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Summary of: Quality of life in the urban environment and primary health services for the elderly during the Covid-19 pandemic: An application to the city of Milan (Italy)

Research Focus and Methodology

The research paper focuses on the impact of the COVID-19 pandemic on urban accessibility to healthcare services in Milan and how it affects the quality of life for the elderly. The study uses a GIS-based methodology to measure urban accessibility to healthcare services for the elderly in both ordinary working scenarios and during the pandemic. The research highlights the unprecedented challenges posed by the pandemic and the need to assess urban accessibility to essential services for the most vulnerable demographics, such as the elderly.

Age-Friendly Approaches and Methodological Application

The paper delves into the increasing vulnerability and dependence of elderly people on medical care services and the necessity of age-friendly approaches in urban planning strategies. It underlines the importance of ensuring equal accessibility to essential services, especially in view of the coronavirus pandemic. The authors propose a two-step-float-catchment-area (2SFCA) methodology to measure accessibility to primary healthcare services and incorporate a multimodal transportation network that includes walking streets, bus lines, and urban railway lines.

Spatial Accessibility Evaluation and Findings

The study, which is part of the MOBILAGE project, funded by the Fondazione Cariplo, focuses on the city of Milan, which was particularly affected by the pandemic. The methodology is applied to evaluate the spatial accessibility of the elderly to primary healthcare services and the consequences of reduced accessibility during the COVID-19 lockdown. The findings show that the elderly population suffered a decrease in accessibility to primary health services, especially in the city suburbs, as a result of limited services and activities.

Need for Policy Intervention and Decision Support

The authors discuss the disproportionate accessibility to primary health services among the elderly population, emphasizing the need for policies to address these disparities and reduce the potential effects of the COVID-19 pandemic on the health and quality of life of the elderly. The study aims to provide decision support tools to local administrators for evaluating and assessing the accessibility level to medical care services in urban areas, especially during emergencies and crises.

Holistic Approach and Study Limitations

The paper emphasizes the need for a holistic and integrated approach to urban accessibility, taking into account both the components of land use and transport systems. It concludes by highlighting the limitations of the study, including the lack of available data and the need for further exploration of the relative benefits of the proposed methodology within other urban contexts.

Summary and Conclusion

In summary, the research paper provides a detailed analysis of the impact of the COVID-19 pandemic on urban accessibility to healthcare services for the elderly in Milan. It underscores the necessity of developing integrated policies and tools to address disparities in accessibility and improve the quality of life for the elderly, especially during emergencies and crises.

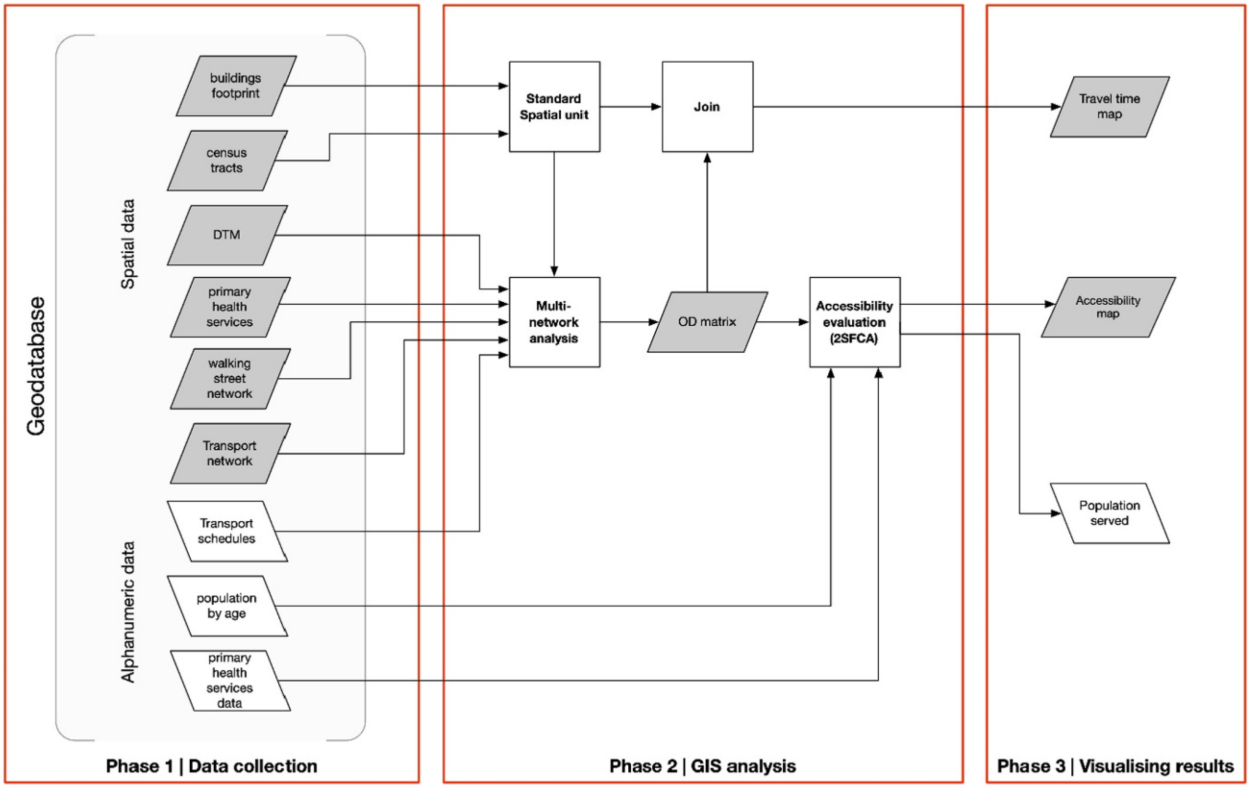
The passages and figures from the article I think is important and could help understand the theory:

In the scientific panorama, the two-step floating catchment area (2SFCA) method is one of the most popular approaches for measuring spatial accessibility.

The methodology consists of two steps: the first aims to evaluate the balance of supply and demand, quantifying the stress level of services, while the second estimates accessibility as the sum of available services, weighted by their ratios and their distances from users.

In this study, a GIS-based procedure was developed to evaluate the elderly's level of accessibility to primary health services, considering the demographic characteristics of potential users and multimodal transport services (i.e., walking in the street, the frequency of service and the localisation of urban transport stops)

We considered the network as the combination of both walkable streets and local public transport lines (bus and metro) in order to better simulate elderly mobility habits. The ArcGIS Network Analysis tool was used to compute the OD travel matrix. We ran **three different simulations during morning peak-hour (9:00) for a person aged 65–69, 70–74 and 75 and over** respectively, accordingly considering three different walking speeds



In the literature, the use of a hexagonal cell (rather than a square one) is recommended for dealing with areas that have problems related to the connectivity of different space units and the identification of shorter paths for calculating travel distances (Kibambe Lubamba et al., 2013). For this GIS-based procedure, we used a **regular hexagonal cell as the spatial unit with a side length of 50 m** that provides greater aesthetic attraction — but above all a greater accuracy — in the calculation and visualisation of results.

a modified Two-Step Floating Catchment Area (2SFCA) method was used to measure the accessibility to primary health services. The theoretical basis behind this method is described in greater detail below:

The first step is to compute, for each healthcare centre *j* (Milan Local Health Agency facility), a ratio R_j (Eq. (1)) of supply and demand. The supply of healthcare services is quantified by the number of available surgeons for each building (S_j); the demand is the sum of the population, potential users divided into three age ranges in location i, with P_i weighted to consider a time-distance-decay function, W_{ij}, which is a function of the total travel time. The travel times between residential locations *i* and healthcare structures *j* are estimated by Network Analyst and ArcMap, taking into account both walking and transit routes. Due to the Covid-19 pandemic, policymakers are now facing a further, more urgent challenge unprecedented in recent human history due to its rapid and dangerous expansion. In fact, an emergency such as the present one, with its significant impacts on most urban activities, affects all the components of the urban system (economic productivity, socio-cultural life, communication — up to changing personal relationships), including the social subsystem (Allam & Jones, 2020; McKibbin & Fernando, 2020). Hence, in order to consider the limited supply of healthcare services during the spread of Covid-19, a *k* coefficient was introduced. It varies between 0 and 1, to highlight the variable availability of services for the elderly.

$$R_j = \frac{S_j \bullet \left(\frac{S_j}{S}\right) \bullet k}{\sum_{65-69} P_i \bullet W_{ij}^{65-69} + \sum_{70-74} P_i \bullet W_{ij}^{70-74} + \sum_{>75} P_i \bullet W_{ij}^{>75}} \tag{1}$$

For the second step, A_i, **the accessibility of each hexagonal cell** was obtained (as reported in Eq. (2)) by **summing the supply-demand ratios of the *j* health centres serving the *i* cell** — multiplied for the impedance function coefficients W_{ij}, to take into account both the spatial distribution of health centres and the population.

$$A_i = \sum_{65-69} R_j \bullet W_{ij}^{65-69} + \sum_{70-74} R_j \bullet W_{ij}^{70-74} + \sum_{>75} R_j \bullet W_{ij}^{>75} \tag{2}$$

The distance-decay function W_{ij} was introduced to reflect elderly people's mobility habits: a **Gaussian impedance function**, whose values vary between 1 and 0, was used; **this function's main characteristic is that it quickly decreases when time travel is close to the maximum availability of minutes that each elderly age category requires (according to their physical capabilities) to access at the health service** (Kwan, 1998).

$$W_{ij} = e^{-t_{ij}^2 / \beta} \tag{3}$$

The coefficient β was set equal to 180 for people aged between 65 and 69, 160 for those between 70 and 74 and 140 for those aged 75 and over, in order to best represent mobility attitudes of different elderly age categories according to outcomes in the scientific literature (Bauer & Groneberg, 2016). Fig. 2 below shows the Gaussian impedance functions used in our application.

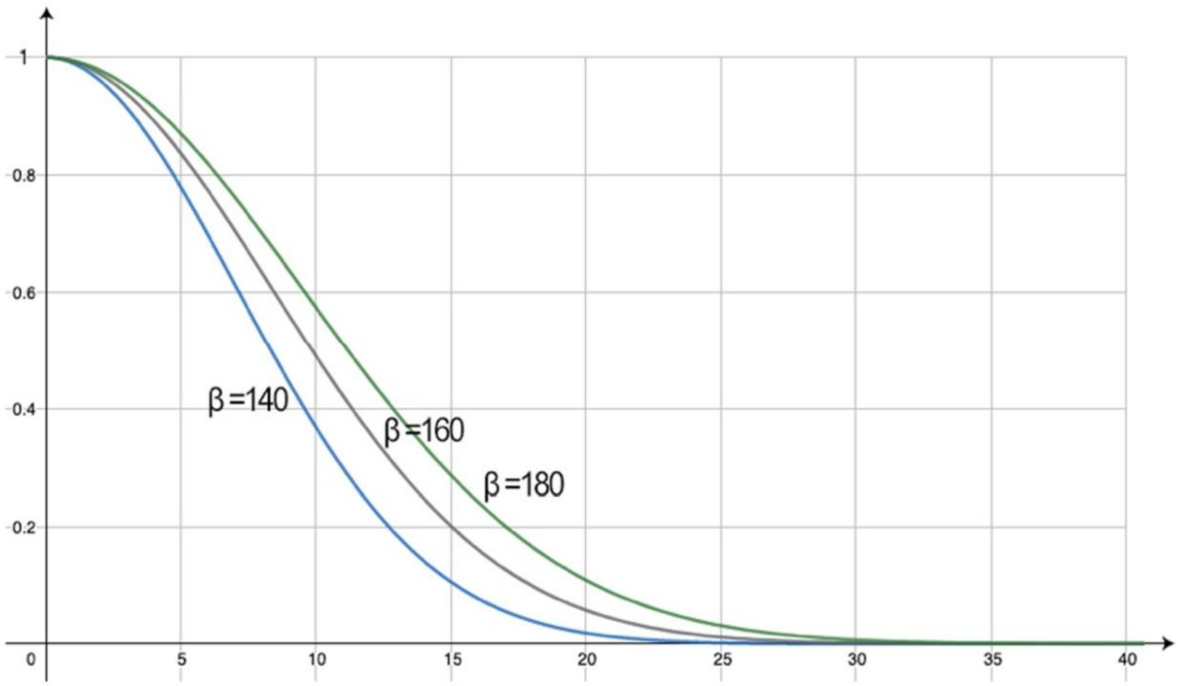


Fig. 2. The three Gaussian distance-decay functions.

The coefficient *k* was introduced to consider the variation of the number of available services in different scenarios: it represents the ratio between the available services *Sj* during emergency scenarios, instances when the supply of healthcare services could be reduced, and the number of services functioning ordinarily.

$$k = \frac{\sum_{j}^{n} S_j}{\sum_{j=1}^{m} S_j} \tag{4}$$

Firstly, OpenStreetMap data was used to create the pedestrian network, taking into account only walkable roads and their gradient. Then, GTFS data from the ATM was used to add bus and railway routes and stops in the transport network. Since public transport is not a continuous service in space and time, additional modelling operations were needed to connect the pedestrian system to the public transit system (Rossetti et al., 2020; Zecca et al., 2020). Once the multimodal network was ready, the ArcGIS Network Analyst tool was used to compute an OD (Origin and Destination) matrix, **containing in each cell the total travel time to get from a generic hexagonal cell to a certain healthcare centre**. The variation of transport costs was not considered when computing generalised costs since these are flat within the Milan municipality, as travel fares do not depend on physical distances and public transport modality.

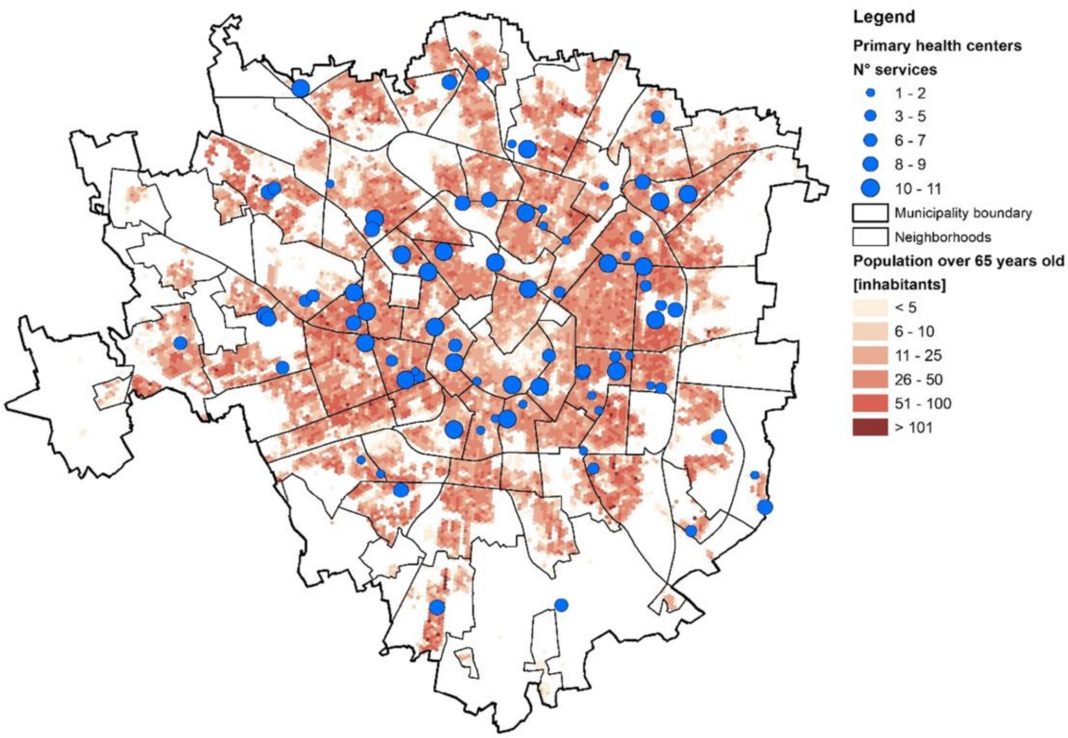


Fig. 3. The distribution of the adult population and primary health services (private and public) in the city of Milan.

The data they used in the study:

Table 2
Alphanumeric and spatial input data.

Data	Category of data	Type of geometry	Source	Year
Population	Alpha-numeric	–	ISTAT	2011
Transport schedules	Alpha-numeric	–	Transport companies	2020
Primary health services	Vector/alpha-numeric	Point	Local Health Agency	2020
Walking street network	Vector	Polyline	Open Street Map	2020
Transport network	Vector	Polyline	Transport companies	2020
Census tracts	Vector	Polygon	ISTAT	2011
Buildings	Vector	Polygon	Geoportal	2011
Digital terrain model	Raster	–	Geoportal	2017

The accessibility levels' thresholds were chosen according to the quantile classification — a data classification method that distributes a set of values into groups containing an equal number of values

(Bauer et al., 2018; Shah & Adhvaryu, 2016; Zhu et al., 2018). **The attribute values are added up, then divided into the predetermined number of classes**. In this application, ten accessibility levels were considered, ordered from greater to poorer accessibility (Carpentieri et al., 2020).

For this application, we evaluated the accessibility to primary health services for the elderly before (base scenario) and during the Covid-19 pandemic emergency (Covid-19 scenario). For the first scenario, we considered the supply of services (transport and health) in the month of February 2020, during a morning weekday

Table 4

Number of inhabitants per level of accessibility in the base scenario.

Level of accessibility	Percentage of inhabitants			Number of elderly people
	65–69	70–74	≥75	
Level 1 (very good)	9.2%	9.1%	9.3%	28,268
Level 2	12.3%	12.2%	12.8%	38,700
Level 3	12.3%	12.1%	12.1%	37,536
Level 4	11.8%	11.7%	11.8%	36,367
Level 5	10.5%	10.4%	10.8%	32,861
Level 6	10.9%	10.8%	10.6%	33,142
Level 7	10.3%	10.7%	10.4%	32,226
Level 8	8.5%	8.8%	8.5%	26,574
Level 9	7.9%	7.8%	7.7%	24,074
Level 10 (very poor)	6.3%	6.4%	6.0%	19,107
	72,869	78,002	157,984	

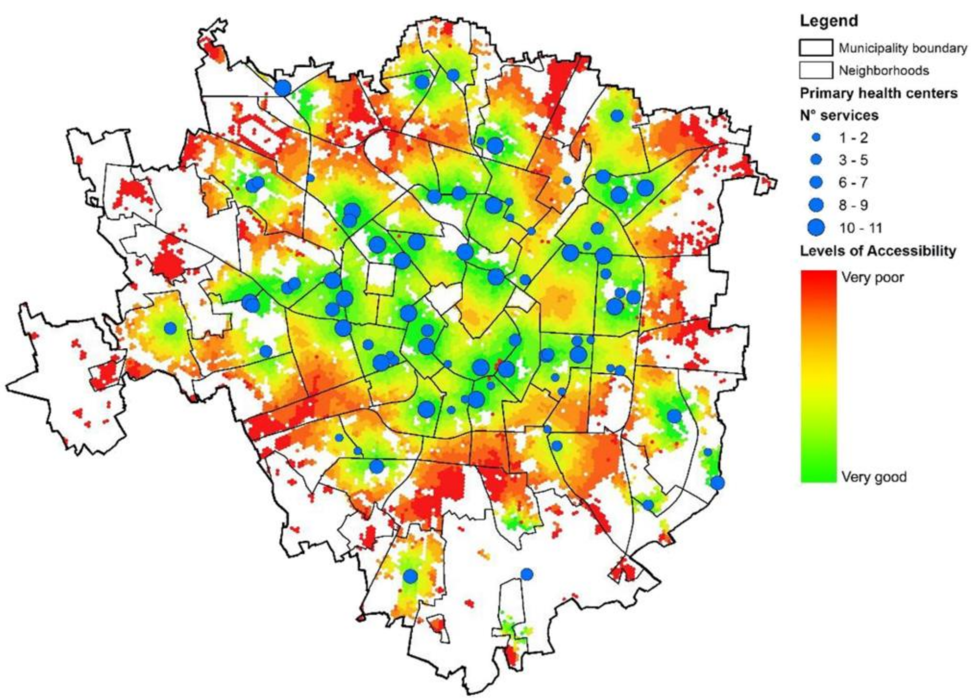


Fig. 8. Spatial accessibility of the inhabitants above 65 to the whole primary health supply of the city of Milan before Covid-19 outbreak.

Key Takeaways:

- Do not mention about wheelchair users, only walking and using public transport aspects are considered.
- Regular hexagonal cell as the spatial unit with a side length of 50 m is used to describe residential units, not clear which specific point they took to measure the distance-travel time for each destination (assuming center point, from the following description: "from a generic hexagonal cell to a certain healthcare centre")
- They used a nominal scale to quantify levels of accessibility (levels 1-10)
- I think the calculation of accessibility measure makes a lot of sense in this paper, we can only quantify elderly people as one category (e.g. over 65) to make it easier.
- They only measure the accessibility to a health facility. In our case, we have more than one category (e.g. opportunity), so we should adjust the accessibility score to include POI category as well (e.g., instead of having A_i we will have A_{ij} like in the Nature paper). We can use a similar time-decay function W_{ij} to calculate which area will be served by which POI for each category.