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The mobility for the elderly population encompasses different dimensions of urban life including housing, transportation, work-related activities and social interactions. The initiatives for the elderly are mainly undertaken in the areas of health while in reality, this is only a part of the overall picture that might be considered while planning urban accessibility strategies.

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Elderly Mobility

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Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.tema.unina.it
e-mail: redazione.tema@unina.it

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TeMA Journal of Land Use, Mobility and Environment

EDITORIAL PREFACE

Special Issue 2.2018

Elderly Mobility

Massimo Bricocoli[a], Aleid E. Brouwer[b], Carmela Gargiulo[c]

[a] Department of Architecture and UrbanStudies (DAStU), Politecnico di Milano
e-mail: massimo.bricocoli@polimi.it

[b] Department of Economic Geography, Faculty of Spatial Sciences, University of Groningen
e-mail: a.e.brouwer@rug.nl

[c] Department of Civil, Architectural and Environmental Engineering (Dicea), University of Naples Federico II
e-mail: gargiulo@unina.it

This Special Issue of TeMA Journal of Land Use, Mobility and Environment collects the research works of one of the sessions organised in the framework of the XX Scientific Meeting of the Società Italiana degli Economisti dei Trasporti e della Logistica (SIET), focused on the MOBILAGE (Mobility and aging: daily life and welfare supportive networks at the neighbourhood level) research project financed by Fondazione Cariplo within the "Aging and social research: people, places and relations" 2017 Call for scientific research. The session was addressed to investigate elderly (people aged 65+) mobility, by exploring the supply and demand of Local Public Transport (LPT) in urban areas.

The progressive ageing of population, particularly in developed economies (Myles, 2002; Groueff, 2015), is one of the issues that cities have to face nowadays and in the next years, according to the world urban population projections. In fact, improvements in nutrition, sanitation and medical care have increased life expectancy to a level never experienced by previous generations (Oeppen & Vaypel, 2002; Pugliese, 2011).

It is estimated that, taking into account the 28 member states, in 2030 the European Union will have more people aged 65-79 years than aged 0-14 years. Moreover, in 20 years, the percentage of people over 80 years old – the so-called "oldest old" – will almost double. In particular, by 2030, Italy is projected to have the second oldest population in the world, after Japan (UN/DESA, 2015). In addition to an increasingly older population, Italy has a total fertility rate of 1.39 children per woman, considerably below the replacement level of 2.1 children per woman. Despite being recognized as a crucial issue of urban policies (OECD, 2015) and a central axis of investigation since it encompasses different dimensions of urban life, there is still limited knowledge regarding the relationship between the (physical and functional) organization of urban systems and how older people experience the city (Smith 2009; Altunkas et al., 2017). Studies related to the improvement of urban accessibility to open and built spaces and to activities of interest for elderly seem not to catch the attention of the scientific debate, compared to the other lines of research mainly focused on the

benefits of an active ageing in terms of health and mobility options. In particular, mobility promotes healthy ageing by providing opportunities for physical activity and movement whereas sedentary lifestyles, particularly at older age, increase many of the risks commonly associated with ageing (Masoumi & Shaygan, 2016; McPhee et al., 2016), thus increasing the healthcare expenditure.

According to Banister and Bowling (2004), mobility (travel) seems to form one important element in quality of life for the elderly, but the standard transport representations in terms of trips made, travel distance and transport mode only represents part of the picture. There have been substantial increases in travel by the elderly and their range of activity involvement is very varied. Banister and Bowling (2004), states that mobility, locality and social networks influence perceptions of quality of life, and their study shoes that the perceptions of what constitutes quality of life for the elderly can be reconstructed in terms of six main 'building blocks':

- peoples' standards of social comparison and expectations of life;
- a sense of optimism and belief that "all will be well in the end";
- having good health and physical functioning;
- engaging in a large number of social activities and feeling supported;
- living in a neighbourhood with good community facilities and services (including transport);
- feeling safe in one's neighbourhood.

These factors seemed to contribute far more to the perceived quality of life than indicators of material circumstance, such as actual levels of income, education, home ownership or social class (Bowling et al., 2002). As the paper of the two authors has underlined, transport is important in terms of getting access to local services and facilities (building block 5), and in engaging in social activities (building block 4). The transport elements are reinforced by the importance of locality, neighbourhood and social networks (building blocks 4 - 6).

Nevertheless, both in the academic and urban governance field elderly are often depicted as fragile, lonely and marginalized: "they are usually mentioned in terms of numbers, but the analyses rarely result in concrete proposals and measures" (Gargiulo et al., 2018). In the absence of scientific evidence and knowledge of each specific context, these descriptions resemble pretty much myths and misconceptions (Rosenbloom, 1988). The risk is that these myths can confound the understanding of what the real needs of the elderly are. Moreover, these myths and misconceptions can mask actual fallacies of the transportation system by attributing, for example, a lack of accessibility to an inherent frailty of older users. Another element to take into account is that of time. People, who would have been included in a study on elderly 10 or 20 years ago, are not the same who are turning 'old' today – taking 65 years as the commonly used threshold for define g old age. In fact, those turning 'old' today and in the next years are the so called 'baby-boomers', which belong to the generation born right after the Second World War. Baby-boomers have benefited from many technological improvements developed during the last few decades. They are certainly healthier than the generation of their parents (Lubitz et al., 2003) and much more conversant with the use of technological devices. The other main feature is that baby-boomers are much attached to the use of private car, as they are the first generation who has fully experienced modern mobility based on a regular use of private automobile, and they are likely to retain this characteristic in the future (Burlando & Cusano, 2014; Berg et al, 2015). Therefore, effective public interventions have to take into account what are the socio-demographic characteristics of elderly people, where do they live and how they interact with their

physical and social environment (Bricocoli & Marchigiani, 2012) – including how they move in space and what are their preferences in terms of transportation.

Within this context, the research project MOBILAGE (Mobility and aging: daily life and welfare supportive networks at the neighbourhood level) aims at filling some literature gaps. First by developing an empirical research on elderly in Italy (municipality of Milan), exploring the supply and demand of LPT, and of welfare and community services, an issue that has been largely neglected in the academic literature, and in the Policy debate. Second, by carrying out the analysis at neighbourhood level because "space matters" and elderly behave differently according to the place they reside in. Third, by investigating the role of mobility in improving the elderly's quality of life. Finally, the fourth issue concerns the definition of some "types" of elderly, showing different needs, mainly referring to travel behavior, and use of welfare services and community welfare.

MOBILAGE aims to develop new forms of governance for the urban accessibility of the elderly by defining decision support tool to public administrations to improve the urban accessibility of the elderly to the activities and services of their interest, thus contributing to increase their quality of life.

For this purpose, the main aims of each research unit are defined as follows:

- the team of the university of Groningen will coordinate the literature review, combing strand of literature on mobility issues and the use of public transports, the effect of ageing on mobility and the well-being effects related with ageing and mobility. The literature review will serve as a theoretical basis for the different empirical studies to be executed in Milan and Napels. The university of Groningen will also assist in the empirical research done with GIS Trackers, in which the university holds substantial experience. The respondents (elderly Italian) will be tracked for a period of time - specific time has to be decided on, depending on new insights gained in the different steps of the MOBILAGE process. The trackers will be worn on the body of the respondents for that period and all movement is recorded by GIS software, hence providing insights in daily mobility patterns and modal split of these elder Italians. The GIS data can be combined with personal characteristics, neighborhood characteristics GIS data and for example data on weather conditions and the like. This will allow us to gain in depth insight in mobility pattern of elderly people. Furthermore, we will conduct in depth interviews with the respondents before and after the tracking period, in order to clarify any fuzziness that might appear from the trackers. The mixed methods will consist of in-depth interviews, diary analysis and multivariate spatial regressions;
- the team of the University of Milan will define the profile and needs of elderly by direct survey spur from the interaction with some elderly associations. The survey is composed by seven main sections: (a) socio-economic data, demographic data, health status and physical functioning; (b) elderly social networks and social activities; c) travel behavior; (d) demand of LPT services; evaluation of the LPT service: strengths and weaknesses; (e) demand of the welfare services and community welfare: strengths and weaknesses; f) neighborhood where they reside: strengths and weaknesses; g) factors that mainly contribute to their (perceived) quality of life. The results will allow to: (i) identify the main types of elderly according to socio-economic and demographic characteristics, their health status, physical functioning, mobility patterns and propensity, social networks and social activities, etc.; (ii) investigate barriers, and obstacles old people face in their daily life; (iii) identify the demand for transport and welfare services, distinguishing bottom up practices of elderly residents; (iv) define which main patterns (i.e. elderly types, and neighborhoods' characteristics) play a role in shaping the perception of the elders' quality of life;

- the team of the University of Naples will define a methodology for classifying the different types of urban fabric, given the different levels of accessibility for the elderly people. The overlapping of the areas of influence of the many activities of interest and the "density" and distribution of these types of services, on the one hand, and the presence of protected pedestrian paths and local public transport stops, on the other, will allow to identify which portions of the area investigated are more adequately meeting the demand of the elderly segment of the population and which ones, instead, lack in physical and/or functional supply, also taking into account the morphology of the area. The team will also coordinate the activities to develop a GIS based supply-demand tool for ageing social service to help policy makers to identify the optimal location of new welfare services and/or the improvement of existing ones. The use of GIS platform will allow to provide a geographical distribution of the supply-demand relationship and accessibility to the welfare services in the study area of Milan. Starting from the analysis of the current situation, it will be possible to simulate different scenarios of intervention in order to identify the one that provides the best balance between supply and demand, in terms of cost-benefit. In particular, this GIS tool will be used by the local authorities to evaluate the effectiveness of different actions to improve quality of life of older people (i.e. locating and designing new places where elderly socialize, enhancing local mobility network).

Based on the contributions of scholars coming from different disciplinary backgrounds, the session allowed defining the state of the art on the issues concerned with policies aimed at "aging in place" with a focus on the implications in terms of related mobility issues and on the supply and demand of welfare services and community welfare.

In detail, the first paper "Mobility and accessibility of the ageing society defining profiles of the elderly population and neighbourhoods" intends to consider how to define profiles of ageing mobilities, discussing a methodology for detecting different elderly populations and neighbourhoods.

The second paper "Smart Mobility and elderly people. Can ICTs make the city more accessible for everybody?" pursues three main aims: (i) exploring the actions that can be implemented to ensure better accessibility for the elderly in urban areas; (ii) identifying the actions that should be taken into account to improve the elderly accessibility, through the study of some European projects ICTs based; (iii) analysing how Italian cities are declining the topic of Smart Mobility, with particular attention to the use of new technologies to improve the elderly trips.

The third paper "Growing old and keeping mobile in Italy. Active ageing and the importance of urban mobility planning strategies" seeks to investigate the connection between ageing and urban mobility planning in Italy through the reading of different statistical reports and strategic documents.

Then, the paper titled "Accessibility for the elderly in urban areas: a set of variables" proposes a set of variables that allow to define the offer in terms of urban accessibility (physical, functional and environmental subsystems) and the demand of the elderly population (socio-economic subsystem).

The paper "The tourist-religious mobility of the "silver-haired people": the case of Pietrelcina" proposes a reconfiguration of the territorial organization in order to prefigure a systemic territorial-supply aimed at improving particularly accessibility referred to older slow tourism, meant as an innovative form of territorial use.

The next paper "Measuring spatial accessibility for elderly. An application to subway stations in Milan" presents a method for mapping and measuring accessibility to subway stations for elderly, in order to identify the neighborhoods that present more accessibility problems.

The paper "Is Milan a city for elderly? Mobility for aging in place", investigated 11 Milanese neighbourhoods through face-to-face interviews addressed to a sample of 129 elderly to see how elderly perceive their neighbourhood in terms of mobility.

The paper titled "Measuring Urban Accessibility of Elderly People. An Application at the City of Naples" is to develop a GIS-based procedure to analyses urban accessibility of elderly people to support specific future planning strategies to improve quality of life of older people, considering the characteristics of local transport services and urban structure. For the quantitative validation, the developed GIS-based procedure is applied at the city of Naples selecting the municipality bus transport network.

Finally, the article "Key characteristics of an age-friendly neighbourhood" reviews and critically analyze the literature on the contribution between key characteristics of the neighbourhood that improve the outdoor mobility of old adults, quality of life and well-being in a number of countries all around the worlds. It also aimed to identify gaps in the level of scientific knowledge about this subject.

We thank to everyone who has contributed to draw up the MOBILAGE draft and who are involved in its development. We thank in particolar our colleagues Ilaria Mariotti, Fulvia Pinto and Floriana Zucaro who provided insight and expertise that have been assisting the research.

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MOBILITY AND ACCESSIBILITY OF THE AGEING SOCIETY

DEFINING PROFILES OF THE ELDERLY POPULATION AND NEIGHBOURHOODS

MINA AKHAVAN, GIOVANNI VECCHIO

Department of Architecture and Urban Studies,
Politecnico di Milano
e-mail: mina.akhavan@polimi.it; giovanni.vecchio@polimi.it
URL: http://www.dastu.polimi.it

ABSTRACT

A large body of literature already explores how mobility is associate with the well-being and quality of life in elderly people. However, many studies so far have been widely discipline specific. This paper aims, thus, to critically review relevant mobility- and accessibility-related studies that, from different disciplines, focus on the well-being of the older adults. To do so, the Capabilities Approach is assumed as a theoretical perspective able to convey how individual well-being is differently shaped and experienced by each person. More specifically, this study intends to consider how to define profiles of ageing mobilities, discussing a methodology for detecting different elderly populations and neighbourhoods. The relationship between urban mobility and quality of life in fact differs according to the examined populations and settings, involving features that are peculiar of the elderly. The possibility to define profiles contributes to develop different "narratives of ageing" that, according to this group of population and their territorial context, allows a more precise understanding of how varied forms of mobility contribute to a differently defined well-being and quality of life. The expected outcomes of this study are twofold: (i) to provide a theoretical framework with the complexity of factors in mobility, in order to be applied in future empirical research studies, as a basis for further analyses with quantitative and qualitative methods; and (ii) to introduce a methodology for defining profiles of ageing mobilities, considering elements that may be differently inflected according to the setting taken into exam.

KEYWORDS

Ageing population; Mobility and Accessibility; Profiles of the Older Adults; Well-Being and Quality of Life

1 INTRODUCTION

Everyday urban mobility is increasingly discussed as a fundamental contributor to individuals' well-being and quality of life (hereinafter QoL). A growing literature deals with varied forms of mobility and their manifold consequences on individuals and societies. Mobility in fact is a differentiated capacity to be mobile, differently available to each person depending on one's own individual, social and spatial characteristics (Flamm & Kaufmann, 2006; Kaufmann, 2002; Kaufmann et al., 2004). Each person may differently use or not this capacity, depending on his/her personal needs and wants (Ferreira et al., 2017). However, in contemporary societies "the need to be mobile, at least virtually, has become incorporated in people's lives" (Kellerman, 2012), particularly for reaching those goods, services, places and people that may matter to each person (Cass, Shove & Urry, 2005) and are necessary not to be socially excluded (Kenyon et al., 2002; Lucas, 2012; Preston & Rajé, 2007; Stanley & Vella-Brodrick, 2009).

relationship between urban mobility and QoL has been explored in relation to specific urban populations, amongst them the elderlies, which are the focus of this paper. The reason for dealing with ageing populations is at least twofold. On the one hand, particularly in the Western World one of the main issues that many cities of today are facing is the progressive ageing of population: as for the European Region, considering the 28 member states, it is estimated that nearly 25 percent of the population in 2030 will be above 65 (Population Reference Bureau, 2006). On the other hand, travel-related abilities change over one's life and tend to increase with age (Stjernborg et al., 2015), with relevant consequences on the individual well-being.

Consequently, the manifold contribution of mobility to the QoL requires to discuss how mobility and well-being are differently shaped and related to each other in the case of ageing populations. The paper, thus, aims to discuss a conceptual framework for the mobility and the accessibility of the ageing society, by drawing on a critical review of the relevant interdisciplinary literature discussing the mobility of the elderlies and its contribution to their well-being.

In general, well-being is a complex and fuzzy concept: while some studies differentiate between the two terms well-being and QoL, in this paper we use them interchangeably but assume a clear theoretical stance, based on the *Capabilities Approach* (Sen, 1985, 1992, 1999, 2009). The approach in fact assumes well-being as overall aim, but gives a primary space to individuals: it recognizes that individual well-being is differently shaped and experienced by each person, and focuses on "the freedom that a person actually has to do this or be that – things that he or she may value doing or being" (Sen, 2009). More specifically, this study intends to consider how to define profiles of ageing mobilities, discussing a methodology for detecting different elderly populations and neighbourhoods.

Existing frameworks dealing with elderly mobilities in fact tend to privilege different perspectives: the factors determining the ability to move of ageing people (Goins et al., 2015; Umstattd Meyer et al. , 2014; Webber et al., 2010); the contribution of mobility to the well-being of the elderlies (Nordbakke & Schwanen, 2014; Ryan et al., 2015); or the setting of priorities for inclusive transport systems, focusing on ageing, impairments and travels (Martens, 2018). Instead, this study intends to define profiles for developing different 'narratives of ageing' (Bruner, 1999): according to the subjects and their territorial context, these may allow a more precise understanding of how varied forms of mobility contribute to a differently defined well-being and QoL- Furthermore, such narratives may enhance the design of different planning and policy measures contributing to the elderly well-being.

The paper is structured as follows. The methodological discussion moves from a review on relevance of mobility in relation to well-being, to a focus on the ageing population considering the specific opportunities they have in both the place-based and people-based features that impede or enhance their ability to move. Drawing on these elements, profiles of populations and neighbourhoods are discussed. On the one hand, profiles consider a person's mobility (ability to move) and movement (putting this ability into practice), investigating if people can move and how they do so. On the other hand, with relation to neighbourhoods, the profile considers the opportunities they offer (an accessible set of significant opportunities at the local scale) and their mobility provisions (degree of accessibility to the other areas of the city), investigating if people need to move to access opportunities and whether they can do so.

2 MOBILITY AND WELL-BEING: A CONCEPTUAL FRAMEWORK

In general mobility is defined as the ability to travel (Giuliano et al., 2003); the ability to move (independently or using assistance or transportation) from one space to another; from home to the neighbourhood and beyond (Webber et al., 2010). Others provide a more detailed definition of mobility: to be able to travel where and when one desires; to be informed about travel options and how to use them; to be able to use them while having the means to pay for them (Suen & Sen, 2004).

For Flamm and Kaufmann (2006) mobility is concerned with three main factors: (i) *access* (range of conditions under which available options may be used); (ii) *skills* (required in order to plan activities); and (iii) *cognitive appropriation* (the evaluation of the available options vis-à-vis one's projects). Well-being is a complex and fuzzy concept. While some studies differentiate between the two terms well-being and QoL, in this paper we use them interchangeably. Moreover, our focus is on individual well-being and conceptions of well-being at the level of communities, regions and countries are not included. In this study, mobility is assumed as an important element affecting the well-being and QoL of the elderly.

Nevertheless, only a limited number of studies have specifically studies this issue. Among them is the empirical study by Musselwhite and Haddad (2010) in UK, which emphasises the role of mobility and accessibility in the older adult's self-reported QoL and identify their perceptions as needs for accessibility, being independent, and travel for its own sake. Within a wide literature that associates mobility to well-being, QoL and social inclusion (Banister & Bowling, 2004; Nordbakke & Schwanen, 2014; Stanley & Vella-Brodrick, 2009), a capabilities perspective on urban mobility may provide a "more general" (Alkire, 2005), yet more sensitive approach to mobility in terms of its reflections on individuals' freedoms and aspirations; while bringing the gap between objective and subjective approaches to well-being (Gasper, 2007). The Capabilities Approach (CA), introduced by an economist Amartya Sen, in fact conceptualizes one's well-being in terms of his/her "freedom to lead one type of life or another" (Sen, 1992); individual capabilities, defined as the "freedom that a person actually has to do this or be that – things that he or she may value doing or being" (Sen, 2009). Mobility can be thus considered as one of the capabilities available to a person and contributing to her well-being (Beyazit, 2011; Hananel & Berechman, 2016; Nordbakke, 2013; Pereira et al., 2017; Ryan et al., 2015).

However, different are the conceptualisations provided in the literature, so that here a framework based on the shaping and the use of mobility is provided (Vecchio, 2018 for an extended exposition).

The use of mobility is crucial to define the manifold ways in which mobility may contribute or not to the individual well-being. In fact, since different is the use of each capacity, "whether opportunities promote well-being depends on how they are used" (Gasper, 2007). The main contribution is probably given by the instrumental use of mobility, as a way to access activities, values and goods (Cass et al., 2005), achieve a

minimum living standard (Smith et al., 2012), and sustain meaningful relationships (Larsen et al., 2006; Urry, 2007). Mobility could also be valuable in itself: for the travel experiences it allows (Goodman et al., 2014) or the health benefits that some practices may generate (Vale et al., 2016). However, also the voluntary decision not to move when possible may be significant in terms of individual freedom and well-being (Ferreira et al., 2017). Here, mobility was briefly sketched as a capability that contributes to the individual well-being; nonetheless, its composing elements need to be defined in relation to the specific needs and wants of elderly populations.

3 TRAVEL BEHAVIOURS: ELDERLY MOBILITIES AND NEIGHBOURHOODS

While older adults tend to travel more frequently than non-elderly (Paaswell & Edelstein, 1976), the frequency of journeys made by older adults is found to be decreasing with ageing (+60) (Boschmann & Brady, 2013), with walking to appear an exception (Carp, 1971). Determinants of travel behaviours may concern endogenous factors (age and gender) as well as the exogenous ones (socio-economic and contextual features) (Bamberg et al., 2011). Within the more recent and rather scant literature, Schmöcker et al. (2008) have discovered that older adults prefer the modes with more independent mobility, the use of taxis become more frequent with ageing, yet also the positive correlation between accessibility measures (bus stops and rail density) and the use of public transportation.

Underling the importance of improving public transportation for the older adults, Sundling's (2015) study on elderly's travel motives to shift their modes of transport suggest designing services to strengthen the feeling to having control throughout the journey; extended personal service along the trip and making this mode attractive and safe to use.

For the purpose of this paper, people-based and place-based features are referred to as the characteristics that influence the shaping of urban mobility. Whether to focus on improving opportunities for individual or the qualities has long been controversial in urban policy debates (Bolton, 1992), yet some scholars have emphasised the importance of both place- and people-based development policies for a more effective and efficient interventions (Barca et al., 2012).

Several features define both individual mobility and the opportunities that one values, and how to access them: The *people-based characteristics* refer to the subjects who move, while the *place-based features* characterize the urban settings that they differently appropriate through mobility. Such features, widely discussed in the academic literature, are all those characteristics that facilitate or impede mobility, that is, they constitute resources or constraints.

The people-based features that contribute to the shaping of mobility comprise attributes of the individuals: the socio-economic conditions, widely investigated in terms of income and how this allows or not the usage of public transport services or private vehicles (Guzman & Oviedo, 2018); the physical and the cognitive abilities of subjects, two features that are often intertwined – especially in the case of ageing populations (Ryan et al., 2015); the perceptions, related to mobility itself, to the travel experience with specific modal options, or even to one's ability to move, which condition the person's willingness to move (Nordbakke, 2013); and the personal attitudes, including for example one's needs and wants whose pursuit depends also on mobility (Cass et al., 2005).

Instead, place-based features include a number of attributes of the spatial setting under exam:, a number of stable contextual characteristics such as territorial structures, population dynamics, socio-economic trends, and spatial policies (Kaufmann, 2002), which also define the distribution of opportunities (Zali et al., 2016) and, consequently, the structure of trips in one territorial setting; the physical features of spaces that could

result inadequate fir the needs of different groups (Meşhur, 2016); and elements specifically related to mobility, such as transport infrastructures and services. These features are considered mainly as independent variables that define contextual spatial and temporal conditions (Ryan et al., 2015) and influence the overall accessibility of an area (Rashid et al., 2010). Spatial features are relevant in relation to what they mean to people: a good example in this sense are the 'spatialities of ageing', which highlight how "both spaces and old age as a social category co-evolve and are continually being made and remade" (Schwanen et al., 2012).

4 TOWARDS PROFILES OF AGEING MOBILITIES AND NEIGHBOURHOODS

Considering the place-based and people-based features that dynamically define different forms of individual mobility, it is possible to define, accordingly, different profiles of ageing mobilities. Drawing on the elements highlighted in sections 2 and 3, the definition of profiles is an incremental process based on two steps: first, it draws on the conceptualisation of mobility as a *capability*: a differentiated ability that each individual may have or not (defined as *mobility*) and may consequently put into practice or not (referred as *movement*); second, it assumes that the main contribution of mobility to the individual well-being is conveyed by the access to valued opportunities, which could be available or not at the scale of the neighbourhood, or could be reached thanks to the local mobility services.

The definition of profiles, then, considers how the elderly differently shape and use mobility, examining also how the provision of valued opportunities and mobility services is diverse in different typologies of neighbourhoods. The proposed conceptualisation draws on a critical review of the existing literature and intends to valorise two elements.

In relation to ageing populations, it is possible to emphasise the individuals' freedom of choice over alternative lives (Sen, 1990), considering their ability and the consequent decision to move or not in order to reach specific opportunities. In relation to neighbourhoods, profiles privilege an operational dimension since they allow to focus on measures that may addressing the provision of mobility services or valued activities.

The added value of an approach based on capabilities are in fact its operational impacts, which allow to "include indicators such as quality of life and well-being" (Beyazit, 2011). Therefore, "instead of asking about people's satisfactions, or how much in the way of resources they are able to command, we ask, instead, about what they are actually able to do or to be" (Nussbaum, 2000); the proposed profiles intend to enhance the understanding of how mobility contributes to individuals' wellbeing, observing mobility as a differently available capacity that is differently deployed according to the kind of neighbourhood in which ageing populations are living.

Operationally, this implies considering "what can one do with these resources to improve the welfare of individuals, especially the disadvantaged" (Hananel & Berechman, 2016), by proposing "comparative assessments of states of affairs by comparing capabilities or freedoms (inter alia)" (Alkire, 2008). The following subsections outlines these profiles of ageing mobilities and neighbourhoods, showing possible implications for planning and policy approaches.

4.1 PROFILES OF AGEING MOBILITIES

Profiles of ageing mobilities are defined considering the interplay of mobility and movement. Mobility is the ability to move through space and overcome spatial friction, while movement consists of putting mobility into

practice. Several individual features delineate whether an individual can move or not, while his/her personal choice defines if mobility is put into practice (and therefore the subject moves) or not.

In this sense, subjective factors are fundamental for determining different forms of ageing mobilities, in at least three senses: first, these define if the person needs to move or not, according to the opportunities one needs to accomplish her needs and wants; second, these contribute to the assessment of one's capacity to move, according to her physical, cognitive and psychological conditions; third, these determine if the person intends to move or not, determining if a person feels at ease or not when experiencing movement.

The distinction between mobility and movement could be significant for different categories of subjects, but here are considered taking into account the specific features of elderlies and how these may impact their ability to move. Regarding these variables, four profiles are here defined (Fig. 1).

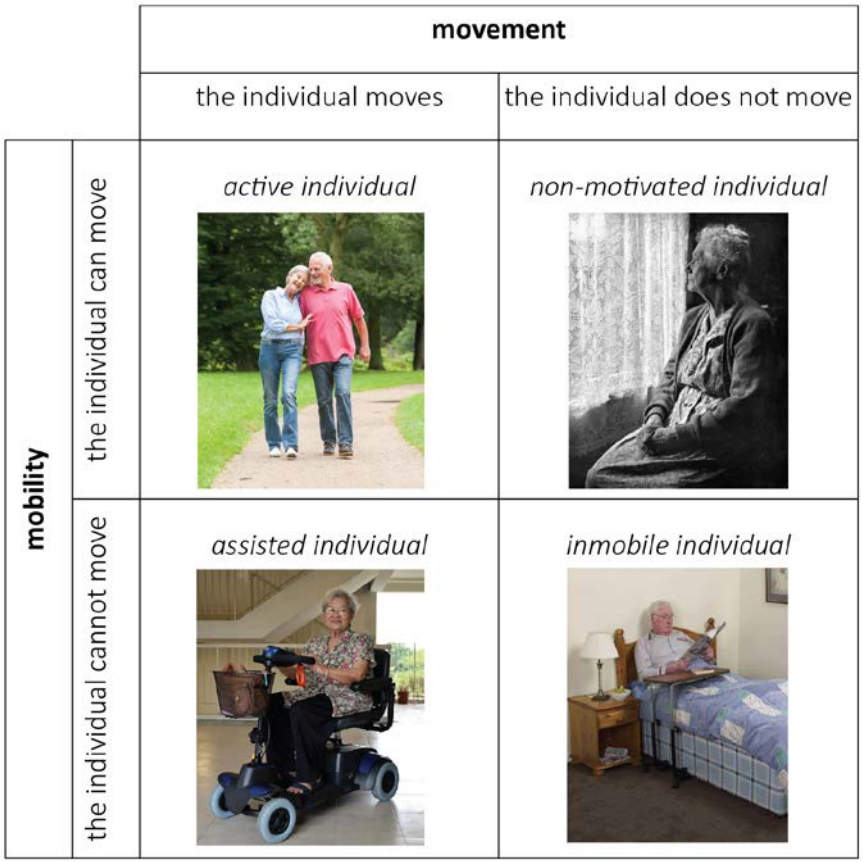

Fig. 1 Four profile of ageing mobilities

Active individuals are those that are able to move and decide to put this ability into practice, to reach the opportunities/ destination they value. This category includes those individuals that can move independently, even if with different degrees of autonomy; and do so they do not rely on human or technological supports.

Assisted individuals are those that are not able to move on their own but nonetheless tend manage to fulfil movement.

While their individual features may not be favourable for their mobility, individuals in this category may rely on different forms of assistance thanks to which they may be able to move through space. Assistance may be provided by other individuals (e.g. people accompanying the elderly) or assistive devices (e.g. wheelchairs or scooters).

Non-motivated individuals are those who do not achieve movement despite having the ability to do so. This category includes individuals who may have the ability for moving but may decide not to do so, due to a personal decision.

Such decision may be explained with personal perceptions (e.g. a person feeling herself as a nuisance for other passengers; Nordbakke, 2013), experiences (e.g. having being involved in accidents such as falls or car crashes; Webber et al., 2010) and even psychological issues (e.g. suffering from depression; Gayman et al., 2008). *Immobile individuals* are those who are not able to move and therefore do not move. Individuals in this group are not able to move from one space to another due to varied individual features: spanning from physical (e.g. disabilities), economic (e.g. lack of economic resources), or psychological constraints. They may also lack forms of assistance that could contribute to overcome their individual inability to move. Independently from the provision of valued opportunities and mobility services in the neighbourhoods in which they live, immobile elderlies experience severe issues in accessing those opportunities that are relevant for them.

4.2 PROFILES OF AGEING NEIGHBOURHOODS

Profiles of ageing neighbourhoods are defined considering the interplay of mobility supply and opportunities. Mobility supply is the set of services and infrastructures that allows to reach a number of surrounding areas (e.g. other neighbourhoods in the same city or surrounding municipalities). Here, mobility supply is generically defined as good or bad.

Opportunities instead are the set of places, activities and services that the elderly population of a neighbourhood has reason to value and is therefore willing to reach. Despite a rich literature on age-friendly neighbourhoods (Buffel et al. , 2012; Lui et al., 2009; Menec et al., 2011; Plouffe & Kalache, 2010), the typologies here defined take into consideration the opportunities valued by ageing populations and the possibilities they have for moving.

In this sense, subjective factors are significant for defining how the features of the neighbourhoods are perceived by elderlies: these refer for example to the availability of local opportunities and their ability to respond to one's needs and wants; to the quality of transport supply, to be perceived as safe and reliable; to the quality of the built environment required to access the transport services (Ewing & Cervero, 2001) and, particularly, to its walkability (Humpel et al., 2002). Considering these aspects, four profiles are outlined as follows (Fig. 2).

Open neighbourhoods are those that offer the opportunities that ageing populations value and also provide good connections to other areas. These are the neighbourhoods that potentially provide the best conditions for elderly well-being: opportunities are easily accessible at the local scale but at the same time it is possible to access relevant activities and services located in other places, increasing thus the range of opportunities available to the elderlies.

Dependent neighbourhoods do not offer valued opportunities, but are well connected to other areas in which relevant activities are present. Their condition configures a dependence from surrounding places: the inhabitants of the neighbourhood need to move beyond their local area if they want to reach significant opportunities, but the available mobility supply allows to easily do so. Mobility is thus crucial to guarantee the well-being of the ageing populations in dependent neighbourhoods.

Self-contained neighbourhoods provide valued opportunities at the local scale, while the available mobility supply does not allow good connections to other areas.

These neighbourhoods allow thus to easily access local opportunities, implying a reduced need for mobility. Nonetheless, the lack of access to other areas potentially reduces the range of reachable opportunities, forcing the local elderly population to participate only in the locally available activities.

Isolated neighbourhoods do not offer valued opportunities nor have the necessary mobility supply for reaching other areas. In terms of elderly well-being these areas are the most critical, since the lack of local activities and services cannot be currently compensated by the possibility to move.

5 DISCUSSION AND CONCLUSION: KEY OUTCOMES AND WAYS FORWARD

This paper has made an attempt to make an overview of the existing literature on mobilities of the ageing society with relation to the notion of well-being and quality of life with the aim (i) to provide a theoretical framework with the complexity of factors in mobility, to be applied in future empirical research studies, in other words as the basis for further analyses with quantitative and qualitative methods; and (ii) to introduce a methodology for defining profiles of ageing mobilities, considering elements that may be differently inflected according to the setting taken into exam.

The profiles presented in the paper are intended as a first methodological contribution to better understand and tackle manifold forms of ageing mobilities and their varied contributions to the elderly's well-being. However, the perspective here chosen is mainly a local one, focusing on the scale of the neighbourhood and how ageing populations experience it; nonetheless, different scales should be examined when considering how mobility contributes to individuals' well-being, since a) the arrangements of land use and transport supply involve different, wider scales and b) the local dimension may receive very different definitions according to the examined setting (e.g. a settlement in a metropolitan area, a village in a rural region). Considering that the definition of profiles depends on the examined setting, the paper discussed the practical issues and limitations related to each category of profiles that can be relevant to better conceptualise the complex relationship between ageing, mobilities and well-being.

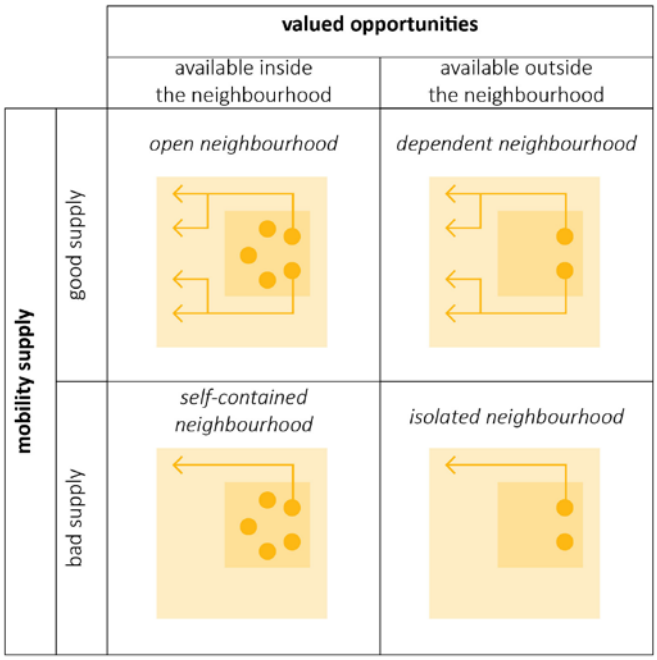

Fig. 2 Four profile of ageing neighbourhoods

Practical issues and limitations of ageing mobility profiles. While the variables here chosen for defining profiles could be significant in different settings, the specific definition of what counts as mobility depends on the examined context as well as on the subjects taken into account.

A first issue concerns what kind of ability to move is taken into consideration. According to the setting, different could be the prevailing modal choices as well as the dominant mobility practices: for example, in the United States cars would have a central role, while in the Netherlands bicycles could be a significant modal alternative. Consequently, different would be the ability to move to be considered when defining if a person can move or not. Furthermore, such ability is not simply present or absent, but could be available with different intensity (Robeyns, 2016). It could be in fact that an individual is able to move despite the presence of some constraints: for example, a person may be able to use public transport but may experience difficulties when entering a bus and another person instead may easily enter it without specific efforts. Therefore, both subjects are able to move but the ability available to them is different. This aspect would suggest the definition of a sufficiency threshold for mobility, that is, defining if people are able to fare well enough in relation to their ability to move. In conclusion, what counts as ability to move and what is a sufficient degree of mobility should be defined according to the setting and the elderly population taken into account.

Practical issues and limitations of ageing neighbourhood profiles. The definition of ageing neighbourhood profiles can usefully draw on the proposed categories, but these simply provide a conceptual framework that needs to be defined according to the examined setting. Both mobility and opportunities in fact are strongly context-related and should be assessed according to specific local features. As for mobility, the definition of what is good supply can take into consideration at least two factors. First, the modal choices that are considered as relevant for reaching valued opportunities depend on the place-based features of the settings and on local habits. Second, crucial are the connections provided by the available mobility supply, for example assuming that a good mobility supply allows to reach a certain number of areas or opportunities within a given travel time. However, even the definition of valued opportunities is not straightforward. First, it requires to consider what set of activities can be significant for the wellbeing of local elderlies, including for example basic services (shops, health care facilities, …) but also other significant destinations (e.g. places of encounter). Second, a sufficiency threshold for such opportunities should be defined, assessing at what conditions people may consider to have access to a certain service or activity.

The definition of neighbourhood profiles depends thus on the interplay of mobility and opportunities, which conjointly determine at what conditions wellbeing is granted at the local level. For example, considering the previously mentioned factors a possible result could be the following description: a neighbourhood would offer valued opportunities if it made available one health care facility, a commercial activity and a place of encounter within a travel time of 15 minutes, to be covered by public transport.

To enhance the contribution of profiles, three actions are necessary: context-based definition of profiles, assessment of significant interplays between profiles, design of relevant policy measures.

As for the definition of profiles, the features that determine them needs to be chosen according to specificities and needs of the examined setting. The previously presented typologies are intended as a tool for orienting analysis, possibly taking into consideration both quantitative and qualitative approaches. For example, quantitative analyses can be significant for determining the number of available opportunities, the mobility supply and the accessibility levels defined by the interaction between these two elements, as well as the characteristics of the elderly population.

Nonetheless, qualitative approaches (such as surveys, interviews and focus groups) are crucial to involve the relevant stakeholders (different ageing populations, policymakers, service providers…) in the definition of relevant opportunities, sufficiency thresholds for their availability, and acceptable travel times, as well as in the construction of the ageing mobilities profiles.

Regarding the assessment of significant interplays between profiles, it is necessary to consider how the interaction between different mobilities and neighbourhoods determines diverse possibilities for accessing valued opportunities. For example, the same assisted individual would experience a different access to opportunities in a dependent or in a self-contained neighbourhood. To the best of our knowledge, the literature on ageing mobilities tends to focus on the analysis of people-based or of place-based features, without devoting significant attention to the interaction between the two. Such aspect seems thus to open a significant direction for further empirical research on the issues of ageing, mobilities and wellbeing. However, from the perspective of urban mobility planning and policy some interactions in particular can be significant. Policymakers in fact can more easily address the needs of those population and places for which interventions on mobility can enhance the current experienced wellbeing. In this sense, it can be more relevant for policymakers to focus on the subjects who do move (that is, active and assisted individuals) and how they differently behave in the four typologies of neighbourhood.

As for the design of relevant policy measures, the interplay between different profiles can be considered, in order to determine the needs of these configurations, and consequently design relevant actions for tackling them. In this sense, the definition of profiles and their detection in place can contribute to the territorialisation and individualisation of policy measures (Bifulco et al., 2008).

Territorialisation refers to the 'positive discrimination' of disadvantaged areas that require priority interventions, while individualisation implies the development of tailored measures for populations in need. While previous studies have highlighted the complex relationship between urban planning policies, mobility and well-being (Tiboni & Rossetti, 2014), we believe that profiles can be the first step towards the definition of policy measures that address the different elderly mobilities and their varied contribution to individual well-being.

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AUTHOR'S PROFILE

Mina Akhavan is currently a Postdoctoral Research Fellow and Adjunct Professor at Politecnico di Milano- Department of Architecture and Urban Studies, where she received a PhD degree in Spatial Planning and Urban Development (2015); a doctoral thesis on port infrastructure development dynamics and their impact on urban development. Her research interests also concern the impact of globalization and logistics network; transnational urbanism; new working spaces; and more recently she has been involved in a research on the mobility of the ageing society.

Giovanni Vecchio is an urban planner and policy designer, currently research fellow at Politecnico di Milano. He received his PhD in Urban Planning, Design and Policy at Politecnico, and he has been visiting scholar in Colombia (Observatorio Urbano, Universidad de La Salle, Bogotá) and the Netherlands (Wageningen University). His research interests focus on urban mobility, individual capabilities, technologies, and community initiatives, working at the crossroad between human and territorial development.

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SMART MOBILITY AND ELDERLY PEOPLE

CAN ICT MAKE THE CITY MORE ACCESSIBLE FOR EVERYBODY?

ROSARIA BATTARRA[a], FLORIANA ZUCARO[b], MARIA ROSA TREMITERRA[b]

[a] Institute of Studies on Mediterranean Societies (ISSM), National Research Council
e-mail: battarra@unina.it
URL: www.issm.cnr.it

[b] Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II
e-mail: floriana.zucaro@unina.it; mariarosa.tremiterra@unina.it
URL: www.tema_lab.unina.it

ABSTRACT

The ageing population is a phenomenon whose relevance grows over time and quickly spreads in different territorial contexts. Therefore, cities will have to take into account the ageing population and define policies and strategies to improve the quality of life. For this purpose is particularly remarkable the transport sector because it allows to use the urban services and to promote an active ageing. Within the field of urban studies aimed at facing the new challenges related to social developments, including that of the ageing population, the Smart City paradigm has been spread to make cities safe, accessible and sustainable. The strategies to improve accessibility and safety of the mobility system using ICTs can have positive impacts in terms of ensuring elderly people the ability to lead an autonomous life and participate actively in society according to one's individual needs. In this framework, the aim of the paper is to analyse how Italian cities are declining the topic of Smart Mobility, with particular attention to the use of new technologies to improve the elderly trips. The paper attempt to show that in the sample of Italian cities analysed the ICTs applied to the transport sector do not fully realize their potential; this is not due to the limited fields of application, but rather to the lack of a "system-orientated" perspective when applying innovations. The adoption of a smart approach cannot be limited to a market-induced uncritical introduction of devices or sensors, instead, it will be necessary to refine the tools for understanding the needs of specific categories of users, such as the elderly, to define integrated strategies able to operate on many aspects simultaneously.

KEYWORDS

Elderly; Smart Mobility; Italian Cities

1 INTRODUCTION

The ageing population is a phenomenon whose relevance grows over time and quickly spreads in different territorial contexts (UN, 2001; Christensen et al., 2009). At the beginning of 2016, in Europe, the percentage of population aged 65 or over was 19% with an increase of 2.4% compared to 10 years before (Eurostat, 2016). TFPAhis trend is common to all EU countries and the percentage of elderly is predicted to grow up to 30% by 2080. The increase in the percentage of elderly people can also be observed in Italy: in 2016 the elderly were 22% of the population and the old age index (ratio of the 65-year-old population or over to the 0-14 age group) was 161. This index, according to ISTAT, is expected to raise to 215 in 20 years (ISTAT, 2017).

Therefore, cities will have to take into account the ageing population and define policies and strategies to improve the quality of life for this specific category of users.

According to the World Health Organization (WHO, 2007) the strategic topics to make an age-friendly city are eight: housing, outdoor spaces and building, transportation, social participation, respect and social inclusion, civic participation and employment, communication and information, community support and health services. Among these, the transport sector is particularly remarkable because it allows to use the urban services, to interact with others and therefore to promote an active ageing, optimizing opportunities for health, participation, and security in order to enhance quality of life as people age (WHO, 2011).

Within the field of urban studies aimed at facing the new challenges related to social developments, including that of the ageing population, the Smart City paradigm has been spread to make cities safe, accessible, sustainable and, at the same time, more cohesive and inclusive (Papa et al., 2015; Papa et al., 2016). Thanks to the application of the Smart City paradigm, solutions have been defining to improve the performance, usability and environmental compatibility of urban services for all city users.

A central issue of this approach is the use of ICT to effectively address some environmental challenges (pollution and energy consumption reduction, etc.) by making urban settlements more sustainable. Furthermore, with the use of ICTs, "smart" solutions can improve not only the performance of urban services for citizens, firms and city users, but also the quality of life and the accessibility to infrastructures (Santinha & de Castro, 2010). All these aspects are included in the model of Smart City (Giffinger et al., 2007), consisting of six dimensions – Environment, Governance, Economy, People, Living and Mobility.

Among the above-mentioned dimensions, many cities are investing in Smart Mobility due to technological advances and the interest of large enterprises in the transport sector. Although there are several meanings and interpretations of the Smart Mobility concept, it can be defined as a network system mainly characterized by connections, both digital and physical, in order to satisfy people's needs; use of appropriate technologies to enhance performance and attractiveness of the mobility system; sustainability to reduce the need of travel and consequently energy consumption and carbon emissions, according to previous studies on this issue (Lam & Head, 2012).

However, the application of ICTs in the Smart Mobility is a useful means both for transcending distance and optimizing traffic fluxes and, at the same time, for collecting citizens' feedback about livability in cities and quality of public transport services (Lyons, 2016; Benevolo et al., 2016). However, if ICTs allow to improve transport efficiency and reduce its impact on the environment, an integrated combination of multiple aspects such as accessibility, safety and ICTs is necessary, in order to take into account the needs of its users, including the elderly ones (Joumard et al., 2010).

The strategies to improve accessibility and safety of the mobility system using ICTs can have positive impacts in terms of ensuring elderly people the ability to lead an autonomous life and participate actively in society according to one's individual needs.

In this framework, the aim of the paper is to analyse how Italian cities are declining the topic of Smart Mobility, with particular attention to the use of new technologies to improve the elderly trips. The study concerns Italian provincial capitals with a population of 100,000 or more inhabitants in 2017.

Through a critical approach and considering that ICT cannot be considered as a solution, the paper pursues three main aims: (i) exploring the actions that can be implemented to ensure better accessibility for the elderly in urban areas; (ii) identifying the actions that should be taken into account to improve the elderly accessibility, through the study of some European projects ICTs based; (iii) analyzing how Italian cities are declining the topic of Smart Mobility, with particular attention to the use of new technologies to improve the elderly trips.

The paper is divided into 4 parts: the first one, through a review of the literature, defines the three components of Smart Mobility for the elderly; the second part analyses the initiatives and the actions that can have positive impacts on the elderly mobility according to the three categories of Smart Mobility (accessibility, safety and ICT); the third one describes the Smart Mobility for the cities surveyed through a set of indicators (extension of the pedestrian areas and cycle paths, car sharing supply, public transport stops, electronic bus stop signs, etc.); the fourth highlights the critical issues to be tackled in order to implement a smart mobility for the elderly.

2 SMART MOBILITY: ACCESSIBILITY, SAFETY AND ICT

It is well known that since the 1990s a new interpretative model has been established for the study of the urban phenomena of the Smart City, which has seen a rapid and pervasive affirmation in recent years worldwide (Mahizhnan, 1999; Caves & Walshok, 1999; Graham & Marvin, 2001; Komninos, 2002).

Among the different features that according to many authors (Giffinger et al., 2007) contribute to the making of smart cities, a relevant role is assigned to mobility: a smart city is also an "accessible" city where – thanks to the use of ICT – solutions to improve the performance, efficiency and environmental compatibility of transport for all city users are adopted.

Similarly to the many heterogeneous definitions of Smart City (Albino et al., 2015; Batty et al., 2012; Caragliu et al., 2011; Mosannenzadeh & Vettorato, 2014; Papa et al., 2015), there are many different approaches and points of view on the subject of mobility that can be deduced from literature.

Many authors have recently highlighted the interrelation and overlap between the concepts of smart and sustainable mobility (Lyons, 2016; van Nunen et al., 2011; Noy & Givoni, 2018; Zawieska & Pieriegud, 2018), arguing that since transport is significantly responsible for the phenomena of environmental pollution an intelligent mobility is first and foremost a sustainable mobility. In this sense, the ICTs should be aimed primarily at minimizing the negative impacts of transport on the urban environment.

The role that ICTs play in the Smart City approach in general, and more in detail in the mobility sector, has been the subject of numerous investigations. For example, according to a research promoted by the European Community in 2014, technologies are essentially tools that can support the management of networks, improve services and enhance the level of information for the community (Manville et al., 2014).

However, several authors (Staricco, 2013; Benevolo et al., 2016; Papa & Lauwers, 2015; Battarra et al., 2018) emphasize the low effectiveness of an uncritical adoption of ICT to pursue a hypothetical

improvement in the efficiency of mobility, to intervene (when necessary) with integrated actions that operate simultaneously on different aspects (networks, components, management, etc.).

Within the general framework briefly outlined, how does smart mobility specialize in serving the elderly?

As previously mentioned, in the case of "weak" users (elderly, disabled, children), difficulties or even impossibility to reach certain destinations or to move freely in the city may be grounds for isolation and social exclusion (Banister & Bowling, 2004; Engels & Liu, 2011; Titheridge et al., 2009).

In that respect, the first essential component that characterizes Smart Mobility for the elderly is accessibility, which can be defined as the "ability of places to be reached, in order to make elderly able to participate to city daily life, by preventing inequality in terms of spatial access" (Aguiar & Macário, 2017; Lättman et al., 2018; Solá et al., 2018).

In fact, accessibility is interpreted by many as a multidimensional concept that includes "a transport dimension (e.g. transport mode), a land use dimension (e.g. the built environment), a temporal dimension (e.g. travel times), and an individual dimension (the needs, abilities and opportunities of individuals)" (Geurs & Ritsema van Eck, 2001). For a long time accessibility was considered to be necessarily connected to the individual journeys by car, but in the case of the elderly in particular (whose motor and cognitive skills decrease over the years and thereby the risks related to travel, such as accidents, falls, etc., increase), accessibility must essentially be guaranteed by the Local Public Transport (LPT) and soft mobility (on foot or by bike, provided that their physical conditions allow them to). In this sense, then, Smart Mobility for the elderly increases the level of accessibility of the city through "safe" and even "sustainable" modes of movement. The presence of pedestrian areas, restricted traffic zones and cycle paths in the urban planning is therefore of crucial importance for the elderly to move safely. Thus, the other essential component of mobility for the elderly is safety, which can be defined as the capability not to restrict elderly's opportunities to move without endangering their own health and that of others.

Smart Mobility for the elderly cannot fail to take into account the need for interventions in cities, which might help them move around safely (such as the construction of pedestrian paths, equipped public transport stops, maintenance of sidewalks, pedestrian crossings with traffic light systems, urban furniture), but also the need for public transport management policies aimed at facilitating this mode of movement (from the distribution of stops to the training of on-board personnel) (Abou-Raya & ElMeguid, 2009; Tournier et al., 2016;).

In this context, the ICT applied to all the components of the transport system – from those relating to the infrastructure network (whether related to the transport of goods and people or information) to those more closely managerial – can facilitate the achievement of the objectives of accessibility, sustainability and safety mentioned above. In other words, far from an approach that assigns to communication and information technologies a decisive role in improving mobility, there is no doubt that devices, networks, sensors as well as the Intelligent Transportation System (ITS) applied to vehicles can improve the transport services and therefore support the mobility of the elderly too. It is not a matter of uncritically adopting a business like approach oriented to the interests of the market, but of verifying whether and under what conditions ICTs can contribute, together with other factors, to improving accessibility.

Beyond the various positions briefly referred to herein, it is clear that one of the challenges that cities will have to face is to become more accessible to everyone by promoting strategies and interventions aimed at improving the performance of the mobility system in terms of accessibility to services and urban spaces and increasing sustainability through the reduction of the negative impacts of the transport system.

3 SMART MOBILITY FOR THE ELDERLY: INITIATIVES AND MEASURES

In order to assess whether the introduction of ICT is contributing to making cities more accessible to all categories of users (including the weakest sections of the population, such as the elderly), we have analysed some experiences currently going on in Europe, setting aside the Intelligent Transportation Systems1 and focusing attention on less specialized projects for elderly users.

Within the framework of the strategies promoted by the European Commission aimed at innovating the transport system through the introduction of ICTs, there are numerous projects specifically addressed to the elderly.

One of the projects financed under the Horizon 2020 program is *City4Age - Elderly-friendly city services for active and healthy ageing* that promotes the use of the Internet of Things to create urban spaces where the elderly can move independently. The cross-referencing of data collected from various technologies (wearable and mobile devices, smartphones, sensors installed in the city and inside the elderly's homes) serves to detect and warn on alarming negative behavior changes. The trial launched in 2016 provides for tests on groups of elderly people resident in six pilot cities: Madrid, Athens, Montpellier, Singapore, Lecce and Birmingham.

Many projects involving the use of ICTs to increase autonomy and mobility of the elderly are included in the *Active and Assisted Living program (AAL) - ICT for ageing well*. The program aims at funding enterprises for the development of ICT-based products, systems and services that could effectively support the elderly in their daily lives. The philosophy behind the program is that applying technology-based solutions will enable elderly people to organise their lives by choosing where and how to live. Within the framework of the *AAL Program*, which concerns different aspects of the daily life of elderly people (health, housing, etc.), some projects on targeted mobility have been financed. They include *Com'on project*, developed by the Copenhagen Living Lab, with the objective to address the issues of orientation during the travels of the elderly by public transportation. The overall objective is to develop, test and implement a digital platform that provides services to support the elderly people to move around on their own with public transportation. The services provided should increase their trust and autonomy, by giving specific information on mobility and designing interfaces easily usable by the elderly, even by those not accustomed to the use of information technology.

Stimulate project envisages the use of advanced communication technologies to optimize travels of the elderly in order to carry out surveys on the neighbourhood scale. To this end, the Luxembourg institute that designed this project aims to provide support and advice in the planning of trips, optimize the choice of transport means and itineraries, receive personal assistance while travelling. For ease of use, all the services offered by the platform, which uses GIS technologies, will be accessible via web browsing, PC, tablet and mobile phones.

The NavMem system, developed in Oldeburg (Germany), is targeted at elderly people with mild cognitive impairments and focuses on assisting them during their travels in unfamiliar environments, such as in parts of the city located outside their neighborhoods. Through the ICTs it is possible to simulate a virtual navigation companion that provides spatial indications, such as direction and distance to the next intermediate goal (which could be a bus stop, for example), but also detailed instructions related to the

[1] For more detailed information on the points specified above, see: Yang & Coughlin, 2014; Guo et al., 2010.

landmarks. The system can also temporarily share the user's position so that direct assistance can be provided whenever needed.

Happy walker is an easily accessible and affordable platform facilitating a consistent, intuitive, personalised set of mobility enhancement services, e.g. outdoor monitoring and safety, self-management and life-style. Personalisation refers to both (current) characteristics of the user (profiling), e.g. physical condition, preferences, motivation, and (current) characteristics of the direct surroundings, e.g. living accommodation, neighbourhood, and further range of aims and actions of the user, e.g. visiting family, public transport, etc..

SIMON project - Assisted Mobility for Older and Impaired Users is a pilot project being tested in Madrid, Lisbon, Parma and Reading. Its purpose is to manage the incorporation of ICT solutions by providing services through a platform that helps identify public parking spots and access to restricted traffic zones by using the LPT (Fig. 1).

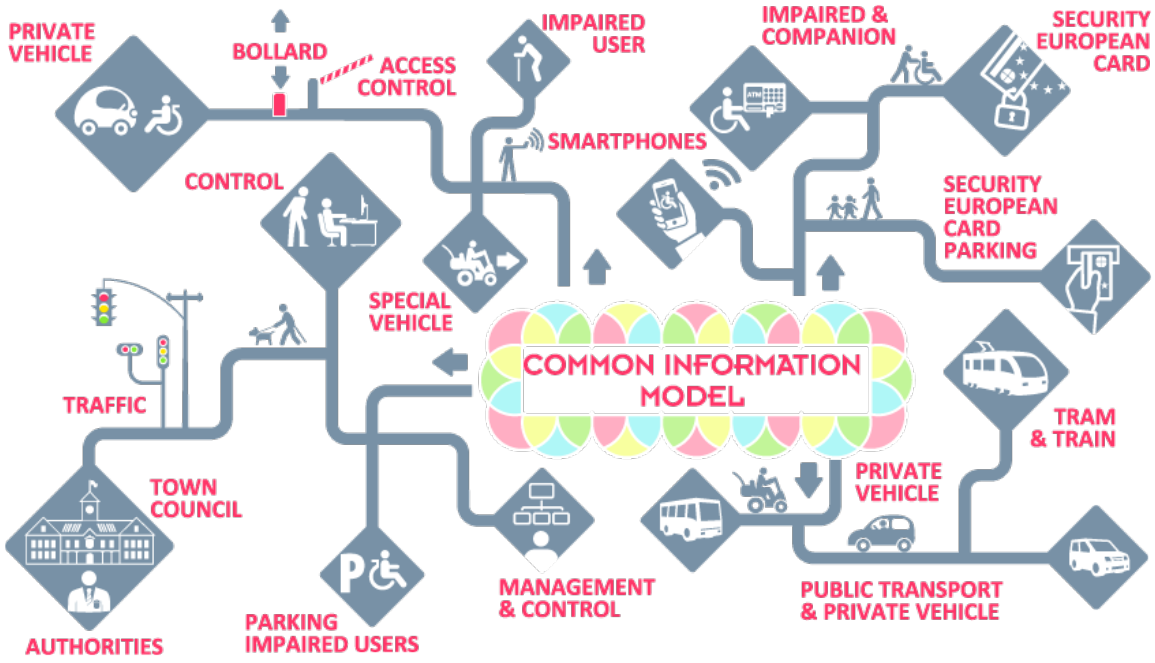


Fig. 1 The SIMON project diagram

Other projects promote innovative actions aimed at increasing the use of public transportation, rather than making extensive use of ICT, as in the case of the *Bus Buddying - Mobility Training to Become Independent Travellers project* – developed in Leeds – and the *GOAL project*. The first one provides that some volunteers support elderly and disabled people during their trips to gradually make them get used to the means of transport; the *GOAL project* (*Growing Older and staying mobile*) aims to deepen the knowledge on the travel needs of the elderly to better orientate public intervention strategies.

Another field of application of ICTs is that of the traffic light network aimed at making pedestrian crossings safer for the elderly. For example, *CrossWalk* app communicates automatically with the traffic light as soon as a pedestrian approaches the intersection. By giving a specific group green light for longer instead of all pedestrians, the car traffic doesn't get obstructed too much. The innovative technology makes it possible to align the duration of the green pedestrian traffic light with individual needs.

ICTs and GIS technologies have contributed to improving the performance of car sharing and paratransit systems, for example by optimizing the routes of the fleets, making available online booking and payment for the race, etc. (Fig. 2).

The framework briefly outlined provides information on several measures that are being implemented, which – when set alongside more traditional ones that do not necessarily require the use of ICTs – complete the framework of strategies aimed at improving the accessibility to urban spaces by elderly users (Tab. 1).

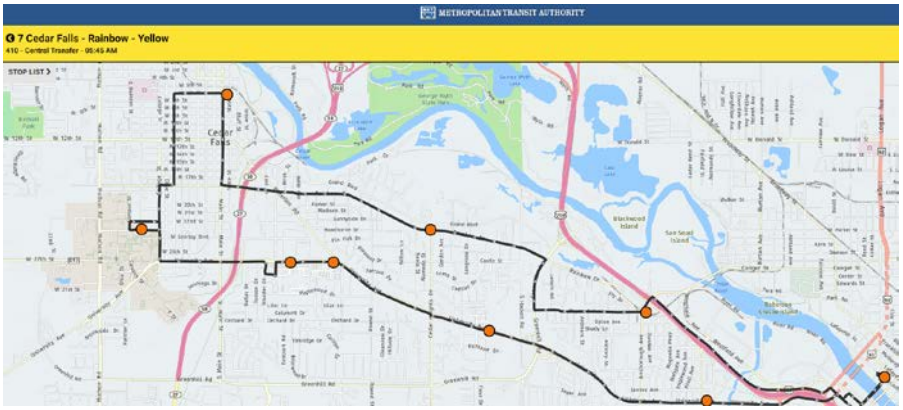


Fig. 2 Waterloo, Belgio, US, UK – Real Time Paratransit Map

The first two categories, namely "Improvement of public transport" and "Improvement of Public transport comfort", are specifically aimed at increasing accessibility through the use of LPT. To this end, it is necessary to operate not only on the best organisation of the network by preparing an adequate number of stops and locating them in relation to the presence of specific services for the elderly, but also increasing the comfort during travel and waiting times.

As regards the Smart Mobility component linked to Safety, actions are mainly directed to the optimal configuration of the traffic light network and to street lighting, while others are aimed at promoting soft and sharing mobility.

The last category collects high technological devices and products that should support the elderly in choosing the most suitable modes of transport and during their travels by providing information on waiting times, routes, intermodal exchanges, service interruptions, etc.

In conclusion, it is worth emphasizing that several enterprises developed products and services targeted to the elderly with the aid of technologies considering that the senior market segment will further expand in the next few years, but these products and services do not always result from a careful knowledge of this market segment and therefore are not suitable to meet the real mobility needs of the elderly.

Furthermore, cases of large-scale application are still rather rare, as these are often projects financed within European programs that have as one of the expected results the development of products/tools to be provided to local authorities, in the form of guidelines, prototypes, pilot projects; but how much of what is experienced in research environments is then transferred to practice? Such interventions are often not included within a coherent framework of strategies and probably they do not adhere to the real needs of a very heterogeneous target such as that of the elderly. ICT uncritically grafted into a backward context becomes a superstructure, a captivating but superfluous label.

CATEGORIES	ACTIONS
Improvement of Public Transport	Stops near activities of interest, high presence of stops, high frequency of the service, reduced fees
Improvement of Public Transport comfort	Presence of benches, platform roofs, low-floor buses, reserved seats, Video Surveillance Systems, communication and information campaigns
Improvement of road network	Road crossings signaled by traffic lights, sidewalks, speed bumps, street lighting, street lighting with variable green time
ITS for private transport	In-vehicle signing systems, special intelligent cruise control, systems that give information on the characteristics of complex traffic situations the driver is about to cross
Promotion of soft mobility	Cycle network, pedestrian zones, restricted traffic zones
Promotion of sharing mobility	Car and bike sharing, ridesharing, paratransit
Implementation of info-mobility services	Variable message signs, ticketing and travel planner, mobile apps

Tab. 1 Types of Smart Mobility measures for elderly

4 METHODOLOGY

ICT Innovations and the emerging Internet of Things (IoT) related to the creation of an open network of sensors can contribute to improve sustainability and efficiency of urban mobility. However, these technologies need to be integrated with mobility habits of people to guarantee their success (Battarra et al., 2018; Lee et al., 2018; Papa et al., 2016; Wilkowska et al., 2018). In particular, quality of life and well-being of senior citizens can be enhanced by these technological advances, supporting them through services, infrastructure and new forms of urban organisation that better respond to their requirements.

Against this background and in light of what described in the section above, the proposed methodology is aimed at evaluating if and how some Italian provincial capitals are improving the urban accessibility of elderly by applying the Smart Mobility approach. To reach this aim, the following four main steps have been developed: selection of city sample, selection of parameters and related data collection, standardization of parameters and construction of the ternary diagrams.

4.1 SELECTION OF URBAN CITY SAMPLE

As stated in the paragraphs above, the issue of accessibility for the elderly and measures for its improvement is closely linked to the physical and functional characteristics of the urban system (extension, population, density, clivometry, etc.) and of the transport system (infrastructural network, local public transport service).

The sample of the cities to be investigated was selected on that basis and taking into account that the objective of this contribution – as already mentioned – is to analyse whether and to what extent the ICTs applied to mobility could improve accessibility for the elderly. We chose medium-large sized cities because, as widely supported in literature (Banister, 2014; Manville et al., 2014; Komninos et al., 2014; Yigitcanlar & Bulu, 2016) and evidenced by existing experiences, they represent the most fertile ground for the testing of innovations, also because it is where the interests of private enterprises mainly focus. The sample of investigations is represented by the Italian cities having between 100,000 and 3 million inhabitants as of 2017. By using this size threshold, we selected 45 provincial capitals together accounting for 24% of the

Italian population (about 14 million people). Thus, it would appear that in a very small number of municipalities (0.5% of Italian municipalities) resides about one quarter of the Italian population. Therefore, this sample can be assumed as representative of the most Italian urbanized areas where numerous Smart Mobility initiatives have been promoting (Papa et al., 2016).
In relation to their demographic size, cities can be divided into 3 classes shown in Tab. 2, while Tab. 3 summarizes the main elderly demographic data.

CLASS	INHABITANTS	N° OF CITIES	CITIES
I class	from 580.000 to 2.900.000 inhabitants	6 cities	Rome, Milan, Naples, Palermo, Genoa
II class	from 150.000 to 400.000 inhabitants	21 cities	Bologna, Florence, Bari, Venice, Verona, Messina, Padova, Trieste, Taranto, Brescia, Prato, Reggio Calabria, Modena, Parma, Reggio Emilia, Perugia, Livorno, Ravenna, Cagliari, Foggia
III class	from 100.000 to 150.000 inhabitants	19 cities	Rimini, Salerno, Ferrara, Sassari, Monza, Siracusa, Latina, Pescara, Forlì, Bergamo, Trento, Vicenza, Terni, Bolzano, Novara, Ancona, Piacenza, Andria

Tab. 2 Sample of the cities partition

The six cities included in the first class are Rome, Milan, Naples, Turin, Palermo and Genoa, which alone collect over 50% of the population of the cities surveyed.
The elderly population (65 years old and over) is 23% of the overall population of the cities surveyed (about 3.3 million): this percentage differs little from the national average of 22%. Looking at the average percentage of elderly population in the three classes of cities, there are no significant differences, but if we look at each class in detail, significant differences emerge. In the first class, the average percentage goes from a minimum of 19% for the two cities of Southern Italy (Naples and Palermo) to the maximum percentage of Genoa that together with Trieste and Venice (II class) and Ferrara (III class) represent the cities that as of 2017 have the highest percentage of elderly people (over 28%).
Upon analysis of the cities included in the second class, the percentages of elderly people range from 20% in Reggio Emilia to 28% in Trieste and Venice. The cities with the lowest percentages of elderly people (with certain exceptions) are those located in Central and Southern Italy. As regards the third class, Ferrara is the city with the highest percentage (28%).
Considering the old age index as of 2017 (that is the ratio of the number of elderly people aged 65 and over compared to the population under the age of 14) it appears that 32 cities out of 45 have a higher index than the national average (165). There are significant differences among the largest cities: the indices of Naples and Palermo are almost half that of Turin and Genoa. The city with the highest old age index is Cagliari (270), while Andria, with its old-age index of 109, has the lowest one.
The index of elderly dependence (ratio of the elderly population aged 65 and over to the population aged between 15 and 64) once again reflects a similar trend as the old age one.
Comparing the 2012 data with those of 2017, there had been an overall increase of 7.3% in the cities surveyed, which is a lower percentage than the national average (9.4%).
In conclusion, it can be said that the ageing process seems to involve mainly the Central-Northern Italian regions, given that, as mentioned above, Liguria is the "oldest" region of the country (the percentage of over 65 years old people is 28.2%), whereas the "youngest" is Campania (17.8%).

CITIES	65 YEARS OLD AND OVER	OLD AGE INDEX	ELDERLY DEPENDENCE INDEX	% 65 YEARS OLD AND OVER	VAR. % 65 YEARS OLD AND OVER 2012 - 2017
Genoa	165,813	249.50	47.20	28.41	3.13
Turin	226,188	207.68	41.00	25.51	4.79
Milan	315,044	178.76	36.62	23.31	1.10
Rome	630,604	163.77	33.94	21.95	10.62
Palermo	133,474	138.70	30.06	19.81	13.51
Naples	186,812	131.12	29.15	19.26	7.71
I class	**1,657,935**	**170.0**	**35.2**	**22.59**	**7.01**
Trieste	57,925	253.71	46.91	28.36	3.00
Venice	72,532	238.46	45.63	27.69	2.73
Livorno	41,311	211.10	42.14	26.00	6.74
Cagliari	41,003	269.81	41.89	26.61	10.26
Florence	98,674	214.84	41.52	25.81	5.15
Padova	53,886	210.57	41.34	25.68	5.49
Verona	65,085	200.23	40.74	25.29	5.78
Bologna	98,614	214.90	40.44	25.39	1.12
Brescia	48,718	188.04	39.92	24.77	6.63
Ravenna	38,877	193.67	38.84	24.44	7.33
Modena	43,997	174.41	38.09	23.82	6.62
Perugia	39,127	175.58	37.17	23.47	8.49
Taranto	46,043	173.54	36.26	23.07	19.31
Bari	75,574	188.65	36.24	23.31	11.21
Parma	43,897	171.55	35.14	22.58	6.25
Messina	52,594	170.84	34.24	22.20	7.16
Prato	41,972	151.27	34.19	21.81	9.43
Foggia	32,194	151.65	32.75	21.22	14.70
Reggio C.	38,790	157.09	32.58	21.25	12.09
Catania	65,398	145.95	32.19	20.87	11.12
Reggio E.	34,990	137.07	31.53	20.40	8.11
II class	**1,131,201**	**189.04**	**38.20**	**24.12**	**7.21**
Ferrara	37,017	263.45	45.73	28.04	5.19
Terni	29,246	218.68	42.49	26.24	6.17
Ancona	25,794	207.53	41.29	25.62	4.61
Pescara	30,690	203.03	41.13	25.49	7.00
Forlì	29,760	191.22	40.98	25.23	6.46
Piacenza	25,472	194.78	39.92	24.89	3.34
Monza	30,261	183.98	39.69	24.61	7.51
Bergamo	29,727	194.92	39.47	24.71	5.40
Vicenza	27,237	187.65	38.66	24.28	6.00
Bozen	25,190	164.19	37.93	23.55	6.75
Salerno	32,472	201.66	37.64	24.08	6.34
Rimini	34,913	177.25	37.02	23.45	10.94
Novara	24,194	180.27	36.29	23.20	8.26
Trento	26,231	160.35	35.06	22.34	12.36
Sassari	28,061	186.45	33.24	22.00	15.77
Siracusa	26,071	155.05	32.94	21.36	15.68
Latina	26,240	145.63	32.04	20.80	23.13
Andria	17,112	109.33	25.33	17.06	14.68
III class	**505,688**	**183.03**	**37.55**	**23.75**	**8.74**
TOTAL	**6,083,960**	**169.55**	**35.21**	**23.17**	**7.22**
ITALY	**13,528,550**	**165.33**	**34.80**	**22.33**	**9.36**

Tab. 3 The elderly in the sample of cities - 2017 (sorted by "Elderly Dependence Index")

4.2 SELECTION OF PARAMETERS AND DATA COLLECTION

After identifying the sample of 45 Italian cities, 24 parameters have been selected (Tab. 4) with the aim of providing a quantitative and therefore objective evaluation of each one of the three components of Smart Mobility for elderly:

- Accessibility: needs to be guaranteed, in order to make elderly able to participate in city daily life, "by preventing inequality in terms of spatial access" (Santana, 2017);
- Safety: needs to be guaranteed, in order not to restrict the mobility of elderly;
- ICT: needs to be guaranteed, in order to help elderly move easily and independently.

The definition of these three components derive from the study of the Smart Mobility initiatives and measures collected before (see section 3), as most of them aim at increasing accessibility. Since the elderly are vulnerable users and require welfare, their everyday trips can be facilitated by digital devices and services.

The proposed set helps quantify some of the main characteristics of a city "elderly-friendly", such as walkability, access to activities, network connection, communication and information.

The selection of parameters has been made according to the previously mentioned works about the Smart Mobility and accessibility for elderly issues, as well as the availability of data for measuring them. These data have been collected from ISTAT database for the period 2012-2014, common to all the parameters used. The set (Tab. 4) describes the main elements related to public road transport and soft urban mobility, according to the fact that elderly are more likely to use these travel patterns (e.g. Kim & Ulfarsson, 2004; Schmöcker et al., 2008). In this perspective, the selected parameters illustrate the urban mobility supply and some of the physical-functional characteristics of urban system, consistent with available data at local level.

CATEGORY	ID	PARAMETER	UNIT
Accessibility	A1	Public transport demand	No. passengers/inh.
	A2	Public transport supply	No. veicles/inh.
	A3	Bus stop density	No. stops/sq.km.
	A4	Toll parking	No. stalls/1,000 cars
	A5	Taxi licenses	No./10,000 inh.
	A6	Car sharing demand	No. users/1,000 inh.
	A7	Car sharing supply	No. available vehicles/100,000 inh.
	A8	Bike sharing supply	No. bikes/10,000 inh.
	A9	Altimetric zone	Lowlands/Middle-mountain areas
Safety	S1	Elderly deceased in traffic accidents	No/100,000 inh.
	S2	Elderly pedestrians dead or injured in traffic accidents	No/10,000 inh.
	S3	Pedestrian zones	Sq.m./100 inh.
	S4	Restricted traffic zones	Sq.Km./100 sq.km.
	S5	Cycle lanes	km/100 sq.km.
	S6	Street lighting	No./sq.Km.
ICT	ICT1	Electronic payment park systems	1 or 0
	ICT2	Road panels with variable message	1 or 0
	ICT3	SMS for traffic	1 or 0
	ICT4	SMS for public transport information	1 or 0
	ICT5	Electronic bus stop signs	1 or 0
	ICT6	Electronic travel ticket by mobile devices	1 or 0

Tab. 4 Set of Smart Mobility parameters

4.3 STANDARDIZATION OF PARAMETERS

The data collected were not comparable, as they were measured in different units (e.g. n° available cars/100,00 inhabitants, sq.m/100 inhabitants, etc.). In particular, Accessibility and Safety components collect continuous parameters, while ICT is expressed by binary values. This last aspect is still the weak link for studies that seek to assess in a quantitative way the effects of Smart Mobility initiatives, as ICT component cannot be withdrawn but binary values have the major disadvantage of containing less information.

To convert Accessibility and Safety continuous parameters into binary ones we made use of Natural Breaks classification and this operation was implemented in GIS environment, in order to elaborate a dataset useful for the next steps of the research. Then, the average binary value was calculated for each one of the three Smart Mobility components, by referring to the 45 Italian cities surveyed. This step allowed to obtain a qualitative weight, expressed as percentage, useful to assess the Smart Mobility for the elderly "performance" of every city of the sample.

4.4 TERNARY DIAGRAMS

The last step of the methodology was to plot Accessibility, Safety and ICT average values on ternary diagrams, in order to identify the Italian cities that implement Smart Mobility for elderly by integrating all its three components or focusing on some of them. In fact, in the middle of the diagram there is the balance area, while at the vertices there are the areas of the three components of SM (which surfaces are defined by calculating an integral). The remaining areas are the ones where the components can be read in pairs.

Therefore, in the ternary diagram it is possible to identify seven areas and, according to the position of each city, it is possible to read which component/s of Smart Mobility characterize/s it. Fig. 3 represents those areas:

- Area 1 - Safety;
- Area 2 - ICT;
- Area 3 - Accessibility;
- Area 4 - Enabling, as ICT can be considered as a tool to increase urban accessibility of elderly;
- Area 5 - Sustainability, as soft (referring to Safety component) and sharing mobility (referring to Accessibility component) contribute to increase sustainability of transport;
- Area 6 - Inclusion, as technologies can support older people's engagement in city life by increasing their security;
- Area 7 - Balance area.

5 RESULTS

The methodology described above allowed evaluating if Smart mobility in the Italian small-medium sized cities is oriented to elderly needs. Four ternary diagrams have been obtained: one for each cluster (according to the demographic sizes) and one for all the samples (Fig. 4 collects all the results). Furthermore, within each cluster a further articulation of the old population (over 60) was made by Quartile method, in order to take into account both the demographic size of the cities and the different distribution of senior citizens within them. In particular the percentile classification obtained is the following:

- percentile 1: cities about 21% of elderly;

- percentile 2: cities about 23% of elderly;
- percentile 3: cities about 25% of elderly;
- percentile 4: cities with more than 25% of elderly.

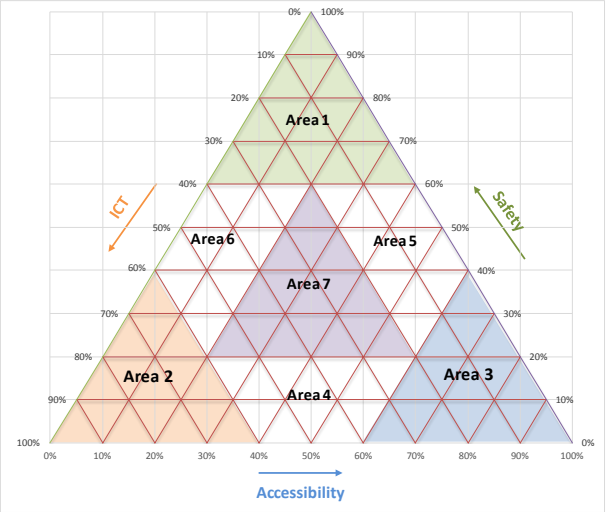


Fig. 3 The seven areas of Smart Mobility

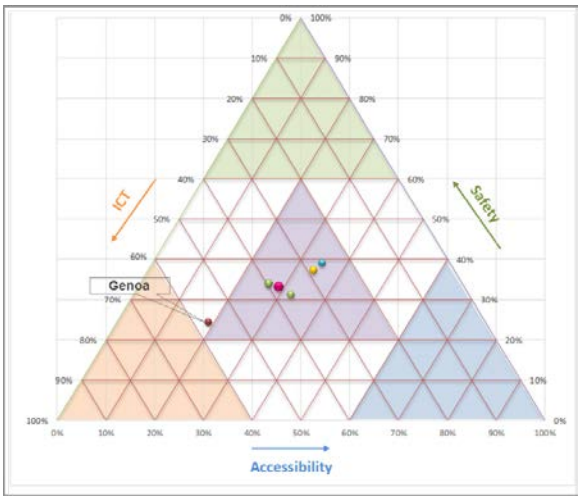
The average value of cluster 1 is located within the Balance area (Area 7, Fig. 4a) and it means that the biggest cities of the sample have the three components of Smart Mobility in balance. This first result can be explained by the fact that the greater the number of inhabitants of a city (and therefore its transport demand), the greater the supply of public transport with all the related services.

Focusing on the individual cities of cluster 1, Milan and Turin are more oriented towards Safety (39% and 37.2% respectively), while the three remaining cities in the balanced area seem to pay more attention to ICT. Only Genoa is outside the Balance area and has the highest value of the ICT component than the whole cluster (57% compared to an average of 37%). In fact, Genoa has been investing in the ICT Innovations for the last years and has committed itself to guaranteeing the right to move for everyone, to improving the quality of public transport offered and to reducing emissions of pollutants (Battarra et al., 2015). In particular, many interventions have been launched to promote sustainable mobility (car sharing, bike sharing, cycle paths) and infomobility services through participation in European projects and funding (Schaffers et al., 2011).

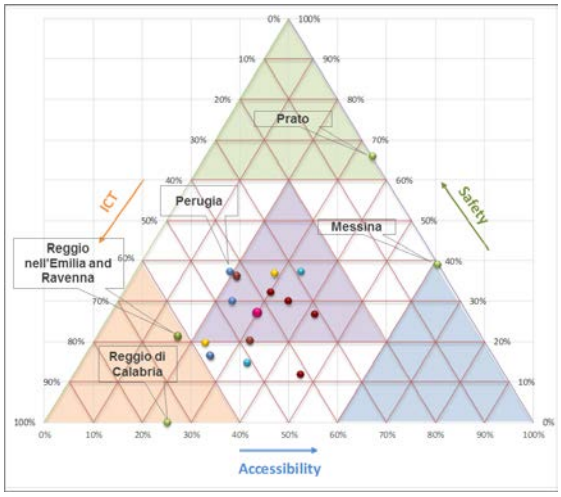
Compared to cluster 1 the ternary diagram of cluster 2 is more oriented to the ICT component (Area 2), according to the position of the average value (43%) and almost all the cities within the Balanced area (Area 7) are characterized by a high elderly population (at least 23%, Fig. 4b).

Reggio Calabria, Reggio Emilia and Ravenna have the best performance in the ICT (75% for the first city and 62% for the other two). These high performances depend on the fact that they host several ICT companies operating in several fields, from mobility to industry, commerce and so on.

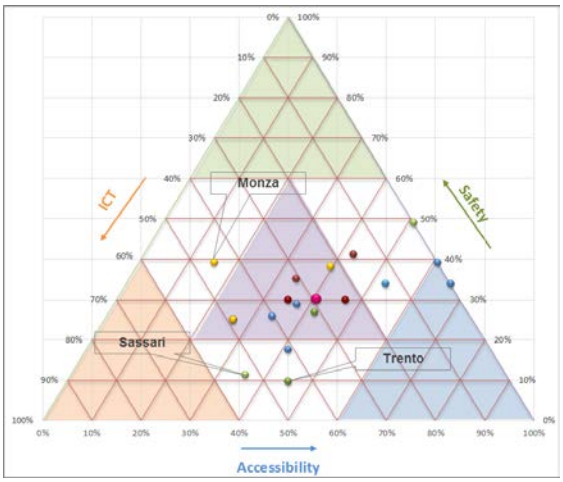
Along the Safety axis, there are Prato and Messina that have mainly invested on one individual component that is Safety (66%) and Accessibility (61%) respectively, completely overlooking ICT (0%). Therefore, these two cities result to be unbalanced regarding the Smart Mobility for elderly.



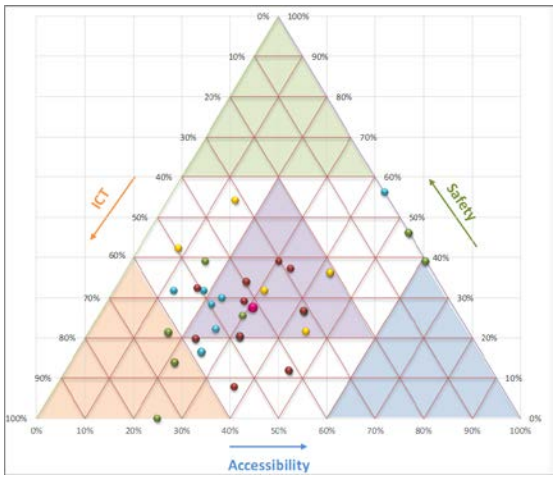
4a



4b



4c



4d

percentile 1: cities about 21% of elderly
percentile 2: cities about 23% of elderly
percentile 3: cities about 25% of elderly
percentile 4: cities with more than 25% of elderly

Average value

Fig. 4 The triangles of Smart Mobility for elderly

Perugia is the only city in the area of Inclusion (Area 6) and this can be due to the geographic position of its city center that is not easily accessible. To provide its older inhabitants with easier access to their activities of interesting, internet accessible public services were developed, escalator and elevator systems improved and a "helping hand" (online and by telephone) was ensured to assist them when they encounter problems using the online services.

The ternary diagram of cluster 3 shows that Smart Mobility components are less balanced than the other two clusters (Fig. 4c) and that in the smallest cities of our sample accessibility seems to be guaranteed, according to the average value (41%).

As for cluster 2, there are few cities along the Safety axis: Latina, Novara and Salerno are the least balanced cities (0% for the ICT component) and those that have invested more in Accessibility (51%, 61% and 66%), compared to the whole cluster 2.

Monza is the only city in the area of Inclusion (Area 6) with a high performance in ICT (56%), while Sassari and Trento are located within the Enabling area (Area 4) by using ICT for improving the accessibility of elderly.

It is worth noting that both the Safety and Accessibility areas do not collect cities and this interesting configuration within the third ternary diagram can be explained according to two main considerations: (i) the normalization method used by the authors – as ICT data were binary – determines a lack of information related to these data; (ii) the kind of ICT data were qualitative and therefore they only inform about the presence or absence of this component of Smart Mobility in a city. In particular, this last aspect represents a limit of this research that authors intend to overcome by contacting and directly involving ICT companies and public bodies in their research work.

Moving on to the cluster of the whole sample surveyed, some considerations can be made:

- Most provincial capitals are concentrated within the Balance Area (about 1/3 of the sample) and have the largest percentage of elderly people, such as Bologna, Rome, Milan;
- Along the Safety axis there are five cities of the sample that do not give particular attention to this component and have few elderly inhabitants;
- Within the Areas of Inclusion and Enabling (Area 6 and Area 4) there are several cities oriented to the use of ICT to facilitate the walkability of the elderly;
- All previous results seem to highlight that Italian cities pay attention mainly to ICT and Accessibility issues.

6 CONCLUSIONS

This research work, starting from a definition of Smart Mobility that integrates the technological component with those of accessibility and safety, has attempted to answer the question posed in the title: can Smart Mobility make the cities more accessible for the elderly? To answer this question it seems appropriate to make some preliminary reflections.

The researches for this paper started from the review of some of the recent experiences of Smart Mobility to support the mobility of the elderly, which inspired us on the possible actions to be implemented in urban areas. These actions have been articulated in what have been defined as the three main components of Smart Mobility for the elderly: accessibility, safety and ICT. Subsequently, a set of indicators that could provide a Smart Mobility reliable framework was selected as to verify the current situation of the cities surveyed with respect to the three components.

The framework outlined by research is extremely varied and uneven as regards the current connotation of cities in relation to Smart Mobility.

This scenario can be attributed to several factors. Firstly some specific elements of the analysed contexts (clivometry, morphology, territorial distribution of the population, etc.), as well as socio-economic and cultural factors that characterise the elderly population, can have decisive impacts on the chances of travel. These impacts are difficult to evaluate by using a set of variables, which inevitably flattens out the differences, thus making the interpretation of the results less obvious in some respects. During the research work, we tried to take into account these aspects as much as possible (by inserting the % indicator of mountainous territory and articulating the analysis of the results in relation to the size thresholds of the cities), but in the subsequent research developments we will need to verify how to take into account the

specific nature of local contexts both as regards the characterisation of the elderly population and the peculiar physical-morphological conditions of urban centers.

As already assumed within the European Community, another pivotal aspect to think about is that although ICT can play an important role in improving the mobility of the elderly, it is also true that little or nothing is known – at least in Italy – on the elderly ability to use new technologies. Many have addressed the issue of e-inclusion of the elderly, believing that new technologies risk becoming an insurmountable barrier and that the digital divide will become a new form of marginalization for the elderly (Bobillier Chaumon et al., 2014; Carlo, 2014; Mordini et al., 2009; Niehaves & Plattfaut, 2014).

If, therefore, trusting the infomobility systems (that, for example, can simplify the use of LPT) seems to be justified by the many ongoing experiences, it is necessary to increase the level of familiarity of the elderly with smartphones, apps, etc. in order to promote targeted strategies that allow a better use of ICT. Currently, in Italy statistics are only available at national level (and the data are not reassuring), while a level of analysis at a more detailed territorial scale would be necessary.

Still in the attempt to answer the initial question, from this study as well as from other research carried out on the issue of Smart City it is possible to state also for the mobility sector that cities with the best performances in terms of greater accessibility for weak users are those that integrated "traditional" policies with those that instead require the use of ICT. Information campaigns, coaching and training in the use of the LPT, tariff incentives, but also public vehicles made more comfortable and the provision of new stops carefully located in relation to the units of services specifically addressed to the elderly (ASL, medical clinics, administrative offices, places of worship, etc.) can achieve significant results if integrated with strategies that envisage the adoption of ICT in the mobility system. Indeed, the cities operating in this direction (Milan, Genoa, Florence, etc.) that adopted an integrated approach rank at the top of the Italian rankings on the smart cities (Boscacci et al., 2014; FPA, 2017; Papa et al., 2014).

In conclusion, it could be claimed that, although in subsequent research developments the indicator system used to "measure" what is being done in Italian cities in adopting a "Smart Mobility" approach to support the mobility of the elderly will be improved, to date ICTs applied to the transport sector do not fully realize their potential. This is not due to the limited fields of application, but rather to the lack of a "system-orientated" perspective when applying innovations.

In other words, the adoption of a smart approach cannot be limited to a market-induced uncritical introduction of devices, sensors, technological platforms or apps in the mobility sector, in the name of a "more efficient mobility" and a user-friendly city. Instead, it will be necessary to refine the tools for understanding the needs of specific categories of users, such as the elderly, to define integrated strategies able to operate on many aspects simultaneously. Given the complexity of the studied issue, long-term future research efforts will be required, ideally by considering this work as a starting point. One of the possible topics of study could concern the increase of the set of parameters by including the local public transport charge for elderly, the presence of protected paths and the urban microclimate (air temperature). In fact, parameters of this kind could allow to consider socio-economic aspects and environmental characteristics of built environment. A further analysis could concern the comparison of Italian cities with European ones, in order to identify similarities and differences of local urban policies for increasing elderly quality of life.

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AUTHOR'S PROFILE

Rosaria Battarra is an architect, since 1998 researcher of the National Research Council - Institute of Studies on Mediterranean Societies (ISSM). She carries out her research activity at the Department of Civil, Architectural and Environmental Engineering of the University of Naples Federico II, developing research on the issues of urban renewal and how to implement urban transformation actions. More recently, the research interest has turned to the themes of governance of the metropolitan city, in the light of the increasingly widespread use of the "smart city" paradigm. She is adjunct professor at the Faculty of Engineering of the University of Naples Federico II. From 2007 to 2014 she was head of the Department of Planning and Real Estate of the Urban Transformation Company Bagnolifutura S.p.A.. She is author of numerous papers presented at national and international conferences and over 40 publications.

Floriana Zucaro is an engineer, Ph.D. in Hydraulic, Transport and Territorial Systems Engineering at the Department of Civil, Building and Environmental Engineering – University of Naples Federico II. She received a M.Sc. in Environmental and Territorial Engineering at the University of Naples Federico II with a specialization in management of urban and territorial transformations. In 2014 she won a scholarship within the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II. Her research interests are in the field of land use planning and energy saving integration in urban policies, sustainable land use and sustainable mobility.

Maria Rosa Tremiterra is an engineer, Ph.D. student in Civil Systems Engineering at University of Naples Federico II. She received a master's degree in Architecture and Building Engineering with a thesis in urban planning. In 2014, she won a one-year grant for post-lauream education and research within the Project Smart Energy Master at the Department of Civil Engineering, Building and Environmental Engineering, University of Naples Federico II.

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GROWING OLD AND KEEPING MOBILE IN ITALY

ACTIVE AGEING AND THE IMPORTANCE OF URBAN MOBILITY PLANNING STRATEGIES

CLAUDIA BURLANDO, INES CUSANO

University of Genoa, Department of Economics and Business
Italian Center of Excellence on Logistics, Transport and Infrastructure (CIELI)
e-mail: burlando@economia.unige.it; cusano@economia.unige.it
URL: www.economia.unige.it

ABSTRACT

The world is facing a series of changes that will modify the way we envisage urban transport planning. Demographic switch coupling higher life expectancy and lower fertility rates is occurring all around the world. While ageing is indeed a triumph of development and increased longevity is perceived as one of humanity's greatest achievements, the phenomenon and its transition in society need to be managed.
The rapid increase of the elderly group means profound changes which require solutions at various levels. The World Health Organization has established a path towards Active ageing, and it is within this strategy that this paper aims at analyzing the role of mobility as an enabler of active ageing. While mobility in general is very important, it was decided to concentrate on urban mobility, as cities are, by definition, the place where people benefit from urbanization economies and where transport plans are put in place. An increase of age, health and economic conditions determine the possibility to enjoy urbanization economics more and for longer time. Yet such fruition is determined by the accessibility to such places or services. It is for this reason, among others, that urban mobility planning is such a relevant tool that could lead towards a switch of paradigm towards more friendly and inclusive (for seniors and not only) urban environments.

KEYWORDS

Active Ageing; Urban Mobility; Italian Scenario

1 INTRODUCTION

Ageing is a triumph of progress and the increasing longevity is perceived as one of humanity's greatest achievements. Life expectancy has reached 80 years in more than 30 countries. While at present only Japan has an older population of more than 30%, by 2050 other 64 countries will join that group (UN, 2013).
Today's elderly people are significantly different from previous generations; today's elderly are wealthier, healthier and more mobile.
The opportunities that this demographic shift present are as endless as the contributions that a socially and economically active, secure and healthy ageing population can bring to society (Keister & Deeb-Sossa, 2001; UNFPA, 2012).
A distinctive trend in ageing has been taking shape in very recent years in Europe, and active ageing has finally become a political priority (Walker & Maltby, 2012). Demographic change shows different speeds in different countries and, Italy is at the top of the list for its share of elders. According to the Italian Institute of Statistics (ISTAT) since 2015 Italy is undergoing zero growth in terms of population, a phenomenon that has not been registered since the First World War.
With this demographic shift impacting urban transport systems it is necessary to re-think about options to keep up with the mobility needs of a growing population segment maintaining their wellbeing and quality of life. Evidence shows that studies of this kind are hardly ever carried out and urban mobility plans tend to ignore the demand characteristics of senior users (Burlando & Cusano, 2014).
This work's focus is Italy that represents an interesting scenario because high shares of elders coupled with a sharp decrease of births are sentencing a country of old people for years to come.
If the goal is that of keeping the growing elderly population active, then their mobility should be included in the equation. Urban mobility planning strategies are fundamental but to be successful they need to take into account the real needs of the often-neglected elderly group.

2 THE ROLE OF MOBILITY IN ACTIVE AGEING STRATEGIES

According to the World Health Organization (WHO), the state of health is determined by the coexistence of three conditions: the physical-biological health, the social-environmental wellbeing and the psychological-emotional wellbeing and thus healthy ageing is more than just the absence of disease (WHO, 2015).
Among the elderly, the idea of physical self-care is becoming stronger and unlike the past, today's elderly know who they are and are perfectly aware of their role in society, their needs and aspirations (Giustini et al., 2009).
According to the EU Commission (Ageing Report, 2012), the key challenge for policymakers in the EU will be to transform the social models in such a way that the implications arising from an ageing population will become manageable (EU, 2012).
Sustainable and inclusive growth, fostered by the EU needs to work to prevent the city from becoming a place for goods and services with "restricted access" just for youngsters, coordinating urban mobility and city planning as much as possible.
This is more evident with the growing application of ICT in the transport field that, if properly managed, has the capacity to contribute to more efficient transport services.
The growing digitalization of urban transport systems poses the challenge of user acceptance and requires bridging the digital divide between age groups. Managing this transition towards a higher use of technology

for daily urban displacements requires analyzing the needs of those less familiar with technology to boost inclusion instead of marginalization.

Transport enables social participation and a denied mobility has an impact in accessing key areas such as employment, healthcare or education. Increasingly, though, it is not just mobility itself, which is seen as an enabling factor, but the potential accessibility of locations, services and facilities that people need to reach or engage with to avoid exclusion (Shergold & Parkhurst, 2012).

Accessibility can be defined as the ease with which people can reach destinations for different purposes (Metz, 2000) and it is inextricably linked to the quality of life and general wellbeing (Zali et al., 2016).

In general terms, higher levels of mobility and participation in social and physical activities are normally associated with greater life satisfaction (Banister & Bowling, 2004). Different studies show that there has been a growth in the travel activities of the elderly and an increase in leisure trips, car trips and licensing rate in the last decade (Arentze et al., 2008; Newbold et al., 2005). They are more "mobile", but how, when and why the move are questions that need to be addressed.

The centrality of car use is undeniable, yet, elder's personal perceptions of safety, security and comfortableness of driving under certain circumstances or conditions (such as congested roads, poor lighting, signaling, etc.) influence their mobility behavior (Rimmö & Hakamies-Blomqvist, 2002).

Even if the link between active ageing and mobility is recognized, the complexity of maintaining wellbeing through mobility is poorly reflected in today's planning or transportation supply for seniors (Siren et al., 2015). Mobility is also associated with the freedom to travel when desired and not just when needed (Stjernborg et al., 2014) and access to reliable, affordable and safe transport is important f help avoid loneliness and isolation.

In general, mobility has a wide range of possible options such as cars, motorbikes, bicycles, public transport, other solutions that require technological knowledge or information (car sharing, carpooling, Uber), and any possible mix of the above. For the elderly the number of options shrinks, due to their actual ability to make use of all available options.

This "denied accessibility" is a greater problem if it is the consequence of ignoring not providing sufficient information and education and deepening the digital divide.

If the characteristics of mobility supply do not match the needs of such a broad and mobile segment of the population, reducing the options to (a) costly private individual transport or (b) traditional local public transport (cheap but growingly uncomfortable), then there will be an increasing accessibility problem failing in the quest for inclusive urban settings.

And while it is somewhat true that "keeping older people driving as long and safely as possible may well be the most feasible and cost-effective mobility option for an ageing society" (Rosenbloom, 2009), it is necessary to establish other options that will be available once using the car will not be a feasible option. All these considerations seem much more relevant considering that life after pension represents a considerable period worth living a good life (OECD, 2011).

3 AN INSIGHT INTO THE ITALIAN SCENARIO

Why is Italy such an interesting case to investigate the connection between ageing and urban mobility planning? Statistics are a good starting point to answer this question.

Across the EU Member States, Italy (21.7%), Germany (21.0%) and Greece (20.9%) had the highest shares of people aged 65 or older in the total population (Eurostat, 2016).

With 12% of the almost 500 million inhabitants of the European Union, Italy is the fourth country for its dimension and has 144.5 elderly for every 100 youngsters representing the "oldest" country in the Union, closely followed by Germany.

The average life of Italians is of around 84 years of age for women and around 79 years of age for men, both on top of the European Union ranking (ISTAT, 2016). Moreover, Italy ranks very low in fertility rates (1,41 child per woman), and the average childbearing age is still on the raise (31.5 years vs. 29.2 in Germany, 29.8 in Spain and 28.1 in the UK[1]).

Life after retirement is an important factor: a 65-year-old man can expect to live circa 18.4 years while women up to 22 years (ISTAT, 2016).

Lastly, Italy is among the EU27 countries with the highest age-dependency ratio (almost 56% according to the World Bank statistics[2], 2014) showing a strong generational imbalance.

A study carried out by ANIASA – CENSIS (2015) on the main demographic and socio-economic trends that Italy will be facing until 2030, show that:

- There is a growing trend of elders taking care of their own psycho-physical health, with 54% practising outdoor activities compared to 21% in 2005;
- The share of elders that have familiarity with technology is growing fast, with only 5% in 2006 using internet to 21% in 2015;
- The share of seniors with "active driving licenses" is also growing, reaching 50% in 2015, while the rate of license possession has grown from 38.5% to 53% in the last 10 years.

Consulting the sites of the Ministry of Infrastructures and Transport and Italian Automobile Association, among others, the lack of studies on mobility patterns is quite alarming in the face of the studied trends.

Regarding strictly mobility patterns an interesting source of information, and one of the very few existing ones, is ISFORT 's (Higher Institute of Transport Education and Research) focus on mobility of the elderly in its October 2016 release.

The study shows that the mobility rate of Italians, i.e., the percentage of people getting out of their houses and making trips, is 80% for the general population, while the percentage is almost 75% for the 60-69 group, and around 64% for those over 70 years. It shows that when elders do go out they tend to be in line with the general population and the reason behind not going out can be highly heterogeneous: raging from precarious health to lack of transport alternatives or mainly lack of motives to do so.

The average daily trips of seniors are in line with that of the general population since 2012, with 2.7 trips per day (Fig. 1), showing how the mobile part of seniors tend to be as mobile as the general population. The trip duration is quite similar between the general population, with 59 minutes, the 60-69 group with 57 minutes (possibly a considerable number of the interviewees is still working as the retirement age in Italy is 66 years since 2015) and the 70-80 group registers almost 50 minutes.

Analogously, the number of daily trips and duration shows how senior citizens' behaviours are quite similar to those of the general population.

[1] Data for 2012 by the Central Intelligence Agency World Factbook.
[2] http://data.worldbank.org/indicator/SP.POP.DPND.

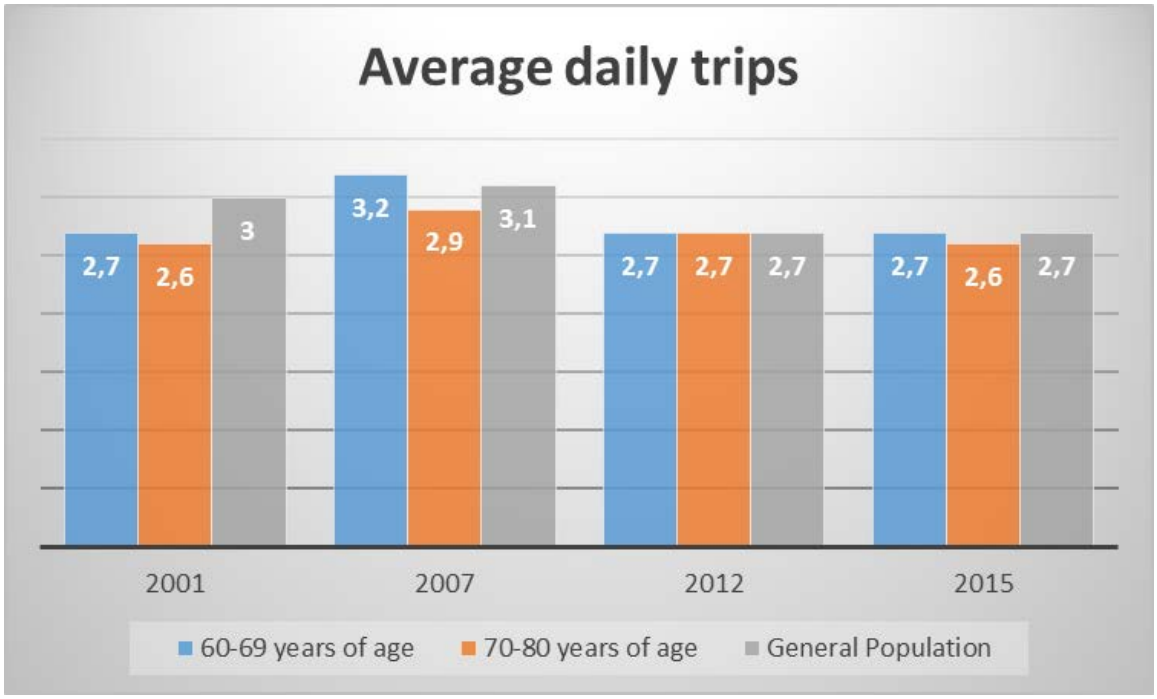

Fig. 1 Average daily trips per age groups for 2001, 2007, 2012 and 2015 in Italy - Source: ISFORT, 2016

Fig. 2 A and B show a comparison between 2007 and 2015 in terms of the transport means used for trips, highlighting there has been an increase in car use as driver for all age categories. This is alarming considering that Italy is among the European countries with higher car use with 38 million vehicles in 2017 in comparison to 15 million in 1980 (data from the Italian Automobile Club - ACI[3]). There has also been a decrease in Public Transport use and walking/bike use for the elderly groups with a slight increase in trips as car passenger. Older adults over 65 years are at a higher risk of injury compared with younger adults due to frailty and associated increased injury susceptibility, placing them at a double disadvantage when walking or cycling, compared to when travelling in a vehicle (O'Hern & Oxley, 2015).

When it comes to the reasons behind trips, data show that more than 50% of the trips are made for family management activities for the 60-70 group and 33% for leisure. In addition, the majority of the trips for the 70-80, 58%, are done for family management, with leisure activities at 40%. Most trips for all categories are carried in proximity of the destination (1-2 km). For the 70-80 group this share is quite relevant with 42%, while short distance trips (3-5 km) represent 26%, thus showing that 68% of all trips take place between 1 and 5 km.

Two things can be taken out from this first attempt to assess the urban mobility choices and patterns in Italy: the need to assess the short distance travel options and to provide ways to discourage the use of private vehicles by developing other valid options (public transport and flexible services) feasible and attractive. The usual diatribe private transport versus traditional local public transport needs to be re-dimensioned in the light of this first set of information and of some of the characteristics of the elder category in Italy.

[3] http://www.aci.it/laci/studi-e-ricerche/dati-e-statistiche/veicoli-e-mobilita.html

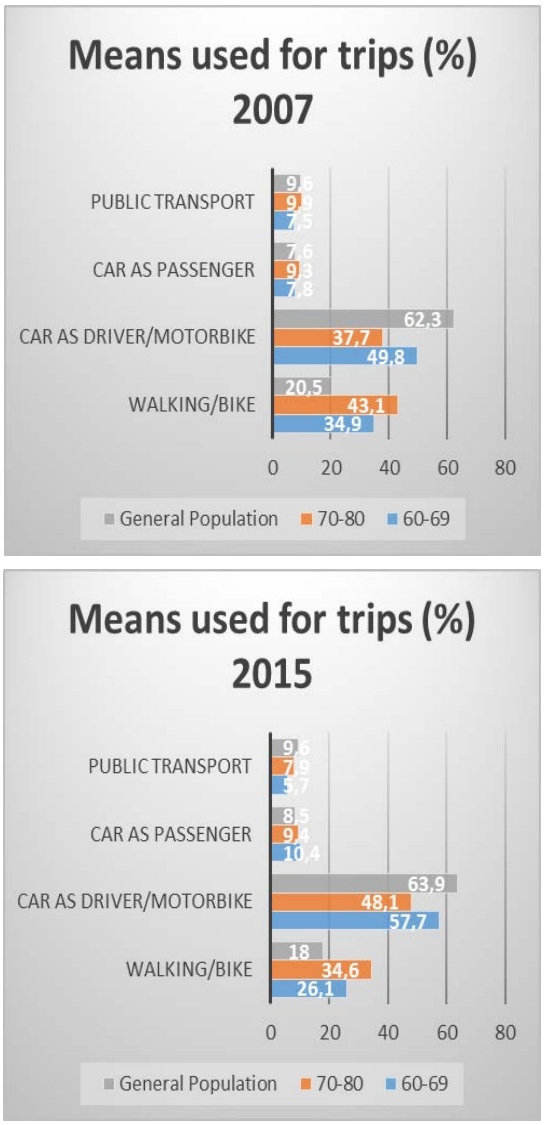

Fig. 2 Means used for trips per age groups in 2007 (A-above) and 2015 (B-under) in Italy - Source: ISFORT, 2016

4 FINAL REMARKS

A typical Italian elderly person makes an average of 2.7 daily trips, a figure in line with other age groups. Around half of these trips are made by car and as the population continues to age and reassess their usual driving patterns, they will need access to adequate transportation alternatives that will allow them to continue living actively in their neighborhoods.

Considering that most of the displacements are between 1 and 5 km, walking could be the link that connects senior Italians to their destination. An interesting study carried out by Metro Vancouver Canada found that living in neighborhoods with a greater prevalence of destinations was associated with more trips on foot, suggesting that given the opportunity, older adults are willing to walk instead of drive to reach nearby locations (Chudyk et al., 2015).

Older adults over 65 years are at a higher risk of injury compared with younger adults due to frailty and associated increased injury susceptibility, placing them at a double disadvantage when walking or cycling, compared to when travelling in a vehicle (O'Hern & Oxley, 2015).

While these assumptions are perfectly rational and sensible, car use trends show how even in the close-proximity range, Italians (young and old) rely on the car. In this sense, higher parking tariffs in city centers has been a policy often used by local governments to discourage car use.

Walking has numerous incentives: it is healthy, cheap and "green", yet crumbling or absent sidewalks, inadequate signaling and lack of time to cross-large intersections are obstacles to boosting walking as a mobility option.

The use of public transport should be more appealing, essentially by understanding what factors discourage senior citizens from using it. For example, wider use of live departure boards and audio-visual announcements on buses could increase older people's confidence in using public transport (Holley-Moore & Creighton, 2015).

In a country of drivers, the absence of a comprehensive scheme for older drivers who have to stop driving for functional reasons is alarming. It is surprising that even countries that have introduced age-related screening for older drivers, a comprehensive framework to help seniors remain mobile after having stopped cessation is missing (Marin-Lamellet & Haustein, 2015).

If properly informed, today's seniors are willing to accept innovation, which may enlarge their mobility options with limited costs for the public administrations thanks to technology compensating for diminished capacity (Katsavounidou, 2017; Coughlin, 2009). However, this willingness seems to be completely ignored by public administrators responsible for developing urban mobility plans.

Mobility planning in Italy should be an integral part of city planning rather one of two separate entities that speak different languages. Even though car use is a consolidated lifestyle, it is likely that seniors will use public transport where it is accessible and safe.

Importantly, investments in new and accessible services should be made once knowledge on this age group's habits and preferences has been assessed. Some interviews and focus groups that have been carried out with seniors in the city of Genoa during 2017 show that what is perceived as vehicle comfort for those over 65 (ease of getting on and off, lower seats, wider corridors) is in stark contrast with the criteria adopted by the local Public operator in its acquisition of new vehicles.

The mobility needs of the elderly have a strong local connotation which fail to be recognized by treating the elderly as a monolithic category. The need for a proper age segmentation is confirmed by several studies that have disaggregated the "elderly" category into different sub categories with very specific needs (Currie & Delbosc, 2010; Mandl et al., 2013; Coughlin, 2009; Haustein, 2012; Kim & Ulfarsson., 2004; Siren & Haustein, 2013).

The starting point to bring urban mobility planning closer to an active ageing of the population is a sound knowledge of mobility demands that greatly differ from those of the past and that tend to vary between geographical contexts (Nordbakke & Schwanen, 2014).

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AUTHOR'S PROFILE

Claudia Burlando is a researcher in applied economics, Department of Economics (DIEC), School of Social Sciences, University of Genoa. Member of Italian Center of Excellence on Logistics, Transport and Infrastructure (CIELI). Member of national and international research programmes financed by the Italian Government. Consultant of Italian Municipalities on urban logistics. Member of technical group for Urban Mobility Plan of the City of Genoa. Author of national and international publications.

Ines Cusano is an research scholar in the transport field, Department of Economics (DIEC), School of Social Sciences, University of Genoa. She holds a PhD Italian Center of Excellence on Logistics, Transport and Infrastructure (CIELI). She has participated in different EU funded projects and has collaborated with the European Commission as external expert in the urban mobility sector. Author of national and international publications.

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A SET OF VARIABLES FOR ELDERLY ACCESSIBILITY IN URBAN AREAS

CARMELA GARGIULO, FLORIANA ZUCARO,
FEDERICA GAGLIONE

Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II
e-mail: gargiulo@unina.it; floriana.zucaro@unina.it; federica.gaglione@unina.it
URL: www.tema_lab.unina.it

ABSTRACT

Until a few years ago, the elderly were considered as fragile, lonely, marginalized citizens, unable to live independently and had generally been "invisible" in studies and planning instruments that involved the governance of urban transformations. In recent years, a major focus of attention has been paid to the matter in urban development policies too (OECD, 2015), which should be oriented towards the construction of an urban model aimed at reducing the social exclusion of the elderly. For this purpose, this contribution describes a first research segment developed by the University of Naples operating unit concerning the definition of a set of variables to measure accessibility of the elderly segment of the population to the neighbourhood scale. In particular, the paper pursues a twofold objective: cognitive and methodological. Firstly, to outline the cognitive framework on the issue of urban accessibility for the elderly through a review of the main studies on this topic, the plans of sustainable urban mobility, the service plans and the governance tools for urban transformation, as well as of the most recent European best practices. The cognitive framework shall allow identifying the limits to be overcome in the reorganisation of the city.
Secondly, this paper is intended to identify the set of significant variables taken from the cognitive framework and quantify its specific weight. The paper also proposes a first parameterization of the variables in the GIS environment, which refer to quantitative geo-localized data rather than collected from sample surveys, such as interviews, widely used in literature.

KEYWORDS
Elderly; Built Environment; Urban Accessibility

1 INTRODUCTION

In all the Western industrialized countries and in many developing ones, the population ageing index is gradually increasing and it is foreseen that by 2050 one in every five persons throughout the world will be at least 70 years old and that elderly people in 64 countries will represent the 30% of the entire population.
The demographic change taking place poses many challenges of a social, economic, cultural and urban nature. Since the Second World Assembly on Ageing held in Madrid in 2002, the strengths on which to trigger and develop the International Action Plan for the social integration of elderly people have emerged. The most important of these strengths relate to safeguarding elderly people's health and well-being, and fostering an environment favourable to their capacity for initiative. The Plan, like many other subsequent documents, underlies the need for a cultural overturning marked by the recognition of the elderly as a resource and no longer as a problem or an obstacle to the social and economic development of the community and the organization of the urban system, borne in mind that in Italy, for example, in 2017 life expectancy at 65 has reached 21 years and the related health conditions are expected to improve. Until a few years ago, the elderly were considered as fragile, lonely, marginalized citizens, unable to live independently and had generally been "invisible" in studies and planning instruments that involved the governance of urban transformations. In recent years, a major focus of attention has been paid to the matter in urban development policies too (OECD, 2015), which should be oriented towards the construction of an urban model aimed at reducing the social exclusion of the elderly. In recent studies and research on the topic the ease of movement within the urban system and, more generally, accessibility to places and services, is identified as a prerequisite for the possibility of including elderly people in the economic and social processes (Glass et al., 2006; Newson & Kemps, 2005). Facilitating elderly people's mobility is a key element in ensuring their commitment to civic and social life, their participation in community activities and in pursuing human interactions that enrich their health, well-being and quality of life (Dickerson et al., 2007). In light of these brief considerations, the MOBILAGE research project aims to develop new forms of governance for the urban accessibility of the elderly. MOBILAGE also aims to define decision support tool to public administrations to improve the urban accessibility of the elderly to the activities and services of their interest, thus contributing to increase their quality of life. For this purpose, this contribution describes a first research segment developed by the University of Naples operating unit concerning the definition of a set of variables to measure accessibility of the elderly segment of the population to the neighbourhood scale. In particular, the paper pursues a twofold objective: cognitive and methodological. Firstly, to outline the cognitive framework on the issue of urban accessibility for the elderly through a review of the main studies on this topic, the plans of sustainable urban mobility, the service plans and the governance tools for urban transformation, as well as of the most recent European best practices. The cognitive framework shall allow identifying the limits to be overcome in the reorganization of the city. Secondly, this paper is intended to identify the set of significant variables taken from the cognitive framework and quantify its specific weight. As a first approximation, it can be stated that the four main categories of reference (subsystems) in which the variables are articulated are: socio-economic subsystem, environmental subsystem, physical subsystem and functional subsystem. Variables that refer to the physical and functional characteristics of the neighbourhood (supply) and the types of behaviour of the segment of the population (demand) will be identified within each category. The paper also proposes a first parameterization of the variables in the GIS environment, which refer to quantitative geo-localized data rather than collected from sample surveys, such as interviews, widely used in literature. In particular, the paper is articulated in four sections: the first

section proposes a review of the scientific literature on the issue of accessibility for the elderly; the second section proposes a reading of sustainable urban mobility plans, service plans; the third section is dedicated to the most effective identification and parameterization of variables, which are significant for physical and functional accessibility due to the socio-economic characteristics of the elderly population; the fourth section compares the variables emerged from the scientific literature with those proposed in this paper.

2 BACKGROUND

Since the early 1980s a number of initiatives on the old ageing issue have been promoted at governance and academic levels, although the "Global Age-Friendly Cities" project launched by the WHO in 2006 is most of the time mentioned as the starting point for age-friendly community development initiatives. In 1982 the UN approved the first Report on the World Assembly on Ageing to encourage the dialogue among policy makers, researchers and non-governmental organizations on "the implications of aging of the population for social, economic and urban development" (UN resolution 37/51). From 1991 to 1999 (the latter declared Year of Older Persons) several institutional documents were formulated to provide the main principles of well-being to older people, such as dignity, independence and participation. As a matter of fact, these documents were characterized by a continuous re-definition of terminologies, planning aim priority settings and the need of stressing the use of a multidisciplinary approach. If the UN policy recommendations of the 90s were mainly led by gerontological research, at the turn of the new millennium the attention shifted from social, civic and health matters to how to enhance people's quality of life as they get old through urban planning (Biggs et al,. 2000; Buffel et al., 2012). This shift occurred for four main reasons: (i) the demographic change related to an increase in the number of people aged 60 and over, which percentage raised from 7.7% in 1950 to 17.8% in 2010 and is expected to rise to 25.1% by 2050 (OECD, 2015); (ii) the urbanization process, as population growth and urbanization are projected to add 2.5 billion people to the world's urban population by 2050 (Beard & Petitot, 2010); (iii) the spread of accessibility, sustainability, universal design concepts referred to some urban models such as healthy, compact and harmonious city; (iv) the idea to promote retirement communities to make people age in places that effectively meet their needs, also according to WHO principles of an age-friendly city (Evans, 2009; Rioux & Werner, 2011). In particular, the "new" interest in accessibility in cities within urban and transport planning, community design and urban geography disciplines promoted a broad research on how built environment allows to relate people, promote walkability and integrate different land uses (Angelidou, 2017; Batty, 2009; Busi, 2011; Tiboni & Rossetti, 2014). This has meant to discuss the need of "appropriate, well-designed places in which people choose to spend time and that provide a place for people to relax, socialize and be part of urban life" (Gehl & Matan, 2009; Meshur, 2016; Papa et al., 2016a). In other words, during the 2000s the raised questions about elder friendly cities started to relate to the mutual interaction between built environment and behavior of the elderly: on the one hand, the physical and functional organization of the urban system determines the opportunities to move and participate in the urban life (offer) and, on the other hand, the behaviours and habits of the elder population (demand) require a new configuration of the physical and functional assets of settlement systems. This duality has fuelled the debate on how to increase urban accessibility for elderly people, both by referring to the infrastructure network (transport and communication) and the localization of activities of interest (Alsnih & Henser, 2003; Arentze et al., 2008; Broome et al., 2010; Broom et al., 2012). A large literature has been produced on the key factors that influence travel decisions among people aged 65+ (Ritter et al., 2002; Spinney et al., 2009; Szeto et al., 2017; Wong et al., 2017), while a most recent line of research has focused on how the network of open spaces (built and not built) promotes social

participation, interaction among elderly and physiological benefits needed for the maintenance and enhancement of physical health and functioning (Sugiyama & Thompson, 2007; Yuryev et al., 2010). In particular, studies such as Temelová & Slezáková (2014), Yung et al. (2016) and Wen et al. (2018) have investigated elderly preferences about localization, accessibility, infrastructure and facility, maintenance and landscape features of public open spaces, by stressing the need of providing a sense of place that is inclusive and caring for its older users. Instead, little research has explored the development of new forms of governance for the urban accessibility of the elderly giving particular attention to the mutual influences among the forms of urban organisation, the configuration of infrastructural networks and lifestyles.

3 METHODOLOGY

As argued in the previous section, the senior segment of population has rarely been considered within urban development policies, despite the spread of the age-friendly approach. Policies and strategies to regulate the urban system should be promoted to meet the needs and requirements of this segment of the population, making the city more accessible, safe and inclusive through the organisation of spaces and mobility networks. In this perspective, this study aims to develop a methodology for defining the urban features necessary to increase accessibility levels, also in relation to the habits and behaviours of the elderly population. The proposed methodology is divided into four phases. In the first phase, the cognitive framework on urban governance tools has been drawn up, as well as the cognitive framework on studies and research on this topic, in order to identify the main urban features required to favor age-friendly environments/communities. The selection criteria for the instruments regulating urban transformations were two: those adopted in the last ten years and the ones relating to the Italian provincial capitals. The cognitive framework on research and studies, which refer to different subject areas, has shown that urban accessibility is mainly studied both in terms of organisation of the displacement networks and in relation to widespread behaviours and health conditions. Studies concerning, instead, the localization and distribution of activities on the territory are lacking. In fact, according to Buffel et al. (2012) "physical environments have a significant impact upon all age groups but especially for those reliant on their immediate locality for support and assistance". More specifically, the studies refer to three main areas of research: (i) studies on upgrading transport supply to improve the displacement of the elderly (Alsnih & Hensher, 2003; Haustein, 2012; Morency et al., 2011; Scheiner, 2006; Shoval et al., 2010; Wong et al.,2017); (ii) studies relating to the redevelopment of open spaces (built and not built), to encourage the participation and social aggregation of the elderly (Bowling & Dieppe, 2005; Gehl et al., 2006; Buffel et al., 2012; Scharlach & Lehning, 2013; Toepoel, 2013); iii) studies on the positive incidence of soft mobility on the reduction of diseases affecting the elderly (Macniven et al., 2014; Maisel, 2016; Moran et al., 2014; Pan et al., 2009; Stewart et al., 2001; Van Cauwenberg et al., 2016). The second phase concerned the classification of the characteristics identified in the previous phase in three macro-categories:

- Socio-economic characteristics: describe the behaviour of the elderly, such as age, education, employment and income, which most affect their choice of moving around;
- Urban accessibility characteristics: describe the levels of accessibility to urban areas including a judgment on the form and intensity of land use (or more generally on the distribution of activities in space) and a judgment on the performance of transport networks (or more generally on the degree of spatial separation between two or more activities);
- Built environment characteristics: describe the geometry and the physical aspects of the urban texture.

In the third phase, from the above listed initial set of urban and social characteristics were selected the ones recognized in literature as significant, based on the results of the analysis techniques used. These techniques favor the processing of questionnaires to collect information on elderly people's lifestyles and the use of multivariate statistical techniques (such as ANOVA test and multiple regression) for the assignment of weights and the relative identification of significant variables (Haustein, 2012; Hawkesworth et al., 2018; Morency et al., 2011; Scheiner, 2006).

Because of the systemic-holistic approach which inspired the whole research work (Papa et al., 1992), in phase 4 the significant variables were reclassified in the following subsystems in which a city wishing to improve urban accessibility for the elderly can be articulated:

- Socio-economic subsystem: describes the behaviour and the habits of the elderly;
- Environmental subsystem: describes the climatic and context characteristics;
- Physical subsystem: describes the localization and distribution of open and built spaces of interest for elderly;
- Functional subsystem: describes the main activities of interest for elderly.

The set of variables that allow to define the offer in terms of urban accessibility (physical, functional and environmental subsystems) and the demand of the elderly population (socio-economic subsystem) has been established in view of the characteristics identified (phase 5 and Tab. 1). In addition to the characteristics identified as significant in literature, other relevant features for the objectives of the research work have been introduced. In this perspective, the purpose of our contribution, as a part of a broader research work, is to integrate the set of variables taken from the literature with further elements of interest related to each of the identified subsystems (phase 6). Tab. 2 shows the proposed set of variables. Phase 7 concerned the parameterization of each of the variables of the proposed set, aimed at estimating the urban characteristics to appropriately define the strategies and interventions needed to improve the accessibility of the elderly. This is an innovative operation compared to other research studies, which mostly use qualitative data taken from sample surveys such as questionnaires. From Tab. 2 it is possible to notice that if the quantification of the socio-economic subsystem variables is already available by consulting the databases of institutes that deal with statistical analyses concerning both the population and the mobility, for the remaining subsystems (environmental, physical and functional) quantitative data will be obtained through spatial analyses in the GIS environment.

ID	VARIABLE	WEIGHT	PAPER
SOCIO-ECONOMIC SUBSYSTEM			
1	Population over 60 divided into age groups (60-70,70-80,> 80)	p= - 0.25 p< 0.001 p= 0.37 p= - 0.55	Wong et al., 2017 Hawkesworth et al., 2018 Morency et al., 2011 Scheiner, 2006
2	Population divided by gender	p= - 0.27 p= 0.578 p= - 0.29 p= - 0.02	Wong et al., 2017 Haustein, 2012 Scheiner, 2006 Schwanen & Páez, 2001
3	Education level of the population	p= 0.273 p= 0.41-0.38 p= 0.06-0.10	Haustein, 2012 Scheiner, 2006 Schwanen & Páez, 2001
4	State of employment	p= 0.4 p= 0.09 p= (0.15-0.45) p= 0.05	Wong et al., 2017 Haustein, 2012 Morency et al., 2011 Schwanen & Páez, 2001

5	Income	p= 1.9 p= 0.29 p= 0.15-0.17 p= 0.37-0.50	Wong et al., 2017 Hawkesworth et al., 2018 Haustein, 2012 Scheiner, 2006
6	Possession of car	p= 0.27-0.71 p= 0.46 p= 0.03	Haustein, 2012 Morency et al., 2011 Schwanen & Páez, 2001
PHYSICAL SUBSYSTEM			
7	Metro stations	p= 0.7 p= 0.5 p= 0.3	Wong et al., 2017 Morency et al., 2011 Haustein, 2012
8	Bus and tram stops	p= 0.94 p= 0.80 p= 0.50	Hawkesworth et al., 2018 Schwanen & Páez, 2001
9	Presence of pedestrian paths	p= 0.02 p= 0.005 p= 0.86	Wong et al., 2017 Hawkesworth et al., 2018
10	Distance from the tram	p= 0.29 p= 0.15	Haustein, 2012 Wong et al., 2017
11	Distance from the station	p= 0.45 p= 0.30	Haustein, 2012 Morency et al., 2011
FUNCTIONAL SUBSYSTEM			
12	Shops and services	p= 0.72 p= 0.66	Hawkesworth et al., 2018 Scheiner, 2006
13	Density green area	p= 0.67 p= 0.50	Hawkesworth et al., 2018 Wong et al., 2017

Tab. 1 Significant variable (according to their weight)

ID	VARIABLE	MEASURE	SOURCE
SOCIO-ECONOMIC SUBSYSTEM			
1	Population over 60 divided into age groups (60-70,70-80, > 80)	Inhabitant (Ab.)	Istat-Municipality
2	Population divided by gender	(Males, Females and Total)	Istat-Municipality
3	Education level of the population	(Degree of study)	Istat-Municipality
4	Old index	(%)	Istat-Municipality
5	Health state	(Excellent, Mediocre and Bad)	Istat-Municipality
6	State of employment	(Labor Force in age>65)	Istat-Municipality
7	Income	(EUR)	Istat-Municipality
8	Possession of car	(%)	ISFORT
ENVIROMENTAL SUBSYSTEM			
9	Orography (elevation)	m	GIS
10	Temperature	C°	ENEA
PHYSICAL SUBSYSTEM			
11	Metro stations	R.i.= 500m	Geographic information system GIS
12	Bus and tram stops	R.i.= 500m	Geographic information system GIS
13	Presence of cycle paths	Km	Openstreetmap_GIS

14	Presence of road crossings signaled by traffic lights	n°	Geographic information system GIS
15	Presence of benches and public baths	n°	Geographic information system GIS
16	Presence of pedestrian paths	Km	Openstreetmap-GIS
17	Presence of parking areas	Km²	Openstreetmap-GIS
18	Presence of escalators, elevators	n°	Geographic information system GIS
19	Distance from the tram	m	Geographic information system GIS
20	Distance from the station	m	Geographic information system GIS
21	Distance of residence from the first intersection	m	Geographic information system GIS
22	Built open space network	Km	Geographic information system GIS
23	Network of protected paths	Km	Geographic information system GIS
24	Cycle network	Km	Geographic information system GIS
25	Street lighting	n°	Geographic information system GIS
FUNCTIONAL SUBSYSTEM (services of local interest)			
26	ASL	Influence ray (R.i.)= 500m	Services plan Bari Services plan Lodi
27	Poly-diagnostic center	R.i.= 560 m	Falco, 1978 Urban standards, II edition
28	Pharmacies	R.i.= 500 m	Services plan Bari Services plan Lodi
29	Local market	R.i.= 600 m	Falco, 1978 Urban standards, II edition
30	Circles for the elderly	R.i.= 200 m	Services plan Bari Services plan Lodi
31	Social center	R.i.= 200 m	Falco, 1978 Urban standards, II edition
32	Churches	R.i.= 400 m	Falco, 1978 Urban standards, II edition
33	Cinema	R.i.= 515 m	Falco, 1978 Urban standards, II edition
34	Theater	R.i.= 1000 m	Falco, 1978 Urban standards, II edition
35	Theater	R.i.= 1000 m	Falco, 1978 Urban standards, II edition
36	Green areas	R.i.= 100 m	Falco, 1978 Urban standards, II edition
37	Municipal library	R.i.= 600 m	Falco, 1978 Urban standards, II edition

38	Sports center	R.i.= 1000 m	Falco, 1978 Urban standards, II edition
39	Post office	R.i.= 500 m	Falco, 1978 Urban standards, II edition
40	Bank	R.i.= 500 m	Falco, 1978 Urban standards, II edition
41	Police and Carabinieri	R.i.= 500 m	Falco, 1978 Urban standards, II edition
42	Supermarket	R.i.= 500 m	Falco, 1978 Urban standards, II edition
FUNCTIONAL SUBSYSTEM (services of general interest)			
43	Hospital	R.i.= 1100 m	Falco, 1978 Urban standards, II edition
44	Private Clinic	R.i.= 1100 m	Falco, 1978 Urban standards, II edition
45	Urban park	R.i.= 1000 m	Falco, 1978 Urban standards, II edition
46	Museums	R.i.= 1100 m	Falco, 1978 Urban standards, II edition
47	Cemetery	R.i.= 1100 m	Falco, 1978 Urban standards, II edition
48	Stadium	R.i.= 1100 m	Falco, 1978 Urban standards, II edition

Tab. 2 Suggested variable set and parametrization

4 RESULTS

As argued, the study of scientific literature contributed to the objective of identifying the key urban features that constitute an elder-friendly city:

- Perception of the speed and volume of traffic;
- Neighborhood aesthetics (e.g., foliage, attractive buildings and scenery, absence of litter);
- Satisfaction with the ease and pleasantness of neighborhood;
- Overall safety;
- General functionality of the neighborhood (e.g., traffic condition, street lighting at night, unattended dogs and safety from crime);
- Walkability, pedestrian safety and attractive routes;
- Local park and natural environments nearby.

Some features, such as the aesthetics of the neighborhood, the presence of pedestrian paths and local parks, are meant to make the movement of the elderly easier and enjoyable; other features, such as street lighting and traffic perception, significantly affect their sense of security and their participation in social activities. The key features that significantly influence the urban accessibility of the elderly, articulated in the

four urban subsystems defined above (socio-economic subsystems, environmental subsystems, physical subsystems, functional subsystems), have been referred to the variables identified in literature as relevant for their statistical weights. The set of 13 variables identified has been extended with other features that allow to consider further elements of interest for this research work, related to both the demand and the offer of the urban system. In particular, the "Old index" and "Health state" variables have been added to the socio-economic subsystem in order to take into account, respectively, the population structure and the elderly potential to movement and participation in the city life. The "Elevation" and "Temperature" variables have been added to the environmental subsystem, as the presence of altitude differences and the microclimatic conditions (sunlight, ventilation, humidity) influence the displacement choices of the elderly who prefer a soft mobility. Other variables related to pedestrian safety of the weakest elderly users have been added to the physical subsystem, such as "Presence of road crossings signaled by traffic lights", "Usable sidewalks", "Presence of escalators and/or elevators" and "Street lighting". "Green network" is a further variable that characterizes the physical subsystem to take into account the many benefits that the network of not built open spaces brings to these weak users in terms of longevity, health, human well-being and thermal comfort improvements (Arnberger et al., 2017; Gargiulo et al., 2017; Hansmann et al., 2007; Papa et al., 2016b; Salata & Yiannakou, 2016). Some functional variables have been added to the functional subsystem to identify in a more detailed way than the related scientific literature all possible types of local and general services of interest for the elderly, such as "Pharmacy", "Local market", "Clubhouses for elderly ","Social center", in order to consider a broader and more diversified functional offer. Subsequently, efforts were made to identify possible interventions to improve elderly people's quality of life through the study of all the most recent plan instruments of the Italian provincial capitals. The Sustainable Urban Mobility Plans (SUMP) and Service Plans proved to be the only ones particularly sensitive to the issue of improving urban accessibility for the elderly. Several Italian provincial capitals, such as Milan, Parma and Turin, have paid particular attention to the issue starting from the core objectives of the plan: equity, security, social inclusion and everyone's right to access the city without barriers. Starting from these objectives, strategies and actions have been developed in order to improve urban accessibility for the elderly through:

- The increase in soft mobility facilities;
- The improvement of street lighting;
- Improving safety at traffic intersections;
- Reducing obstacles on sidewalks.

It is worth noting that the 100 Station Plan of Naples pays particular attention to the issue of improving accessibility (especially to rail network stations) through the integration of urban transformation governance and transport planning, although this plan was developed over 10 years ago (2001). In particular, this plan identifies the catchment area of the railway stations, according to the geometric, morphologic and functional characteristics that influence the pedestrian accessibility (Papa & Trifiletti, 2010), in line with the future steps of the MOBILAGE project research as described below. The Service Plans of the cities of Lodi and Bari make use of the radii of influence of some services for the elderly population in urban areas, such as:

- ASL (Local Health Service)= 500m;
- Pharmacies= 500m;
- Clubhouses for elderly= 200m.

The values of the radii of influence provided by the Service Plans above mentioned are, actually, the theoretical quantities from which to start to define the relative catchment areas. Hence, a subsequent phase

of this research work is aimed at defining, for each of the activities of interest for the elderly, different radii of influence due to the different age segments in which the over 60 population can be articulated. This goal is linked to the consideration that the will to travel gradually reduced distances is due to the increase in age and/or the reduction of health conditions. The parameterization of the variables identified is the first step to define a methodology for classifying the different types of urban fabric, given the different levels of accessibility for the elderly people. The overlapping of the areas of influence of the many activities of interest and the "density" and distribution of these types of services, on the one hand, and the presence of protected pedestrian paths and local public transport stops, on the other, will allow (at a later stage of the MOBILAGE research project) to identify which portions of the area investigated are more adequately meeting the demand of the elderly segment of the population and which ones, instead, lack in physical and/or functional supply, also taking into account the morphology of the area. This experimentation will be carried out in the VIII Municipality of Naples Vomero and Arenella, that is one of the two areas examined by the MOBILAGE project.

5 CONCLUSIONS

From the cognitive framework of the scientific literature and the Italian urban governance tools, this research work identified two main gaps about the issue of urban accessibility of elderly. First, elder people rarely feature in urban policies and governance tools aimed at efficiently satisfying their specific needs, despite the growth of the "age-friendly approach". Our review confirms Uhlenberg (2009) and MacLeod et al. (2016) considerations about the fact that planning documents barely mention elder people's needs. They are usually mentioned in terms of numbers, but the analyses rarely result in concrete proposals and measures. In particular, this issue within urban planning tool has been discussing less intensely than other plans such as the urban mobility ones (in general). According to Buffel et al. (2012), "in this context, elderly people illustrate many of the tensions running through urban change" (see section 2). Second, to deal with this ageing challenge occurring in a shifting economic and global ecological context (EEA, 2013) it can be assumed that a city needs a physical and functional reorganisation. On the one hand, both public transport and soft mobility network should be redesigned in order to increase the attractiveness of the city and the elderly well-being by allowing a better accessibility to urban open and built spaces and to activities. On the other hand, a proper mix of functions and accessibility to the same places for different social and generational groups guarantee that the built space will contribute to the social equilibrium of a society. Intervening on both these two elements means improving urban accessibility for all ageing groups, by making built spaces livable and accessible to every category of people, including persons with disabilities (UN, 2006; Tiboni & Rossetti, 2012). In particular, the issue related to the most suitable localization and distribution of activities of interest for elderly is still lacking within the scientific debate. Few studies have addressed the issue of how the "spreading" of local and welfare facilities for elderly can contribute to increase urban accessibility levels. In order to fill this gap, the proposed set of variables has included many elements related to local and general activities as well as to the environmental and physical characteristics. The research work is based, in fact, on the consideration that the improvement of urban accessibility requires the adoption of a holistic-systemic approach to integrate activities already developed in the territory, networks of displacement and open spaces (built and not built), and user needs. In the light of the above, our paper suggests that decision makers and urban planners should adopt an integrated approach to plan ageing cities, as this challenge can be seen as an opportunity to increase city's sustainability, attractiveness and competitiveness in the areas of land use, transport, welfare services and social cohesion.

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IMAGE SOURCES

Cover image: EEA, (2013). https://www.eea.europa.eu/articles/a-europe-to-thrive-in/cities-in-transition-leaflet.

AUTHOR'S PROFILE

Carmela Gargiulo is a full professor of Urban Planning Techniques at the University of Naples Federico II. Since 1987 she has been involved in studies on the management of urban and territorial transformations. Since 2004, she has been Member of the Researcher Doctorate in Hydraulic, Transport and Territorial Systems Engineering of the University of Naples "Federico II". She is Member of the Committee of the Civil, Architectural and Environmental Engineering Department of the University of Naples "Federico II". Her research interests focus on the processes of urban requalification, on relationships between urban transformations and mobility, and on the estate exploitation produced by urban transformations. On these subjects she has co-ordinated research teams within National Project such as Progetto Finalizzato Edilizia - Sottoprogetto "Processi e procedure" (Targeted Project on Building – Subproject "Processes and procedures), from 1992 to 1994; Progetto Strategico Aree Metropolitane e Ambiente, (Strategic Project Metropolitan Areas and Environment) from 1994 to 1995; PRIN project on the "Impacts of mobility policies on urban transformability, environment and property market" from 2011 to 2013. Scientific Responsible of the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II, from 2012 to 2015. She is author of more than 90 publications.

Floriana Zucaro is an engineer, Ph.D. in Hydraulic, Transport and Territorial Systems Engineering at the Department of Civil, Building and Environmental Engineering – University of Naples Federico II. She received a M.Sc. in Environmental and Territorial Engineering at the University of Naples Federico II with a specialization in management of urban and territorial transformations. In 2014 she won a scholarship within the Project Smart Energy Master for the energy management of territory financed by PON 04A2_00120 R&C Axis II. Her research interests are in the field of land use planning and energy saving integration in urban policies, sustainable land use and sustainable mobility.

Federica Gaglione is an engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II. Her research topic concerns the urban accessibility. The aim is to develop a decision support tool that, on an urban scale, allows to choose the most effective actions to improve urban accessibility for vulnerable users, by contributing to improve their quality of life.

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THE TOURIST-RELIGIOUS MOBILITY OF THE "SILVER-HAIRED PEOPLE"

THE CASE OF PIETRELCINA

ROSA ANNA LA ROCCA[a], ROMANO FISTOLA[b]

[a] Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II
e-mail: larocca@unina.it
URL: www.tema_lab.unina.it

[b] Department of Engineering, University of Sannio
e-mail: rfistola@unisannio
URL: www.romanofistola.it

ABSTRACT

This study deals with religious tourism as a particular social and cultural activity attaining high levels of interest also in the scientific context. Within this form of tourism, the segment of "senior travelers" plays an important role considering the increase of the population aging phenomenon. Although there is not yet a unique and shared definition of senior tourism, it is possible to outline some characteristics to define this specific form of use of the urban system. The case study of Pietrelcina (BN) in Campania has been considered as a meaningful example of international religious pole connected to San Pio cult. In this regard, the study is aimed to explore the possibilities of defining territorial strategies for the promotion of territorial resources. The main objective of this study is to overcome the sectorial approach, based on the "mono-pole supply" (the organization of tourist flows "exclusively oriented", centralized in the most popular destination), suggesting a systemic-territorial supply reconfiguration aimed at improving the accessibility to older slow tourism. The study, thus, proposes a reconfiguration of the territorial organization in order to prefigure a systemic territorial-supply aimed at improving particularly accessibility referred to older slow tourism. Slow tourism as innovative form of territorial use could improve the relationship between tourism and territory that was the original sense of pilgrimage.

KEYWORDS

Elderly; Silver Tourism; Territorial Tourism Accessibility; Pietrelcina (BN) Campania

1 INTRODUCTION

This study deals with the relation between two increasing phenomena that are affecting present cities. On one side the aging of the population, on the other side the growth of the tourism as a cultural and social practice. It is realistic to suppose that in the next future cities would face, among the others, these new demands related to urban living and territorial use. Our opinion is that town planning, whose main objective is the development of urban livability for all type of users (residential as well as non-residential), must have a leading role in the definition of strategies and interventions to get this target.

There is consensus on the opinion that tourism is the main existing industry both for the substantial contribution to GPD and for generating new job opportunites. As a producer of incomes, tourism has become the main driver of the urban transformation policies for increasing attractiveness from private investments as well as from tourist flows.

The lack in planning efficiency emerges when tourism load on the city has got unsustainable and invasive (the phenomenon is also defined as "over-tourism") and the use of extreme measures seems the only feasible solution as in the recent cases of Venice or Barcellona (La Repubblica, 2018; Hugues et al., 2018). On the contrary, the city of Amsterdam has taken a different approach to the problem, providing actions to subtly move tourists away from the most popular attractions by re-branding less known places thus redistribute tourist flows and entice tourists to venture further afield from the inner city. Tourism is a double-face phenomenon, it requires attention in the planning of its development, in order to share its benefits out among stakeholders, politic administrative levels, and permanent residents. The sustainable tourism concept, even though still unclear, can be seen as an urban adjunctive load that does not upset the existing equilibrium of the city, but rather it extols territorial potentialities benefiting actively local communities (social, political and territorial level). This type of tourism in the western industrialized countries is assuming the label of "cultural tourism".

Concerning this theme, scientific literature is extremely copious, defining cultural tourism as a new form of activity, whose aim is developing a potential economy, saving territorial resources.

In the present study, we assume cultural tourism as defined by UNWTO (World Tourism Organization) in 1985 and later by ATLAS (Association for Leisure and Tourism Education) in order to point out that, in the wide range of cultural tourism definitions, religious tourism flows can be included. According to these definitions, that have gained official status, this study considers religious tourism as the movement of people that concentrate in places where something of "miraculous" and/or connected with faith happened, in order to boost their own culture too.

Focusing on this special tourism segment, this paper is structured in two main parts. The first part aims at pointing out the characteristics of religious tourism demand, a form of emergent tourism identified as "silver tourism". The second part analyzes the case of Pietrelcina (BN) in South Italy as a representative example to spark sustainable and aging-friendly form of territorial development.

2 ELDERLY POPULATION: A "LIQUID THRESHOLD"

In this paragraph, we tried to outline how it is not possible to define exactly who can be defined as elderly people, stating that the limit imposed by the statistical logic should be overcome through a more *flexible threshold* that could better fit the current social trends. The national, European and world demographic statistics show a progressive aging of the population. The 2017 Revision of World Population Prospects

prepared by the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, for example, indicates an increase in the population aged over 65, outlining a rapid and global growth of aging population (Fig. 1). The conventional statistic threshold for seniority usually set in 65 years, as this age generally corresponds to the exit from employment.

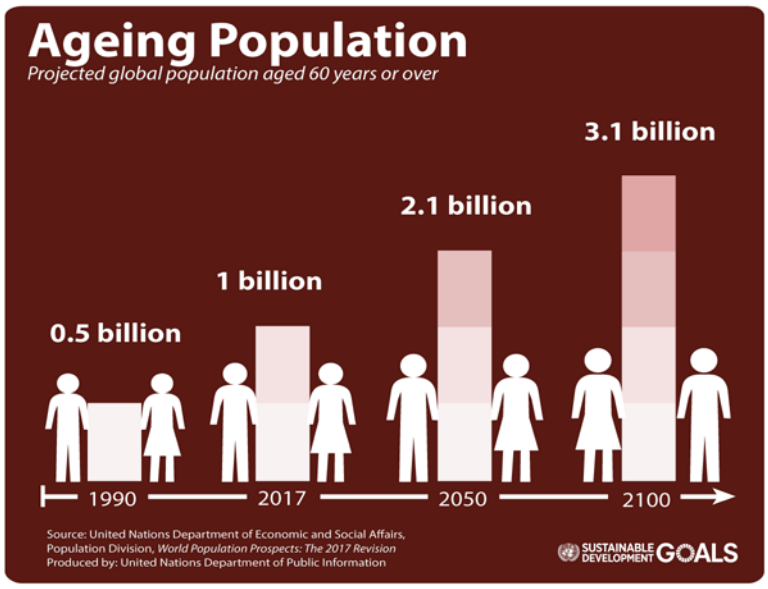

Fig. 1 Trend of growth for the world population aged 65 or over calculated by the United Department of Economic and social affair of the United Nation

However and at least for the western economy countries, the undeniable aging process requires some observations related not exclusively to the age, but also to the change in habits, in culture, in availability of leisure, in the composition and in the economic structure of the family itself that is modifying the current population's profile. These factors can be complemented by the medical progress and the better lifestyles leading to the improvement of the global life expectancy (Fig. 2).

Fig. 2 Average data of the global life expectancy forecasting calculated by the United Department of Economic and social affair of the United Nation

Thus, it is questionable whether it is possible to define a "flexible threshold", more responsive to the change before mentioned, instead of that one strictly defined by statistics. In support of this, in the last decade the concept of *active aging* is emerging to indicate how active the new aging population is, as well as their role in present communities. In Italy, for instance, elderly parents keenly contribute to the economy of their sons' family sometimes covering for the lack of social services to young families and working mothers (e.g., babysitting their nephews). In a recent survey conducted by Share (Survey of Health, Ageing, and Retirement, 2014) under the coordination of the Munich Center for the Economics of Aging (MEA), Max-Planck-Institute for Social Law and Social Policy, some life steps, defining the switch to senility, are indicated below:

- The exit from employment;
- The leaving from the family state of the last son;
- The nephew's birth;
- The consort's loss;
- The worsening in health conditions.

As many difficulties are evident defining exactly at what age this "life switch" happens, the report outlines five flexible classes to define the transition to the senility:

- Prolonged aging characterized by a slow transition from one step to the next;
- Medium-long aging characterized by an irregular transition from the different steps;
- Middle aging, characterized by a regular transition from one step to the next;
- Deferred aging, characterized by irregularity in the transition.

The classification could be arguable, especially for the definition of the single step (e.g. is there a fixed age for becoming grandfather/grandmother or to be widow/widower?) but it is worth underline how old age could be defined through wider limits than the statistical ones, varing from country to country according to culture and lifestyles. This consideration is even more meaningful for the object of this study that considers tourism, traditionally defined as the movement of people outside from their original residential place or usual environment for less than one year for different purposes other than employment. Mobility is a base activity for tourism, according to the given definition, and with respect to the present case study, it is assumed that religious tourist flows are made of people who, even though aged, have a good mobility capital. The interest of the study, thus, is focused on a specific demand of use of the city (the religious tourism flows) that could be defined as a not more young population of city-users. Some consideration concerning the aging population trend in Italy can be useful to better argue our research. In Italy, in 2017 according to the data of Italian Statistical Institute (ISTAT), older adults corresponding to 65 aged overcome 13.5 million and represent the 22.3% of total population. In 2007, the same population was 20.1% of total population (Fig. 3). ISTAT forecasts for the period 2015-2065 the growth between the 21.7% and the 32.6% of the total population. The reasons for this growth can be identified in two of the demographical phenomena that contemporary are occurring in this particular historical period. On one side the decline in birth rate[1] that can be observed as a bottom-up aging phenomenon. On the other side, the increase of the life expectancy that in Italy is about +19 years for a man that has 65 years nowadays, and about +22 years for a woman; the

[1] In Italy, in 2016 the birth rate decreased of about -2.4%, except for the province of Bolzano. The national fertility rate (average number of children per woman) also decreased, with reference to mothers of Italian nationality (1.34 children / woman) and foreign mothers (1.95 children / woman) (ISTAT, 2017).

increase is respectively of +0.1% e +0.5% from the year before (2016). By all the previous considerations and with regard to a brief literature review (Tab. 1), this study proposes to consider that population involved in the religious tourism could be composed by people within the age range 55-70 composing a new emergent demographic group defined as "active aging"[2]. The innovation of this approach essentially consists of a new vision that considers elderly as a *resource*[3] for the society rather than *claimers.*

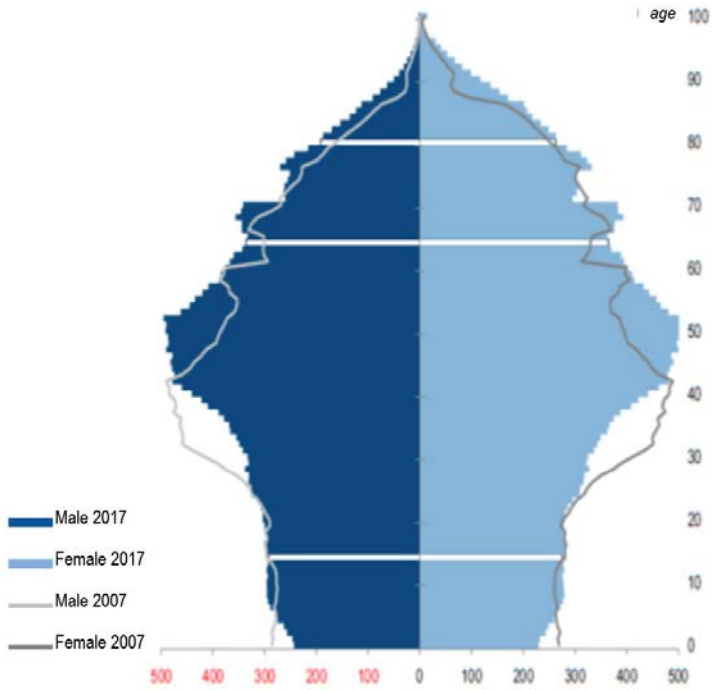

Fig. 3 Population pyramid in Italy: comparison 2007-2017 calculated by the Italian Statistical Institute (ISTAT, 2017)

SOURCE	DEFINITION	THRESHOLDS
World Assembly on Ageing (1982)	On a first approximation, the elderly population is defined as that composed of people with 55 or more years	Over 55
ISTAT	Population aged over 65 (ex-retirement age limit)	Over 65
World Report on aging and health, 2015	Older person: a person whose age has passed the median life expectancy at birth	No age defined
WHO, 2002 UNFPA, Help Age International, 2012 Active Aging Report, 2012 Tourage, 2014	According to a synthetic classification based on two age classes: older adults is population over 60 years and over 80 years. An analytic classification considers five-year or ten-year class starting from people 60 years old.	Different classes: 1. (60-69) = elderly 2. (70-79)= old people 3. (80-89) = very old people

Tab. 1 Definition of seniority thresholds in literature

[2] The European Union has recently defined this expression to intend the process of optimizing opportunities for health, participation and security in order to enhance quality of life (WHO, 2002). The concept also refers to the change in the organization of work system and the increasing of the retirement age.
[3] The reverse mentoring for instance is a practice aimed at overcoming the gap between generations within the same company using the exchange of knowledge among different professional profiles.

3 ACTIVE AGING AND SENIOR TRAVELERS: THE SILVER TOURISM

The growth of tourism phenomenon also concerns the behaviors and preferences of elderly people that seems to be the most dynamic among the types of tourism demand (Fig. 4) even though data show a preference toward the residential trips[4] or no trip in the case of people aged 65 or over (Figs. 5 and 6).

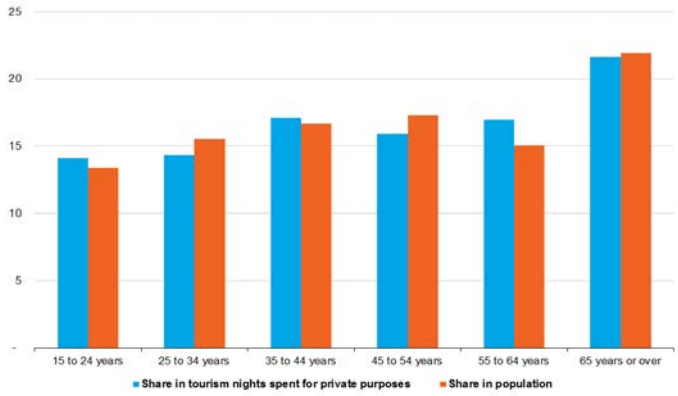

Fig. 4 Relation between EU population and tourism movement by classes of age (Eurostat, 2016)

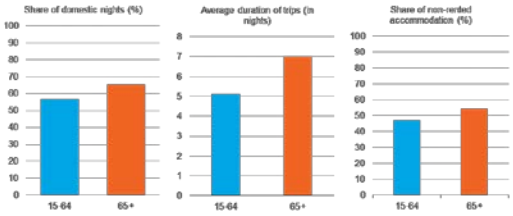

Fig. 5 Preferences in tourism by age (Eurostat, 2016) (left)

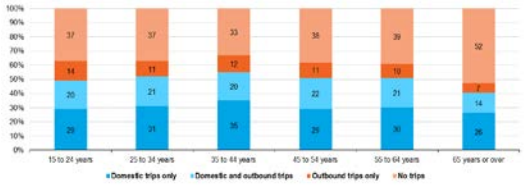

Fig. 6 Participation in tourism by classes of age (Eurostat, 2016) (right)

Silver tourism and the study of its preferences is the object of attention as it represents a possible segment of development for tourism market given the increase of this population.

Some researchers define silver tourism as the segment of population aged over 55 years, focusing on their behaviors (Shoemaker, 2000). Scholars indicate four different tourism markets according to the characteristics of the possible components, thus, they define a "no more young" population interested in the travel experience: a) the mature market (Lazer, 1985); b) the older market (Allan, 1981); c) the senior market (Shoemaker, 1989) and d) the more recent silver market (Branchik, 2010). Along this line, it could be shared the opinion concerning a re-definition of the limits that outline old people by using "fuzzy classes" that could be better defined in possible further development of this research.

An interesting contribution to the definition of the classes of age can be the survey requested by the Directorate-General for Employment, Social Affairs, and Inclusion and coordinated by Directorate-General for

[4] Residential trips refer to the flows of tourism that remain inside the residential country, the trips abroad are not considered.

Communication (DG COMM "Research and Speechwriting" Unit) in 2011 on Active Aging. The first part of the report concerns the perception of aging. Across the 27 Member States, "old age" is felt to be within a range of 61-70 (average age about 65). As it would be expected, perception varies according to the age of respondents. Therefore, the perception of the age at which one stops being regarded as young is indicated within a range of 36-50 years (Fig. 7).

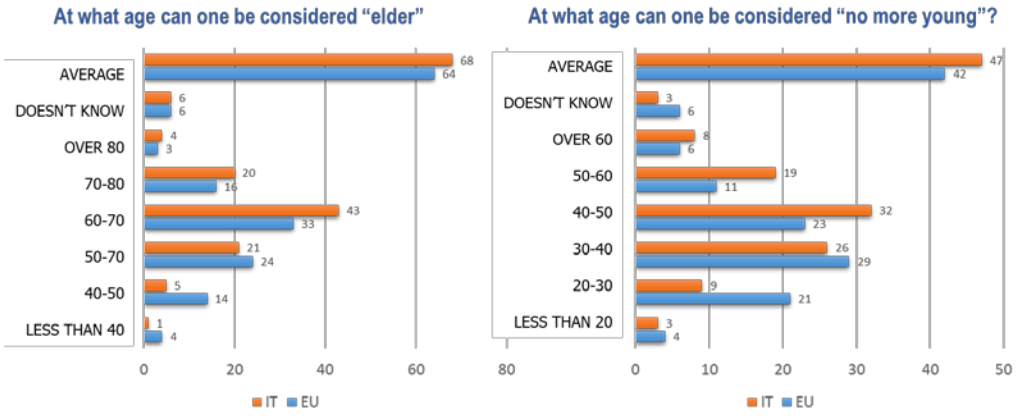

Fig. 7 Perception of aging in Italy and Europe (elaboration from Eurostat 2011)

This has supported our assumption of considering silver tourism as composed by a range of people within a minimum of 55 years to an upper threshold not well demarcated but composed of people able to move independently (without physical limitations and in good health).
In the light of this concerns, this study focuses on religious tourism as flows of people, tending to be aging, that will concentrate in cities and will involve the planning of the organizations and the assets of the cities chosen as destinations (Papa et al., 2014).

4 RELIGIOUS TOURISM: FROM CHARACTERISTICS OF FLOWS TO URBAN TYPES OF POLES

In this part of the present study, religious tourism (Amber, 2018) has been considered referring to two main aspects: on one side the composition of the flows of users (demand); on the other side the individuation of possible typologies of territorial poles that attract these flows (supply).
According to the National Institute for Tourism Research (ISNART, 2016), in Italy, religious tourism is estimated to be about 5 million of presences (about 1.5% of the total inbound tourism) that generates around 2.5 billion of euros of expenditure (accommodations, guides, restaurants, souvenirs). It must be observed, however, that only the 3% of total tourists stay overnight and this makes the monitoring of the phenomenon quite difficult. Nevertheless, this tourism is growing at about 1.2% in the last two years. Considering this segment of tourism as an emergent phenomenon worthy of attention, as data are difficult to achieve and not having possibilities to go forward through direct surveys, we referred to recent studies (BMT 2015; Coldiretti 2014; La Repubblica 2015; TTG_Italia, 2015) concerning religious tourism, in order to define a possible profile of the characteristics corresponding to religious tourism demand (Tab. 2).

Some specifications concerning the definition of religious tourism have been taken into account in order to better understand this phenomenon. The scientific debate main focuses on the difference occurring between pilgrimage and religious tourism. In the case of pilgrimage, it is possible to refer to a form of social mobility that seems to be not affected by the spread of tourism phenomenon. In the case of religious tourism, instead, it is possible to refer to people whose movements generated from different motivations that are not exclusively connected to the faith but concerns culture and leisure as well. This difference is more evident when the religious destination is a complex pole like Rome for example whose attractiveness is shared among several tourisms even though its role of leader of the Catholicism is indubitable for the presence of the Vatican State within the same city. The spread of Catholicism is the origin of the religious tourism because it has enlarged the number of the three original holy places (Rome, Jerusalem & the Holy Land & Santiago de Compostela).

PARAMETERS	CHARACTERISTICS	SOURCES
Age range	55-70	Shoemaker, 2000 Branchik, 2010
Sex	Women (57%) aged 51-65	Coldiretti, 2014
Education level	Graduate	La Repubblica, TTG Italia
Social Status	Married with suns	La Repubblica, TTG Italia
Employment	Retired (42%) Employer (16%) Housewives (18%) Independent (7%) Worker (8%) Craftsman (2%) Entrepreneurs (7%)	Coldiretti, 2014
Motivation	Religious Cultural Leisure	Istat, Coldiretti, 2014
Travel Type	Organized	La Repubblica, TTG Italia
Means of moving	Bus Bus + Airplane Bus + Train Train	La Repubblica, TTG Italia

Tab. 2 Possible profile of religious tourists

The following part of the paper, thus, focuses on the identification of possible typologies of attractive religious poles in order to better introduce the case study chosen as significant for a potential proposal of sustainable territorial development.

4.1 ATTRACTION POLES OF THE RELIGIOUS TOURISM: A POSSIBLE TAXONOMY

In this part of the study, we tried to outline a possible classification of the sites that polarize religious flows of tourism connected with the Catholic faith. Typologies of poles were not ranked at the present state of the research, but they have been defined by the literature trying to extract the general characteristics that can describe their organization as attractive religious poles and that could express the relationship between the motivation of movement and characteristics of the node-pole.

For this purpose, five classes of religious poles have been defined:

- Poles whose relevance is connected with the Holy Bible and with Evangelic history;
- Poles whose relevance is connected with the Holy Virgin Mary worship;

- Poles of relevance for evangelization;
- Poles of traditional and historical pilgrimages;
- Poles coincide with relevant cities for Christianity.

The first class refers to the main destinations of Catholic religious worship such as the Holy Land and the places of the birth of Christ, of the Catholic faith and the evangelical culture. These are complex poles both from the point of view of their urban organization and for the complexity of their political and cultural situation that affect the poles' safety condition for tourists. Nevertheless, in these poles, the flows of religious tourism are consistent and interlace with different cultures and religions.

The second type includes the poles whose relevance is linked to the cult of the Virgin Mary. In this class have been considered both the pole in which are located important sanctuaries dedicated to the Virgin (e.g., Pompeii, Fatima) and the places where the Virgin appeared (Lourdes, Medjugorje, Fatima) that are felt as sites in which miracles can still happen. The urban settlement briefly can be referred to three main urban development patterns:

- The attraction pole and the inner city coincide (Pompeii, Loreto) and the presence of the holy place represents the main urban function;
- The attraction pole is external to city but its presence influences the organization of the whole urban system and the urban supply of services and facilities (Lourdes);
- The pole is independent of urban settlement and is physically distinct from it (Međugorje in Bosnia, Montevergine in southern Italy).

The third class refers to poles that are relevant places, connected with the history of missionaries that offered a humanitarian contribution to the Catholic evangelization (e.g., the places of Mother Theresa of Calcutta).

The fourth typology refers to the traditional routes of pilgrimage (e.g., the Camino de Santiago or the Via Francigena); they are not strictly linked to religious faith, but they can be meant as a way to test personal challenges and to rediscovery slow and simple way of living (Fistola & La Rocca, 2018).

In the fifth typology, poles coincide with cities relevant in the history of the Catholic religion. The poles are strictly linked to the life of the holy person who made miracles and had a sanctification process as certification of him/her accomplishments (St Francis and St Claire of Assisi, St Pio of Pietrelcina and San Giovanni Rotondo, St Rita of Cascia, and so on). The case study proposed belongs to this last typology of attractive religious poles.

5 THE CASE STUDY OF PIETRELCINA (BN) IN CAMPANIA

Pietrelcina is a small city close to Benevento (12 km) the fifth province of the Campania region, in the South of Italy. The city is worldwide famous among the religious poles for being the birthplace of Father Pio (Francesco Forgione), who become a saint in 2002. The municipality (28.7 sq. km. with about 3,114 inhabitants and a density of about 109 ab/sq. km.) has a strategical position within a territory where many other less known attractive poles are located. At present, strategies of territorial development give great attention to the "places of San Pio" but considered as single points within the attractiveness of the municipality, in the lack of a systemic vision that, on the contrary, could improve the potentialities of this particular territory.

As outlined in some studies (Bencardino & Marotta; 2004; Corrado, 2005; Fadda, 2004; ONT, 2008) the main weaknesses of territorial policies of development concern two distinct but deeply connected levels: on

the one hand, the dearth of a systemic vision through which territorial resources could be improved (we refer particularly to the absence of a structured system of accommodation to increase a settled tourism).
On the other end, a still weak political leadership, able of triggering cooperation between public and private stakeholders, according to a wider and long-term vision of promotion of the territorial system of resources, rather those of "isolated polarities".

5.1. THE IMPACT OF THE TOURIST FLOWS IN PIETRELCINA

Availability of data represents the main difficulty when studying tourism phenomenon (La Rocca, 2014).
In this regard, the management of commuter tourism is much more complicated by the need of apply direct analysis to measure the incoming flows that can also modify by the effect of several variables (i.e., the occurrence of specific events, seasonal and climatic conditions, reliance on tour operators, etc.).
Although we do not yet have resources to carry out a wide and exhaustive survey on the field, the analysis of the impacts generated by the tourist load in Pietrelcina was carried out in coordination with the Municipality that provided data to evaluate the phenomenon in the period 2013-2014.
The limited availability of data, however, allowed us to elaborate a first suitable procedure to estimate the impact of the incoming tourism load. The tourist pressure index has been estimated about the average number of urban waste (data available on the Regional Waste Observatory Information System of the Campania Region) produced by the equivalent population in a year (365 days) calculated as:

$$Wm = \frac{1}{n}\sum_{i=1}^{n} \left(w_i \frac{1}{respop} \right) \qquad (1)$$

Where:
Wm is the average daily urban waste production per capita in the municipality "i";
n is the number of municipalities in the neighboring territory;
wi is the total production of urban waste from the municipality I;
respop is the residential population at the date of the surveys.

In the case study, the territory is composed by the municipalities of Benevento, Paduli, Pago Veiano, Pesco Sannita bordering Pietrelcina (Fig. 8). Table 3 and 4 contain the values referred to the production of urban waste for the considered municipalities.
Obtained from (1) the average daily per capita production in the considered territory (0.81 kg / day in 2013; 0.84 kg / day in 2014) and counting the total production of urban waste registered in Pietrelcina in the years 2013 and 2014, the value of the equivalent population (eq_pop) is obtained from the report (2):

$$\mathrm{eq\_pop} = \frac{w_p}{365} \frac{1}{w_m} \qquad (2)$$

where:
eq_pop is the equivalent population (residents + tourists);
wp is the total annual production of urban waste in the municipality of Pietrelcina;
wm is the value of the average daily production of urban waste per capita calculated previously.

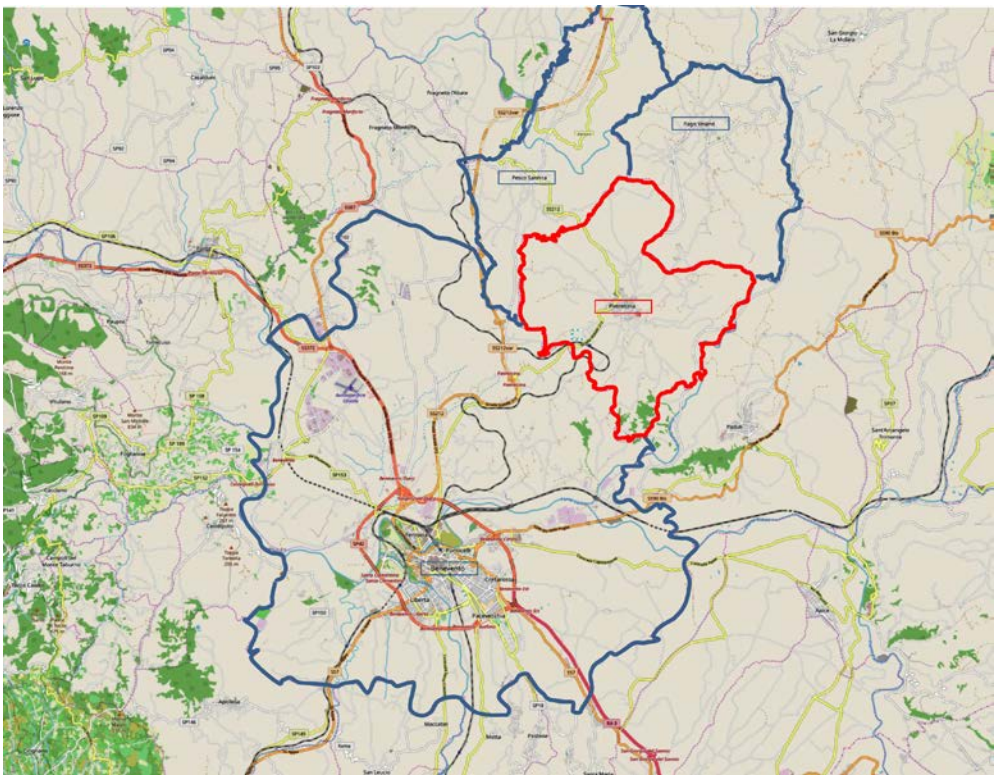

Fig. 8 Pietrelcina and neighboring municipalities

MUNICIPALITY	RESID. POP.	PROV.	TOT. WASTE [Kg]	SWC [%]	WASTE PER CAPITA/DIE [Kg]
Benevento	60,797	BN	25,009,882	63.06%	1.13
Paduli	4,045	BN	1,010,540	71.17%	0.68
Pago Veiano	2,497	BN	689,958	72.83%	0.76
Pesco Sannita	2,050	BN	509,550	55.94%	0.68
Pietrelcina	**3,075**	**BN**	**1,043,953**	**69.40%**	**0.90**

Tab. 3 Urban Waste production in 2013 in the considered municipalities

MUNICIPALITY	RESID. POP.	PROV.	TOT. WASTE [Kg]	SWC [%]	WASTE PER CAPITA/DIE [Kg]
Benevento	60,770	BN	24,147,448	65.00%	1.09
Paduli	4,022	BN	994,168	69.00%	0.68
Pago Veiano	2,459	BN	834,216	76.00%	0.93
Pesco Sannita	2,011	BN	493,340	53.00%	0.67
Pietrelcina	**3,083**	**BN**	**1,069,886**	**75.00%**	**0.95**

Tab. 4 Urban Waste production in 2014 in the considered municipalities

By deducting from the value of the equivalent population obtained from (2) the value of the resident population an estimate of the values of the daily and annual tourist presences can be obtained (Table 4).

TOURISTS	2013	2014
Presence/day	456	399
Presence/year	166,440	145,569

Tab. 5 Estimate values of tourists in Pietrelcina

Considering that tourists do not produce quantity and type of waste like the residents, it was decided to adjust the estimated values have been corrected by an incidence rate corresponding to the percentage of urban waste not produced by tourists (metal, WEEE, pruning, batteries and accumulators, tires, toners, textiles, metal packaging, household composting, etc.), to the total quantity of MSW. The estimated corrective value for the Municipality of Pietrelcina is 12.87% both in 2013 and 2014. In table 6 the values of the estimated presences of tourists have been shown. Another step of the procedure has taken into account that the city of Benevento (as capital city of the province) attracts part of the tourists, the estimated values had a further correction and final value have been referred to a range of annual tourist presences calculated on the basis of the illustrated procedure (Tab. 7 and Fig.9).

TOURISTS	2013	2014
Presence/day	514	450
Presence/year	187,860	164,303

Tab. 6 Estimate of the final presence of tourists in Pietrelcina (minimum values)

TOURISTS	2013	2014
Presence/day	1075	776
Presence/year	392,613	283,206

Tab. 7 Estimate of the final presence of tourists in Pietrelcina (maximum values)

The assessment of "tourist weight" on the urban system can be expressed through indicators that relate the variables linked to tourist flows with the population and the extent of the concerned area.
Although the limited availability of data, already underlined, we elaborated an estimation of tourist pressure applying the procedure to the period 2000-2002 during which some significant events occurred (Fig. 10). The values of the tourist intensity indicators (tourists/residents) and density (tourists/sqkm) in correspondence with these peaks express the "weight" of the phenomenon in the territory under study.
Although the values reveal the presence of significant tourist flows, at present, the Municipality of Pietrelcina has not yet implemented an organic management design of these flows that could act as amplifiers for the promotion of the territory of the province of Benevento. Furthermore, the characteristics of the tourist demand, as outlined in the present study, could increase the quality levels of the facilities offered to a population that is no longer young either resident or temporary (Giannopoulou et al., 2014).

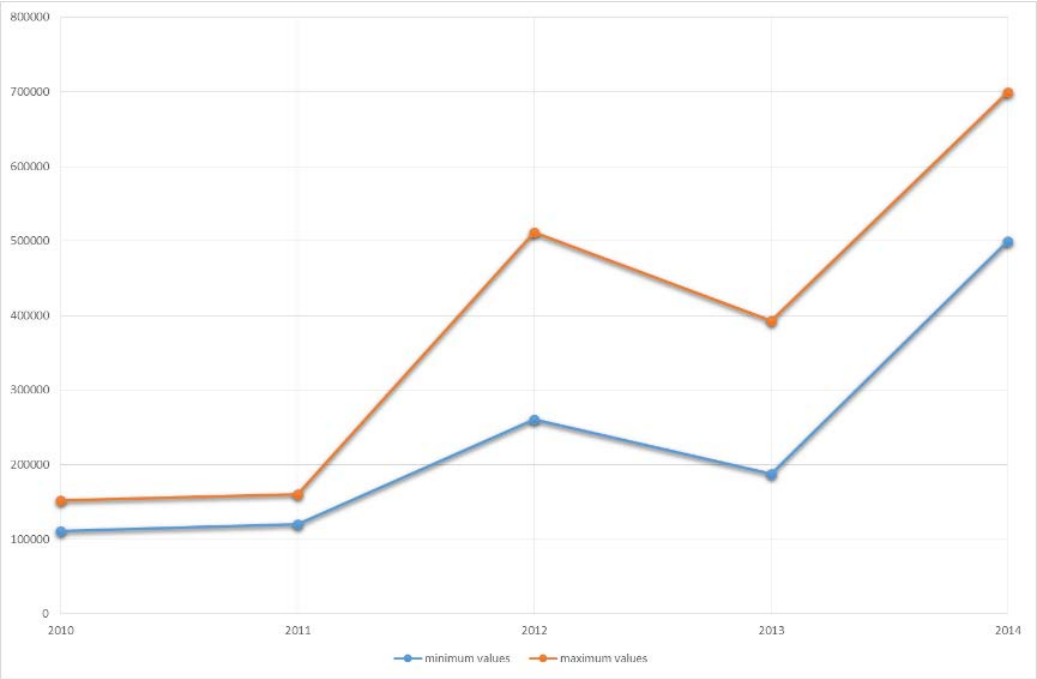

Fig.8 The estimated values of the tourists in Pietrelcina per years (authors' elaboration on EPT and Municipality data)

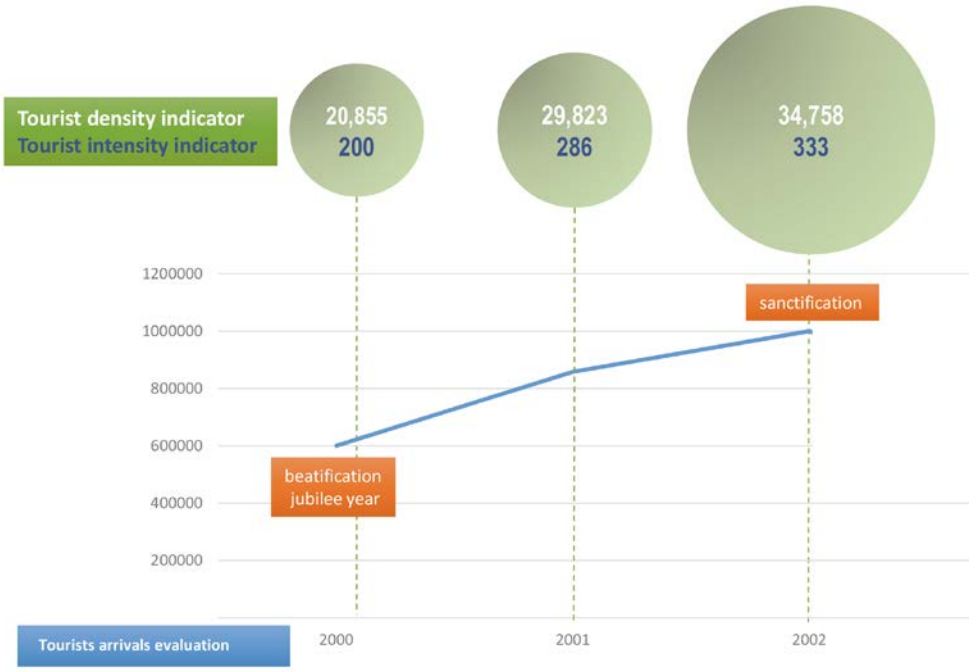

Fig. 10 Medium trend of tourist flows per year and tourist indicators in Pietrelcina 2000-2002. Tourist density expresses the number of tourist presences per sqkm; the tourism intensity refers to the ratio between tourists and inhabitats (authors' elaboration on EPT data)

6 SUSTAINABLE TERRITORIAL ACCESSIBILITY: A PROPOSAL FOR THE CASE STUDY

The proposal arising from the previous analysis and considerations is based on the key idea that the polarization attractiveness of Pietrelcina could be an occasion to shift the territorial resources towards a global design of tourist-oriented development of the provincial territory according to a systemic and holistic vision. The whole territory, thus, could benefit from the positive effects of tourism and could be part of an integrated system of services and facilities to promote less known but significant cultural and territorial heritage.

A final step of the work, therefore, concerned the identification of places of complementary tourist attractions to be implemented through coordinated actions of promotion and development of the present resources (Figs. 12 and 13). By the use of web-scraping techniques, a first map of the attractive poles have been elaborated and, then, compared with the alphanumeric EPT databases in order to evaluate their presence as officially recognized elements (Fig. 11).

A possible hierarchy of these poles have been elaborated on the basis of the physical distance (Fig. 12) from the initial pole of Pietrelcina: we considered as principal poles the ones located at a maximum distance fixed in 20 km; as secondary poles, we considered the ones located at a maximum distance equal to 50 km. The resulting network of connections represents a first attempt to connect the poles within a "religious tourism network" dedicated to elderly users.

It should be specified that the study needs further developments as well as the analysis carried out.

At this stage of the research, it is reasonable to state that the first objectives set have been achieved.

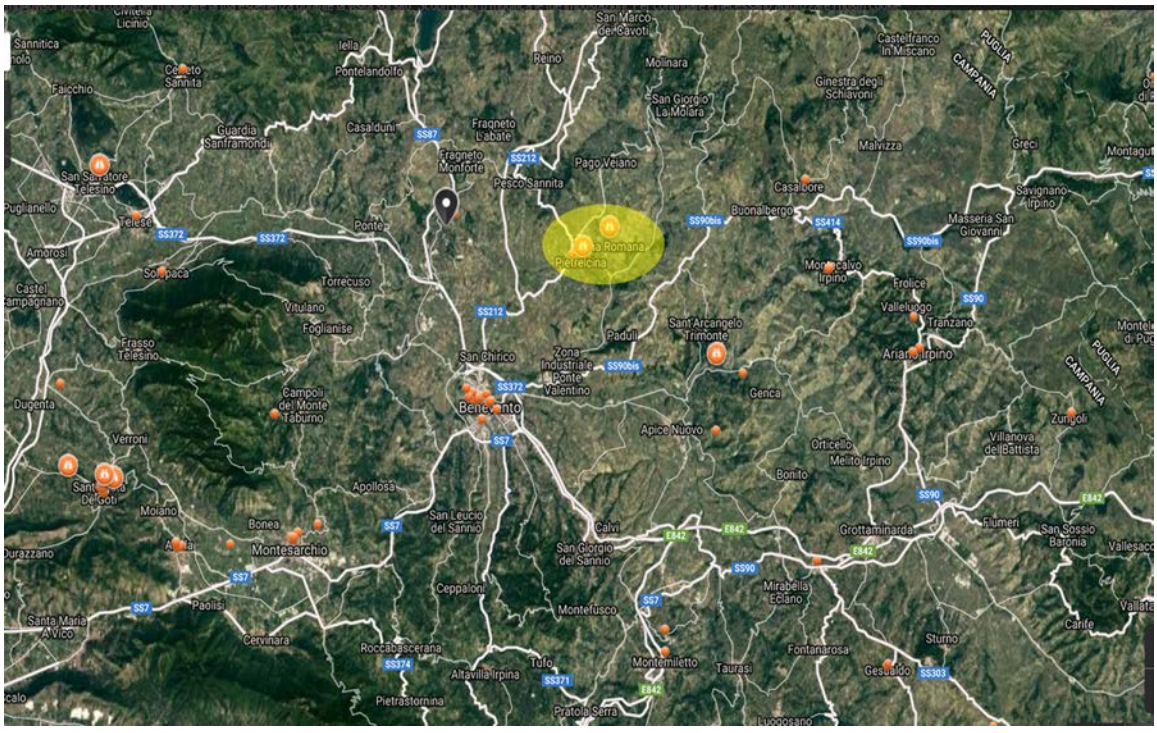

Fig. 11 Poles of attraction for religious and cultural tourism in the concerned territory. In yellow the area of Pietrelcina

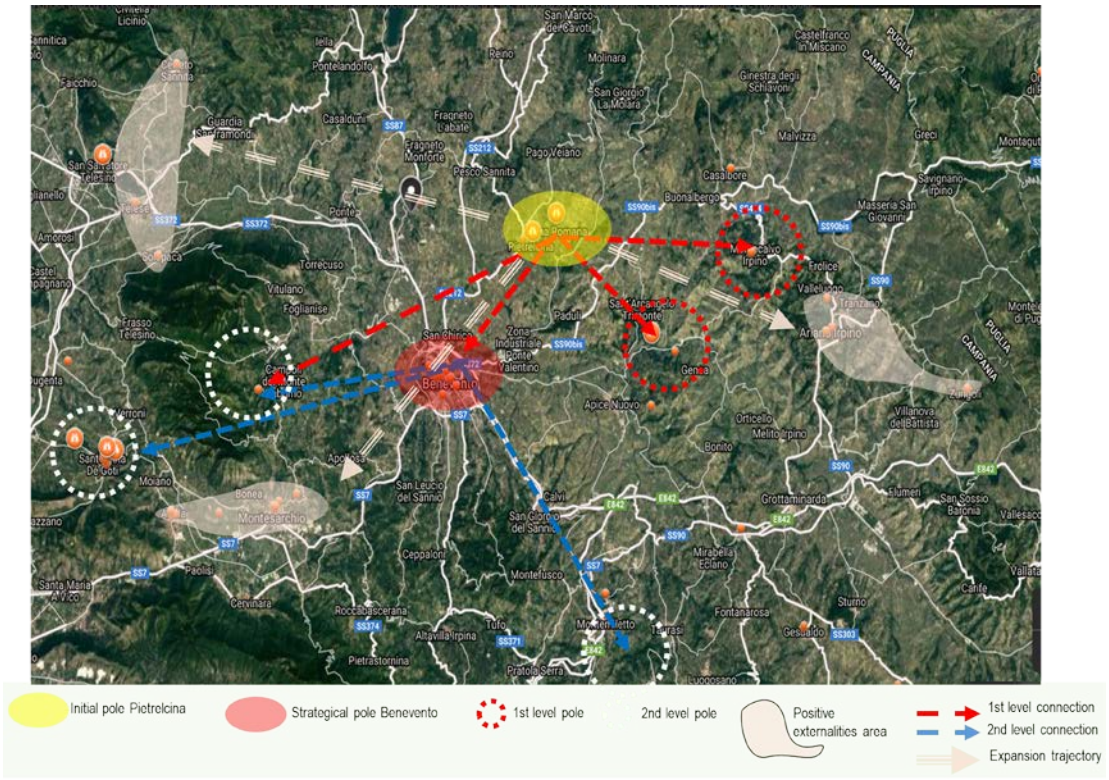

Fig. 12 From the pole to the network. The map shows the possible connection among the different attractive poles within the considered territory and the potentialities of generating positive effects by the cultural religious tourism development

7 CONCLUSION

The study has underlined two phenomena that are affecting the dynamics of evolution of current urban systems. On the one hand, the growing aging of the population requires careful retraining of the urban services supply to improve accessibility for all users; on the other hand, the increase of the tourism phenomenon as a "social practice" which is now indispensable for current lifestyles.

The goal of studying the relationships between these phenomena derives from the awareness that they cannot be extraneous to the debate regarding the need to adapt urban planning tools and procedures to such emerging needs.

The growth trends of both phenomena make it possible to envisage that the tourist population, in the coming decades, may be composed of a "no more young" population characterized by the willingness to travel also because of the desire to increase and strengthen their knowledge.

In line with these considerations, the study focused on the segment of religious tourism which currently has a high level of interest due to the consistency of the movement flows that it is able to activate.

Nevertheless, the analysis carried out still show limits in the availability of data, useful for the evaluation of this phenomenon. However, the study examined the case of Pietrelcina in Campania region, as the main international religious pole, with the aim of highlighting the role of "territorial driver" that it could play within a development plan that is compatible with the peculiarities of the territory.

The tourist flows generated by religious motivation can represent a kind of fruition able to act as an amplifier of sustainable and non-invasive behaviors if properly managed and if included in a great master plan that prevents the massification of the development model.

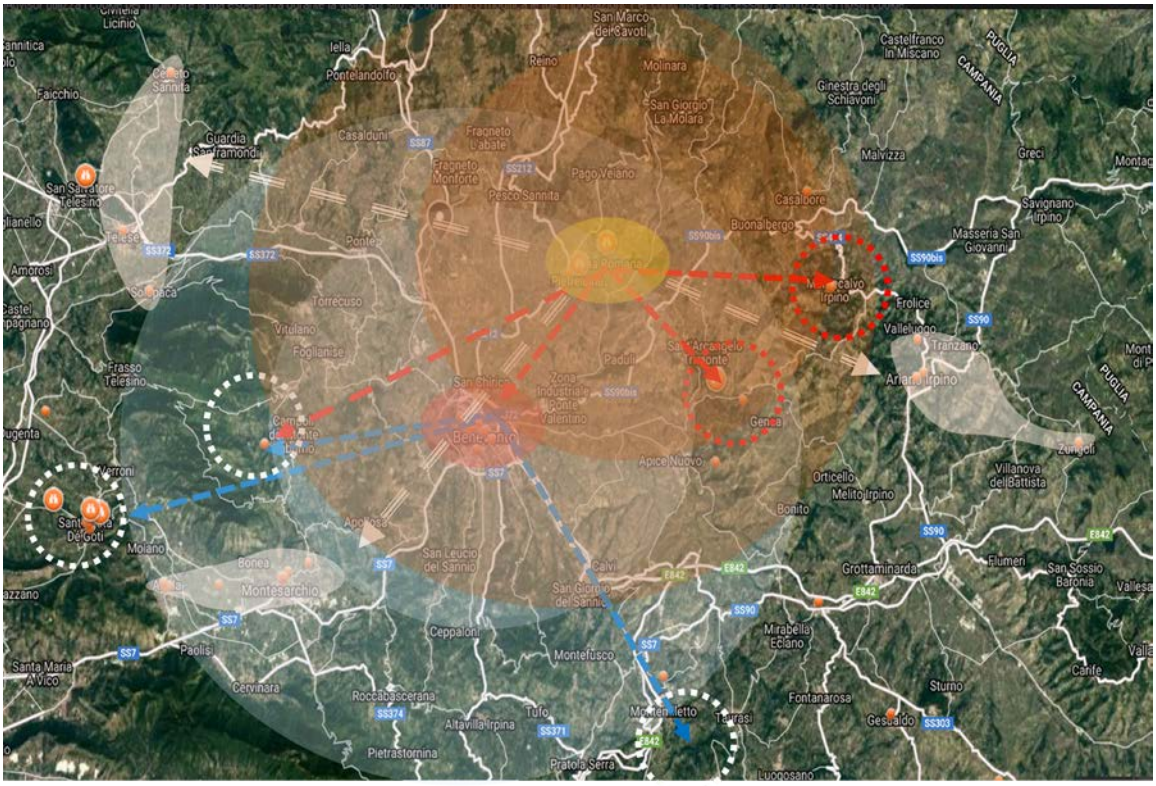

Fig. 13 A possible sustainable territorial tourist accessibility map. In this first state of the study, territorial accessibility has been defined referring to the hypothetical distance among poles. In-depth definition will be the object of further development of the study

Religious tourism, in fact, has a characteristic that makes it different from the other tourist typologies. It consists in the particular link with the visited territory, as the destination coincides with the place of the cult itself. However, it is necessary that this place is made accessible before it can be considered as a "destination".

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IMAGE SOURCES

Cover image: httpswww.businessinsider_com;

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Figg. 4, 5, 6, and 7: https://ec.europa.eu/eurostat

AUTHOR'S PROFILE

Rosa Anna La Rocca is an architect, PhD in Urban and Regional Planning, researcher at University of Naples Federico II. Her research activities refer to the analysis of phenomena that can change urban organization and they are focused on the study of three main relationships: tourism and town planning; land use and mobility, innovation technologies and urban transformations.

Romano Fistola is an architect, associate professor at University of Sannio (Benevento) where he teaches "Urban Planning" and "Management of Urban and Spatial Changes". His research interests deal with the study of new technologies, GIS, urban system and sustainability recently referred to the concept of "Smart City". He is author of more than 100 papers published on national and international books and journals.

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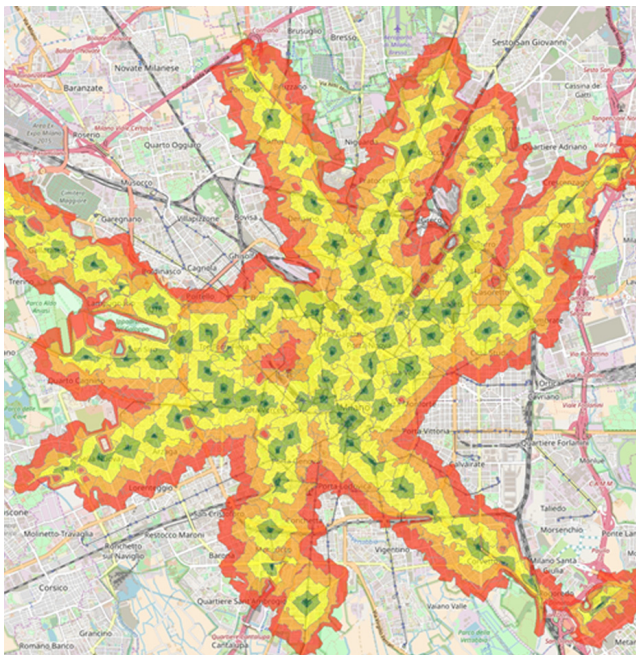

MEASURING SPATIAL ACCESSIBILITY FOR ELDERLY

AN APPLICATION TO SUBWAY STATIONS IN MILAN

FABIO MANFREDINI, CARMELO DI ROSA

Mapping and Urban Data Lab, Department of Architecture and Urban Studies
Politecnico di Milano
e-mail: fabio.manfredini@polimi.it; carmelo.dirosa@polimi.it
URL: www.dastu.polimi.it

ABSTRACT

This paper presents a method for mapping and measuring accessibility to subway stations for elderly. The methodology measures pedestrian accessibility by means of isochrones to specific urban functions, for quantifying the total amount of elderly people living within each isochrones and for evaluating the presence of services around each station. In particular, a real application on Milan city is carried out with the most updated available data.
Main aim is the identification of neighbourhoods that present more accessibility problems. The number of inhabitants, and in particular of aged persons living in less accessible areas are therefore quantified, such as the number of activities located within walking distance are counted.
The methodology can be applied to other spatial contexts and can be furtherly improved by integrating other information in the model. Accessibility analysis has an increasing role in policy making and evaluation for policies targeted towards social inclusion. because poor pedestrian infrastructures can hinder the potential movement of an increasing amount of urban population.

KEYWORDS

Accessibility; Public Transport Services Elderly; Milan

1 INTRODUCTION

According to OECD (2015), cities in advanced economies are growing older more quickly than rural areas. In these countries, the populations are ageing as a result of low fertility, low immigration, and long lives. There is evidence that people are living longer without severe disability (Christensen et al., 2009) also thanks to technological and medical development. WHO (WHO, 2015) defines Healthy Ageing "as the process of developing and maintaining the functional ability that enables wellbeing in older age". The ability to be mobile is included among the functional abilities that policy should improve for all older people.

This relatively new condition raises novel demand of knowledge about the accessibility to relevant urban functions and services for elderly in cities.

Within health and medicine studies (Fernández-Mayoralas et al., 2000), urban and geographic studies (Fobker & Grotz, 2006; Forbes, 1964), transportation science (Lin et al., 2014; Mayoa et al., 2012; Metz, 2000; Zielstra & Hochmair, 2011;), spatial sciences (O'Sullivan et al., 2000) many methodological and conceptual research projects have been carried out on accessibility issues for specific groups of people and, among these, for elderly. Accessibility measures and maps are useful in helping to identify social groups and locations with poor levels of access to services and facilities (Achuthan et al., 2010). Accessibility has been analyzed and mapped for different mean of transport (car, train, public transport, foot), for different destinations (foods, health services, public transport, job places) and in different urban and regional contexts.

In this general framework, the research MOBILAGE, Mobility and aging: daily life and welfare supportive networks at the neighborhood level, supported by Fondazione Cariplo, is aimed at investigating which role local public transport (LPT), and welfare and community services play in improving the quality of life of elderly and at providing the public administration with a GIS decision support tool to find out the most appropriate forms of governance to improve and integrate care services for the elderly and urban policy and mobility measures in the city of Milan.

The project involves three partners: Politecnico di Milano – DAStU as principal investigator, University of Naples – DICEA TeMA*Lab* and University of Groningen – Faculty of Spatial Science.

Within the MOBILAGE project, an analysis of the supply and demand of local public transport (LPT), and of welfare and community services concerning the elderly living in the municipality of Milan, is carried out. In particular, this paper refers to a specific task assigned to DAStU concerning data analysis and mapping of accessibility issues in Milan.

2 METHODOLOGY

The paper presents a methodology for measuring spatial accessibility to subway stations in the city of Milan. The methodology integrates several spatial data analysis techniques performed with geographical information system tools aimed at calculating the number of elderly living at different time breaks walking distances around existing subway stations in the city of Milan.

The analysis is based on the following steps:

- Acquisition of the road network and construction of the pedestrian road network (May, 2018) for the city of Milan;
- Acquisition of the point subway station dataset for the city of Milan;

- Generation of the 2, 5, 10, 15, 20 minutes isochrones based on the pedestrian road network around each subway stations;
- Acquisition of the polygon census blocks dataset with socio-demographic variables (2011) and transformation of the census blocks in points;
- Quantification of inhabitants and of elderly people living within each isochrones;
- Acquisition and geocoding of the commercial activities related to food and beverages in the city of Milan, integration of this dataset with the isochrones spatial dataset, analysis of the number of activities around each station.

In the following paragraphs we will present and comment the previous activities. In particular, sub-paragraph 2.1 deals with the construction of the pedestrian road network, sub-paragraph 2.2 with the methodology for calculating accessibility by means of isochrones and sub-paragraph 2.3 with the methodology for counting the number of elderly living within each isochrone.

2.1 THE CONSTRUCTION OF THE PEDESTRIAN ROAD NETWORK

The first methodological issue was related to the identification of a correct and reliable source for the road network. The AMAT Agency (Agenzia Mobilità Ambiente e Territorio) is the official agency devoted to support the Milan administration in analysing mobility, developing maps and analysis, models and simulations, developing planning tools and projects for transport and mobility. Among these activities it provides to the municipality the official road graph for Milano. In 2014 AMAT started a project aimed at integrating its own road graph with OpenStreetMap (OSM) road graph.

OSM was chosen because of its quality, its continuous updating by a community of volunteers, its spatial coverage that goes beyond administrative boundaries and its open licence. OpenStreetMap recently improved dramatically in terms of the quantity and quality of available data and is currently more and more used in different field of research (VGI, digital cartography, urban studies, modelling) (Hacklay, 2010; Mooney & Minighini, 2017; Ramm et al, 2011).

OSM is a collaborative project aimed at creating an "open source" and editable map of the world. The data are grouped into different features, described by a numbers of tags such as amenity, buildings, highway and many others. Thanks to this source, it is possible to realize maps according to the distribution of infrastructures (street hierarchy), the presence of points of interests, the connection with public transport, etc. OSM features can be easily integrated in GIS packages and can be extracted through web based data mining tools (Overpass Turbo). In this context, an extraction of OSM road network has been performed by February 2018 selecting some specific tags.

Since our aim was the evaluation of the accessibility to specific locations by foot, we cleaned the road network in order to remove high speed roads and motorways from the network. For the same reason, we added to the network, pedestrian footways and paths collected through specific queries in OSM (Tab. 1). Tab. 1 shows the complexity of the pedestrian OSM road network and its articulation in different categories according to the different types of roads.

Finally, we extracted the nodes for all the intersections of the network in order to guarantee the pedestrian connections among roads. With this last operation, we developed an updated OSM pedestrian network composed by several road categories (Fig. 1). This network could be further modified or improved by adding or removing specific types of roads.

PRIMARY FEATURES	VALUE	NUMBER OF EDGES
highway	footway	58,249
highway	service	44,760
highway	residential	43,041
highway	unclassified	33,714
highway	tertiary	19,377
highway	pedestrian	10,020
highway	cycleway	9,186
highway	secondary	8,820
highway	path	5,839
highway	track	5,186
highway	primary	4,943
highway	steps	1,784

Tab. 1 Main map features for the construction of the pedestrian road network. Source: elaboration of the authors of OSM data

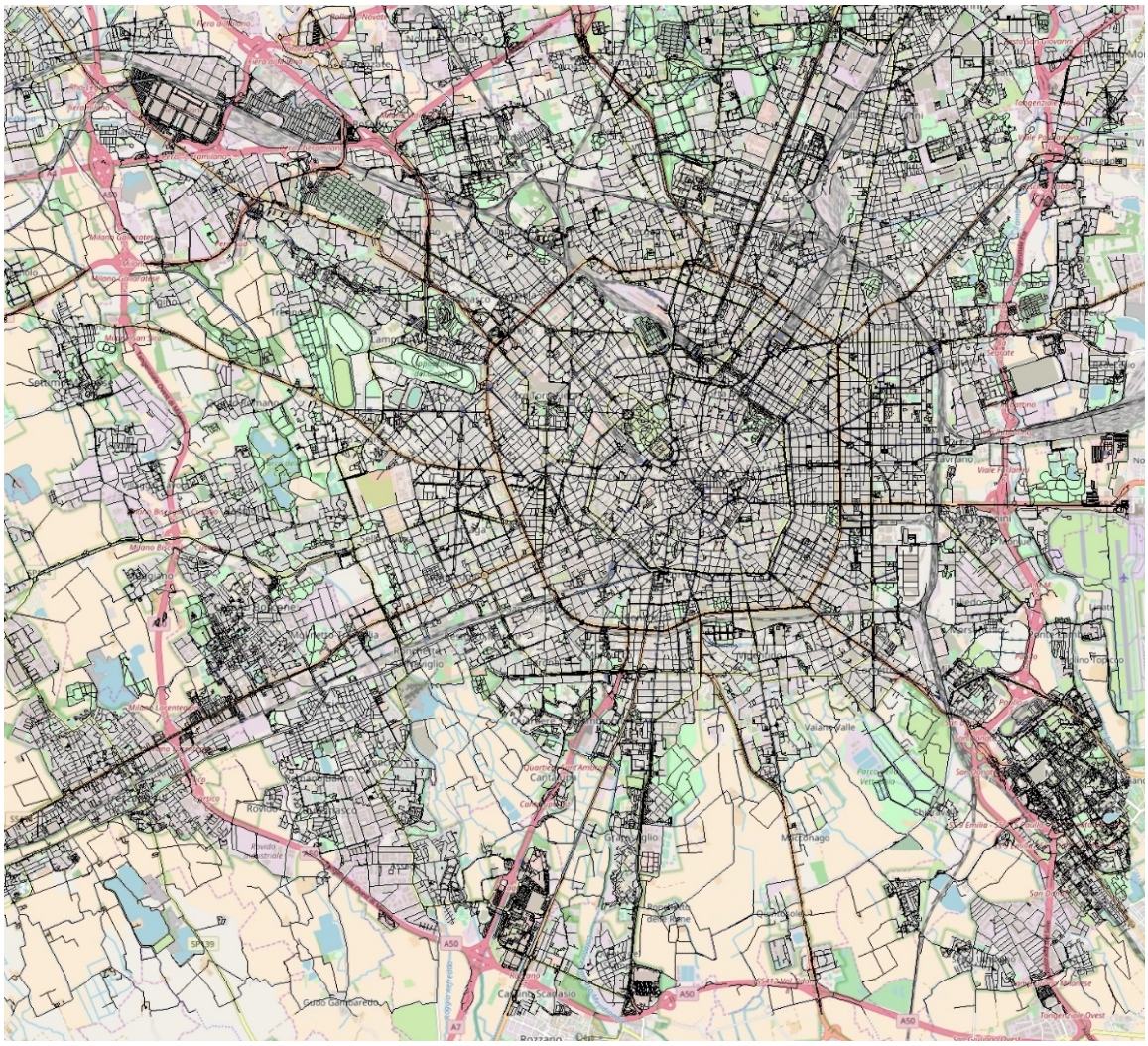

Fig. 1 Map of the pedestrian road network. Source: elaboration of the authors of OSM data

2.2 CALCULATING THE PEDESTRIAN ISOCHRONES AROUND SUBWAY STATIONS

Once we obtained the pedestrian road network, we integrated in our model the spatial distribution of subway stations collected through the open data portal of the Milan Municipality in order to calculate the isochrones around each subway station.

In this context, subway stations, other than specific destinations are a gateway for accessing other services for elderly, related to leisure, free time, culture, health issues, visiting friends and family.

Since we were interested in the analysis of accessibility for elderly people by foot we defined a simplified average pedestrian speed of 1 m/sec despite the walking speed depends on several and complex factors (age, health condition, weather conditions, pendency, characteristics of the ground surfaces).

This average speed has been added to the network segments as a prerequisite for the application of the Dijkstra's algorithm used for the generation of the isochrones within ArcMap Network Analysts.

The algorithm finds the shortest path within a road network for reaching specific locations, i.e. the subway stations and generates the polygons according to a time or length cost function. Isochrone maps are commonly used to depict areas of equal travel time.

We specified 5 break values that identify the different isochrones (2, 5, 10, 15 and 20 minutes). Each isochrone defines the urban area from which it is possible to reach the destination based to its value and to the real pedestrian network. Fig. 2 shows the isochrones around existing subway stations and highlights which parts of the city, at 1 m/sec average speed, are closer to subway stations.

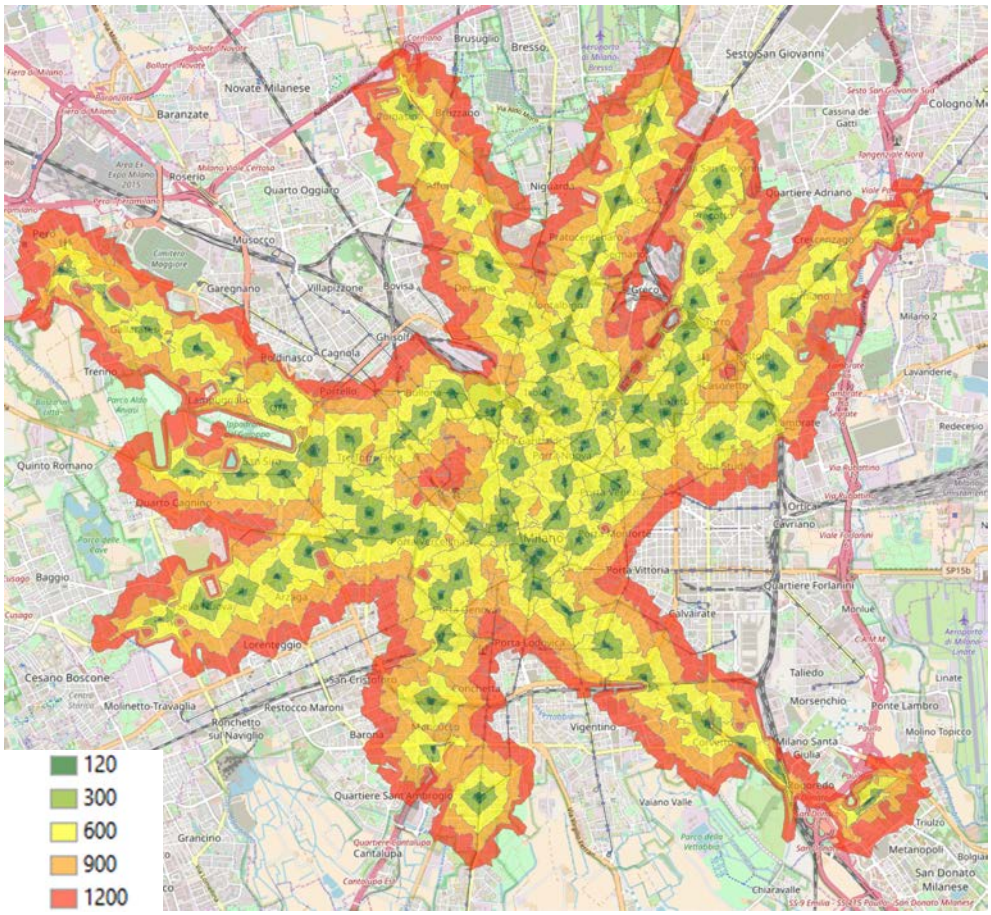

Fig. 2 Isochrones around existing subway stations: seconds for reaching the nearest station - time breaks in seconds. Source: elaboration of the authors

2.3 THE QUANTIFICATION OF ELDERLY PEOPLE ACCORDING TO DIFFERENT LEVEL OF ACCESSIBILITY TO SUBWAY STATIONS

The subsequent step was the quantification of elderly people living in the city of Milan according to different levels of accessibility to subway stations in order to identify not only which neighbourhoods are more far away from subway station but also how many elderly live in census tracts included in the different isochrones. Our aim was to measure the number of elderly people with potential problems of accessibility to public transport service.

For this purpose, we acquired the 2011 Population and Housing Census dataset provided by Istat at the spatial resolution of census tract which is the smallest statistical unit available in Italy. In cities, a census tract corresponds to a city block. For each census tract dozens of census variables are available. For this reason, the Census statistics based on city blocks can be very useful for analysing and mapping spatial phenomena at a very detailed scale, despite they are updated every ten years.

We transformed the 6085 city blocks of Milan in point and we summarized the overall number of inhabitants and of elderly people included in each isochrone in order to quantify the number of elderly people living around each subway station. This conversion of polygon census tracts to points was aimed at finding a univocal criterion for the attribution of the population living in each census tracts to a specific isochrone. More precisely, when the point is located within the isochrone polygon, its population value is attributed to the same polygon. Fig. 3 represents, as coloured points, the census blocks belonging to the different isochrones. In black are depicted the areas of Milan from which it is possible to reach a subway station only by more than 20 minutes walking. These neighbourhoods therefore present some serious issues of accessibility not only to relevant

nodes of the public transport network but also to dozens of destinations that can be reached through the subway system.

Tab. 2 presents some basic statistics on the overall number of inhabitants and elderly people (aged 65-74 and over 74) living in the different isochrones in the year 2011.

ISOCHRONE	INHABITANTS	ELDERLY (65 - 74)	Elderly (>74)	Elderly > 65 (%)
< 2 minutes	8,613	995	1,141	24.8%
2 - 5 minutes	116,531	14,188	14,664	24.8%
5 - 10 minutes	323,252	39,716	41,483	25.1%
10 - 15 minutes	238,384	29,589	30,904	25.4%
15 - 20 minutes	169,643	20,243	21,510	24.6%
> 20 minutes	385,700	46,994	48,679	24.8%
Total	1242,123	151,725	158,381	25.0%

Tab. 2 Overall number of inhabitants and elderly people in the different accessibility areas
Source: elaboration of the authors on Istat data

Over 385.000 people live at more than 20 minutes walking distance from a subway station. Of this value, more than 94,000 are aged over 65, around 30% of the overall number. This means that, even in the Italian city with the most extensive public transport network, there is an accessibility issue both for the general population and, in particular, for elderly.

A further methodological step concerned the integration between the spatial dataset on food and beverage shops provided by the Municipality of Milano and the isochrone in order to highlight the stations with lack of

this kind of services around them. Moving from the consideration that the more the foot path toward the subway station offers possibilities to stop and to have a short rest in a bar or coffee shop, the more it can be easy to reach the destination for urban populations in general but for elderly in particular, we calculated the number of activities related to supply of food and beverage, collected through the open data website of Milan within the 15 minute isochrone for each subway station. Tab. 3 shows that around 15% of the subway stations is characterized by lack of services related to food and beverages. From the perspective of healthy and active ageing this condition can discourage people from moving by walking to their destinations especially under specific conditions (weather, health and mobility issues just to cite some).

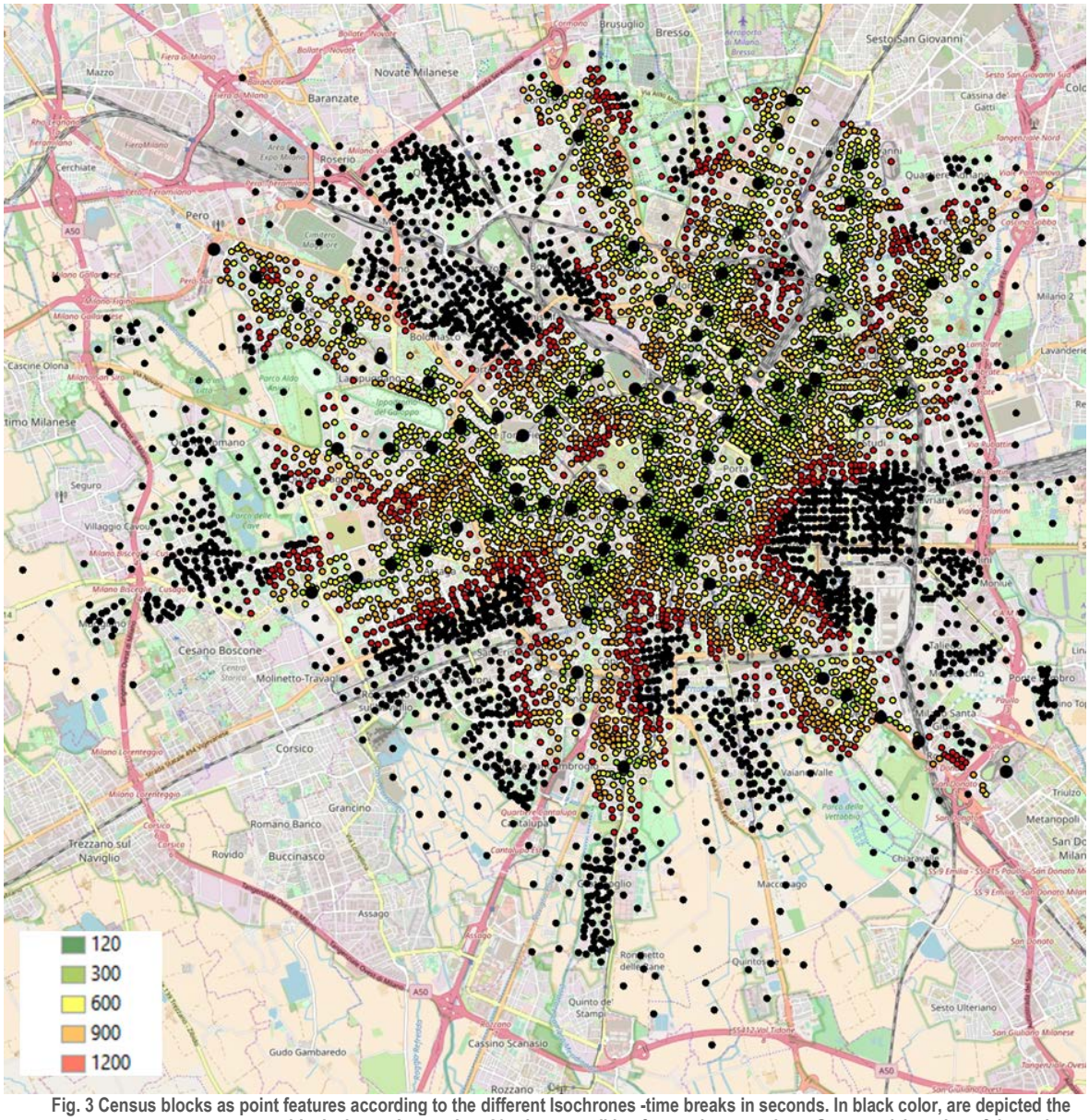

Fig. 3 Census blocks as point features according to the different Isochrones -time breaks in seconds. In black color, are depicted the census blocks located more than 20 minutes walking from subway stations. Source: elaboration of the author

NUMBER OF ACTIVITES (FOOD AND BEVERAGES)	NUMBER OF SUBWAY STATIONS	PERCENTAGE OF SUBWAY STATIONS
< 20	9	10.1%
20 - 60	15	16.9%
60 - 100	14	15.7%
100 - 200	27	30.3%
> 200	24	27.0%
	89	100.0%

Tab. 3 Food and beverage shops within the 15 minute isochrones. Source: elaboration of the authors

3 COMMENTS AND FUTURE WORKS

This paper discussed the development of a methodology aimed at mapping accessibility for elderly. We applied a methodology for measuring accessibility by means of isochrones to specific urban functions, for quantifying the total amount of people living within each isochrones and for evaluating the presence of services around each function. In particular, we tested the method to subway stations in Milano. The methodology is based on data publicly available such as OpenStreetMap, dataset on the public transport services that are easy to find in other international and Italian contexts.

The methodology can be certainly improved, extended to other spatial contexts and applied to other services (LPT services, schools, cultural facilities, commercial facilities, etc.) in order to provide different analysis of accessibility related to more complex and articulated urban functions. Daconto et al. (2018), for example, analysed elderly's people accessibility to food opportunities in Milan which is another relevant issue for guaranteeing wellbeing and quality of life dealing with the potential difficulties to walk and move in the city for reaching food shops and similar activities. The effect of micro-level barriers, road pendency and their impacts on pedestrian accessibility can also be integrated in the model in order to evaluate also some ground level issues, such as obstructions in pavements, that can be very relevant for reducing mobility opportunities of specific groups of population.

The methodology can also be improved by using different criteria for the identification of a correct average pedestrian speed in order to take into account differences in physical capabilities and mobility levels and can also be used to provide different scenarios according to the development of new urban transformation and new urban functions (i.e. new subway lines). Furthermore, it could be possible to integrate more specific information on the socio-demographic characteristics of elderly living in the different isochrones and on their mobility behaviours in order to recognize different mobility profiles and needs. The specific access to services can be better incorporated in the model by adding some specific information to the subway stations such as the presence of physical barriers, the presence (or absence) of mobile chairs or other elements that can make it difficult to reach not only the station but also the mean of transport. Accessibility analysis can also have an increasing role in policy making and evaluation for policies targeted towards social inclusion. because poor pedestrian infrastructures can hinder the potential movement of an increasing amount of urban population.

Within the MOBILAGE project further experimentations will be carried out in order to understand better the dimension and the development of accessibility issues for elderly and to provide policy makers new tools for identifying and promoting targeted actions aimed at improving opportunities of mobility for elderly.

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WEB SITES

Istat – Italian National Institute of Statistics - https://www.istat.it/

OVERPASS TURBO – web based tool for OSM data extraction https://overpass-turbo.eu/

OPEN DATA COMUNE DI MILANO – open data portal of Milan Municipality https://dati.comune.milano.it/

AUTHOR'S PROFILE

Fabio Manfredini is the responsible of the "Mapping and Urban Data Lab", Department of Architecture and Urban Studies, Politecnico di Milano. His main areas of expertise are methods and techniques of territorial and environmental analysis, design and management of geographical information systems, statistical and spatial analysis, mapping and data visualization. In the last years, he specialized in the use of innovative data source (mobile phone and social media data) for urban studies and for mobility mapping. He has published the outcomes of his main researches on national and international journals.

Carmelo Di Rosa is a senior technician of the "Mapping and Urban data Lab", Department of Architecture and Urban Studies, Politecnico di Milano. His main areas of expertise are the design and the management of relational databases for the construction of mobility indicators for urban studies. VBA developer of user interfaces, expert in GIS and statistical analysis, he has collaborated in the publication of articles in national and international journals.

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IS MILAN A CITY FOR ELDERLY?

MOBILITY FOR AGING IN PLACE

ILARIA MARIOTTI[a], ALEID E. BROUWER[bc] , MARCELLO GELORMINI[d]

[a] Department of Architecture and Urban Studies,
Politecnico di Milano
e-mail: ilaria.mariotti@polimi.it
URL: www.dastu.polimi.it

[b] Academy of HRM & Business, NHL Stenden University of applied Science Leeuwarden, The Netherlands.
e-mail:aleid.brouwer@nhl.nl

[c] Faculty of Spatial Sciences. University of Groningen,
The Netherlands

[d] World Health Organization
e-mail: marcello.gelormini@gmail.com

ABSTRACT

Italy is among the 'eldest' countries in the world, with increasing numbers of elderly becoming older and participating in society. In order to ensure that these and future elderly are able to age in place, the possibilities to get around in one's own neighborhood should be available and safe in use. In order to gain insight in the mobility issues of elderly in Italy we investigated 11 Milanese neighborhoods through in depth interviews to see how elderly perceive their neighborhood in terms of mobility. We find that that the respondent move at least twice a day outside and have a preference for local public transport and walking, followed by the use of the private car. Most of them prefer to age in place and feel happy in their current environment. However, more research needs to be done to give proper policy handles for local municipalities before we can agree what is necessary for age friendly neighborhoods.

KEYWORDS

Elderly; Mobility; Neighborhood; Milan; Local Public Transport

1 INTRODUCTION

One of most pressing challenges related to contemporary urban living is certainly the progressive ageing of population at the global level, and particularly in high-income countries (van Hoven et al., 2012). The ageing of the population causes structural problems for i.g. the finance of care or ageing in place. The current generation of people turning old is healthier, more highly educated and more active than any previous generation. The profile of elders, their background and preferences play a key role in shaping their decisions in terms of mobility.

As consumers, older people have much higher spending capabilities (Dobbs et al., 2016); as travelers, they have grown up experiencing the great expansion of individual means of transportation such as cars (Siren & Haustein, 2016). Awareness of this is fundamental when planning interventions aimed specifically at improving mobility among elders.

Modern cities need to adapt to the emerging needs of elderly people (Buffel & Philipson, 2012), and for achieving this goal we need to understand their daily patterns in mobility.

One of the main aspect improving the quality of life of elderly is mobility, which encompasses different dimensions of urban life that include housing (de Jong & Brouwer, 2012), transportation, work-related activities and social interactions. Mostly it is related to decisions about moving from one place to another with the help of transport network and services (Beimborn et al., 1999) and as such important for everyday activities, from grocery shopping to reaching the workplace. For elderly it also adds a healthy lifestyle by providing opportunities for physical activity and movement (McPhee et al., 2016).

Within this context, this paper gives insights in the demand of mobility among elderly (65+) living in the municipality of Milan, which is the Italian large city that has implemented sustainable mobility (see Comune di Milano, 2015 for the Urban Plan for Sustainable Mobility - PUMS), and it has been awarded in 2016 by the European Union with the 2016 Access City Award, as the most accessible-friendly city, particularly for people with disabilities. Specifically, we compare mobility patterns across age groups and gender, including the level of use of public transportation among elders.

To reach the aim of the paper, the results of face-to-face interviews addressed to a sample of 129 elderly living in 11 Milanese neighborhoods, characterized by a high concentration of elderly, are presented. It results that the respondent move at least twice a day outside and have a preference for local public transport (LPT) and walking, followed by the use of the private car. Most of them prefer to age in place and feel happy in their current environment.

The paper is structured into 4 sections. The introduction is followed by a background section. Section 3 is dedicated to the description of the elderly in the city of Milan: how many they are, in which neighborhood they are concentrated. The survey and the descriptive statistics are described in section 4.Conclusions and policy implications follow.

2 BACKGROUND

Mobility is central in assessing the quality of life in modern cities (Biagi et al., 2018, Pucci & Colleoni, 2016;) since it encompasses many dimensions, from the psychological aspects of travelling to the benefits of physical activity and the ability to maintain a social network (Alsnih & Hensher, 2003).

Mobility is determined by the spatial distribution of activities and services and the transport infrastructure. Directly linked to mobility, is the concept of accessibility, which has been defined as the "ease with which

any land-use activity can be reached from a location using a particular transport system" (Dalvi & Martin, 1976). Mobility and accessibility are fundamental for carrying out everyday activities; mobility promotes healthy ageing by providing opportunities for physical activity and movement (McPhee et al., 2016). For this reason, the organization of space and services that cities can offer becomes critical for the participation of elderly to public life and their well-being.

The current generation of (pre) elderly are Baby-boomers (born in the period after the second world war). They have benefited from many technological improvements and much more conversant with the use of technological devices. In terms of transportation, the baby boomers are the first generation who has fully experienced modern mobility, with a regular use of private automobile, and have a high preference for driving their own car (Burlando & Cusano, 2014).

This attachment to the private car make them use little public transport. Furthermore, research indicated that many feature of public transport services are still far from being user-friendly for older users in Europe (Ryan et al., 2015).

From the average time allowed for boarding and validating the ticket to the comfort of seats and benches, there are still too many elements that make the experience of riding a bus or a tram almost 'hostile' to older people (Metz, 2003). This despite the fact that any improvement to public transport, even if only targeted towards older users, would benefit everyone.

In many cities people over 65 years benefit from discounted fares. This policy, quite widespread, responds to the logic of facilitating the transportation of people whose travel options are conventionally considered very limited. This is less true, the new generation of elderly is healthier than ever before and has a stronger preference for cars, compared to all the other means of transportation.

When analyzing walking behaviors of elderly in relation to overall mobility, when people live in a pedestrian-friendly environment, walking can represent a valid alternative. Among elderly, walkability is associated with increased physical activity (King et al., 2011), lower bodyweight (Frank et al., 2010) lower levels of depression (Berke et al., 2007) and higher levels of social capital (Leyden, 2003).

Urban spaces are in general full of barriers (Tiboni & Rossetti, 2012) like steps too steep or doors tough to open. It is difficult for elderly people to navigate the complexity that modern cities have reached.

While few studies on elderly mobility have been carried out in Europe and worldwide (Burlando & Cusano, 2014), little is known about the Italian context, although Italy is one of the oldest country, with about ¼ of the residents aged between 60 and 80 (ISFORT, 2016).

To our knowledge, the only studies concerning the mobility attitude of Italian elderly have been developed by ISFORT (Istituto Superiore di Formazione e Ricerca per i Trasporti) with its annual report AUDIMOB (Osservatorio su stili e comportamenti di mobilità degli Italiani). Specifically, AUDIMOB developed a study on elderly mobility in Italy in 2015 by age classes (60-69 and 70-80 years) and travel behavior (why they move and how often, which transport modes they choose, number of trips daily, distance walked daily, etc.) (ISFORT, 2016).

This study has shown a decreased mobility by elderly over the total population, but compared to the year 2001, the traffic volume generated by elderly has increased.

Besides, the use of the private car among elderly has increased since 2007 (about +8% for the elderly 60-69, and +10% for those aged more 70-80), with a reduction of the use of Local Public Transport (LPT), bike and foot. Furthermore, they found that the willingness to change the modal choice is larger for people aged 60-69 (31.7% is willing to reduce the use of car, and 34.2% is willing to use the LPT), than for those aged

70-80 (19.3% is willing to reduce the car use and 1 out of 4 would prefer LPT). The present paper aims to fill the gap in the literature by focusing on the Milan case.

3 ELDERLY IN MILAN: WHO AND WHERE

The distribution of elderly in Italy seems to follow a geographical patterns: northern and central regions are those with the highest percentage of old people over the total population (Fig. 1). Between the 'youngest' region (Campania, 17.6%), and the 'oldest' (Liguria, 28%) there is a difference of more than 10 percentage points.

Table 2 – Distribution of Italian population aged 65 years or more, by administrative region

Region	% on total pop (Year 2015)
Liguria	28%
Friuli Venezia Giulia	25.1%
Toscana	24.8%
Umbria	24.6%
Piemonte	24.5%
Marche	23.7%
Emilia-Romagna	23.5%
Molise	23.4%
Abruzzo	22.6%
Valle d'Aosta	22.5%
Veneto	21.7%
Lombardia	21.6%
Basilicata	21.6%
Sardegna	21.6%
Lazio	20.7%
Puglia	20.5%
Calabria	20.2%
Trentino Alto Adige	19.9%
Sicilia	19.9%
Campania	17.6%

Source: ISTAT (2016)

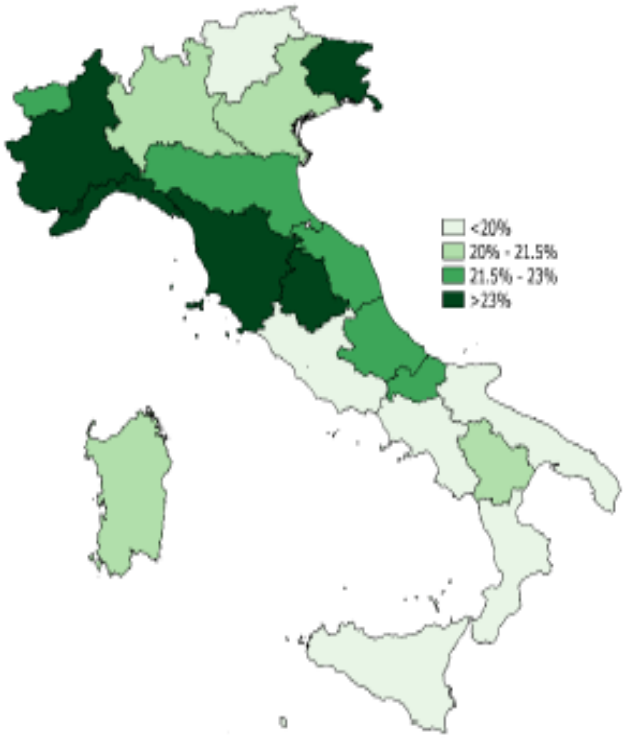


Figure 1 – People aged 65 years or more as % of total population, by region

Source: elaborations from ISTAT (2015)

Fig. 1 People aged 65+ and % of total population by region
Source: authors' elaboration on STAT (2015)

Based on the data from the National Institute of Statistics (ISTAT) in 2015 the population of elderly – considered as people aged 65 years or more – in Milan amounts to a total of 316,434 individuals (Tab. 1), which represent 21.6% of the total national population (Fig. 1).

AGE GROUP	MALE	FEMALE	TOTAL
65 – 69 yrs.	33,158	41,988	75,146
70 – 74 yrs.	28,646	38,032	66,678
75 yrs. or more	64,554	110,056	174,610
Total	64,554	110,056	316,434

Tab. 1 Population of elderly residents in Milan (by age group and sex)
Source: ISTAT (2015)

Looking at a smaller scale, the municipality of Milan is composed by 88 macro-neighborhoods (NIL- Nuclei d'identità locale, "Local identity nuclei"), which are characterized by a different concentration of elderly (Fig. 2). When calculating the Location Quotient of elderly at the level of NIL, 11 NIL show a value higher than 1, meaning that they show a concentration of elderly larger than the average in Milan.

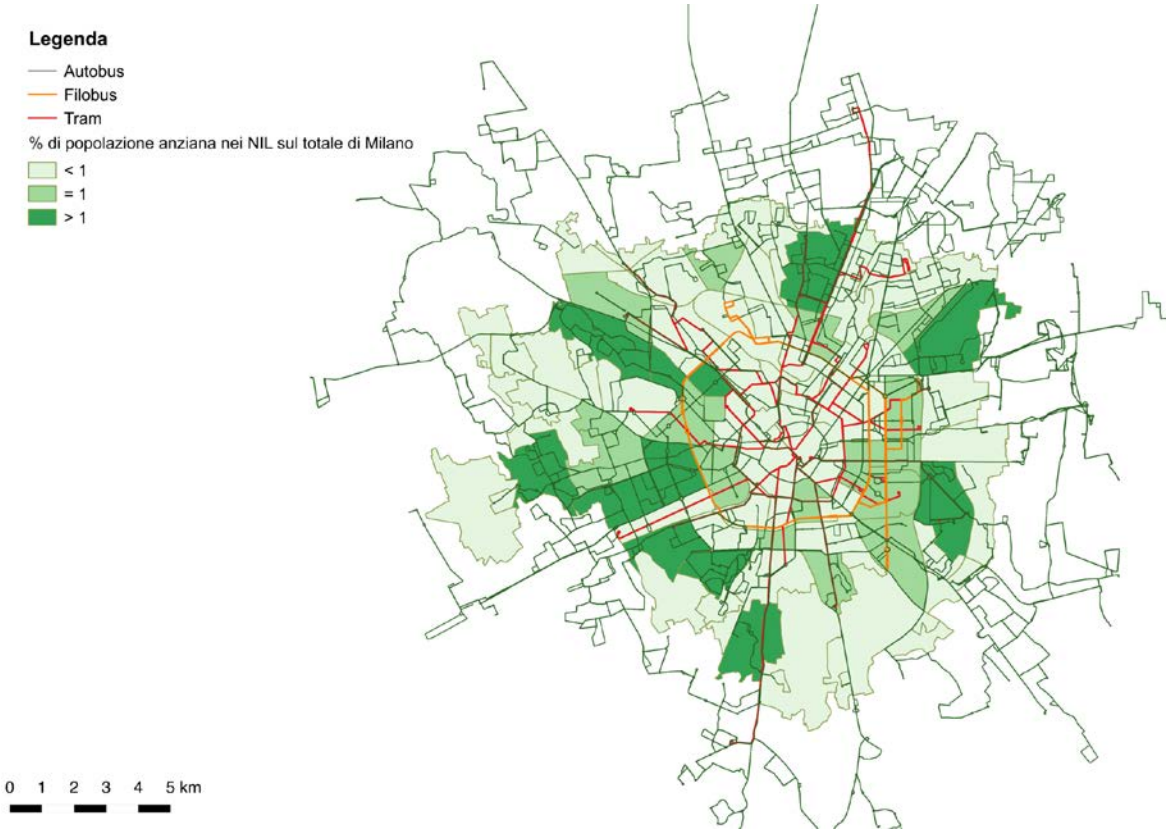


Fig. 2 Macro-Neighborhoods of Milan (NIL). Location Quotient about elderly
Source: Authors' elaboration

Note: Location Quotient (LQ) = ((ElderlyNIL/ PopulationNIL)/(Elderly Milan/ PopulationMilan))*100. The 11 Nil are: Lambrate, Parco Lambro-Cimiano, Affori, Niguarda-Ca' Granda, Baggio, Gallaratese, Quarto Oggiaro, Lodi-Corvetto, Barona, Gratosoglio-Ticinello, Mecenate.

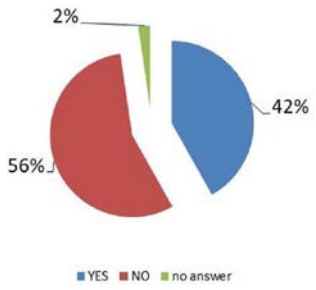
4 ELDERLY MOBILITY IN MILAN: RESULTS FROM THE SURVEY

In the period May-June 2017, face-to-face interviews to elderly living in the 11 neighborhoods, presented in the previous section, have been carried out. First a focus group with 30 elderly has been developed to the test the questionnaire, then 149 people have been contacted, and 129 have completed the interview. Potential participants have been approached during their everyday activities in different public and private spaces (recreational places – i.e. park, cultural associations –, services – i.e. supermarket, post office –, bus stops, and underground stops), at different days, and different times.

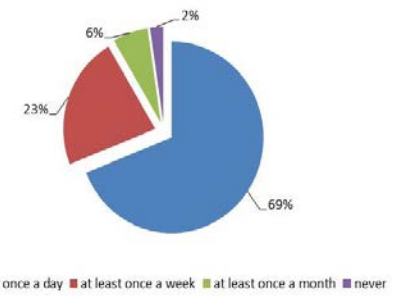
The questionnaire was composed of 5 main sections: (i) socio-demographic background; (ii) education, economic background and use of means of communication; (iii) health status; (iv) social interactions and housing and surrounding environment; (v) mobility habits.

The face to face interviews have been carried out using the KoBoToolbox app for the smartphone. The average age of the 129 interviews is 76 years, and specifically, 47.3% are young elderly (65-75), and 52.7% are old elderly (+76); besides, they are female for 42.6% and male for 57.4%. About 94% are retired, and 17% achieved a university degree, 40.3% high school, 28.7% secondary school and 13.2% primary school.

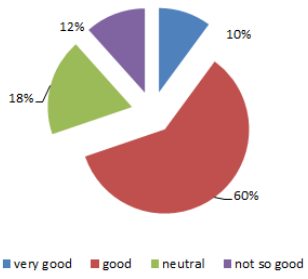
a) Use of internet



b) Interaction with families/ friends



c) Place in ageing



d) Place ageing in

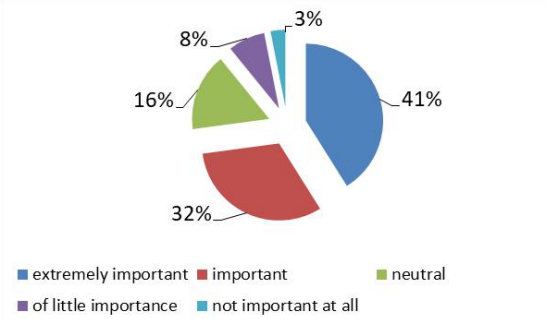


Fig. 3 (a, b, c, d) Respondents' answers. Source: Authors elaboration

On average, they declared a good health status, about 84% are satisfied with their life in general and 42% of them use internet (Fig. 3a). As concerns social interactions, the respondents tend to be rather active with 69% interacting at least once a day (Fig. 3b).

The majority rated positively the neighborhood where she/he lives in terms of quality of life (place in ageing: 70%), and stated to prefer to ageing in place (41% extremely important, 32% important) (Fig. 3c).

The analysis of elderly mobility underlines that 24% makes 2 moves per day, 30% 4 moves, 25% 6 moves and 21% 8 and more moves. They show a preference for walking (35.4%), mainly for daily duties, visit

friends and relatives living nearby, using LPT (30.8%), private car (22.8%) and finally bike (11%). Among the LPT they declared to prefer buses than the underground because the stops are closer to each other, and the underground elevators do not always function. The bike is preferred by men, which are less concerned than women about the lack of bike lanes in the neighborhood.

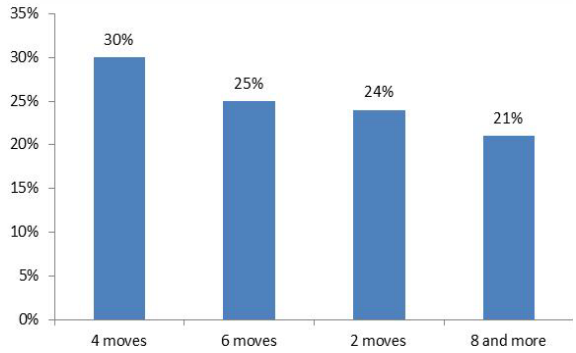
5 CONCLUSIONS AND POLICY IMPLICATIONS

Summarizing, it results that the respondent move at least twice a day outside and have a preference for LPT and walking, followed by the use of the private car.

Most of them prefer to age in place and feel happy in their current environment. Of course, these respondents are the elderly that are vital and still able to get around by themselves, this is a bias in the respondents – due to our selection method – that we are aware of.

Banister and Bowling (2004) state that mobility and social networks are important for elderly and their perceived quality of live, but also agree that the range of activity involvement is very varied. Of course, we do not know how the people that we not interviewed feel about the transport possibilities in their neighbourhood and whether they have obstacles in using LPT, walking or other.

a) Average n. of moves by day



b) Use of transport modes (%)

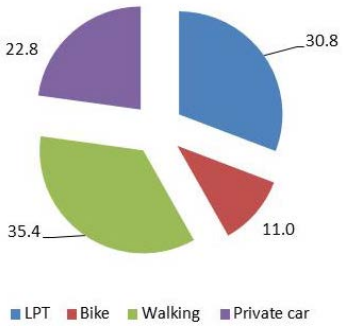


Fig. 4(a, b) Elderly mobility. Source: Authors elaboration

Even though the selection bias exist, we can say that as long as health allows, Milanese elderly are using LPT and walking as major travel modes, and even though they like the use of the private car, it is not the travel mode that is used most. McPhee et al. (2016) link especially physical activity in movement as a tool to promote healthy ageing.

Combined with the fact that most of the respondents are willing to age in the same neighbourhood, this is a sign that Milanese elderly can age in place. Also the fact that quite a large group of the respondents still use the bike – even though more men than women – allows us to say that Milanese neighbourhoods are sufficient to age in, in terms of mobility, for those that are healthy enough to go out.

Interesting, women are more satisfied with their local environment than men. Law (1999) points out that there is a gender bias in how men and women experience their daily mobility and this might be reflected in how content they are about their daily environment.

Even though the first results indicate that ageing in place is possible in Milanese neighbourhoods, we are aware that we have no information about the perception and use of transport from those elderly we did not interview because they tend to stay mainly at home.

In order to give policy suggestions we should find out why the people that stay at home and therefore not use LPT, or do their own shopping on foot are not going out. Are they restricted by health reasons, or do they feel unsafe or do they find it hard to use LPT?

This could be health issues, or are there physical limitations and obstacles in the daily mobility environment, that could be overcome by different planning or regulations? Urban design can contribute to the walkability of the neighbourhood.

To create a truly age friendly environment urban design needs to meet to the mobility need of all elderly, even those that are now home bound (Rosenbloom, 2009). Besides, further research might focus on describing more in depth elderly mobility in each NIL, and propose tailored policy tools (Maltese & Mariotti, 2012) to improve it.

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AUTHOR'S PROFILE

Ilaria Mariotti is Associate Professor in Urban and Regional Economics at DAStU-Politecnico di Milano (IT). She achieved a M.Sc in Regional Science at the University of Reading (UK), a Ph.D In Spatial Sciences at the University of Groningen (NL), and a Ph.D in Transport Economics at the University of Genoa (IT). Her main research interest concerns the location of manufacturing and logistics firms, the effects of FDI in the home and host countries, sustainable mobility and elderly.

Aleid Brouwer is a research professor at the NHL Stenden University of Applied Sciences in Leeuwarden (NL) and also has an appointment at the University of Groningen (NL). She holds a M.Sc. in Economic Geography and a Ph.D. in Spatial Sciences both from the University of Groningen. Her research focuses on a wide range of topics among which entrepreneurship, vital regions, vulnerable groups and ageing in place.

Marcello Gelormini is a public health expert with long experience in international cooperation. He has worked on a wide range of health topics, including how the built environment affects health outcomes in urban contexts. He is currently collaborating with WHO/Europe on epidemiological surveillance on antimicrobial resistance in the European region.

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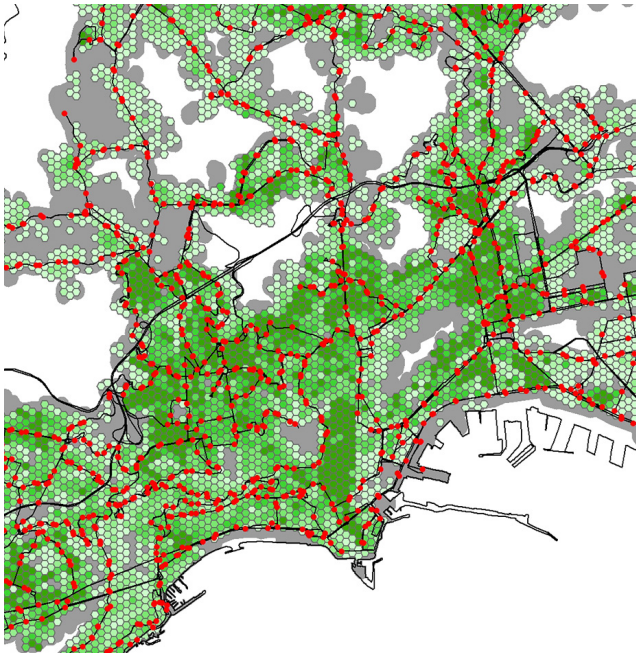


MEASURING WALKING ACCESSIBILITY TO PUBLIC TRANSPORT OF THE ELDERLY:

THE CASE OF NAPLES

ENRICA PAPA[a], GERARDO CARPENTIERI[b], CARMEN GUIDA[b]

[a] School of Architecture and Cities, University of Westminster
e-mail: e.papa@westminster.ac.uk
URL: https://www.westminster.ac.uk

[b] Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II
e-mail: gerardo.carpentieri@unina.it; carmen.guida@unina.it
URL: www.tema_lab.unina.it

ABSTRACT

Demographic ageing represents an essential challenge for local authorities and public transport providers. Decision-makers should not ignore the specific needs of this weak segment of the population and should implement appropriate policies. This paper develops a GIS-based method to analyse public transport accessibility of elderly people to support policies and planning strategies. To test the proposed method, we propose an application to the city of Naples in Italy. We selected this study case because it represents an example of high population density, complex urban structure and low level of quality of life, especially for the elderly. The application to the city of Naples showed that the urban accessibility changes dramatically for different age segments. Results also reveal patterns of public transport coverage that are significantly low particularly in suburban settings.
The structure of this paper is organised into four sections: in the first section, we introduce the main topic of mobility of elderly; in the second section, we describe and discuss the GIS-based method proposed; in the third section, we report on the application to the city of Naples; in the last section, we analyse the results and discuss future research developments.

KEYWORDS
Elderly mobility; GIS; Public transport system; Accessibility

1 ELDERLY MOBILITY AND ACCESSIBILITY IN URBAN AREAS

Demographic ageing is an increasing phenomenon in urban areas. In Europe, the share of people aged 65 years and over is expected to increase from 19.4% in 2017 to 30% of the total population in 2060 (Eurostat, 2018). Indeed, the elderly represent an essential group of interest considering their significant increase in number as cities population continues to age. The growing number of people living with an age over 65 who lead an active lifestyle represents an essential challenge for local authorities and public transport providers in urban contexts. Not just the number of elderly population is an issue, but also its distribution in urban areas. In the past, elderly people mostly lived in central urban areas. This was due to an age-specific migratory process when young families moved to suburban fringes. Currently, the spatial distribution of elderly people is uniform in metropolitan areas (Fobker & Grotz, 2006). This phenomenon constitutes a challenge for local authorities, which should provide essential services for that specific group of the population. In particular, studies showed that mobility and accessibility trends of the elderly are a critical trial to transport systems (Aceves-González et al., 2015; Buehler and Nobis, 2010; Currie and Delbosc, 2010; Voss et al., 2016). On the other hand, the provision of a sustainable transport system, designed for the elderly's mobility needs, is both urgent and necessary (O'Neill, 2016).

Indeed older individuals suffer from weakening skills that may negatively affect their ability to move and to use different modes of transport. While car use appears to be a powerful mobility enabler, the challenge of reducing car ownership and usage is an environmental goal (Morency et al., 2011; Paez et al., 2007). Public transport companies and local authorities should prioritise the specific needs of this portion of the population and should implement appropriate policies to promote sustainable transport modes for the elderly. To support the mobility needs of elderly, one key policy would be to develop sustainable accessibility policies (Geurs & Wee, 2004; Salata & Yiannakou, 2016) and improve public transport accessibility for this segment of the population. In the last years, scholars focused extensively on equity and social inclusion as essential goals in urban and mobility planning, with a particular emphasis on the role of public transport in assuring social inclusion for the elderly population. Thus, it is essential to understand the influence that transport disadvantage and social exclusion have on a person's well-being (Delbosc & Currie, 2011). It is crucial to provide decision support tools to local administrator to evaluate and assess the social inclusion level in urban areas. In order to contribute to these debates in literature, this paper proposes a GIS-based decision support tool to measure the walking accessibility to the public transport services for elderly and provides an application to the metropolitan area of Naples in Italy.

This paper is a part of the research project 'MOBILAGE. Mobility and ageing: daily life and welfare supportive networks at the neighbourhood level', funded by Fondazione Cariplo and that involves the University of Naples, the University of Groningen and the Polytechnic University of Milan. The project is targeted to develop strategies and decision-making tools for improving the location of services for the elderly and their accessibility using public transport. The structure of the paper is organised into four different parts. Following this introduction, a GIS-based procedure is proposed to analyse the coverage of public transport systems for elderly; in section 3, we discuss the application to the city of Naples; in section 4, we analyse the results and discuss further research developments.

2 METODOLOGICAL NOTES

In this study, we use a contour accessibility measure, adding some improvements to the original formula. In particular, we enhance it with the demographic characteristics of elderly users, with the level of service of

public transport (service frequency) and the urban morphology (the walking streets network and its slope) (Wang & Cao, 2017).

In general, 'contour accessibility measures' identify catchment area using the average walking distance or walking time to reach the transport hubs. In several applications, buffers of 400m around bus stops and 800m around rail stations are commonly used to identify the area from which most transit users will access by walking (El-Geneidy et al., 2013; Masoumi & Shaygan, 2016; Weinstein Agrawal et al., 2008; Zhao et al., 2003). One difference we apply in this study is that we consider the network walking distances, measured on the actual walking network, and not the Euclidean buffers (circular buffers around a point) (Gutiérrez & Garcà-Palomares, 2008).

Another improvement from the original contour measure formula is that we hypothesise that catchment radius of a public transport stop is dependent on the frequency of the public transport service provided at that stop, following the principle that customers are willing to walk more to access a higher-frequency transit service (Ryan et al., 2015). Accordingly, the coverage of transport service of high-frequency routes is larger than the one offering lower-frequency routes (Alshalalfah & Shalaby, 2007). Finally, another factor we consider is how walking speed changes with the customers' age. Bohannon and Andrews (2011) revealed that walking speed declines with age. Accordingly, we consider a walking speed that is dependent on public transport users' age.

We divided the study into hexagonal cells with the side length of 50m that provides high accuracy in the graphical and numerical results. In literature, the use of a hexagonal cell rather than a square one is best advised for dealing with the measurement of shorter walking paths (Kibambe Lubamba et al., 2013). We then assigned to each cell the population of different age segments, using the cover surface of buildings (Carpentieri and Favo, 2017).

Firstly we proportionally transferred the number of inhabitants of the census track to the buildings located in each census track. Then we calculated the total number of inhabitants for each hexagonal cell as the sum of inhabitants living in the buildings located in each hexagonal cell (see Figure 1).

Fig. 1 Hexagonal cells, census tracts and building surfaces

Accessibility of a cell *d* and for different age segments has been calculated according to the following formula:

$$A_{dAGE} = W_{dAGE} \cdot P_{dAGE}$$

where:

$W_{dAGE} = 1 \; if \; d_d < d_{frAGE}; \; d_d = 0 \; otherwise$

$d_{frAGE} = T_{fr} \cdot s_{AGE}$

$T_{fr} = \alpha \cdot fr$

$s_{AGE} = \beta \cdot AGE$

where

P_{dAGE} is the population in the cell *d* of a specific age segment

d_{SAGE} is the distance users are willing to walk measured on the walking network

T_{fr} is the walking time users are spending

fr is the public transport service frequency in the closest station to the cell

s_{AGE} is the walking speed for different age segment

α, β are two calibrated parameters

The proposed GIS-based procedure is organised in three main steps: (1) Data collection, (2) GIS analysis and (3) Visualization of results. Using the ERSI GIS Model Builder tool of ArcGIS Pro 2.2 software, we defined the geoprocessing workflow used to execute operations that organise and analyse the alphanumeric and spatial data (see Figure 2). In Step 1, datasets are uploaded in the GIS. In Step 2, geoprocessing, data and network analysis operations elaborate the data to obtain the quantitative and spatial outputs. In Step 3, maps and tables obtained to visualise the results of the analysis. We used the ESRI ArcGIS Pro 2.2 (for collecting, geoprocessing and analysing the data) and the Network Analysis tool of ESRI to calculate the bus stops catchment area, considering the attributes of surface elevation (slope), walking speed of each user age category and time of access to bus stops.

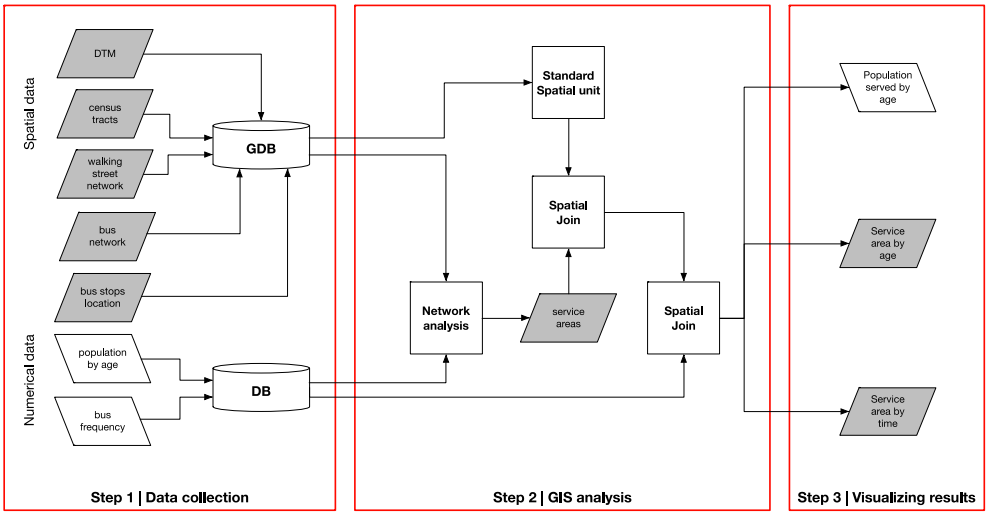


Fig. 2 Workflow diagram of the GIS-based procedure

3 THE APPLICATION TO THE CITY OF NAPLES

To test the methodology, we applied it to the city of Naples, which represents an interesting case study because of its high population density, its non-uniform urban structure and its increasing ageing population. The city of Naples has 970,185 inhabitants (ISTAT, 2017) living in 117.27 km² and is the fifth Italian city regarding population density. In the last twenty years, the city has been affected by a gradual increase in the elderly population. As of 2017, the number of elderly people was 186,812 (20% of the total population). For this study, we considered only the bus routes served by the Mobility Company of Naples (ANM), because GTFS open data were available only for this service . The ANM operate about 90% of urban bus trips in the city of Naples (City of Naples, 2016). This service consists of 306km of urban lines and 111km of suburban lines. We considered the 1.867 bus stops located within the administrative city area boundaries and the services from 6:00am to 2:00pm of a weekday (see Figure 3c).

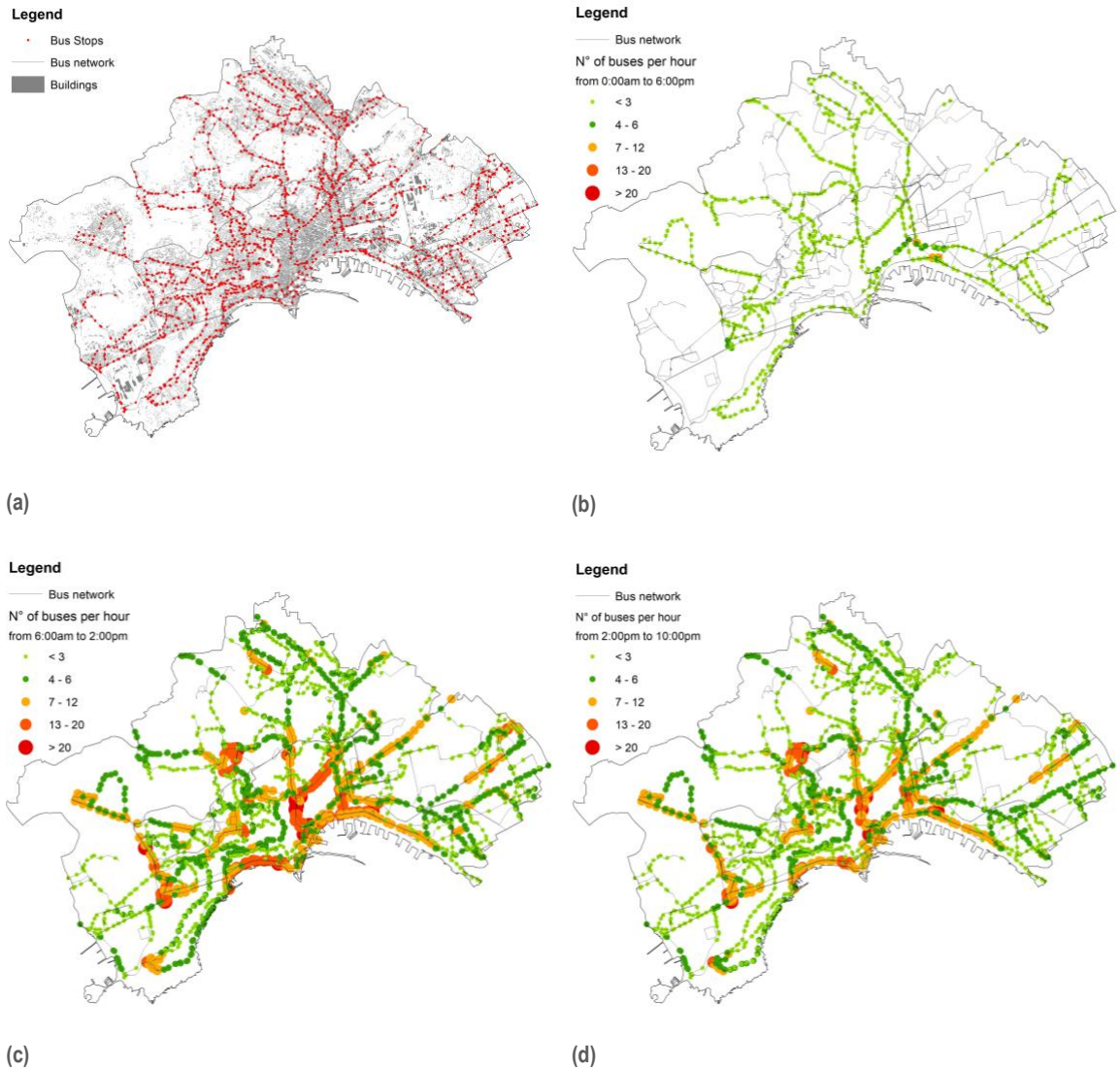


Fig. 3 The bus network of the city of Naples (a) and the bus frequency for each stop in the different time intervals: from 0:00 am to 6:00am (b), from 6:00am to 2:00pm (c); from 2:00pm to 10:00pm (d)

According to national commuting census of 2011 run by the Italian National Institute for Statistics (ISTAT, 2011), the average daily commuting in the city of Naples is 342,109 trips, with the following modal share: 1.1% by rail; 17.6% by bus; 33.6% by car and motorcycle; and 37.7% by other means of transport (ISTAT, 2011). In Naples, it is possible to identify different urban patterns, morphological patterns, and socio-economic characteristics. The historical area is located in the city centre , which has high population density and high accessibility to public transport services (metro and bus). The peripheral areas were developed during the 19th and 20th-centuries and have low accessibility to public transport services and are mostly residential.

In our analysis, we used spatial and alphanumeric datasets from the different open sources. In particular, we used the data on the bus network produced by the Naples bus service provider (ANM). The demographic data were extracted from the ISTAT (2011). The Digital Terrain Model and the Buildings polylines are from the Web Coverage Service (WCS) provided on the open access National Geoportal owned by the Italian Ministry of the Environment and Protection of Land and Sea (available at http://www.pcn.minambiente.it/). We created the road network through the topological correction of the Open Street Map database. Table 1 provides the list of alphanumeric and spatial input datasets (vector and raster) used. Another source of data was the Moovit Public Transit Index data.

DATA	CATEGORY OF DATA	TYPE OF GEOMETRY	SOURCE	YEAR
Population	Alfa-numeric	-	ISTAT	2011
Bus stops	Vector	Point	Naples public transport company (ANM)	2018
Road network	Vector	Polyline	Open Street Map	2011
Bus network	Vector	Polyline	Naples public transport company (ANM)	2018
Census tract	Vector	Polygon	ISTAT	2011
Buildings	Vector	Polygon	National Geoportal	2011
Digital Terrain Model	Raster	-	National Geoportal	2017

Tab. 1 Data used to application to the City of Naples application

Figure 4 shows the walking catchment area of the bus stop network. In particular, it displays the different catchment areas considering of not the slope of the road network (Figure 4a); it also shows the bus network coverage for different age groups and different walking speeds (Figure 4b, 4c and 4d). We consider three different age groups: from 65 to 70 years old (young elderly), from 70 to 75 years old (medium elderly) and over 75 years old (old elderly).

The maps show a significant difference between the catchment areas with and without the slope attribute for the three elderly age groups considered. In particular, the analysis evidences a reduction of 18% (12.7 sq.km) of the catchment area without the slope for the elderly people from 65 to 70 years old compared to the catchment area with the slope. In the case of the catchment areas for elderly people over 75 years, the difference is almost 33% (22.8 sq.km).

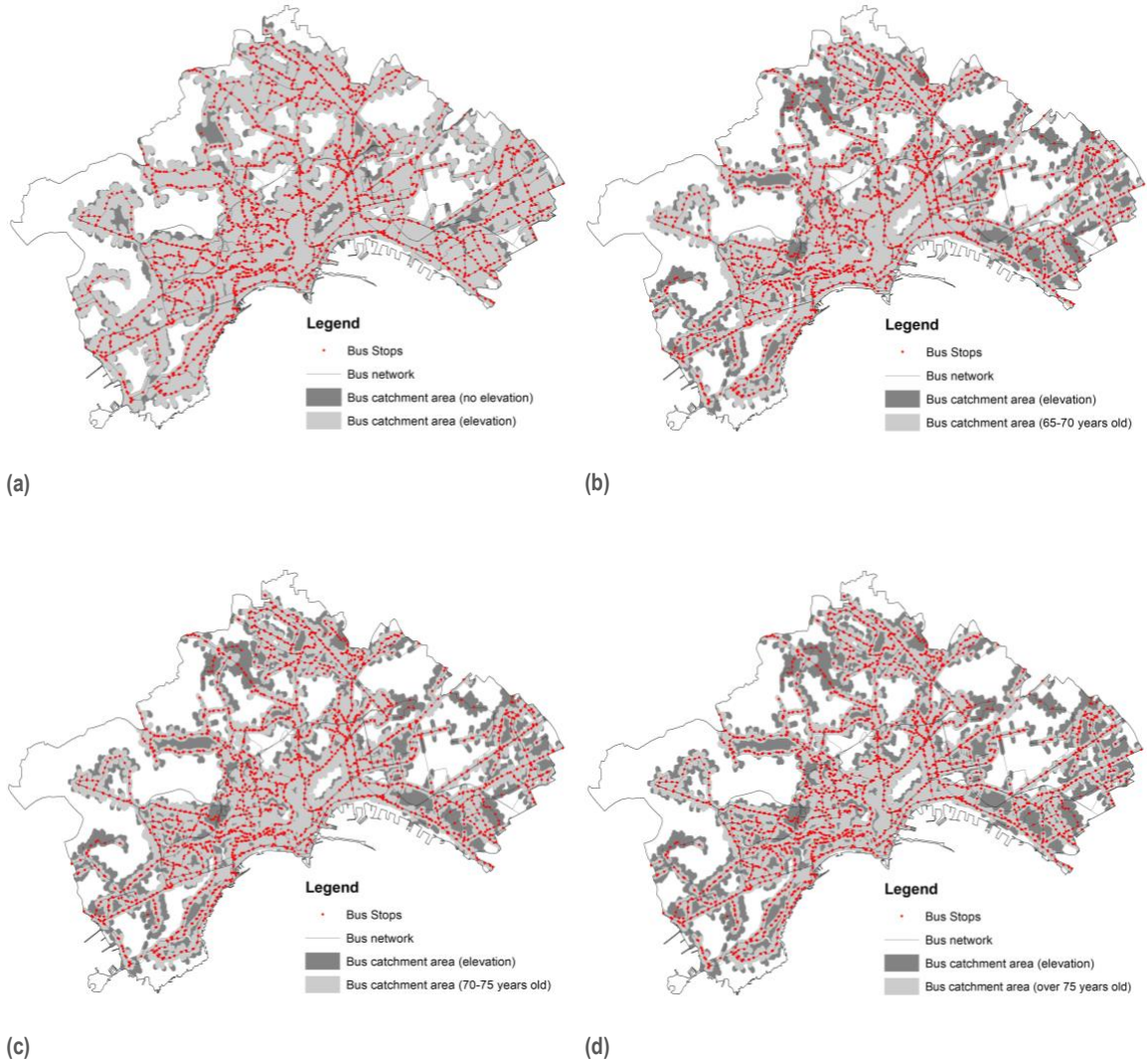
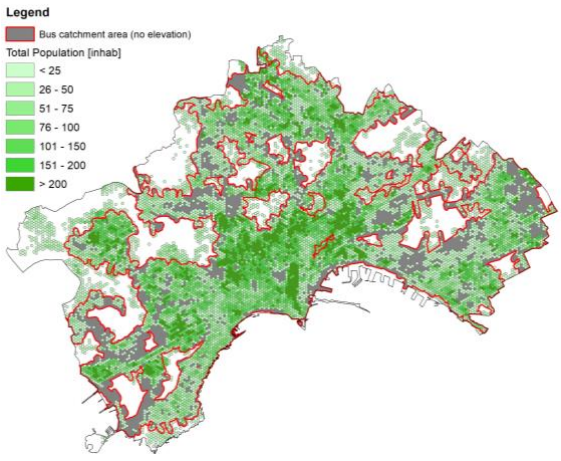


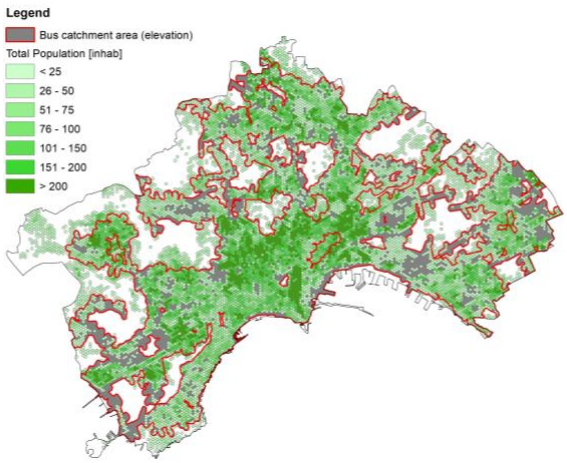
Fig. 4 The comparison of bus catchment areas with and without the slope parameter for an middle age user (a) and for different elderly age categories: 65-70 years (b), 70-75 years (c), over 75 (d)

Figure 5 shows that almost 89% of the total population is located in the bus catchment area if we do not consider the actual walking network slope (no elevation). Considering the slope parameter (with elevation), the total population is limited only at the 8% (67,322 inhab.). This demonstrates how crucial is to take into account the real walking condition, especially in a particular context as the city of Naples. The analysis also provides evidences that over 32% (59,072 inhab.) of elderly people over 75 years old live in areas that are not covered by bus services.

Table 2 summaries main results from the accessibility analysis. In details, 20,680 inhabitants between 65 and 70 years old do not have easy access to bus services in Naples, which correspond to 36% of the total population; 11,100 inhabitants between 70 and 75 years old do not have easy access to bus services that correspond to the 27% of the total population.



(a)



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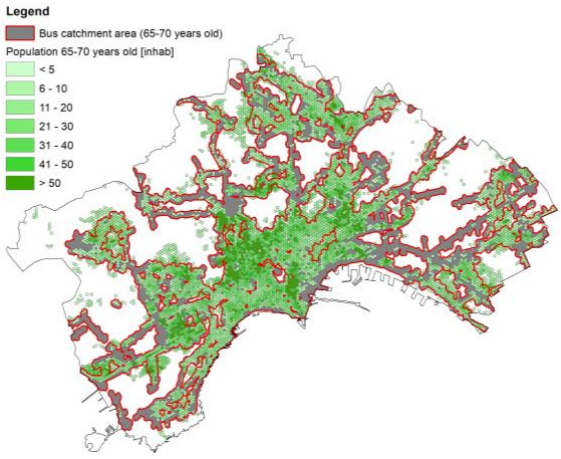
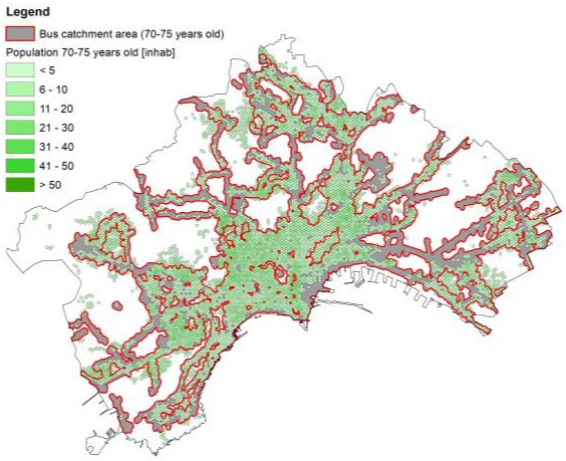
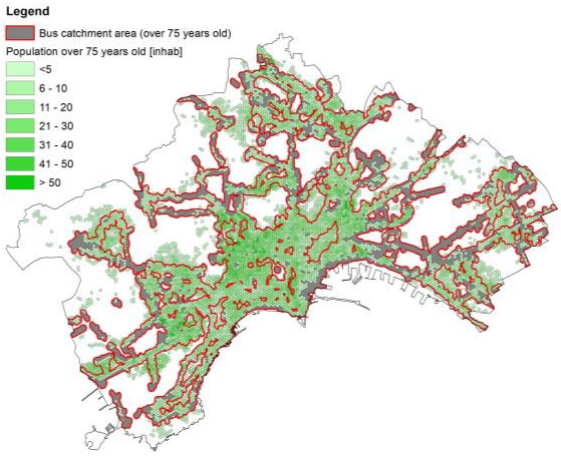


(c)



(d)



(e)

Fig. 5 Accessibility for the different elderly age groups: between 65 and 70 years old (c), between 70 and 75 years old (d), and over 75 years old (e)

AGE INTERVAL	BUS CATCHMENT AREA	NUMBER OF INHABITANTS	NUMBER OF INHABITANTS WHO LIVE IN THE BUS CATCHMENT AREA	NUMBER OF INHABITANTS WHO LIVE OUTSIDE THE BUS CATCHMENT AREA
-	[sq.km]	[inhab]	[inhab]	%
Total inhabitants (no elevation)	81.5	961,106	861,234	10%
Total inhabitants (elevation)	70.8	961,106	793,912	17%
65 - 70 inhabitants	58.1	56,835	36,155	36%
70 - 75 inhabitants	52.1	41,001	29,901	27%
Over 75 inhabitants	48.0	84,928	57,636	32%

Tab. 2 Results of application of GIS-based procedure to the city of Naples

Some peripheral neighbourhoods (Piscinola, Marianella, Chiaiano, Scampia) have a higher percentage of elderly people unserved which exceeds 50%. The percentage of inhabitants between 65 and 70 years old the percentage of inhabitants who lives outside the catchment area is 20% in all neighbourhoods. The neighbourhoods with higher percentage of elderly people within the catchment areas of bus service are Chiaia, Posillipo, S. Ferdinando, which are all located in central areas. In particular, in these neighbourhoods the percentage of inhabitants between 70 and 75 years old covered is over the 90%.

3 CONCLUSION AND FUTURE DEVELOPMENTS

The growth of the elderly population in the last decades has generated a serious accessibility exclusion phenomenon. Some aspects influence the accessibility for the elderly population. This study provides evidences how this is particularly true in the city of Naples. The study of scientific literature on the relationship between catchment areas, transport service frequency and age of users revealed the importance of considering these aspects in the evaluation of public transport accessibility. We develop a GIS-based procedure to evaluate the extension of public transport catchments areas by using open datasets. The results of the application show that the level of transport exclusion for the elderly population is twice the value calculated for the entire population. Results also show great difference of essential public transport services for elderly people between the richer central areas and the suburban settings. It would be crucial to address transport investments and policies towards reducing the transport exclusion in these areas.

Therefore, we suggest the following research directions for further research: (1) to add other variables in the analysis and in particular the security of bus stop, the connectivity of bus lines, the road walking quality; (2) to add to the metro service catchment area to our analysis; (3) to improve the used accessibility measure and calculate a potential accessibility measures, adding the location of activities and services of interest for the elderly people; (4) to apply the GIS-based procedure to the City of Milan; (5) to develop a web GIS tool to support the public administration and transport company.

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AUTHOR'S PROFILE

Enrica Papa, PhD, is a Senior Lecturer in Transport Planning and Course Leader of the MSc Transport Planning and Management at the School of Architecture and Cities of the University of Westminster. Her research interest are in transport geography, Transit Oriented development and spatial accessibility planning

Gerardo Carpentieri is an Engineer, Ph.D. in Civil Systems Engineering at University of Naples Federico II and Research Fellow of Land Use Planning at the Department of Civil, Architectural and Environmental Engineering at University of Naples Federico II.

Carmen Guida is a Ph.D Student in Civil Systems Engineering at Department of Civil, Architectural and Environmental Engineering of University of Naples Federico II.

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KEY CHARACTERISTICS OF AN AGE-FRIENDLY NEIGHBOURHOOD

FULVIA PINTO, MINA SUFINEYESTANI

Department of Architecture and Urban Studies,
Politecnico di Milano
e-mail: fulvia.pinto@polimi.it; mina.sufineyestani@polimi.it
URL: www.dastu.polimi.it

ABSTRACT

European Union's inhabitants are quickly ageing. Therefore, ageing is an emerging issue, causing different kinds of problems. Among them, mobility is a remarkably complicated challenge, as it encompasses much more inter-related problems that have profound physical, mental and social consequences on well-being. Urban planning researchers indicate that a low level of mobility is generally linked to a low quality of life especially amongst elderly.
Mobility has an important positive effect on old people's independence and involvement in socio-economic life resulting in profits for themselves as well as the whole of society. Besides, mobility facilitates senior access to medical and health, educational, cultural, recreational services and other local welfare services; particularly to establish and foster social relations, and help them to combat social exclusion. Overall, everyday mobility is necessary for their social well-being, and physical and mental health.
This paper aimed to review and critically analyze the literature on the contribution between key characteristics of the neighbourhood that improve the outdoor mobility of old adults, quality of life and well-being in a number of countries all around the worlds. It also aimed to identify gaps in the level of scientific knowledge about this subject.

KEYWORDS

Quality of Life; Well-Being; Mobility, Age-Friendly Neighbourhood; Review

1 INTRODUCTION

It is well known that older people have a preference to spend the major part of their time in their homes and neighbourhoods, in other words, they are more vulnerable to changes to the environment or potential challenges of their residential housing. These can consist of urban hazards and risks such as traffic jam, access to public toilets or resting places, pedestrian safety, or the physical layout of homes which may lead to limited mobility or noticeable risk of fall (Buffel et al., 2012; Golant, 2014).

Enabling and supporting ageing in place includes political, economic, social, and geographical areas. Allowing older adults to grow old in a familiar environment and to preserve independence and self-determination is sometimes considered positive (Davies & James, 2011). Whereas, some scholars also draw criticism and attention to the restrictions and potential shortcomings of ageing in place. These criticizes address, for example, the suitability of the physical design of the home and neighbourhood, as well as the increased risk of loneliness and isolation and low amount of social support in the home and community (Howden-Chapman et al., 1999; Means, 2007).

Studies within environmental gerontology have revealed that a broader (geographic) viewpoint is required to investigate the multidimensional term of ageing in place. This is also shown by discussions about a shift from ageing in place to further research on 'place in ageing', which is focused on "identifying and understanding the key role of contexts of ageing" (Gardner, 2011).

Consequently, not only the home but also the neighbourhood and community have been found to be crucial when discussing the quality of life, health, and well-being of older adults (Howden-Chapman et al., 1999; Iwarsson et al., 2007). According to definition of WHO (2007) an age-friendly city is" an inclusive and accessible urban environment that promotes active and healthy ageing", considering this definition we categorized the features of age-friendly neighbourhood to: (i) an accessible built environment; (ii) and an inclusive social environment (Fig. 1).

As a whole, an age-friendly community should provide a comprehensive and accessible physical and social environment in which support health, social involvement, and security of the elderly (Lai et al., 2016).

Fig. 1 Eight Domains of an Age-friendly City
https://www.agefriendlylou.com/louisville-initiative
http://www.hecmworld.com/reverse-mortgage-news/age-friendly-cities-elders-seniors-planning
(Jackisch et al., 2015)

Over the past few decades, there has been increased interest in the connections of everyday mobility with neighbourhood, well-being and quality of life, both in mobility research (van den Berg et al., 2016) and in transport studies (Banister & Bowling, 2004; Nordbakke & Schwanen, 2015; Spinney et al., 2009).
A considerable number of studies have been supported the importance of the elderly's mobility for their quality of life (e.g. Gabriel & Bowling, 2004; Levasseur et al., 2004; Puts et al., 2007) and a few of them also have been examined relationship between age-friendly environment with QOL and well-being (Engel et al., 2016; Nieboer & Cramm, 2017; Tiraphat et al., 2017). It should be noted that there are seven literature reviews about transportation, mobility, neighbourhood, built environment, health, healthy and active ageing and well-being. But none of these studies have been focused on the best practices to identify characteristics of an age-friendly neighbourhood that promote outdoor mobility and quality of life all together (Alidoust & Bosman, 2015; Annear et al., 2014; Yen et al., 2009; Yen & Anderson, 2012; Kerr et al., 2012; Levasseur et al., 2015; Rosso et al., 2011).
The goal of this study is to summarize the recent published articles on mobility and quality of life in neighbourhood which is age-friendly and to identify gaps in the level of scientific knowledge about this subject.

2 METHODS

In order to identify the scientific publications to be included in this review and analysis, six search engines and data bases were used to allow access to the largest number of existing publications on the relationship under analysis (Scopus, Science Direct, Sage, Wiley, Taylor & Francis Online, Research gate and NCBI[1] (pubmed)). These search engines were selected due to their interdisciplinary nature, to cover several disciplines involved in ageing and the relationship between mobility and QOL (or other indicators of well-being). Inclusion criteria were English-only and peer-review articles published between 1990 and 2018 with the following keywords and search terms (n=53) [strategy: (1 AND 2) AND (3 OR 4)]: 1) neighbourhood* OR neighborhood* OR environment* OR setting* OR context* OR built environment* OR social environment* OR physical environment* OR universal design* OR inclusive design OR urban design OR communit* design OR environment* design*, and 2) ageing in place OR aging in place OR age-friend* OR elder* OR old* OR adult* OR geriatric OR aged OR ageing OR aging OR senior OR old people OR older people and 3) accessibility OR access* OR Proximity OR connect* OR mobilit* OR disabilit* OR walkabl* OR pedestrian* OR walk* OR cycl* OR travel* OR active transport* OR bike OR biking* OR trip* OR public transit* OR bus* OR transport* OR public transport* OR physical function* OR physical activ* and 4) quality of life OR well-being OR Healthy ageing OR healthy aging OR active ageing OR active aging.
Moreover, the study group was restricted to studies with urban old people aged 60 years or older (male and female); furthermore, articles were excluded if they were a review or commentary or if they provided qualitative data only and not include interpretation, data collection and analysis. Additional articles were identified through review of reference lists of included articles, title and abstract. Identified citations were exported into Mendeley and duplicates were removed.
Applying these parameters, 14 studies were selected to be critically reviewed (Tab. 1) and key features of age-friendly neighbourhood environment were emerged (Tab. 2). In order to present an organized set of data on this subject and with our aim in mind, the findings and results were classified in three categories: (i)

[1] National Center for Biotechnology Information Search database.

mobility, physical activity, walking, and travel behaviour; (ii) quality of life and well-being; and (iii) socio-economic characteristics.

N°	AUTHORS	SAMPLE CHARACTERISTICS AND LOCATION	MAIN GOAL	TYPE OF STUDY
1	Banister & Bowling, 2004	1000 older people aged 65 years and over in Britain, UK.	To explore the constituents of perceived QOL in older age.	Quantitative and qualitative Secondary data (re-use of qualitative data) Interviews
2	Gabriel & Bowling, 2004	999 people aged 65 or more years living in private households in Britain, UK.	To contribute to the development of a conceptual framework and body of knowledge on QOL in old age based on older people's views	Qualitative and quantitative: Interview data
3	Levasseur et al., 2004	A convenience sample of 46 people aged 60 to 90 living in the community. Québec, Canada.	To explore the relationships between subjective QOL and social participation of older adults with physical disabilities.	Quantitative A cross-sectional design
4	Scheiner, 2006	A net sample of 4.500 personally interviewed persons aged ≥60 years in the city of Bonn, the left-Rhine suburban space of Bonn, and a part of the Eifel, a rural area about 50 km from Bonn, Germany.	To understand if the car makes elderly people happy and mobile? Settlement structures, car availability and leisure mobility of the elderly	Qualitative Interviews Quantitative
5	Puts et al., 2007	25 older men and women. Amsterdam and vicinity.	To explore the meaning of QOL to older frail and non-frail persons living in the community	Qualitative Interviews: the audiotaped interviews were transcribed and coded for content and analyzed using the grounded-theory approach.
6	Spinney et al., 2009	1558 non-working elderly, Canada.	To quantify the impacts of transport mobility and to investigate their impacts on the QOL non-working elderly Canadians.	Quantitative Statistics Canada's GSS Time-diary survey
7	Haustein, 2012	1,500 standardized telephone interviews, individuals aged 60 years and above living in the German federal state of North Rhine-Westphalia (NRW).	To understand mobility behavior of the elderly, and why do we need a segmentation approach for the elderly.	Qualitative Interviews Quantitative
8	Nordbakke & Schwanen, 2015	4.712 people aged 67— and older, Norway in October–November 2011.	To analyse the link between transport and well-being by considering the extent to which older adults believe that their needs for out-of-home activity participation remain unsatisfied.	Quantitative Nationally representative data
9	Engel et al., 2016	160 community-dwelling older adults (aged 65 years and more) on low income from Metro Vancouver, Canada.	To examine the association between the built environment and social cohesion with QOL.	Quantitative Cross-sectional data from The Walk the Talk (WTT)

10	van den Berg et al., 2016	344 respondents in 2014, the southeast of the Netherlands.	To estimate feelings of loneliness as an important aspect of QOL in relation with mobility aspects and built environmental characteristics.	Quantitative
11	Nieboer & Cramm, 2017	945 community-dwelling older adults living in Rotterdam's districts Lombardijen, LageLand/ Prinsenland, Oude Westen, and Vreewijk, the Netherlands.	To identify relationships between age-friendly environments (in terms of social and physical neighbourhood attributes) and older people's overall wellbeing.	Quantitative Questionnaire
12	Tiraphat et al., 2017	4183 older adults (60 years) using multistage stratified systematic sampling from all four regions in Thailand.	To examine the association between age-friendly environments and QOL among Thai older adults.	Qualitative and quantitative Cross-sectional interview
13	Wong et al., 2017	719 respondents aged ≥60 years; A multi-stage sampling method was used to collect views of community-dwelling older people from two local districts of Hong Kong, China.	To examine the effects of perceived age-friendliness of neighbourhood environments on self-rated health (SRH) among community-dwelling older Chinese.	Quantitative A structured questionnaire
14	Hawkesworth et al., 2017	795 men and 638 women aged 69–92 years from two national cohorts, covering 20 British towns.	To investigate the association between objectively measured PA (Actigraph GT3x accelerometers) and multiple dimensions of the built environment.	Using a cross-sectional multilevel linear regression analysis. Exposures were captured by a novel foot-based audit tool that recorded fine-detail neighbourhood features relevant to PA in older adults, and routine data.

Tab.1 Selected studies for literature review

In this review evidence, documenting the critical role of the neighbourhood in promoting or inhibiting quality of life, well-being, and mobility in older individuals will present.

The remainder of the article is structured as follows. First, it reviews the literature on the concept of environment and physical activity and walking aimed to recognize effective factors that contribute to improve mobility, and then presents the studies on quality of life and well-being in relationship with neighbourhood environment.

After that, data for determining the social and built environment of neighbourhood, which are affect mobility and quality of life, were collected using review of literature from interdisciplinary point of view. Finally, the discussion and conclusion were presented and gaps about this subject were identified for future studies in order to improve mobility, well-being, and quality of life of elderly in neighbourhood.

In the next sections, we are going to discuss the main outcomes measures identified in the assessment of the literature-included mobility, physical activity and walking, travel behaviour; quality of life and well-being; and socio-economic characteristics.

3 RESULTS

3.1 MOBILITY, PHYSICAL ACTIVITY, WALKING, AND TRAVEL BEHAVIOUR

There is a growing body of knowledge that associate mobility and other relevant terms to the social and built environments of neighbourhood.

Regarding built environment aspects, a review of the literature illustrates the lower distance to public transport stops, and enhanced connectivity through public transport to final destinations considered as important factors to promote mobility of elderly (Banister & Bowling, 2004; Lai et al., 2016; Nordbakke & Schwanen, 2015; van den Berg et al., 2016). On the subject of social environment, we found more results; For instance, accessibility of the urban environment and its impacts on the elderly's social life have been broadly discussed in the literature. Since loss of mobility increases with age (Guralnik et al., 1993), the social life of the elderly is correlated with the accessibility of their environment. Indeed, transport is a key indicator of accessibility particularly in terms of getting access to local services and facilities, and engaging in social activities (Banister & Bowling, 2004).

van den Berg et al.'s work (2016) examine the impacts of travel behaviour and mobility aspects and attributions of the built environment on loneliness. They suggest that accessibility reduces feelings of loneliness that means people living nearer to a highway are less lonely.

They also understood that the neighbourhood features explain a considerable part of difference in loneliness. Whereas, people's perception of the neighbourhood and its facilities are the most significate predictors. Moreover, this study indicates that the use of various transport means (bicycle, car and public transport) remarkably decreases loneliness.

This highlights the critical role of mobility. In other words, transportation modes provide access to social relations out of the neighbourhood and may be critical to maintain one's social network. In addition, public transport provides a space where people are in close proximity and where social interactions can happen. This study has shown that people's residential environment and access to social relations (enabled by mobility tools) play a key role in feelings of loneliness or social isolation.

As a whole, all objective neighbourhood characteristics except distance to highway tested in their study have no impact on loneliness. By contrast, subjective satisfaction with neighbourhood and amenities are related to low level of loneliness. Furthermore, the outcomes determine that being a volunteer and the frequency of social relations have more explanatory power.

Another study conducted by Banister & Bowling (2004) suggest that the transport elements are reinforced by the importance of locality, and social network. These elements are both positive in the matter of availability, safety, trust and engagement, but they also act as an obstacle in terms of vulnerability and isolation (particularly at night).

The negative perception of the speed and traffic volume have perceived as the key issue in the local area (Banister & Bowling, 2004).

As stated by Levasseur et al. (2015) mobility and social participation in seniors have been demonstrated to be positively linked to indicators of most age-friendly characteristics, i.e., with 1) proximity to resources and recreational facilities, 2) social support, 3) having a car or driver's license, 4) public transportation, and 5) security, and negatively related to 6) low user-friendliness of the walking environment, and 7) insecurity.

3.2 QUALITY OF LIFE AND WELL-BEING

Key findings of latest studies recognized significant relations between social, physical or built environment indicators and quality of life and well-being.

The study by Tiraphat et al. (2017) demonstrated significant associations between perceived age-friendly environments, in particular, physical, security and social environments, and quality of life.

The strongest predictor of quality of life was social trust, followed by criminal safety, service accessibility, social support, social cohesion, aesthetics, and walkable neighbourhood. This study found an important positive relation between social trust, social support and social cohesion and quality of life among the elderly. Concerning crime, this study revealed a noteworthy correlation between criminal safety and physical as well as mental health-related quality of life. Some of the studies might claim that the social environment is more important than the physical environment in regards to the quality of life of this population (Levasseur et al., 2004).

Regarding physical or built environments, Tiraphat et al. (2017) also found the significant association between accessibility, aesthetics and places for walking in neighbourhood and quality of life. They did not find an association between street connectivity and quality of life among Thai older persons. Additionally, they did not disclose a relationship between traffic safety and the quality of life.

While Engel et al. (2006) in contrast to Tiraphat et al. (2017) revealed that street connectivity and social cohesion might be critical for aged people's capability well-being.

Based on the findings of van den Berg et al. (2016) two main factors including feeling at home in the neighbourhood and accessibility are essential for people's quality of life in all neighbourhoods, regardless of urban density. Besides, they realized social relations are vital for people's quality of life. In addition, they recommend that in addition to the more objective aspects (such as social network size and frequency of social interaction) it is crucial to study subjective aspects of social relations as well.

This study discovered that the urban density was not affecting feelings of loneliness or social isolation. However, they found that people who are more satisfied with their neighbourhood and facilities they will probably feel less lonely.

The primary analysis by Levasseur et al. (2004) explored the associations between environmental features and HRQOL as well as capability well-being. Interpersonal relationships, responsibilities, fitness and recreation were the categories of social participation most related to quality of life. They displayed that social roles were more associated with quality of life in comparison to daily activities. Besides, satisfaction with the accomplishment of life habits was also more positively correlated with quality of life rather than the performance itself.

"Correlations between some social participation categories, especially those related to social roles than daily activities and specific QOL domains were higher may be due to the fact that daily activities are basic skills acquired over a long period of time and might provide less fulfilment than social roles. In addition, social roles might be more connected to personal standards and aspirations, which are the main aspects of QOL. This exploratory study suggests that social participation is a restricted determinant of quality of life. Truly, social participation was positively associated with QOL of older people with physical disabilities, but only weakly may be explained by the more profound meaning of QOL which takes into consideration the person's cognitive and emotional perceptions".

In the study by Puts et al. (2007), non-frail or frail respondents did not report well-being as most important. In this study, they did not find any important difference in the main themes between the frail and non-frail persons. However, non-frail respondents mentioned health as the most important and necessary to enjoy

life, and thus well-being. "As frailty increased, quality of life was observed to decrease and the priorities of the domains of quality of life were observed to change". For the frail persons, social contacts were most significant and described as a requirement to well-being. "So for both the frail and the non-frail persons, this hierarchical SPF model with well-being as realized by the satisfaction of physical and social needs, can be recognized in this results.

Resources for physical well-being (such as food, healthcare, money) and resources for social well-being (such as education or a spouse) were described in this study as a prerequisite for quality of life". Furthermore, social activities such as helping others found very essential for the high level of QOL in this study. As an additional theme, home and neighbourhood were important for QOL. As well, this study showed that quality of life consists of more than health and functional capacity. In conclusion, for the elderly, quality of life included being in good health, feeling good, having social relationships, being active, helping other people and living in a nice house in a decent neighbourhood.

According to Banister & Bowling (2004), mobility, locality and social networks influence perceptions of QOL, and their study shows that the perceptions of what constitutes QOL for the elderly can be reconstructed in terms of six main 'Building Blocks': 1. Peoples' standards of social comparison and expectations of life; 2. A sense of optimism and belief that "all will be well in the end"; 3. Having good health and physical functioning; 4. Engaging in a large number of social activities and feeling supported; 5. Living in a neighbourhood with good community facilities and services (including transport); 6. Feeling safe in one's neighbourhood.

These factors seem to have contributed far more to the perceived QOL than indicators of material circumstance, such as actual levels of income, education, home ownership or social class. As the outcome of the paper has underlined, transport is important in terms of getting access to local services and facilities (Building Block 5), and in engaging in social activities (Building Block 4). The transport elements are reinforced by the importance of locality, and social networks (Building Blocks 4–6).

The study by Gabriel & Bowling (2004) stands out in that it considers potential and actual movement as one constituent of well-being amongst others, such as "having good social relations, a positive outlook, good health and physical functioning, enough financial resources and engaging in hobbies and leisure activities". The main QOL themes that emerged were: "having good social relationships, help and support; living in a home and that is perceived to give pleasure, feels safe, is neighbourly and has access to local facilities and services including transport; engaging in hobbies and leisure activities as well as maintaining social activities and role in society; having a positive psychological outlook and acceptance of unchangeable circumstances; having good health and mobility; and having enough money to meet basic needs, to participate in society, to enjoy life and to retain one's independence and control over life".

A recent study by Nieboer & Cramm (2017) clarified that "levels of age-friendliness and older people's ability to realize the instrumental goals to achieve overall well-being varied seriously among neighbourhoods, with older people living in less age-friendly communities reporting lower levels of well-being".

Spinney et al. (2009) also tried to unravel the community advantages of transport mobility, to include maintenance of both social and community networks have been successful as far as they expectedly affect the irrelevant domains of well-being.

The results suggest GSS Time- Use data are apposite for further development of a quality of life index that adds in the benefits of transport mobility. "Their results indicate that it is important to ensure these empirically based generalizations are based on enjoyment level associated with different activities.

For example, they discovered that daily engagement in activities associated with providing helping services to other community members might prove burdensome and those people would like to spend more time alone".

3.3 SOCIO-ECONOMIC CHARACTERISTICS

A review of the literature showed that age, other personal and household characteristics were linked to neighbourhood environment and mobility characteristics and in general were used as explanatory variables.
The results of van den Berg et al. (2016) indicate that "although age has little explanatory power, older people are likely to feel lonelier. However, age explains only a small part of the variance in loneliness. Adding other personal and household characteristics increased the model fit considerably.
It also changed the effect of age, showing the largest negative effect on the age category 35–64. Regarding the other personal and household characteristics, the results showed that households in the age category of 35–64 with children are less lonely, whereas household younger than 35 years of age with children are more likely to be lonely. In line with other studies, this study found lower educated people to be lonelier and healthier people, people who volunteer and people who have more social interactions to be less lonely".
This research found that younger people living in an apartment are more likely to be lonely. This may however also be a reflection of income, as high-income households in the Netherlands are less likely to live in an apartment. For the youngest age group, a recent move is related to a lower likelihood of being lonely, whereas it found a positive effect of a long residence for the oldest age group.
"Status is known to be linked to lower-order means to achieve well-being, such as wealth, education, and work (Nieboer & Cramm, 2017). This association implies that older people with higher education and income levels who continue to do voluntary work in the community are those reporting the highest status levels. These people may expect more from their neighbourhoods in terms of the ability to achieve well-being, such as transportation, civic participation, communication, and education.
Those with lower educational and income levels who do not participate in community activities may expect less from neighbourhoods in terms of these specific attributes. The same relationship is expected to apply to stimulation and civic participation; those reporting higher levels of stimulation were most critical about civic participation in the neighbourhood.
Higher educated older persons were more critical regarding the domains such as civic participation, transportation, and communication and information in their neighbourhoods, suggesting a socioeconomic rise in the perceived lack of neighbourhood attributes facilitating ageing in place" (Nieboer & Cramm, 2017).
A study by Levasseur et al. (2004) showed that the 'health and functioning' domain of the QOL is the most associated with both performance and satisfaction in the accomplishment of both daily activities and social roles. It means that participants with better health and functioning QOL performed better and were more satisfied with their social participation.
In line with Levasseur et al. (2004), Nordbakke & Schwanen (2015) understood health condition and health-related problems with walking, as well as living arrangement (living with a partner/spouse), are associated with the level of unmet activity needs.
The lay models presented by Gabriel & Bowling (2004) also emphasised the importance of financial circumstances and independence, which need to be incorporated into a definition of the overall quality of life. As well, they conclude that "to achieve a better understanding of the quality of later life, it is important to move beyond health and functional status and their impact on life as a proxy concept and measure.

A model of the quality of life and its associated measurement scales should be based on concepts derived from older people themselves". This is because this analysis indicated that objective measures of household income and distance to nearest public transport stop were not related to the level of unmet activity needs, whereas the subjective evaluations 'cannot afford it' and 'poor public transport supply' did have statistically significant impacts.

The issue of preserving the ability to drive a car in later life is also evident and being able to drive reduces unmet activity needs has received considerable attention (Nordbakke & Schwanen, 2015) "Given that car ownership may at some moment become unaffordable for older people (e.g. due to loss of a spouse or a continuing decline in real terms of retirement pension), it is important that transport and social policies not only maintain or develop older people's driving skills and abilities but also ensure that owning and using a car remain financially feasible among old people".

It is concluded that policymakers looking for increasing well-being above a minimum threshold of what counts as a decent life should enhance older adults' ability to drive in old age and car availability (Puts et al., 2007; Nordbakke & Schwanen, 2015; Levasseur et al., 2015).

Similarly, Banister & Bowling (2004) explained that an increasing amount of travel is being undertaken by car, but this level will increase further given the growth in elderly car ownership, health and license holders (Banister & Bowling, 2004).

FACTOR	EXPLANATION	LITERATURE
Socio-economic Characteristics		
Gender, sex		Banister & Bowling 2004; Engel et al., 2016; Levasseur et al., 2004; Nieboer & Cramm, 2017; Nordbakke & Schwanen, 2015; Puts et al., 2007; Spinney et al., 2009; Tiraphat et al., 2017; van den Berg et al., 2016;
Age		Banister & Bowling, 2004; Levasseur et al., 2004; Nieboer & Cramm, 2017; Puts et al., 2007; Spinney et al., 2009; Tiraphat et al., 2017; van den Berg et al., 2016
Income	Financial circumstances	Banister & Bowling, 2004; Gabriel & Bowling, 2004; Nordbakke & Schwanen, 2015; Tiraphat et al., 2017; van den Berg et al., 2016;
Education		Levasseur et al., 2004; Engel et al., 2016; Nieboer & Cramm, 2017; Puts et al., 2007; Tiraphat et al., 2017; van den Berg et al., 2016;
Marital status		Banister & Bowling, 2004; Engel et al., 2016; Nieboer & Cramm, 2017; Nordbakke & Schwanen, 2015; Puts et al., 2007; Tiraphat et al., 2017
Ethnicity/ Race		Engel et al., 2016; Nieboer & Cramm, 2017
Household size and composition		Banister & Bowling 2004; van den Berg et al., 2016
Length of residence		Tiraphat et al., 2017; van den Berg et al., 2016
Residence location		Nordbakke & Schwanen, 2015; Tiraphat et al., 2017
House ownership		Banister & Bowling, 2004; Levasseur et al., 2004
Employment status		van den Berg et al., 2016
living arrangement	Alone With a spouse or partner With another family member With a friend or roommate Other	Levasseur et al., 2004; Engel et al., 2016; Spinney et al., 2009; Tiraphat et al., 2017

Dog owner		Haustein, 2012
Season ticket		Haustein, 2012; Scheiner, 2006
Free access to public transportation	free bus-passes or discounted fares for older people	Gabriel & Bowling, 2004; Haustein, 2012
Access to smart mobile phone/ internet		Haustein, 2012; Nieboer & Cramm, 2017; Wong et al., 2017
Mobility Assets	(Driving License and Car)	Banister & Bowling, 2004; Nordbakke & Schwanen, 2015
Health Status	Illness and restrictions	Banister & Bowling, 2004; Gabriel & Bowling, 2004; Levasseur et al., 2004; Puts et al, 2007; Spinney et al., 2009; Tiraphat et al., 2017; van den Berg et al., 2016
Health-related QOL (HRQOL)		Engel et al., 2016
Physical Functioning and capacity	Functional autonomy, activity limitation, mobility aid, mortality and disability	Banister & Bowling, 2004; Levasseur et al., 2004; Nieboer & Cramm, 2017; Puts et al., 2007; Spinney et al., 2009
Physiological well-being	Depression, anxiety, anger, stress and cognitive functioning	Gabriel & Bowling, 2004; Engel et al., 2016; Puts et al., 2007; Spinney et al., 2009
Social well-being		Nieboer & Cramm, 2017
Capability well-being	EQ-5D-5L ICECAP-O	Engel et al., 2016
Quality of life	Level of satisfaction	Banister & Bowling, 2004; Levasseur et al., 2004; Spinney et al., 2009; Tiraphat et al., 2017
Age-friendly Neighbourhood		
Accessible Physical and Built Environment		
Walkability	Network of pedestrian path, road pavement quality, attractive routes and nice place to walk	Banister & Bowling, 2004; Tiraphat et al., 2017
Street Connectivity	Distance from first intersection and block length	Engel et al., 2016; Tiraphat et al., 2017
Density	Open and built area near buildings	Engel et al., 2016; van den Berg et al., 2016
Housing type and neighbourhood	Affordable and suitable	Gabriel & Bowling, 2004; Levasseur et al., 2004; van den Berg et al., 2016
Land Use	Diversity and mix-access	Engel et al., 2016
Green area	Park, garden, forest and nature (green and blue spaces)	Hawkesworth et al., 2017; Engel et al., 2016; van den Berg et al., 2016; Wong et al., 2017
Third Places	Recreation and leisure activities (cinema, theater, museum, café, coffee shop, restaurant, bar, stadium, cemetery, church, social and community centers, beauty salons, library, sport center, university, and so on)	Gabriel & Bowling, 2004; Levasseur et al., 2004; Nordbakke & Schwanen, 2015
Shops, Services, Facilities and Places	Post office, bank, police station, supermarket, local market, and so on	Banister & Bowling, 2004; Hawkesworth et al., 2017; Nordbakke & Schwanen, 2015; Scheiner, 2006; van den Berg et al., 2016
Health care services	Pharmacies, private clinic and hospital	Banister & Bowling, 2004; Nordbakke & Schwanen, 2015
Facilities for people aged 65 +		Banister & Bowling, 2004
Physical barrier		Engel et al., 2016
Hilliness		Engel et al., 2016; Nordbakke & Schwanen, 2015

Lack of cul- de- sacs		Engel et al., 2016
Accessibility and Proximity		Banister & Bowling, 2004; Tiraphat et al., 2017; van den Berg et al., 2016
Public Transportation system		Banister & Bowling, 2004; Nordbakke & Schwanen, 2015; van den Berg et al., 2016
Distance from bus and tram stops		Haustein, 2012
Distance from metro stations		Wong et al., 2017
Availability of seats and shelters along the bus and tram route		Wong et al., 2017
Cycle path and way		Engel et al., 2016
Safe crosswalks	Safe crossing points with extended green times	Banister & Bowling, 2004; Nieboer & Cramm, 2017
Bench, place to rest and public toilet		Nordbakke & Schwanen, 2015
Parking area		Nieboer & Cramm, 2017; Nordbakke & Schwanen, 2015
Escalators and elevator		Nieboer & Cramm, 2017; Puts et al., 2007
Aesthetics	Foliage, attractive buildings and scenery, absence of litter, rubbish collection, and graffiti	Banister & Bowling, 2004; Engel et al., 2016; Tiraphat et al., 2017
Safety and Security	Traffic Hazards, unattended dog and Crime	Banister & Bowling, 2004; Engel et al., 2016; Tiraphat et al., 2017
Street lighting	At night	Banister & Bowling, 2004; Wong et al., 2017
Pollution	Air	Banister & Bowling, 2004
Noise		Banister & Bowling, 2004
Weather and climate	Temperature, sunlight, ventilation and humidity	Haustein, 2012; Nordbakke & Schwanen, 2015; Pinto, 2014
Neighbourhood satisfaction	Rating neighbourhood quality	Banister & Bowling, 2004
Inclusive Social Environment		
Social relations and contacts	Relationship, communication network, interaction, ties, bonds, friends and family	Banister & Bowling, 2004; Gabriel & Bowling, 2004; Levasseur et al., 2004; Nordbakke & Schwanen, 2015; van den Berg et al., 2016
Social roles and activities		Gabriel & Bowling, 2004; Levasseur et al., 2004; Nordbakke & Schwanen, 2015
Social support		Tiraphat et al., 2017
Social trust		Banister & Bowling, 2004; Tiraphat et al., 2017
Social cohesion		Engel et al, 2016; Tiraphat et al., 2017
Activity participation, involvement and engagement	Being a volunteer	Levasseur et al., 2004; Nordbakke & Schwanen, 2015
Sense of belonging		Spinney et al., 2009

Tab.2 Literature Review of Age-friendly Neighbourhood Factors associated with Mobility, QOL and Well-being

4 DISCUSSION AND CONCLUSION

The substantial evidence provides a comprehensive understanding of neighbourhood characteristics associated with mobility, quality of life and well-being. In addition, this study prepares support for the relationship between an inclusive social environment and accessible built environment and quality of life and mobility in elderly.

Drawing on the literature review and the findings, neighbourhood environment plays a crucial role in mobility and quality of life and consequently support their well-being. This paper suggests that neighbourhood from two major aspects can influence on mobility, quality of life and well-being negative and positive directions. As highlighted in selected studies, mobility, quality of life and well-being in seniors have been demonstrated to be correlated with indicators of most age-friendly neighbourhood characteristics, as you can see in Tab. 3.

POSITIVELY ASSOCIATED WITH:	NEGATIVELY ASSOCIATED WITH:
Proximity to community resources, services, and recreational facilities	Poor user-friendliness of the walking environment
Street connectivity	Neighbourhood insecurity (the speed and traffic volume, Criminal safety, and lighting)
Aesthetic	Physical barrier
Having a car or driver's license	Loneliness
Public transportation (lower distance to public transport)	
Living closer to a highway	
Neighbourhood security	
Good health and physical functioning	
Feeling at home in the neighbourhood	
Satisfaction with accomplishment of life habits	
Education	
Enough financial resources	
Engaging in hobbies and leisure activities	
Social support	
Social trust	
Social cohesion	
Being a volunteer and participation in community (Stay active)	
Social networks and number of social interactions, contacts, and relations	

Tab. 3 Summery of main findings about association between age-friendly neighbourhood, mobility, qol and well-being

In addition, we identified some gaps in the level of scientific knowledge about this subject. A majority of the existing literature used quantitative method while there is more need to use mixed-method and cross-sectional studies. Some of them just measured in terms of objective or subjective and perceived aspects of quality of life and well-being.

We conclude here with a few additional points critical of the mainstream literature. In addition to the more objective aspects (such as social network size and frequency of social interaction), it is necessary to study subjective domains of social relations and take into consideration objective and subjective or perceived aspects altogether. Some of the studies might suggest that the social environment is more important than the physical environment in regards to the quality of life, so further studies are necessary in order to conclude it.

There is a lack of literature about communication and information domain of age-friendly city. Future studies should benefit from the use of broader measures of enacted mobility. Majority of previous studies acknowledged walking and physical activity measures as the major measures of mobility, however, use of assistive devices, public transportation, and a car can promote mobility, quality of life and well-being, and access to welfare services.

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AUTHOR'S PROFILE

Fulvia Pinto is an associate professor at the Department of Architecture and Urban Studies – Politecnico di Milano. Ph.D. in Urban and Regional Planning; professor of Urban and Regional Planning at the Politecnico di Milano. Research activities are mainly focused on urban environment requalification, on the relationship between city, mobility and environment, on the new energy certification protocols for urban planning tools. Recent research experiences have been developed in a number of national and international projects. She is author of more than 90 publications and speaker at International and National Conferences.

Mina Sufineyestani is first year PhD student in Urban Planning, Design, and Policy, Department of Architecture and Urban Studies (DASTU), Politecnico di Milano. Social and urban researcher and planner, interested in human-environment interactions, the impacts of planning, urban design, outdoor spaces, neighbourhoods and housing on social and psychological aspects and quality of life and well-being of the user.

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