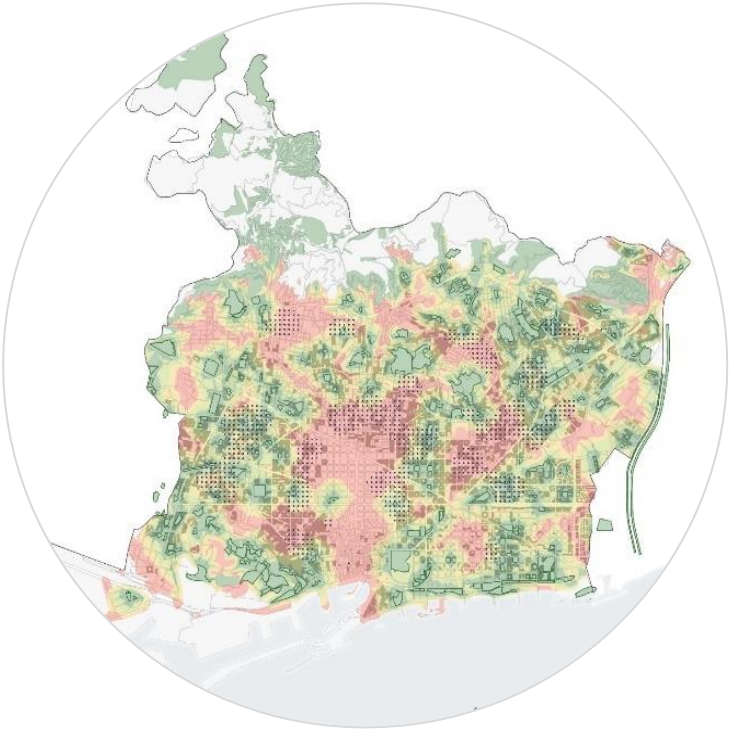
TERRITORIALISATION OF RISKS

RESILIENCE PLAN DIAGNOSIS



Where do the people furthest from the city's public green spaces live?

November 2020

Department of
Urban Resilience

Ajuntament de Barcelona

TEXT

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Department of Urban Resilience
Deputy Manager's Office for Mobility and Infrastructures
Urban Ecology

BR BARCELONA REGIONAL AGÈNCIA DESENVOLUPAMENT URBÀ

https://ajuntament.barcelona.cat/ecologiaurbana/ca
www.bcnregional.com
br@bcnregional.com

EDITING AND COORDINATION

Ares Gabàs Masip, Head of the Urban Resilience Department. Barcelona City Council
Marc Montlleó Balsebre, Director of Environmental Projects and Energy Efficiency. Barcelona Regional

TECHNICAL TEAM

Giovanni Pagani, *Collaborator at the* Urban Resilience Department
Maria Gómez Llabrés, *Collaborator at the* Urban Resilience Department
Claudia Villazon, *Technician at the Urban Strategy Department.* Barcelona Regional
Lluís Barril, *Technician at the GIS Department*. Barcelona Regional
Miquel Pybus, *Head of the Urban Strategy Department.* Barcelona Regional
Gemma Noguera, Urban Resilience Department
Daniel Prats, *Collaborator at the* Urban Resilience Department
Pedro Sepúlveda, *Collaborator at the* Urban Resilience Department
and the technical and administrative support team at Barcelona Regional.

Contents

Introduction

Global development trends are leading to populations being largely concentrated in urban areas. According to United Nations data, today more than 54% of the world's population is concentrated in cities, and this figure is expected to rise to 68%, or 6.3 billion people, by 2050. Consequently, cities play, and will increasingly play, a key role in human development, in fostering living conditions that guarantee protection, health, equality, equal opportunities and well-being for their inhabitants.

This is the context in which applying the concept of resilience to citizens and urban systems makes sense. Urban resilience is understood as the capacity of a city to prevent, or when faced with unavoidable situations, to minimise, the impact of the natural and anthropic risks it is exposed to, whether acute shocks or chronic stresses, and to recover in the shortest possible time in order to maintain essential functions.

The main shocks that Barcelona is exposed to derive from the effects that climate change may have on the city. On the other hand, most of the stresses that the city is exposed to come from the social, environmental and economic domains.

Thus, within the framework of the development of Barcelona's resilience plan, a study was carried out to identify and define the risks that could affect the city's public spaces.

First of all, with the aim of defining a list of the key risks that threaten Barcelona's public space, a working session was organised in March 2019 with around twenty municipal representatives from the different departments involved in the design, management and maintenance of public space, as well as professionals involved in ensuring peaceful coexistence and the provision of social services in the city. At the meeting, there was a general consensus regarding the concerns and risks that were deemed the most critically important: homelessness and atmospheric pollution. In second place came noise pollution, the heat island effect, a lack of green spaces, extremely heavy rainfall, drought, urban safety, tourism pressures and traffic congestion. Based on this classification, the next step was to restructure and refine the resulting table of risks by incorporating the comments received, and so identify a list of questions on how each risk might affect the city's public space.

Finally, based on the questions posed, and focusing the analysis on the most vulnerable groups, a risk assessment procedure was developed in order to map the points at which the places in the city with the highest levels of risk intersect with the areas that the section(s) of the population vulnerable to a particular risk are most likely to use or to live. For those risks that it was possible to map, the information used had in some cases already been studied in other contexts, meaning that it was only necessary to add the perspective of the impact on vulnerable

groups. In other cases, work also had to be done on data development to understand the impact of a particular risk.

This document is a compilation of the maps drawn up for the analysis stage of the Resilience Strategy with regard to risks affecting public space, with the aim of gaining a full overview of the city's vulnerabilities differentiated by location, thus allowing the identification of priority measures by area, in response to the identification of one particular risk, or the overlapping of several.

Each risk map is presented in the first part of this work together with the methodological details of the data used. The second section includes the conclusions reached and explains the measures that the City Council is currently developing, or the possible lines of work to be pursued to reduce the risk and mitigate the impact.

1. What? The question

By age group, where do the sections of the population furthest away from the city's green spaces live?

2. Why? The reason

Urban greenery has become essential to guaranteeing adequate living conditions in cities, and a better quality of life. The creation of pleasant spaces for leisure and recreation, reflection and relaxation, for health and physical exercise, improves the urban landscape, encourages social relations, creates identity-affirming spaces, permits the celebration of community and volunteering events, and encourages environmental education and certain artistic activities.

We define urban greenery as those spaces within the city that are open to the public and cover an area of more than 0.5 hectares. For this study, a total of 190 green spaces around the city were analysed, including:

- Historic parks (defined as such by Barcelona City Council)
- Parks and gardens (the basis of the city’s urban green infrastructure)
- Green spaces within city blocks.
- Green squares (with more than 30% plant coverage and 40% permeable soil)
- Points of access to the Collserola Nature Park and the Besòs River Park

The study does not include private gardens and other areas that are not managed as public spaces.

Urban greenery makes a decisive contribution to quality of life, as it brings multiple benefits, both environmental and social. In compact cities like Barcelona, it is a key element in the definition of urban structure. Among the social benefits of urban greenery are the physical and emotional well-being of city residents, the creation of spaces for recreation and relaxation where there is also the opportunity to interact with the natural world. The environmental benefits it provides include an increase in animal biodiversity, the mitigation of the effects of climate change, the reduction of atmospheric and noise pollution, and even the generation of economic activity.

Thus, proximity to the city's green spaces is essential for the overall well-being of those who live in the city. In several studies carried out by different authors[1], it has been observed that access to such spaces increases the amount of time spent doing physical activity in the open air, as well as having a positive effect on reducing stress, helping to improve and alleviate depression, and shortening the recovery times for various illnesses, to mention just a few of the benefits.

As places for meeting others and social for interaction, these spaces are essential[2] for social cohesion. For vulnerable groups that are more prone to loneliness, such as the elderly, they are even more necessary.

The document *"Towards a national indicator for urban green space provision and environmental inequalities in Germany: Method and findings" (Henry Wüstemann, Dennis Kalisch, Jens Kolbe),* provides a good overview of indicators, above all European level indicators. This document mentions the following: *"Sufficient access to urban green space represents a key aspect for adequate living conditions and a healthy environment in urban areas."* (Krekel et al., 2016; Nowak and Heisler, 2010; Cornelis and Hermy, 2004; Zupancic et al., 2015). The significance of urban green space for human well-being and the sustainable development of urban areas has led to the setting of targets and thresholds for the provision of urban green space at European, national and sub-national levels. In Europe, the European Environment Agency (EEA) considers that people should have access to green space located no more than a 15-minute walk away, so at a maximum distance of 900 - 1,000 m (Stanners, David and Philippe Bourdeau, 1995).

1 Andersson, E., Barthel, S., Ahrné, K. (2007). Measuring social-ecological dynamics behind the generation of ecosystem services. Ecological Applications, 17 (5), 1267–1278.
Galea, S. et al., (2005). Urban built environment and depression: a multilevel analysis. Department of Epidemiology, U. Michigan (2005).
Korpela, K., Ylén, M. (2007). Perceived health is associated with visiting natural favourite places in the vicinity. Health & Place, 13 (1), 138–151.
Takano, T., Nakamura, K., Watanabe, M. (2002). Urban residential environments and senior citizens longevity in megacity areas: The importance of walkable green spaces. Journal of Epidemiology and Community Health, 56 (12), 913–918.
Taylor, A. F., Kuo, F. E. (2009). Children with attention deficits concentrate better after walk in the park. Journal of Attention Disorders, 12 (5), 402–409.
White, M., Alcock, I., Wheeler, B., Depledge, M., (2012), European Centre for Environment & Human Health "Would You Be Happier Living in a Greener Urban Area.A Fixed-Effects
Analysis of Panel Data". Psychological Science June 2013 24: 920-928, first published on April 23, 2013.

2 Gotham, K., Brumley, K. (2002). Using space: Agency and identity in a public-housing development. City and Community, 1, 267–289.

However, in Barcelona, a 15-minute walk to reach a green space may mean going beyond neighbourhood boundaries, and so may be difficult to fit into people's daily routines.

Within the framework of the *Green Infrastructure and Biodiversity Plan 2020*, Barcelona has promoted numerous measures that contribute to increasing urban green space in the city, as in densely populated urban areas with few large parks, such as Eixample, Gràcia, Ciutat Vella and the old quarter of Sant Andreu, few such spaces are close by. In these areas, most green spaces are city block interiors, and various green squares also play a significant role.

This document analyses the proximity of medium and large green spaces in the city (and also those located outside it but which are close to the municipal boundaries), taking into account variables such as the mobility speed of the population by age group, slope gradient, and the availability of facilities to improve vertical mobility (lifts and escalators). The aim of the analysis was to detect, on a city-wide scale and in an indicative way, where the people affected by a lack of nearby public green spaces - i.e. those who have to walk more than 5 minutes to reach one - live.

3. How? Data and methodology

3.1 Calculation of proximity to public green spaces

The map below shows all of the city's public green spaces (parks, green spaces within city blocks and green squares) with a surface area of more than 0.5 hectares. The points of access to the Collserola Nature Park and the Besòs River Park have also been included.

Based on this selection, proximity maps have been drawn up, which show the area effectively covered by each green space in terms of walking time. The areas were calculated using the city's road network, and three variables were taken into account: mobility speed by age group, slope, and the availability of escalators and lifts. The impact of each of the variables on the calculation of the areas is detailed below.

Mobility speed by age group

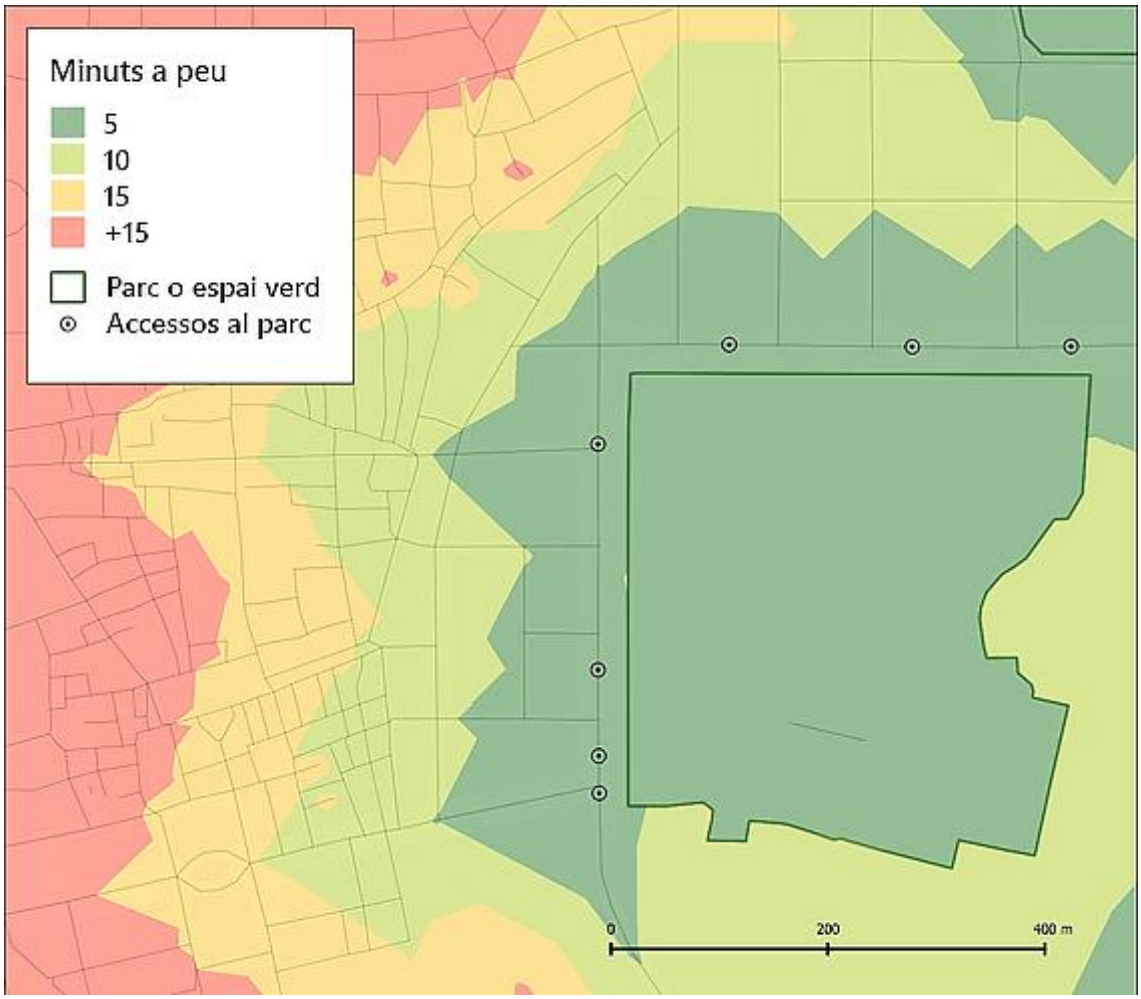
The average mobility speed for an adult is around 4 km/hour. At this speed, an adult can cover a distance of one kilometre in 15 minutes.

In order to make the areas calculated more representative of each age group, two mobility speeds were taken into account: for 0-4 year olds and over 75s (considered to be the most

vulnerable sections of the population), the speed used was 2 km/hour. For all other age groups the speed used was 4 km/hour.

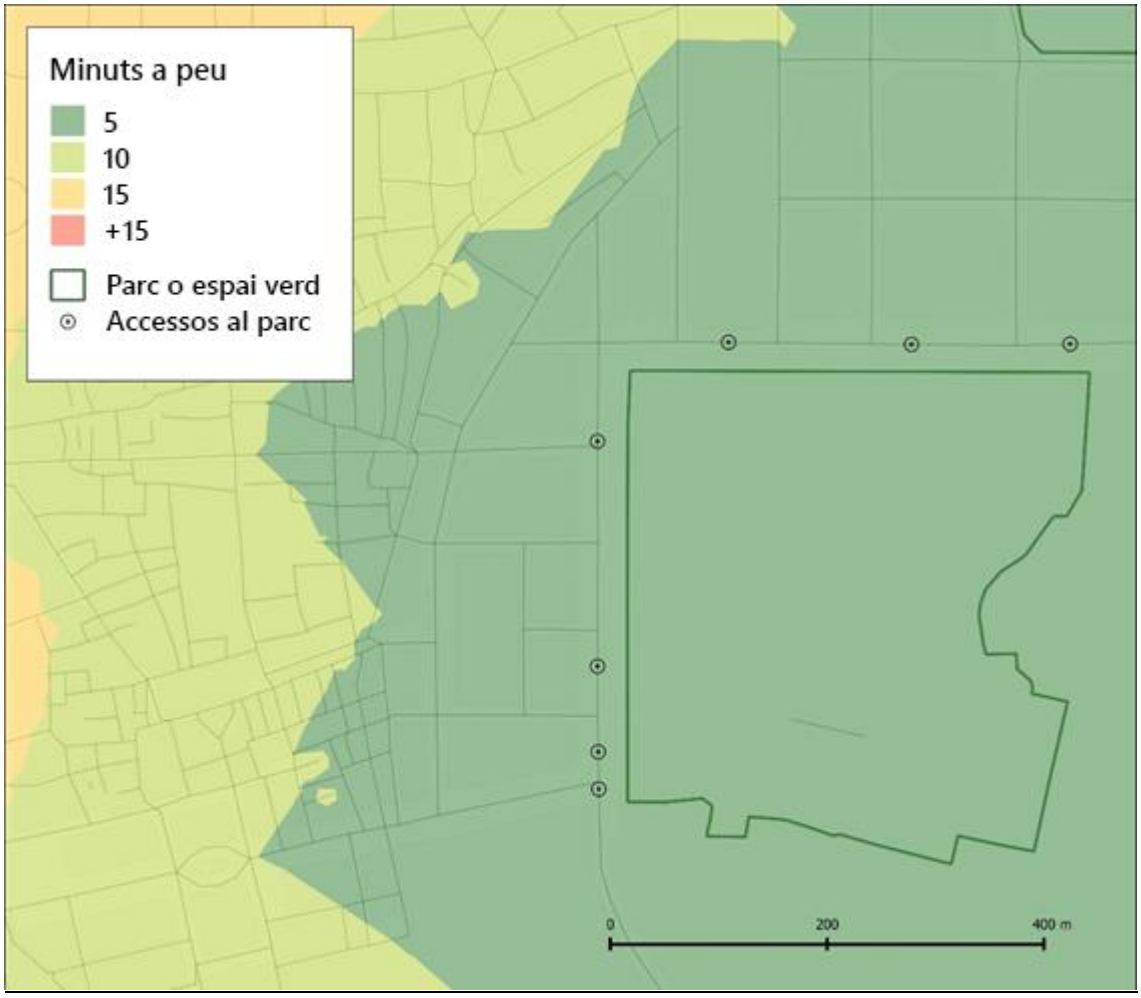
Figures 1 and 2 show the result of this differential calculation of mobility speed by age group.

Figure 1. *Detail of the area covered by the Ciutadella Park at a mobility speed of 2 km/hour*



Source: Barcelona Regional

Figure 2. *Detail of the area covered by the Ciutadella Park at a mobility speed of 4km/hour*



Source: Barcelona Regional

Influence of slope gradient on walking time

To take into account the effort required to traverse a street with a steep gradient, an impedance has been applied in accordance with the gradient of the street section in question: the steeper the gradient, the slower the mobility speed.

This means that parks in areas with steep slopes tend to cover smaller areas of land compared to the parks that are located in flatter parts of the city.

Escalators and lifts on the street

To make the analysis more precise, different mobility speeds were taken into account for sections with escalators or lifts:

- Escalators: a speed of 1.8 km/hour, which is the average speed for an escalator.
- Lifts: Slope impedance was not applied, but half a minute was added to the walking time for the section to allow for the waiting and operating time of the lift.

3.2 Population

There is no single answer to the question "Where are the most vulnerable sections of the population to be found?", because, according to the time of day, a person may be at home, at work or enjoying free time out and about. The population moves around, and therefore determining "where they are located" is something that cannot be resolved directly.

So in order to identify the areas with the highest concentration of population regardless of the time of day, we worked with two sets of data: **the 2018 municipal register of residents** at block level, which gave us a clearer idea of "where people live", and **the location of public facilities classified by type**, in order to understand where they might potentially spend part of their day.

By using the data from the municipal register, it was possible to define the areas with the highest density of residents, and the information on facilities allowed us to identify the areas of the city that are potentially those in most frequent use.

We know that a substantial number of people spend a significant number of hours a day at their places of work, or moving around the city in order to carry out job-related tasks. This information, which could also help us to understand "where people are", unfortunately could not be included in this study, as the city does not have a reliable and comprehensive data matrix that would enable us to know how many people are in a given place for work purposes.

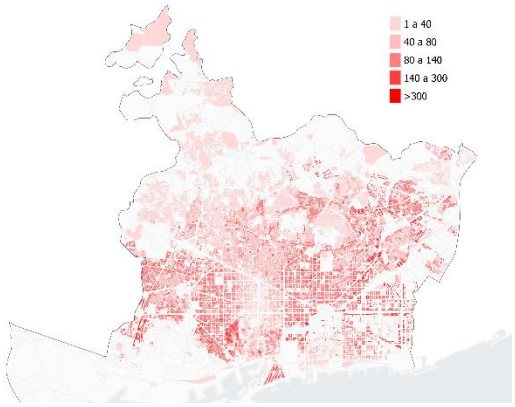
Another factor that needs to be taken into account when assessing vulnerability is the age of the population. As the data from the municipal register of residents is organised in five-year age bands, by subdividing we were able to determine the most vulnerable sections of the population. The same thing was done with the data on facilities, as classification by type allowed us to select those serving each age group. In this case the groups by age were the following: from 0-4 years of age, from 5-14, from 15-19, from 20-34, from 35-74 and 75 and over, and the vulnerable populations (0-4 years of age, and 75 and over*).*

3.2.1 Delimitation of the most densely populated areas

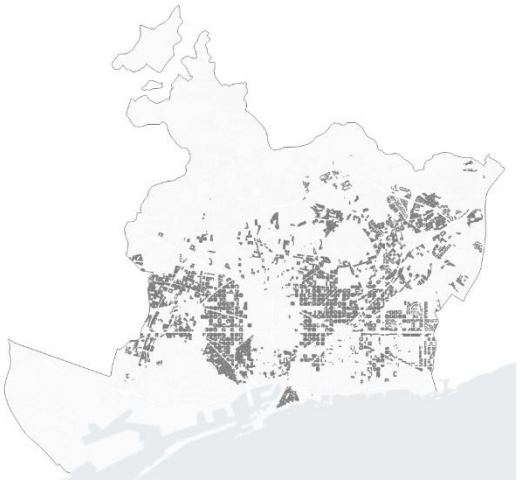
By using data from the municipal register, the aim was to obtain an overview of those areas of the city with the largest resident populations. Superimposing the data on the matter in question on the map allowed the identification of critical points.

The process followed consisted of calculating population density for each age group and selecting the areas with a population density above the average for the city. *Figure 3* shows the result after selection by population density.

Figure 3. *Selection process of areas with an above average population density. Population density is shown on the left, and the selection of areas above the threshold on the right.*



Map with calculation of population density. Inhabitants / km².

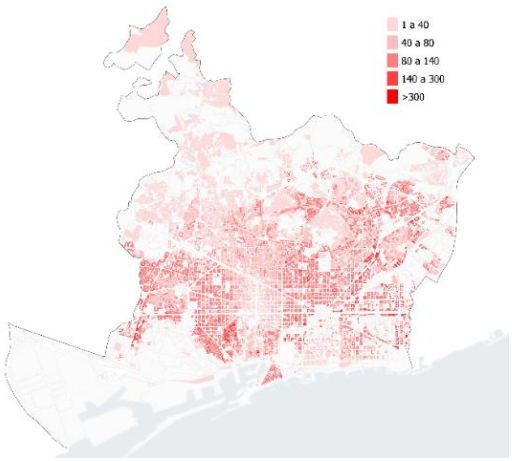


Result: Areas with an above average population density. Each age group has its own areas.

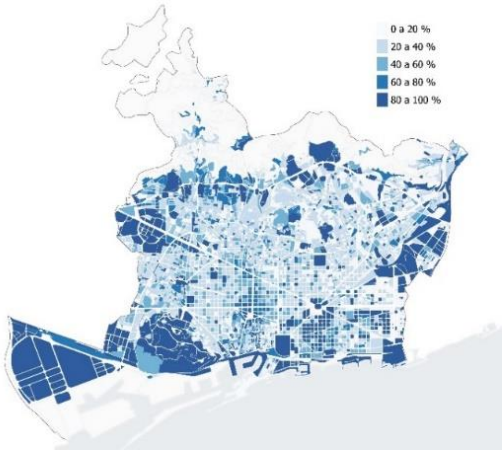
Looking at the result, it is striking that many areas of the city that we would expect to be densely populated, in fact are not. This is the case of the area around Passeig de Gràcia, and much of Ciutat Vella, to give two prominent examples. In these central areas of the city, a shift towards commercial use as shops, offices or service providers has reduced the housing stock, and as a result we see a population density that is below the average for the city.

Figure 4 allows a better understanding of the problem. A comparison of the population density map with the map of non-residential use of premises shows how the one is almost the inverse of the other.

Figure 4. *Map of population density compared with the map of non-residential use of premises*



Population density by city block. Inhabitants / km²



Percentage of non-residential use of premises, by city block.

3.2.2 Delimitation of the most frequently used areas

In order to gain an idea of which areas of the city are potentially most used by the target population, the data on the location of the public and private facilities that provide services aimed at these groups has been used. The starting hypothesis was that the areas with the highest concentration of facilities were also those that would be subject to the greatest influx of these groups of people.

A first step in identifying these areas was to classify the facilities by age group, according to the type of service they provide. **Table 1** shows the complete list of types of facilities, and the age group at which they are targeted.

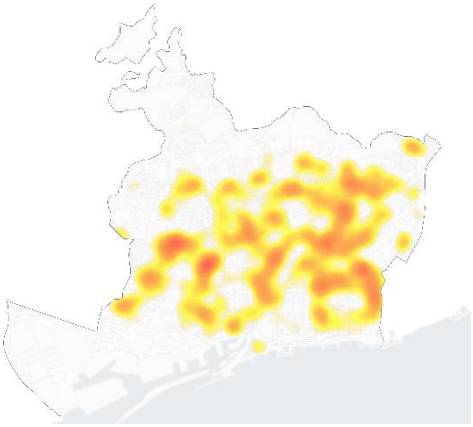
Table 1: Facilities by type, and the age groups they cater to

Type of facility	From 0 to 4 years of age	From 5 to 14 years of age	From 15 to 19 years of age	From 20 to 34 years of age	From 35 to 74 years of age	> 75 years of age
Hostels and shelters for the homeless				X	X	
Higher secondary education – Baccalaureate			X			
Children's libraries	X	X				
Senior citizen centres						X
Children's activity centres		X				
Specialised care day centres				X	X	X
Winter reception centres				X	X	X
Women's refuges			X	X	X	
Family reception centres		X		X	X	
Reception centres for the elderly						X
Reception centres for children and young people		X	X			
Day-care centres for the homeless				X	X	X
Day-care centres for senior citizens						X
Mental health day centres				X	X	X
Mental health centres for children and teenagers		X	X			
Adult mental health centres				X	X	X
Open centres and pre-workshops for children and teenagers		X	X			
Occupational centres for people with disabilities				X	X	
Day nurseries	X					
Kindergartens	X					
Primary education		X				
Compulsory secondary education (ESO)			X			
University education				X	X	
Vocational training				X	X	
Assisted housing for the elderly						X
Hospitals for the chronically ill and the elderly						X
Prep schools		X				
Secondary boarding schools			X			
Supported housing for people with disabilities				X	X	
Residential mental health centres				X	X	
Toy libraries	X	X				
Care homes for the elderly						X

From this classification, a heat map was generated for each age group to identify the areas of the city with the highest concentration of facilities.

Figure 5. *Processing of facility locations in order to obtain a heat map*

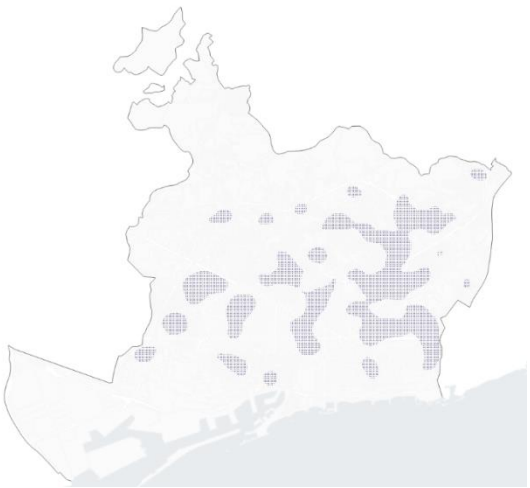
Map showing the locations of facilities targeting a specific age group



Heat map showing the areas with the highest concentration of facilities

The final layer was obtained using the selection of the areas in the heat map with a large number of facilities. The result can be seen in *Figure 6*.

Figure 6. *Final layer with areas with a high concentration of facilities. Each age group has its own areas*



4. Vulnerability maps by age group

4.1 Vulnerability maps by age group

In order to obtain an overview of the territorialisation of the problem, vulnerability maps have been drawn up for the different age groups. These maps identify the areas most affected that coincide with points with high population density and a high concentration of facilities.

Although the vulnerability maps provide a general overview and their results need to be put into context, they provide a good starting point for identifying areas where specific action studies could be conducted.

In this case the maps link the population by age group with areas that have no public green space of more than 0.5 hectares within a 5-minute walk. Six levels of vulnerability have been defined, based on the criteria listed in table 2:

Table 2. Levels of vulnerability, from the lowest to the highest

1P. Areas with a high population density where the nearest green space is a 5 - 10 minute walk away
1PE. Areas with a high population density and also a high density of facilities, where the nearest green space is a 5 - 10 minute walk away
2P. Areas with a high population density where the nearest green space is a 10 - 15 minute walk away
2PE. Areas with a high population density and also a high density of facilities, where the nearest green space is a 10 - 15 minute walk away
3P. Areas with a high population density where the nearest green space is more than a 15-minute walk away
3PE. Areas with a high population density and also a high density of facilities, where the nearest green space is more than a 15-minute walk away

4.2 Sections of the population affected

As explained in section 3.1 on methodology, the calculation of proximity to green spaces was carried out taking into account two different mobility speeds in order to accommodate the reality of the age groups with the greatest difficulties. This means that there was considerable variation in the results, depending on whether the calculation was made at a speed of 2 km/hour (for the age groups considered vulnerable) or at a speed of 4 km/hour (for all other age groups). Logically, a lower mobility speed results in smaller areas of proximity.

However, there are **some areas of the city that are located a long way away from any public green spaces**, regardless of the mobility speed used in the analysis (see maps in appendix 6.1). These include large parts of the **Gràcia neighbourhood, much of the central Eixample (between Carrer Casanovas and around Passeig de Gràcia), El Gòtic, Camp de l'Arpa and the 22@ district.**

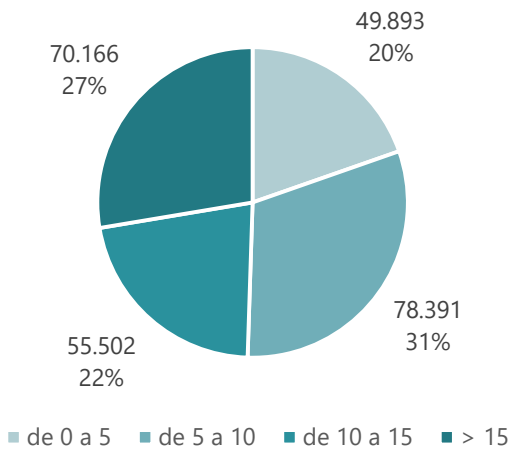
Just by looking at the results obtained in the **vulnerable population** maps, it can be seen that many other areas also need to be added to the list in the previous paragraph. Examples are to be found all over the city, such as the neighbourhoods of **Sant Antoni, Poble Sec, Sants, La Maternitat, La Verneda and El Besòs.** It should also be noted that there is a lack of nearby green spaces in many of the neighbourhoods of **Horta-Guinardó**, as although there are large parks nearby, these are difficult to access as they are located on steep slopes.

By focusing the analysis on those parts of the city with a **higher concentration of inhabitants** (see maps in appendices 6.2 and 6.3), the areas where the lack of green space is of greater importance can be identified. In terms of vulnerable population, the areas with the greatest lack of green space are to be found in the neighbourhoods of **Camp d'en Grassot i Gràcia Nova, El Camp de l'Arpa, Navas, Poble Sec, Sant Antoni, El Raval, Sants and El Carmel.**

Population data

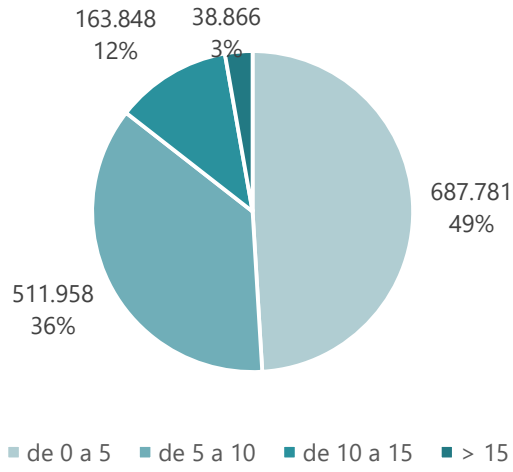
In order to complete the analysis, population data have been extracted and classified according to their proximity to green spaces. The graphs in Figures 7 and 8 show the extent to which the population in the age groups considered vulnerable live further away from green space, compared to the population in the other age groups.

Figure 7. *Vulnerable population (0-4 and 75+ years of age) and the distance to the nearest public green space (> 0.5 hectares). Minutes walk*



Source: Barcelona Regional based on data from the 2018 municipal register of residents, Barcelona City Council.

Figure 8. *Population between 5 and 74 years of age and the distance to the nearest public green space (> 0.5 hectares). Minutes walk.*

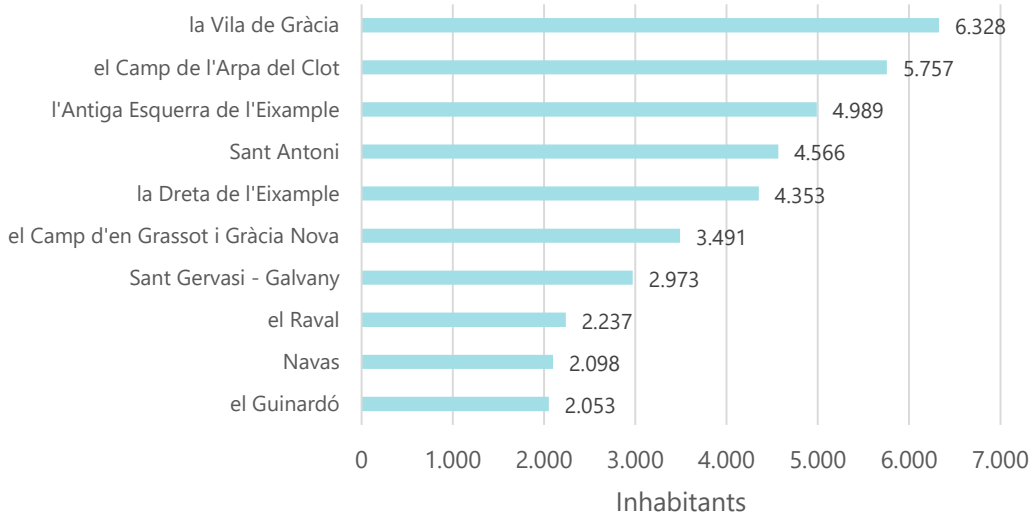


Source: Barcelona Regional based on data from the 2018 census, Barcelona City Council.

The results show that practically half of the **population between 5 and 74** years of age **has a public green space** of more than 0.5 hectares within a five-minute walk from their home. For the population group considered to be vulnerable, however, this figure stands at only 20%. In fact, for around **50% of the vulnerable population, the nearest green space is more than a 10-minute walk away.**

Lastly, we sought to identify the neighbourhoods in which the vulnerable population (>5 years of age and > 75 years of age) were furthest away from public green spaces. The graph in Figure 3 shows the top 10 neighbourhoods in terms of number of inhabitants falling within these groups that do not have any green spaces within a 15-minute walk from their homes.

Figure 9. *Vulnerable population (>5 years of age and > 75 years of age) with no public green space (> 0.5 ha) within a 15-minute walk from their home, by neighbourhood. Selection of the 10 neighbourhoods with the highest values.*



Source: Barcelona Regional based on data from the 2018 municipal register of residents, Barcelona City Council.

5. Related initiatives

Barcelona City Council has a long track record of launching initiatives aimed at turning Barcelona into a greener city. In 2017, a government measure was presented: the"Green-Infrastructure Impetus Plan". Its aim was to specify actions to be taken in order to meet the Barcelona Climate Commitment target of incorporating 1.6 km^2 of green space by the year 2030. This objective was also included in the Climate Plan (2018) and more recently in the Climate Emergency Declaration (2020).

In conclusion, all those measures that seek to increase urban green space in the city will be key to increasing the ratio of urban green space per person, and creating local green spaces. Barcelona's 2020 *Green infrastructure and biodiversity plan* specifies a whole raft of projects aimed at increasing green infrastructure, introducing improvements, working to conserve urban biodiversity, and a quality of life for local residents that fosters health and well-being.

Some of the main initiatives carried out over recent years include large, city-wide projects for increasing green infrastructure as well as smaller one-off projects. Large-scale projects include the "Urban Canopy" (Plaça de les Glòries Catalanes), the Doctor Pla i Armengol Garden (Mas Ravetllat), the new Cristóbal de Moura green hub and the transformation of Avinguda Meridiana. These initiatives are in addition to the increased amount of green space associated with traffic calming processes, such as the redevelopment of the Sant Antoni superblock, which could be applied to other parts of the city in the future. Where small-scale projects are concerned, green rooftops have been promoted; unused spaces have been handed over for agricultural purposes as part of the BUITS (Empty Land Site) Plan; and vertical gardens have been installed on party walls.

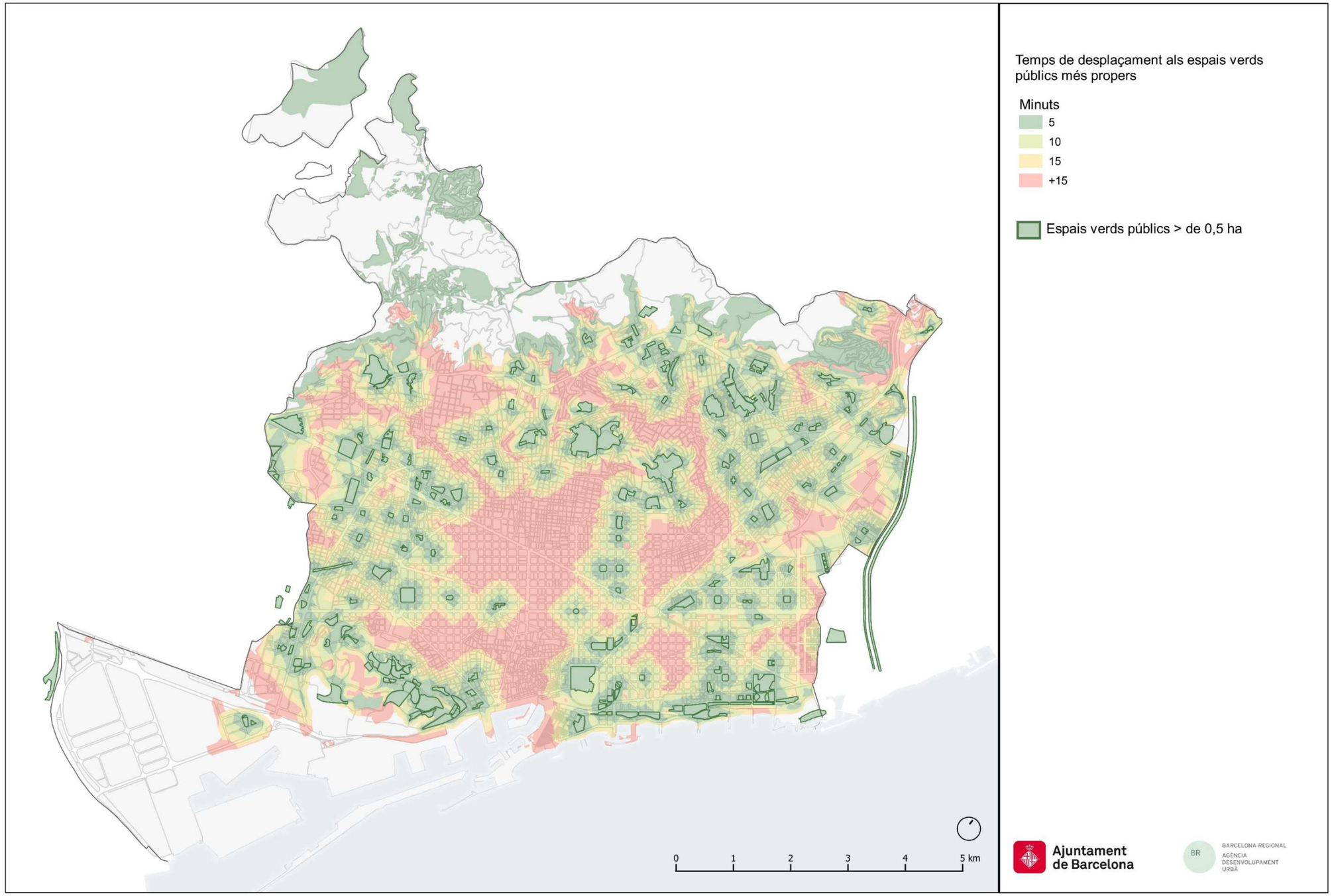
These transformations have gathered pace in the context of Covid-19, and in terms of green space, the aim is to encourage the spontaneous expansion of greenery that has taken place during lockdown, and to make progress in tackling the effects of the climate emergency. During lockdown parks, gardens, roadsides and urban allotments have developed naturally. In July 2020 there was a proposal to naturalise various areas of the city, modifying the way that they are managed and maintained in order to favour biodiversity. Thus the plan to naturalise green urban space and promote a healthier and more biodiversity-friendly city model was born.

The Barcelona Resilience Programme is a new opportunity to highlight the efforts made by local government to implement structural measures with a view to increasing the city's green spaces and the socio-environmental service that they provide. Thus, the plan includes initiatives to increase green infrastructure, and is committed to the renaturalisation of spaces.

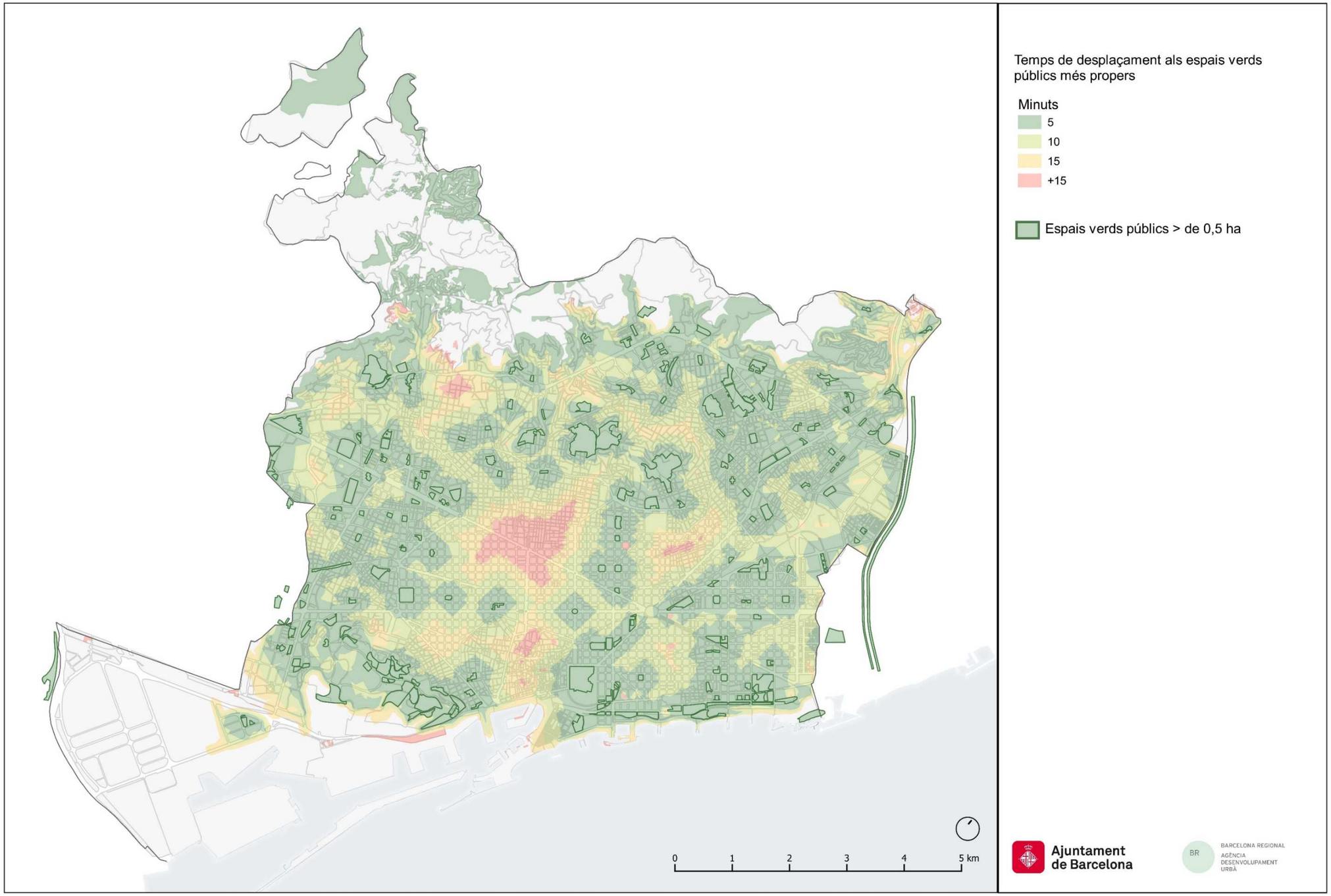
6. Appendices

6.1 Maps showing proximity to public green spaces of more than 0.5 hectares

6.1.1 Map showing proximity to green spaces calculated on the basis of a mobility speed of 2 km/hour

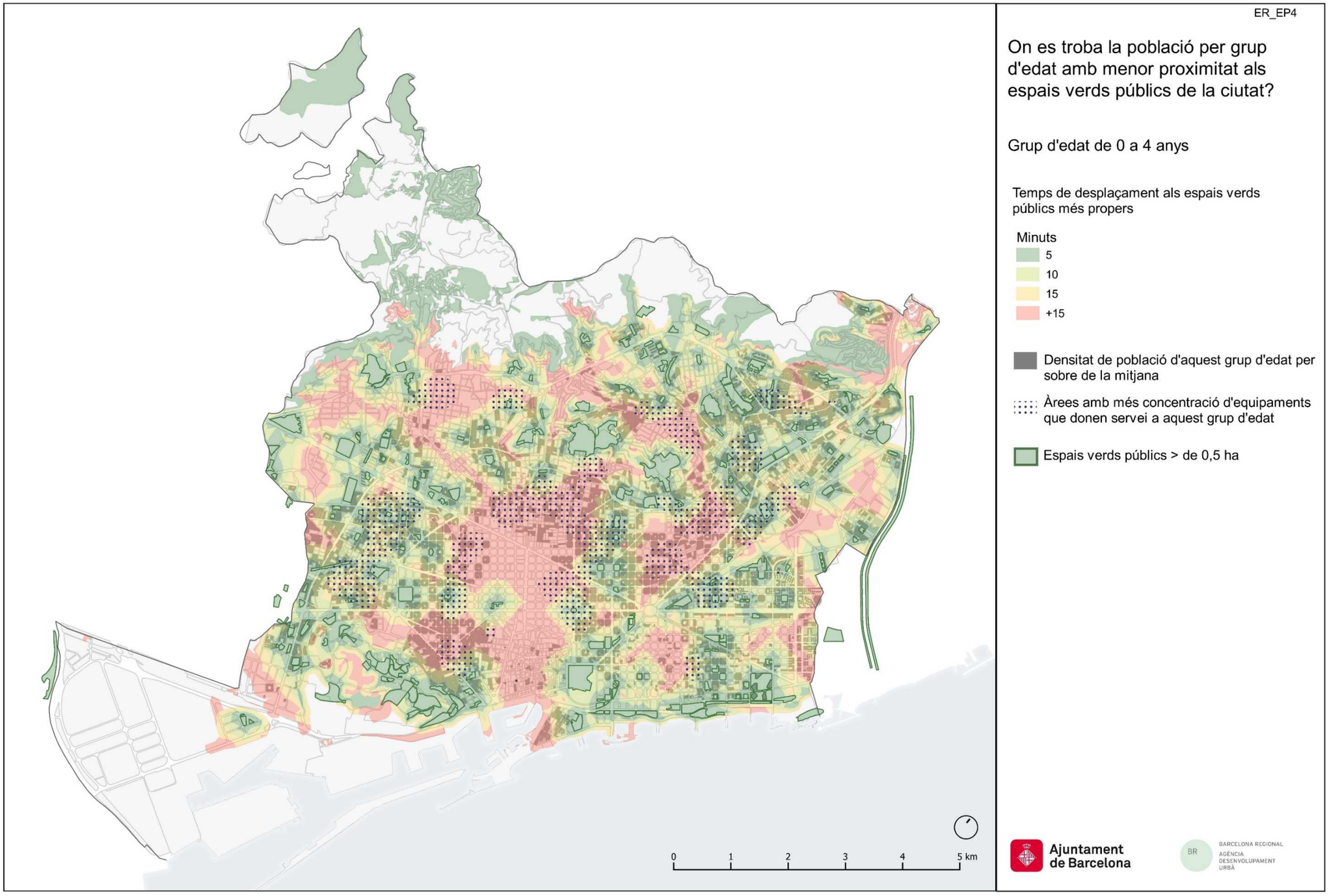


6.1.2 Map showing proximity to green spaces calculated on the basis of a mobility speed of 4 km/hour

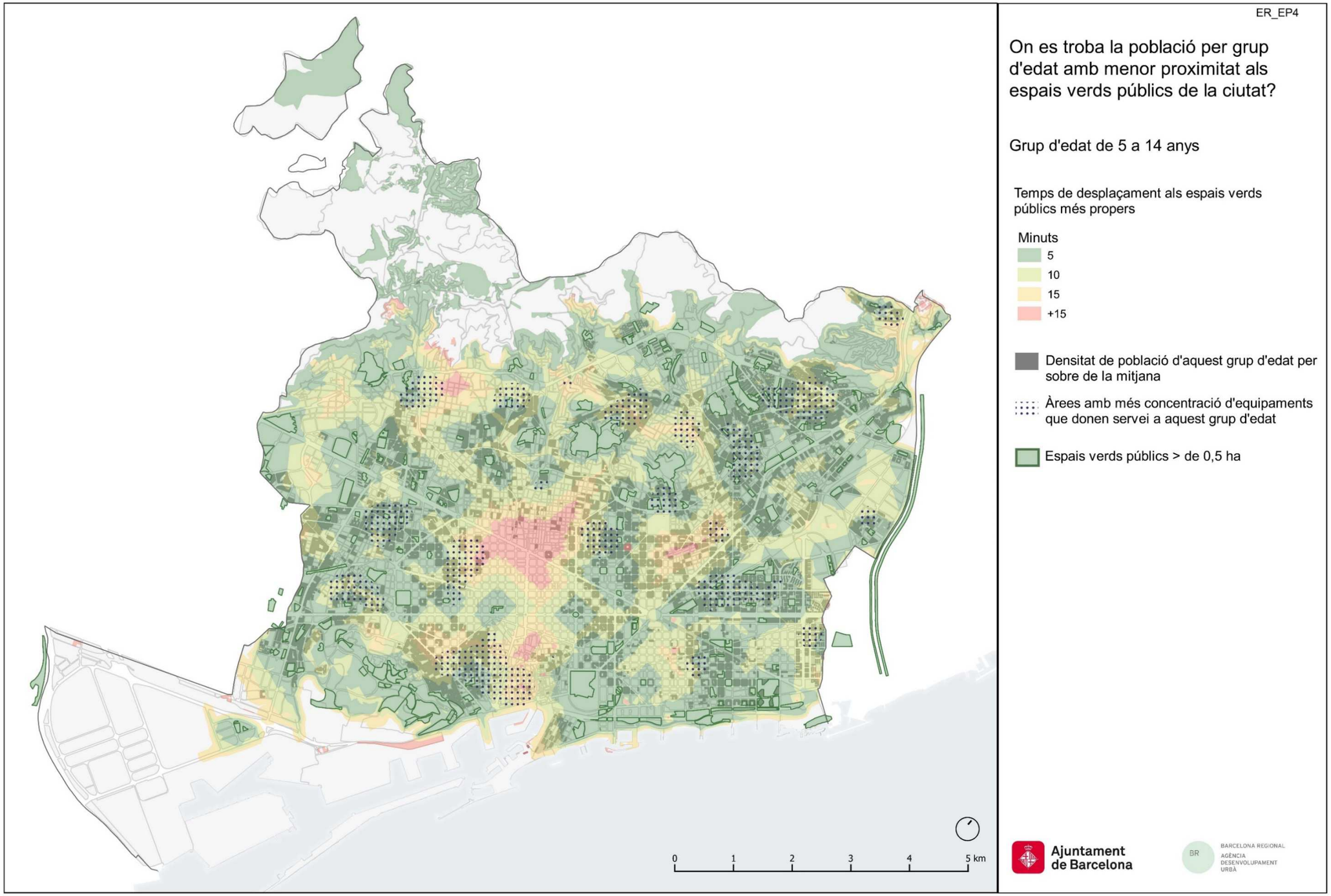


6.2 Overlay maps by age group

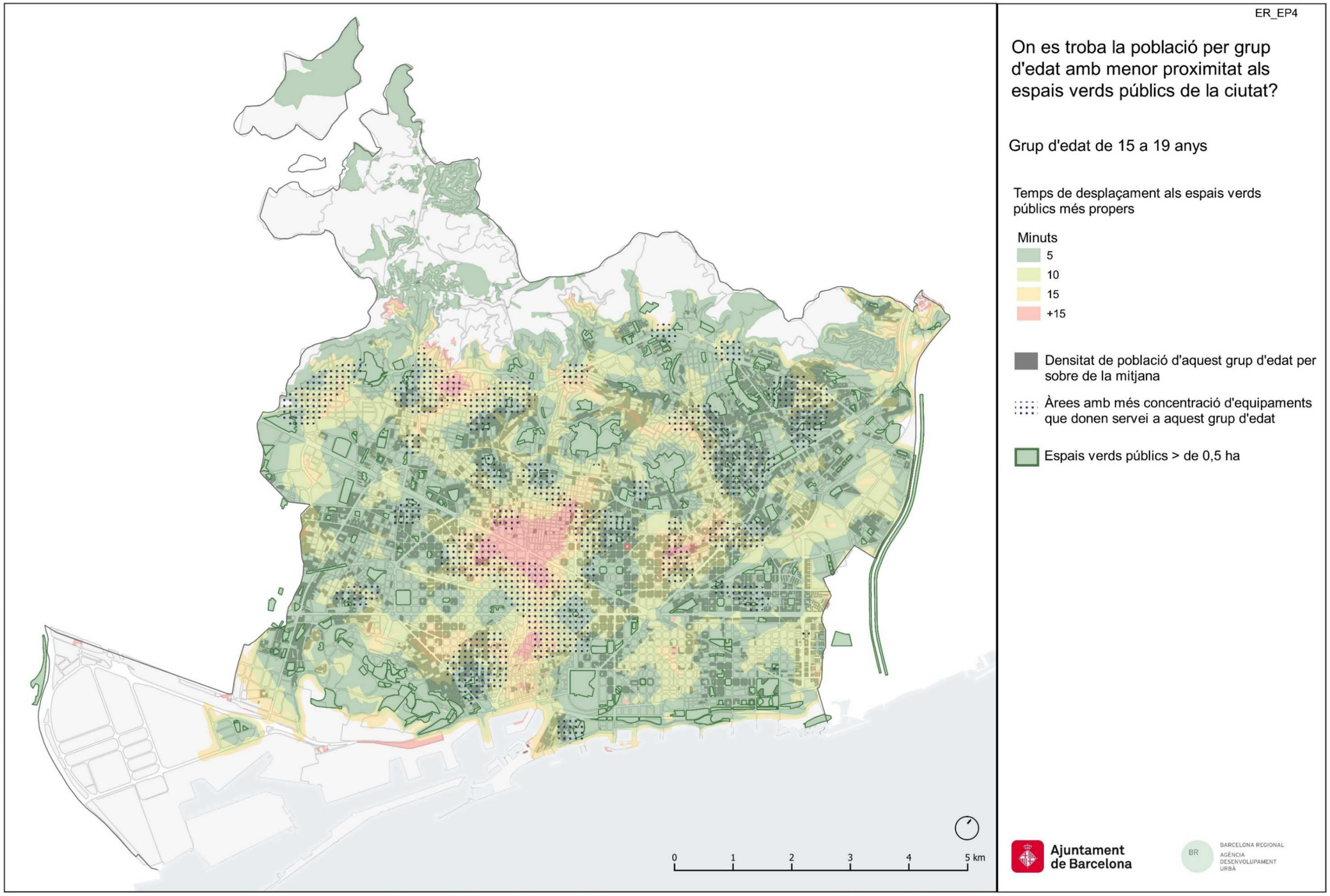
6.2.1 Map 0 - 4 age group



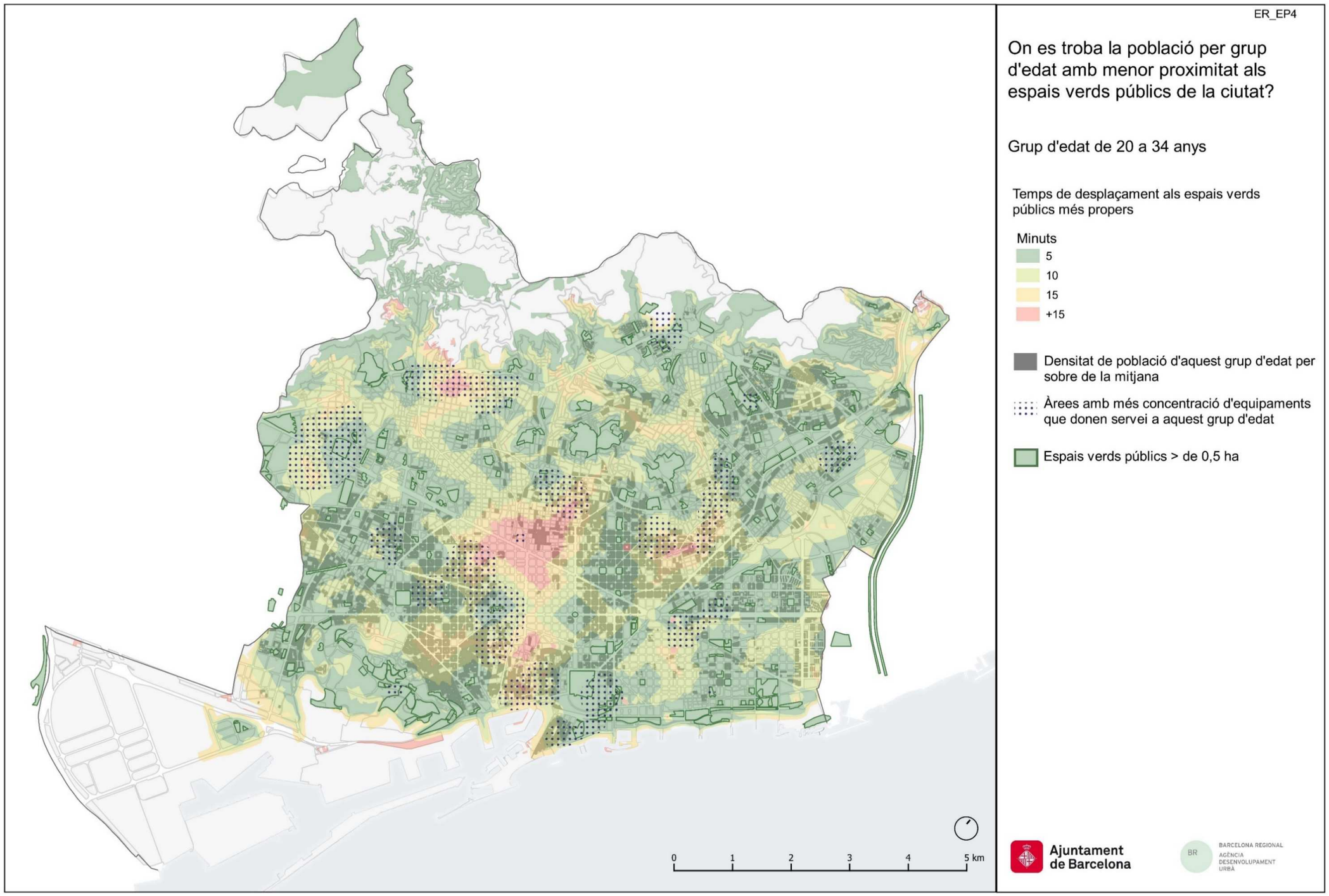
6.2.2 Map 5 - 14 age group



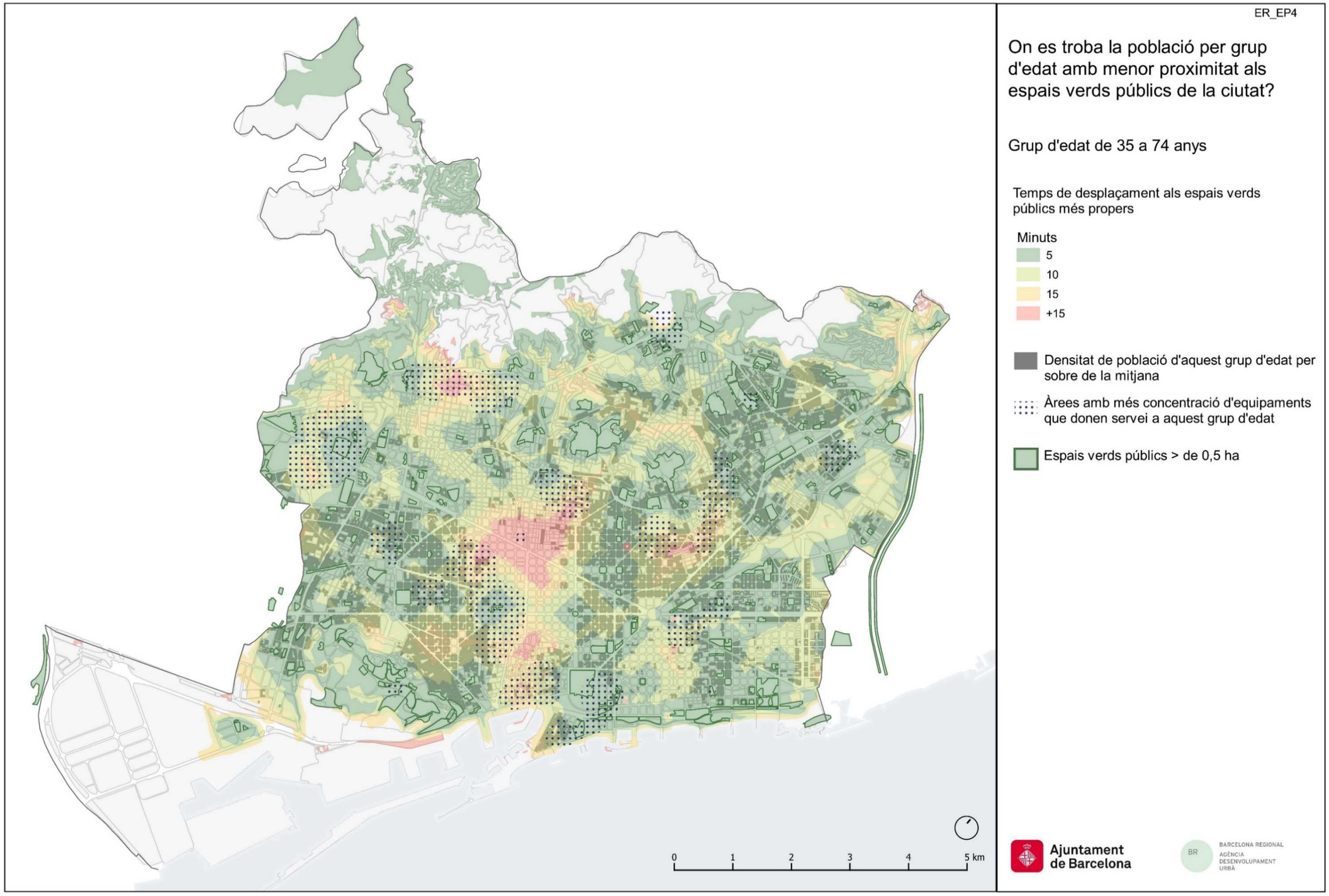
6.2.3 Map 15 - 19 age group



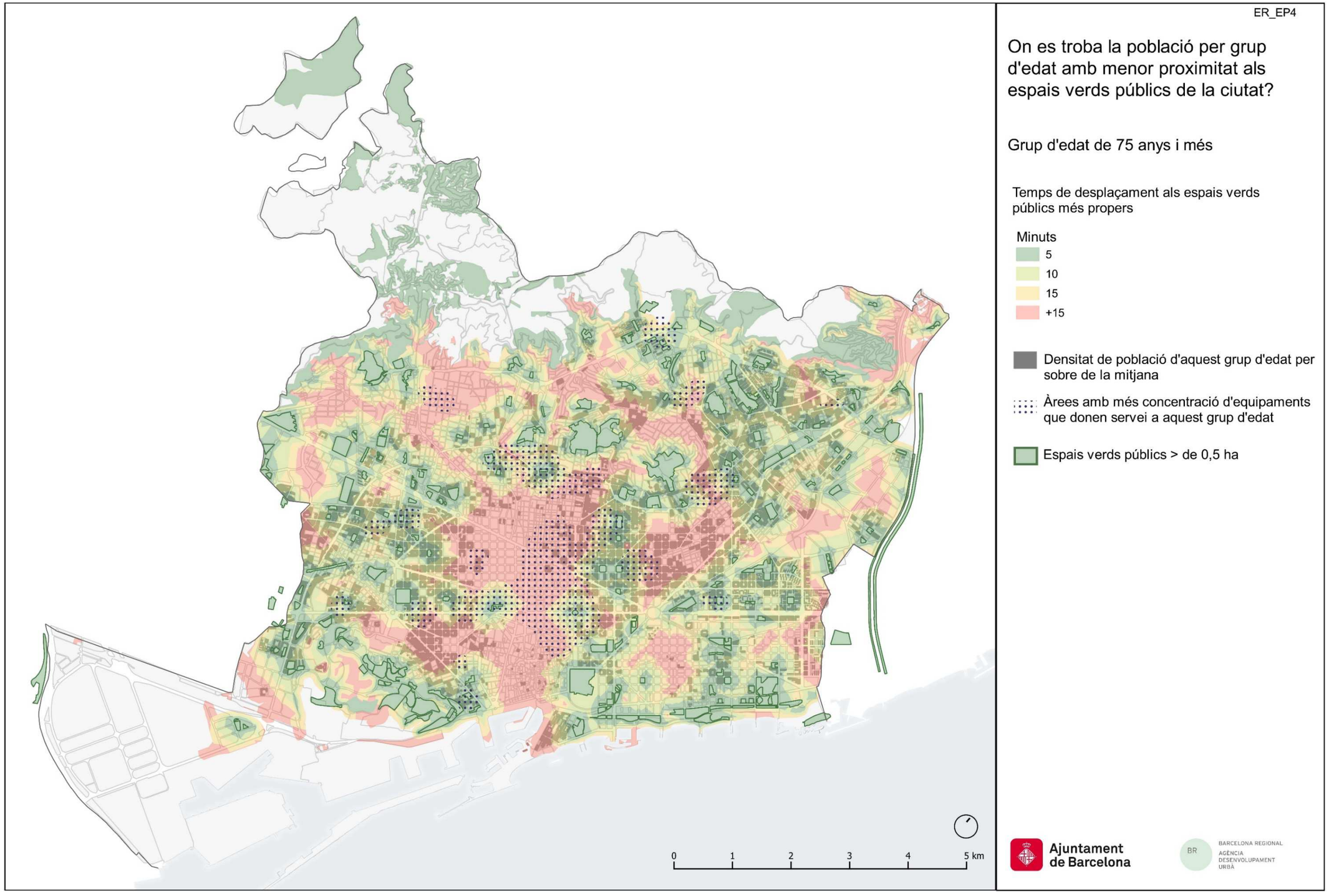
6.2.4 Map 20 - 34 age group



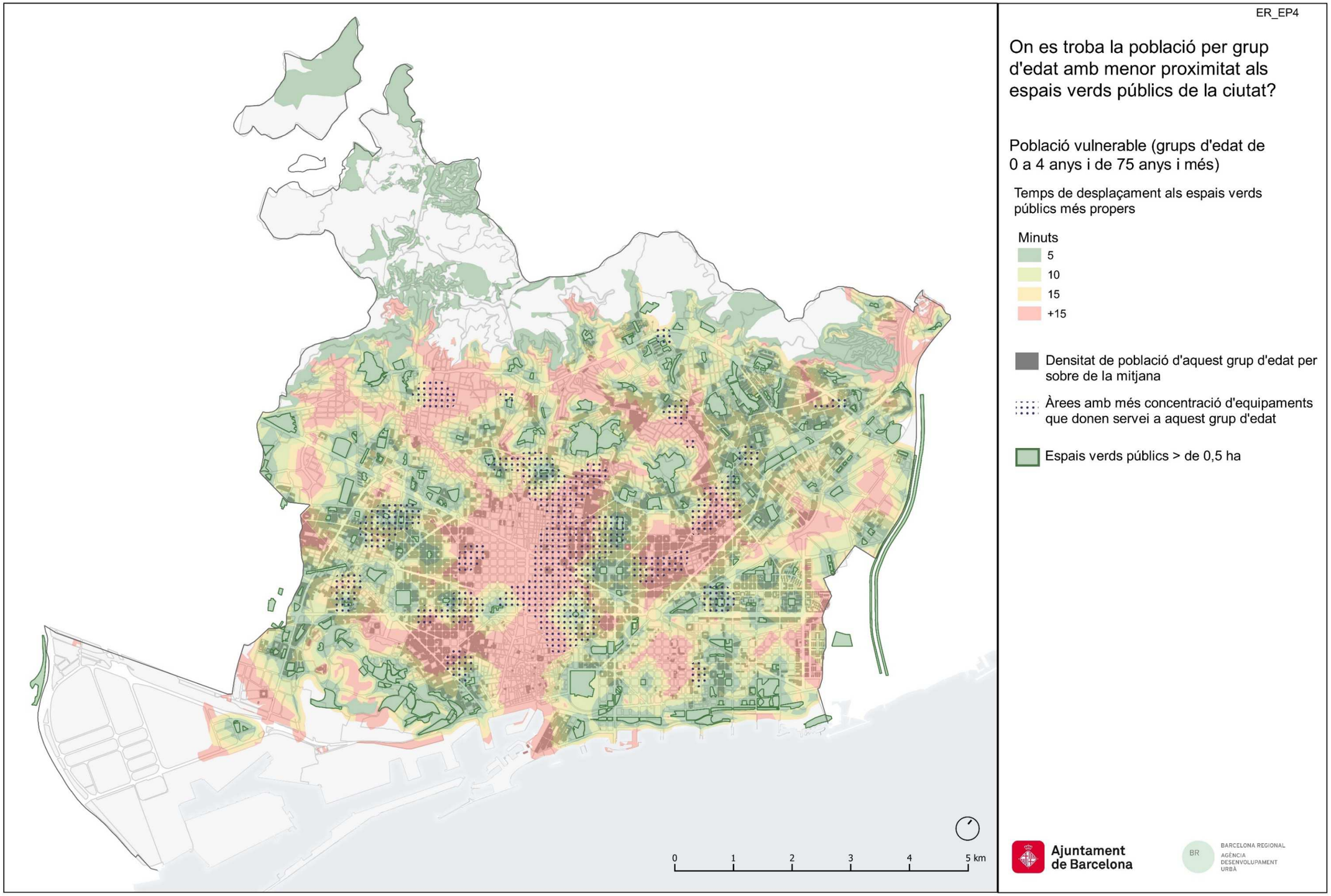
6.2.5 Map 35 - 74 age group



6.2.6 Map 75+ age group

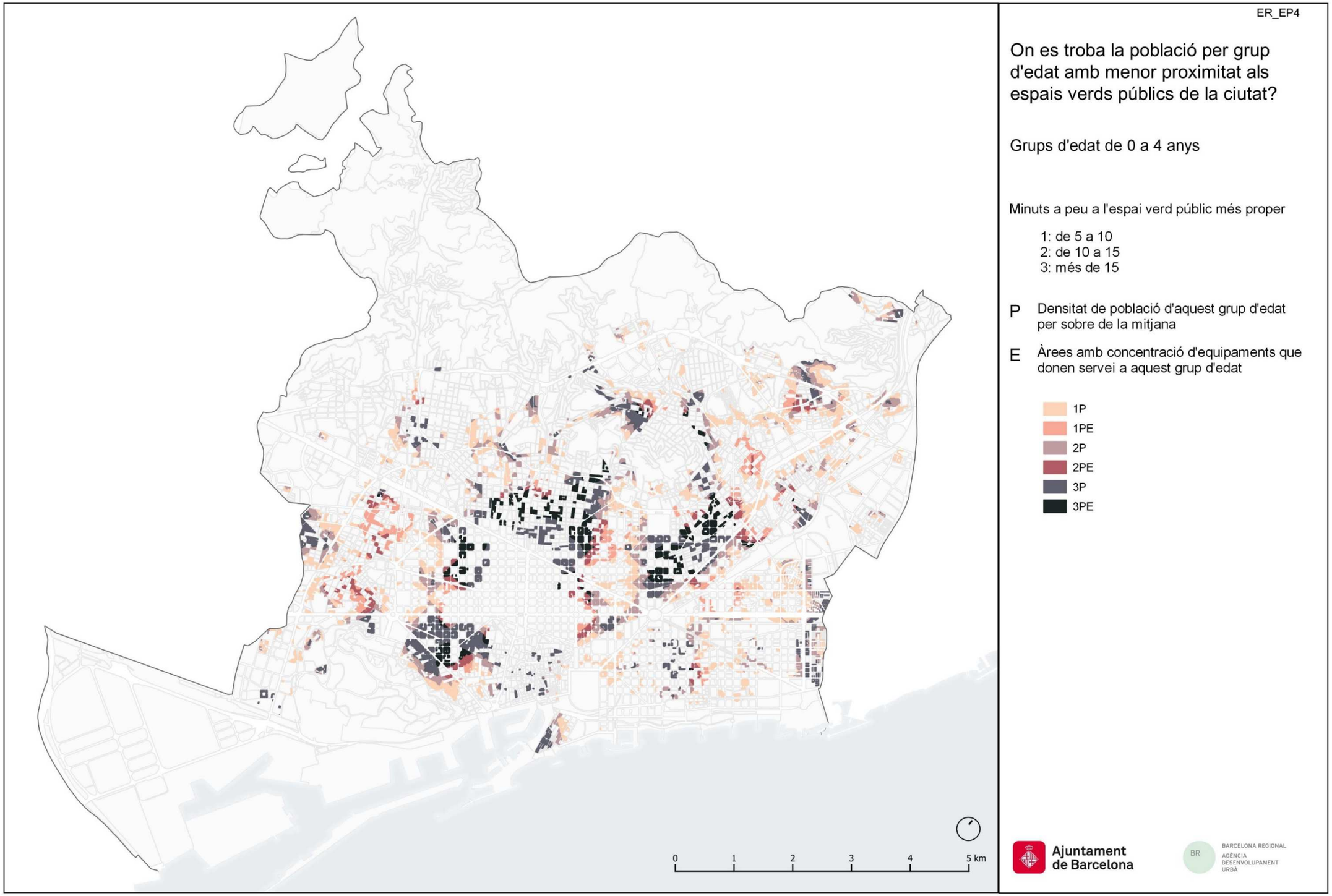


6.2.7 Vulnerable population map (0 - 4 and 75+ age groups)

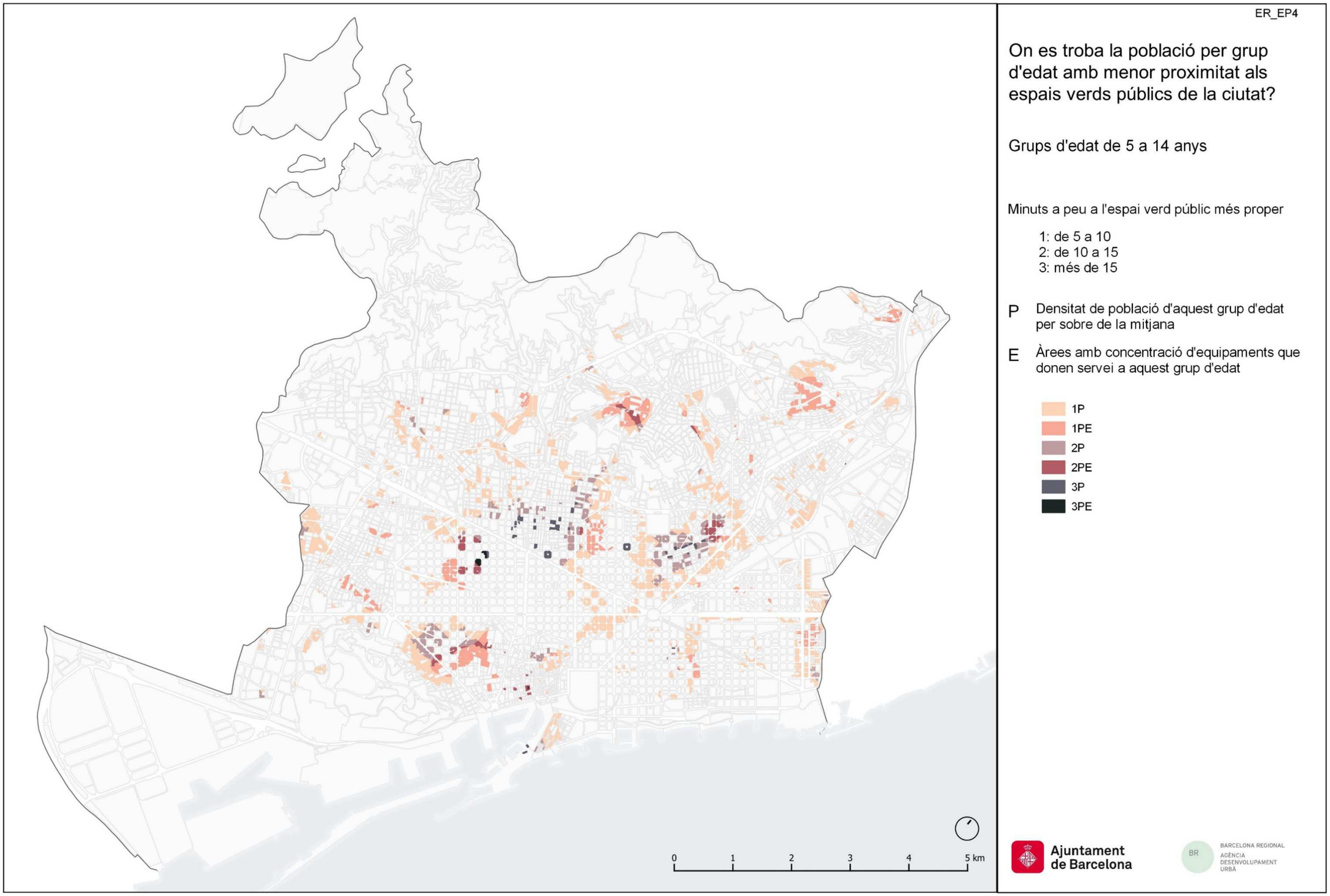


6.3 Vulnerability maps by age group

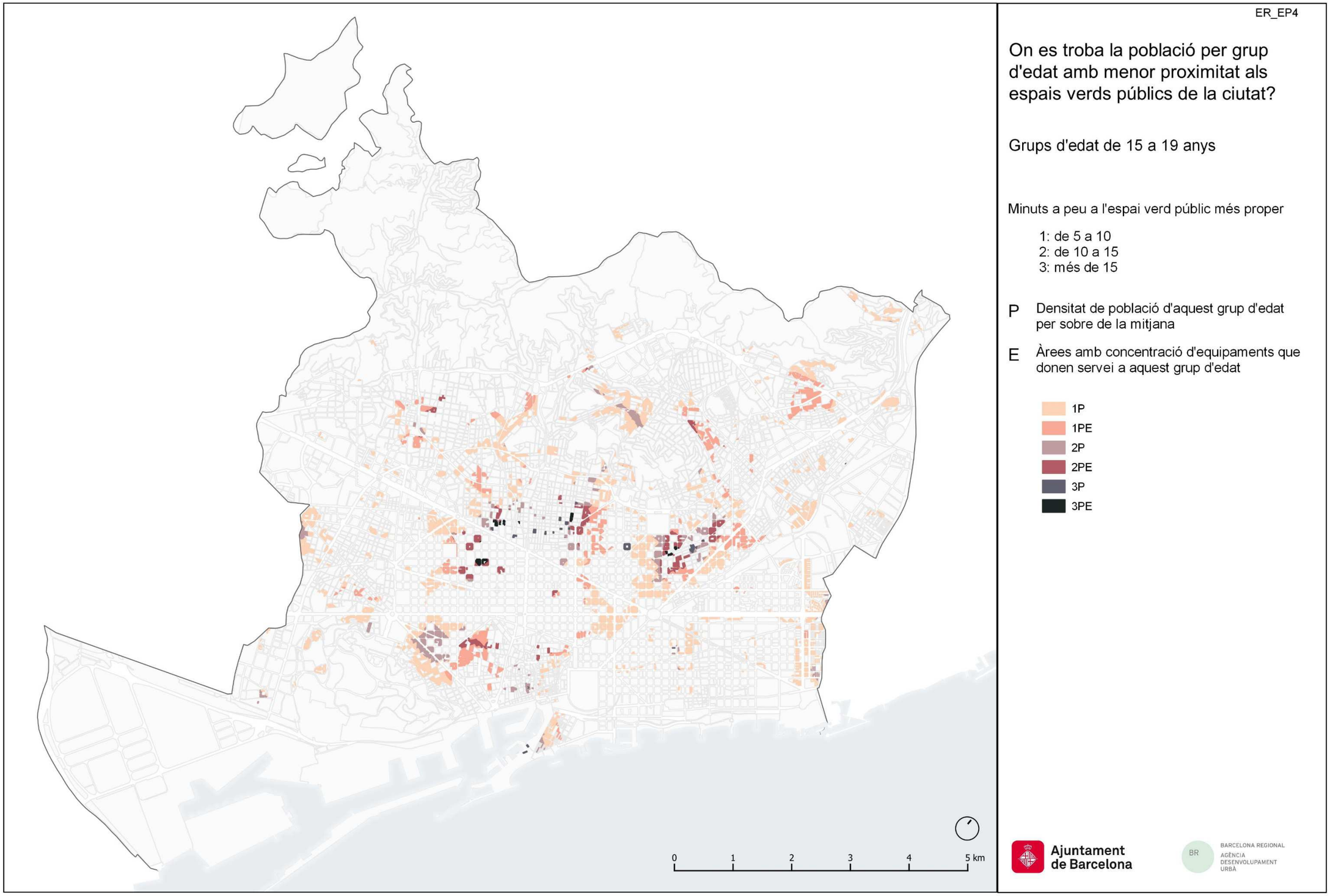
6.3.1 Vulnerability map 0 - 4 age group



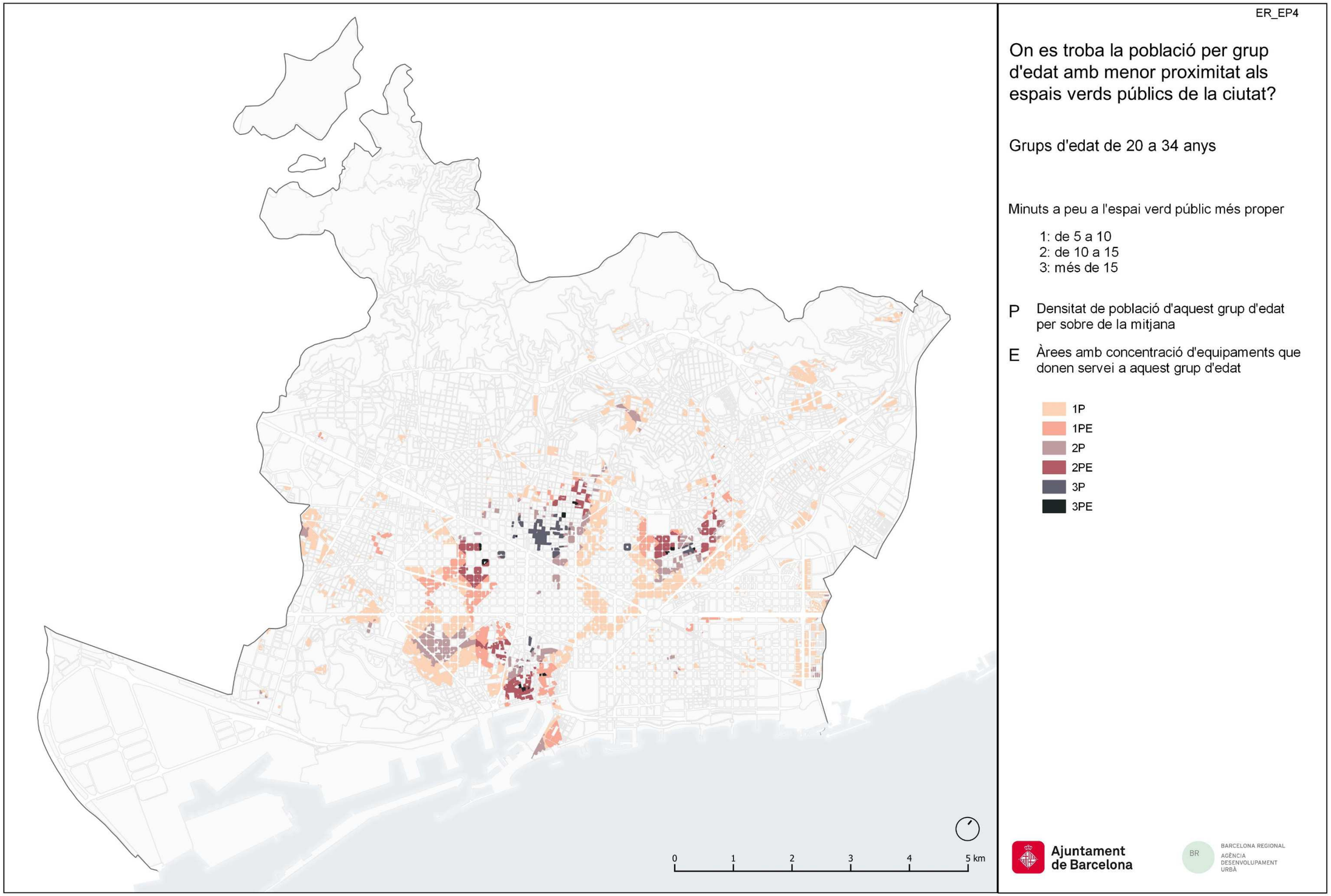
6.3.2 Vulnerability map 5 - 14 age group



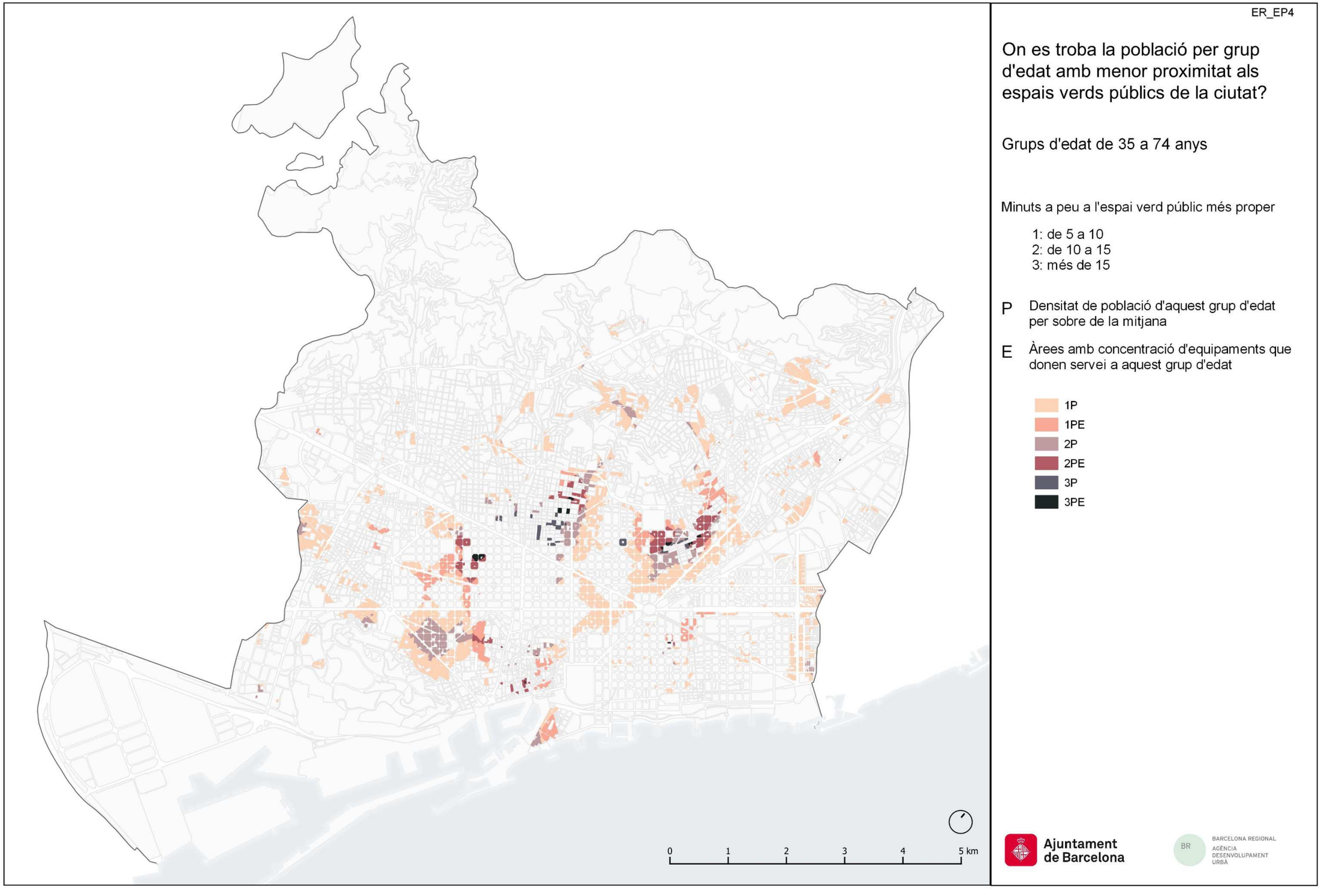
6.3.3 Vulnerability map 15 - 19 age group



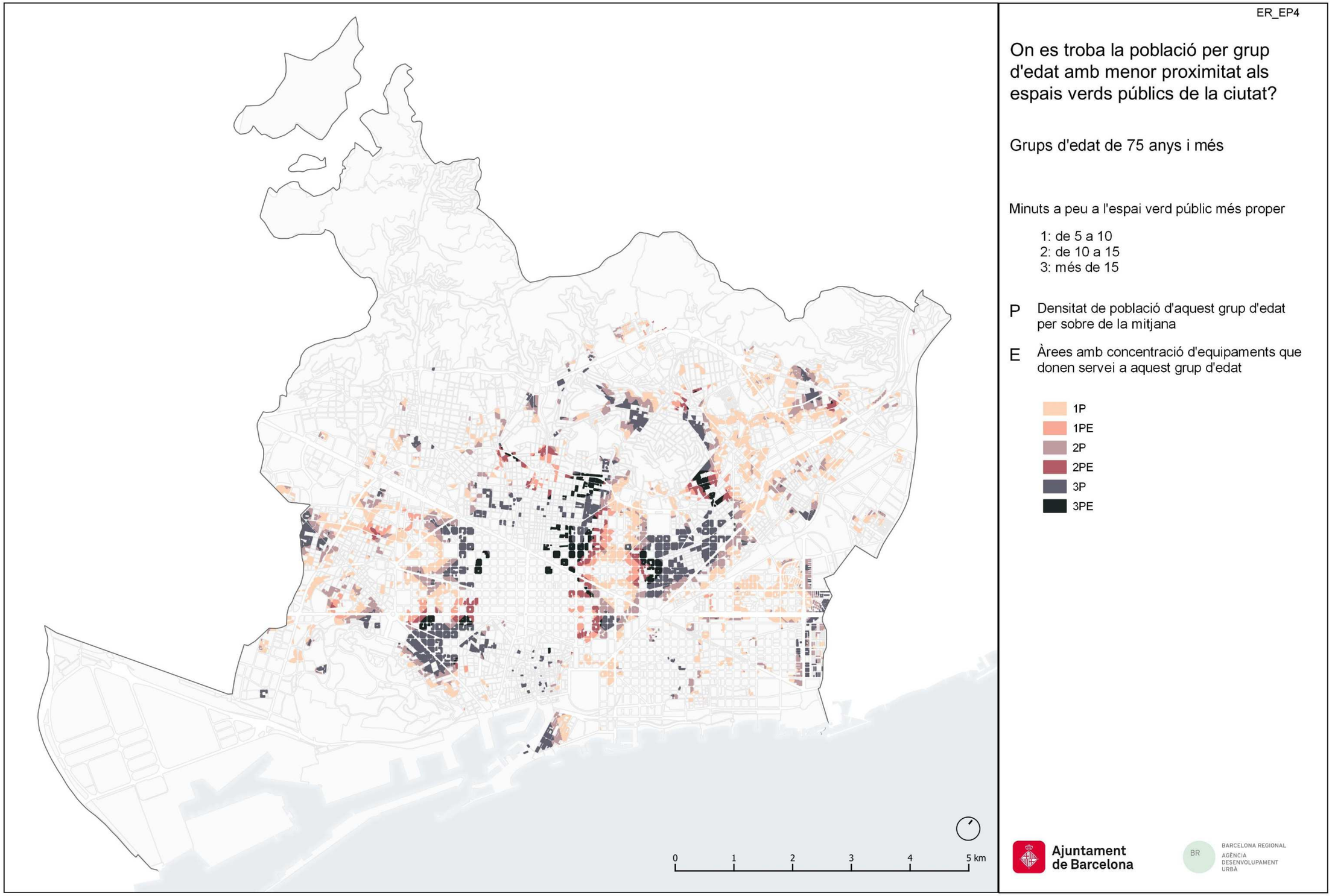
6.3.4 Vulnerability map 20 - 34 age group



6.3.5 Vulnerability map 35 -74 age group



6.3.6 Vulnerability map 75+ age group



6.3.7 Vulnerability map group 0 - 4 and 75+ age groups