TeMA

Journal of
Land Use, Mobility and Environment

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.

TeMA Journal of Land Use, Mobility and Environment offers papers with a unified approach to planning and mobility. TeMA has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).

Special Issue 2.2018

ELDERLY MOBILITY

ISSN 1970-9889
University of Naples Federico II

TeMA Journal of
Land Use, Mobility and Environment

Special Issue 2.2018

Elderly Mobility

Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence
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

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.
The Italian *National Agency for the Evaluation of Universities and Research Institutes* (ANVUR) classified TeMA as scientific journal in the Area 08. TeMA has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 3.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

TeMA
Journal of
Land Use, Mobility and Environment

Special Issue 2.2018

Elderly Mobility

Contents

TeMA

Journal of
Land Use, Mobility and Environment

TeMA Elderly Mobility
SPECIAL ISSUE 2.2018 | 53-66
print ISSN 1970-9889, e- ISSN 1970-9870
http://dx.doi.org/10.6092/1970-9870/5738

Review paper received 10 July 2018, accepted 18 September 2018

Fondazione CARIPLO

SIET Italian Society of Transport and Logistics Economists
XX Scientific Meeting, "Mobility and the city: policies for sustainability"
Special Session : Elderly Mobility
Milan, June 20th-22nd, 2018

How to cite item in APA format:
Gargiulo, C., Zucaro, F. & Gaglione, F. (2018). Accessibility for the Elderly in Urban Areas. A Set of Variables. *Tema. Journal of Land Use, Mobility and Environment*, 53-66. doi: http://dx.doi.org/10.6092/1970-9870/5738

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.

ACKNOWLEDGEMENTS

This work has been supported by Fondazione Cariplo (Grant n° 2017-0942). The authors acknowledge the financial support from the Fondazione Cariplo.

REFERENCES

Alsnih, R., & Hensher, D. A. (2003). The mobility and accessibility expectations of seniors in an aging population. *Transportation Research Part A: Policy and Practice*, *37*(10), 903-916. doi:https://doi.org/10.1016/S0965-8564(03)00073-9

Angelidou, M. (2017). Smart city planning and development shortcomings. *TeMA. Journal of Land Use, Mobility and Environment*, *10*(1), 77-94. doi:http://dx.doi.org/10.6092/1970-9870/4032

Arentze, T., Timmermans, H., Jorritsma, P., Kalter, M. J. O., & Schoemakers, A. (2008). More gray hair—but for whom? Scenario-based simulations of elderly activity travel patterns in 2020. *Transportation*, *35*(5), 613-627. doi:https://doi.org/10.1007/s11116-008-9170-z

Arnberger, A., Allex, B., Eder, R., Ebenberger, M., Wanka, A., Kolland, F. & Hutter, H. P. (2017). Elderly resident's uses of and preferences for urban green spaces during heat periods. *Urban Forestry & Urban Greening*, *21*, 102-115. doi:https://doi.org/10.1016/j.ufug.2016.11.012

Batty, M. (2009). Accessibility: in search of a unified theory. *Environment and Planning B: Planning and Design*, 36, 191-194. doi:https://doi.org/10.1068/b3602ed

Beard, J. R., & Petitot, C. (2010). Ageing and urbanization: can cities be designed to foster active ageing? *Public Health Reviews*, *32*(2), 427-450. doi:https://doi.org/10.1007/BF03391610

Biggs, S., Bernard, M, Kingston, P., & Nettleton, H. (2000). Lifestyles of belief: narrative and culture in a retirement community. *Ageing & Society*, *20*(6), 649-672. Retrieved from https://www.researchgate.net/profile/Paul_Kingston/publication/232004739_Lifestyles_of_belief_Narrative_and_culture_in_a_retirement_community/links/542fcf400cf277d58e921782.pdf

Bowling, A., & Dieppe, P. (2005). What is successful ageing and who should define it? *Bmj*, *331*(7531), 1548-1551. doi:https://doi.org/10.1136/bmj.331.7531.1548

Broome, K., Nalder, E., Worrall, L., & Boldy, D. (2010). Age-friendly buses? A comparison of reported barriers and facilitators to bus use for younger and older adults. *Australasian journal on ageing*, *29*(1), 33-38. doi:https://doi.org/10.1111/j.1741-6612.2009.00382.x

Broome, K., Worrall, L., Fleming, J., & Boldy, D. (2012). Evaluation of flexible route bus transport for older people. *Transport Policy*, *21*, 85-91. doi:https://doi.org/10.1016/j.tranpol.2012.02.005

Buffel, T., Phillipson, C., & Scharf, T. (2012). Ageing in urban environments: Developing 'age-friendly' cities. *Critical Social Policy*, *32*(4), 597-617. doi:https://doi.org/10.1177/0261018311430457

Busi, R. (2011). Metodi, tecniche e politiche per la mobilità nella città amica. *TeMA. Journal of Land Use, Mobility and Environment*, *4*(2). doi:http://dx.doi.org/10.6092/1970-9870/442

Dickerson, A. E., Molnar, L. J., Eby, D. W., Adler, G., Bedard, M., Berg-Weger, M., ... & Page, O. (2007). Transportation and aging: A research agenda for advancing safe mobility. *The Gerontologist*, *47*(5), 578-590. doi:https://doi.org/10.1093/geront/47.5.578

EEA. (2013). *Cities in transition: challenges and opportunities for the elderly*. Retrieved from https://www.eea.europa.eu/articles/a-europe-to-thrive-in/cities-in-transition-leaflet

Evans, S. (2009). *Community and ageing: Maintaining quality of life in housing with care settings*. Portland, US: Policy Press.

Falco, L. (1978). *Gli standard urbanistici*. Rome, IT: Edizioni delle autonomie

Gargiulo, C., Tulisi, A., & Zucaro, F. (2017). Climate change-oriented urban green network design: a decision support tool. In K. Gakis & P. Pardalos (Eds.), *Network Design and Optimization for Smart Cities* (pp. 255-278). World Scientific. doi:

https://doi.org/10.1142/9789813200012_0011

Gehl, J., Kaefer, L. J., & Reigstad, S. (2006). Close encounters with buildings. *Urban design international*, *11*(1), 29-47. doi:https://doi.org/ 10.1057/palgrave.udi.9000162

Gehl, J., and Matan, A. (2009). Two perspectives on public spaces. *Building Research and Information*, 37(1), 106-109. doi: https://doi.org/10.1080/09613210802519293

Glass, T. A., De Leon, C. F. M., Bassuk, S. S., & Berkman, L. F. (2006). Social engagement and depressive symptoms in late life: longitudinal findings. *Journal of aging and health*, *18*(4), 604-628. doi:https://doi.org/10.1177/0898264306291017

Hansmann, R., Hug, S. M., & Seeland, K. (2007). Restoration and stress relief through physical activities in forests and parks. *Urban forestry & urban greening*, *6*(4), 213-225. doi:https://doi.org/10.1016/j.ufug.2007.08.004

Haustein, S. (2012). Mobility behavior of the elderly: an attitude-based segmentation approach for a heterogeneous target group. *Transportation*, *39*(6), 1079-1103. doi:https://doi.org/10.1007/s11116-011-9380-7

Hawkesworth, S., Silverwood, R. J., Armstrong, B., Pliakas, T., Nanchalal, K., Jefferis, B. J., ... & Casas, J. P. (2018). Investigating associations between the built environment and physical activity among older people in 20 UK towns. *J Epidemiol Community Health*, *72*(2), 121-131. doi:https://doi.org/10.1136/jech-2017-209440

MacLeod, S., Musich, S., Hawkins, K., Alsgaard, K., & Wicker, E. R. (2016). The impact of resilience among older adults. *Geriatric Nursing*, *37*(4), 266-272. doi:https://doi.org/10.1016/j.gerinurse.2016.02.014

Macniven, R., Pye, V., Merom, D., Milat, A., Monger, C., Bauman, A., & van der Ploeg, H. (2014). Barriers and enablers to physical activity among older Australians who want to increase their physical activity levels. *Journal of physical activity and health*, *11*(7), 1420-1429. doi:https://doi.org/10.1123/jpah.2012-0096

Maisel, J. L. (2016). Impact of older adults' neighborhood perceptions on walking behavior. *Journal of aging and physical activity*, *24*(2), 247-255. doi:https://doi.org/10.1123/japa.2014-0278

Meshur, H. F. A. (2016). Evaluation of Urban Spaces from the Perspective of Universal Design Principles: The Case of Konya/Turkey. *TeMA. Journal of Land Use, Mobility and Environment*, *9*(2), 191-208. doi:http://dx.doi.org/10.6092/1970-9870/3786

Moran, M., Van Cauwenberg, J., Hercky-Linnewiel, R., Cerin, E., Deforche, B., & Plaut, P. (2014). Understanding the relationships between the physical environment and physical activity in older adults: a systematic review of qualitative studies. *International journal of behavioral nutrition and physical activity*, *11*(1), 79. doi:https://doi.org/10.1186/1479-5868-11-79

Morency, C., Paez, A., Roorda, M. J., Mercado, R., & Farber, S. (2011). Distance traveled in three Canadian cities: Spatial analysis from the perspective of vulnerable population segments. *Journal of Transport Geography*, *19*(1), 39-50. doi:https://doi.org/10.1016/j.jtrangeo.2009.09.013

Municipality of Bari, (2015). Service Plan. Retrieved from https://www.comune.bari.it/web/trasparenza/pianificazione-e-governo-del-territorio

Municipality of Lodi, (2011). Service Plan. Retrieved from http://www.comune.lodi.it/flex/cm/pages

Newson, R. S., & Kemps, E. B. (2005). General lifestyle activities as a predictor of current cognition and cognitive change in older adults: a cross-sectional and longitudinal examination. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *60*(3), P113-P120. doi:https://doi.org/10.1093/geronb/60.3.P113

OECD. (2015). *Ageing in Cities*. Paris, F: OECD Publishing. doi:https://doi.org/10.1787/9789264231160-en

Pan, S. Y., Cameron, C., DesMeules, M., Morrison, H., Craig, C. L., & Jiang, X. (2009). Individual, social, environmental, and physical environmental correlates with physical activity among Canadians: a cross-sectional study. *BMC public health*, *9*(1), 21. doi:https://doi.org/10.1186/1471-2458-9-21

Papa, E., & Trifiletti, E. G. (2010). Il sistema della mobilità: la cura del ferro. In R. Papa (Ed.), *Napoli 2011: città in trasformazione* (pp. 78–165). Naples, IT: Mondadori Electa.

Papa, R., Gargiulo, C., Fistola, R., & Battarra, R. (1992). *La città come sistema complesso in crisi strutturale - strumenti e tecniche per il governo metropolitano*. Roma, IT: Fondazione Aldo Della Rocca.

Papa, R., Gargiulo, C., & Battarra, R. (2016a). *Città Metropolitane e Smart Governance: Iniziative di successo e nodi critici verso la Smart City*. Naples, IT: FedOA-Federico II University Press. doi:http://dx.doi.org/10.6093/978-88-6887-005-8

Papa, R., Gargiulo, C., & Zucaro, F. (2016b). Towards the Definition of the Urban Saving Energy Model (UrbanSEM). In R. Papa & R. Fistola, *Smart Energy in the Smart City* (pp. 151-175). Cham, CH: Springer. doi:https://doi.org/10.1007/978-3-319-31157-9_9

Rioux, L., & Werner, C. (2011). Residential satisfaction among aging people living in place. *Journal of environmental psychology*, *31*(2), 158-169. doi:https://doi.org/10.1016/j.jenvp.2010.12.001

Ritter, A. S., Straight, A., & Evans, E. L. (2002). *Understanding senior transportation: Report and analysis of a survey of consumers age 50*. Washington, US: AARP, Public Policy Institute. Retrieved from https://assets.aarp.org/rgcenter/il/2002_04_transport.pdf

Salata, K. D., & Yiannakou, A. (2016). Green Infrastructure and climate change adaptation. *TeMA. Journal of Land Use, Mobility and Environment*, *9*(1), 7-24. doi: http://dx.doi.org/10.6092/1970-9870/3723

Scharlach, A. E., & Lehning, A. J. (2013). Ageing-friendly communities and social inclusion in the United States of America. *Ageing & Society*, *33*(1), 110-136. doi:https://doi.org/10.1017/S0144686X12000578

Scheiner, J. (2006). Does the car make elderly people happy and mobile? Settlement structures, car availability and leisure mobility of the elderly. *European Journal of Transport and Infrastructure Research*, *6*(2), 151-172. Retrieved from http://www.ejtir.tbm.tudelft.nl/ISSUES/2006_02/pdf/2006_02_03.pdf

Schwanen, T., & Páez, A. (2010). The mobility of older people: an introduction. *Journal of Transport Geography*, *18*(5), 591–595. doi: https://doi.org/10.1016/j.jtrangeo.2010.06.001

Shoval, N., Auslander, G., Cohen-Shalom, K., Isaacson, M., Landau, R., & Heinik, J. (2010). What can we learn about the mobility of the elderly in the GPS era? *Journal of Transport Geography*, *18*(5), 603-612. doi:https://doi.org/10.1016/j.jtrangeo.2010.03.012

Spinney, J. E., Scott, D. M., & Newbold, K. B. (2009). Transport mobility benefits and quality of life: A time-use perspective of elderly Canadians. *Transport policy*, *16*(1), 1-11. doi:https://doi.org/10.1016/j.tranpol.2009.01.002

Stewart, A. L., Verboncoeur, C. J., McLellan, B. Y., Gillis, D. E., Rush, S., Mills, K. M., ... & Bortz, W. M. (2001). Physical activity outcomes of CHAMPS II: a physical activity promotion program for older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(8), M465-M470. doi:https://doi.org/10.1093/gerona/56.8.M465

Sugiyama, T., & Thompson, C. W. (2007). Outdoor environments, activity and the well-being of older people: conceptualising environmental support. *Environment and Planning A*, *39*(8), 1943-1960. doi:https://doi.org/10.1068/a38226

Szeto, W. Y., Yang, L., Wong, R. C. P., Li, Y. C., & Wong, S. C. (2017). Spatio-temporal travel characteristics of the elderly in an ageing society. *Travel Behaviour and Society*, *9*, 10-20. doi:https://doi.org/10.1016/j.tbs.2017.07.005

Temelová, J., & Slezáková, A. (2014). The changing environment and neighbourhood satisfaction in socialist high-rise panel housing estates: The time-comparative perceptions of elderly residents in Prague. *Cities*, *37*, 82-91. doi: https://doi.org/10.1016/j.cities.2013.12.002

Tiboni, M., & Rossetti, S. (2012). L'utente debole quale misura dell'attrattività urbana. *Tema. Journal of Land Use, Mobility and Environment*, *5*(3), 91-102. doi:http://dx.doi.org/10.6092/1970-9870/1200

Tiboni, M., & Rossetti, S. (2014). Achieving People Friendly Accessibility. Key Concepts and a Case Study Overview. *TeMA. Journal of Land Use, Mobility and Environment*. Special Issue INPUT 2014. doi:http://dx.doi.org/10.6092/1970-9870/2487

Toepoel, V. (2013). Ageing, leisure, and social connectedness: how could leisure help reduce social isolation of older people?. *Social indicators research*, *113*(1), 355-372. doi:https://doi.org/10.1007/s11205-012-0097-6

Uhlenberg, P. (Ed.). (2009). *International handbook of population aging* (Vol. 1). Berlin, De: Springer Science & Business Media.

United Nations (UN). (2006). Convention on the rights of persons with disabilities. Retrieved from http://www.un.org/disabilities/documents/convention/convoptprot-e.pdf

Van Cauwenberg, J., Van Holle, V., De Bourdeaudhuij, I., Van Dyck, D., & Deforche, B. (2016). Neighborhood walkability and health outcomes among older adults: The mediating role of physical activity. *Health & place*, *37*, 16-25. doi: https://doi.org/10.1016/j.healthplace.2015.11.003

Wen, C., Albert, C., & Von Haaren, C. (2018). The elderly in green spaces: Exploring requirements and preferences concerning nature-based recreation. *Sustainable Cities and Society*, *38*, 582-593 doi: https://doi.org/10.1016/j.scs.2018.01.023

Wong, R. C. P., Szeto, W. Y., Yang, L., Li, Y. C., & Wong, S. C. (2017). Elderly users' level of satisfaction with public transport services in a high-density and transit-oriented city. *Journal of Transport & Health*, *7*, 209-217. doi:https://doi.org/10.1016/j.jth.2017.10.004

Yung, E. H., Conejos, S., & Chan, E. H. (2016). Social needs of the elderly and active aging in public open spaces in urban renewal. *Cities*, *52*, 114-122. doi:https://doi.org/10.1016/j.cities.2015.11.022

Yuryev, A., Leppik, L., Tooding, L. M., Sisask, M., Värnik, P., Wu, J., & Värnik, A. (2010). Social inclusion affects elderly suicide mortality. *International Psychogeriatrics*, *22*(8), 1337-1343. doi:https://doi.org/10.1017/S1041610210001614

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.