Detailed plan of the level of vulnerabilities and rehabilitation needs in the Raval neighborhood, Barcelona (Source: Authors).

Review of socio-residential vulnerability identification methodologies. Application to the cities of Bilbao and Barcelona

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Abstract: This article presents the most widely used methodologies to measure, analyse and assess the state of the building stock and the life conditions of people living in vulnerable neighbourhoods, in an attempt to identify limitations and opportunities within the design of more suitable instruments that will allow us to identify residential communities in a vulnerable situation, residential exclusion or at difficulty to access rehabilitation subsidies or allowances. The methodology adopted is based on the obtention of a first vulnerability index constructed from quantitative data that allows us to focus on the most vulnerable areas of the cities under study. Later, it is complemented with qualitative analysis, interviews to technical officers, entities' representatives, and site visits and observations. The main obtained results consist of different methodological approaches and analytic and geospatial measurements of the residential vulnerability in the cities of Barcelona and Bilbao: from quantitative large-scale multicriterial analysis, geospatial analysis on specific aspects, to small-scale qualitative study cases, fieldwork and interviews to different actors. In conclusion, by applying those different methodologies in the same specific areas, we were able to determine how data disaggregation and specificity in relation to urban and building form and location provide relevant differential results that help to qualify certain patterns that can be detected but not explained by quantitative larger-scale integrative analysis. Besides, the qualitative information provided by key local agents of different networks was crucial to explain and understand the nature of geographical and time-changing patterns of residential vulnerability.

Keywords: urban vulnerability; urban regeneration; housing rehabilitation; built stock assessment.

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1. Introduction

The cities of southern Europe present a common and growing pattern towards an increase in urban economic and social inequality (Musterd & Murie, 2002); a situation that worries the public administrations that face the challenge of promoting the improvement of the most deprived vulnerable residential areas. Until now, the study methodologies and the parameters that have been the basis for promoting rehabilitation programs have focused on literally improving buildings, without managing to address the root of the dilemma, the lack of resources of the socio-residential fabric, a fact that makes it difficult to face (the necessary) comprehensive improvements in neighborhoods (Turkington & Watson, 2015).

The new urban paradigm requires opting for sustainable urban regeneration, as opposed to new construction (Rode & Burdett, 2018). According to the principles of the new urbanism, the Declaration of Toledo in 2010 (Spanish Presidency, 2010) focuses on the intervention on the existing city and highlights the importance of integrated urban regeneration for smart, sustainable and socially inclusive urban development in Europe (Hernández-Aja et al., 2018).

This change in perspective is consolidated in Spain with Law 8/2013 (State Agency Official State Gazette, 2013) based on the sustainable development of the urban environment, as well as the promotion of actions that lead to the rehabilitation of buildings and the regeneration and renovation of existing built stock (Scuderi, 2019). Moreover, public policies in Spain have gone from being called "housing and rehabilitation" to "rehabilitation and rental" policies, assuming the end of the cycle marked by the real estate machine, and the look towards the consolidated city as the urban activity of the coming years (González et al., 2017; Rubio del Val, 2019).

The concept of urban vulnerability summarizes and defines situations that highlight the lack of means to undertake necessary changes in an urban space. Vulnerability is that intermediate, unstable zone that combines the precariousness of work and the fragility of proximity supports (Castel, 1995; Krellenberg et al., 2016). Urban vulnerability refers to two issues: on the one hand, the increase in threats and risks that affect people, groups, states. At the same time, the weakening of the mechanisms to face these risks (Alguacil et al., 2014). As a synthesis, urban vulnerability is a multidimensional concept, which includes many other processes and elements that occur in the social and urban structure and dynamics, its measurement must be equally complex and multidimensional (Krellenberg et al., 2017). In this context, the RE-INHABIT project (García Almirall et al., 2023), in

which this publication is framed, focuses on identifying and classifying the issue of vulnerable neighborhoods in order to identify criteria for developing regeneration and urban intervention policies.

In neighborhoods with similar morphologies, different problems can develop, which is why multidimensional approaches based on public policies against socio-residential problems, strategies to improve the physical and sociological characteristics of vulnerable neighborhoods, are essential. There are situations of highly deteriorated housing stock that, due to the combination of socioeconomic and legal characteristics (tenure regimes, impact of the economic crisis, lack of social cohesion in the communities), and physical-technical characteristics, are excluded from public action or aid programs (Havard et al., 2008).

In short, it is about advancing in a rigorous and exhaustive knowledge of the reality of our neighborhoods, deploying and combining qualitative and quantitative methodologies that help to focus on the essential problems of each neighborhood and to carry out the evaluation of the level of residential vulnerability, as well as the identification of buildings with a more disadvantaged physical state.

Thus, the main aim of this publication is to review and compare the methodologies more commonly used to measure, analyze and evaluate the state of the building residential stock and the life conditions of people living in vulnerable neighborhoods, in an attempt to identify limitations and opportunities within the design of more suitable instruments.

With this objective, different methodologies are applied, some of them already existing, for the measurement and identification of vulnerable areas in Barcelona and Bilbao within the framework of the REINHABIT project (García Almirall et al., 2023). The main novelty is that, by applying them to the same area, they allow areas to be compared and identify their complementarity and limits. All of this makes it possible to validate some of the methodologies, verify the limits of the data and information available, the value of the information contained in public administration sources, as well as the entire set of data and information distributed among technicians, social agents, neighborhood associations and others that verify certain patterns of use and degradation of homes, buildings and neighborhoods.

The second objective of the research, in addition to comparing different methodologies for measuring and identifying socio-residential vulnerability, is the identification and measurement of socio-residential vulnerability

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in Barcelona and Bilbao, as a result of the application of the different methodologies in these case studies. Thus, this research has made it possible to highlight some of the relevant aspects in the decline of some neighborhoods that are integrated into the needs of the social groups that inhabit them and in the building deficiencies due to their original characteristics but also due to their lack of maintenance and adequate conservation.

2. Methodology

The vulnerability concept is multifaceted, which makes operationalizing and assessing it extremely difficult. The very fact that current data is available and that disaggregated territorial units are required creates a fresh challenge when attempting to convert the idea into a quantifiable entity. The effort to operationalize and make the concept of vulnerability quantitative and analytical advances thanks to reference studies (Otero Vidal, 2011; Urban Vulnerability Observatory, 2011; Ruiz-Almar et al., 2012; Antón-Alonso et al., 2020) As stated before, this article reconstructs part of the work carried out within the RE-INHABIT framework project and the review of existing methodologies is presented in two blocks that are:

- Methodologies for the characterization of vulnerability phenomena with a social focus (socio-residential).

- Methodologies for the characterization of deficiencies in buildings, typical of socially vulnerable environments, with a focus on physical condition.

For each of them, the indicators used, the type of results obtained and the main advantages and disadvantages will be described.

However, and at the same time, it is possible to organize the results of the RE-INHABIT project according to the nature of the methodological strategy followed in each stage (mostly related to a quantitative or qualitative strategy). The first stages of the project were focused on the identification and mapping of the vulnerability related phenomenon. This entailed the construction of a large database - both of the Bilbao and the Barcelona cases - including variables related to the socioeconomic and the socioresidential dimensions. The use of specific statistical tools (factorial analysis and multi-criteria analysis) allowed us to generate two measurements of vulnerability that were mapped using GIS. The results obtained by this methodology are explained in depth in the next section.

A second strategy (mostly related to the qualitative dimension of the phenomenon of vulnerability) was also carried out within this project. A set of 20 interviews to technicians, politicians and local entities was conducted between 2020 and 2021, aiming at the level of the actor's representations on the subject under study. The complementation of results obtained from quantitative strategies with these more qualitative results helped shed light on some dimensions of vulnerability. The results of this strategy are also presented in depth in the next section.

Finally, it is important to mention some methodologies that were also carried out within the project for the analysis of large-scale built stock. These combine characteristics of the two aforementioned methods, allowing multi-level analysis that has resulted in innovative ways of approaching the phenomenon and at the same time has provided new contributions to the study of urban vulnerability.

3. Review of the methodologies carried out in the REINHABIT project

3.1 Methodologies for determining socio-residential vulnerability

3.1.1 Quantitative methodologies

All the quantitative vulnerability measurement options described so far have as their main objective the elaboration of an index. To do this, all the trends use the available secondary sources and operationalize urban vulnerability using various indicators (Andújar Llosa, 2020; Grothe, 2020; Otero Vidal, 2011; Ruiz-Almar et al., 2012; Urban Vulnerability Observatory, 2011). Various methods coexist to calculate this synthetic index, which differ in the strategy used or in the way of calculating it (Fernández-García et al., 2017). Table 1 shows various synthetic indices of urban vulnerability indicating their main characteristics (Fernández Aragón et al., 2020). In the context of the REINHABIT project, two synthetic indices of residential vulnerability were developed:

The first of them was applied to Bilbao (Fernández Aragón et al., 2020) and focused on building a synthetic index that placed urban areas, specifically neighborhoods, on a continuum with respect to their degree of vulnerability considering variables of a sociodemographic, socio-occupational and residential nature.. For the elaboration of this index, a factorial analysis of principal components was carried out. As a novelty, this comprehensive index was made up of four partial indices that showed in detail the origin of the aforementioned vulnerability: social vulnerability, labor vulnerability, residential vulnerability and demographic vulnerability. Likewise, unlike other indices, the ISVUI did not use the data from the 2011

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Table 1 | Synthetic urban vulnerability indexes.

Index	Socio economic studies			Urban vulnerability studies		
	Townsend Deprivation Index	Small-Area Index of Socioeconomic Deprivation	INSE	English Indices of Deprivation (IoD 2019)	Índices sintéticos de Vulnerabilidad Urbana	IVU
Author	(Townsend, 1988)	(Harvard et al., 2008)	(Fernández-García et al., 2017)	(Noble et al., 2019)	(Ministry of Development & Instituto Juan de Herrera, 2010)	(Egea et al., 2008)
Year	1988	2008	2017	2019	2010	2008
Country	UK	France	Spain	UK	Spain	Spain
Geographic dimension	Neighborhood (Census unit)	Census Unit	City (census unit)	Neighborhood	Census unit	Census unit
Methodology	Logarithmic transformation and standardization	Principal Component Analysis (PCA)	Confirmatory Factor Analysis	Factor analysis and regularization methods	Multicriteria analysis	Exploratory factor analysis
Indicators	Socioeconomic indicators	Sociodemographic indicators	Sociodemographic indicators	socioeconomic indicators	Sociodemographic indicators	Sociodemographic indicators
	Residential indicators	socioeconomic indicators	socioeconomic indicators	Residential indicators	socioeconomic indicators	socioeconomic indicators
		Residential indicators	Residential indicators	Ambiental indicators	Subjective residential indicators	Subjective residential indicators

(Source: Translation from Fernández Aragon et al., 2020).

Census, instead, it used the data from the 2018 Municipal Housing Statistics carried out by Eustat (Basque Institute of Statistics). This made it possible to obtain an updated index for the Basque municipalities but comparable with any municipality in Spain thanks to the fact that said base shares census variables. In order to validate and show its descriptive nature, this index was applied to the neighborhoods of the municipality of Bilbao and compared with previous studies in the area. The results of the index show a multidimensional and highly polarized vulnerability. At the most negative extreme, neighborhoods are detected in which both the general index and the partial ones show signs of high vulnerability. Table 2 shows the indicators used in each of the four divisions.

Using the variables and dimensions described, a summary of the information was made through the Principal Components technique in order to determine the most relevant factors that influence urban inequality, in other words, those issues that can cause vulnerability and characterize the different neighborhoods. This technique allows us to summarize a lot of statistical information in a few explanatory factors (Hair et al., 1999), making it a fundamental tool for understanding the underlying structure of urban inequality. Thus, Table 3 details the composition of these factors and, ultimately, the dimensions of the ISVUI, as well as their weights.

As stated above, this comprehensive index is made up of 4 partial indices –or dimensions–: the social vulnerability index; the occupational vulnerability index;

the residential vulnerability index; and the demographic vulnerability index. Together they add up to a single value that classifies the neighborhoods, but separately they show us in detail the origin of the aforementioned vulnerability (Fig. 1). As a way of validating the index, it has been applied to the neighborhoods of the municipality of Bilbao and compared with previous studies in the

Table 2 | Indicators for the ISVUI index.

Dimension	Indicator
Sociodemographic	percentage of elderly people (over 65 years)
	young people percentage
	sex ratio
	percentage of people with foreign origin
socio-occupational	percentage of people receiving subsidies
	percentage of unemployed people
	percentage of people with no education
	percentage of people with university education
	percentage of people with professional education
	average income
Socioresidential	percentage of dwellings with heating
	percentage of dwellings with elevator
	average rental price
	average dwelling area
	average dwelling age
Participation	percentage of electoral abstention
	percentage of neighborhood associations

(Source: Translation from Fernández Aragón et al., 2020).

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Table 3 | Structure matrix.

	Factor 1	Factor 2	Factor 3	Factor 4
percentage of people with university education	0,983			
average dwelling area	0,956			
percentage of people with no education	-0,955			
average income	0,949			
average rental price	0,913			
percentage of electoral abstention	-0,786			
percentage of people with professional education	-0,753			
percentage of people receiving subsidies		0,963		
Percentage of job applications		0,927		
Percentage of people with foreign origin		0,873		
percentage of dwellings with heating			0,881	
percentage of dwellings with elevator			0,835	
average dwelling age			-0,743	
young people percentage				0,890
Percentage of elderly people				-0,819
Number of people per dwelling				0,639
sex ratio				0,639
percent variance applied	50,38	23,64	15,6	10,36

(Source: Translation from Fernández Aragón et al., 2020).

area. At a spatial level, we can observe three groups that represent the 3 main types of highly vulnerable neighborhoods according to their location: the old part of the city –Bilbao la Vieja, San Francisco or Zabala–; northern working-class periphery –Otxarkoaga or Arabella–; and the southern working class periphery –Iturrigorri-Peñascal, Uretamendi or Altamira–. The comparison of the results of this research with those obtained in others confirms and validates the capacity of the ISVUI as a tool for detecting vulnerability. Regarding the results obtained in the analysis of neighborhoods in Bilbao, it should be noted that those neighborhoods categorized as "High vulnerability" present a situation of multidimensional vulnerability and highly polarized with respect to the "non-vulnerable". Consequently, we can affirm that there is a remarkable inequality in Bilbao that the ISVUI is capable of showing. It also highlights the usual trend towards the concentration or segregation of areas categorized as vulnerable.

The second synthetic index developed in the context of the project focused on the determination and mapping of socio-residential vulnerability in the city of Barcelona, carried out in 2017 (Garcia-Almirall et al., 2021). The methodology that was designed followed previous experiences and methodologies (Otero Vidal, 2011; Urban Vulnerability Observatory, 2011; Ruiz-Almar et al., 2012; Andújar Llosa, 2020; Antón-Alonso et al., 2020; Grothe, 2020) was based on a set of indicators (Garcia-Almirall et al., 2021) developed through the use of routine statistical Open Data and supplemented with unique data specifically developed and provided by the Barcelona City Council (Table 4). It was possible to determine the sociodemographic, socioeconomic, and characteristics of urban and residential space at the neighborhood, population census unit, and urban block levels thanks to the analysis' use of secondary data and its structuring in georeferenced axes, components, and indicators. In order to seek priority
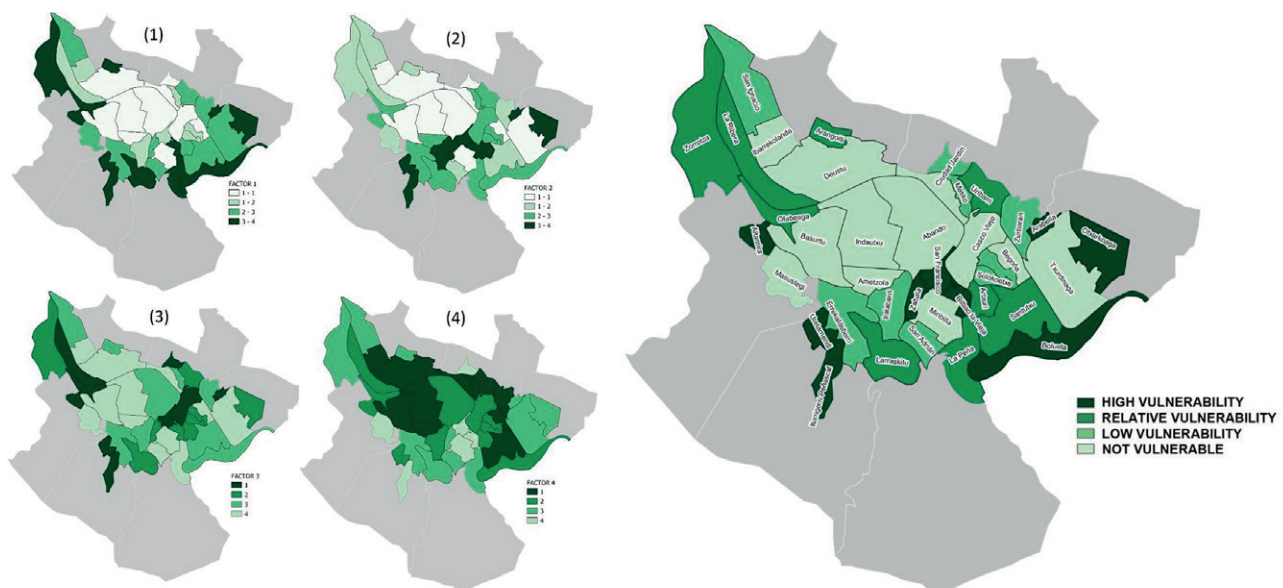

Figure 1 | Maps for each of the four dimensions of vulnerability studied and integrated map of the ISVUI index in Bilbao. (Own elaboration from Fernández Aragón et al., 2020).

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strategies for action in the most susceptible areas, the research's goal was to identify, ascertain, and construct a measure of differentiation related to the level of residential vulnerability of some neighborhoods with respect to others. The study's findings led to a set of maps that let us pinpoint the regions with the highest concentrations of vulnerability indicators using a synthetic multi-criteria analysis (Fig. 2). The study was divided into three axes/ components of study:

- Axis 1. Socio-economic vulnerability, characterized by unemployment (especially high rates), a precarious labor market (instability and low income), and the low educational level of the working classes (especially related to school dropouts).

- Axis 2. Sociodemographic vulnerability, characterized by demographic aging (related to situations of dependency, health problems, deterioration of

Table 4 | Indicators and weights used divided by axis/component.

Component	Indicator	Weight	
		Indicator	Axis
Socio-economic vulnerability			
Residential exclusion	Grants for rental accommodation payment	6	
	Evictions	8	
	Punctual municipal grants	5	
Economic shortcomings	Non-contributory or disability pensions	2	28
	Per capita family income	3	
Risk potentiality	Unemployed population	3	
	Unskilled workers	1	
Socio-demographic vulnerability			
Mobility	Non-European population (nationality)	2	
	High rates of internal migration	2	
	Low rates of internal migration	0	
	Child population index	1	
Dependence	Aging index	3	
	Over aging index	2	16
	Mortality due to respiratory diseases	1	
	Number of residents per dwelling	1	
Residential density	Dwelling surface per resident	2	
	Population density	1	
	Dwelling density	1	
Residential and socio-urban vulnerability			
Physical	Dwelling average surface	1	
	Aging of buildings	2	
	Average category of residential uses*	1	
Buildings' risk	Buildings' conservation: state of ruin, bad or deficient*	4	
	Building typology*	1	
Accessibility	Buildings 4 stories or higher without elevator	3	21
	Buildings over 40y without rehabilitation aids	1	
Rehabilitation activity	Interior Conservation Requirements	2	
	Facade Conservation Requirements	2	
	Buildings older than 40 with no rehabilitation licenses	3	
Energy efficiency	Energy Efficiency Rating F or G*	1	
	Social housing applications	2	
	Mortgages	1	
	Rental housing	1	
Tenancy	Cadastral value	2	
	Ownership structure (vertical or horizontal)	1	11
	Ownership type (natural person or legal entity)	1	
Urban activity	Empty premises at ground floor	2	
	Commercial uses at ground floor	1	

(Source: Garcia-Almirall et al., 2021).

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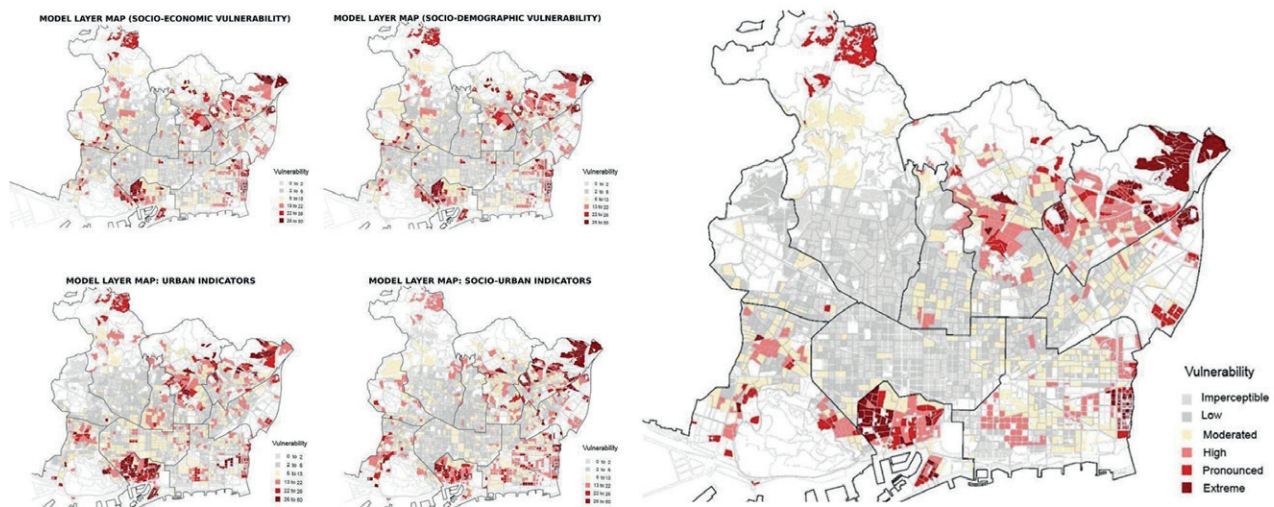*Technology and Sustainability*

Figure 2 | Maps for each of the four dimensions of vulnerability studied and integrated map of the vulnerability index in Barcelona. (Own elaboration from Garcia-Almirall et al., 2021).

housing, low or lack of income, and increase in single-person dwellings), and the greater complexity of the housing structure (linked to the consolidation of family types with high social vulnerability such as extended households of migrant low-income population).

- Axis 3. Residential and socio-urban vulnerability refers to the degradation of both housing and neighboring residential urban environments, which becomes a risk of vulnerability among the resident population. Poor housing as well as residential environments that do not meet the basic habitability requirements due to their poor state of conservation, insufficient surface area, or lack of basic facilities, are the highest expressions of residential vulnerability.

The results show that the most vulnerable areas are those contained in the historic center and the extreme northeast of the city, with a special remark in the neighborhood of El Raval, the north-east limits of the city with a remarkable concentration in the north-eastern extreme (Zona Nord), and the neighborhoods near the eastern limit of the city limited by river Besòs with special extreme values in the south-eastern neighborhood of Besòs-Maresme. These larger groups of vulnerable areas strongly reaffirm previous results on the topic of study (Instituto Juan Herrera 1996; Uban Vulnerability Observatory, 2021), and can be also related to historical factors of disadvantage and the historical evolution of the city (Oyon et al., 2021).

3.1.2 Qualitative methodologies

Even though quantitative tools have been used to measure and identify the vulnerability phenomenon, it has been proved that some of its components may escape from a quantitative approach, making it necessary to establish mixed-type research strategies. Thus, qualitative approaches are extremely useful as they intend to capture the level of representations of the users and population under study and ask questions concerning how they live and cope with the 'material' or objective identified situations. A combination of qualitative and quantitative tools has allowed this research to shed some light on very important characteristics on the subject of vulnerability.

In the framework of the study of socio-residential vulnerability, the qualitative contributions that emerge from the readings and analysis of organizations, as well as the representations offered by the staff of the local public administration, are especially relevant. Recent publications highlight the importance of having powerful methodological tools that can measure and take into account the level of organization and neighborhood involvement as a tool to mitigate the effects of socio-residential vulnerability (Piasek et al., 2021, 2022).

There is a need to complement quantitative data with a qualitative approach. This study shows the need to study vulnerability from the perspective of the accumulation of advantages and disadvantages (between neighborhoods and within them), in relation to the study of the objective conditions and the way in which these

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situations are experienced. Then, the need to shed light on less visible factors is highlighted, but which operate as causes of situations of disadvantage and exclusion: certain characteristics of buildings or dwellings, attributes of the neighborhoods themselves, the role of the administration in its actions or omissions. Likewise, in the case of Barcelona (Piasek et al., 2022), the migratory component has appeared as a characteristic feature of both the city and the case studies, implying certain tensions to be resolved within the neighborhoods and associations in relation to mutual recognition, the dynamics it generates and its implications for participation.

3.2 Methodologies for the analysis of large-scale built stocks

From studies on socio-residential vulnerability, it can be deduced that the state of the buildings in a certain neighborhood is a determining factor in how different situations of vulnerability are perceived. Likewise, the rehabilitation and updating of existing built stocks through rehabilitation aid policies is a future challenge for the social improvement of these neighborhoods.

For this, methodologies for the analysis of large-scale built stocks are necessary. These are usually based on the definition of parameters to be observed, combining the collection of quantitative and qualitative primary data through the assessment of expert technicians.

In the context of the REINHABIT project and commissioned by the Barcelona City Council, several prediagnosis studies have been carried out on the construction of the areas that had been detected as the most vulnerable. The objective of these studies was to accurately detect,

at the building level, those cases where it was a priority to carry out rehabilitation actions in order to apply the rehabilitation aid program for "high complexity estates" (Uzqueda et al., 2021). In this rehabilitation aid program, the city council acts proactively by identifying the places where there is the greatest need (Thomsen et al., 2015), offering legal advice to residents and carrying out the rehabilitation works, with variable financing in each case.

The aforementioned studies consisted of a pre-diagnosis of the state of conservation of the buildings carried out from the outside and establishing five indexes corresponding to the priority level of need for rehabilitation of each building. In addition, a series of observable indicators in the buildings (damage and deficiencies) were taken into account for the pre-diagnosis (Cornadó et al., 2021): the presence of capillary and/or seepage damp, unstable facade elements or cladding, the presence of security nets, cracks in the facade walls, cracks in the cladding, windows in poor condition and damaged facilities. This process continued with a verification phase through meetings with multiple district technicians to review the results obtained, ending with interior visits to those buildings identified as most in need of rehabilitation (Fig. 3). Consequently, highly disaggregated information is available from primary sources in 25 neighborhoods and a total of 11,738 buildings and 96,307 dwellings.

The fact of having such disaggregated information shows how in a given area, classified as highly vulnerable residential, buildings with very different states of conservation and rehabilitation needs can coexist. To facilitate the reading of these situations, tools such as the kernel density methodology have been applied (Baddeley & Turner, 2006; Diggle, 1985; McSwiggan et al.,

Figure 3 | Methodology of prediagnosis and examples of studied buildings. (Own elaboration from Cornadó et al., 2021).
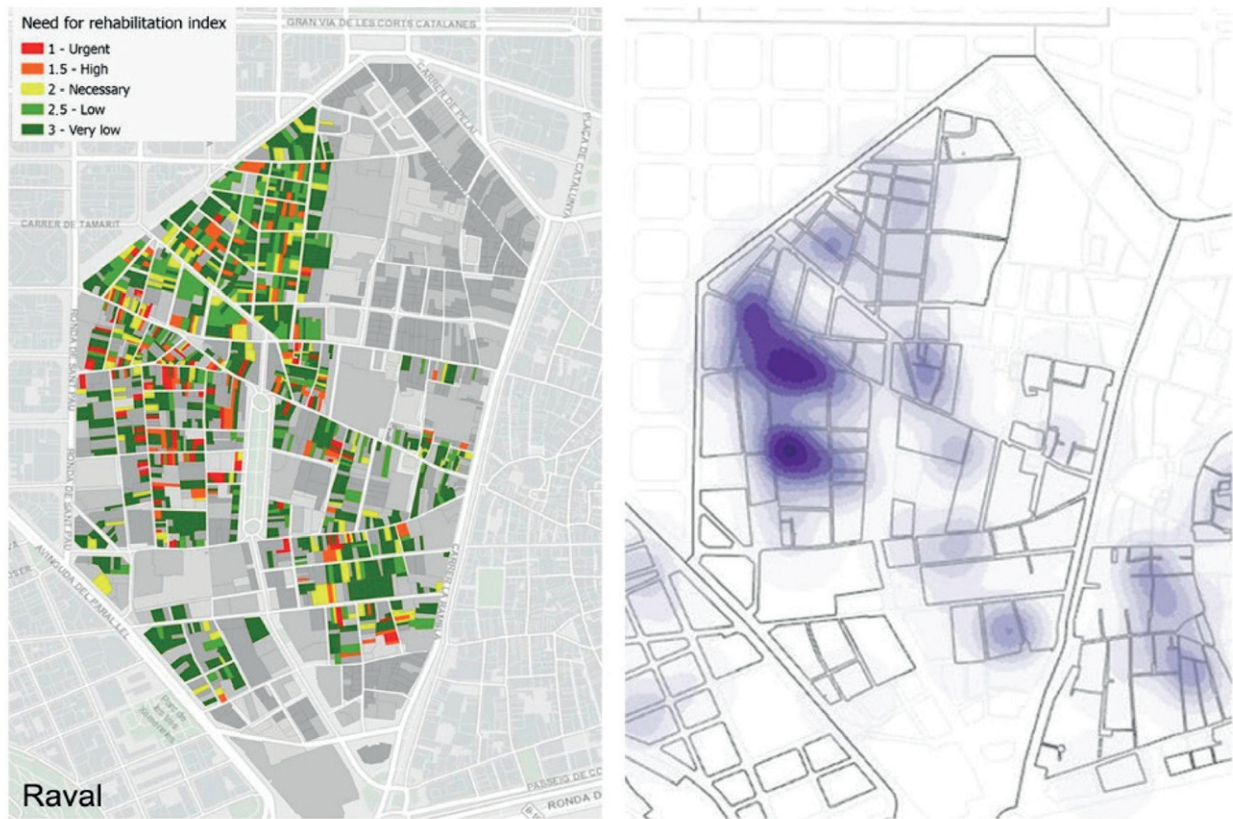
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Figure 4 | Example of disaggregation in the need for the rehabilitation index and kernel density model. (Own elaboration from Cornadó et al., 2022).

2016; Rezazadegan et al., 2011), used in other contexts such as seismic or fire risk detection, which help to locate the areas with the greatest need for rehabilitation (Fig. 4) (Cornadó et al., 2022).

Table 5 | Habitability dimensions and indicator subgroups.

Habitability dimensions	Indicator Subgroup
Availability of space	Usable area
	Usable space per resident
	Overcrowding signs
Light and ventilation	Ventilation and illumination of dwelling interiors
	Ventilation and illumination of common spaces
Accessibility	Accessibility
State of repair	State of repair of dwellings
	State of repair of common spaces
	Maintenance
	Appropriation

(Source: Vima-Grau et al., 2021).

A third scale of analysis is one that takes the dwelling itself as a unit of analysis, probably the most possible disaggregated unit. In some of the previous work in the context of the project (Vima-Grau et al., 2021), we carried out an extensive qualitative and quantitative primary data collection applying fieldwork observation and methodologies, similar to those that have been previously explained, to a much smaller building stock (70 multi-family buildings with 603 dwellings). In order to analyze housing conditions in a broad sense, we defined a total of 47 indicators divided in four habitability dimensions and ten indicator subgroups (Table 5).

Each indicator was labelled to define whether the housing conditions were substandard, inadequate or adequate, according to most standards included in current regulations (Àrea Metropolitana de Barcelona Mancomunitat de Municipis, 1976; Generalitat de Catalunya, 2012). We opted for a multicriterial evaluation that allowed us to define ten habitability indexes based on a weighted sum of the initial indicators. This multicriterial evaluation procedure was repeated in order to describe

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the sample based on the four habitability dimensions, as well as to obtain a general index of habitability.

Results allowed us to account on the specificities defining very different housing conditions within a small sample of buildings or even within a same building. We could also proof in detail how the quality of housing in areas that had been previously described as vulnerable and with high needs of rehabilitation ranges from inadequate to critically substandard in some cases, and it is substandard in approximately 20% of cases.

4. Conclusions

Understanding the problems that affect these neighborhoods has required the analysis of a selection of case studies. Developing a literature review on each neighborhood: the reconstruction of history, of the main urban interventions, specific planning (if any), and identification of milestones or central actors. This compilation of previous studies and experiences is completed with research based on qualitative and quantitative methodologies that give a very precise result of the case study. This vision allows prosecuting a critical analysis of local and regional policies and interventions, past, present and projected on the case studies. Main conclusions can be summarized as follows:

- Quantitative research techniques are very useful for the objective identification and

- quantification of vulnerable areas where public policies should focus.

- Qualitiative methods provided a better knowledge on how people understand and represent the phenomena of socio-residential vulnerability previously identified on an objective level. Also, they

- allow to include aspects that were not initially contemplated and assessed.

- Combined methods applied to the study and assessment of the residential building stock need of rehabilitation provide greater understanding and primary disaggregated data at building scale on an aspect that requires a closer small-scale analysis.

- The main value of combined quantitative and qualitative methodologies is to highlight that we start to count with data that is precise and valuable enough to inform and guide local government institutions in their pursue of priorizing underprivileged areas that need it the most.

They can also be very useful tools to help urban regeneration and housing rehabilitation policies to pursue environmental justice and the redistribution of wealth.

Acknowledgments

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