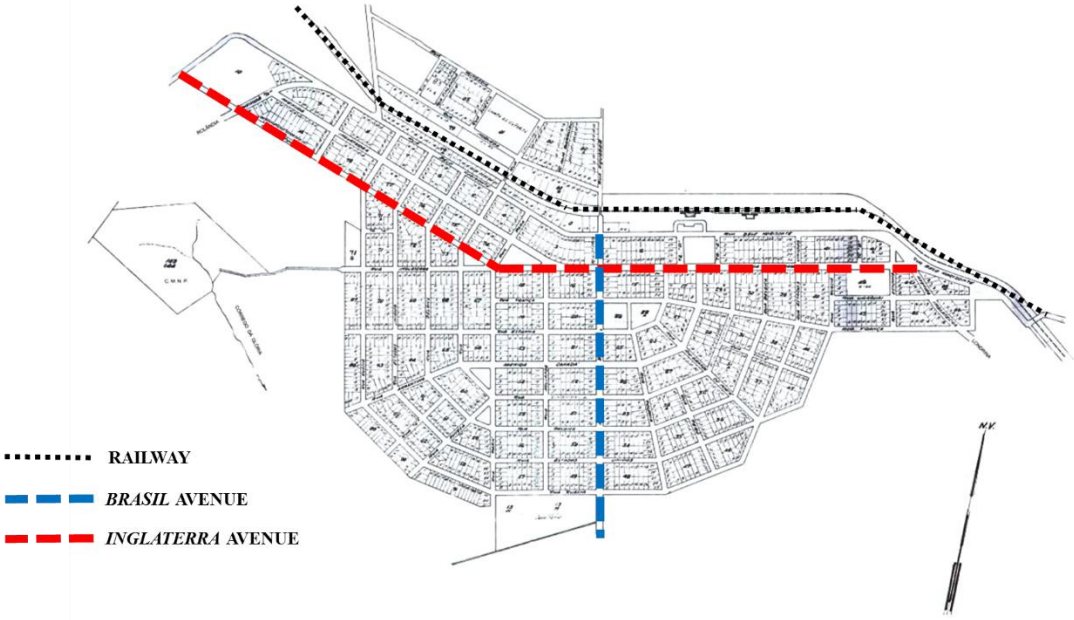
Figure 25 – Initial grid of Cambé and Londrina



Source: Yamaki (2003); Organized by the author (2016)

The initial core of Cambé is composed by a semi-circle format, which is crossed by the main avenue, known as *Inglaterra* Avenue, that connects Cambé with other settlements in the east-west directions. The railway was implemented in 1935 and was settled parallel to *Inglaterra* Avenue defining the urban limit. *Brasil* Avenue structures the connection to the south of the town (Figure 26). This former structure implies that Cambé was planned to grow to the east-west and south directions (NETO, 1987).

Figure 26 – Initial grid of Cambé and its main axis



Source: Cambé Master Plan (2008)[2]; Organized by the author (2017)

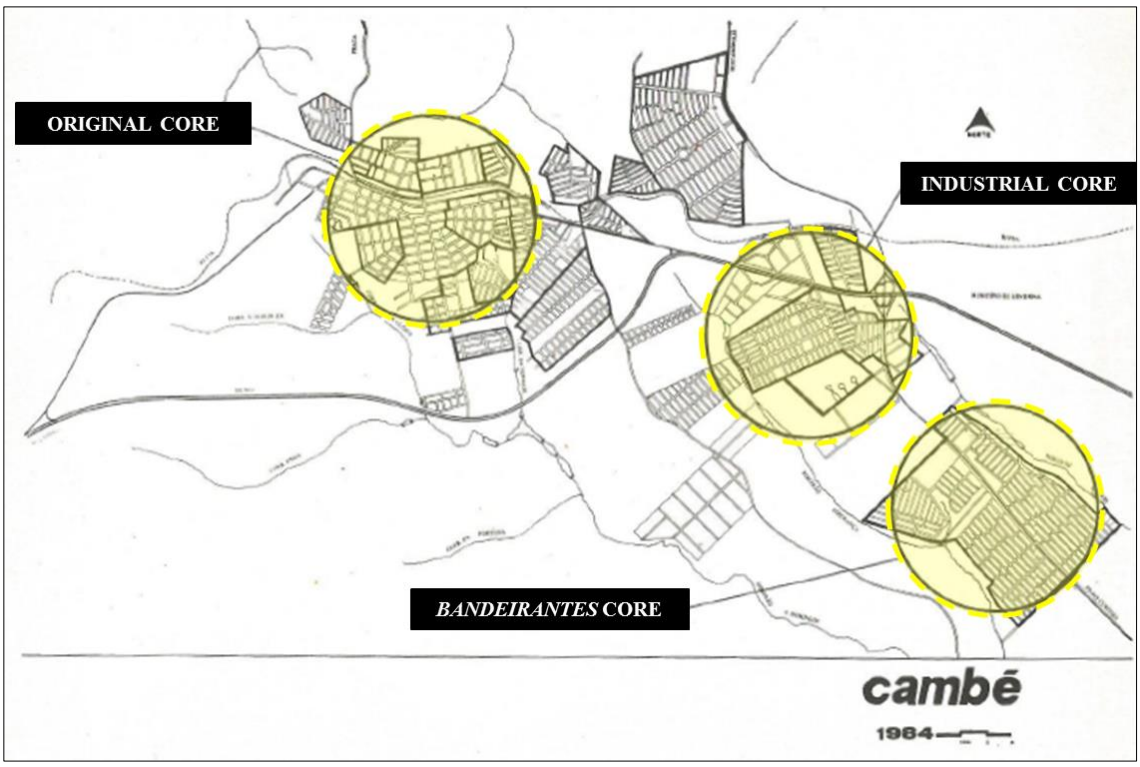
The decade of 1960s was marked by the decline of the coffee economy which had a strong effect in the agricultural sector. Many people got unemployment, and many lost their land. In this sense, Cambé faced an urban population increase and a population density decrease in the countryside. The industry took place as an important economic strategy for Cambé and for Paraná State in the end of the 1960s. In the 1970s, following those economic transformations (PLHIS, 2012), land speculation became the big agent for the urban sprawl in Cambé (SILVEIRA, 1989; PLHIS, 2012).

Because of the urban migration, two new urban cores emerged, in addition to the existing central core: the Industrial Core, which was settled along BR-369 highway in the

[2] *apud* PLHIS (2012)

north/northeast portion of Cambé, and the *Bandeirantes* Core, which was developed along the PR-445 highway to the southeast direction. Those new areas were developed both during the same period and far from the initial core, and were not only developed for the industry, but also provided social housing. This resulted in a scattered structure that emphasizes the Brazilian urban segregation of the lower social class (Figure 27).

Figure 27 – Initial grid of Cambé and the two additional cores



Source: Silveira (1989); Organized by the author (2017)

The original core is the downtown area where there is a prevalence of retail and services, and therefore it constitutes the main economical exchanges place. Until the 1950s, the growth of Cambé occurred around the original core, with the incremental growth of new areas. After the 1960s, scattered development started to appear along highway BR-369, which served as a connector axis after the establishment of the other two cores: Industrial and *Bandeirantes* (Figure 28).

The Industrial Core was created to attend the housing demand of the working-class and resulted in small sized lots arrangements, what according to Brazilian regulations, strength the formation of dense districts. On the other hand, the *Bandeirantes* Core, because it was situated far from downtown and closer to Londrina city, presented an economical dependency with the latter (SILVEIRA, 1989).

The three main urban cores play an important role in Cambé, each one with its specific spatial characteristics that related to the historical process. According to the morphogenetic concept, distinct fragments of cities represent different temporalities and identities, resulting in a diverse arrangement of spaces (KRAFTA, 2014).

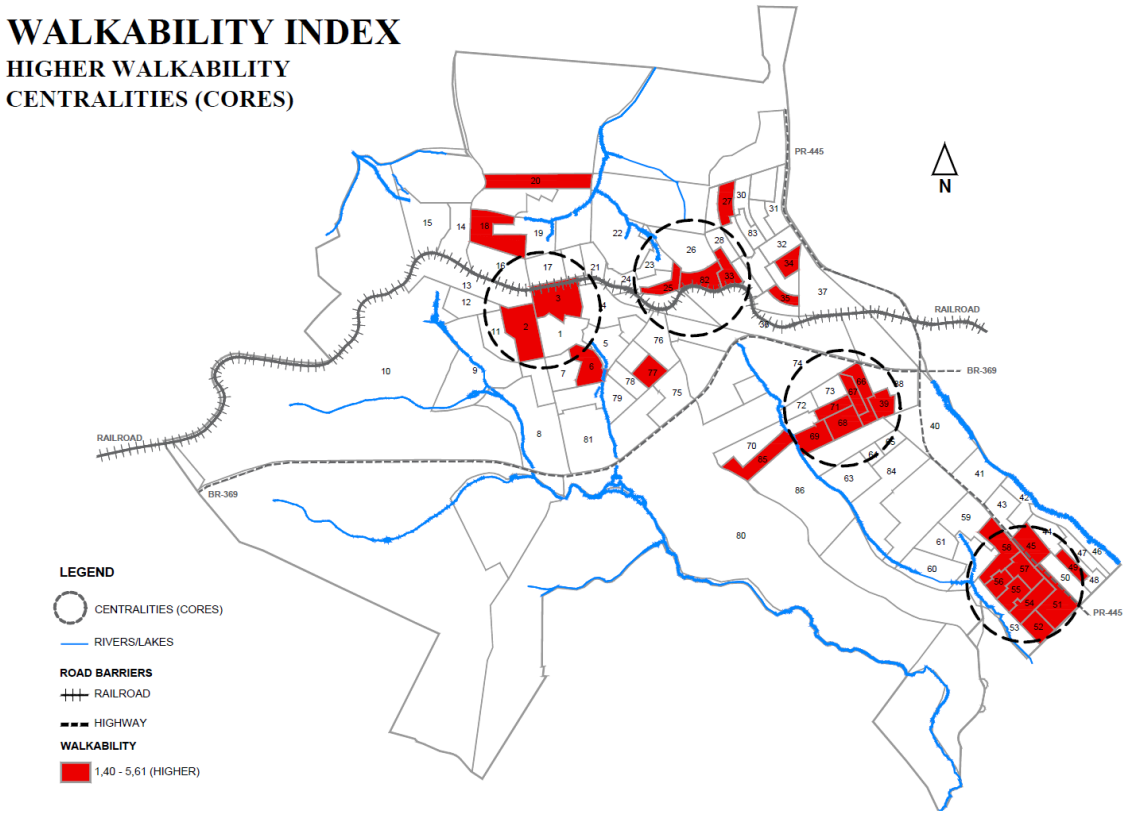
Figure 28 – Cambé urban sprawl

Source: Cambé Master Plan (2008)[3]; Organized by the author (2017)

The analyses of the walkability index map show that census tracts' clusters with higher walkability are typically concentrated in these three cores (original, industrial and *Bandeirantes*). Another small cluster was formed by three adjacent higher walkability census tracts (25, 33, and 82) that are situated along the access to Cambé from PR-445 highway (Figure 29).

[3] *apud* PLHIS (2012)

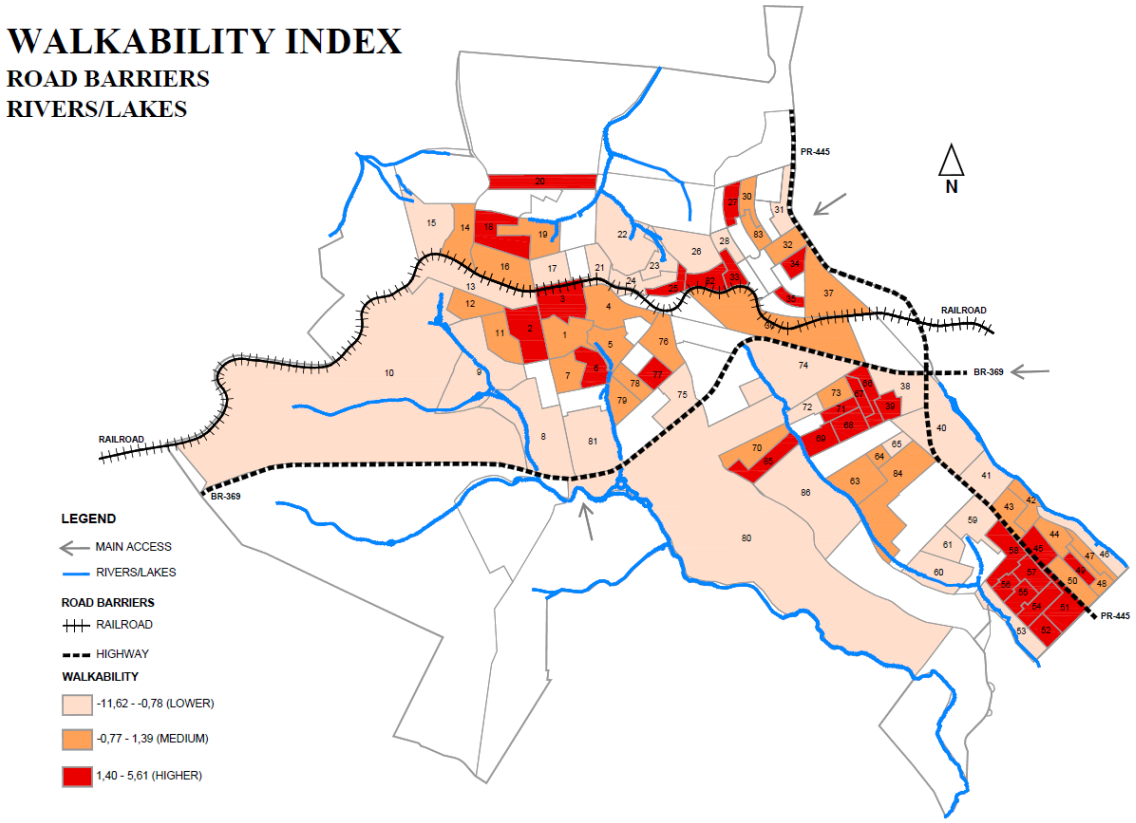
Figure 29 – Clusters defined by higher walkability census tracts in Cambé



Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2017)

Physical barriers, such as the railway, the highways and the valleys divide Cambé, and have therefore, strengthened the formation of the clusters. Notwithstanding, the census tracts' clusters with higher walkability are followed by medium walkability, and finally by lower walkability census tracts, establishing a concentric structure (Figure 30).

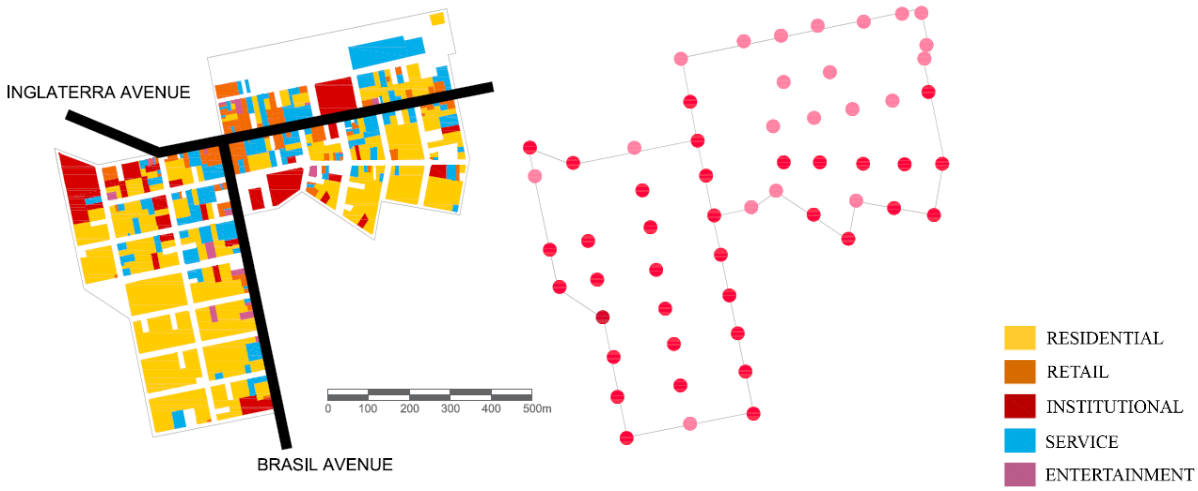
Figure 30 – Walkability Index map with physical barriers



Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2017)

A detailed analysis of each high walkability cluster pointed out their spatial arrangements considering the four variables of the index. The Original Core cluster (downtown) is outlined by census tracts 2 and 3 (Figure 31). It can be verified that land use mix and the density of street intersections prevail, confirming that both of them contribute for a higher walkability. The central area of Cambé presents different types of use, including residential use. This mix of uses enhances accessibility as Saelens; Sallis; Frank (2003) pointed out in their study. However, the greatest land use mix includes mainly retail, service and institutional uses that take place along the two main roads: *Inglaterra* and *Brasil* Avenues. Even though the former area is characterized by large block format (square shape), there is still a continuity of the urban tissue.

Figure 31 – Original core cluster: land use mix and street intersections

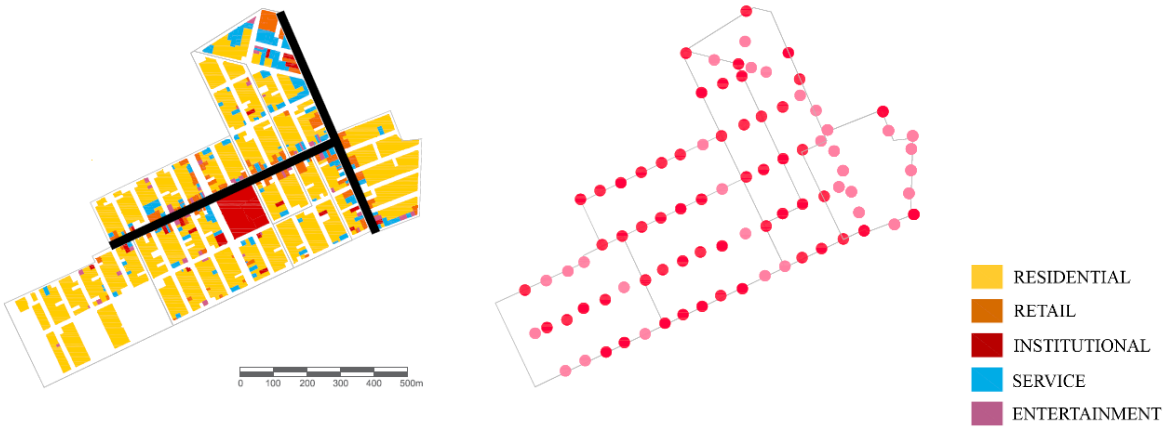


Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

The Industrial Core cluster is comprised by 39, 66, 67, 68, 69 and 71 census tracts (Figure 32). This area was settled for social housing and is close to industrial areas. The pattern for social housing projects in Brazil is usually characterized by a grid with rectangular blocks without retail areas. This typology is a strategy to respond to the housing shortage, by promoting a high number of lots within a small area. Therefore, because the area presents an orthogonal grid, it is well connected.

Two main streets provide access to the residential areas. These streets show a concentration of retail and services uses, unfolding in a linear mixed-use pattern. Although, there is still a prevalence of residential use in the area, making it well connected and supplied by other types of use. In areas with high residential density, services arise for attending the demand and, according to Beaujeu–Garnier (1997), retail business have the tendency to be implemented in the most central area in order to take full advantage of the converged communications networks.

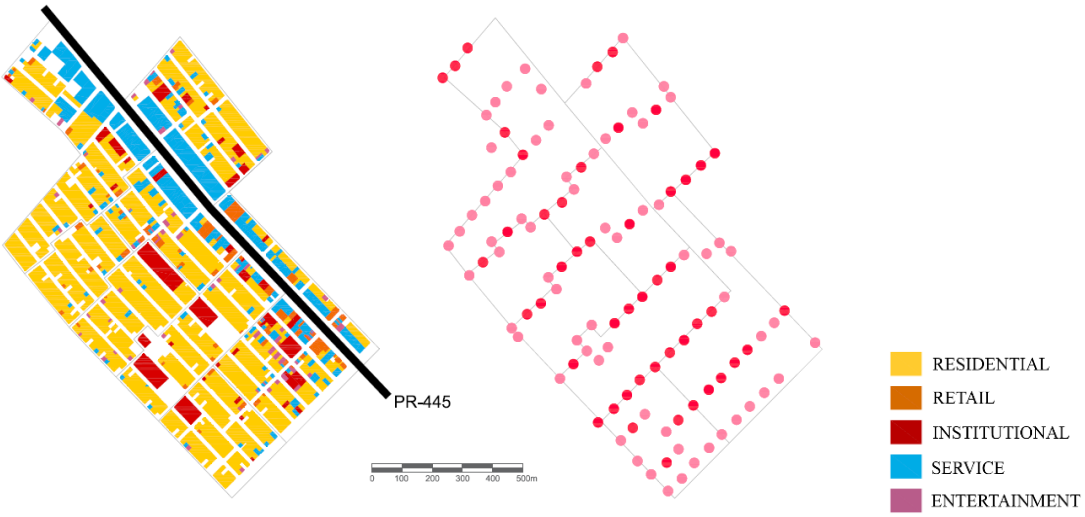
Figure 32 – Industrial core cluster: land use mix and street intersections



Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

In the *Bandeirantes* Core, the cluster is defined by census tracts 45, 51, 52, 54, 55, 56, 57 and 58 (Figure 33). This area is divided by PR-445 highway and is closer to Londrina's edge. Along the PR-445 highway, there is a predominance of services, including small industries and automobile services, for example. However, this area presents a spread land use mix. The grid pattern and lots show similar characteristics as to the Industrial Core, creating then a well-connected and compacted housing density.

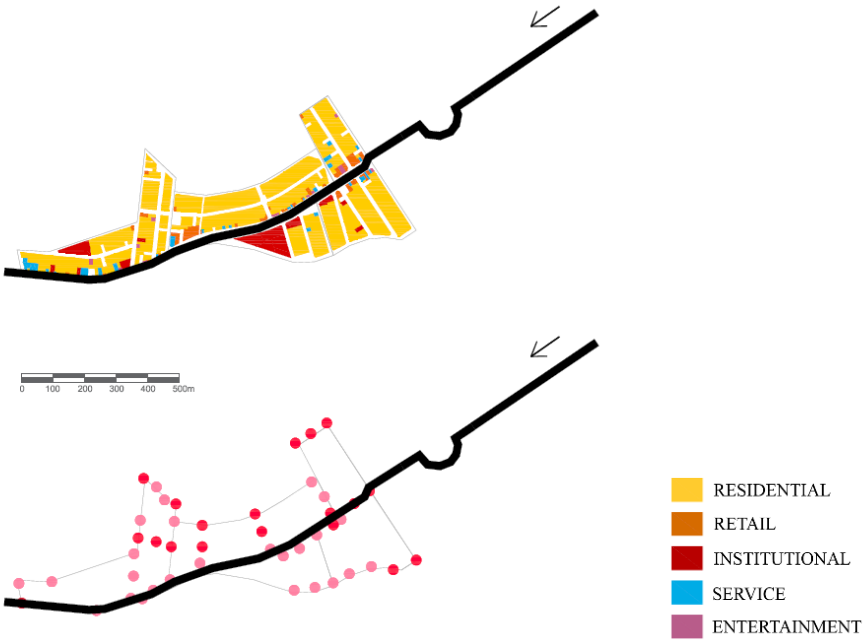
Figure 33 – *Bandeirantes* core cluster: land use mix and street intersections



Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Another small cluster is formed by the higher walkability census tracts 25, 33 and 82. It is located at the east of the original core, nearby the railway. This area create an axis that gives access to Cambé through the Ana Rosa neighbourhood, and because this axis is considered a physical barrier, the intersection density reduces. Although this area presents all types of land use, especially along the main street, there is a predominance of land use mix (Figure 34).

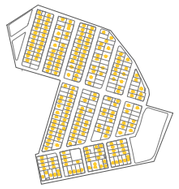
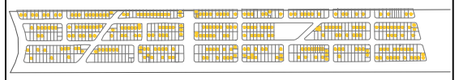
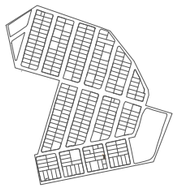
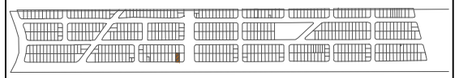
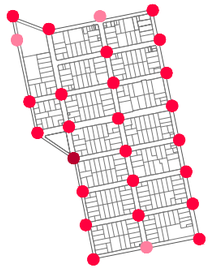
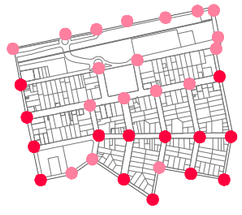
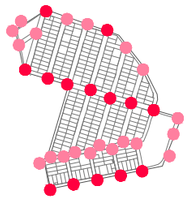
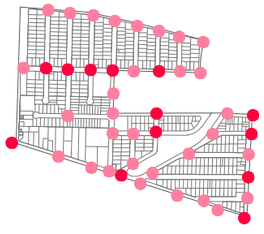
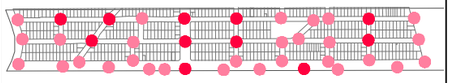
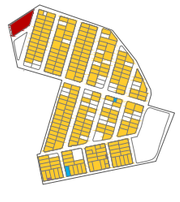
Figure 34 – Ana Rosa neighbourhood: cluster located in the access axis

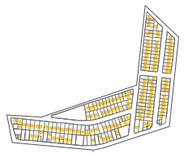
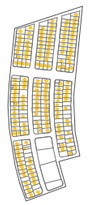
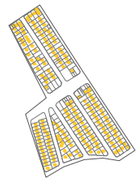
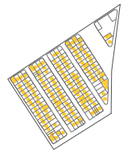
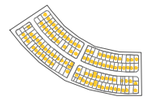
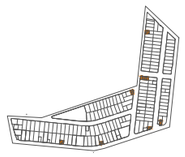
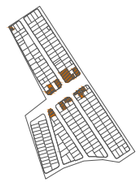
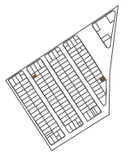
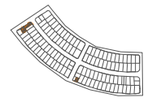
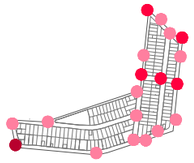
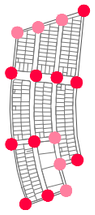
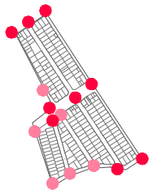
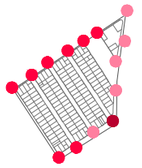
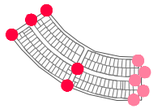
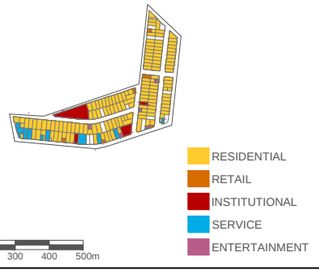
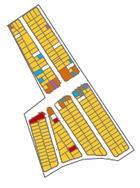
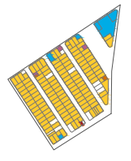
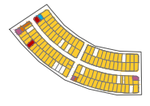


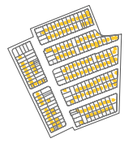
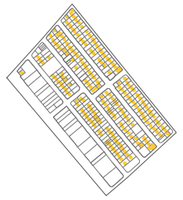
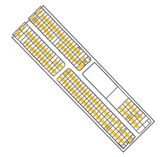
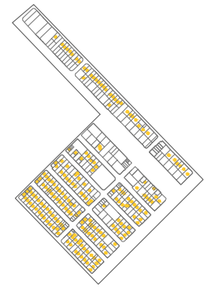
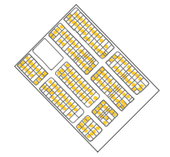
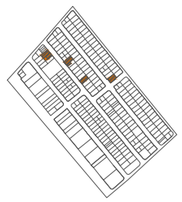
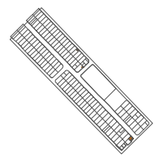
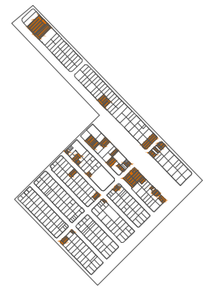
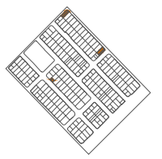
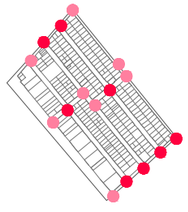
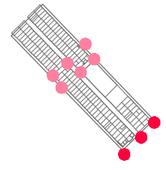
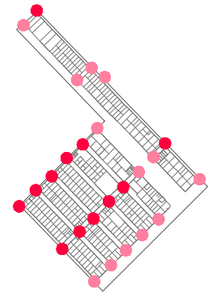
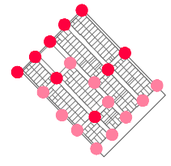
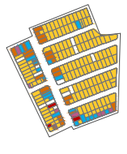
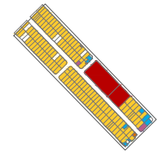
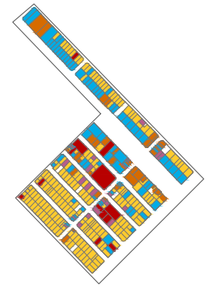
Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

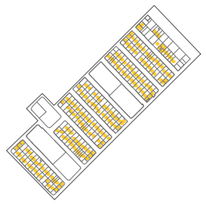
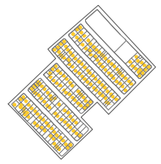
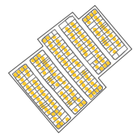
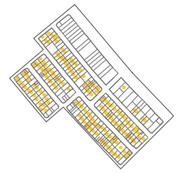
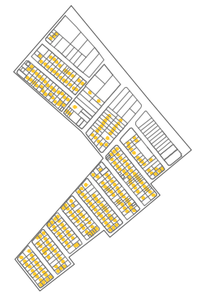
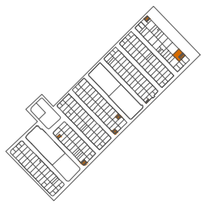
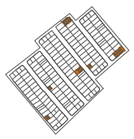
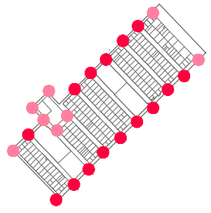
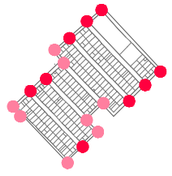
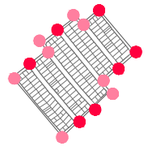
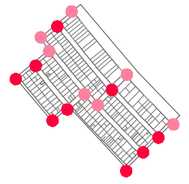
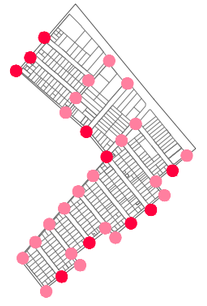
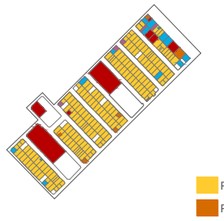
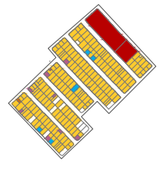
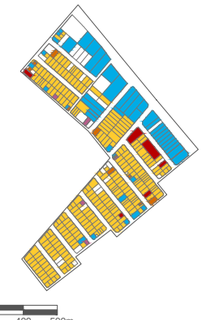
Even though the research focused in the details of these four cores of higher walkability, all census tracts were organized in a comparative board for spatial considerations. It is possible to observe that high walkability census tracts in Cambé, comprises areas of where there is a prevalence of land use mix, and that its spatial continuity is improved by the intersection density. These areas present a higher concentration of daily destinations that are closer to inhabitants' residences (Board 16).

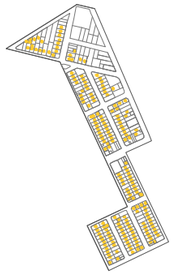
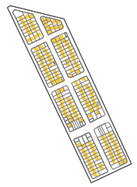
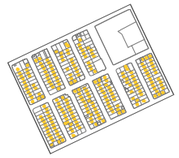
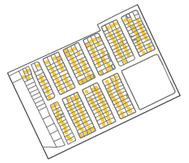
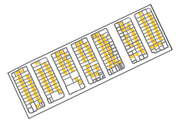
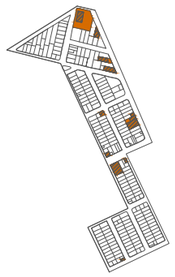
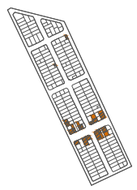
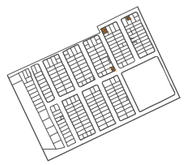
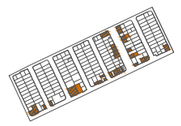
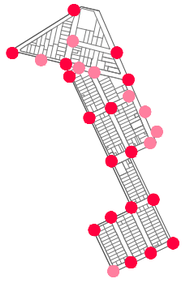
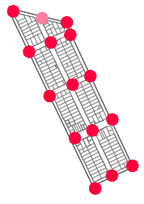
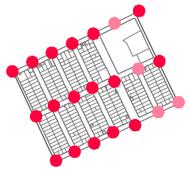
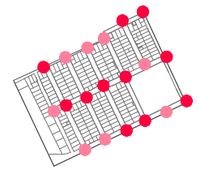
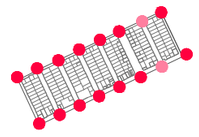
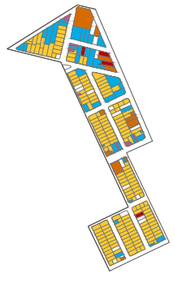
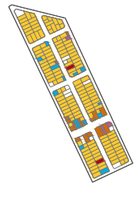
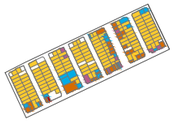
Board 16 - Higher walkability census tracts: variables from the index

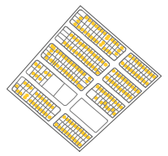
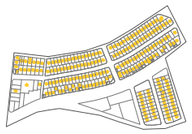
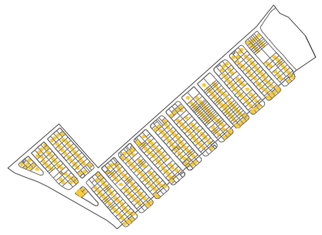
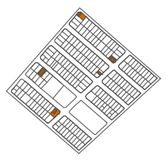
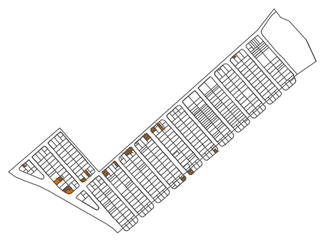
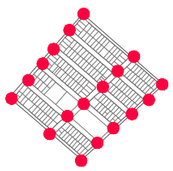
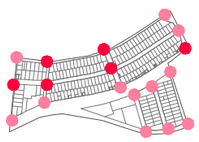
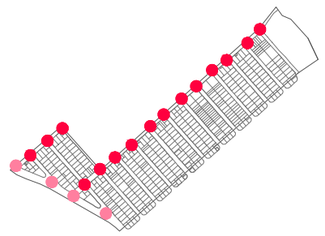
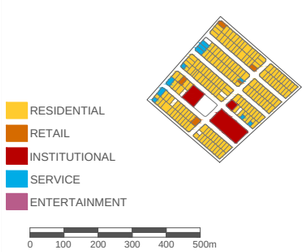
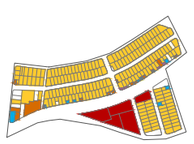
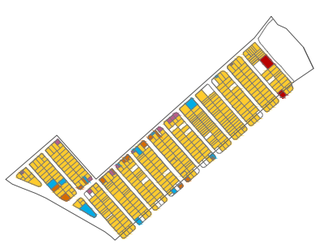
	CENSUS TRACT 2	CENSUS TRACT 3	CENSUS TRACT 6	CENSUS TRACT 18	CENSUS TRACT 20
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO					
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 25	CENSUS TRACT 27	CENSUS TRACT 33	CENSUS TRACT 34	CENSUS TRACT 35
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO					
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 39	CENSUS TRACT 45	CENSUS TRACT 49	CENSUS TRACT 51	CENSUS TRACT 52
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO					
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 54	CENSUS TRACT 55	CENSUS TRACT 56	CENSUS TRACT 57	CENSUS TRACT 58
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO					
INTERSECTION DENSITY					
LAND USE MIX					

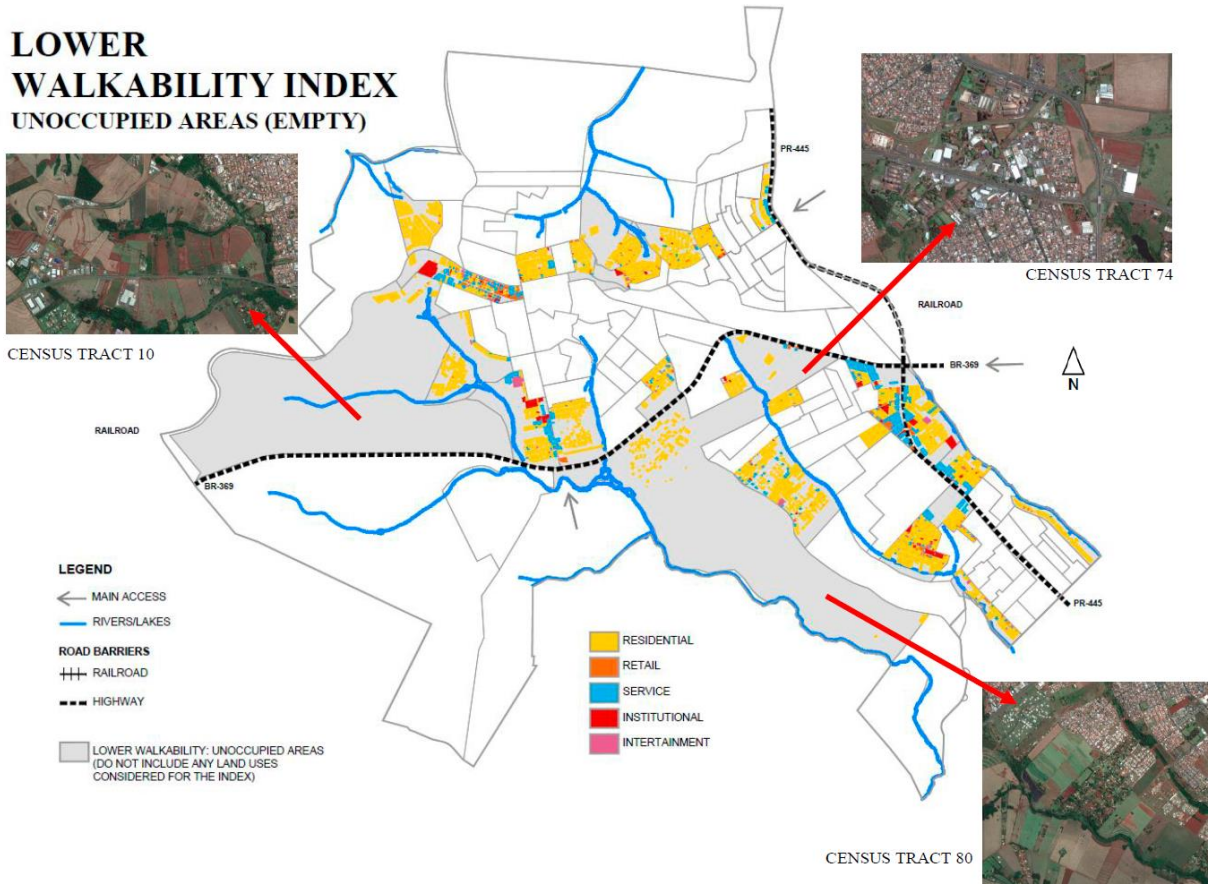
	CENSUS TRACT 66	CENSUS TRACT 67	CENSUS TRACT 68	CENSUS TRACT 69	CENSUS TRACT 71
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO					
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 77	CENSUS TRACT 82	CENSUS TRACT 85
NET RESIDENTIAL DENSITY			
RETAIL FLOOR AREA RATIO			
INTERSECTION DENSITY			
LAND USE MIX			

Source: Cambé townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

Lower walkability census tracts are located on the outer borders of the centralities, as described before, and most of them are in the outskirts of Cambé. In those census tracts there are significant empty areas and they are usually closer to road barriers (railway and highways) and waterways (rivers and lakes). Some of them can be highlighted and show typically bigger areas with no occupation (census tracts 10 and 80, mainly) or settled by industries (census tract 74). The industrial use was not considered for the index, once they are defined as "big boxes" (FRANK et al., 2010a) (Figure 35).

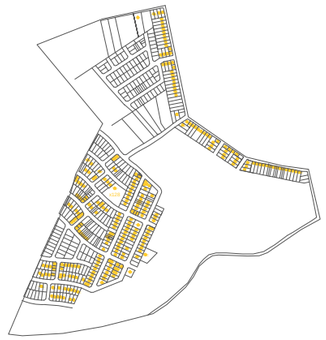
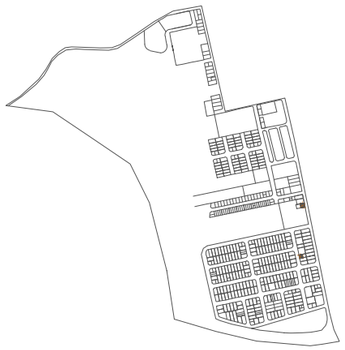
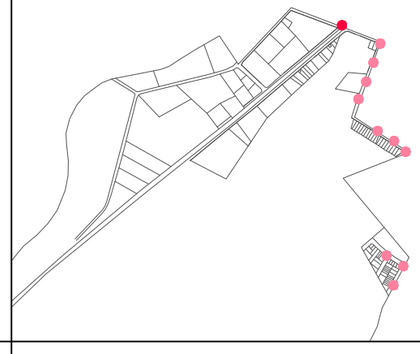
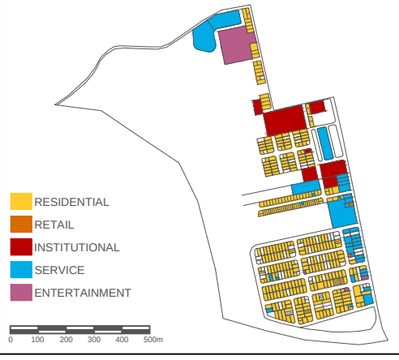
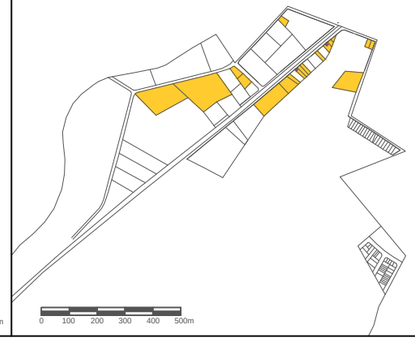
Figure 35 – Lower walkability census tracts: empty areas



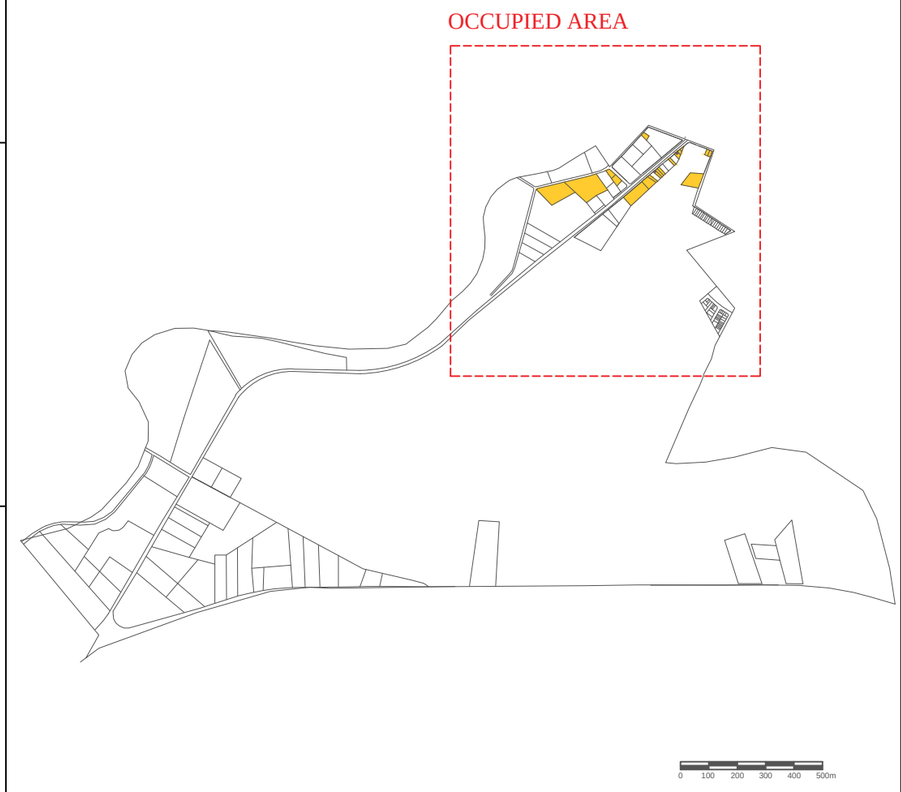
Source: Cambé Townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

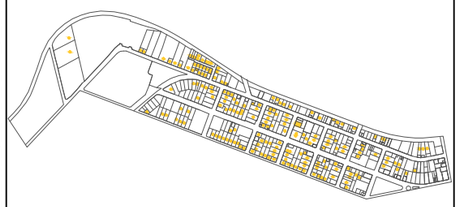
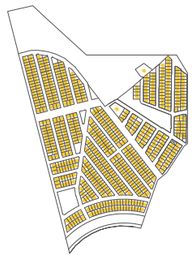
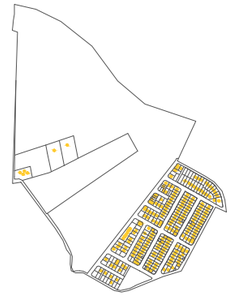
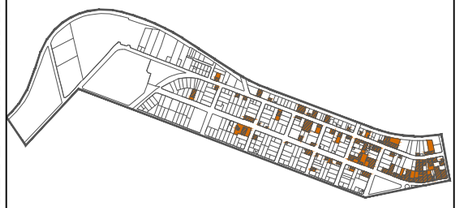
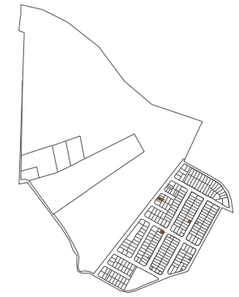
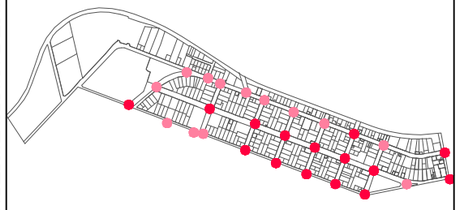
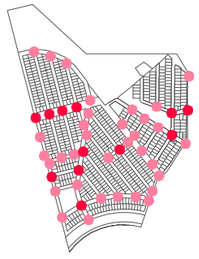
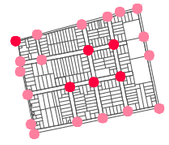
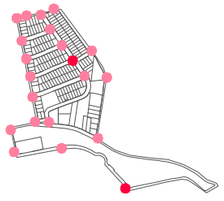
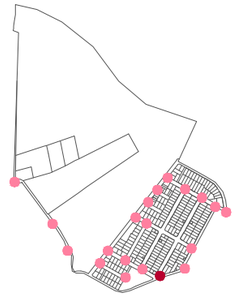
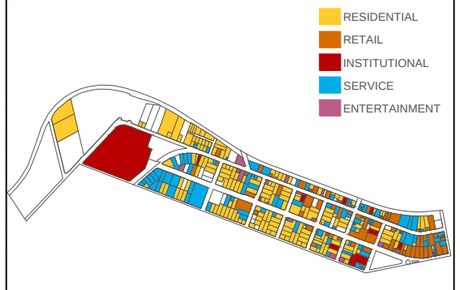
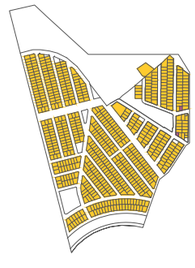
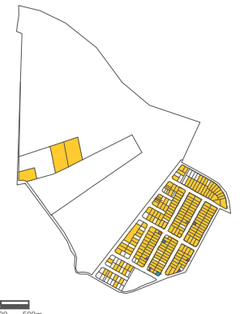
The comparative board of the lower walkability census tracts demonstrates areas with lack of continuity of the urban tissue that, as a result, reduces the intersection density. The void spaces, which are usually vacant lands, create isolated areas. The residential use is the majority and some census tracts do not have any retail facilities (Board 17).

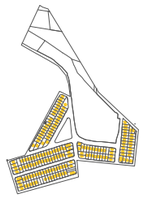
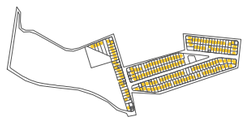
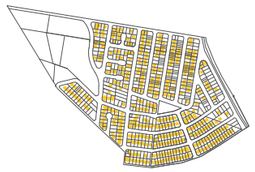
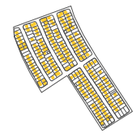
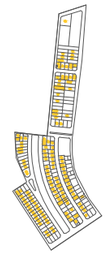
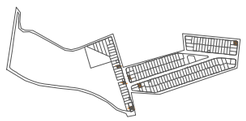
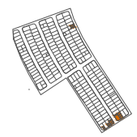
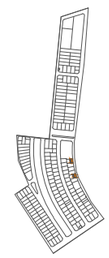
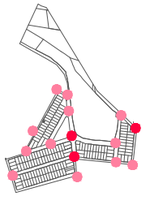
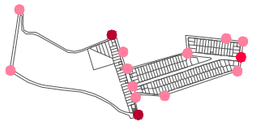
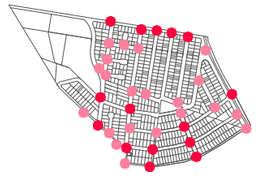
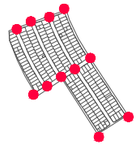
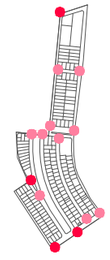
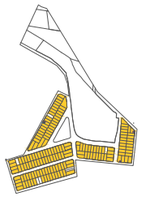
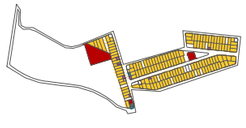
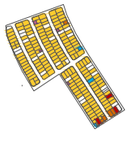
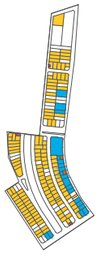
Board 17 - Lower walkability census tracts: variables from the index

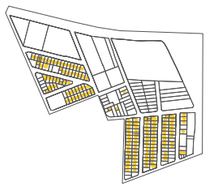
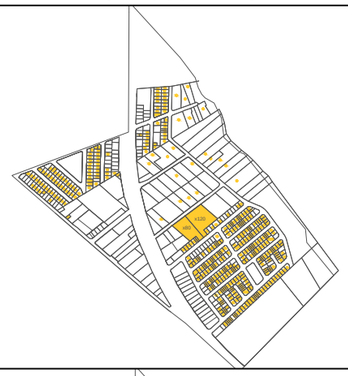
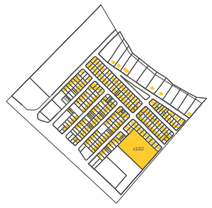
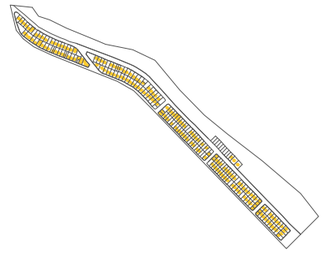
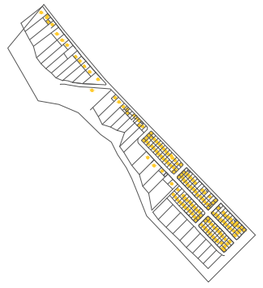
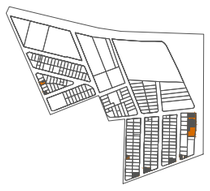
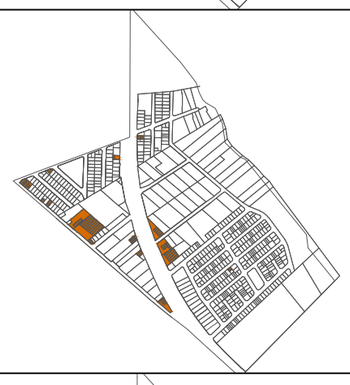
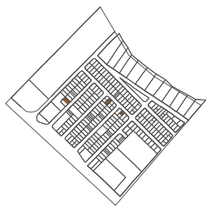
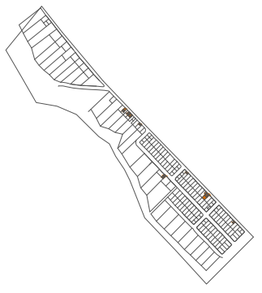
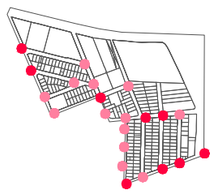
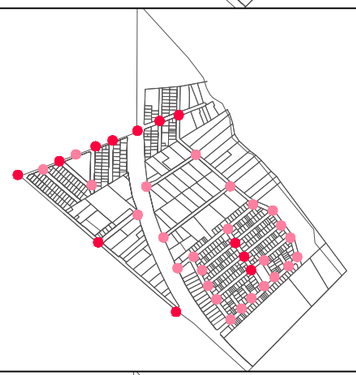
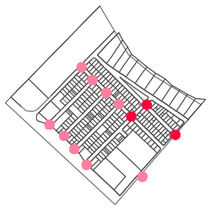
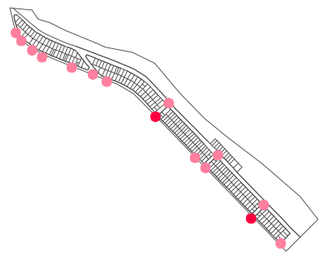
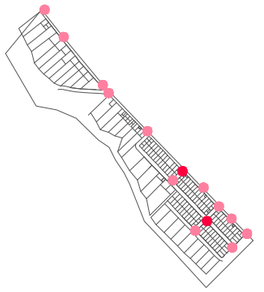
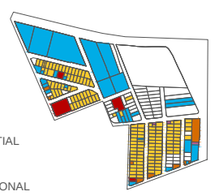
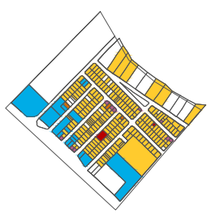
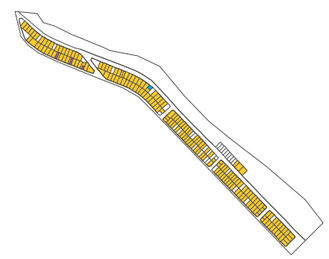
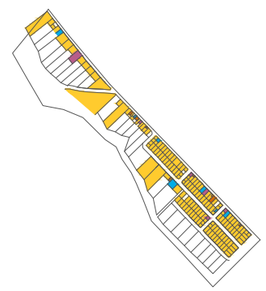
	CENSUS TRACT 8	CENSUS TRACT 9	CENSUS TRACT 10
NET RESIDENTIAL DENSITY			
RETAIL FLOOR AREA RATIO			---
INTERSECTION DENSITY			
LAND USE MIX			

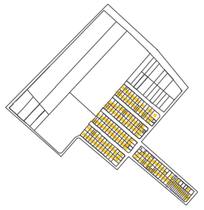
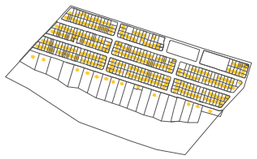
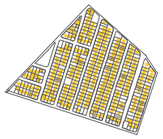
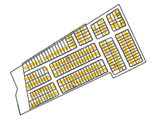
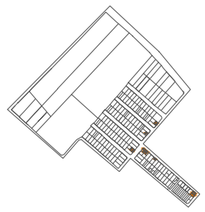
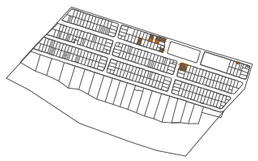
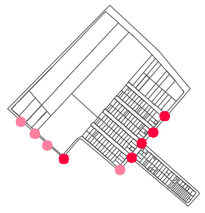
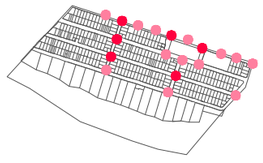
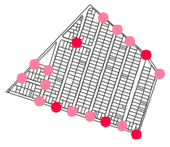
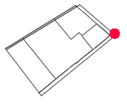
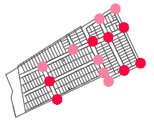
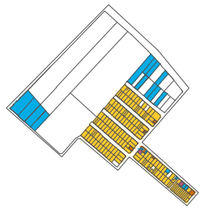
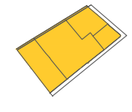
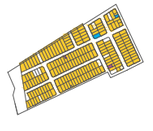
*FULL VIEW OF THE CENSUS TRACT

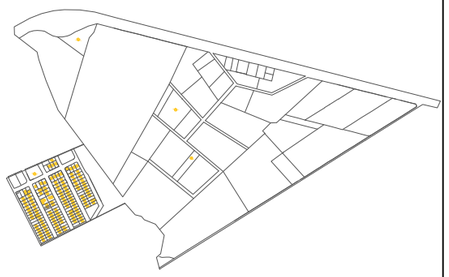
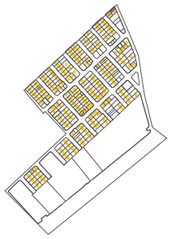
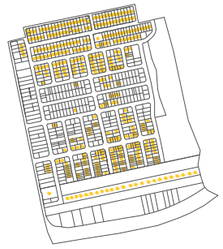
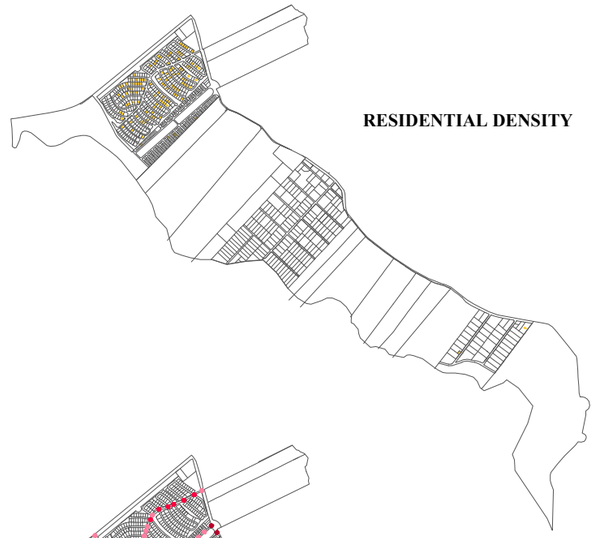
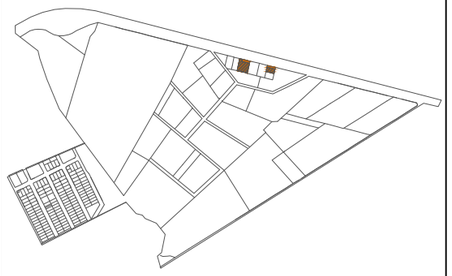
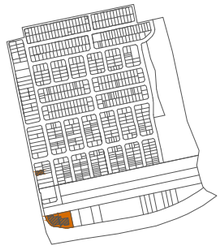
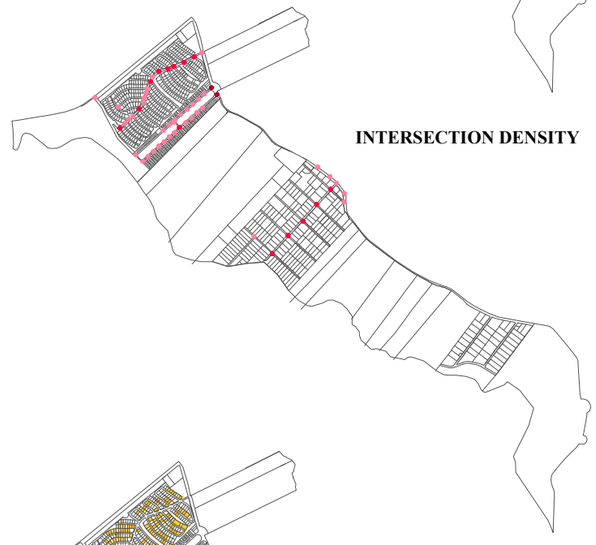
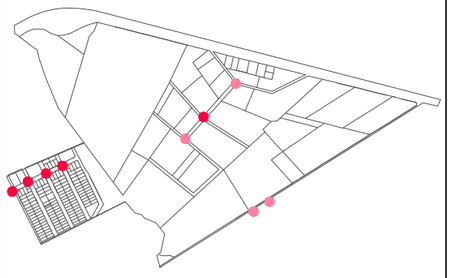
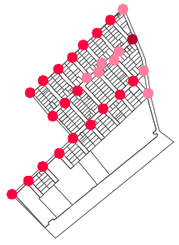
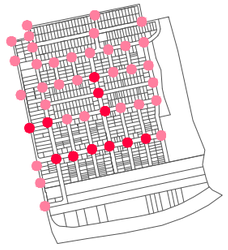
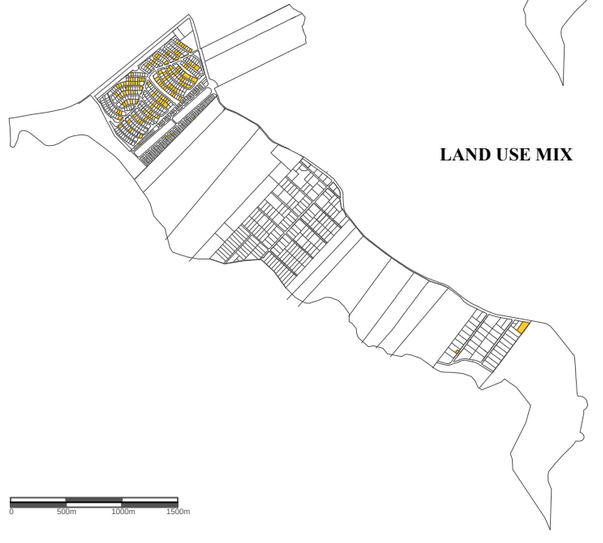


	CENSUS TRACT 13	CENSUS TRACT 15	CENSUS TRACT 17	CENSUS TRACT 21	CENSUS TRACT 22
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO		----------			
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 23	CENSUS TRACT 24	CENSUS TRACT 26	CENSUS TRACT 28	CENSUS TRACT 31
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO	----------				
INTERSECTION DENSITY					
LAND USE MIX	 RESIDENTIAL RETAIL INSTITUTIONAL SERVICE ENTERTAINMENT 0 100 200 300 400 500m	 0 100 200 300 400 500m	 0 100 200 300 400 500m	 0 100 200 300 400 500m	 0 100 200 300 400 500m

	CENSUS TRACT 38	CENSUS TRACT 40	CENSUS TRACT 41	CENSUS TRACT 46	CENSUS TRACT 53
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO				----------	
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 59	CENSUS TRACT 60	CENSUS TRACT 61	CENSUS TRACT 65	CENSUS TRACT 72
NET RESIDENTIAL DENSITY					
RETAIL FLOOR AREA RATIO				----------	----------
INTERSECTION DENSITY					
LAND USE MIX					

	CENSUS TRACT 74	CENSUS TRACT 75	CENSUS TRACT 81	CENSUS TRACT 86	CENSUS TRACT 80
NET RESIDENTIAL DENSITY					 RESIDENTIAL DENSITY
RETAIL FLOOR AREA RATIO					 INTERSECTION DENSITY
INTERSECTION DENSITY					 LAND USE MIX
LAND USE MIX					

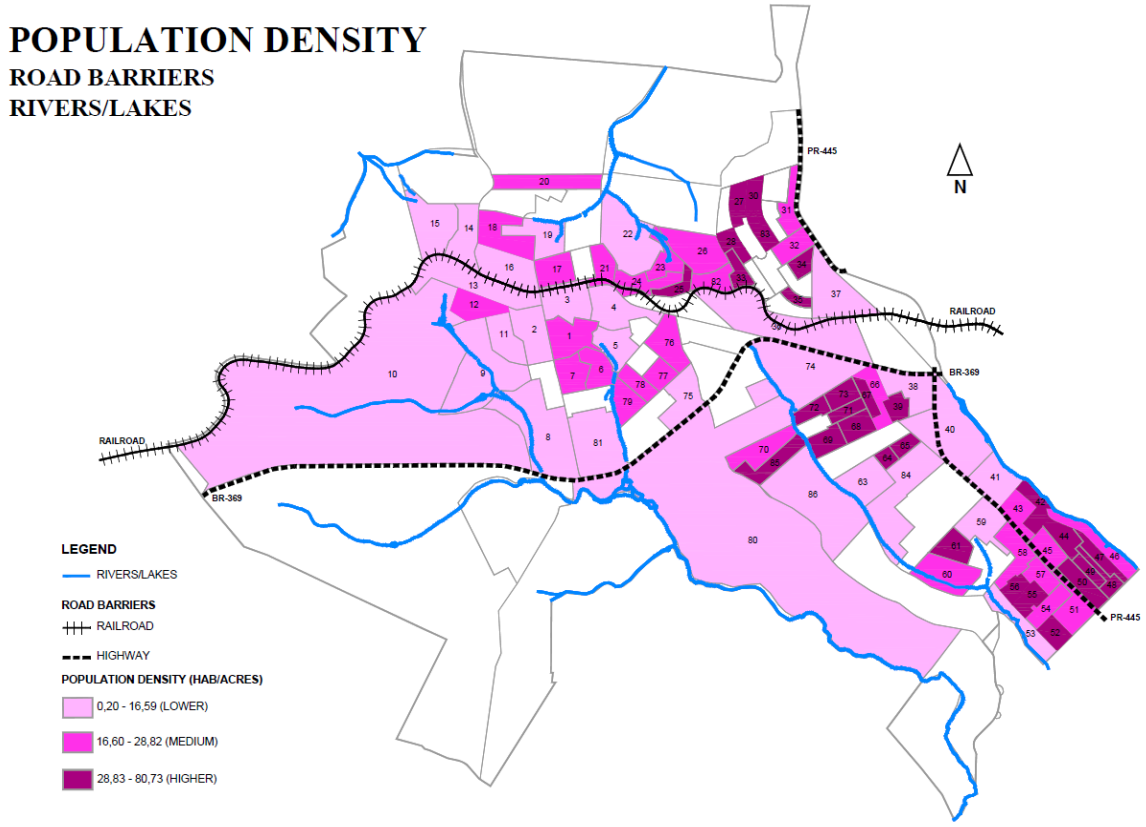
Source: Cambé townhall (2015); IBGE (2010); Google Street View (2016); Organized by the author (2017)

4.2 Walkability index and population density in Cambé

Considering that one variable of the Walkability Index proposed by Frank et al. (2010) is residential density, the relationship between higher walkability areas and higher density population should be similar. The spatial analysis pointed out those results especially in the Industrial and *Bandeirantes* cores. Nevertheless, lower walkability areas, located in the outskirts of Cambé with unoccupied regions, are not so dense.

In order to compare these issues, the population density of Cambé was mapped by taking into account the resident data from Census 2010 (Figure 36).

Figure 36 – Population density map with physical barriers

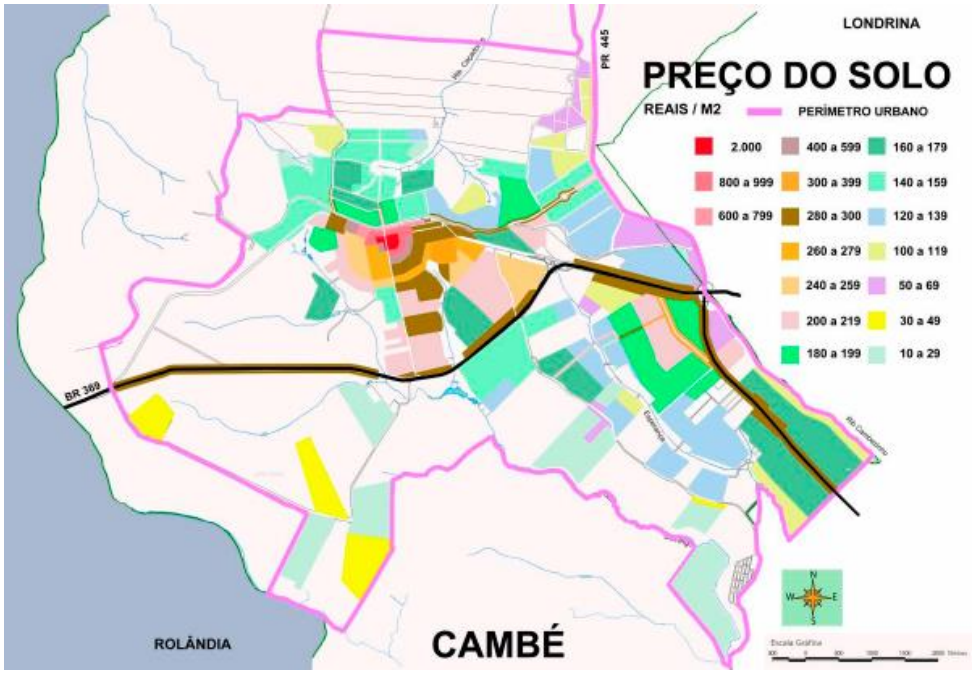


Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2017)

The overlapping of these variables reveals a couple of statements: first, the Industrial and *Bandeirantes* cores are denser than the Original Core, highlighting therefore a predominance of residential use. On the other hand, downtown area is characterized by a wider diversity of land use. Second, the north part of the Industrial Core, known as the Ana Rosa neighbourhood (census tracts 27, 28, 30, 33, 34, 35 and 83) also demonstrated higher population

density. According to Silveira (1989) this area is affected by the Industrial Core (SILVEIRA, 1989). Third, census tracts 28, 61, 65 e 72 were classified as with lower walkability, even though they show a higher density. Those areas are locus of social housing projects, far from the original urban core (downtown). In addition, the land's price is lower compared with others regions exposing the pattern of Brazilian cities (PLHIS, 2012). (Figure 37).

Figure 37 – Cost of land (reais/m²) in Cambé



Source: PLHIS (2012)

Furthermore, it is necessary to highlight that the walkability index and the population density data are statistically correlated, showing that there is a linear association between both data: 51,3% of people living in areas of higher walkability are also living in more populated areas and 52,2% of people living in lower walkability areas are also living in less populated areas (Table 2).

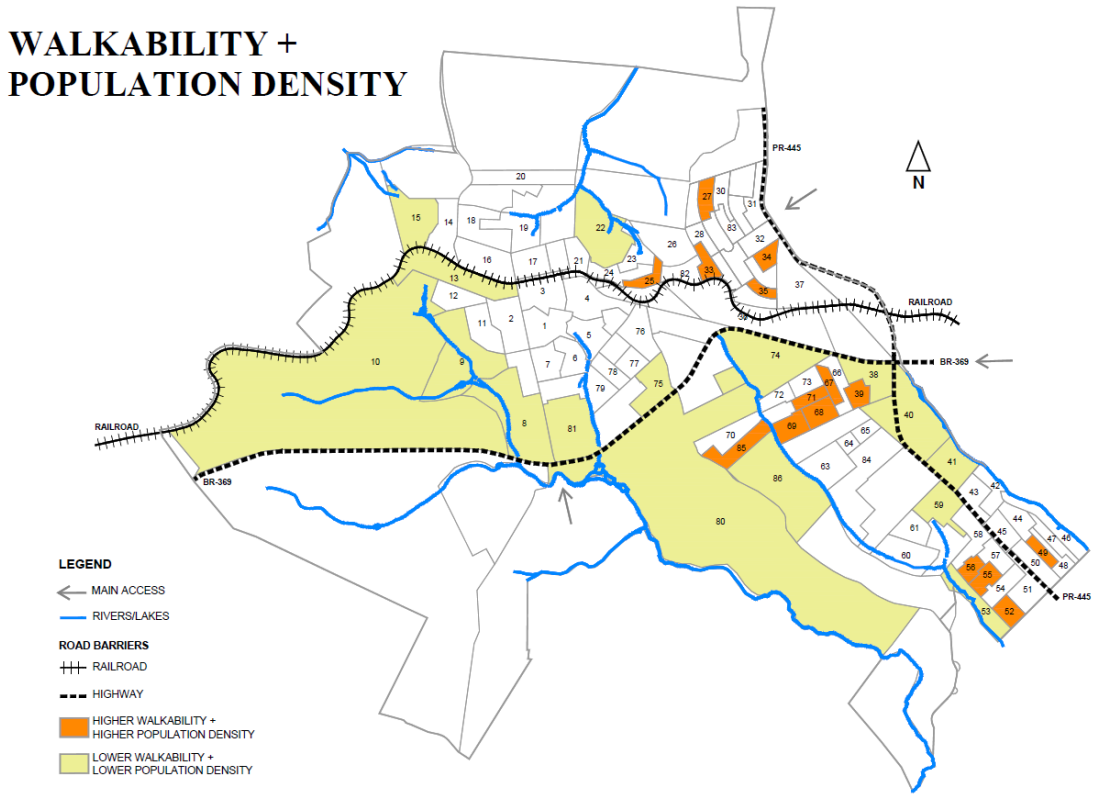
Table 2 – VIGICARDIO sample distribution according to walkability index and population density

			POPULATION DENSITY		
			HIGHER	MEDIUM	LOWER
WALKABILITY INDEX	HIGHER	N	204	159	35
		%	51,3%	39,9%	8,8%
	MEDIUM	N	**104**	**145**	**171**
		%	24,8%	34,5%	40,7%
	LOWER	N	**56**	**117**	**189**
		%	15,5%	32,3%	52,2%

Source: Organized by the author (2017)

The overlap of the walkability index and the population density maps (Figure 38) shows that census tracts with higher walkability and higher population density are located according to the Industrial and *Bandeirantes* urban cores and in the Ana Rosa neighbourhood. Census tracts with lower walkability and lower population are concentrated along the physical barriers, especially the highways.

Figure 38 – Overlay of maps: walkability index and population density



Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2017)

4.3 Descriptive data: demographic, clinical, behavioural, social capital and self-rated health

The sample of this study is composed of 1180 respondents, which comprises the total sample from the VIGICARDIO database. From the respondents, 54,4% were female, 39,4% aged between 40 – 49 years old, 66,2% were married, 48,0% presented between 0 and 4 years of education, 61,7% were classified at C or lower social class, 71,4% did not do any exercise for leisure, 90,4% did not report chronic diseases (hypertension or diabetes) and 68,6% were not obese (Table 3).

Table 3 – Distribution of the sample according to demographic, clinical and behavioural characteristics – VIGICARDIO project (N and %)

CHARACTERISTICS	N	%
GENDER		
Female	642	54,4
Male	538	53,8
AGE		
40 - 49	465	39,4
50 - 59	361	30,6
60 - 69	239	20,3
70 - 79	83	7,0
80 or greater	21	1,8
MARITAL STATUS		
Single	98	8,3
Married	781	66,2
Divorced / Separated	98	8,3
Widower	121	10,3
Stable coupling	82	3,5
EDUCATION (Years of study)		
0 –4	566	48,0
5 - 8	292	24,7
9 or greater	320	27,1

ECONOMIC CLASS		
A	48	4,1
B1	84	7,1
B2	318	27,0
C1	384	32,5
C2	229	19,4
D – E	116	9,8
PHYSICAL ACTIVITY FOR LEISURE		
Positive	337	28,6
Negative	842	71,4
REPORTED CHRONIC DISEASES (Hypertension and Diabetes)		
Positive	113	9,6
Negative	1063	90,4
OBESITY		
Positive	347	29,4
Negative	809	68,6

Source: Organized by the author (2017)

For the social capital results, the distribution of residents in the three categories of walkability are almost the same retaking that they were divided in tertiles; 26,3% cannot trust in most of the people from their neighbourhood/locality; 36,1% agree that they need to be careful or someone can take advantage on them and; 51,7% agree that people do not trust in each other to borrow or take money; 62,8% revealed a positive perception in relation to solidarity in their neighbourhood and 27,3% say that people always help each other in their neighbourhood/locality; 67,8% classify their neighbourhood/locality as peaceful and 27,5% feel secure to walk at night alone (Table 4). For self-rated health, 47,9% of the sample rated their health as good (Table 5).

Table 4 –Distribution of the sample according to Walkability Index categories, social capital indicatives and self-rated health – VIGICARDIO project (N and %)

CHARACTERISTICS	N	%
WALKABILITY INDEX		
Higher	404	34,2
Medium	395	33,5
Lower	381	32,3

SOCIAL CAPITAL		
You can trust most of the people who live in your neighbourhood/locality:		
Totally agree	260	22,0
Partly agree	229	19,4
Neither agree nor disagree	90	7,6
Partly disagree	272	23,1
Totally disagree	310	26,3
In your neighbourhood/locality it is necessary to be careful that someone will take advantage on you:		
Totally agree	426	36,1
Partly agree	262	22,2
Neither agree nor disagree	73	6,2
Partly disagree	111	9,4
Totally disagree	284	24,1
Most of the people in your neighbourhood/locality are willing to help you in case you need it:		
Totally agree	366	31,0
Partly agree	375	31,8
Neither agree nor disagree	108	9,2
Partly disagree	158	13,4
Totally disagree	150	12,7
In your neighbourhood/locality people usually do not trust each other to lend or borrow money:		
Totally agree	610	51,7
Partly agree	164	13,9
Neither agree nor disagree	253	21,4
Partly disagree	61	5,2
Totally disagree	52	4,4
Nowadays, how often do you say people in your neighbourhood/locality help each other?		
Always	322	27,3
Most of the time	193	16,4
Sometimes	308	26,1
Rarely	208	17,6
Never	93	7,9

In your opinion, your neighbourhood is usually:		
Very peaceful	322	27,3
Moderately peaceful	478	40,5
Neither peaceful nor violent	157	13,3
Moderately violent	165	14,0
Very violent	41	3,5
Regarding your safety, how do you feel when you walk alone at night?		
Moderately safe	324	27,5
Not so safe	271	23,0
Neither safe nor unsafe	64	5,4
Moderately unsafe	277	23,5
Very unsafe	220	18,6
Social capital score		
0	22	1,9
1	26	2,2
2	152	12,9
3	267	22,6
4	305	25,8
5	229	19,4
6	147	12,5
7	32	2,7

Source: Organized by the author (2017)

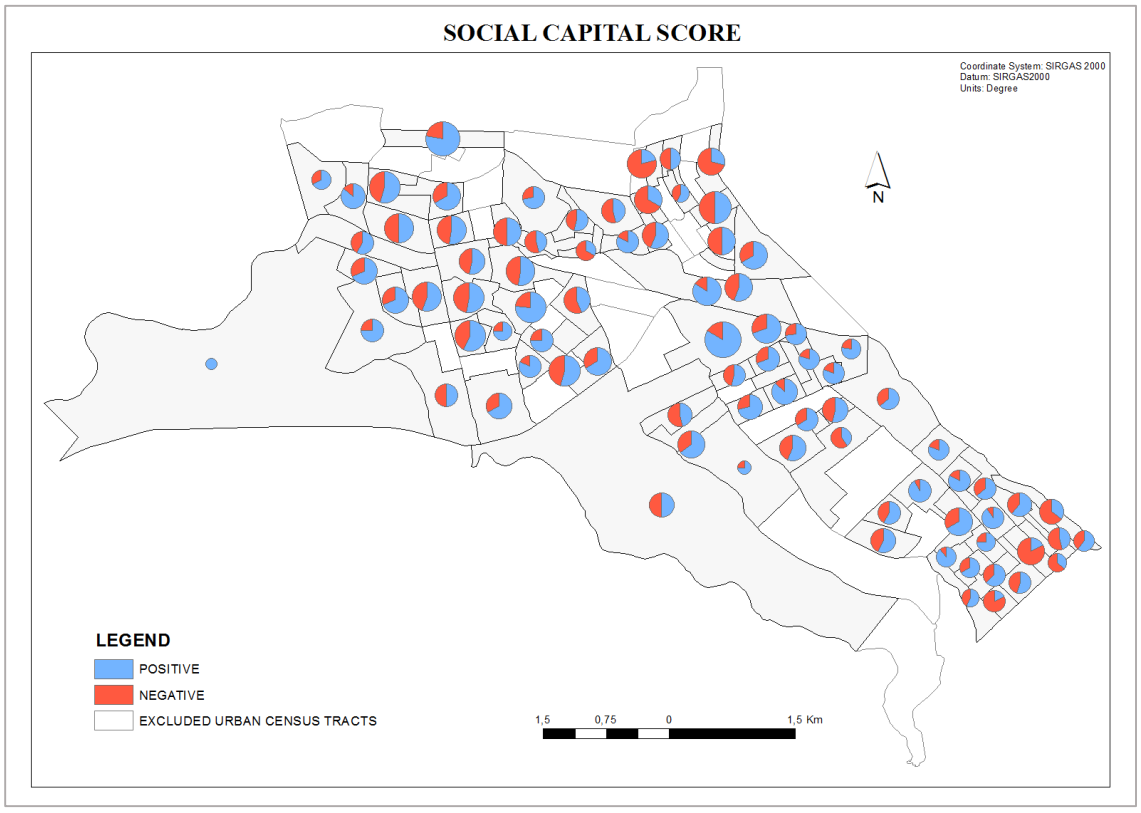
Table 5 –Distribution of the sample according to self-rated health

SELF-RATED HEALTH		
How do you classify your health condition?		
Very Good	107	9,1
Good	565	47,9
Regular	416	35,3
Bad	59	5,0
Very bad	26	2,2

Source: Organized by the author (2017)

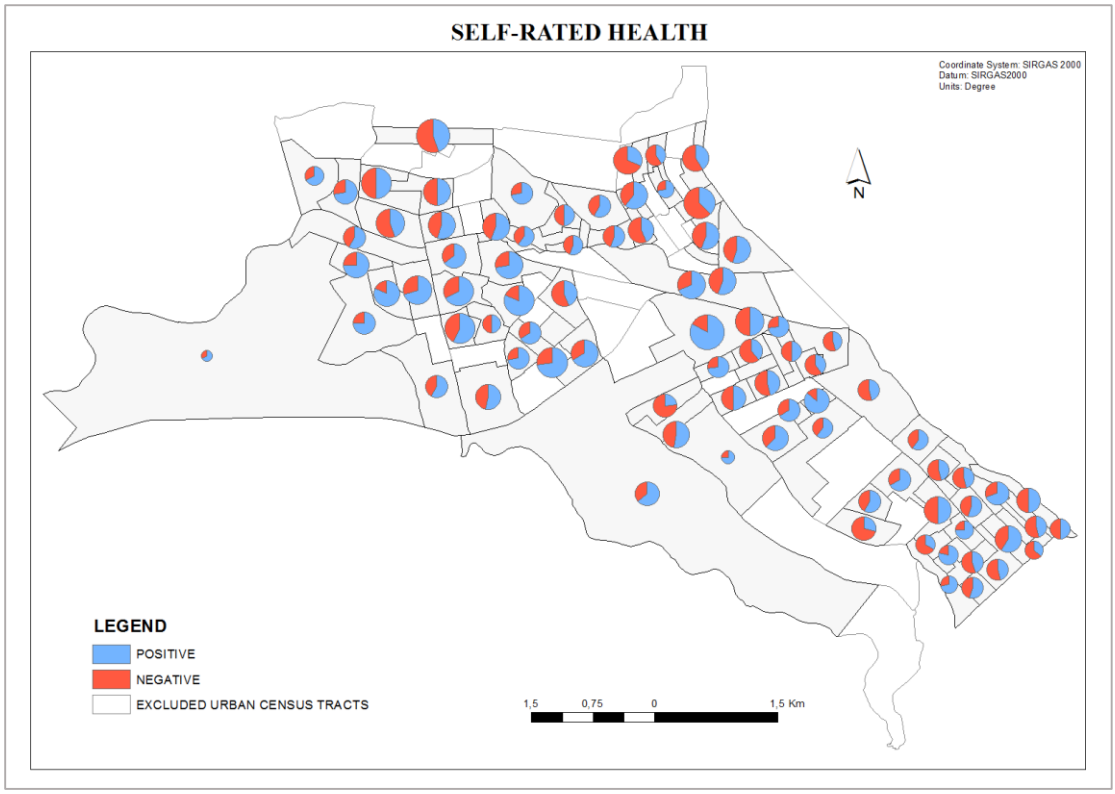
Considering studies that show that social class (income) is associated with and can affect self-rated health directly in Brazil (ALVES; RODRIGUES, 2005; CHIAVEGATTO FILHO; LEBRÃO; KAWACHI, 2012; REICHERT; LOCH; CAPILHEIRA, 2012) and in other countries and areas such as Britain (ARBER; GINN, 1993), Thailand (ZIMMER; AMORNSIRISOMBOON, 2001), China (FENG et al., 2012) and United States (TUCKER-SEELEY et al., 2012), data of social capital score, self-rated health and social class categories were mapped (Figures 39 to 43) even though there are disparities between samples of each census tract. The VIGICARDIO study was focused on the analysis of the entire urban area of Cambé and the selection of different samples for each census tract was a strategy that aimed to cover all regions and areas of the town.

Figure 39 – Map of social capital score: negative and positive



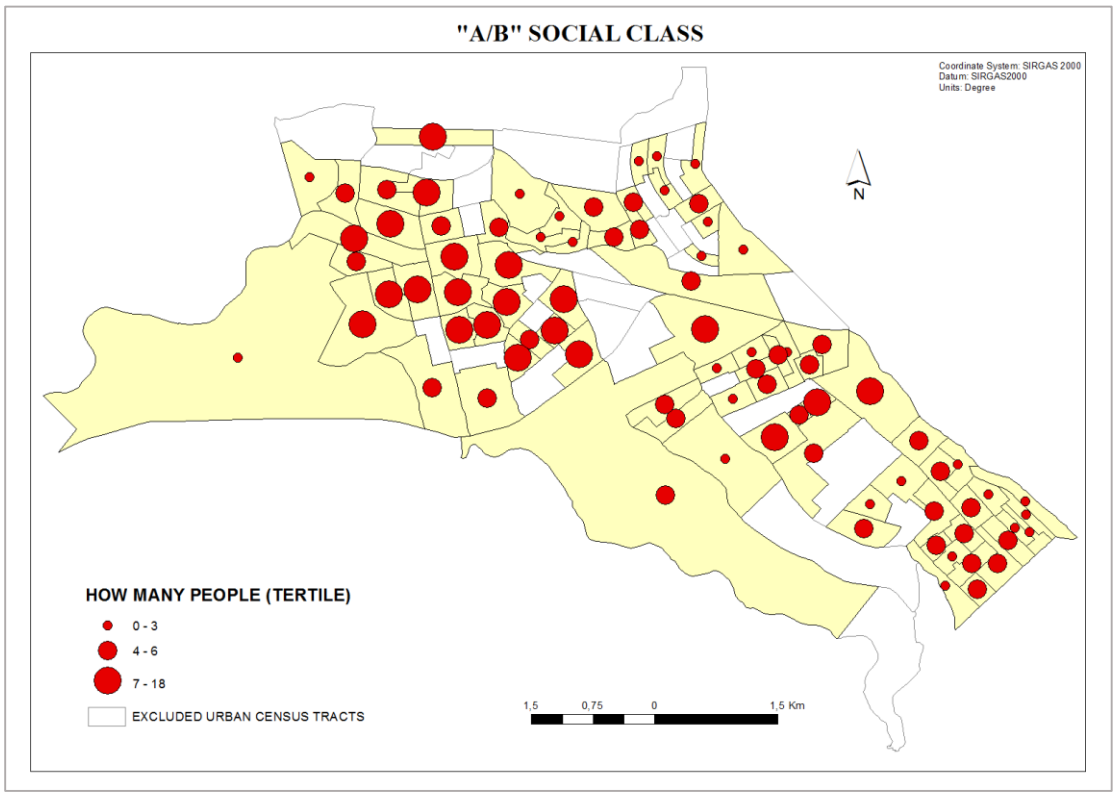
Source: VIGICARDIO (2011); IBGE (2010); Organized by the author (2017)

Figure 40 – Map of self-rated health: negative and positive



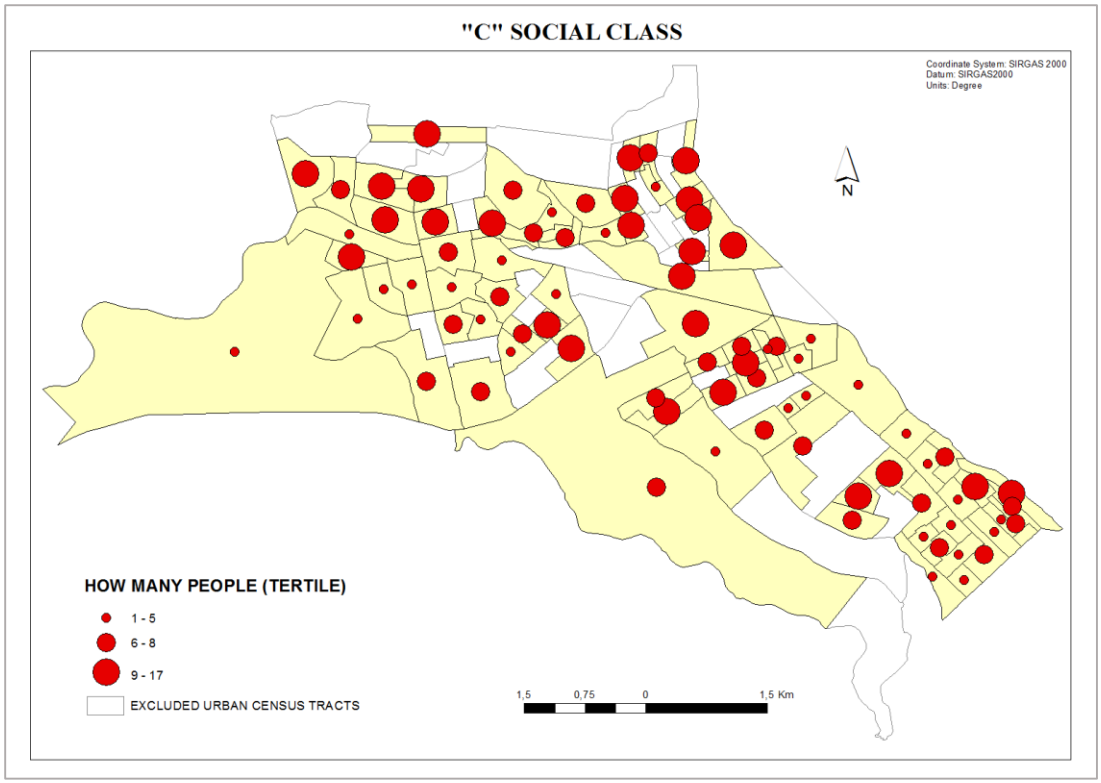
Source: VIGICARDIO (2011); IBGE (2010); Organized by the author (2017)

Figure 41 – "A/B" social class map



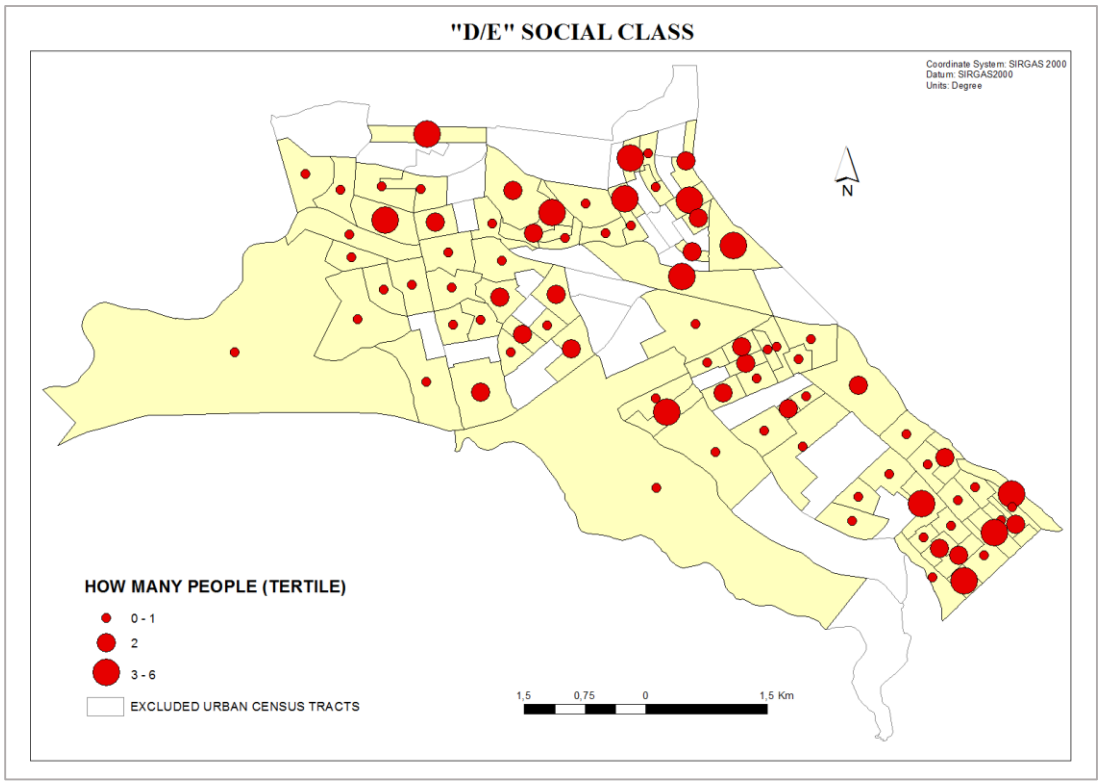
Source: VIGICARDIO (2011); IBGE (2010); Organized by the author (2017)

Figure 42 – "C" social class map



Source: VIGICARDIO (2011); IBGE (2010); Organized by the author (2017)

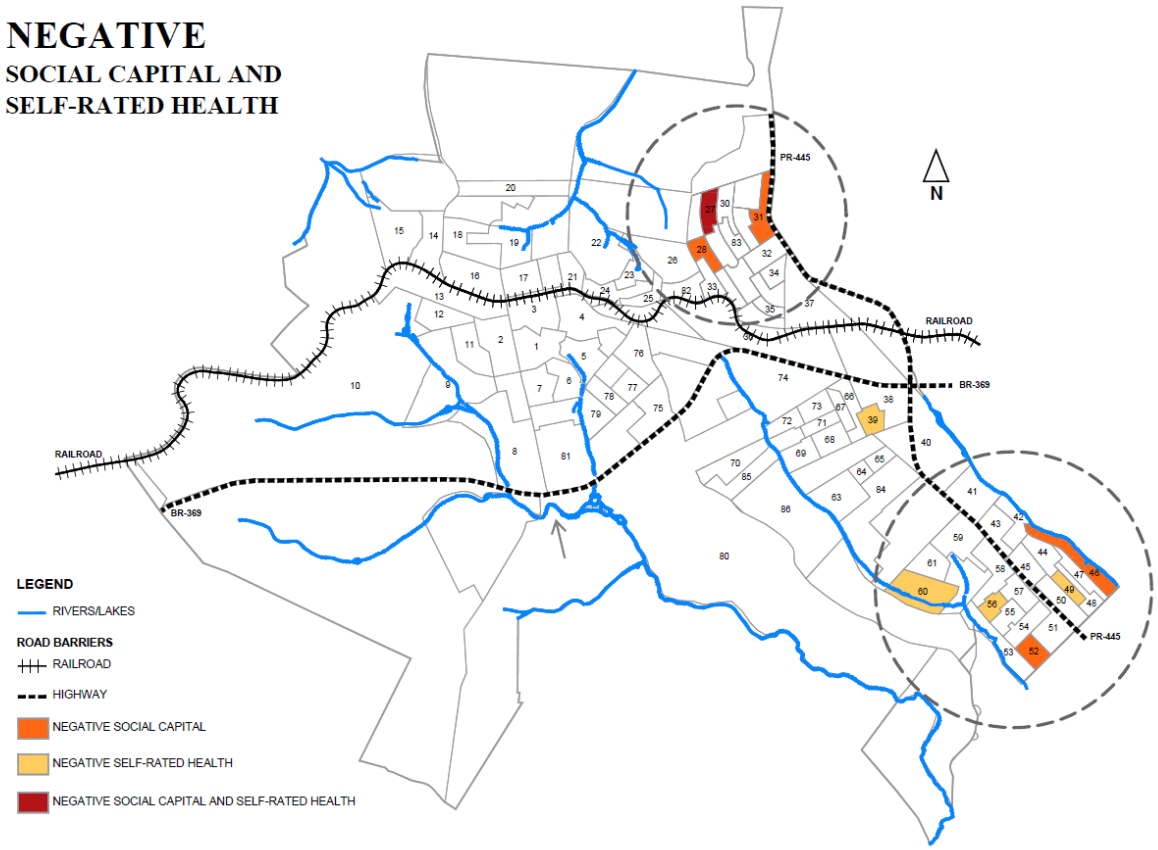
Figure 43 – "D/E" social class map



Source: VIGICARDIO (2011); IBGE (2010); Organized by the author (2017)

From the overlapping of social capital score and self-rated health samples per census tract, it is possible to infer that social class influence social capital and self-rated health outcomes in Cambé. Independently of the walkability index, census tracts that presented considerable negative social capital score or/and negative self-rated health were mainly concentrated in the north and southeast outskirts of the urban area or close to the highways. Those places are locus of lower social classes: "C" and "D/E" (Figure 42, 43 and 44). This pattern is usual in Brazilian cities: higher social class population living in downtown area and lower social class population in the outskirts, because of the land cost.

Figure 44 – Census tracts with negative social capital score and negative self-rated health



Source: Cambé Townhall (2015); IBGE (2010); Organized by the author (2017)

Some census tracts present higher walkability index and higher population density, but also more negative social capital and self-rated health (27 and 49), which are census tracts located in the outskirts of Cambé, where social housing areas are concentrated. On the contrary, census tracts that present lower walkability index and lower population density, but more positive social capital and self-rated health indicatives (22, 75, 80 and 81), are located in areas with private residential areas and small ranches such as holiday homes. These results

show the influence of social class in the understanding of social capital and self-rated health in Cambé.

4.4 Stratified correlations: Social Capital and Self-rated Health according to Walkability Index and Population Density strata

Based on the assumption that higher indicatives of social capital are related positively to self-rated health in Cambé (LOCH, 2013), this research main objective is to understand if walkability levels interfere or change this association. It was verified for each strata (higher, medium and lower) of walkability index and population density if the relation between social capital and self-rated health can vary according to the level of walkability or to how many people live in a certain area (Table 6). Also, it was verified the statistical significance (p-value < 0,05) and the prevalence of each confounder variable (demographic, clinical and behavioural) for each strata of walkability and population density (Table 7).

The built environment (walkability index), population density, neighbourhood level social capital and self-rated health variables were correlated by using the IBM SPSS 20 software. The binary logistic regression was used to calculate all the correlations. The logistic regression has been used in many studies involving especially epidemiology areas and also regarding to walkability index in the health discussion (FRANK et al., 2006; BERKE et al., 2007; OWEN et al., 2007; SALLIS et al., 2009; KING et al., 2011; REIS et al., 2013; CAUWENBERG et al., 2016).

Self-rated health is the dependent variable and social capital the independent one. For the logistic regression, positive outcomes of social capital were considered the reference measure in all correlations and the exposure to negative self-rated health is the outcome for the dependent variable. The results presented have 95% of confidence interval (CI) and the association measure is odds ratio. Crude and adjusted data (by gender, age, social class, education, physical activity for leisure, reported chronic diseases and obesity) data were correlated.

Table 6 - Correlation between social capital and self-rated health according to walkability index and population density strata. Crude and adjusted data (n=1180); p-value < 0,05

CRUDE / ADJUSTED** DATA		NEGATIVE SELF-RATED HEALTH - DEPENDENT VARIABLE (OR CI 95%)								
SOCIAL CAPITAL INDICATIVES - INDEPENDENT VARIABLE		HIGHER WALKABILITY			MEDIUM WALKABILITY			LOWER WALKABILITY		
		%	OR (CI 95%)	OR ADJUSTED (CI 95%)	%	OR (CI 95%)	OR ADJUSTED (CI 95%)	%	OR (CI 95%)	OR ADJUSTED (CI 95%)
TRUST IN MOST OF THE PEOPLE OF YOUR NEIGHBORHOOD/LOCALITY	POSITIVE	49,0	1,0	1,0	36,6	1,0	1,0	35,9	1,0	1,0
	NEGATIVE	45,8	0,88 (0,59 – 1,32)	0,99 (0,63 – 1,55)	46,4	**1,50 (1,01 – 2,22)***	1,43 (0,92 – 2,22)	41,0	1,24 (0,80 – 1,92)	0,96 (0,59 – 1,54)
PEOPLE WILL NOT TAKE ADVANTAGE ON YOU	POSITIVE	39,2	1,0	1,0	36,0	1,0	1,0	30,5	1,0	1,0
	NEGATIVE	50,2	**1,56 (1,02 – 2,40)***	**1,65 (1,03 – 2,65)***	46,7	1,56 (1,05 – 2,31)*	1,34 (0,86 – 2,07)	44,2	**1,80 (1,15 – 2,83)***	**2,02 (1,25 – 3,26)***
PEOPLE ARE WILLING TO HELP	POSITIVE	45,1	1,0	1,0	39,2	1,0	1,0	34,5	1,0	1,0
	NEGATIVE	50,0	1,22 (0,81 – 1,82)	1,29 (0,82 – 2,02)	46,7	1,36 (0,90 – 2,06)	1,51 (0,95 – 2,41)	45,6	**1,59 (1,02 – 2,49)***	1,39 (0,86 – 2,23)
PEOPLE TRUST IN EACH OTHER TO BORROW OR TAKE MONEY	POSITIVE	46,0	1,0	1,0	39,6	1,0	1,0	30,4	1,0	1,0
	NEGATIVE	46,7	1,03 (0,65 – 1,62)	1,06 (0,64 – 1,75)	42,6	1,13 (0,75 – 1,70)	0,90 (0,57 – 1,43)	42,9	**1,72 (1,07 – 2,77)***	**1,86 (1,11 – 3,12)***
PEOPLE HELP EACH OTHER FREQUENTLY	POSITIVE	48,6	1,0	1,0	38,2	1,0	1,0	29,9	1,0	1,0
	NEGATIVE	44,1	0,83 (0,56 – 1,25)	0,93 (0,59 – 1,46)	43,5	1,24 (0,83 – 1,85)	1,13 (0,72 – 1,76)	46,8	**2,06 (1,32 – 3,22)***	**1,82 (1,13 – 2,93)***
NEIGHBORHOOD IS SAFE	POSITIVE	43,7	1,0	1,0	37,8	1,0	1,0	36,7	1,0	1,0
	NEGATIVE	52,7	1,44 (0,95 – 2,17)	1,17 (0,74 – 1,83)	51,8	**1,77 (1,14 – 2,73)***	1,39 (0,85 – 2,28)	43,7	1,34 (0,84 – 2,14)	1,18 (0,71 – 1,95)
NEIGHBORHOOD IS SAFE TO WALK AT NIGHT	POSITIVE	42,2	1,0	1,0	35,4	1,0	1,0	35,3	1,0	1,0
	NEGATIVE	51,3	1,44 (0,97 – 2,16)	1,46 (0,93 – 2,29)	47,4	**1,64 (1,11 – 2,43)***	1,29 (0,82 – 2,02)	42,9	1,38 (0,90 – 2,12)	1,48 (0,92 – 2,38)
SOCIAL CAPITAL SCORE	POSITIVE	45,5	1,0	1,0	35,2	1,0	1,0	37,9	1,0	1,0
	NEGATIVE	49,7	1,18 (0,79 – 1,77)	1,09 (0,70 – 1,72)	51,8	**1,98 (1,33 – 2,95)***	**1,87 (1,20 – 2,92)***	40,6	1,12 (0,73 – 1,73)	0,85 (0,53 – 1,37)
SOCIAL CAPITAL INDICATIVES - INDEPENDENT VARIABLE		HIGHER POPULATION DENSITY			MEDIUM POPULATION DENSITY			LOWER POPULATION DENSITY		
		%	OR (CI 95%)	OR ADJUSTED (CI 95%)	%	OR (CI 95%)	OR ADJUSTED (CI 95%)	%	OR (CI 95%)	OR ADJUSTED (CI 95%)
TRUST IN MOST OF THE PEOPLE OF YOUR NEIGHBORHOOD/LOCALITY	POSITIVE	45,8	1,0	1,0	47,2	1,0	1,0	30,8	1,0	1,0
	NEGATIVE	46,1	1,01 (0,65 – 1,58)	1,24 (0,75 – 2,06)	47,5	1,01 (0,69 – 1,50)	0,87 (0,56 – 1,34)	38,7	1,42 (0,93 – 2,17)	1,20 (0,75 – 1,90)
PEOPLE WILL NOT TAKE ADVANTAGE ON YOU	POSITIVE	38,6	1,0	1,0	41,0	1,0	1,0	28,4	1,0	1,0
	NEGATIVE	48,2	1,48 (0,93 – 2,37)	1,67 (0,98 – 2,86)	51,5	**1,52 (1,03 – 2,26)***	1,46 (0,95 – 2,25)	40,6	**1,73 (1,13 – 2,64)***	**1,78 (1,12 – 2,82)***
PEOPLE ARE WILLING TO HELP	POSITIVE	45,5	1,0	1,0	44,4	1,0	1,0	30,9	1,0	1,0
	NEGATIVE	46,7	1,05 (0,69 – 1,60)	1,03 (0,63 – 1,67)	51,9	1,36 (0,91 – 2,02)	1,40 (0,90 – 2,16)	42,9	**1,68 (1,07 – 2,64)***	1,54 (0,94 – 2,53)
PEOPLE TRUST IN EACH OTHER TO BORROW OR TAKE MONEY	POSITIVE	44,1	1,0	1,0	45,0	1,0	1,0	28,9	1,0	1,0
	NEGATIVE	46,8	1,12 (0,69 – 1,79)	1,17 (0,68 – 2,02)	47,9	1,12 (0,74 – 1,71)	1,01 (0,69 – 1,73)	37,2	1,46 (0,93 – 2,28)	1,30 (0,79 – 2,11)
PEOPLE HELP EACH OTHER FREQUENTLY	POSITIVE	44,0	1,0	1,0	48,0	1,0	1,0	26,5	1,0	1,0
	NEGATIVE	46,0	1,08 (0,71 – 1,66)	1,08 (0,66 – 1,77)	46,5	0,94 (0,63 – 1,40)	0,91 (0,59 – 1,40)	41,1	**1,94 (1,25 – 3,00)***	**2,21 (1,36 – 3,61)***
NEIGHBORHOOD IS SAFE	POSITIVE	42,3	1,0	1,0	45,0	1,0	1,0	32,8	1,0	1,0
	NEGATIVE	50,0	1,36 (0,90 – 2,07)	1,21 (0,75 – 1,93)	51,5	1,30 (0,86 – 1,96)	1,03 (0,65 – 1,62)	45,1	1,68 (0,93 – 3,05)	1,20 (0,62 – 2,33)
NEIGHBORHOOD IS SAFE TO WALK AT NIGHT	POSITIVE	40,7	1,0	1,0	44,4	1,0	1,0	28,0	1,0	1,0
	NEGATIVE	50,5	1,49 (0,98 – 2,27)	1,23 (0,75 – 2,02)	50,3	1,26 (0,86 – 1,86)	1,36 (0,89 – 2,08)	41,1	**1,79 (1,17 – 2,74)***	**1,68 (1,04 – 2,71)***
SOCIAL CAPITAL SCORE	POSITIVE	43,0	1,0	1,0	45,8	1,0	1,0	31,1	1,0	1,0
	NEGATIVE	49,4	1,29 (0,85 – 1,96)	1,07 (0,66 – 1,73)	50,0	1,18 (0,80 – 1,75)	1,10 (0,71 – 1,69)	42,2	**1,62 (1,05 – 2,51)***	1,53 (0,96 – 2,46)

**adjusted by gender, age, education, social class, reported chronic diseases, obesity and physical activity for leisure.

Source: Organized by the author (2017)

Table 7 - Correlation between demographic, clinical and behavioural variables and self-rated health according to walkability index and population density strata. Crude data (n=1180); p-value < 0,05

CRUDE DATA		NEGATIVE SELF-RATED HEALTH - DEPENDENT VARIABLE (OR CI 95%)					
DEMOGRAPHIC, CLINICAL AND BEHAVIORAL VARIABLES		HIGHER WALKABILITY		MEDIUM WALKABILITY		LOWER WALKABILITY	
		%	OR (CI 95%)	%	OR (CI 95%)	%	OR (CI 95%)
GENDER	MALE	41,3	1,00	30,3	1,00	35,8	1,00
	FEMALE	52,1	**1,55 (1,04 – 2,30)***	51,1	**2,40 (1,60 – 2,60)***	41,5	1,27 (0,83 – 1,96)
AGE	40-49	38,5	1,00	31,5	1,00	34,5	1,00
	50-59	51,7	**1,71 (1,06 – 2,77)***	50,4	**2,21 (1,37 – 3,58)***	44,3	1,51 (0,82 – 2,50)
	60+	53,5	**1,84 (1,13 – 3,00)***	46,2	**1,87 (1,16 – 3,01)***	38,9	1,21 (0,71 – 2,07)
SOCIAL CLASS	A/B	43,6	1,00	31,5	1,00	29,2	1,00
	C	47,2	1,16 (0,76 – 1,78)	50,4	**1,89 (1,24 – 2,87)***	45,7	**2,04 (1,27 – 3,26)***
	D/E	60,0	1,94 (0,95 – 3,97)	46,2	**2,27 (1,16 – 4,43)***	36,7	1,40 (0,61 – 3,23)
EDUCATION	9+	33,0	1,00	27,4	1,00	25,0	1,00
	5-8	44,0	1,59 (0,89 – 2,87)	38,2	1,64 (0,94 – 2,87)	46,9	**2,65 (1,44 – 4,88)***
	0-4	55,6	**2,54 (1,54 – 4,19)***	52,8	**2,97 (1,83 – 4,82)***	42,3	**2,20 (1,26 – 3,84)***
REPORTED CHRONIC DISEASES	NO	42,6	1,00	40,4	1,00	36,6	1,00
	YES	81,8	**6,06 (2,74 – 13,42)***	64,3	**2,66 (1,20 – 5,91)***	59,0	**2,49 (1,27 – 4,91)***
OBESITY	NO	48,5	1,00	42,2	1,00	38,4	1,00
	YES	45,5	0,89 (0,57 – 1,38)	40,6	0,93 (0,62 – 1,41)	41,6	1,14 (0,70 – 1,86)
PHYSICAL ACTIVITY FOR LEISURE	YES	40,6	1,00	28,0	1,00	26,7	1,00
	NO	49,5	1,44 (0,92 – 2,25)	47,6	**2,34 (1,49 – 3,68)***	44,0	**2,17 (1,31 – 3,57)***
		HIGHER POPULATION DENSITY		MEDIUM POPULATION DENSITY		LOWER POPULATION DENSITY	
		%	OR (CI 95%)	%	OR (CI 95%)	%	OR (CI 95%)
GENDER	MALE	32,7	1,00	43,5	1,00	30,8	1,00
	FEMALE	57,1	**2,74 (1,78 – 4,21)***	50,6	1,33 (0,91 – 1,97)	38,1	1,39 (0,91 – 2,11)
AGE	40-49	33,1	1,00	40,8	1,00	30,3	1,00
	50-59	53,3	**2,31 (1,39 – 3,84)***	54,5	**1,74 (1,09 – 2,77)***	38,8	1,46 (0,89 – 2,42)
	60+	57,0	**2,68 (1,59 – 4,50)***	49,2	1,41 (0,87 – 2,27)	35,0	1,24 (0,74 – 2,08)
SOCIAL CLASS	A/B	42,4	1,00	39,2	1,00	27,3	1,00
	C	47,7	1,24 (0,77 – 2,00)	51,9	**1,68 (1,11 – 2,53)***	40,0	**1,77 (1,14 – 2,76)***
	D/E	44,4	1,09 (0,53 – 2,21)	60,0	**2,33 (1,15 – 4,72)***	48,3	**2,48 (1,12 – 5,51)***
EDUCATION	9+	31,7	1,00	31,6	1,00	24,3	1,00
	5-8	41,8	1,55 (0,80 – 3,01)	51,5	**2,30 (1,32 – 3,98)***	34,8	1,66 (0,93 – 2,96)
	0-4	52,5	**2,37 (1,31 – 4,32)***	54,8	**2,62 (1,62 – 4,23)***	43,8	**2,43 (1,48 – 3,99)***
REPORTED CHRONIC DISEASES	NO	42,0	1,00	45,8	1,00	32,1	1,00
	YES	76,2	**4,42 (2,10 – 9,30)***	64,1	**2,12 (1,07 – 4,20)***	66,7	**4,22 (1,92 – 9,31)***
OBESITY	NO	49,4	1,00	47,2	1,00	32,6	1,00
	YES	38,4	0,64 (0,40 – 1,02)	48,8	1,07 (0,70 – 1,63)	39,5	1,35 (0,87 – 2,11)
PHYSICAL ACTIVITY FOR LEISURE	YES	38,6	1,00	34,9	1,00	22,7	1,00
	NO	48,2	1,48 (0,91 – 2,41)	53,1	**2,12 (1,38 – 3,25)***	39,9	**2,27 (1,38 – 3,71)***

Source: Organized by the author (2017)

Considering only data that showed statistical significance (p-value < 0,05), for walkability index, it was verified that negative indicatives of social capital are related to negative self-rated health in the three walkability categories. However, living in lower walkability areas can worsen self-rated health outcomes. The same results were found for population density, when living in lower population density areas can worsen self-rated health.

In relation to the walkability index, for people who live in higher walkability census tracts, the perception that neighbours will take advantage aggravated self-rated health for both crude and adjusted data (CRUDE OR 1,56 CI 95% = 1,02 – 2,40; ADJUSTED OR 1,65 CI 95% = 1,03 – 2,65).

In contrast, for crude and adjusted data, people who live in lower walkability census tracts that have the perception that neighbours will take advantage (CRUDE OR 1,80 CI 95% = 1,15 - 2,83; ADUSTED OR 2,02 CI 95% = 1,25 - 3,26); that neighbours do not trust in each other to borrow or take money (CRUDE OR 1,72 CI 95% = 1,07 - 2,77; ADJUSTED OR 1,86 CI 95% = 1,11 - 3,12); and that neighbours do not help each other frequently (CRUDE OR 2,06 CI 95% = 1,32 - 3,22; ADJUSTED OR 1,82 CI 95% = 1,13 - 2,93) presented more negative self-rated health in comparison with people who live in higher walkability areas. The perception that neighbours are not willing to help was only related to negative self-rated health for crude data (OR 1,59 CI 95% = 1,02 - 2,49).

People living in medium walkability and with negative perception of trust (OR 1,50 CI 95% = 1,01 – 2,22), of safety (OR 1,77 CI 95% = 1,14 – 2,73) and of safety to walk at night in the neighbourhood (OR 1,64 CI 95% = 1,11 – 2,43) presented association with negative self-rated for crude data. Negative social capital score was related to negative self-rated health for crude (OR 1,98 CI 95% = 1,33 – 2,95) and adjusted data (OR 1,87 CI 95% = 1,20 – 2,92).

Regarding population density, people who live in medium population density areas and who perceive that neighbours will take advantage was related to negative self-rated health only for crude data (OR 1,52 CI 95% = 1,03 – 2,26). On the other hand, living in lower population density areas showed that when people have the perception that neighbours are not willing to help and when presenting negative social capital score, self-rated health can be worsened for crude data only (OR 1,68 CI 95% = 1,07 – 2,64; OR 1,62 CI 95% 1,05 – 2,51, respectively). Associations for crude and adjusted data in lower population density category showed that people who have the perception that neighbours will take advantage (CRUDE OR 1,73 CI 95% = 1,13 – 2,64; ADJUSTED OR 1,78 CI 95% = 1,12 – 2,82), neighbours do not help each other frequently (CRUDE OR 1,94 CI 95% = 1,25 – 3,00; ADJUSTED OR 2,21 CI

95% = 1,36 – 3,61) and that they do not feel safe to walk at night (CRUDE OR 1,79 CI 95% = 1,17 – 2,74; ADJUSTED OR 1,68 CI 95% = 1,04 – 2,71), the self-rated health was worse.

Although the medium category for both walkability and population density presented relevant outcomes, understanding the contrast between higher and lower c was compelling for this study. This decision of analysis enables to highlight the contrasts between the upmost categories.

For lower walkability census tracts in comparison to higher walkability ones, people who trust less in neighbours (have the perception that people will take advantage and people are not trustful to borrow or take money) and perceive poorer solidarity (people do not help each other frequently), presented more negative self-rated health, even after adjustment.

Considering statistical significant data, in lower walkability census tracts, aging 50-59 years old (44,3%), belonging to social class C (45,7%), having studied 5-8 years (46,9%), with reported chronic diseases (59%) and not practicing physical activity for leisure (44%) are associated to poorer self-rated health. Although with no statistical significance, being female (41,5%) and obese (41,6%) are also a prevalent data in relation to poorer self-rated health. In addition, it is relevant to highlight that the lower walkability was the only strata that presented higher prevalence for obesity in comparison to medium and higher strata.

For population density, living in census tracts with lower population density in comparison to higher population density, people who trust less in neighbours (have the perception that people will take advantage), perceive poorer solidarity (people do not help each other frequently) and do not feel safe to walk at night, presented more negative self-rated health.

In regard to lower population density strata, statistical significant data point out that belonging to social class D/E (48,3%), having studied 0-4 years (43,8%), with reported chronic diseases (66,7%) and not practicing physical activity (39,9%) are associated to poorer self-rated health. Despite of not showing any statistical significance, being female (38,1%), aging 50-59 years old (38,8%) and being obese (39,5%) affect poorer self-rated health in lower strata of population density.

In summary, it is possible to affirm that for Cambé, negative social capital is associated with negative self-rated health for all three categories of walkability and population density. However, living in lower walkability census tracts, trusting less in neighbours and perceiving poorer solidarity, worsen the self-rated health when compared to living in higher walkability areas. In regards to population density, one can observes that living in lower population density areas, trusting less in neighbours, perceiving poorer solidarity and not

feeling safe to walk at night, worsen the self-rated health when compared to living in higher population density areas.

In conclusion, living in higher walkability and higher population density areas, even if presenting negative social capital indicatives, can contribute to have a better self-rated health.

5 DISCUSSIONS

The results of this study showed that, people who live in lower walkability areas, trust less in neighbours and perceive poor solidarity in their neighbourhood, are more likely to present negative self-rated health, when in comparison to higher walkability areas. Furthermore, people who live in areas with lower population density, trust less in neighbours, perceive poorer solidarity and do not feel safe in their neighbourhood, have the tendency to indicate poorer self-rated health in comparison to higher population density areas.

Although this study showed associations between social capital indicatives and self-rated health, the way social capital can effectively affect health it is not fully understood yet (LOCH, 2013). However, it was observed that social aspects could effect health habits (CASSEL, 1976). Therefore, there is an opportunity to introduce social capital concepts in the public health field, through the implementation of mechanisms that are designed to understand its influence on health (GIORDANO et al, 2013).

For example, trust was a prevalent result for lower strata for both walkability and population density. This outcome shows the association between trust and self-rated health according to many previous studies.

Subramanian; Kim; Kawachi (2002) study showed that trust is positively associated to self-rated health in USA, although this relation might be more complex when considering more subjective aspects. Nieminem et al (2010) research indicated that trust and reciprocity are more likely to be associated with positive self-rated health, even after adjusted data in Finland. Lau; Ataguba (2015) also demonstrated that trust is related to positive outcomes of self-rated health in South Africa.

Safety was another social capital indicative that was associated to self-rated health in lower population density areas in this study, even though this indicator seems to be more related to demographic variables. Gender and income levels can be strongly related to safety perception (WOOD et al, 2008): men reported feeling safer than women, and people with higher income level also reported feeling safe. In Cambé, being man and belonging to the A/B social class, which were the positive reference for this study, can be related to feeling safer, and consequently, to a more positive self-rated health.

In addition, many studies have been proving that demographic variables can also be related to health and when considering self-rated health, demographic factors play particularly an important role.

Kavanagh; Turrell; Subramanian (2006) study showed that living in deprived areas is associated to poorer self-rated health in Tasmania, Australia. Lau; Ataguba (2015) reported that socioeconomic conditions were significant for their study, and that this issues should be considered by policy makers in South Africa, which is a country with higher income disparities and present a burden of disease context. In Brazil, the socioeconomic scenario is similar, where there are high rates of income and social inequalities. In this study, lower income and lower education were associated to poorer health.

Nieminem et al (2010) study revealed that not only socioeconomic factors such as education and income can influence self-rated health, but also demographic variables such as age, and clinical causes like long-standing illness and functional limitations. Kishimoto et al. (2013) showed that gender and age should be understood separately when studying self-rated health, once bonding and bridging social capital can influence men and women in different levels. In Cambé, being female and aging 50 years or greater presented the highest prevalence of negative self-rated health.

Waverijn et al. (2014) studied the longitudinal effect of social capital on self-rated health for people with chronic diseases, and results showed that social capital in individual and collective context were associated to positive changes in self-rated health over time. In addition, it is important to highlight that neighbourhood support is important for people with chronic diseases once they are more dependent on their immediate living environment. In Cambé context, people who reported chronic diseases were strongly associated to poorer self-rated health in all strata of walkability and population density.

In Cambé, social capital was associated to self-rated health differently, depending on the built environment context, which can be divided into higher, medium and lower strata for walkability and population density. Because the built environment can facilitate social capital approaches (DESIGN FOR HEALTH, 2008), it is important to understand social capital concepts that are inserted in the built environment, especially in the lower strata of walkability and population density in Cambé in order to comprehend self-rated outcomes.

Social capital can be enhanced through social interactions, community life (LEYDEN, 2003) and proximity (CABRERA; NAJARIAN, 2013). Furthermore, according to Jacobs (2011), contacts are necessary to create a strong network, and therefore, pedestrian friendly areas can influence the creation of these social ties (FREEMAN, 2001). As a result, people who live in suburban areas develop less social capital than people who live in more walkable spaces (LUND, 2002).

Leyden (2003) study showed that more walkable areas with a bigger mix of land use can contribute to the development of networks, where people know their neighbours, participate politically, trust in others and are more socially involved in Galway, Republic of Ireland. Rogers et al. (2011) research presented that more destinations in a walkable distance are associated to indicators of social capital. In a more recent research, Rogers et al. (2012) showed that higher levels of social capital are related to education and years lived in the neighbourhood, and that participation in community activities and trust were higher for people who perceived their neighbourhood to be walkable. For Wilkerson et al. (2012), reciprocity and trust among neighbours, knowing each other and being in contact with them can be more easily developed, when there are no high-traffic streets and when physical attributes for interaction exist (e.g. front porches, continuous sidewalks, no existence of bars on windows and doors, and litter and graffiti).

Mason (2010) showed in her study that community design contributes to building trust even if the design cannot overcome income inequalities in Boise, USA. However, cul-de-sac design streets can contribute to increase trust, safety perception among women or families with a high number of children. Although it is not the urban form itself that provides walkability, since cul-de-sac do not provide street intersections and therefore social interactions, the reason for this outcome in particular is that adults and children can interact more easily in cul-de-sac streets and parks.

Considering the built environment attributes in Cambé, the analysis of lower walkability areas are characterized by the high presence of vacant lands, with the predominance of residential use in detriment of retail or service uses, less street intersections and bigger lots. Lower residential density is also associated with lower walkability. The same thing can be said for lower population density. In this context, lower walkability and lower population density areas represent built environment characteristics that do not provide social ties. As a result, they can make social capital indicatives weaker.

6 CONCLUSIONS

People are becoming obese, sedentary and most prone to have NCDs because of the lack of physical activity. Therefore, cities that encourage walking can positively influence health, thus the importance of walkable cities. Strategies for creating a more walkable city are important issues to be considered in cities nowadays: encourage people to walk more in daily routines to attend their necessities and provide more open spaces for physical activity and social interaction, for example.

This study showed that the built environment contribute for a healthier lifestyle and influence social relations to perhaps increase the positive perceptions of health. In general, social capital were positively associated to self-rated health, but when considering the built environment in this correlation, living in higher walkability and population density areas are better for the residents' health outcomes.

The results enabled to approach the main objective of this research, which was to verify if the relationship between social capital and self-rated health can vary according to the walkability levels in Cambé. Furthermore, the specific objectives were also achieved: first, it was possible to analyse the urban form related to walkability, mainly in higher and lower walkability levels; second, it was feasible to understand which elements of the walkability index are related to social capital and self-rated health in Cambé.

Although the outcomes of this research were achieved, this study presents some limitations. The main limitation is that the VIGICARDIO study was not developed to achieve specific walkability outcomes, even though the database was an important and coherent source of information for this research. Notwithstanding, this research moves forward with the discussion of built environment, social capital and health and explores different ways of relating these parameters.

An important challenge this research undertook was with the application of a walkability index in a medium-size town such as Cambé. This experience helped to demonstrate that even with no detailed data, this instrument can be adapted for the use of distinct cities in different contexts. In this sense, this research presents distinct findings in comparison with the walkability indexes that were applied in metropolitan regions or neighbourhoods in cities of developed countries such as Australia (MAYNE et al., 2013) or the United States (FRANK et al., 2010a). This study also differs from others in larger cities in Latin America such as in Bogotá - Colombia (CERVERO et al., 2009) or in Curitiba - Brazil (REIS et al., 2013).

Moreover, an important consideration should be given to socioeconomic issues concurrently with social capital and health issues in Brazil. The Brazilian cities' urban form are reflections of social inequalities and can influence on how the inhabitants interact to each other and how they perceive their own health. This research illustrates that socioeconomic status, such as income level, needs a deeper understanding as a major factor that influence health and social capital.

For future studies, it is important to highlight that the built environment and its influence on health and social capital should be better understood and many research has to be further explored to incorporate different socioeconomic conditions in order to achieve more local goals. In addition, it is important to understand that census tracts do not consider the spatial structure and are not homogeneous, what might show some fragility in the application of the walkability index as a reduction tool. Moreover, more qualitative analysis of the physical attributes of walkable spaces should be further developed.

REFERENCES

ADLER, Paul; KWON, Seok-Woo. Social capital: prospects for a new concept. **The Academy of Management Review**, [S. l.], v. 27, n. 1, p. 17–40, jan. 2002.

AGAMPODI, Thilini et al. Measurement of social capital in relation to health in low and middle income countries (LMIC): A systematic review. **Social Science & Medicine**, [S. l.], v. 128, p. 95–104, jan. 2015.

AHNQUIST, Johanna; WAMALA, Sara; LINDSTROM, Martin. Social determinants of health – A question of social or economic capital? Interaction effects of socioeconomic factors on health outcomes. **Social Science & Medicine**, [S. l.], v. 74, n. 6, p. 930–939, jan. 2012.

ALESINA, Alberto; LA FERRARA, Eliana. Participation in Heterogeneous Communities. **The Quarterly Journal of Economics**, [S. l.], v. 115, n. 3, p. 847–904, aug. 2000.

ALVES, Luciana; RODRIGUES, Roberto. Determinantes da autopercepção de saúde entre idosos do Município de São Paulo, Brasil. **Revista Panamericana de Salud Pública**, [S. l.], v. 17, n. 5–6, p. 333–341, 2005.

APPLEYARD, Donald. **Livable Streets**. 1st ed. Berkeley, CA: University of California Press, 1981. 364 p.

ARBER, Sara; GINN, Jay. Gender and inequalities in health in later life. **Social Science & Medicine**, [S. l.], v. 36, n. 1, p. 33–46, jan. 1993.

BEAUJEU-GARNIER, Jacqueline. **Geografia Urbana**. 4. ed. Lisboa: Fundação Calouste Gulbenkian, 1997, 525 p.

BENTLEY, Rebecca; JOLLEY, Damien; KAVANAGH, Anne. Local environments as determinants of walking in Melbourne, Australia. **Social Science & Medicine**, [S. l.], v. 70, n. 11, p. 1806–1815, feb. 2010.

BERKE, Ethan et al. Association of the Built Environment With Physical Activity and Obesity in Older Persons. **Research and Practice**, [S. l.], v. 97, n. 3, p. 486–492, mar. 2007.

BJORNSTROM, Eileen; RALSTON, Margaret. Neighborhood Built Environment, Perceived Danger, and Perceived Social Cohesion. **Environment and Behavior**, [S. l.], v. 46, n. 6, p. 718 –744, 2014.

BOURDIEU, Pierre. Capital Social – notas provisórias. In: NOGUEIRA, M. A.; CATANI, A. (Ed.). **Escritos de Educação**. 2. ed. Rio de Janeiro: Vozes, 1999. 65-69 p.

BROWNSON, Ross et al. Measuring the Built Environment for Physical Activity. State of the Science. **American Journal of Preventive Medicine**, [S. l.], v. 36, n. 4S, p. S99-S123, apr. 2009.

BUTLAND, Bryony et al. Foresight: Tackling Obesities: Future Choices – project report. 2· ed. **Government Office for Science**, London, 2007.

CABRERA, Joseph; NAJARIAN, Jonathan. How the Built Environment Shapes Spatial Bridging Ties and Social Capital. **Environment and Behavior**, [S. l.], v. 47(3), p. 239-267, 2013.

CAMBÉ. Plhis. Social Housing City Plan, 2012.

Cambé Townhall. Available in: http://www.cambe.pr.gov.br/site/. Access in: 30/07/2016.

Cambé Townhall. Digital Documents, 2015.

CANADIAN GOVERNMENT. Concepts, measurement and policy implications. In: **Social Capital Workshop 2003**.

CASSEL, John. The contribution of the social environment to host resistance. **American journal of epidemiology**, [S. l.], v. 104, n. 2, p. 107-123, 1976.

CAUWENBERG, Jelle et al. Neighborhood walkability and health outcomes among older adults: The mediating role of physical activity. **Health & Place**, [S. l.], v. 37, p. 16–25, 2016.

CERIN, Ester et al. Destinations that matter: Associations with walking for transport. **Health & Place**, [S. l.], v. 13, n. 3, p. 713–724, 2007.

CERVERO, Robert et al. Influences of Built Environments on Walking and Cycling: Lessons from Bogotá. **International Journal of Sustainable Transportation**, [S. l.], v. 3, p. 203–226, jul. 2009.

CERVERO, Robert; KOCKELMAN, Kara. Travel demand and the 3ds : Density, Design and Diversity. Transportation Research Part D: **Transport and Environment**, Great Britain, v. 2, n. 3, p. 199-219, feb. 1997.

CHIAVEGATTO FILHO, Alexandre; LEBRÃO, Maria; KAWACHI, Ichiro. Income inequality and elderly self-rated health in São Paulo, Brazil. **Annals of Epidemiology**, [S. l.], v. 22, n. 12, p. 863–867, oct. 2012.

COLEMAN, James. Social Capital in the Creation of Human Capital. **American Journal of Sociology**, v. 94, Supplement: Organizations and Institutions: Sociological and Economic Approaches to the Analysis of Social Structure, Chicago, p. S95-S120, 1988.

COLEMAN, James. Social capital. In: COLEMAN, James. **Foundations of Social Theory.** Social Forces, Massachusetts, v. 69, n. 2, p. 300-321, 1990.

D'ARAUJO, Maria Celina. **Capital social**. 2. ed. Rio de Janeiro: Zahar, 2010. 66 p.

DE BOURDEAUDHUIJ, Ilse; SALLIS, James; SAELENS, Brian. Environmental correlates of physical activity in a sample of Belgian adults. **American Journal of Health Promotion**, [S. l.], v. 18, n. 1, p. 83–92, sep./oct.2003.

DESIGN FOR HEALTH. **Planning Information Sheet: Building Social Capital with Comprehensive Planning and Ordinances**. Version 1.2, 2008.

DING, Ding; GEBEL, Klaus. Built environment, physical activity, and obesity: What have we learned from reviewing the literature? **Health & Place**, [S. l.], v. 18, n. 1, p. 100-105, 2012.

DUNCAN, Mitch J. et al. Relationships of Land Use Mix with Walking for Transport : Do Land Uses and Geographical Scale Matter? **Journal of Urban Health: Bulletin of the New York Academy of Medicine**, New York, v. 87, n. 5, p. 782–795, 2010.

DURAND, Casey et al. A systematic review of built environment factors related to physical activity and obesity risk : implications for smart growth urban planning. **Obesity reviews**, [S. l.], v. 12, p. e173–e182, 2011.

DU TOIT, Lorinne et al. Does Walking in the Neighborhood Enhance Local Sociability? **Urban Studies**, [S. l.], v. 44, n. 9, p. 1677–1695, aug. 2007.

ELLIS, Geraint et al. Connectivity and physical activity : using footpath networks to measure the walkability of built environments. **Environment and Planning B: Planning and Design**, [S. l.], v. 42, p. 1–22, 2015.

EYRE, Kahn et al. Preventing cancer, cardiovascular disease, and diabetes: a common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association. **Diabetes Care**, [S. l.], v. 27, p. 1812-1824, jul. 2004.

FARR, Douglas. **Urbanismo sustentável**: desenho urbano com a natureza. Tradução: Alexandre Salvaterra. 1. ed. Porto Alegre: Bookman, 2013. 326 p.

FENG, Zhixin et al. An exploratory multilevel analysis of income, income inequality and self-rated health of the elderly in China. **Social Science and Medicine**, [S. l.], v. 75, n. 12, p. 2481–2492, dec. 2012.

FERLANDER, Sara. The Importance of Different Forms of Social Capital for Health. **Acta sociologica**, [S. l.], v. 50, p. 115–128, jun. 2007.

FIELD, John. **Social Capital (Key Ideas)**, 2008. Available in: Google Books. Access in: 12/11/2015.

FITZPATRICK, K. M.; LAGORY, M. E. **Unhealthy places: the ecology of risk in the urban landscape**. New York: Routledge, 2000, 274 p.

FRANK, Lawrence et al. Health and the Built Environment: A Review. **The Canadian Medical Association**, jun. 2012.

FRANK, Lawrence et al. Many pathways from land use to health. **Journal of the American Planning Association**, Chicago, v. 72, n. 1, p. 75-87, 2006.

FRANK, Lawrence et al. The development of a walkability index: application to the Neighborhood Quality of Life Study. **British journal of sports medicine**, [S. l.], v. 44, n. 13, p. 924-933, 2010a.

FRANK, Lawrence et al. **Neighborhood Design, Travel, and Health in Metro Vancouver: Using a Walkability Index - Executive Summary**. UBC, 2010b.

FRANK, Lawrence. Land Use and Transportation Interaction: Implications on Public Health and Quality of Life. **Journal of Planning Education and Research**, [S. l.], v. 20, n. 1, p. 6-22, 2000.

FRANK, Lawrence; ENGELKE, Peter. Multiple Impacts of the Built Environment on Public Health: Walkable Places and the Exposure to Air Pollution. **International Regional Science Review**, [S. l.], v. 28, n. 2, p. 193-216, apr. 2005.

FREEMAN, Lance. The effects of sprawl on neighborhood social ties: An explanatory analysis. **Journal of the American Planning Association**, [S. l.], v. 67, n. 1, p. 69–77, mar. 2001.

FRENCH, Sarah et al. Sense of Community and Its Association With the Neighborhood Built Environment. **Environment and Behavior**, [S. l.], v. 46, n. 6, p. 677–697, 2013.

FRIEDKIN, Noah. Information flow through strong and weak ties in intraorganizational social networks. **Social Networks**, The Netherlands, v. 3, n. 4, p. 273–285, dec. 1982.

FRUMKIN, Howard. Urban sprawl and public health. **Public health reports**, v. 117, n. 3, p. 201-217, may/jun. 2002.

GALEA, Sandro; KARPATI, Adam; KENNEDY, Bruce. Social capital and violence in the United States, 1974-1993. **Social Science and Medicine**, [S. l.], v. 55, n. 8, p. 1373–1383, 2002.

GEHL, Jan. **Cidades para pessoas**. 2. ed. São Paulo: Perspectiva, 2013, 280 p.

GILES-CORTI, Billie et al. Increasing walking: How important is distance to, attractiveness, and size of public open space? **American Journal of Preventive Medicine**, [S. l.], v. 28, n. 2 SUPPL. 2, p. 169–176, 2005.

GILES-CORTI, Billie; DONOVAN, Robert. The relative influence of individual, social and physical environment determinants of physical activity. **Social science & medicine** (1982), v. 54, n. 12, p. 1793–812, jul. 2002.

GIORDANO, Giuseppe et al. Testing the association between social capital and health over time: a family-based design. **BMC Public Health**, [S. l.], v. 13, n. 1, p. 665-673, 2013.

GRANOVETTER, Mark. **The Strength of Weak TiesThe Strength of Weak Ties**, 1973. Available in: https://sociology.stanford.edu/sites/default/files/publications/the_strength_of_weak_ties_and_exch_w-gans.pdf (Acess in 27/07/2016).

GRASSER, Gerlinde et al. Objectively measured walkability and active transport and weight-related outcomes in adults: A systematic review. **International Journal of Public Health**, [S. l.], v. 58, n. 4, p. 615–625, 2013.

GROAT, Linda; WANG. David. **Architectural Research Methods**. Illustrated Edition. New York: Wiley, 2002, 340 p.

HAN, Sehee; KIM, Heaseung; LEE, Hee-sun. A multilevel analysis of social capital and self-reported health : evidence from Seoul, South Korea. **International Journal for Equity in Heath**, [S. l.], v. 11, n. 3, p. 1–12, 2012.

HANCOCK, Trevor; DUHL, Leonard. Promoting health in the urban context. **WHO Healthy Cities Papers**, n. 1, Copenhagen: FADL, 1988.

HANDY, Susan et al. How the built environment affects physical activity: Views from urban planning. **American Journal of Preventive Medicine**, [S. l.], v. 23, n. 2S, p. 64-73, 2002.

HANIFAN, Lyda. The Rural School Community Center. In: **The Annals of the American Academy of Political and Social Science.** Sage Publications, Inc., 1916. p. 130-138.

HARRIS, Jenine et al. Mapping the development of research on physical activity and the built environment. **Preventive Medicine**, [S. l.], v. 57, n. 5, p. 533–540, 2013.

HASLAM, David. **Obesity : a medical history**, [S. l.], v. 8, p. 31–36, 2007.

HELLIWELL, John; PUTNAM, Robert. The social context of well-being. **Philosophical Transactions of the Royal Society B: Biological Sciences**, [S. l.], v. 359, n. 1449, p. 1435-1446, aug. 2004.

HINO, Adriano et al. [Projeto ESPAÇOS de Curitiba, Brazil: applicability of mixed research methods and geo-referenced information in studies about physical activity and built environments]. **Pan American journal of public health**, [S. l.], v. 32, n. 3, p. 226–33, 2012.

HINO, Adriano et al. Built environment and physical activity for transportation in adults from Curitiba, Brazil. **Journal of Urban Health**, New York, v. 91, n. 3, p. 446–462, 2013.

HOEHNER, Christine et al. Perceived and objective environmental measures and physical activity among urban adults. **American Journal of Preventive Medicine**, [S. l.], v. 28, n. 2 SUPPL. 2, p. 105-116, 2005.

HUMPEL, Nancy et al. Environmental factors associated with adults' participation in physical activity A review. **American Journal of Preventive Medicine**, [S. l.], v. 22, n. 3, p. 188-199, 2002.

IBGE. Brazilian Institute of Geography and Statistics. Census 2010.

IBGE. Brazilian Institute of Geography and Statistics. Population estimate of the municipalities for 2015. Available in: http://saladeimprensa.ibge.gov.br/noticias?view=noticia&id=1&busca=1&idnoticia=2972. Acess in: 27/07/2016.

ISLAM, M. Kamrul et al. Social capital and health: does egalitarianism matter? A literature review. **International journal for equity in health**, [S. l.], v. 5, p. 1-28, apr. 2006.

JACOBS, Jane. **Morte e Vida de Grandes Cidades**. 3. ed. São Paulo: Martins Fontes, 2011, 510 p.

KAVANAGH, Anne; TURRELL, Gavin; SUBRAMANIAN, Steven. Does area-based social capital matter for the health of Australians? A multilevel analysis of self-rated health in Tasmania. **International Journal of Epidemiology**, v. 35, p. 607-613, jun. 2006.

KAWACHI, Ichiro et al. Social capital, income inequality, and mortality. **American Journal of Public Health**, [S. l.], v. 87, p. 1491–1498, sep. 1997.

KAWACHI, Ichiro; BERKMAN, Lisa. Social cohesion, social capital and health. In: BERKMAN, Lisa; KAWACHI, Ichiro. **Social epidemiology**. Oxford: Oxford University Press, 2000. p. 174-190.

KAWACHI, Ichiro; SUBRAMANIAN, SV.; KIM, Daniel. Social capital and health: a decade of progress and beyond. In: KAWACHI, Ichiro; SUBRAMANIAN, Steven; KIM, Daniel. **Social capital and health**. New York: Springer, 2008. p. 1-26.

KENZER, Marina. **Healthy cities : a guide to the literature**, [S. l.], v. 11, n. 1, p. 201–220, apr. 1999.

KIM, Daniel et al. US state- and county-level social capital in relation to obesity and physical inactivity : A multilevel, multivariable analysis. **Social Science & Medicine**, [S. l.], v. 63, p. 1045–1059, apr. 2006.

KIM, Daniel; KAWACHI, Ichiro. A Multilevel Analysis of Key Forms of Community- and Individual-Level Social Capital as Predictors of Self-Rated Health in the United States. **Journal of Urban Health: Bulletin of the New York Academy of Medicine**, New York, v. 83. n. 5, p. 813-826, jun. 2006.

KIM, Daniel; KAWACHI, Ichiro. U.S. State-Level Social Capital and Health-Related Quality of Life: Multilevel Evidence of Main, Mediating, and Modifying Effects. **Annals of Epidemiology**, [S. l.], v. 17, n. 4, p. 258–269, apr. 2007.

KIM, Daniel; SUBRAMANIAN, Steven; KAWACHI, Ichiro. Bonding versus bridging social capital and their associations with self rated health: a multilevel analysis of 40 US communities. **J Epidemiol Community Health**, [S. l.], v. 60, n. 2, p. 116-122, feb. 2006.

KING, Abby et al. Aging in neighborhoods differing in walkability and income: Associations with physical activity and obesity in older adults. **Social Science and Medicine**, [S. l.], v. 73, n. 10, p. 1525–1533, sep. 2011.

KISHIMOTO, Yoko et al. Group involvement and self-rated health among the Japanese elderly: an examination of bonding and bridging social capital. **BMC Public Health**, [S. l.], v. 13, p. 1189-1199, 2013.

KRAFTA, Romulo. **Notas de aula de morfologia urbana**. 1. ed. Porto Alegre: Editora da UFRGS, 2014, 352 p.

KRIZEK, Kevin; JOHNSON, Pamela. Proximity to Trails and Retail: Effects on Urban Cycling and Walking. **Journal of the American Planning Association**, Chicago, v. 72, n. 1, p. 33–42, 2006.

LAU, Yan; ATAGUBA, John. Investigating the relationship between self-rated health and social capital in South Africa: a multilevel panel data analysis. **BMC Public Health**, [S. l.], v. 15, n. 1, p. 1–10, 2015.

LEE, Chanam; MOUDON, Anne. The 3Ds + R: Quantifying land use and urban form correlates of walking. Transportation Research Part D: **Transport and Environment**, [S. l.], v. 11, n. 3, p. 204-215, 2006.

LEGH-JONES, Hannah; MOORE, Spencer. Network social capital, social participation, and physical inactivity in an urban adult population. **Social Science & Medicine**, [S. l.], v. 74, n. 9, p. 1362–1367, feb. 2012.

LESLIE, Eva et al. Residents' perceptions of walkability attributes in objectively different neighborhoods: A pilot study. **Health and Place**, [S. l.], v. 11, n. 3, p. 227–236, 2005.

LEYDEN, Kevin. Social Capital and the Built Environment: The Importance of Walkable Neighborhoods. **American Journal of Public Health**, [S. l.], v. 93, n. 9, p. 1546-1551, sep. 2003.

LINDSTRÖM, Martin; HANSON, Bertil; OSTERGREN, Per-Olof. Socioeconomic differences in leisure-time physical activity: the role of social participation and social capital in shaping health related behaviour. **Social science & medicine** (1982), [S. l.], v. 52, p. 441–51, 2001.

LOCH, Mathias. **Associação entre capital social e comportamentos relacionados à saúde:** estudo de base populacional. 2013. Tese (Doutorado em Educação Física) – Universidade Estadual de Londrina, Londrina, 2013.

LOCHNER, Kimberly; KAWACHI, Ichiro; KENNEDY, Bruce. Social capital: A guide to its measurement. **Health and Place**, [S. l.], v. 5, n. 4, p. 259-270, 1999.

LOTFI, Sedigheh; KOOHSARI, Mohammad. Neighborhood Walkability in a City within a Developing Country.**Journal of urban planning and development**, [S. l.], v. 137, n. December, p. 402–408, dec. 2011.

LOVASI, Gina et al. Using built environment characteristics to predict walking for exercise. **International journal of health geographics**, [S. l.], v. 7, p. 10, feb. 2008.

LUCUMÍ, Diego et al. Social Capital, Socioeconomic Status, and Health-Related Quality of Life Among Older Adults in Bogotá (Colombia). **Journal of Aging and Health**, [S. l.], v. 27, n. 4, p. 730-750, 2015.

LUND, Hollie. Pedestrian Environments and Sense of Community. **Journal of Planning Education and Research**, [S. l.], v. 21, n. 3, p. 301–312, 2002.

MALTA, Deborah et al. Doenças crônicas não transmissíveis: mortalidade e fatores de risco no Brasil, 1990 a 2006. In: **Saúde Brasil 2008: 20 anos de Sistema Único de Saúde (SUS) no Brasil**. Ministério da Saúde, Brasília/DF, 2009. p. 337-364.

MASON, Susan. Can community design build trust? A comparative study of design factors in Boise, Idaho neighborhoods. **Cities**, [S. l.], v. 27, n. 6, p. 456–465, aug. 2010.

MATOS, Heloiza. **Capital social e comunicação:** interfaces e articulações. 1. ed. São Paulo: Summus, 2009. 277 p.

MAYNE, Darren J. et al. An objective index of walkability for research and planning in the Sydney Metropolitan Region of New South Wales, Australia: an ecological study. **International journal of health geographics**, [S. l.], v. 12, p. 61, 2013.

MCNEILL, Lorna; KREUTER, Matthew; SUBRAMANIAN, Steven. Social Environment and Physical activity: A review of concepts and evidence. **Social Science & Medicine**, [S. l.], v. 63, n. 4, p. 1011–1022, 2006.

MCPHERSON, Miller; SMITH-LOVIN, Lynn; COOK, James. Birds of a feather: Homophily in Social Networks. **Annual Review of Sociology**, [S. l.], v. 27, p. 415–44, 2001.

MOORE, Spencer et al. Social capital and core network ties: A validation study of individual-level social capital measures and their association with extra- and intra-neighborhood ties, and self-rated health. **Health & Science**, [S. l.], v. 17, p. 536-544, 2011.

MOUDON, Anne; LEE, Chanam. Walking and Biking: An Evaluation of Environmental Audit Instruments. **American Journal of Health Promotion**, [S. l.], v. 18, n. 1, p. 21–37, sep./oct. 2003.

MUMMERY, W. Kerry et al. Associations between physical inactivity and a measure of social capital in a sample of Queensland adults. **Journal of Science and Medicine in Sport**, [S. l.], v. 11, n. 3, p. 308–315, 2008.

NETO, José G. **Cambé: confronto político e organização 1947-1968**. Cambé: Prefeitura do Município de Cambé, 1987, 146 p.

NIEMINEN, Tarja et al. Social capital as a determinant of self-rated health and psychological well-being. **International Journal of Public Health**, [S. l.], v. 55, p. 531-542, 2010.

NIEMINEN, Tarja et al. Social capital, health behaviours and health: A population-based associational study. **BMC public health**, [S. l.], v. 13, n. 613, p. 1–11, 2013.

NOGUEIRA, Helena; REMOALDO, Paula. **Olhares geográficos sobre a saúde**. Lisboa: Edições Colibri, 2010, 157 p.

OWEN, Neville et al. Neighborhood Walkability and the Walking Behavior of Australian Adults. **American Journal of Preventive Medicine**, [S. l.], v. 33, n. 5, p. 387–395, 2007.

OWEN, Neville et al. Understanding environmental influences on walking: Review and research agenda. **American Journal of Preventive Medicine**, [S. l.], v. 27, n. 1, p. 67–76, 2004.

PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE. Physical Activity Guidelines Advisory Committee Report, **Department of Health and Human Services**, Washington, DC: U.S, 2008.

POORTINGA, Wouter. Do health behaviors mediate the association between social capital and health? **Preventive medicine**, [S. l.], v. 43, p. 488–493, jul. 2006.

PORTES, Alejandro. Capital social: Origens e aplicações na sociologia contemporânea. **Sociologia, Problemas e Práticas**, [S. l.], v. 33, p. 133–158, 2000.

POWELL, Katie et al. The role of social networks in the development of overweight and obesity among adults : a scoping review. **BMC Public Health**, [S. l.], v. 15, p. 1–13, 2015.

PRETTY, Jules. Social Capital and the Collective Management of Resources. **Science**, [S. l.], v. 302, n. 5652, p. 1912–1914, dec. 2003.

PUTNAM, Robert. **Making democracy work:** civic traditions in Modern Italy. 1. ed. Princeton: Princeton University Press, 1993. 258 p.

_____. Bowling alone: America's declining social capital. **Journal of Democracy**, Baltimore, [S. l.], v. 6, n. 1, p. 35-42, 1995.

RECH, Cassiano et al. Personal, social and environmental correlates of physical activity in adults from Curitiba, Brazil. **Preventive Medicine**, [S. l.], v. 58, n. 1, p. 53–57, 2014.

REGO, Renato L. **As cidades plantadas: os britânicos e a construção da paisagem do norte do Paraná**. 1. ed. Maringá: Edições Humanidades, 2009, 220 p.

REICHERT, Felipe; LOCH, Mathias; CAPILHEIRA, Marcelo. Autopercepção de saúde em adolescentes, adultos e idosos. **Ciência e saúde coletiva**, [S. l.], v. 17, n. 12, p. 3353-3362, 2012.

REIS, Rodrigo et al. Walkability and physical activity: Findings from curitiba, brazil. **American Journal of Preventive Medicine**, [S. l.], v. 45, n. 3, p. 269–275, 2013.

ROGERS, E. M. **Diffusion of innovations**. 3rd ed. New York: The Free Pass, 1983. 453 p.

ROGERS, Shannon et al. Examining Walkability and Social Capital as Indicators of Quality of Life at the Municipal and Neighborhood Scales. **Applied Research in Quality of Life**, [S. l.], v. 6, n. 2, p. 201–213, 2011.

ROGERS, Shannon et al. Measuring community sustainability : exploring the intersection of the built environment & social capital with a participatory case study. **Journal of Environmental Studies and Sciences**, [S. l.], v. 2, p. 143–153, 2012.

ROGERS, Shannon; GARDNER, Kevin; CARLSON, Cynthia. Social capital and walkability as social aspects of sustainability. **Sustainability**, Switzerland, v. 5, n. 8, p. 3473–3483, aug. 2013.

SAELENS, Brian et al. Neighborhood-Based Differences in Physical Activity: An Environmental Scale Evaluation. **Research and Practice**, [S. l.], v. 93, n. 9, p. 1552–1558, sep. 2003.

SAELENS, Brian; HANDY, Susan. Built Environment Correlates of Walking: A Review. **NIH Public Access**, [S. l.], v. 40, n. 206, p. S550–S566, 2010.

SAELENS, Brian; SALLIS, James. **Neighborhood Environment Walkability Scale (NEWS)**, [S. l.], p. 78–81, 2002.

SAELENS, Brian; SALLIS, James; FRANK, Lawrence. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. **Annals of behavioral medicine : a publication of the Society of Behavioral Medicine**, [S. l.], v. 25, n. 2, p. 80–91, 2003.

SALLIS, James et al. Neighborhood built environment and income: Examining multiple health outcomes. **Social Science and Medicine**, [S. l.], v. 68, n. 7, p. 1285–1293, feb. 2009.

SALLIS, James et al. Role of built environments in physical activity, obesity, and cardiovascular disease. **Circulation**, [S. l.], v. 125, n. 5, p. 729–737, feb. 2012.

SALLIS, James; BAUMAN, Adrian; PRATT, Michael. Environmental and policy interventions to promote physical activity**. American journal of preventive medicine**, [S. l.], v. 15, n. 4, p. 379–397, 1998.

SALLIS, James; OWEN, Neville; FISCHER, Edwin. Ecological models of health behavior. In: GLANZ, K.; RIMER, B.; VISWANATH, K. **Health behavior and health education: theory, research and practice**. 4. ed. San Francisco: Jossey-Bass, 2008, p. 465-485.

SAPAG, Jaime; KAWACHI, Ichiro. Social capital and health promotion in Latin America. **Revista de Saúde Pública**, São Paulo, v. 41, n. 1, p. 139-149, 2007.

SCHMIDT, Maria Inês et al. Chronic non-communicable diseases in Brazil: Burden and current challenges. **The Lancet**, [S. l.], v. 377, n. 9781, p. 1949–1961, may 2011.

SILVEIRA, Ricardo. **Planejamento urbano participativo: a experiência de Cambé**. 1 ed. Londrina: Universidade Estadual de Londrina, 1989, 148 p.

SOUTHWORTH, Michael. Designing the Walkable City. **Journal of Urban Planning and Development**, [S. l.], v. 131, n. 4, p. 246–257, dec. 2005.

SRINIVASAN, Shobha; O'FALLON, Liam; DEARRY, Allen. Creating Healthy Communities, Healthy Homes, Healthy People: Initiating a Research Agenda on the Built Environment and Public Health. **American Journal of Public Health**, [S. l.], v. 93, n. 9, p. 1446-1450, sep. 2003.

SUBRAMANIAN, Steven; KIM, Daniel; KAWACHI, Ichiro. Social Trust and Self-Rated Health in US Communities: a Multilevel Analysis. **Journal of Urban Health: Bulletin of the New York Academy of Medicine**, New York, v. 79, n. 4, p. S21-S34, 2002.

SUGIYAMA, Takemi et al. Do Relationships Between Environmental Attributes and Recreational Walking Vary According to Area-Level Socioeconomic Status? **Journal of Urban Health: Bulletin of the New York Academy of Medicine**, New York, v. 92, n. 2, p. 253–264, 2015.

SUGLIA, Shakira et al. Why the Neighborhood Social Environment Is Critical in Obesity Prevention. **Journal of Urban Health: Bulletin of the New York Academy of Medicine**, New York, v. 93, n. 1, p. 206–212, 2016.

SUMINSKI, Richard et al. Features of the neighborhood environment and walking by U.S. adults. **American Journal of Preventive Medicine**, [S. l.], v. 28, n. 2, p. 149–155, 2005.

SUNG, Hyungun et al. Land Use Policy Effects of street-level physical environment and zoning on walking activity in Seoul, Korea. **Land Use Policy**, [S. l.], v. 49, p. 152–160, 2015.

TALEN, Emily. Sense of Community and Neighborhood Form : An Assessment of the Social Doctrine of New Urbanism. **Urban Studies**, [S. l.], v. 36, n. 8, p. 1361–1379, 1999.

TRANSPORTATION RESEARCH BOARD. Does the built environment influence physical activity?: Examining the evidence. Committee on Physical Activity, Health, Transportation, and Land Use, **Institute of Medicine of the National Academies**, 2005.

TUCKER-SEELEY, Reginald et al. Financial Hardship and Self-Rated Health Among Low-Income Housing Residents. **Health Education & Behavior**, [S. l.], v. 40, n. 4, p. 442–448, aug. 2013.

UESHIMA, Kazumune. et al. Does Social Capital Promote Physical Activity? A Population-Based Study in Japan. **Plos One**, [S. l.], v. 5, n. 8, p. 1-6, aug. 2010.

UNDP Brazil. United Nations Development Programme, 2000.

VELÁSQUEZ-MELÉNDEZ, Gustavo; MENDES, Larissa; PROENÇA PADEZ, Cristina. Built environment and social environment: associations with overweight and obesity in a sample of Brazilian adults. Ambiente construido y ambiente social: asociaciones con el exceso de peso en adultos. **Caderno de Saúde Pública,** Rio de Janeiro, v. 29, n. 10, p. 1988-1996, out. 2013.

VIGICARDIO. **Cardiovascular diseases in Paraná State: mortality, risk profile, remedy therapy and complications**, 2011.

WAVERIJN, Geeke et al. A prospective analysis of the effect of neighbourhood and individual social capital on changes in self-rated health of people with chronic illness. **BMC public health**, [S. l.], v. 14, n. 1, p. 675-685, 2014.

WEN, Ming; BROWNING, Christopher; CAGNEY, Kathleen. **Neighborhood Deprivation , Social Capital and Regular Exercise during Adulthood : A Multilevel Study in Chicago**, [S. l.], v. 44, n. 13, p. 2651–2671, dec. 2007.

WEN, Ming; ZHANG,Xingyou. Contextual Effects of Built and Social Environments of Urban Neighborhoods on Exercise: A Multilevel Study in Chicago. **American Journal of Health Promotion**, v. 23, n. 4, p. 247–255, mar./apr.2009.

WESP. World Economic Situation And Prospects Report, 2014.

WILKERSON, Amy et al. Neighborhood Physical Features and Relationships With Neighbors: Does Positive Physical Environment Increase Neighborliness? **Environment and Behavior**, [S. l.], v.44, n. 5, p. 595 –615, 2012.

WITTEN, Karen et al. Neighborhood Built Environment and Transport and Leisure Physical Activity : Findings Using Objective Exposure and Outcome Measures in New Zealand. **Environmental Health Perspectives**, [S. l.], v. 120, n. 7, p. 971–977, jul. 2012.

WOOD, Lisa et al. The anatomy of the safe and social suburb : An exploratory study of the built environment, social capital and residents' perceptions of safety. **Health & Place**, [S. l.], v. 14, p. 15–31, 2008.

WOOD, Lisa; FRANK, Lawrence; GILES-CORTI, Billie. Sense of community and its relationship with walking and neighborhood design. **Social Science and Medicine**, [S. l.], v. 70, n. 9, p. 1381–1390, 2010.

WOOLCOCK, Michael; NARAYAN, Deepa. Social Capital : Implications for Development Theory, **Research and Policy**. v. 15, n. 2, p. 225–249, ago. 2000.

WORLD HEALTH ORGANIZATION. Diet, nutrition and the prevention of chronic diseases. **WHO Technical Report Series**, n. 916, 2003.

WORLD HEALTH ORGANIZATION. **Non communicable Diseases Country Profiles**, 2014a.

WORLD HEALTH ORGANIZATION. **Global Status Report on Non communicable Diseases**, 2014b.

YAMAKI, Humberto. **Iconografia Londrinense**. 1. ed. Londrina: Edições Humanidades, 2003, 107 p.

YIN, Robert. **Estudo de caso**: planejamento e métodos, 2.ed. Porto Alegre: Bookman, 2001, 205 p.

YUAN, Connie; GAY, Geri. Homophily of network ties and bonding and bridging social capital in computer-mediated distributed teams. **Journal of Computer-Mediated Communication**, [S. l.], v. 11, n. 4, p. 1062–1084, 2006.

ZIMMER, Zachary; AMORNSIRISOMBOON, Pattama. Socioeconomic status and health among older adults in Thailand: an examination using multiple indicators. **Social Science and Medicine**, [S. l.], v. 52, p. 1297–1311, 2001.

APPENDICES

APPENDIX A – Walkability index calculation

CENSUS TRACT	INTERSECTION DENSITY				RESIDENTIAL DENSITY				RETAIL FLOOR AREA RATIO			
	QUANTITY	AREA (ACRES)	DENSITY	Z SCORE	QUANTITY	AREA (ACRES)	DENSITY	Z SCORE	AREA (ACRES)	CONSTRUCTION (ACRES)	RATIO	Z SCORE
1	34	57,39	0,59	0,22	357	35,05	10,18	-0,94	1,15	0,78	0,68	-0,06
2	27	61,62	0,44	-0,45	440	28,62	15,37	-0,01	1,79	1,82	1,02	0,88
3	32	63,59	0,50	-0,17	203	15,34	13,23	-0,39	4,65	3,93	0,84	0,39
4	42	66,48	0,63	0,39	354	30,98	11,43	-0,72	2,83	1,98	0,70	0,00
5	35	45,57	0,77	0,97	191	15,36	12,43	-0,54	0,04	0,04	0,84	0,39
6	34	36,55	0,93	1,67	230	18,59	12,37	-0,55	0,01	0,01	1,00	0,83
7	23	37,37	0,62	0,31	208	21,92	9,49	-1,06	1,77	1,31	0,74	0,10
8	46	166,20	0,28	-1,15	359	23,20	15,48	0,01	0,09	0,06	0,63	-0,19
9	43	160,58	0,27	-1,19	401	26,72	15,00	-0,08	0,06	0,06	1,00	0,83
10	11	1291,66	0,01	-2,30	21	11,85	1,77	-2,44	0,00	0,00	0,00	-1,95
11	22	47,10	0,47	-0,33	249	25,40	9,80	-1,01	0,05	0,05	1,00	0,83
12	26	38,72	0,67	0,56	260	22,78	11,41	-0,72	0,27	0,18	0,67	-0,09
13	28	102,30	0,27	-1,16	219	23,07	9,49	-1,06	7,49	5,18	0,69	-0,03
14	23	53,39	0,43	-0,48	210	13,32	15,76	0,06	0,01	0,01	1,00	0,83
15	46	81,19	0,57	0,10	659	33,49	19,68	0,76	0,00	0,00	0,00	-1,95
16	33	69,51	0,47	-0,29	286	31,23	9,16	-1,12	1,54	0,96	0,62	-0,22
17	23	39,65	0,58	0,16	249	25,11	9,92	-0,99	0,14	0,11	0,77	0,19
18	44	62,11	0,71	0,72	439	28,37	15,47	0,01	0,09	0,09	1,00	0,83
19	36	53,90	0,67	0,54	238	15,57	15,29	-0,03	0,11	0,10	0,88	0,49
20	40	58,36	0,69	0,62	294	17,99	16,34	0,16	0,07	0,07	1,00	0,83
21	21	39,52	0,53	-0,05	175	14,14	12,38	-0,55	0,24	0,09	0,39	-0,85
22	22	114,18	0,19	-1,51	237	17,37	13,65	-0,32	0,07	0,06	0,87	0,46
23	16	32,51	0,49	-0,22	171	11,15	15,34	-0,02	0,00	0,00	0,00	-1,95
24	8	32,74	0,24	-1,29	157	9,98	15,73	0,05	0,16	0,16	0,99	0,79
25	19	19,35	0,98	1,90	146	10,27	14,21	-0,22	0,22	0,17	0,76	0,16
26	35	69,31	0,50	-0,16	406	25,88	15,69	0,05	0,24	0,19	0,78	0,22
27	16	23,13	0,69	0,64	537	12,45	43,13	4,96	0,13	0,06	0,45	-0,71
28	11	20,36	0,54	-0,01	174	12,10	14,38	-0,19	0,30	0,21	0,69	-0,03
30	15	22,79	0,66	0,50	217	14,12	15,37	-0,01	0,04	0,04	1,00	0,83
31	14	30,45	0,46	-0,36	156	10,55	14,78	-0,12	0,08	0,03	0,39	-0,88
32	16	30,29	0,53	-0,06	171	11,35	15,06	-0,07	5,24	0,82	0,16	-1,52
33	17	20,50	0,83	1,24	180	11,92	15,10	-0,06	0,83	0,67	0,81	0,29
34	14	18,00	0,78	1,02	154	9,88	15,59	0,03	0,05	0,04	0,78	0,23
35	10	12,29	0,81	1,17	103	7,42	13,88	-0,28	0,11	0,09	0,84	0,38
36	37	199,14	0,19	-1,54	367	33,09	11,09	-0,78	0,07	0,18	2,57	5,18
37	34	88,20	0,39	-0,68	298	13,03	22,88	1,33	0,09	0,05	0,58	-0,34
38	23	61,27	0,38	-0,72	159	11,04	14,40	-0,18	1,03	0,62	0,60	-0,27
39	19	20,84	0,91	1,59	161	10,24	15,72	0,05	1,50	1,21	0,80	0,28
40	38	150,36	0,25	-1,25	620	40,05	15,48	0,01	4,28	2,33	0,54	-0,44
41	12	57,92	0,21	-1,45	418	20,60	20,29	0,87	0,19	0,15	0,79	0,23
42	17	29,08	0,58	0,18	200	14,06	14,23	-0,22	0,26	0,18	0,68	-0,05
43	17	36,45	0,47	-0,33	195	13,79	14,14	-0,23	0,94	0,84	0,89	0,51
44	18	28,26	0,64	0,41	240	17,12	14,02	-0,25	0,41	0,31	0,76	0,17
45	16	32,50	0,49	-0,22	195	12,89	15,13	-0,05	0,38	0,36	0,92	0,61
46	15	42,37	0,35	-0,81	189	12,67	14,91	-0,09	0,00	0,00	0,00	-1,95
47	16	22,13	0,72	0,78	204	13,02	15,67	0,04	0,00	0,00	0,00	-1,95
48	10	20,08	0,50	-0,19	158	10,15	15,56	0,02	0,16	0,13	0,83	0,36
49	9	15,00	0,60	0,25	137	8,44	16,24	0,14	0,03	0,03	1,00	0,83
50	20	34,25	0,58	0,18	318	19,09	16,66	0,22	1,29	0,96	0,75	0,13
51	26	45,09	0,58	0,15	204	13,27	15,38	-0,01	2,86	2,25	0,79	0,23
52	20	22,09	0,91	1,57	188	11,68	16,10	0,12	0,15	0,14	0,91	0,57
53	14	54,88	0,26	-1,24	157	16,07	9,77	-1,01	0,25	0,16	0,64	-0,18
54	23	30,34	0,76	0,93	191	12,23	15,62	0,03	0,34	0,19	0,56	-0,39
55	17	22,26	0,76	0,95	195	12,61	15,46	0,00	0,03	0,02	0,57	-0,37
56	15	16,66	0,90	1,54	159	10,66	14,91	-0,09	0,34	0,25	0,72	0,06
57	17	26,23	0,65	0,46	152	9,76	15,57	0,02	1,31	0,87	0,66	-0,12
58	31	44,32	0,70	0,68	267	17,77	15,03	-0,07	0,45	0,33	0,73	0,08
59	9	54,61	0,16	-1,63	161	8,19	19,66	0,76	0,22	0,17	0,77	0,19
60	19	66,00	0,29	-1,10	298	27,06	11,01	-0,79	0,48	0,32	0,67	-0,10
61	16	33,58	0,48	-0,28	328	20,74	15,81	0,07	0,20	0,14	0,68	-0,07
63	29	60,58	0,48	-0,28	338	20,84	16,22	0,14	0,33	0,27	0,82	0,34
64	2	11,78	0,17	-1,61	352	9,65	36,49	3,77	0,23	0,22	0,97	0,75
65	1	14,95	0,07	-2,05	481	13,75	34,97	3,50	0,00	0,00	0,00	-1,95
66	26	27,81	0,93	1,69	185	11,31	16,36	0,17	1,51	0,88	0,59	-0,32
67	15	17,24	0,87	1,41	154	9,02	17,06	0,29	0,74	0,57	0,76	0,17
68	21	29,02	0,72	0,78	215	12,58	17,09	0,30	0,45	0,35	0,78	0,21
69	19	29,88	0,64	0,40	194	10,85	17,89	0,44	0,10	0,10	1,00	0,83
70	24	46,39	0,52	-0,11	397	25,79	15,39	-0,01	0,51	0,45	0,89	0,51
71	16	17,00	0,94	1,72	140	7,99	17,51	0,37	1,21	1,05	0,87	0,46
72	14	21,43	0,65	0,48	196	13,53	14,49	-0,17	0,00	0,00	0,00	-1,95
73	21	24,72	0,85	1,33	196	12,34	15,89	0,08	0,00	0,00	0,00	-1,95
74	16	182,65	0,09	-1,96	145	14,04	10,33	-0,91	0,58	0,47	0,82	0,32
75	28	56,57	0,49	-0,21	203	16,29	12,46	-0,53	0,55	0,49	0,90	0,54
76	24	50,60	0,47	-0,29	309	21,10	14,65	-0,14	1,23	0,75	0,61	-0,25
77	18	23,90	0,75	0,91	194	12,61	15,38	-0,01	0,36	0,19	0,53	-0,49
78	16	24,57	0,65	0,47	213	13,27	16,05	0,11	0,19	0,15	0,81	0,29
79	18	34,36	0,52	-0,08	217	14,15	15,33	-0,02	0,07	0,07	1,00	0,83
80	59	1154,10	0,05	-2,12	113	22,44	5,04	-1,86	0,00	0,00	0,00	-1,95
81	45	110,32	0,41	-0,58	370	26,47	13,98	-0,26	4,44	0,54	0,12	-1,61
82	18	27,73	0,65	0,46	215	13,10	16,41	0,17	0,79	0,51	0,65	-0,14
83	13	19,51	0,67	0,53	176	12,11	14,54	-0,16	0,13	0,09	0,72	0,06
84	32	132,24	0,24	-1,30	495	17,27	28,66	2,37	0,12	0,12	1,00	0,83
85	33	41,48	0,80	1,09	372	23,35	15,93	0,09	0,51	0,38	0,74	0,10
86	83	190,97	0,43	-0,47	739	52,08	14,19	-0,22	0,27	0,27	1,00	0,83

LAND USE MIX											
SERVICE				ENTERTAINMENT				INSTITUTIONAL			
AREA (ACRES)	PROPORTION	Ln(P)	ENTROPY	AREA (ACRES)	PROPORTION	Ln(P)	ENTROPY	AREA (ACRES)	PROPORTION	Ln(P)	ENTROPY
2,31	0,04	-1,40	-0,08	0,39	0,01	-2,17	-0,02	1,45	0,03	-1,60	-0,06
5,60	0,09	-1,04	-0,14	0,87	0,01	-1,85	-0,04	5,59	0,09	-1,04	-0,14
8,43	0,13	-0,88	-0,17	0,35	0,01	-2,26	-0,02	4,61	0,07	-1,14	-0,12
4,04	0,06	-1,22	-0,11	0,62	0,01	-2,03	-0,03	2,16	0,03	-1,49	-0,07
0,24	0,01	-2,28	-0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
0,11	0,00	-2,52	-0,01	0,01	0,00	-3,46	0,00	0,57	0,02	-1,81	-0,04
2,34	0,06	-1,20	-0,11	0,23	0,01	-2,21	-0,02	0,02	0,00	-3,18	0,00
9,59	0,06	-1,24	-0,10	3,41	0,02	-1,69	-0,05	6,09	0,04	-1,44	-0,08
0,39	0,00	-2,61	-0,01	0,13	0,00	-3,08	0,00	0,00	0,00	0,00	0,00
0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
0,28	0,01	-2,22	-0,02	0,39	0,01	-2,08	-0,02	8,50	0,18	-0,74	-0,19
0,43	0,01	-1,96	-0,03	3,44	0,09	-1,05	-0,13	0,54	0,01	-1,86	-0,04
9,91	0,10	-1,01	-0,14	1,00	0,01	-2,01	-0,03	8,83	0,09	-1,06	-0,13
0,93	0,02	-1,76	-0,04	0,07	0,00	-2,87	-0,01	1,45	0,03	-1,57	-0,06
0,00	0,00	0,00	0,00	0,06	0,00	-3,12	0,00	0,00	0,00	0,00	0,00
6,41	0,09	-1,03	-0,14	0,47	0,01	-2,17	-0,02	6,42	0,09	-1,03	-0,14
1,70	0,04	-1,37	-0,08	0,08	0,00	-2,68	-0,01	0,14	0,00	-2,46	-0,01
0,88	0,01	-1,85	-0,04	0,19	0,00	-2,53	-0,01	1,47	0,02	-1,63	-0,05
0,09	0,00	-2,79	-0,01	0,05	0,00	-3,03	0,00	2,52	0,05	-1,33	-0,09
0,38	0,01	-2,19	-0,02	0,20	0,00	-2,47	-0,01	1,28	0,02	-1,66	-0,05
0,30	0,01	-2,11	-0,02	0,11	0,00	-2,54	-0,01	1,06	0,03	-1,57	-0,06
0,05	0,00	-3,34	0,00	0,06	0,00	-3,25	0,00	0,00	0,00	0,00	0,00
0,01	0,00	-3,76	0,00	0,02	0,00	-3,16	0,00	0,00	0,00	0,00	0,00
0,04	0,00	-2,93	0,00	0,12	0,00	-2,44	-0,01	1,19	0,04	-1,44	-0,07
0,71	0,04	-1,43	-0,08	0,14	0,01	-2,13	-0,02	1,13	0,06	-1,23	-0,10
0,52	0,01	-2,13	-0,02	0,03	0,00	-3,32	0,00	0,17	0,00	-2,61	-0,01
0,08	0,00	-2,48	-0,01	0,11	0,00	-2,33	-0,02	1,90	0,08	-1,09	-0,13
0,13	0,01	-2,21	-0,02	0,09	0,00	-2,36	-0,01	0,22	0,01	-1,97	-0,03
0,05	0,00	-2,65	-0,01	0,10	0,00	-2,36	-0,01	0,16	0,01	-2,17	-0,02
2,50	0,08	-1,08	-0,13	0,06	0,00	-2,72	-0,01	0,00	0,00	0,00	0,00
0,66	0,02	-1,66	-0,05	0,20	0,01	-2,17	-0,02	0,30	0,01	-2,01	-0,03
0,28	0,01	-1,86	-0,04	0,11	0,01	-2,26	-0,02	0,29	0,01	-1,85	-0,04
0,95	0,05	-1,28	-0,10	0,09	0,01	-2,29	-0,02	0,02	0,00	-3,01	0,00
0,05	0,00	-2,41	-0,01	0,13	0,01	-1,99	-0,03	0,13	0,01	-1,97	-0,03
0,03	0,00	-3,89	0,00	1,92	0,01	-2,02	-0,03	0,05	0,00	-3,59	0,00
3,96	0,04	-1,35	-0,09	1,99	0,02	-1,65	-0,05	2,02	0,02	-1,64	-0,05
12,35	0,20	-0,70	-0,20	0,12	0,00	-2,69	-0,01	1,37	0,02	-1,65	-0,05
1,00	0,05	-1,32	-0,09	0,32	0,02	-1,81	-0,04	0,17	0,01	-2,09	-0,02
19,25	0,13	-0,89	-0,16	1,34	0,01	-2,05	-0,03	6,47	0,04	-1,37	-0,08
7,28	0,13	-0,90	-0,16	0,34	0,01	-2,23	-0,02	0,25	0,00	-2,36	-0,01
0,37	0,01	-1,89	-0,03	0,18	0,01	-2,20	-0,02	0,14	0,00	-2,33	-0,02
1,88	0,05	-1,29	-0,09	0,45	0,01	-1,91	-0,03	2,16	0,06	-1,23	-0,10
0,38	0,01	-1,87	-0,04	0,24	0,01	-2,07	-0,03	0,30	0,01	-1,98	-0,03
5,95	0,18	-0,74	-0,19	0,35	0,01	-1,96	-0,03	1,42	0,04	-1,36	-0,09
0,05	0,00	-2,97	0,00	0,10	0,00	-2,64	-0,01	0,00	0,00	0,00	0,00
0,37	0,02	-1,78	-0,04	0,13	0,01	-2,22	-0,02	1,31	0,06	-1,23	-0,10
1,05	0,05	-1,28	-0,10	0,16	0,01	-2,09	-0,02	0,82	0,04	-1,39	-0,08
0,36	0,02	-1,63	-0,05	0,05	0,00	-2,45	-0,01	1,80	0,12	-0,92	-0,16
1,90	0,06	-1,26	-0,10	0,77	0,02	-1,65	-0,05	0,31	0,01	-2,04	-0,03
6,14	0,14	-0,87	-0,17	0,99	0,02	-1,66	-0,05	2,19	0,05	-1,31	-0,09
0,28	0,01	-1,89	-0,03	0,09	0,00	-2,38	-0,01	1,18	0,05	-1,27	-0,10
0,47	0,01	-2,07	-0,03	0,48	0,01	-2,06	-0,03	0,00	0,00	0,00	0,00
0,86	0,03	-1,55	-0,06	0,19	0,01	-2,20	-0,02	3,28	0,11	-0,97	-0,15
0,22	0,01	-2,00	-0,03	0,23	0,01	-1,99	-0,03	2,13	0,10	-1,02	-0,14
0,25	0,02	-1,82	-0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
4,42	0,17	-0,77	-0,19	0,35	0,01	-1,87	-0,04	0,35	0,01	-1,87	-0,04
7,54	0,17	-0,77	-0,19	0,19	0,00	-2,37	-0,01	0,90	0,02	-1,69	-0,05
4,88	0,09	-1,05	-0,13	0,09	0,00	-2,79	-0,01	0,00	0,00	0,00	0,00
0,24	0,00	-2,44	-0,01	0,15	0,00	-2,66	-0,01	2,63	0,04	-1,40	-0,08
0,39	0,01	-1,93	-0,03	0,34	0,01	-1,99	-0,03	0,94	0,03	-1,55	-0,06
1,32	0,02	-1,66	-0,05	0,57	0,01	-2,02	-0,03	0,38	0,01	-2,21	-0,02
0,17	0,01	-1,84	-0,04	0,07	0,01	-2,25	-0,02	0,00	0,00	0,00	0,00
0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
3,45	0,12	-0,91	-0,16	0,26	0,01	-2,03	-0,03	0,35	0,01	-1,91	-0,03
0,49	0,03	-1,55	-0,06	0,12	0,01	-2,15	-0,02	0,12	0,01	-2,15	-0,02
0,90	0,03	-1,51	-0,07	0,23	0,01	-2,11	-0,02	4,19	0,14	-0,84	-0,17
0,23	0,01	-2,11	-0,02	0,18	0,01	-2,23	-0,02	0,11	0,00	-2,42	-0,01
1,88	0,04	-1,39	-0,08	0,32	0,01	-2,16	-0,02	2,20	0,05	-1,32	-0,09
0,82	0,05	-1,32	-0,09	0,31	0,02	-1,74	-0,05	0,02	0,00	-2,83	-0,01
0,11	0,00	-2,31	-0,02	0,05	0,00	-2,63	-0,01	0,00	0,00	0,00	0,00
0,14	0,01	-2,25	-0,02	0,08	0,00	-2,51	-0,01	3,67	0,15	-0,83	-0,18
0,68	0,00	-2,43	-0,01	0,05	0,00	-3,54	0,00	0,37	0,00	-2,69	-0,01
1,10	0,02	-1,71	-0,05	0,20	0,00	-2,45	-0,01	0,00	0,00	0,00	0,00
0,69	0,01	-1,86	-0,04	0,50	0,01	-2,00	-0,03	9,25	0,18	-0,74	-0,19
0,55	0,02	-1,63	-0,05	0,00	0,00	0,00	0,00	1,97	0,08	-1,08	-0,13
0,66	0,03	-1,57	-0,06	0,04	0,00	-2,82	-0,01	0,07	0,00	-2,57	-0,01
0,03	0,00	-3,05	0,00	0,00	0,00	0,00	0,00	0,03	0,00	-3,06	0,00
0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2,41	0,02	-1,66	-0,05	0,02	0,00	-3,71	0,00	0,00	0,00	0,00	0,00
0,26	0,01	-2,03	-0,03	0,05	0,00	-2,73	-0,01	2,24	0,08	-1,09	-0,13
0,15	0,01	-2,11	-0,02	0,12	0,01	-2,20	-0,02	0,30	0,02	-1,81	-0,04
3,15	0,02	-1,62	-0,06	0,19	0,00	-2,85	-0,01	17,49	0,13	-0,88	-0,17
0,69	0,02	-1,78	-0,04	0,32	0,01	-2,11	-0,02	0,22	0,01	-2,27	-0,02
3,79	0,02	-1,70	-0,05	1,21	0,01	-2,20	-0,02	0,33	0,00	-2,77	-0,01

LAND USE MIX										
RESIDENTIAL				RETAIL				FINAL VALUE	Z SCORE	WALKABILITY INDEX
AREA (ACRES)	PROPORTION	Ln(P)	ENTROPY	AREA (ACRES)	PROPORTION	Ln(P)	ENTROPY			
35,05	0,61	-0,21	-0,19	1,15	0,02	-1,70	-0,05	0,39	0,20	-0,37
28,62	0,46	-0,33	-0,22	1,79	0,03	-1,54	-0,06	0,59	1,71	1,68
15,34	0,24	-0,62	-0,21	4,65	0,07	-1,14	-0,12	0,63	2,03	1,69
30,98	0,47	-0,33	-0,22	2,83	0,04	-1,37	-0,08	0,51	1,05	1,10
15,36	0,34	-0,47	-0,23	0,04	0,00	-3,02	0,00	0,25	-0,92	0,89
18,59	0,51	-0,29	-0,21	0,01	0,00	-3,63	0,00	0,27	-0,77	2,85
21,92	0,59	-0,23	-0,19	1,77	0,05	-1,32	-0,09	0,41	0,35	0,01
23,20	0,14	-0,86	-0,17	0,09	0,00	-3,24	0,00	0,40	0,24	-2,23
26,72	0,17	-0,78	-0,19	0,06	0,00	-3,41	0,00	0,20	-1,29	-2,91
11,85	0,01	-2,04	-0,03	0,00	0,00	0,00	0,00	0,03	-2,61	-11,62
25,40	0,54	-0,27	-0,21	0,05	0,00	-3,01	0,00	0,45	0,60	-0,24
22,78	0,59	-0,23	-0,19	0,27	0,01	-2,15	-0,02	0,42	0,37	0,67
23,07	0,23	-0,65	-0,21	7,49	0,07	-1,14	-0,12	0,63	1,98	-1,44
13,32	0,25	-0,60	-0,21	0,01	0,00	-3,62	0,00	0,33	-0,32	-0,40
33,49	0,41	-0,38	-0,23	0,00	0,00	0,00	0,00	0,23	-1,06	-2,04
31,23	0,45	-0,35	-0,22	1,54	0,02	-1,66	-0,05	0,57	1,54	-0,40
25,11	0,63	-0,20	-0,18	0,14	0,00	-2,46	-0,01	0,30	-0,56	-1,03
28,37	0,46	-0,34	-0,22	0,09	0,00	-2,86	-0,01	0,33	-0,29	1,98
15,57	0,29	-0,54	-0,22	0,11	0,00	-2,69	-0,01	0,33	-0,29	1,25
17,99	0,31	-0,51	-0,23	0,07	0,00	-2,94	0,00	0,31	-0,42	1,81
14,14	0,36	-0,45	-0,23	0,24	0,01	-2,22	-0,02	0,34	-0,21	-1,70
17,37	0,15	-0,82	-0,18	0,07	0,00	-3,19	0,00	0,19	-1,40	-4,28
11,15	0,34	-0,46	-0,23	0,00	0,00	0,00	0,00	0,23	-1,05	-3,44
9,98	0,30	-0,52	-0,22	0,16	0,00	-2,31	-0,02	0,33	-0,27	-2,00
10,27	0,53	-0,27	-0,21	0,22	0,01	-1,95	-0,03	0,44	0,56	4,29
25,88	0,37	-0,43	-0,23	0,24	0,00	-2,46	-0,01	0,27	-0,72	-0,78
12,45	0,54	-0,27	-0,21	0,13	0,01	-2,26	-0,02	0,38	0,08	5,61
12,10	0,59	-0,23	-0,19	0,30	0,01	-1,83	-0,04	0,30	-0,56	-0,80
14,12	0,62	-0,21	-0,18	0,04	0,00	-2,81	-0,01	0,23	-1,02	0,79
10,55	0,35	-0,46	-0,23	0,08	0,00	-2,58	-0,01	0,37	0,03	-1,68
11,35	0,37	-0,43	-0,23	5,24	0,17	-0,76	-0,19	0,52	1,14	-0,57
11,92	0,58	-0,24	-0,20	0,83	0,04	-1,39	-0,08	0,37	0,00	2,71
9,88	0,55	-0,26	-0,20	0,05	0,00	-2,53	-0,01	0,33	-0,28	2,01
7,42	0,60	-0,22	-0,19	0,11	0,01	-2,04	-0,03	0,29	-0,61	1,83
33,09	0,17	-0,78	-0,19	0,07	0,00	-3,46	0,00	0,22	-1,16	0,17
13,03	0,15	-0,83	-0,18	0,09	0,00	-3,01	0,00	0,37	0,03	-0,33
11,04	0,18	-0,74	-0,19	1,03	0,02	-1,77	-0,04	0,49	0,97	-0,93
10,24	0,49	-0,31	-0,22	1,50	0,07	-1,14	-0,12	0,49	0,93	4,45
40,05	0,27	-0,57	-0,22	4,28	0,03	-1,55	-0,06	0,55	1,43	-1,50
20,60	0,36	-0,45	-0,23	0,19	0,00	-2,49	-0,01	0,43	0,51	-1,29
14,06	0,48	-0,32	-0,22	0,26	0,01	-2,04	-0,03	0,31	-0,41	-0,32
13,79	0,38	-0,42	-0,23	0,94	0,03	-1,59	-0,06	0,52	1,15	0,78
17,12	0,61	-0,22	-0,19	0,41	0,01	-1,84	-0,04	0,32	-0,39	0,34
12,89	0,40	-0,40	-0,23	0,38	0,01	-1,93	-0,03	0,57	1,53	1,66
12,67	0,30	-0,52	-0,22	0,00	0,00	0,00	0,00	0,24	-1,00	-4,67
13,02	0,59	-0,23	-0,19	0,00	0,00	0,00	0,00	0,36	-0,07	-0,42
10,15	0,51	-0,30	-0,21	0,16	0,01	-2,10	-0,02	0,44	0,54	0,54
8,44	0,56	-0,25	-0,20	0,03	0,00	-2,65	-0,01	0,43	0,51	1,97
19,09	0,56	-0,25	-0,20	1,29	0,04	-1,43	-0,08	0,46	0,68	1,39
13,27	0,29	-0,53	-0,22	2,86	0,06	-1,20	-0,11	0,64	2,10	2,62
11,68	0,53	-0,28	-0,21	0,15	0,01	-2,15	-0,02	0,38	0,06	3,89
16,07	0,29	-0,53	-0,22	0,25	0,00	-2,35	-0,02	0,29	-0,61	-4,28
12,23	0,40	-0,39	-0,23	0,34	0,01	-1,95	-0,03	0,49	0,93	2,44
12,61	0,57	-0,25	-0,20	0,03	0,00	-2,85	-0,01	0,40	0,26	1,80
10,66	0,64	-0,19	-0,18	0,34	0,02	-1,69	-0,05	0,27	-0,79	2,27
9,76	0,37	-0,43	-0,23	1,31	0,05	-1,30	-0,09	0,58	1,61	2,43
17,77	0,40	-0,40	-0,23	0,45	0,01	-2,00	-0,03	0,51	1,06	2,43
8,19	0,15	-0,82	-0,18	0,22	0,00	-2,40	-0,01	0,33	-0,29	-2,60
27,06	0,41	-0,39	-0,23	0,48	0,01	-2,14	-0,02	0,35	-0,14	-3,23
20,74	0,62	-0,21	-0,18	0,20	0,01	-2,22	-0,02	0,33	-0,32	-0,89
20,84	0,34	-0,46	-0,23	0,33	0,01	-2,26	-0,02	0,34	-0,18	-0,26
9,65	0,82	-0,09	-0,10	0,23	0,02	-1,72	-0,05	0,20	-1,25	0,05
13,75	0,92	-0,04	-0,05	0,00	0,00	0,00	0,00	0,05	-2,45	-5,01
11,31	0,41	-0,39	-0,23	1,51	0,05	-1,26	-0,10	0,55	1,36	4,59
9,02	0,52	-0,28	-0,21	0,74	0,04	-1,36	-0,08	0,40	0,25	3,54
12,58	0,43	-0,36	-0,22	0,45	0,02	-1,81	-0,04	0,53	1,23	3,29
10,85	0,36	-0,44	-0,23	0,10	0,00	-2,48	-0,01	0,30	-0,56	1,51
25,79	0,56	-0,25	-0,20	0,51	0,01	-1,96	-0,03	0,43	0,43	0,72
7,99	0,47	-0,33	-0,22	1,21	0,07	-1,15	-0,12	0,48	0,84	5,12
13,53	0,63	-0,20	-0,18	0,00	0,00	0,00	0,00	0,21	-1,25	-2,41
12,34	0,50	-0,30	-0,22	0,00	0,00	0,00	0,00	0,42	0,39	1,18
14,04	0,08	-1,11	-0,12	0,58	0,00	-2,50	-0,01	0,16	-1,63	-6,15
16,29	0,29	-0,54	-0,22	0,55	0,01	-2,02	-0,03	0,31	-0,44	-0,85
21,10	0,42	-0,38	-0,23	1,23	0,02	-1,61	-0,06	0,54	1,31	0,34
12,61	0,53	-0,28	-0,21	0,36	0,01	-1,83	-0,04	0,43	0,47	1,79
13,27	0,54	-0,27	-0,21	0,19	0,01	-2,12	-0,02	0,31	-0,48	0,86
14,15	0,41	-0,39	-0,23	0,07	0,00	-2,67	-0,01	0,24	-0,96	-0,32
22,44	0,02	-1,71	-0,05	0,00	0,00	0,00	0,00	0,05	-2,45	-10,50
26,47	0,24	-0,62	-0,21	4,44	0,04	-1,40	-0,08	0,35	-0,17	-3,21
13,10	0,47	-0,33	-0,22	0,79	0,03	-1,55	-0,06	0,44	0,57	1,53
12,11	0,62	-0,21	-0,18	0,13	0,01	-2,18	-0,02	0,29	-0,62	0,35
17,27	0,13	-0,88	-0,16	0,12	0,00	-3,03	0,00	0,40	0,21	0,81
23,35	0,56	-0,25	-0,20	0,51	0,01	-1,91	-0,03	0,32	-0,39	1,98
52,08	0,27	-0,56	-0,22	0,27	0,00	-2,86	-0,01	0,30	-0,52	-0,85

APPENDIX B – Mixed lots descriptive board

CENSUS TRACT	MIXED LOTS		
	SEPARATED CONSTRUCTIONS	SAME CONSTRUCTION	TOTAL
1	12	0	12
2	16	0	16
3	23	5	28
4	19	2	21
5	4	1	5
6	3	0	3
7	3	2	5
8	2	4	6
9	2	0	2
10	2	0	2
11	2	2	4
12	4	0	4
13	46	2	48
14	13	0	13
15	2	1	3
16	28	1	29
17	9	1	10
18	12	0	12
19	2	1	3
20	8	0	8
21	5	1	6
22	8	1	9
23	3	0	3
24	11	0	11
25	14	1	15
26	4	2	6
27	7	0	7
28	9	0	9
30	8	0	8
31	3	0	3
32	19	0	19
33	12	0	12
34	5	0	5
35	2	1	3
36	1	0	1
37	9	1	10
38	5	4	9
39	21	0	21
40	7	0	7
41	11	1	12
42	16	0	16
43	11	2	13
44	8	0	8
45	16	0	16
46	3	1	4
47	6	1	7
48	14	0	14
49	6	1	7
50	35	2	37
51	23	1	24
52	9	0	9
53	14	1	15
54	9	1	10
55	14	2	16
56	2	2	4
57	10	2	12
58	17	3	20
59	6	1	7
60	8	1	9
61	17	6	23
63	10	2	12
64	0	0	0
65	0	0	0
66	13	2	15
67	15	3	18
68	21	3	24
69	12	2	14
70	11	1	12
71	25	3	28
72	4	0	4
73	6	0	6
74	0	0	0
75	12	0	12
76	16	1	17
77	3	2	5
78	4	0	4
79	1	1	2
80	0	0	0
81	2	0	2
82	20	3	23
83	14	1	15
84	10	1	11
85	14	0	14
86	8	1	9
TOTAL	**841**	**87**	**928**

ATTACHMENTS

ATTACH A – Loch (2013) questionnaire

DATA COLLECTION INSTRUMENT

STATE UNIVERSITY OF LONDRINA
PUBLIC HEALTH GRADUATION

CARDIOVASCULAR DISEASES IN PARANÁ STATE : MORTALITY , RISK PROFILE , THERAPY DRUG AND COMPLICATIONS

Information of the sample household

Localization

Address: _____
Census tract: _____ **Nº:**_____ **Complement:**_____
Telephone: _____ **Obs.:**_____

Residents

1. Name: _____ **Gender:** _____ **Age:**_____
2. Name: _____ **Gender:** _____ **Age:**_____
3. Name: _____ **Gender:** _____ **Age:**_____
4. Name: _____ **Gender:** _____ **Age:**_____
5. Name: _____ **Gender:** _____ **Age:**_____
6. Name: _____ **Gender:** _____ **Age:**_____
7. Name: _____ **Gender:** _____ **Age:**_____
8. Name: _____ **Gender:** _____ **Age:**_____

Respondent information

Name: _____ **Code:** _____
Date of birth: _____ **Cellphone number:** _____
Resources: (0) own person (1) assist caretaker (2) substitute caretaker
Date of interview: _____

Data collection information

Interviewer:_____
1º visit: ___ / ___ / ___ □ Interviewed □ No (reason):_____
2º visit: ___ / ___ / ___ □ Interviewed □ No (reason):_____
3º visit: ___ / ___ / ___ □ Interviewed □ No (reason):_____
□ Denied □ Loss □ Exclusion Reason:_____
Date for laboratory tests collection: ____ / ____ / ____ Typing exam: □ 1 □ 2

PART 1 – DESCRIPTION VARIABLES

1. **(CIV) Marital Status**
   (1) Single
   (2) Married
   (3) Divorced
   (4) Widow(er)
   (5) Stable union

2. **(COR) What is your ethnic group?**
   (1) Asian
   (2) Caucasian
   (3) Indian
   (4) Mixed Race
   (5) African descent

3. **(ESTU) Education:**
   (1) Illiterate
   (2) Primary School
   (3) Secondary School
   (4) High School
   (5) Undergraduate
   (6) Post graduate
   (7) Master

4. **(REDE1) How many close friends do you have? (People who make you feel comfortable to talk about personal matters or who you can count on when you need help)**
   [_____]

5. **(REDE 2) If you needed money (an amount corresponding to one week of your salary), how many people, outside your household, would be willing to give you some money if you asked them?**
   (1) None
   (2) 1 or 2
   (3) 3 or 4
   (4) 5 or more

6. **In every community, some people get along well and trust each other, while others do not. Now, I would like to know about the trust and solidarity in your community. In general, do you agree ou disagree with the statements bellow?**

   6.1. (SOL10) You can trust most of the people who live in your neighborhood/locality:
   (1) Totally agree
   (2) Partly agree
   (3) Neither agree nor disagree
   (4) Partly disagree
   (5) Totally disagree

6.2.(SOL11) In your neighborhood/locality it is necessary to be careful that someone will take advantage on you:

(1) Totally agree
(2) Partly agree
(3) Neither agree nor disagree
(4) Partly disagree
(5) Totally disagree

6.3. (SOL12) Most of the people in your neighborhood/locality are willing to help you in case you need it:

(1) Totally agree
(2) Partly agree
(3) Neither agree nor disagree
(4) Partly disagree
(5) Totally disagree

6.4. (SOL13) In your neighborhood/locality people usually do not trust each other to lend or borrow money:

(1) Totally agree
(2) Partly agree
(3) Neither agree nor disagree
(4) Partly disagree
(5) Totally disagree

7. (SOL2) Nowadays, how often do you say people in your neighborhood/locality help each other?

(1) Always
(2) Most of the time
(3) Sometimes
(4) Rarely
(5) Never

8. (VIOL1) In your opinion, your neighborhood is usually:

(1) Very peaceful
(2) Moderately peaceful
(3) Neither peaceful nor violent
(4) Moderately violent
(5) Very violent

9. (VIOL2) Regarding your safety, how do you feel when you walk alone at night?

(1) Moderately safe
(2) Not so safe
(3) Neither safe nor unsafe
(4) Moderately unsafe
(5) Very unsafe

10. (POL1) How much control do you have over decisions in your daily life?

(1) No control
(2) Control in a few decisions
(3) Control in some decisions
(4) Control in almost every decision
(5) Total control

11. In the last 12 months, did you: (check if yes)

11.1.(POL21) Participate in council meetings, open discussions or discussion groups? (___)
11.2. (POL22) Meet a politician, call him/her or send an email or letter? (___)
11.3. (POL23) Participate in protests or demonstrations? (___)
11.4. (POL24) Participate in election or information campaigns? (___)
11.5. (POL25) Report a local problem to newspapers, radio ou tv programmes? (___)
11.6. (POL26) Notify a local problem to the police or justice? (___)

THE FOLLOWING QUESTIONS RELATE TO YOUR JOB AND YOUR HOUSE ASSETS. I WOULD LIKE TO REMEMBER THAT ALL THE DATA OF THIS STUDY WILL ONLY BE USED FOR RESEARCH PURPOSES.

12. (TR1) How many jobs do you have? (___)

(If one or more go directly to question 14)

13. (TR2) In case you do not work, what do you consider yourself?

(1) Retired
(2) Housewife
(3) Unemployed

14. (TR3) If you work, which is your main job?

(_____)

15. (TR4) In this job you are:

(1) Employee
(2) Housekeeper
(3) Freelancer (independent)
(4) Employer
(5) Unpaid

16. (PB10) Do you work with any of these occupations:

	Y/N	How long for (years)?
A1. (PB11) Manufacture and recover of batteries		
A2. (PB12) Secondary foundries: junkyard or prickly bars fusions		
A3. (PB13) Iron foundry production (bronze, brass)		
A4.(PB14) Galvanoplasty		

A5. (PB15) Cut and weld process of metal sheets and pieces with lead		
A6. (PB16) PVC and other plastic production		
A7. (PB17) Rubber industry		

17. Have you ever worked with any of these occupations?

	Y/N	How long for (years)?	How many years ago did you stop?
In case you already read the alternatives before, have you ever worked in any of these places reported before?			
A1. (PB20) Manufacturing and recover of batteries			
A2. (PB21)Secondary foundries: junkyard or prickly bars fusions			
A3. (PB22) Fusion production (bronze, brass)			
A4. (PB23) Galvanoplasty			
A5. (PB24) Cut and weld process of metal sheets and pieces with lead			
A6. (PB25) PVC and other plastics production			
A7. (PB26) Rubber industry			

18. (PB30) Does someone who lives with you works with lead exposure?

(1) Yes
(2) No
(PB31) If **yes**, where? (according to the codes presented above) (___)

19. (PB40) Is there any resource of lead contamination next to your house?

(1) Yes
(2) No
(PB41) If **yes**, how far from your house (in meters)? (___)

20. (COM) Which one of these sources do you get news from?

(1) TV
(2) Radio
(3) Newspaper
(4) Internet
(5) Other

21. (ABEP) Social Class:

	Number of items				
Which one of these items do you have?	**0**	**1**	**2**	**3**	**4+**
TV	0	1	2	3	4
Radio	0	1	2	3	4
Bathroom	0	4	5	6	7
Car	0	4	7	9	9
Housemaid	0	3	4	4	4
Washing machine	0	2	2	2	2
DVD/Video player	0	2	2	2	2
Refrigerator	0	4	4	4	4
Freezer	0	2	2	2	2
What are the educational levels in charge of the house hold finances?					
Illiterate/incomplete primary education/ until 3rd grade of secondary school					0
Complete primary eduaction/ incomplete secondary education/ until 4th grade of secondary school					1
Complete secondary education/ incomplete high school/ complete primary school					2
Complete high school/ incomplete undergraduate studies/ complete secondary school					4
Complete undergraduated studies					8
Total					**( )**

Questions for over 50-year-olds only:

22. Understanding the time:

22.1 Today is?	One point for each correct answer
22.2 In which month are we?	
22.3 What year is this?	
22.4 Considering the days of the week, today is?	
22.5 What time is it now?	
Number of correct answers	**( )**

23. Orientation in space:

22.1 In which room are we now? (living room, bedroom, kitchen)	One point for each correct answer
22.2 Where are we now? (house, apartment, retirement house)	
22.3 What is the name of this neighborhood?	
22.4 What is the name of this city?	
22.5 Which State of Brazil are we now?	
Number of correct answer	**( )**

24. Record:

Pay attention. I will say three words and you will repeat them when I finish. The words are: CAR, VASE, BRICK. Now, repeat the words for me. (1 second for each one, 1 right answer for each one, then repeat the three words until the person learn all of them, count and record the number of attempts). **Number of attempts (_____)** **Number of right answers (_____)**	One point for each repeated word that was correct in the first attempt

25. Attention and calculation:

Do you do calculations?
(1) Yes
(2) No
If **yes**:

25.1. If you took7 reais out of 100 reais, how much would remain? And if we took 7 reais more, how much would remain? (total of five subtractions) Interviewed answer: (_____) Right answer: 93 – 86 – 79 – 72 – 65 **Number of right answers: (_____)**	One point for each correct number on the first attempt

If **no:**

25.2. Spell the word WORLD backwards. Interviewed answer: (_____) Right answer: D – L – R – O – W **Number of right answers: (_____)**	One point for each correct letter on the first attempt

26. Recall memory:

Which are the three words I asked you to memorize? Interviewed answer: (_____) Right answer: CAR, VASE, BRICK **Number of right answers: (_____)**	One point for each correct word

27. Language:

27.1. Please, repeat what I am going to say: **"Not here, not there, not over there"** **Correct answer: (_____)**	One point
27.2. Point to the pencil and the watch and ask: What are these?  ( )  ( ) **Number of correct answers: (_____)**	One point each
27.3. Now listen carefully because I will ask you to accomplish three tasks: 1) Take this paper with your right hand (use the TCLE) 2) With both hands bend the paper in the middle 3) Throw it on the floor **Number of correct attempts: (_____)**	One point each
27.4. Please, read this and do what it says. Show to the interviewed the command: CLOSE YOUR EYES **Correct attempt: (_____)**	One point
27.5. Please, write a sentence. If the interviewed does not answer, say: Write about the weather. _____ **Correct answer: (_____)**	One point (Do not consider grammar or spelling mistakes)

28. Please, copy this drawing:

 **Number of correct answers: (_____)**	One point (Only consider if there are two pentagons that intersect with each other, ten different angles, creating a figure with fours sides or with two angles)

29. (MM) FINAL SCORE: (_____)

QUESTIONS FOR EVERYONE:

PART 2 – LIFE HABITS

30. (FUM1) Do you smoke?
(1) Yes
(2) No
If **no**, go directly to question 33.
If **yes**:
30.1. (FUM2) How often?
(1) Everyday
(2) Occasionally
If **occasionally**:
30.2. (FUM3) How many cigarettes per day? (_____)

31. (FUM4) How old did you start to smoke regularly?
(_____) anos (99) Do not remember

32. (FUM5) Have you ever tried to quit smoking?
(1) Yes
(2) No

33. (FUM6) Do you smoke?
(1) Yes
(2) No
If **yes**:
33.1. (FUM7) How old were you when you quit smoking?
(_____) years old (99) Do not remember

34. (ALC1) Do you frequently drink alcohol?

(1) Yes
(2) No
If **no**, go directly to question 35.
If **yes**:

34.1. (ALC2) How often do you drink alcohol?

(1) Occasionally (less than twice/week)
(2) Frequently (2 to 6 times/week)
(3) Everyday

34.2. (ALC3) In the last 30 days did you drink 4 (for woman)/ 5 (for men) shots of alcohol on one occasion? (more tham 4/5 shots would be 4/5 beer cans or 4/5 glasses of wine or 4/5 shots of "cachaça"/whisky/any other destilled drink)

(1) Yes
(2) No
If **yes**:

34.2.1. (ALC4) How many days during the month did it happen? (_____)

NOW WE ARE GOING TO TALK ABOUT PHYSICAL ACTIVITIES SUCH AS: WALKING, SPORTS AND REGULAR EXERCISES THAT MAKE YOUR BREATHING GET FASTER THAN NORMAL.

35. (EX1) In a normal week do you do physical activity in your spare time?

(1) Yes
(2) No
If **no**, go directly to question 38.
If **yes**:

36. During a normal week which physical activities do you do in your spare time?

	Check if **yes**	How often during the week (days)?	How long per day (minutes)?
36.1 (EX21) Walking?			
36.2 (EX22) Stretching?			
36.3 (EX23) Dancing?			
36.4 (EX24) Bodybuilding?			
36.5 (EX25) Gymnastics?			
36.6 (EX26) Football?			
36.7 (EX27) Other? Which one?			

37. (EX5) Do you regularly do physical activities for more than 6 months?
(1) Yes
(2) No
If **yes**, go directly to question 40.

38. (EX6) Do you intend to take up regular physical activities in the next 30 days?
(1) Yes
(2) No
If **yes**, go directly to question 40.

39. (EX7) Do you intend to start to take up regular physical activities in the next 6months?
(3) Yes
(4) No

40. (EX8) In relation to your paid job, or to your domestic activities, how can you classify them taking into consideration the physical effort necessary:
(1) Very light
(2) Light
(3) Moderate
(4) Heavy
(5) Very heavy

41. (EX9) Do you walk or go by bicycle to your work place?
(1) Yes
(2) No
(99) Does not apply
If **no** or **Dos not apply**, go directly to question 43.

42. (EX10) How long does it take you? (considering a round trip)
(_____) minutes

NOW I WOULD LIKE TO ASK YOU ABOUT YOUR EATING HABITS.

43. (AL1) How many days per week do you usually eat fruits?
(1) Hardly ever
(2) Never
(3) 1 to 2 days
(4) 3 to 4 days
(5) 5 to 6 days
(6) Everyday

44. (AL2) How many days per week do you usually eat vegetables (lettuce, tomato, kale, chayote, eggplant, courgette), not considering potato, cassava or yam?
(1) Hardly ever
(2) Never
(3) 1 to 2 days
(4) 3 to 4 days
(5) 5 to 6 days
(6) Everyday

45. (AL3) How many days per week do you usually eat red meat?

(1) Hardly ever
(2) Never
(3) 1 to 2 days
(4) 3 to 4 days
(5) 5 to 6 days
(6) Everyday
If **never**, go directly yo question 46.

45.1.(AL4) When you eat red meat with fat, do you:

(1) Take off the excess of visible fat
(2) Eat with fat
(3) Do not eat red meat with high-fat

46. (AL5) How many days per week do you eat chicken?

(1) Hardly ever
(2) Never
(3) 1 to 2 days
(4) 3 to 4 days
(5) 5 to 6 days
(6) Everyday
If **never**, go directly to question 47.

46.1.When you eat chicken with its skin, do you:

(1) Take the skin off
(2) Eat with the skin
(3) not eat chicken parts

47. (AL7) How many days during the week do you drink milk?

(1) Hardly ever
(2) Never
(3) 1 to 2 days
(4) 3 to 4 days
(5) 5 to 6 days
(6) Everyday
If **never**, go directly to question 48.

47.1. (AL8) Whenyou drink milk, what kind of milk do you usually drink?

(1) Whole milk
(2) Skimmed or semi-skimmed milk
(3) Both types
(99)Do not know

PART 3 – FUNCTIONAL CAPACITY VARIABLES

48. (RES) Respondent:
(1) Own person
(2) Caretaker

NOW WE ARE GOING TO TALK ABOUT YOUR FUNCTIONAL, MOTOR, COGNITIVE CAPACITIES AND DAILY ACTIVITIES:

49. Do you have any difficulties or need help to:		**Level**
49.1.(CF1)Eat? (1) No (go directly to the next question) (2) Yes →	If **yes**: (2) With difficulty (3) Alone, but need encouragement or supervision (4) Need little help (5) Cannot do, need another person to help you	
49.2.(CF2) Take a shower? (1) No (go directly to the next question) (2) Yes →		
49.3. (CF3) Get dressed? (1) No (go directly to the next question) (2) Yes →		
49.4. (CF4) Take care of your appearance (brush your teeth, comb your hair, shave, trim your nails or put on make up? (1) No (go directly to the next question) (2) Yes →		
49.5.(CF5)Use the toilet (sit down, get up, clean yourself and get dressed)? (1) No (go directly to the next question) (2) Yes →		
49.6. (CF6) Urinate? (1) No (go directly to the next question) (2) Yes →	If **yes**: (2) Occasional incontinence or dripping (3) Frequent incontinence (4) Total incontinence	
49.7. (CF7) Defecate? (1) No (go directly to the next question) (2) Yes →		

50. (CF10) Do you have any difficulty or need help to get up, sit down and lay down, from bed to a chair or to a wheelchair and stand up, and vice-versa?
(1) No (go directly to the next question)
( )Yes

If **yes:**
50.1. How do you move?
(1) With difficulty
(2) Alone, but need encouragement or supervision
(3) Need little help
(4) Cannot do, need another person to help you

51. (CF11) Do you have any difficulty or need help to walk around your house or to take the elevator (in case you live in apartment)?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

51.1. How do you walk around your house?

(2) With difficulty (with a stick, prosthesis, orthosis or walker)
(3) Alone, but need someone to guide, encourage or supervise you
(4) Need help to walk
(5) Cannot walk

51.2. (CF111) Do you need help from any device to walk?

(1) Stick
(2) Device with three supports
(3) Devide with four supports
(4) Walker

52. (CF12) Do you have any difficulty or need help to walk outside your house?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

52.1. How do you walk around your house?

(2) With difficulty (with a stick, prosthesis, othosis or walker)
(3) Need a wheelchair or walk alone, but need someone to guide, encourage or supervise you or has an unstable walking
(4) Use wheelchair with difficulty
(5) Need someone to help you walk or use wheelchair
(6) Cannot go outside of the house (need a stretcher)

53. (CF13) In relation to the use of prothesis and orthosis, you:

(1) Do not use (go directly to the next question)
(2) Can install by yourself
(3) Can install by yourself, but with difficulty
(4) Need someone to verify the instalation or need help to install
(5) Need someone to install the devices

54. (CF14) In relation to the use of wheelchair, do you:

(1) Do not use (go directly to the next question)
(2) Can move in the wheelchair alone
(3) Can move in the wheelchair alone, but with difficulty
(4) Need someone to help move the wheechair
(5) Cannot use a wheelchair (need a stretcher)

If you **use a wheelchair**:

54.1. (CF141) What type oh wheelchair do you use?

(1) Simple
(2) Motorized

54.2. (CF142) Can you move around with your wheelchair in the place you live?
(1) Yes
(2) No

55. (CF15) Do you have any difficulty going up or down the stairs?
(1) No (go directly to the next question)
( ) Yes

If **yes:**
55.1. How do you walk around your house:
(2) With difficulty
(3) Climb and go down in an unsafe way, need someone to guide, encourage or supervise
(4) Climb and go down with someone else's help
(5) Do not use stairs

56. (CF16) Do you need to use stairs in your house?
(1) Yes
(2) No

57. (CF20) Do you have any difficulty to read/see without glasses or other devices?
(1) No (go directly to the next question)
( ) Yes

If **yes:**
57.1.To read or see, do you:
(2) Have visual disorders, but can see enough to accomplish daily activities (DAs)?
(3) See only the contour of objects and need to be guided in your DAs?
(4) Cannot see/blind?

57.1.1. (CF201) To accomplish your DAs, you:
(1) Wear contact lens/glasses
(2) Use magnifying glass
(3) Do not use anything

58. (CF21) Do you have any difficulty to listen without any device?
(1) No (go directly to the next question)
( ) Yes

If **yes:**
58.1.To listen, you:
(2) Only listen when people speak loudly or need someone to install your hearing aid
(3) Only listen shouts or few words or read lips or understand gestures
(4) Total deafness and disability to undestand what other people want to say to you

59. (CF22) Do you have any difficulty to normally speak or communicate without any device?
(1) No (go directly to the next question)
( ) Yes

If **yes:**

59.1.To listen, you:

(2) Have some difficulty, but can express what you are thinking
(3) Have a lot of difficulty, but can communicate basic necessities or respond simple questions (yer or no) or use gestures
(4) Cannot communicate

59.2. (CF221) Do you use any device to help you communicate?

(1) Comunication board
(2) Computer
(3) Do not use

60. Do you have any difficulty to remember facts (in a way that compromise your daily activites accomplishment)?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

60.1.In relation to your memory, you:

(2) Forget recent facts, but remember the important ones
(3) Usually forget facts from daily life
(4) Have total amnesia

61. (CF31) Do you have any difficulty to find yourself in time, place and around people?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

61.1. Do you feel:

(2) Sometimes desoriented?
(3) Oriented only in relation to a brief period (day period), space (where you live) and familiar people?
(4) Total desorientation?

62. (CF32) Do you have any difficulty to understand well what other people explain or ask you?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

62.1. Are you/do you:

(2) Slow to undestand explanations or requests?
(3) Partially, even after repeated explanations, incapable to learn new things?
(4) Not understand what happens around you?

63. (CF33) Can you evaluate the situations and take sensible actions?

(1) Yes (go directly to the next question)
( ) No

If **no:**

63.1. Do you:

(2) Evaluate situations, but need someone to give you advice to make sensible decisions?
(3) Barely evaluate situations and make sensible decisions only when someone give a strong opinion ?
(4) Do not evaluate situations and need someone to make decisions in your place?

64. In relation to your behavior, do you have:

(1) An appropriate behavior?
(2) Disorders (for example: crying, stubborness and apathy) that need ocasional supervision or be warned or need encouragement?
(3) Disorders that need intensive supervision (aggressiveness against yourself or others, annoy other, wandering, constant shouts)?
(4) Dangerous behavior and need tightenings or you can hurt yourself or others or try to runaway?

65. Do you have some difficulty or need help to:		**Level**
65.1.(CF40) Look after your home? (3) No (go directly to the next question) (4) Yes →	If **yes**: (2) With difficulty (3) Alone, but need supervision or encouragement to keep a good level of organization (4) Need help, mainly for more complex activities (5) Do not do	
65.2.(CF41) Do the laundry? (3) No (go directly to the next question) (4) Yes →		
65.3. (CF42) Prepare meals? (3) No (go directly to the next question) (4) Yes →		
65.4. (CF43) Do the shopping? (3) No (go directly to the next question) (4) Yes →		

66. (CF44) Do you have any difficulty or need help to use the telephone (including searching for telephone numbers in a catalog)?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

66.1. In relation to using the telephone, do you:

(2) Use it with difficulty?
(3) Answers the telephone, but only dial few numbers that know by heart or emergency numbers?
(4) Communicate on the telephone, but cannot dial or answer it by yourself?
(5) Do not use the telephone?

67. (CF45) Do you have any difficulty or need help to ride means os transportation (car, adapted vehicle, taxi, bus)?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

67.1. In relation to ride means of transportation, do you:

(2) Use them with difficulty?
(3) Need a companion or ride a adapted vehicle alone?
(4) Only ride vehicles or adapted vehicles with companion and help to go in and out of a vehicle?
(5) Need to be carried in strechers?

68. (CF46) Do you have any difficulty or need help to handle money (including bank accounts)?

(1) No (go directly to the next question)
( ) Yes

If **yes:**

68.1. In relation to handling money, do you:

(2) Manage it with difficulty?
(3) Need help to make certain complex transactions?
(4) Need help to make simple transactions (cash checks, pay bills), but can use given
(5) You do not administrate your own money

PART 4 – HEALTH CARE SERVICES USE

69. (PS1) Do you have health insurance?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

69.1. (PS2) What type (coverage):

(1) Partial
(2) Total
(99) Do not know/remember

70. (SUS) Do you use the health center services (basic health unit)?

(1) Yes
(2) No

If **no**, go directly to question **75.**

71. (PSF1) Do you receive visits from the family health teams (from the health center – doctor, nurse, nursing technician)?

(1) Yes
(2) No
(99) Do not know/remember

72. (ACS) Do you receive visits from the community health workers?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

72.1. (ACS1) How often? (_____) visits/month

73. (PSF2) How do you evaluate the family health team services?

(1) Very good
(2) Good
(3) Regular
(4) Bad
(5) Very bad

74. (MED1) Have you had medical appointments in the last 12 months?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

74.1.(MED2) Can you remember how many appointments? (_____)

74.2. (MED3) From these appointments, how many were attended in the last two months? (_____)

74.3. (MED4) How do you evaluate your relationship with your main doctor?

(1) Very good
(2) Good
(3) Regular
(4) Bad
(5) Very bad

75. (CIR) Have you been operated on in the last 12 months?

(1) Yes
(2) No
(99) Do not know/remember

76. (INT1) Have you been hospitalized (for more than one day) in the last 12 months?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

76.1.(INT2) Can you remember why?

(_____)
(99) Do not know/remember

NOW WE ARE GOING TO TALK ABOUT YOUR DENTAL HEALTH.

77. (DNT1) Have you ever went to a dentist appointment in your life?

(1) Yes
(2) No
(99) Do not know/remember

If **no**, go directly to question **82.**

78. (DNT2) When was the last time you had a dentist appointment?
(1) Less than one year
(2) One to two years
(3) Three years or more
(99) Do not know/remember

79. (DNT3) Where was your last dentist appointment?
(1) Public service
(2) Private service
(3) Health insurance or agreement
(4) Other
(99) Do not know/remember

80. (DNT4) What was the reason of your last dentist appointment?
(1) Check up
(2) Pain
(3) Extraction
(4) Treatment
(5) Other
(99) Do not know/remember

81. (DNT5) How do you evaluate the treatment received in your last dentist appointment?
(1) Very good
(2) Good
(3) Regular
(4) Bad
(5) Very bad

PART 5 – HEALTH CONDITIONS

82. (SB1) Have you ever lost a tooth?
(1) Yes
(2) No

If **no**, go directly to question **84.**
If **yes:**
82.1.(SB2) Can you remember approximately how many? (16 in the upper dental arch and 16 in the lower dental arch)
(_____)

83. (SB3) Do you have dental prothesis?(implant, dental crown, dental bridge or denture)
(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

83.1. (SB4) Prosthesis is/are in:

(1) The upper part of the mouth
(2) The lower part of the mouth
(3) Both

84. (SB5) Do you think that you need dental treatment currently?

(1) Yes
(2) No

85. (SB6) Have you suffered from toothache in the last six months?

(1) Yes
(2) No
(99) Do not know/remember

86. (SB7) Have you observed gum bleeding?

(1) No
(2) Yes, in the last week
(3) Yes, in the last 15 days
(4) Yes, more than a month ago

87. (SB8) Can you feel anysoftened tooth?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

87.1.(SB9) How many?

(_____)

88. (SB10) In relation to your teeth/mouth, are you:

(1) Satisfied
(2) Dissatisfied
(3) Neither satisfied nor dissatisfied
(99) Do not know/remember

89. (SB11) Did you feel uncomfortable eating because of teeth, mouth or gum problems in the last month?

(1) No
(2) Sometimes
(3) Frequently

If **no**, go directly to question **92.**

90. (SB12) Were your eating habits impaired because of teeth, mouth or gum problems in the last month?

(1) No
(2) Sometimes
(3) Frequently

91. (SB13) Did you have to stop your meals because of problems with your teeth, your mouth or gum in the last month?
(1) No
(2) Sometimes
(3) Frequently

92. (SB14) Have you ever felt embarrassed because of problems with your teeth, your mouth or gum?
(1) No
(2) Sometimes
(3) Frequently

NOW WE ARE GOING TO TALK ABOUT YOUR HEALTH IN GENERAL.

93. (EST1) How do you classify your health condition?
(1) Very good
(2) Good
(3) Regular
(4) Bad
(5) Very bad

94. (EST2) Comparing to a year ago, how would do classify your health condition?
(1) Much better
(2) Slightly better
(3) Almost the same
(4) Slightly worse
(5) Much worse

95. (EST3) Comparing to people of the same age as yours, how do you classify your health condition?
(1) Much better
(2) Slightly better
(3) Almost the same
(4) Slightly worse
(5) Much worse

THE FOLLOWING QUESTIONS ARE RELATED TO YOUR SLEEPING HABITS DURING THE LAST MONTH. YOUR ANSWERS SHOULD INDICATE THE MOST EXACT RECOLLECTION OF THE MAJORITY OF DAYS AND NIGHTS OF LAST MONTH.

96. (SON1) What time did you usually go to bed at night in the last month?
Habitual bed time: _____:_____

97. (SON2) How long did it usually take you to fall asleep in the last month?
Minutes (_____)

98. (SON3) What time did you usually wake up in the last month?
Habitual wake up time: _____:_____

99. (SON4) How long did you sleep per night?
Hours of sleep per night (_____)

100. (SON6) How would you classify your sleep quality in general?
(1) Very good
(2) Good
(3) Bad
(4) Very bad

101. (SON7) How often did you take medicine (prescribed or unsprescribed) to help you sleep in the last month?
(1) Never
(2) Less than once/week
(3) Once or twice/week
(4) 3 or more times/week

102. How often did you have difficulty to sleep in the last month because:	Never	Less once/week	Once or twice/week	3 or more times/week
102.1. (SON5a) You could not sleep within 30 minutes				
102.2. (SON5b) You woke up in the middle of the night or morning				
102.3. (SON5c)You needed to go to the bathroom				
102.4. (SON5d) You could not breath comfortably				
102.5. (SON5e) You coughed or snored heavily				
102.6. (SON5f) You were cold				
102.7. (SON5g) You were hot				
102.8. (SON5h) You had nightmares				
102.9. (SON5i) You felt pain				
102.10. (SON5ib) Other	Which one?			
(SON5j) How often did you have difficulty to sleep because of this reason in the last month?				

103. How often did you have difficulty to stay awake while driving, eating or participating in a social activity (party, friends reunion, studying) in the last month?
(1) Never
(2) Less than once/week
(3) Once or twice/week
(4) 3 or more times/week

104. How problematic was for you to keep your enthusiasm to do daily activities during the last month?

(1) Never
(2) Less than once/week
(3) Once or twice/week
(4) 3 or more times/week

105. How likely are you to doze or sleep, and not just feel tired, in the following situations (if you have not gone through any situation, try to imagine how they would affect you)

0 = would never doze
1 = small chance of dozing
2 = medium chance of dozing
3 = most likely to doze

Situations (circle the answer):				
105.1. (SON10A) Siting and reading	0	1	2	3
105.2. (SON10B) Watching TV	0	1	2	3
105.3. (SON10C) Sitting still in a public place (e.g. theater, meeting or lecture)	0	1	2	3
105.4. (SON10D) Riding a car for an hour without stopping, as a passenger	0	1	2	3
105.5. (SON10E) Sitting still after lunch without having consumed alcoholic beverage	0	1	2	3
TOTAL (SON10)				

106. (SON11) Has anyone told you that you snore all or almost every night?

(1) Yes
(2) No

If **yes:**

(SON11A) Did this last at least 12 months?
(1) Yes
(2) No

107. (SON12) Has anyone told you that you do not breath for few moments while sleeping?

(1) Yes
(2) No

108. (PESR) Do you know your weight? (_____) kg

109. (ALTR) Do you know your height? (____ , ____) m

110. (CBE) Left arm circumference: (_____) cm

111. (PA1) Check the first measure of BP (Blood Pressure): _____ /_____

NOW I WILL ASK YOU IF YOU HAVE ALREADY BEEN DIAGNOSED AS SUFFERING FROM CERTAIN DISEASES BY A DOCTOR OR OTHER HEALTH PROFESSIONAL . KEEP IN MIND YOU MUST ONLY REPORT WHAT A DOCTOR OR A HEALTH PROFESSIONAL INFORMED YOU THAT YOU HAVE.

112. Which of the following diseases have you been told by a doctor or other health professional (doctor, nurse, pharmacist, etc.) that you have or had:	
	Yes / No
112.1. (HA) Hypertension / high blood pressure?	
112.2. (DM) Diabetes Mellitus / Sugar in your blood?	
112.3. (CT) High cholesterol?	
112.4. (AG) Angina?	
112.5. (ICC) Congestive cardiac insufficiency?	
112.6. (IAM1)Acute myocardial infarction?	
112.6.1. (IAM2) Did your parents or siblings have some case of IAM before the age of 60?	
112.7. (DCV1) Cerebrovascular disease/stroke?	
(DCV2) If yes, how long ago? (_____) years	
112.7.1. (DCV3) Has it ever recurred? (1) Yes (2)No	
112.7.2. (DCV4) Did your parents or siblings have some case of DCV1 before the age of 60?	
112.8. (IRC) Chronic renal insufficiency?	
112.9. (DP) Pulmonary disease?	
112.10. (FQ) Hip fracture?	
112.11. (ART) Arthritis, arthrosis or rheumatism?	
112.12. (COL) Back problems?	
112.13. (CAN) Some kind of cancer?	
112.14. (DEP) Depression?	
112.15. (DOT) Other? Which?	
QUESTIONS FOR WOMEN ONLY:	
112.20. (OMP) Micropolycystic ovary?	
112.21. (MP) Are you in menopause? (1) Yes (2) No If **no**, go directly to question **113**.	
112.22. (GRAV) Are you pregnant?	
112.23LAC) Are you breast-feeding?	

113. (MSUB) Have you lost your father, mother or siblings by sudden death before the age of 60**?**

(1) Yes

(2) No

If answered **yes for any disease**:

114. (TRAT1) Do you use any medicine to control your diseases?

(1) Yes

(2) No

If **no**, go directly to question **117**.

NOW I WILL ASK YOU ABOUT THE WAY YOU TAKE YOUR MEDICINE. MY INTENTION IS NOT TO EVALUATE YOU. IN THAT WAY, PLEASE, ANSWER THE NEXT QUESTIONS SINCERELY, WITHOUT WORRYING ABOUT THE RESULT.

115. (ADS1) A lot of people have problems taking some medicine. Did you have any problems to take your medicine in the last 15 days?

(1) Yes
(2) No
(99) Do not know/remember

116. (ADS2) Did you stop taking any medicine that you should be taking in the last 15 days?

(1) Yes
(2) No
(99) Do not know/remember

117. (QUE1) Did you fall down in the last 12 months?

(1) Yes
(2) No
(99) Do not know/remember

If **yes:**

117.1. (QUE2) Can you remember how many times? (_____)

117.2. (QUE3) Where? (_____)

BLOCK 6 – MEDICAL TREATMENT

118. (TRAT2) In the last 15 days, did you use any kind of medicine (ex. Continuous prescription medicine, painkillers, stomack medicine, or others)?

(1) Yes
(2) No
(99) Do not know/remember

If **no**, go directly to question **131**.

119. (CF47) About medicine use, do you:

(1) Take it by yourself? (skip to the next question)
(2) Take it with difficulty?
(3) Need supervision (including distance supervision) to secure you take your medicine correctly or they are weekly organized in a box (by another person)?
(4) Take your medicines if they are separated every day
(5) Need someone to bring your medicine at the right time?

120. (RAM) In the last 15 days, did you have any problem or discomfort you think were caused by the medicine you take?

(1) Yes

(2) No

(99) Do not know/remember

121. (ROT) Do schedules, side effects, or the way you take your medicine interfere somehow in your rotine (work or daily activities)?

(1) Yes

(2) No

(99) Do not know/remember

122. (OR1) When medicine is prescripted, does the doctor or dentist guide you about its use?

(1) Yes

(2) No

(99) Do not know/remember

123. (OR2) Does any other health agent (chemist, nurse, nursing thecnician, community health agent) talk to you about the right way to take the medicine?

(1) Yes

(2) No

(99) Do not know/remember

I WILL ASK YOU SOME QUESTIONS ABOUT THE WAY YOU TAKE YOUR MEDICINE. THEY ONLY REFER TO CONTINUOUS PRESCRIPTION MEDICINE (NO DEADLINE). PLEASE, ANSWER THE QUESTIOS WITH NO WORRIES ABOUT THE RESULT.

124. (ADS3) Do you sometimes have problems remembering to take your medication?

(1) Yes

(2) No

125. (ADS4) Do you sometimes oversight taking your medicine?

(1) Yes

(2) No

126. (ADS5) When you are feeling better, do you sometimes stop taking your medicine?

(1) Yes

(2) No

127. (ADS6) When you are feeling worse, do you stop taking it?

(1) Yes

(2) No

128. (ADS7) Number of "NO" answers of questions 124 to 127: [_____]

129. (ACE1) Did you stop taking medicines because they were missing in the last 15 days?

(1) Yes
(2) No

If **yes**:

129.1. (ACE2) What was the reason the medication was missing?

(1) I couldn't get them from the health service where they are provided
(2) The service where I get them from is far away and/or is not open when I can go to tke them
(3) I haven't got money to buy them
(4) Other

NOW, I WILL NEED TO LIST THE MEDICATION YOU TAKE. PLEASE, BRING ALL THE MEDICATION YOU TAKE DAILY OR THAT YOU HAVE USED EVEN EVENTUALY IN THE LAST 15 DAYS. (PAUSE).

130. Do you have prescription for these products?

(1) Yes
(2) No

If **yes**: Copy the information about he treatment ONLY from the MOST RECENT prescription.

Medicine name:
Dosage:
Treatment duration:
How to take (prescribed actions):
Date:
Doctor stamp (yes/no):
Other information:
( ) Prescription with readability problems

REPORT THE MEDICINE IN THE FILE BELOW

BLOCK 7 – MEASUREMENTS

131. Assess the second measure of BP _____/_____
132. Weight (kg):_____
133. Height (m): _____
134. Waist circumference (cm): _____
135. Hip circumference (cm): _____
136. In case of the first and the second measure of BP being divergent, asses the third measure of BP: _____/_____
DATE OF EXAM'S COLECTION: ___/___/___ Hour:_____ : _____

ATTACH B – Approval by the Research Ethics Committee Involving Humans (LOCH, 2013) – State University of Londrina

Universidade Estadual de Londrina

COMITÊ DE ÉTICA EM PESQUISA

COMITÊ DE ÉTICA EM PESQUISA ENVOLVENDO SERES HUMANOS
Universidade Estadual de Londrina/ Hospital Universitário Regional Norte do Paraná
Registro CONEP 268

Parecer de Aprovação Nº 236/10 **CAAE Nº 0192.0.268.000-10** **FOLHA DE ROSTO Nº 368859**	Londrina, 19 de outubro de 2010.

PESQUISADOR: **REGINA KAZUE TANNO DE SOUZA**

CCS/DEPARTAMENTO DE SAÚDE COLETIVA

Prezada Senhora:

O **"Comitê de Ética em Pesquisa Envolvendo Seres Humanos da Universidade Estadual de Londrina/ Hospital Universitário Regional Norte do Paraná"** (Registro CONEP 268)– de acordo com as orientações da Resolução 196/96 do Conselho Nacional de Saúde/MS e Resoluções Complementares, avaliou o projeto:

"DOENÇAS CARDIOVASCULARES NO ESTADO DO PARANÁ: MORTALIDADE, PERFIL DE RISCO, TERAPIA MEDICAMENTOSA E COMPLICAÇÕES."

Situação do Projeto: **APROVADO**

Informamos que deverá ser comunicada, por escrito, qualquer modificação que ocorra no desenvolvimento da pesquisa, bem como deverá apresentar ao CEP/UEL relatório final da pesquisa.

Atenciosamente,

Profª. Dra. Alexandrina Aparecida Maciel
Coordenadora
Comitê de Ética em Pesquisa - CEP/UEL