# ID 1359 | THE RIGHT PATH TO HEALTH: THE WALKABILITY OF A EUROPEAN MEDIUM SIZED CITY CALLED GUIMARÃES

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**ABSTRACT:** The relationship between the act of walking and city space has been over the years object of numerous approaches both by academics and researchers. Nowadays there is an increase in empirical research, above all from areas such as public health, urban planning and transportation, that results from the application of measurement instruments both of the built environment (BE) and of walking, understood here as a form of physical activity (PA) with recognised benefits for health. The exploration of the BE-PA relationship is based on validated instruments that seek to clarify this equation. Developed in countries like USA, Canada or Australia these are less common in the European context. This paper intends to demonstrate that the combined use of information resulting from spatial audits and population surveys are important tools in the planning of proximity of medium sized cities like the case study, Guimarães, thus incorporating the human dimension in the planning process as advocated by Jan Gehl. The measurement instruments developed in recent years are diversified, containing objective and subjective measures. This research was based on the following BE audit tools: the Systematic Pedestrian and Cycling Environmental Scan; the Analytic Audit Tool; the Irvine-Minnesota Inventory; the Measurement Instrument for Urban Design Qualities; the Pedestrian Environment Data Scan; and the Microscale Audit of Pedestrian Streetscapes; incorporating too, the urban elements referred by Gehl. Despite the study aim focus on the development and confirmation of objective measures, two subjective tools were observed: the Neighborhood Environment Walkability Scale because is the most used internationally; and the Assessing Levels of Physical Activity for being that developed for the evaluation of environments for PA in Europe. In these studies, PA is usually measured using internationally validated questionnaires, such as the International Physical Activity Questionnaire (IPAQ). Thus, after identifying the city areas according to their degree of walkability, assessment tools of the variables to be explored were applied. So, a new audit tool was developed having as reference the above mentioned ones, Gehl theories, and the urban context found. With regards the inhabitants survey, PA evaluation questions were based on IPAQ, being reformulated to better understanding by respondents. Given the relatively small scale of the city of Guimarães respondents were asked to indicate on a map appended to the survey the routes they made to six utilitarian destinations and six leisure destinations in order to assess both transportation and leisure walking. The routes made by the subjects were mapped and correct destinations identified, being that, their features were evaluated according to the items of the developed audit tool. The assessments were made using CAD surveys, orthophotomaps, Google Street View and by direct observation through site visits. The developed audit tool presents itself as an instrument that can be easily replicated in similar contexts. Data collected allow the analysis of the correlation between spatial variables, reported walking levels and health indicators, thus identifying the elements that have the greatest relevance in this equation.

**KEYWORDS:** built environment; physical activity; health; spatial audit tool; inhabitant survey.

## 1 INTRODUCTION

Population's health has been from long an important issue for urban planners. Since epidemiological evidences relating sedentary lifestyles with an increase in non-communicable diseases, i.e. chronic diseases, appeared in the 70's and 80's of the 20th century, that physical activity (PA) and its relationship with the built environment (BE) has become a subject for different areas of knowledge such as, urban planning, transportation, public health or exercise science and physical activity (Sallis et al. 2004).

Walking, being a moderate form of PA, can help tackle one of the most burdensome problems in today's society if included in people's daily activities. So, in recent years, and informed by the BE-PA research, the walking environment has regained interest, walkability research became pertinent and urban design theories have been enlightened by scientific evidences. So, measurement instruments of both walking and

the BE appeared as valuable tools of evidence-based urban planning and, to some extent, determinant means of a conscious city healthy plan.

One of the European countries were physical inactivity is more worrisome is Portugal; 64% of Portuguese never exercise and 55% who said that had walked for at least 10 continuous minutes in the last 7 days reported having walked in total 30 minutes or less (EC, 2014). Thus, a high percentage of the Portuguese population do not accomplish the recommended levels of daily PA. Despite that, a huge effort has been made in the last decades by Portuguese municipalities to improve walkability conditions in urban areas. So, it is relevant to understand if, to higher levels of urban quality and walkability conditions correspond, better health behaviours.

In what regards the case study, it is important to know if a municipality like Guimarães, recognised as an example of good urban design practices, shows an increase in the overall walking habits and consequently in the health of its inhabitants. Therefore, this paper refers to an evidence-based research carried out in this social and urban context where, to measure PA levels and BE influences, multidisciplinary assessment methods were developed. Its main objective is to clarify what are the most relevant elements of the BE that affect PA levels, if the macro-scale features, as has been recognise in the literature, or, if instead, the streetscape elements appear as having more weight. Being its main purpose to produce evidences that inform the design and planning of healthy urban environments.

## 2 BACKGROUND

Assessment methods of BE and PA are important instruments on the planning process of healthy urban environments. The most commonly used instruments are those derived from subjective evaluations either from BE or from PA assessed by questionnaires. Objective measures of the BE, can be derived from spatial audits or result from the insertion of large amounts of data (e.g. census data) into Geographic Information Systems (GIS) (Brownson et al. 2009); whereas those from PA, come from detailed measures from pedometer, accelerometer, among others, being GPS also used to relate behaviour with environment, being sometimes, the information collected, also inserted into GIS.

Subjective assessed BE elements can range from land-use-mix or aesthetic to safety from crime and traffic (Brownson et al. 2009). Objectively assessed features inserted in GIS are mainly the three components of walkability indexes or the 3D's, density, diversity and design, that is residential density, land-use-mix and street connectivity, being distance to transit and destination accessibility less frequent (Cervero and Kockelman, 1997; Ewing and Cervero, 2010). Also considered as objective are the ones resulting from spatial audits, despite that, some of them, depend on individual evaluations from the technicians that perform the audit, being considered as subjective, like e.g. the feeling of safety or the pleasurable character of the environment towards walking (Brownson et al. 2009). The most common audited elements are those from the streetscape like, number of elements of street furniture, trees and lightening, land uses (i.e. commercial, residential), sidewalk coverage, street maintenance, existence of public spaces and recreational facilities, safety from traffic and crime, architecture and aesthetic appeal, among others (Brownson et al. 2009). Less measured are e.g. the numbers of people per street segment, level of noise, existence of dogs nearby, among others (Brownson et al. 2009).

There are several international validated instruments to assess the BE for PA. Those that are subjective are e.g. the Neighborhood Environment Walkability Scale (NEWS) (Saelens et al. 2003) or the Assessing Levels of Physical Activity (ALPHA) (Spittaels et al. 2009). Instruments that objectively assess the BE can be, at a larger scale, the GIS, and at a smaller scale, several audit tools as e.g.: the Systematic Pedestrian and Cycling Environmental Scan (SPACES) (Pikora et al. 2002); the Analytic Audit Tool (AAT) (Brownson et al. 2004); the most long the Irvine-Minnesota Inventory (IMI) (Boarnet et al. 2006); the one that attributes greater importance to the perceptual qualities of urban design the Measurement Instrument for Urban Design Qualities (MIUDQ) (Ewing et al. 2006); the pragmatic Pedestrian Environment Data Scan (PEDS) (Clifton et al. 2006); and the most recent and the one that embodies critically the features of the precedents the Microscale Audit of Pedestrian Streetscapes (MAPS) (Millstein et al. 2013).

In these studies, PA is usually classified by different domains, like: transportation walking, leisure walking or total walking; transportation cycling, leisure cycling or total cycling; active transportation (AT), being considered as walking and cycling for transportation; Moderate-to-Vigorous Physical Activity (MVPA);

Leisure-Time Physical Activity, among others. The International Physical Activity Questionnaire (IPAQ) (Booth, 2000) is one of the most used assessment documents for the PA internationally.

More recently, also in use, are mobile phones apps. These tools allow to geo-reference in space and in real-time PA. Access to social networking platforms like those from e.g. MapMyRun (Adlakha et al. 2014) or MapMyFitness (Hirsch et al. 2014) are also important tools, these provide large amounts of information on PA habits, permitting to revise the behaviour and relate it to the physical context. Another tool in use is the SenseCam, this is a wearable camera that each individual can transport, which permits to collect and contextualise e.g. AT of subjects (Oliver et al. 2013). Although these tools present considerable advantages, there is still a lot of difficulties in analysing the large amounts of data resulting from this kind of approaches.

GIS assessments rely on data previously collected and audits are made by in loco assessment or through Google Street View, since this has been validated as a reliable instrument for auditing streets environments (Rundle et al. 2011). Subjective assessments either from the BE or from PA are made by online, mail, telephone or face-to-face interviews. The use, in a study, of tools that generate objective measures of the BE and subjective measures of PA, has been considered as the ones that produce statistically the stronger associations, this is due to the fact that, when the BE is measured objectively less assessment errors are made, and when the PA is reported its different domains are better dissociated from each other (Ding et al. 2011). This is the case of the study here presented.

## 3 METHODS

First, we computed a GIS walkability map (developed elsewhere) to assess the macro-scale urban features (i.e. intersection density, slope, residential density, and land-use-mix) of the all county, city centre and centre parishes. The composed map results from the application of the equation: walkability = [(2 x intersection density) + (2 x slope) + (residential density) + (land-use-mix)] / 6. We chose 8 neighbourhoods to be studied, 4 that present a high walkability level and 4 with a low walkability level. Then, through literature search on the instruments that seek to measure the BE for PA and the PA itself, we made a critical analysis of the ones most used internationally, related them to Jan Gehl's urban theories and observed the social and urban context of the case study, to developed two instruments that clarify the reality found and could enlighten the BE-PA relationship at the micro-scale level.

Although this research focus on the development and confirmation of objective measure, two subjective instruments were observed, the NEWS which was developed by Saelens et al. (2003) and the ALPHA build up by Spittaels et al. (2009). The NEWS, because it is the most used internationally and the ALPHA, because it is the one used for evaluations of BEs for PA in the European context.

The NEWS evaluates resident perception regarding the neighbourhood BE related to PA namely: residential density; land-use-mix; access to services; street connectivity; quality and presence of places to walk or cycle; neighbourhood character or aesthetics (i.e. presence of trees, shade, litter, views, interesting things to look at like buildings and natural sights); safety from crime and traffic; and general neighbourhood satisfaction (Saelens et al. 2003).

The ALPHA has a similar structure to the prior, the NEWS, assessing: residential density; access to local facilities; quality and presence of places to walk or cycle; safety from crime and traffic; neighbourhood pleasantness for walk and/or cycle; street connectivity; and home, work and school environment (Spittaels et al. 2009). This tool focus both on the walking but also on the cycling environment which is an activity with more expression in Europe than in the USA, Canada or Australia (where the NEWS is more applied) and has as an advantage the fact that, in addition to neighbourhood assessment, includes the home, school and workplace environment to. These two tools allows to compare results across countries with similar urban morphologies being widely applicable to large sets of population once they rely only on telephone or internet surveys.

As Brownson et al. (2009) stated, audit tools are the most interesting instruments to assess the quality, appearance and sensations of a particular environment, since they rely on direct observation and their results can be easily translated into urban design directives. So, in addition to the subjective instruments referred, the NEWS and the ALPHA, several objective tools were compared, so the most used and

operationalised audit instruments reviewed were the above mentioned ones, the SPACES, the AAT, the IMI, the MIUDQ, the PEDS, and the MAPS. The choice lies in these, because they represent a complete sampling of what it is most used in this research field.

The SPACES was developed having as reference the Australian context and it is organised in four sections: the type of buildings/features; the walking and cycling paths; the street assessment; and the overall assessment (Pikora et al. 2002). It is a short and practical direct observation instrument that was designed to assess the road and its surroundings (Pikora et al. 2002; Lee and Talen, 2014).

The AAT assess land use environment, transportation environment, facilities, aesthetics, signage, and the social environment (Brownson et al. 2004). Including more items than SPACES was however developed to be easily applied in the field, being the average time spent per street segment of around ten minutes (Day, 2007). The AAT is specially adapted to capture information on BE features related to the transportation environment and land uses (Brownson et al. 2004).

The IMI is the most long containing 162 items, which are categorised into different groups: accessibility; pleasurability; perceived safety from traffic; and perceived safety from crime (Day, 2007). It is the most detailed and permits the evaluation of both macro- and micro-scale BE features allowing to assess e.g. the street pattern of an entire area or the detailed scale of a street environment (Lee and Talen, 2014, p.373).

As Lee and Talen (2014) postulate, quantitative measures tend to omit qualitative factors. There is where the MUIDQ audit tool fits. Based upon human behaviour research and on the work of urban design theorists like, Camillo Sitte, Kevin Lynch, Gordon Cullen, Jane Jacobs, Christopher Alexander, Jan Gehl, William H. Whyte, Amos Rapoport and others, the MIUDQ measures the levels of five qualities of space: imageability; visual enclosure; human scale; transparency; and complexity (Ewing et al. 2006). It seeks to measure subjective qualities of spaces through an objective method.

The PEDS was created for the United States reality and is based on the SPACES. The elements that are measured are grouped in the following: environment; pedestrian facility; road attributes; and walking and cycling environment (Clifton et al. 2006). It was developed to measure the physical environments, natural and built, related to walking (Clifton et al. 2006).

The MAPS (Millstein et al. 2013), and because it is more recent, tries to include both the teachings from urban design theories and the scientific evidence resulting from the application of the referred audit tools. It is based on the AAT and it measures: street design; transit stops; sidewalk qualities; street crossing amenities; and features impacting aesthetics (Cain et al. 2014). It was created to fill a gap in the literature, being appropriated to the measurement of the micro-scale features, measures considered as less explored than macro-scale ones. The MAPS include a short version, the MAPS mini version, with only 15 items.

Thus, we have: the identical SPACES and PEDS, easy to apply tools with reduced number of items; the AAT and the MAPS that assess similar features like land uses and transport related elements, being the last constructed having as reference the first; the IMI that includes the major number of items considered as the most complete; and the MIUDQ that seek to quantify the qualitative aspects of the urban design of street environments.

As stated, besides of the critical analyses of the referred audit tools, Jan Gehl's urban theories were also considered in order to compute the new assessment instrument. Jan Gehl in his book, “Cities for People” (2010), says: “A city that invites people to walk must by definition have a reasonably cohesive structure that offers short walking distances, attractive public spaces and a variation of urban functions” (Gehl, 2010, p.6); which can be translated into some parameters like, good density, high street connectivity, being aesthetically appealing and pleasant (i.e. beautiful architecture, presence of public art, existence of interesting urban furniture, having different things to look at, well design details, views, among others) and a mixed land use. Another of his postulates, is the importance given to the human dimension, which to him, is a key element of a good city planning (Gehl, 2010). Thus, the author points as important factors when planning a human scaled urban space, safety, protection, reasonable dimensions, urban furniture and visual quality (Gehl, 2010). Translating this to measurable features we have, traffic and crime safety (i.e. number of traffic signs and number of street lamps), elements that protect from climate conditions like trees and on-street shadings, dimension of different elements, street furniture and aesthetics. The author points also as deterrents of walking small sidewalk width, level of hindrance (i.e. number of elements at the sidewalk that function like opponents, disturbing walking activities), and time spent at crossings (Gehl,

2010, p.91), which were also included in the new audit being the last, measured by the existence or not of a walking sign at crossings. The author further advocates that there is no topic with greater importance to cities life than active, open and lively edges, with buildings that produce short units with many doors and carefully design details at the ground-floor level (Gehl, 2010, p.88). So, from this it can also be taken another lesson which can be included as some measurable feature like: number of doors, percentage of façade with greater transparency, and aesthetics. The author also points as important the number of people observed, level of noise, existence of places to sit and open views (Gehl, 2010). Whereas that in the case study some of the above mentioned features like, crime rate or level of noise were not determinant, and once the city in question does not present high levels of them, being not alarming, these were not included. In what concern the number of people per street, this was not included as one of the features because, it is beyond the scope of the case study here presented. Places to sit and existence of open views were also included. Many other things could be extracted from Jan Gehl's urban lively places theories but, as Zook et al. allege, there is a difference between places and features that support walking and those that lead to a sense of urban liveliness (Zook et al. 2012, p.216).

In addition, the urban context of the place to be studied is of great relevance when constructing a specific audit tool. Guimarães is a city located in the northwest of Continental Portugal that belongs to the Ave region, has an area of 240,955 km2 of which 2,6 km2 are green areas, with a population of about 158 124 inhabitants dispersed by 48 parishes being its population density of 656 inhabitants per km2 (CMG, 2017). The district is characterised by having a small centre and periphery with intense urbanisation and diffuse industrialisation developed along the valleys, road and rail system (Domingues, 2006). Its historical centre has been classified as Cultural Heritage of Humanity in 2001, the city was European Capital of Culture in 2012 and European City of Sport in 2013, because of that, along the years, many improvements in its streets, public spaces and buildings have been made both in the city centre and in the periphery, but in this last area much is still to be done. Thus, the city of Guimarães can be characterised as, having a centre relatively small, with streets and public places of great interest, its spaces can be characterised as presenting human scale, with outskirts with low levels of urban design quality, bad accesses and lack of basic infrastructures like sidewalks. So, the developed audit tool should be able to assess areas with diverse urban qualities, and above all, that are related to the propensity to walk.

Beyond space, the behaviour must be assessed to, in order to relate it with the features of the physical environment. The most commonly used instrument to assess different domains and levels of PA is the IPAQ (Booth, 2000). So, and in what concerns the inhabitant survey, the IPAQ questions were criticised and reformulated to better understanding by subjects. The IPAQ questions that were rewrite were those used to measure transportation walking, leisure walking and MVPA, leisure and work related (for more details on the IPAQ see, telephone and self-administer, long and short version in Booth, 2000). The inhabitant's surveys is also structured to collect information about socio-demographic variables, physical inactivity related diseases, subjects evaluation about Guimarães spaces and its qualities to contain walking, and routes made to six utilitarian and six leisure destinations by having a map appended to the questionnaire form.

## 4 RESULTS

The developed audit instrument, is divided in three parts, street segments, crossings and geographical area, is characterised as being short and practical and widely applicable, has its roots in the most recent audit tools, in the urban design theories and on the context of a specific environment which is typical of settlements from the diffuse urbanisation of the European countries, and its items, disposed by six groups which are, land use, sidewalks, traffic, structures and natural elements, distinctive architecture and public art, physical disqualification, and crossings, are these; 1) percentage of buildings per street segment with active uses at the ground-floor level; 2) percentage of street segment with sidewalk; 3) width of the major part of the sidewalk; 4) percentage of sidewalk damaged per street segment (or that has no sidewalk) 5) percentage of hindrance per street segment (or that has no sidewalk) 6) percentage of street segment that is covered by trees, awnings, or built structures; 7) how many lighting elements are present; 8) how many benches or other places to seat exists (including bus stops benches); 9) how many doors are present; 10) how many elements of urban furniture are present (including planter boxes); 11) what is the average height of buildings in this side of the sidewalk; 12) how many transit stops are present; 13) how many elements of traffic control are there (such as signs, traffic lights, on-street bumps); 14) the street is predominantly of three, two, one, or zero traffic lanes (pedestrian); 15) how many open views do you

observe for each side of the segment; 16) how many public spaces are present (e.g. parks, squares, gardens); 17) how many street trees are present; 18) how many public art elements are present; 19) percentage of distinctive buildings (distinctive, cultural or historical buildings, and landmarks); 20) what is the proportion of street segment that has windows on the ground-floor within a 15 meter of the sidewalk (or the street if there is no sidewalk); 21) what is the percentage of buildings and outdoor spaces that are not well maintained (e.g. presence of vacant lots, abandoned buildings, garbage, graffiti, broken windows, abandoned cars et al.); 22) how many pedestrian walk signals are present; 23) how many crosswalks are present; 24) how many sidewalk ramps are present. There are also seven items that assess the macro level features of the area in which the subjects lives that are: 25) walkability classification; 26) connectivity classification; 27) slope classification; 28) land-use-mix classification; 29) residential density classification; 30) number of street segments by routes; 31) number of crossings by routes. Thus, in total the audit tool has 31 items.

In what regards the inhabitants survey the questions proposed are: 1) do you walk during the week for at least 10 continuous minutes; 2) In the days that you walk, how many days of the week did you walk for transportation purpose (e.g. to do errands, go to work or school, go shopping, …), and how many days of the week do you walk for leisure; 3) how much time did you spent walking for transportation purpose; 4) how much time did you spent walking for leisure purpose; 5) how many days of a week did you practice physical activity or any activity that makes you sweat or increase your heart rate (e.g. playing any sport, dance, take care of the garden, do the housework, carry heavy weights ) for at least 10 continuous minutes (please do not include walking); 6) in the days that you practice those activities how many time did you spent per day; 7) in Guimarães where did you walk most frequently; 8) do you go by foot to any of these destinations. Can you indicate the route that you make on the map; 9) which place do you like the most to walk in Guimarães, and why; 10) do you usually walk in another city, where and why; 11) what is your weight and height; 12) gender; 13) what is your professional status; 14) what is your education level; 15) do you have any of these diseases; 16) what is your age. Attached to the questions listed above the tool has also an appendix, an A3 map of the all city centre and its periphery neighbourhoods (the areas chosen according to their degree of walkability classified as high walkable or low walkable). The possible answers to the above questions are: 1) yes/no; 2) days per week for transport/days per week for leisure; 3) hours and minutes; 4) hours and minutes; 5) days per week; 6) hours and minutes; 7) neighbourhood/city centre/public park/other; 8) multiple answer school/work/supermarket/ grocery store/ market/pharmacy/... and other, and park/square/garden/gymnasium/coffee shop/restaurant/... and other; 9) free answer; 10) free answer; 11) meters/kg; 12)male/female; 13) employed/unemployed/retired/domestic/student; 14) basic/secondary/superior; 15) diabetes/ cardiovascular disease/dyslipidemia/osteoporosis/cancer/depression/other; 16) number of years. Thus, the questionnaire has 16 questions from which, two are open questions and two others are made in order to permit to geo-reference the subject's routes.

The two instruments are useful tools to assess both the BE and PA levels. Data from the two assessment tools allows the statistical analysis of the association between dependent variables (transportation walking, leisure walking, and MVPA) and independent variables e.g. those from the BE. The instruments presented have been applied to the field and the average time spent was of about 10 minutes for each. The spatial audit tool was developed in order that the assessments could be made through the computer, thus saving work time by sparing in loco visits, being possible to make the assessments at any time in any place. The units of analysis are the segment and the crossing, as is the case of the former. The inhabitant's questionnaire was developed to be appropriated to be applied in face-to-face interviews.

## 5 DISCUSSION AND CONCLUSIONS

It is widely accepted in this research field the use of validated instruments, above all, to permit the international comparison of results, but, the assessment tools available were not adaptable to the social and urban reality found. This is due to the fact that the majority of the existent instruments are developed in countries with social context and urban morphologies very different from the ones of the European reality of medium sized cities.

The assessment instruments constructed have their roots in urban design, transportation, urban planning, public health and physical activity research. The one that assess the BE, tries to include the most relevant elements of the walking environment of a medium sized European city. The questionnaire, seek to gather

the most important information on PA habits, behaviours, personal characteristics and opinions, in a quick toll that is easily applicable in a face-to-face interview.

The one that assess the space is influenced, above all, by the MAPS because, being this, the most recent, it contains the teachings of the former. Objectively assess the BE features instead of subjectively as is the case with the NEWS and the ALPHA, it is not so long as the IMI, it is oriented to assess the walking environment not having elements of the cycling one, like is the case of the SPACES and PEDS, because this behaviour does not have greater expression in Guimarães, it was attributed more relevance to aesthetic features than in the case of the AAT, it include some of the features that compose the MIUDQ, like percentage of ground-floor transparency, without including it in a subjective class or group, and does not include so few information like the MAPS mini version, or so many, like the case of the full version of the MAPS, allowing to develop a research without having to have a very large sample of subjects to make the statistical analysis possible and strong. Thus, the developed audit tool must meet the criterion of a short instrument in order to be possible to statistically analyse a sample of subjects not too big. The questionnaire critically evaluates the most used PA assessment tool, the IPAQ, proposing new and more easily to understand questions, assessing to, personal characteristics, behaviours, and opinions.

As the main purpose of the study is to assess the macro- and micro-scale features that affect PA levels, and as previously a walkability map was constructed and the macro features were already evaluated, the spatial audit tool proposed is ideal to assess the micro-scale elements of the streetscape. Thus, this is composed by elements of the previous audit tools referred, from some resulting from Gehl's urban theories and from the analysis of the urban context found. We search to gather in one small tool the fundamental elements of the street environment, adapting it to the urban reality of the European medium sized cities, that is why e.g. some urban forms, typical from North America, like the cul-de-sac are not present, as is the case of the MAPS.

We search to construct a small tool that includes items that can be easily assessed through the combined use of instruments like CAD surveys, orthophotomaps, and Google Street View, so it could be easily applicable. Thus, the developed audit tool is widely applicable and relevant, being small and practical in what to the field work might concern. The inhabitants survey allows the statistical analyses of the expected associations of BE and socio-demographic variables as well as those related to health i.e. PA levels, BMI and reported diseases. Thus, walkability was measured at different scales and its results were compared with behaviour and health outcomes. Through this analysis we can highlight what are the most relevant BE features of healthy urban environments if the macro- or the micro-scale as Cain et al. (2014) advocate. For a better and faster application, a tablet version with an interactive map should be developed.

Assessment methods of BE-PA equation are relevant instruments to the planning process of healthy urban places, through the developed audit tool and questionnaire we can assess the most important micro-scale urban features and related them with macro-scale ones, the behaviour and health of an entire population.

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# ID 1385 | ASSESSING SPATIAL ACCESSIBILITY OF PHYSICAL FITNESS FACILITIES FOR OLDER ADULTS IN WINTER CITY: A CASE STUDY IN HARBIN, CHINA

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## 1 INTRODUCTION

The spatial distribution of public amenities and the spatial access to them has been a constant focus in geographical research for decades(Smoyer-Tomic et al., 2004). The government of China recognize the significance meaning of public health, the outline of the national fitness programme (2011-2015) (General Administration of Sport of China, 2011) was proposed. During the 5 years from 2011 to 2015, enormous Chinese citizen took participate in daily physical activities, however the quantity of space for physical activities always cannot meet citizen's needs. Accessibility to physical fitness facilities have received a growing attention as a public health concern in China.

There is another fact that the aging has become a more and more serious global society issue, the relevant research has pointed out that China's population of older adults might constitute a larger proportion than youngsters. They estimated that the 60-64yrs group will become the largest portion of population in 2050 and the 60 age and older might be the highest proportion of population in 2100(Banister et al., 2010, as cited in Zhang et al., 2012) . According to the national fitness report of China (General Administration of Sport of China, 2013), the aging group is the prime group who take participate in daily physical activities. Research has shown that adequate physical activities can be beneficial to older adults' health and relevant results have already showed that regular physical activity could reduce hospital admission and the mortality in chronic obstructive pulmonary disease to a certain degree(Garcia-Aymerich et al., 2006). In order to keep both mentally and physically health, it is important for older adults to do daily physical activities properly. For those older adults who live in winter cities, long and extreme cold temperature poses a major barrier to participate in daily physical activities. Poor accessibility to physical fitness facilities may lead to the decrease of frequency for older adults in winter cities. Considering this situation, the accessibility to physical fitness facilities may play an important role to keep good health of older adults in winter cities in both developing country and developed country.

Zhou et al. (2008) summarized that "spatial accessibility is a vital index in the relevant research on healthcare(Wang & Luo, 2005), job access(Wang, 2001; Wang & Monor, 2003),transport(Pooler, 1995), location analysis(Ying et al., 2006) and so on". However, there is a limitation on research related to spatial disparities by taking older adults as subjects in winter cities.