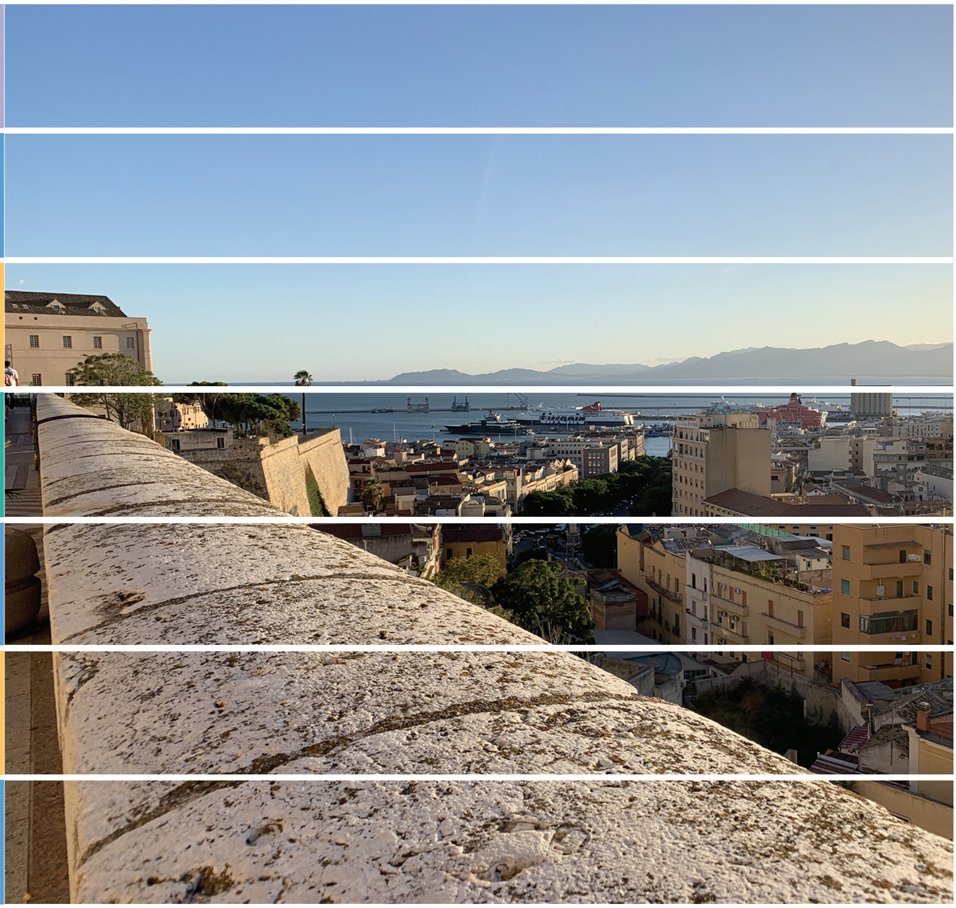
Carmela Gargiulo Corrado Zoppi
Editors

Planning, Nature and Ecosystem Services



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Carmela Gargiulo Corrado Zoppi

Editors

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INPUT aCAdemy 2019

This book collects the papers presented at INPUT aCAdemy 2019, a special edition of the INPUT Conference hosted by the Department of Civil and Environmental Engineering, and Architecture (DICAAR) of the University of Cagliari.

INPUT aCAdemy Conference will focus on contemporary planning issues with particular attention to ecosystem services, green and blue infrastructure and governance and management of Natura 2000 sites and coastal marine areas.

INPUT aCAdemy 2019 is organized within the GIREPAM Project (Integrated Management of Ecological Networks through Parks and Marine Areas), co-funded by the European Regional Development Fund (ERDF) in relation to the 2014-2020 Interreg Italy – France (Maritime) Programme.

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This book is the most recent scientific contribution of the "Smart City, Urban Planning for a Sustainable Future" Book Series, dedicated to the collection of research e-books, published by FedOAPress - Federico II Open Access University Press. The volume contains the scientific contributions presented at the INPUT aCAdemy 2019 Conference. In detail, this publication, including 92 papers grouped in 11 sessions, for a total of 1056 pages, has been edited by some members of the Editorial Staff of "TeMA Journal", here listed in alphabetical order:

- Rosaria Battarra;
- Gerardo Carpentieri;
- Federica Gaglione;
- Carmen Guida;
- Rosa Morosini;
- Floriana Zucaro.

The most heartfelt thanks go to these young and more experienced colleagues for the hard work done in these months. A final word of thanks goes to Professor Roberto Delle Donne, Director of the CAB - Center for Libraries "Roberto Pettorino" of the University of Naples Federico II, for his active availability and the constant support also shown in this last publication.

Rocco Papa
Editor of the Smart City, Urban Planning for a Sustainable Future" Book Series
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IMPROVING ACCESSIBILITY TO URBAN SERVICES FOR OVER 65:

A GIS-SUPPORTED METHOD

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ABSTRACT

By referring to the eight domains of age-friendly cities (WHO, 2007), urban accessibility can be considered as one of the elements cutting across most of them. The relationship between the organization of the urban system (supply) and the mobility of the population over 65 (as for every city user) has prompted scientific debate on how to improve the accessibility of the over 65 to the services of their interest through the pedestrian network and the public transport network. This study is a first research segment of the broader MOBILAGE project, which aims at defining a decision support tool for public administrations to improve elders' accessibility to urban services, thus contributing to enhance their quality of life. Most studies of the literature are interested only in measuring the catchment area of health services, in order to investigate the degree of accessibility to this service, by identifying both the most disadvantaged portions of the urban area and those characterized by a balance between supply and demand. The objective of this first step of research is wider and is oriented to define the catchment area of all services for over 65 on the basis of the existing street network, the orography of the territory and the pedestrian speeds of the three age groups of the old population (65-69; 70-74; >75).

KEYWORDS
Elderly; Catchment areas; Urban accessibility; GIS

* The other author is: Luigi Faga.

1 INTRODUCTION

Advanced ageing has becoming a global phenomenon of this century, mainly due to declining fertility and improved health and longevity. In fact, in both industrialized countries and developing countries (albeit at different paces) the values of the old age index grow faster than the growth rate of the total population.

In OECD countries, the number of people aged 65 and over rose from 7.7% in 1950 to 17.8% in 2010 and it is foreseen it will reach 25% in 2050 (OECD, 2015). During the 2000s, the population share of those 65 years and above rose to 15.1%, while the rate of the total population growth was only 9.7%. Conversely, the decade between 1990 and 2000 saw a more rapid increase in the growth rate of the total population than that of the older one (respectively, 12% and 13.2%).

This unprecedented demographic shift raises some interesting (and still open) questions that involve many disciplinary fields, such as: the social sciences, concerned with the evaluation of the "social productivity" (Laslett & Cuberli, 1992) of the over 65; the economic sciences, focused on how to guarantee adequate retirement benefits without generating an unbearable pay-load for the younger age groups; the medical sciences, aimed at preventing some illnesses related to old age; the urban studies, investigating how to make an age-friendly city. In particular, a "city fit for elderly" holds services, and network infrastructure that optimize involvement, communication and interaction opportunities, in order to guarantee the independence of elders over 65, namely, their active aging in place.

By referring to the eight domains of age-friendly cities (WHO, 2007), urban accessibility can be considered as one of the elements cutting across most of them. In fact, the concept of urban accessibility generally includes the physical characteristics (mobility and open spaces networks), the functional characteristics (services and activities) and the socio-economic characteristics (lifestyles and habits) of an urban system (Papa et al., 2017; Papa, 2018). In the holistic-systemic perspective of the governance of urban transformations, the set of all these components affects the quality of life of individuals and the opportunities for their civic participation and social inclusion. Indeed, urban accessibility is increasingly recognized as the "litmus test" to quantitatively assess the social inclusion and social equity of the whole urban area or part of it, in order to ensure that all citizens benefit from equal distribution of resources, welfare and services (Van Wee & Geurs, 2011; Jones & Lucas, 2012; Lucas, 2012; Zali et al., 2016). In this regard, many studies have investigated the levels of social equity (as well as the levels of social exclusion) of some of the most vulnerable segments of population (for instance children and elderly) that are characterized by specific needs of mobility. Focusing on elderly and according to Scheiner (2006), Campbell (2015), Wang and Shepley

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(2018) "the local activity space of over 65", that is the "geographic area of elderly daily living involvement", declines with age. This implies rethinking and redesigning the built environment by improving connectivity, walkability and proximity of daily life facilities.

In this sense, it is useful to measure the catchment areas of the services of interest of the elderly, in order to investigate the degree of accessibility to each service, by identifying both the most disadvantaged portions of the urban area and those characterized by a balance between supply and demand of the service. In this way, it is possible to support the local public decision-maker in the development of actions aimed at guaranteeing a fair urban accessibility, with a priority focus on the most lacking areas in terms of services and transport networks.

In literature the definition of the elders' catchment areas of the public road transport service and of the health services (especially the hospital care) are the two most consolidated lines of research with respect to this issue, as LPT can have a key role in minimizing social exclusion (Farrington & Farrington, 2005; Langford et al., 2012a; Tseng & Wu, 2018) and people over 65 strongly depend on medical facilities (Kanuganti et al., 2016; Kaur Khakh et al., 2019). Despite the abovementioned studies, few have taken into consideration further kinds of services.

Aimed towards bridging this lack in urban accessibility studies, this work focuses on measuring a sort of new catchment areas of the main services of interest based on the effective street network, the walking speeds of the three segments of the elderly population (65-69, 70-74, >75) and the orography of the city. This is a first research segment of the broader MOBILAGE project, which aims at defining a decision support tool for public administrations to improve elders' accessibility to services, thus contributing to enhance their quality of life.

The paper is articulated as follows: the second section proposes a review of the scientific literature on the elderly accessibility issue; the third section presents a methodology to define a new kind of catchment areas of the main urban services of interest for elderly; the last section describes some first results obtained.

2 STATE OF THE ART

Demographic change raises interesting research questions in the field of urban studies, particularly on the organization of settlement systems. The localization and spatial distribution of services, the local public transport supply and the mobility networks affect the elders' choices of movement. The duality relation between the organization of the urban system (supply) and the mobility of the population over 65 (as for every city user) has prompted scientific debate on how to improve both the elders' accessibility to the transport and pedestrian network (Luk & Olszewski, 2003) and to the services of interest (Guagliardo 2004).

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In particular, other lines of research have examined the issue of accessibility to urban sites and services by measuring the catchment areas of the main services of interest for the elderly. An extensive scientific literature deals with the identification of the level of accessibility to reach a specific urban service, particularly focusing on the services related to health care (Chen, 2017; Luo, 2014), while other research focused on the public road transport service (Langford et al. 2012b; Lin et al., 2014).
In more detail, some of the studies developed (Ngui & Apparicio, 2011; Lou & Whippo 2012; Wan et al., 2012; Mao & Nekorchuk, 2013) have defined the catchment areas for a specific health service (i.e. the hospital care) through the measurement of some characteristics, such as the distance to be covered and the travel time to reach a certain activity (supply). Within each catchment area, the density of the elderly resident population (demand) potentially served is calculated by comparing it to the distance or time needed to reach the service. This calculation is aimed at identifying the portion of urban areas where the demand-supply balance is satisfied and how to adapt, instead, the less-served areas, in order to guarantee the same level of accessibility and, consequently, of social equity. Another research segment has adopted the same methodology for measuring accessibility to public transport (Andersen & Landex, 2008; Wells & Thill, 2012; Lin et al 2014) or other services of interest, such as green areas (Dai, 2011) or public services (Wang, 2007) without orienting such studies to only one of the age groups of the elderly population over 65.
Instead, studies that relate the demand of the elderly to the supply of various types of urban services (such as health, economic-financial, cultural and recreational services) are in a small number, also because of the urban context features.
The objective of this research work is to define a new kind of catchment areas of the main services of interest according to the street network, the orography of the territory and the pedestrian speeds of the three age groups of the elderly population (65-69; 70-74; > 75), in order to classify urban areas according to their level of accessibility to places and services and evaluate the supply-demand balance or potential gaps.

3 METHODOLOGY

As regards the objective of the work aimed at improving accessibility to urban services of interest for the elderly, this section describes the steps of the first segment of research that allowed to identify the new catchment areas for each service category, that we considered of interest for over-65-aged people, classified in three different age-range: 65-69; 70-74; >75.
In the first step, different walking speeds for each age group were defined. To this end the study of the scientific literature has allowed to consider as useful, for the purposes of this

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work, the research carried out by Weber (2016) which determined these values according to the main socio-economic characteristics of the elderly population.
Following, walking speed values are reported:

- for what concerns the first age range (65-69), the average walking speed is 0.81 m/s;
- for the second age range (70-74), the average walking speed is 0.69 m/s;
- for the third age range (over 75), the average walking speed is 0.60 m/s.

From these average walking speeds, in the second step of the methodology process, influence rays for each service category were identified; they represent the maximum pedestrian distances that a general user is willing to walk, to get to a certain service (Tab. 1). These influence rays were identified by referring to a previous work developed by the authors (Gargiulo et al., 2018), concerning the study of territory planning tools, such as the Service Plans (in particular Lodi and Bari) and Urban Sustainable Mobility Plans.
In order to define the influence area of the services used by the three segments of the elderly population, phase 3 was articulated as follows:

- calculating the average pedestrian time (for any type of user) for each influence ray (distance to walk) of the services considered;
- redefining the different influence rays of each category of service (maximum distance that can be walked), according to the different pedestrian speeds of each age group and assuming the average walking time, identified before, to be constant;
- identifying the new influence area of each service, that is, the theoretical area where the users of that service live.

However, this procedure has the limitation of considering the territory as isotropic. In fact, the influence areas thus obtained, do not represent the real areas where the users of a given service actually live, as they do not take into account the morphology of the territory and the presence of the real walkable streets.
For this reason, the slopes have been defined, as they can contribute to reduce the distance that the elderly can walk. Regarding the identification of the walkable streets, a procedure was developed in GIS environment, through the Network Analysis tool and a Digital Elevation Model, in order to define the streets that the elderly can use to access services.
Furthermore, in GIS environment, both the slope and the average pedestrian speed were associated to the street graph in order to define the set of the real walkable paths to reach each urban service.

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ID	VARIABLE	MEASURE
	FUNCTIONAL SUBSYSTEM (services of local interest)	
1	Pharmacies	Influence ray (R.i.)= 500m
2	Asl	R.i.= 500 m
3	Poly-diagnostic center	R.i.= 560 m
4	Cinema	R.i.= 516 m
5	Municipal library	R.i.= 600 m
6	Churche	R.i.= 480 m
7	Bank	R.i.= 500 m
8	Post Office	R.i.= 500 m
9	Municipal office	R.i.= 500 m
10	Union	R.i.= 500 m
11	Supermarket	R.i.= 500 m
12	Green area	R.i.= 100 m
13	Sports Center	R.i.= 1000 m
	FUNCTIONAL SUBSYSTEM (services of general interest)	
14	Hospital	R.i.= 1100 m
15	Private Clinic	R.i.= 1100 m
16	Urban park	R.i.= 1000 m
17	Museum	R.i.= 1100 m
18	Cemetery	R.i.= 1100 m
19	Stadium	R.i.= 1100 m

Tab.1 Traditional influence rays of the main urban services

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ID	POPULATION	SERVICES	TIME (MIN)	RAY INFLUENCE (M)
FUNCTIONAL SUBSYSTEM (services of local interest)				
1	65-69 70-74 >75	Pharmacy	6	292 248 216
2	65-69 70-74 >75	Asl	6	292 248 216
3	65-69 70-74 >75	Poly-diagnostic center	7	340 290 252
4	65-69 70-74 >75	Cinema	6	292 248 216
5	65-69 70-74 >75	Library	7	340 290 252
6	65-69 70-74 >75	Church	6	292 248 216
7	65-69 70-74 >75	Bank	6	292 248 216
8	65-69 70-74 >75	Post office	6	292 248 216
9	65-69 70-74 >75	Municipal office	6	292 248 216
10	65-69 70-74 >75	Union	6	292 248 216
11	65-69 70-74 >75	Supermarket	6	292 248 216
12	65-69 70-74 >75	Green area	2	97 83 72
13	65-69 70-74 >75	Sport Center	12	583 497 432
FUNCTIONAL SUBSYSTEM (services of general interest)				
14	65-69 70-74 >75	Hospital	13	632 538 468
15	65-69 70-74 >75	Private Clinic	13	632 538 468
16	65-69 70-74 >75	Urban park	12	583 497 432
17	65-69 70-74 >75	Museum	13	632 538 468

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18	65-69	Cemetery	13	632
	70-74			538
	>75			468
19	65-69	Stadium	13	632
	70-74			538
	>75			468

Tab. 2 New influence rays of services of interest for the three old populations segments

The catchment areas so computed, according to the localization and the distribution of each category of service of interest of over 65, allowed to define the supply map.

The supply map, compared with the demand map that classifies census tracts on the basis of over-65 population density, allows to identify urban areas characterized by a supply-demand equilibrium, as well as those where it is necessary to intervene to fill the supply-demand gap for elderly.

This research step provides some first results useful to develop a support tool for the decision maker. In fact, for instance, the identification of the urban portions characterized by a high lack of accessibility to services, defines the areas where it is a priority to intervene and allows to provide first indications useful to improve accessibility, such as the localization of new urban services for the over 65 or the identification or improvement of pedestrian paths to reach them.

4 CONCLUSIONS

This work describes a procedure for measuring a different kind of catchment areas of spaces and services of interest for people over 65, taking pedestrian speeds and urban orography into consideration.

The distribution of the demand-supply ratio of a service within an urban area allows determining the rate of the population served and identifying those urban areas where action is needed to reduce (or potentially cancel) the disadvantages caused by a scarce level of accessibility, as well as identifying the areas where the supply of many services overlap. In particular, the study of lack of accessibility for the elderly has almost exclusively concerned mobility and health care services. However, as repeatedly underlined both at scientific and institutional levels, quality of life also depends on the possibility of reaching all the services held in a given urban area. For example, the importance of ensuring access to the different urban services has been emphasized within the most recent reports of the WHO with the aim to promote cities that are willing to adapt to different age and social groups.

If the components of an age-friendly city are well defined in theory, in the governance tools of urban transformation the definition and implementation of strategies and actions for the most vulnerable social groups is not so easy. Considering the city as a whole and adopting an integrated view of user behaviors, of the services available and their accessibility, could help

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"tackle physical and social disparities and meet the needs of all groups in the community" (Plouffe et al., 2018). This holistic approach has characterized the development of the proposed methodology which, through the localization of the demand for services by the over-65s, the distribution of catchment areas, that have been ri-defined on the basis of the new criteria of the research work, and the comparison between them, allows public decision-makers to identify the urban partitions lacking of urban services.

In a subsequent phase of the research work, the location and distribution of the supply will be combined with the physical characteristics of the urban system that influence the choice of a route (for instance presence of sidewalks), to define the network of pedestrian paths suitable for senior citizens to reach the main services of interest. In fact, one of the goals of MOBILAGE project is to provide the public decision-makers with strategies and actions aimed at increasing the quality of life of the elderly by improving urban accessibility.

In this regard, the MOBILAGE research project appears to be in line with current EU policies in allowing elders to actively age in their environment by optimizing some physical and environmental characteristics, such as crosswalks, to make them easily accessible to older people but also to the whole community, which may benefit from such interventions too. Many joint initiatives, in fact, reflect a growing emphasis on participatory approaches to promoting community revitalization from the elders' point of view, thereby fostering active involvement and preventing social exclusion of seniors (Komise, 2009; EC, 2010; Walker & Maltby 2012).

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AUTHOR CONTRIBUTIONS

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