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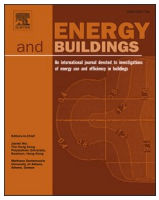

Household strategies for coping with energy poverty: Technological and socio-familial dilemmas

Iván López [a,*], José Ignacio García-Valdecasas [b], Cristina Monge Lasierra [a]

[a] Department of Psychology and Sociology, Area of Sociology, University of Zaragoza, Spain
[b] Department of Sociology and Social Work, Faculty of Labor Sciences, University of Valladolid, Spain

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ABSTRACT

This paper describes the diverse and imaginative strategies adopted by socially vulnerable households in their day-to-day lives at the micro-level (a view from below) for coping with energy poverty. In addition, we identify the perceptions and narratives of these households regarding energy poverty, the condition of their building, and the social actors involved. The research has been conducted in the city of Zaragoza (Spain), a city severely affected by climate change. This is the first qualitative sociological study carried out in Spain with in-depth interviews at the household level, using qualitative analysis software. The results show the continuous dilemmas these households face to keep the dwelling at a comfortable temperature (both excess cold and excess heat, or energy saving): how and when to use technology and appliances, budgetary quandaries, leaning on 'survival strategies', dealing with frequent power supply cuts, changing energy service companies, or moving home. The three analytical dimensions considered – the socio-technical, the socio-spatial, and the socio-temporal – reveal that these dilemmas are frequently a source of stress and uncertainty, especially for those with members who have severe health issues, or who are minors, elderly or single mothers. Likewise, being aware of the importance of the rehabilitation of the buildings where they live is crucial for reducing energy consumption and, therefore, energy poverty. This research contributes to a more detailed understanding of this social problem (its visibility) and possible institutional initiatives for its palliation. The research hypotheses are useful for regions with similar climatic characteristics.

1. Introduction

Ever since Boardman [7] presented energy poverty as a social phenomenon caused primarily by low household income, deficiencies in dwellings in terms of energy efficiency, and energy prices, knowledge regarding energy poverty, its visibility and the social consciousness in this regard has significantly increased [8,26,59].

Energy poverty is defined by EU as "a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy, and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure, and poor energy efficiency of homes" [29].

When analyzing energy poverty, it is important to focus attention on the vulnerable population or vulnerable consumers due to the greater risk to which these social groups are exposed inside homes [89,94]; specifically, to fight against energy poverty, prevent extreme situations such as power cuts in the home and implement more effective mitigating measures [20,79]; and furthermore, to identify hidden energy poverty [6,66].

Referring specifically to one of the main causes, which is insufficient disposable income, the EU defines vulnerable households thus: 'vulnerable households' means households in energy poverty or households, including lower middle-income households, that are particularly exposed to high energy costs and that lack the means to renovate the building that they occupy" [30]. Here we take these definitions, which are necessary for the implementation of these directives in Spain as a member of the EU.

In Spain, the National Strategy against Energy Poverty (2019–2024) establishes for the first time an institutional definition of energy poverty and the 'vulnerable consumer'. However, according to Eurostat, in 2023 one in five households in Spain was unable to keep the home at

* Corresponding author.
E-mail addresses: ivalopez@unizar.es (I. López), joseignacio.garcia-valdecasas@uva.es (J.I. García-Valdecasas), cmonge@unizar.es (C. Monge Lasierra).

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adequately warm in winter. It is the highest record in the European Union, along with Portugal, and it is among the countries where energy poverty has increased the most (doubling since 2018).

Analyzing energy poverty from bottom up, from households' point of view, is crucial for its deeper understanding. We refer to the fact of making energy poverty visible at the micro-social level, that of the household, which includes its members as well as the close circle of friends or family [22,66,69].

However, this level is closely related to the macro-social and economic level or the contextual factors that go beyond the home space [33,48,53]; that is, policies and social decision-makers, energy or housing prices, the characteristics of the labor market, the seasons of the year and outside temperatures, among others.

At the household level, the complex interactions between three dimensions need to be taken into account. The socio-technical dimension [10,13,22,93], includes how household members interact with the climatic situation of the building, domestic appliances or systems to cope with situations of excessive cold or heat. The socio-spatial dimension at the household and community level [2,18,55,98,100] refers to how the space inside the home is used to adapt to indoor temperature. Whilst the socio-temporal dimension [2,41,55,60] focuses on the way people manage their time both inside the dwelling and outside.

When distinguishing energy poverty coping strategies adopted in dwellings, Brunner et al. [12] differentiate between efficiency strategies that are reflected, for example, in small investments or home repairs, and sufficiency strategies that refer to people's changing habits for coping with inadequate temperatures in the home. Previously, Harrington et al. [44] singled out actions aimed at reducing or dispensing with basic household needs other than energy, saving on energy consumption; or the inability of households to cope with the inefficiency of the building, the home's heating systems or appliances.

It is also important to distinguish between palliative measures, the aim of which is to eliminate as far as possible the causes that originate the problem (such as the thermal isolation in the apartment or building), from those aimed at mitigating, or lessening, the effects of energy poverty (mostly used by households) [16,71,79].

These baseline considerations need to be widened with a more detailed analysis of household strategies for coping with inadequate temperatures in the home [40,61] with the aim of identify energy poverty, often invisible, and describing the just energy transition [58,85].

The research presented here was conducted on vulnerable households living in old and energy inefficient buildings. The objectives of this study are: 1) to describe the strategies vulnerable households employ to cope with energy poverty and the differences between them according to the different types of households, 2) to identify their narratives regarding other social actors such as public institutions, energy companies, political actors, or family and friends.

Vulnerability is an open notion that completes the energy poverty's theoretical frameworks. Individual vulnerability focuses on the households' level [48,50,63] while structural vulnerability includes labor conditions, the access to housing, and energy prices [24,72,83]. Also, it's been analyzed both by quantitative indexes in disciplines such as geography or demography [45,76], quantitative socio-economic indexes [16] and by means of subjective measures [46,95].

In the European context, southern European countries suffer larger structural vulnerability along with higher energy poverty incidence and risk of excess winter mortality [72,91], whereas heating is the main social vulnerability concern [38]. Thereby, the discussion and research on energy vulnerability contribute to the distinction between energy or fuel poverty [9,34,42].

The studies on energy poverty carried out in the city of Zaragoza are mainly based on the quantification of this social problem. These include, for example, relating energy expenditure and household incomes [80], or through spatial analysis of the socio-economic impact and media coverage of energy poverty [78,79].

Others analyze the close relationship between thermal expenditure and energy vulnerability with the size of the dwelling and the number of adults in the household [3]; while studies that focus on buildings are also noteworthy, specifically on their energy deficiencies [51], the impact of building renovation on energy savings [32], or building orientation [57].

But none of these approaches identify the dilemmas faced by vulnerable households and the strategies they engage in to face energy poverty on a daily basis, nor do they implement qualitative social research methodology.

In this research, the premise is to focus on those social groups with fewer opportunities to progress economically and socially. The three analytical dimensions considered (socio-technical, socio-spatial and socio-temporal) are analyzed in the following four sections:

1) The living conditions in the home, due to energy inefficiency of the building, and the state of the dwelling and indoor temperature (hot / cold). This analysis provides information about the independent variables that are used to deepen into the description of the next three sections.
2) How vulnerable households develop strategies for coping with the excess of heat and cold in the dwelling. Particularly, the socio-spatial and socio-temporal approaches are most relevant when considering the condition and orientation of the building, whereas the description of households' use of technology and appliances focuses mostly on the socio-technical dimension. The three analytical dimensions are considered when describing dwellings' dilemmas facing inadequate temperatures, as well as in the insight on habits and customs in the dwelling and individuals with special needs.
3) The households' socio-temporal management of budgetary difficulties to pay the energy bills in the short and mid-term. At the same time, the dwelling's disconnection from the energy supply refers mostly to socio-technical responses.
4) Finally, the description of strategies addressing energy saving at home includes the household's attitudes for saving energy and reducing electricity consumption for lighting in the home. In both aspects most emphasis is put on the building and the dwellings' socio-technical and socio-temporal strategies. Also, participants are asked questions about the possibility of moving home in order to achieve better energy efficiency and thermal comfort.

This sociological research contributes from an innovative qualitative sociological analysis to the broadest and deepest knowledge of energy poverty, specifically that of vulnerable households. Its holistic and multidimensional perspective includes the three dimensions mentioned above as well as the interviewees' perceptions of the relevant social actors when coping with energy poverty (public administrations, energy providers, or their closest social network).

2. Methods

The study has been carried out by means of qualitative social research that makes possible a broader and an in-depth and comprehensive description of the consequences of energy poverty in vulnerable households and their coping strategies [63],that is to say, subjective indicators are aimed at overcoming the limitations of quantitative indicators to measure energy poverty [4,70,88,90], as may be, specifically, subjective well-being [14,21,97] and its relation to thermal comfort and decent living conditions [17,36,60,82]. The technique used is that of in-depth interviews [52].

The geographical scope of the study is the city of Zaragoza (Spain). The interest of this case study is both in the forecasts of climate change with notable impact on Spain as part of the Southern Mediterranean and a high energy price, as well as in the characteristics of Zaragoza, a city with an extreme climate that is very hot in summer – reaching maximum temperatures of 44.5 °C – and cold in winter – temperatures can drop to

0 °C. This climate requires measures to adapt buildings and homes to heat and cold.

This continental Mediterranean climate, in addition to the interior of the Iberian Peninsula, occurs in northern Italy and in the Saharan Atlas, among other places. In the case of Zaragoza, it is even more extreme due to its special location in the central sector of the Ebro River Depression, in a semi-arid Mediterranean climatic context. In the 2030–2050 horizon, an increase of 1.63 °C is estimated, according to the Zaragoza Climate Change Adaptation Plan. Thus, the climate of Zaragoza will be the same as that experienced today in the region of Tangier or the north of the regions of Fez and Uchda in Morocco. Rising temperatures are shaping up to be the main climate threat to Zaragoza in the coming years

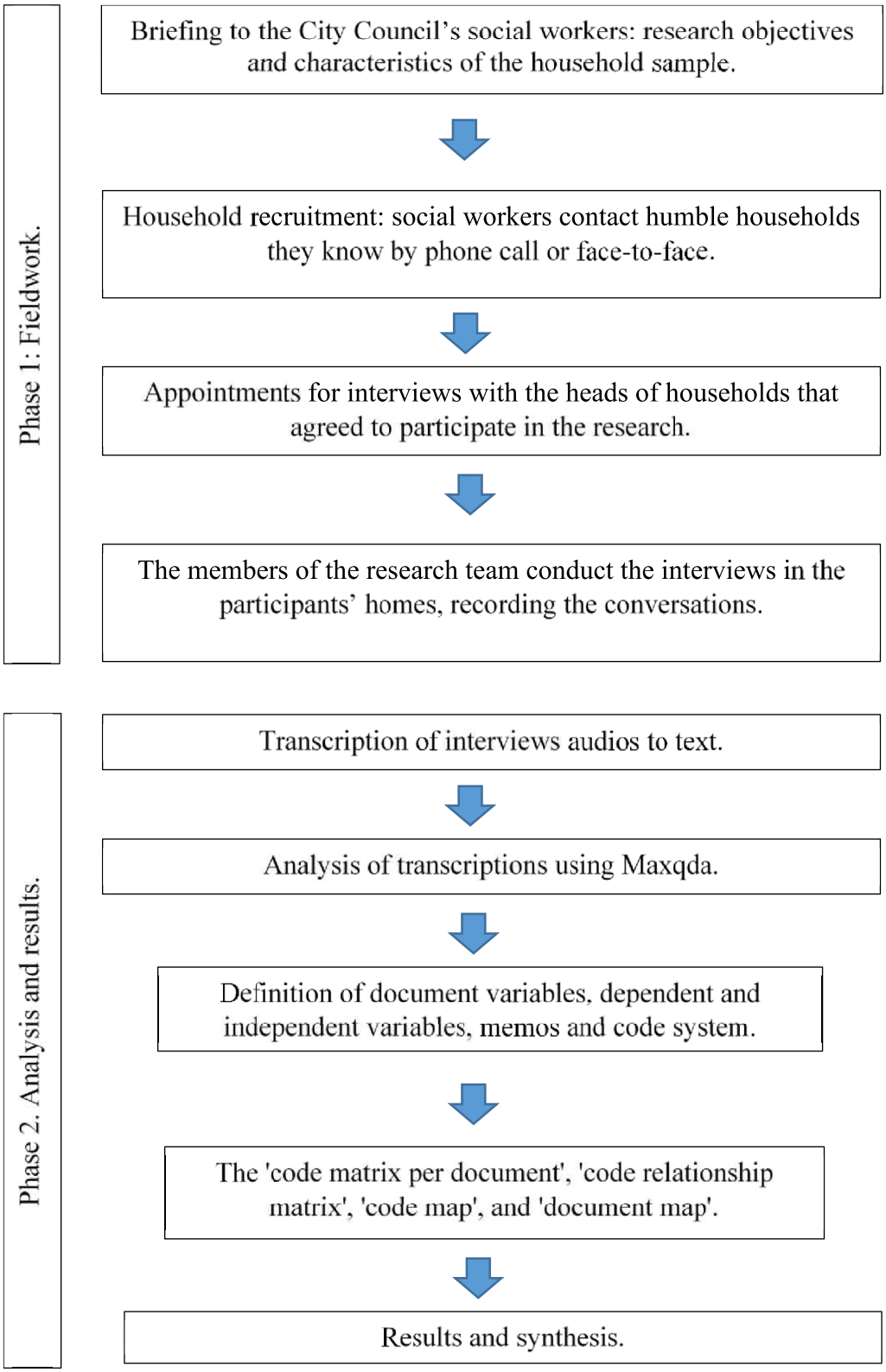

Fig. 1. The fieldwork and analysis research phases. Source: Authors.

[103].

Among the risks and vulnerabilities identified by the Zaragoza Climate Change Adaptation Plan is extreme heat in buildings and negative consequences for human health. Thus, its objectives include the rehabilitation and renovation of homes and buildings, as well as the regeneration of neighborhoods. The purpose is both mitigation and adaptation to climate change, as well as strengthening the participation of citizens in these processes [104].

In Zaragoza, energy poverty affects nine out of ten families assisted by the non-governmental organization Red Cross. Therefore, the population or cohort studied in this research is vulnerable households (in a depressed economic situation and living in poor quality and energy inefficient buildings) that are vulnerable to energy poverty. Specifically, a sample of 15 vulnerable households were interviewed.

The results of this research could have been made broader or have gone deeper by conducting more interviews, either in the same city or expanding them to other cities to compare results. Despite this, as this is a study targeting the segment of financially depressed households, the fifteen interviews carried out are sufficient to reach reliable, or at least exploratory, conclusions. The features of the households interviewed meet the main vulnerable social conditions, encompassing a wide range of types of families or dwellings, such as those with minors, single mothers, migrants, poor workers or the unemployed, or people with severe health problems.

Though more interviews would have led to the 'discourse saturation' (when the participants' arguments are redundant in further interviews) [11], these results have the potential to be applicable to other places with similar climates and similar vulnerable groups. They are also useful as research hypotheses. Social workers from the City Council's Area of Social Action and Family contacted vulnerable households (with low economic resources or at risk of poverty), both by phone call and in person, with whom they had created bonds of trust over time, to ask them to participate in the interviewing process. Previously, the research team gave social workers a briefing on the research objectives, the sample's features, and the profiles of households needed for the interviews.

The team also set appointments for interviews with the heads of the households who agreed, conducted at the homes, thus avoiding the participants' displacement and helping their participation. Above all, the home is a quiet space (without noise or disturbance as there are no other family members at the time of the interview) and recognizable by participants. The hierarchy between the interviewer (who conducts the communication process) and the interviewee is reduced, facilitating a fluid conversation and the transmission of sufficient and reliable information for the social study.

In addition, a requirement of this social research technique is that participants and interviewers have not met beforehand to avoid possible biases or influences in the communication process between them. In this way, researchers informed households that the interviews would be conducted by the members of the research team, and not by social workers. All interviews were audio-recorded, with participants' consent and preserving their anonymity (Fig. 1).

Table 1 shows the features of the sample of the interviews conducted. The profile of single-parent households predominates in the sample of households interviewed, accounting for a total of eight. Immigrants and working poor integrate five of these households, in addition to long-term unemployed present in two of these households. Among single parents, half are household beneficiaries of the 'social bonus' for electricity, or a discount on electricity bills aimed at vulnerable households.

However, there are a total of six immigrant households, seven of the working poor, and four of the long-term unemployed, while nine of the fifteen in the sample receive the social bonus or other aid for electricity bills.

There are minors in ten out of fifteen households interviewed. Among the elderly, one interviewed household had all its members over 65 years of age (a couple of elderly over 80 years of age who live with just one minimum pension). Two others complete the ones with old people: 1) the one made up of a 65-year-old woman, who lives with her

Table 1
Interviews conducted, characteristics of the people interviewed and of the energy system used in the dwelling.

N	V1	V2	V3	V4	V5	V6	V7	V8	V9	OTHER DETAILS
1	X	X		X			X	Gas boiler		None
2	X	X				X		Electric radiator, electric pump, electric central heating	X	None
3								Gas central heating		A woman over 65 years old, living with her daughter, her son (a minor) and her brother (also over 65 years old). Both siblings have minimum pensions, and the daughter works just a few hours part-time.
4								Electric stove	X	A man over 65 years old living on a retirement pension of less than 500 Euros per month.
5	X	X		X			X	Gas central heating	X	None
6					X	X		Gas central heating	X	A 58-year-old woman living with her elderly, sick mother.
7						X		Gas central heating	X	A 61-year-old man, living alone, with no recognized disability but with reduced mobility owing to a serious foot injury.
8	X	X		X			X	Gas central heating		None
9	X	X		X			X	Gas central heating	X	None
10	X	X					X	Gas central heating	X	None
11		X		X				Electric radiator		A woman with two children in her care, one of them a minor.
12		X					X	No heating		None
13			X					Gas central heating		A couple, over the age of 80, living on the man's minimum pension.
14	X	X		X			X	Gas central heating		None
15	X	X				X		Gas central heating		None

Source: Authors.
V1: Household with a single mother.
V2: Household with minors.
V3: All household members are over 65 years old.
V4: Immigrant household.
V5: Household with some members with special needs.
V6: Household with some members who are long-term unemployed.
V7. Household comprising low-income workers.
V8. Type of heating.
V9. Household in receipt of the 'social bonus' for electricity, a discount on electricity bills for vulnerable households.

daughter, a son (a minor), and her brother (over 65 years old). Both brothers have minimum pensions and the daughter works only a few hours (interview #3), 2) another in which lives a man over 65 years old with a non-contributory pension of less than €500 per month (interview #4).

The profile of households with women is completed in this sample with two more cases: 1) that of a 58-year-old woman who lives with her elderly and sick mother (the only one in the sample with special needs), long-term unemployed (interview #6), 2) another with an immigrant woman with two dependent sons (one of them a minor) (interview #11).

As for the heating systems of these homes, the gas boiler predominates, being present in eleven of the homes interviewed. The rest of the households in the sample each have an electric stove, radiator, radiator pump, electric heating, or no system at all.

The interviews lasted between an hour and an hour and a half. The script for the interviews was semi-structured, with open questions (inviting spontaneous responses), and supported by 15 cards with suggested answers. In face-to-face interviews, when a question gathers a long list of possible answers, cards (or flash cards) facilitate interviewees' decision process to choose answers, instead of researchers saying them.

In this research, cards along with open questions, aim to delve deeper into the information provided by the participants. Open questions, first posed by the interviewer, gather spontaneous answers. Answers of this type are not influenced by suggested or proposed options. Thus, from the qualitative perspective, their relevance is that they are especially present in the participants' perception of the topic addressed, as well as because they are expressed in their own words. Next, respondents answer the same question but with suggested answers shown on cards. The aim is to show them options, which they initially might not have considered, sometimes on complex topics. This way, the researcher gathers information that would otherwise be lost and facilitates participants' reflection.

Particularly in this research, during interviews cards address the following topics: changes in the living conditions during the last five or the years (family budget, health, dwelling…) (Card #1); issues in which households frequently have financial difficulties (Card #2); satisfaction with specific aspects of the dwelling (size, rooms, general condition of the home…); (Card #3); living with family members with these important diseases (Card #4); situations in which the temperature at the household is not appropriate (Card #5); consequences and opinions when the energy bill for heating or electricity increases noticeably (Card #6); how households are affected by power or electricity supply outage (Card #7); situations experienced when suffering a power or electricity supply outage (Card #8); situations experienced when changed or tried to change your energy supply provider (Card #9); measures taken to save on energy consumption for heating or electricity (Card #10); measures taken when the home is not at an adequate or comfortable temperature (Card #11); measures taken to reduce electricity consumption for lighting (Card #12); Criteria for changing homes (Card #13); limitations in the dwelling due to severe or chronic health problems of a family member (Card #14); limitations in housing for people with disabilities in the family (Card #15).

The fieldwork and the interviews were carried out in 2022 and transcriptions of the audio recordings are the material used to analyze the discourse of these households. On the one hand, by using deductive logic starting from theoretical premises or hypotheses once the literature and conclusions of related empirical studies were reviewed. The operationalization of indicators is used to design concrete qualitative indicators adequate for 'measuring' or answering research questions in the information collection and analysis process – the project's intangible characteristics, properties, and abstract concepts.

On the other hand, the analysis is based on inductive logic, and thus 'Grounded Theory' which is based on the development of theories, notions or hypotheses based on the empirical data collected [43,87]. Codes reflect social actions and must be simple and precise [19]. The notion of theoretical sensitivity combines concepts and hypotheses deduced from information gathered (the transcripts or interviews) with others already existing (the scientific literature). The knowledge that the researcher has on the subject along with the properties and attributes of the theme analyzed (energy poverty) interact or dialog in more open and flexible manner than the rigid structure of the conceptual framework [37].

For this purpose, Maxqda qualitative analysis software was used. Taking as reference Tutty et al. [92,99], in the initial information processing phase, the 'document variables' (profiles of the households interviewed), as well as the initial code system based on the script of the interview, and which was progressively updated, were entered [75]. The memos were then incorporated into the paragraphs of transcripts, codes and documents.

The analysis of the results was carried out by applying, firstly, the visual tools [64] specifically the 'code matrix per document', the 'code relationship matrix', the 'code map', and the 'document map'. Maps were also developed both to visualize the relationship of memos with codes and to identify clusters of responses obtained primarily through the logic of 'matrix distances'.

The code map is a graphic representation of the relationship between the codes created in a research project. Coding is the process by which codes are assigned to segments of text, images, or videos.

A first or higher level of codes are based on the research objectives disaggregated into thematic areas. Specifically, these are the subsections in the results section of this paper. The transcripts' paragraphs are selected and associated with the codes (top-down coding). At the same time, new codes (subcodes) are created and assigned to the ideas, concepts or households' situations that were not initially foreseen, with labels representative of their content. This new set of codes are part of a second level in the code structure. Aspects describing each code are identified, becoming part of the next codes' level (bottom-up coding), which allows for a deeper and more precise analysis of the participants' discourses. Each code is assigned a color for better visualization. A first set of maps and tables are created with the codes to identify possible errors or inconsistencies in the coding process. In this case, some options implemented were to recode, change the labels or the name of the codes, reorder them, delete them or create new ones.

In this process, we verified the degree of reliability or co-reliability of the codes. For example, we examined the areas where the transcripts' segments (paragraphs) are related to codes and how they match or don't match to decide on the most accurate solutions (results). Specifically, three analytical strategies are applied: the existence of the code in the document (otherwise, we decide on the relevance), the frequency of the codes in the document (the number of times a code appears in a transcript or interview), and the agreement in the segments expressed as a percentage (the level of correlation between documents for each code).

The result is a 'code system', or hierarchical structure of codes and subcodes. Thus, the code represents in a single label or concept the meaning of a segment of information analyzed and is closely related to the objectives of the research. If two codes coincide in the same paragraph or section of information, then there is co-occurrence. The thickness of the line indicates the number of times two codes are related and colors the groups of tags.

Along with the profile variables of the households interviewed, the evolution of 'financial resources in recent years', 'housing' and 'difficulties in paying the heating bill' and the 'electricity bill' were established as independent variables for each household. The results of these variables were, in turn, analyzed. Finally, most results are represented using grouping charts. With this visual tool we compare household's profiles or sections of the code system to identify similarities and differences between them. Similarly, they are useful to describe patterns in the participant's discourses. Likewise, the analysis is illustrated with italicized verbatims (in exactly the same words as were used originally by the participants).

3. Results

3.1. Living conditions in the home and the conditions of the dwelling

- *Current household needs*

When households are asked spontaneously about their main needs and those of their family, they broadly mention, primarily, more economic income (which is associated with the cost of energy bills), the needs of the dwelling itself (detailed below) and solving the problem of the apartment being too hot. Conversely, they indicate that the greatest satisfaction comes from the help they receive from social services, although later in the interview they will nuance this perception.

Finally, being cold in the home is less relevant than being hot, and inadequate energy and lighting might or might not be a need due to the possibility of receiving support from social services (Fig. 2).

In reply to this same question, when posed with suggested answers (showing a card to the interviewees), they express the difficulties these households have paying the heating bill and, in some households, the electricity bill, and buying clothes or food as well (Table 2).

The precarious budget based on the income of these households makes them highly sensitive to changes in their living conditions. Thus, they mention as problems and concerns situations in which they are obliged to take sick leave from work, the fact of not receiving bonus pay while in unemployment (it is customary to receive 14 payments per year in Spain) or even losing their job, divorces, health problems, having dependent people in the home, or the delay in receiving or no longer having access to pensions and different types of support (retirement, dependency, or others).

HOUSEHOLD WITH A SINGLE MOTHER WITH A JOB, AND RECEIVING THE 'SOCIAL BONUS'
Yes [I have difficulties paying the mortgage] because the little that I earn in wages, it just goes on expenses. Now I'm waiting (for the father of the child) to pay me the alimony, but he never pays it on time, he pays it when he feels like it.

The financial support that a large part of the interviewed households receive from public agencies are varied and aimed at improving issues such as heating (gas, electricity bills), food, family, or others; sometimes, according to the interviewees, this support is insufficient. Sometimes they report having to overcome a feeling of embarrassment to apply for such support.

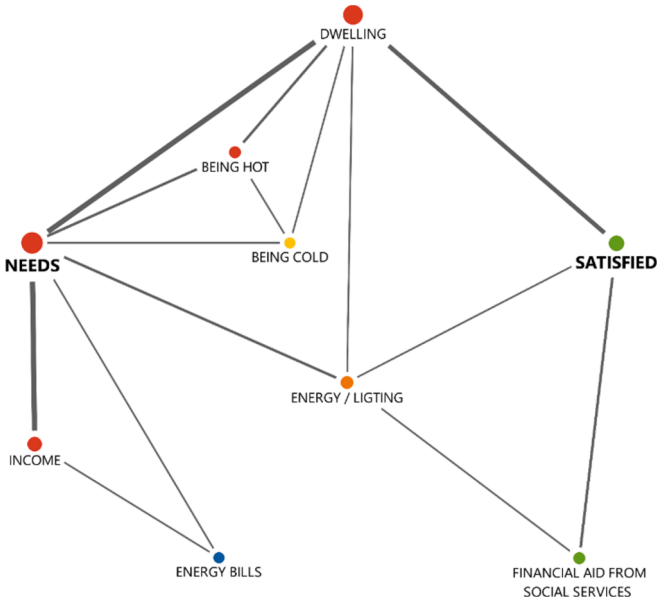

Fig. 2. Grouping chart showing current household needs in terms of their satisfaction or needs regarding energy. Source: Authors.

NEEDS, UNEMPLOYED, RECEIVING THE SOCIAL BONUS OF ELECTRICITY, HOMEOWNER
Last year, finally I had to go to Cáritas (a charity mission organized and run by the Catholic Church) to ask for help, and I wasn't … I wasn't at all ashamed, but it was because I really needed it.

Thereby, they deal with contradictory feelings when their homes are in poor condition, and they may feel ashamed to let other people see their situation, while showing a strong emotional attachment to their home due to the time they have lived in it and the experiences they have lived through there.

These households are often faced with the dilemma of having to decide between keeping the home at a suitable temperature or reducing energy consumption. This dilemma is felt with greater intensity in households with minors, in which other basic needs such as food, clothing or paying the rent are a higher priority.

The 'Social Bonus', which gives entitlement to a discount on the electricity bill, is mentioned when the participants refer to satisfaction with the energy (which includes electricity) in the home.

- *Households' current needs regarding the dwelling itself*

The needs that affect the dwelling are specified as: not having heating or air conditioning, the excess of natural light coming into the lodging (which causes heat in summer, and therefore the need to change the windows or the blinds), insufficient thermal insulation (which affects the cold in winter and heat in summer, especially when there are minors in the home), the age of the dwelling (as they are not energy efficient), or in some cases the need to install doors to separate the spaces (for better internal temperature management in the apartment). Conversely, the satisfaction they have with the home is due, above all, to aspects such as proximity to the workplace or the layout of the spaces inside the dwelling.

Interviewed households mention owning the home as decisive to improving their quality of life in the home since this way they can have greater control over its condition (for example, by carrying out refurbishments or repairs to avoid damp or leaks). In addition, they refer to having social support such as being entitled to the 'Social Bonus' to help with electricity bills. In this case, the dilemma they face by is that of losing entitlement to this type of support when, for example, they get a job, when their financial conditions improve, or when minors reach an age at which they no longer qualify for institutional financial support. However, some households say they have the feeling that the criteria for the granting of these benefits are not applied impartially.

HOUSEHOLD WITH A SINGLE MOTHER, RECEIVING SOCIAL BONUS
So, finally they were going to give it to me [the financial support], but they took it away from me because my daughter was already fourteen years old. So now, every six months it comes to me, the same as it always will come to me, well, one hundred and seventy (a bill for that amount in euros).

For their part, people of immigrant origin highlight the general quality of life in the city as positive compared to that in their country of origin, although they consider not having a family support network to be a problem (this is a situation that also occurs with some local families).

On being asked from a card's list of suggested options, the greatest dissatisfaction with the home is, regarding cold, heat or damp (depending largely on the time of year), along with issues such as leaks, drafts owing to ill-fitting windows, the wear and tear on walls, ceilings and plumbing, or the age of the home. In the opposite sense, the greatest satisfaction with the home is, above all, due to the size or space available, such as the number of bedrooms, the living room, bathroom, kitchen or terraces, as well as furniture, lighting and thermal insulation

Table 2
Aspects with which households frequently have significant economic difficulties.

Aspects with which households frequently have significant financial difficulties.	YES, THEY HAVE DIFFICULTIES	IT DEPENDS	NO DIFFICULTIES	TOTAL	N
Buying food	21.4 %	28.6 %	50.0 %	100.0 %	14
Buying clothes	35.7 %	28.6 %	35.7 %	100.0 %	14
Paying the electricity bills	23.1 %	30.8 %	46.2 %	100.0 %	13
Paying the heating bills	50.0 %	37.5 %	12.5 %	100.0 %	8
Paying the water bills	11.1 %	22.2 %	66.7 %	100.0 %	9
Paying the rent for the dwelling, or the mortgage (where applicable)	10.0 %	20.0 %	70.0 %	100.0 %	10
Specific expenses for other members of the family (children, the elderly)	0.0 %	0.0 %	0.0 %	0.0 %	0
Others	75.0 %	25.0 %	0.0 %	100.0 %	4

Source: Authors.

for those that have it.

A third set of aspects mentioned by the households interviewed have been identified and are more liable to change depending on the family situation at a given time, such as electrical appliances, furniture, beds or wardrobes, or the state of the doors and windows (Table 3).

All participants in this research have in common their concern for the temperature or dampness in the home. However, households that say their family finances have worsened show dissatisfaction with leaks, drafts owing to ill-fitting windows, wear and tear on walls, ceilings and plumbing, or the state of the doors and windows.

Finally, households with people who have significant, or chronic health issues mention their difficulties with spending a higher amount of money on energy bills for heating or electricity, along with their work or leisure and free time (Fig. 3).

Thus, in households where there are people who suffer from significant health issues, participants state that the need is to keep the home warm, and especially so in case of specific pathologies such as mental disorders (stress, dementia, or mental problems in the elderly), respiratory problems (asthma, colds, or others) and high tension.

> HOUSEHOLD WITH A SINGLE MOTHER, RECEIVING THE SOCIAL BONUS
> *INTERVIEWER: Medications?*
> *PARTICIPANT: the day she gets sick I have to depend on a person who comes to be with her for the eight hours that I am working and who takes care of her because, I cannot leave work.*
> *PARTICIPANT: It is a day that I miss, I risk getting fired …*

Those whose financial situation has worsened do not mention higher spending as being a relevant problem, but rather those related to work, their health, their dedication to the family members with health issues, or their available free time.

Households who do have difficulties with these types of expenses point to higher spending on the energy bill, either for heating or electricity. Their main concern is members with health issues' thermal comfort both during the summer and during the winter, affecting them as well in their work and available free time.

3.2. *Household strategies for coping with situations of heat and cold in the home*

- *The orientation of the buildings*

The orientation of the dwelling affects the temperature in different rooms such as the bedrooms or the living room, depending on whether it is morning or afternoon, or the season of the year. Thus, when the heat is excessive, living on the top floor may imply suffering from high temperatures throughout the home, with the thermal comfort of homes at the mercy of the weather.

Window blinds are a highly useful, inexpensive system for alleviating excessive heat. Consequently, they mention the use of the space of the apartment and the habits of the homes may also be conditioned by the fact of having blinds or not and whether they are in good condition.

Overall deterioration of the home, such as damp or deteriorated walls, is an important factor when it is too cold inside, which conditions the use they make of different spaces or rooms, and their perception of coldness.

When the temperature inside the dwelling is too low, these households say they spend less time in the coldest spaces, and sometimes they even go out to the terrace if the sun is shining.

- *Dilemmas and habits regarding use of technology and appliances*

Some households indicate that gas central heating takes a long time to heat the home, so this system is expensive, causing them stress and worry about the bill. Consequently, the technological dilemma faced by households is whether to use individual gas stoves or electric radiators

Table 3
Degree of satisfaction with different aspects of the dwelling.

SATISFACTION WITH THE DWELLING	WELL SATISFIED	IT DEPENDS	NOT SO SATISFIED	NOT SATISFIED	TOTAL	N
The size of the dwelling or space available in it	73.3 %	13.3 %	0.0 %	13.3 %	100.0 %	15
The rooms: living room, bathroom, kitchen, terraces	73.3 %	20.0 %	0.0 %	6.7 %	100.0 %	15
The age of the dwelling	26.7 %	26.7 %	20.0 %	26.7 %	100.0 %	15
The general condition of the dwelling	38.5 %	30.8 %	15.4 %	15.4 %	100.0 %	13
The state of the doors and windows	40.0 %	26.7 %	6.7 %	26.7 %	100.0 %	16
Having problems such as leaks, drafts owing to ill-fitting windows, wear and tear on walls, ceilings and plumbing…	40.0 %	13.3 %	6.7 %	40.0 %	100.0 %	15
Cold, heat or damp in the dwelling (depending on the time of year)	21.4 %	7.1 %	28.6 %	42.9 %	100.0 %	14
Lighting in the dwelling	76.9 %	7.7 %	7.7 %	7.7 %	100.0 %	13
The heating system in the dwelling	46.2 %	7.7 %	23.1 %	23.1 %	100.0 %	13
Thermic insulation in the dwelling	50.0 %	7.1 %	7.1 %	35.7 %	100.0 %	14
Electrical appliances	46.7 %	40.0 %	6.7 %	6.7 %	100.0 %	15
Furniture, beds, wardrobes	53.8 %	38.5 %	7.7 %	0.0 %	100.0 %	13
Others	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0

Source: Authors.

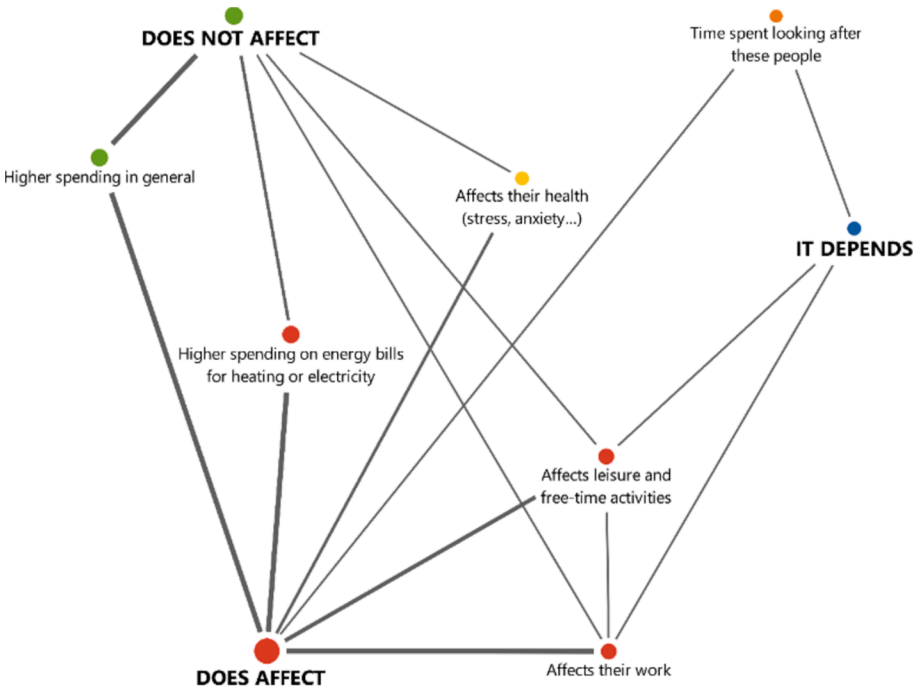

Fig. 3. Grouping chart showing aspects that affect the living conditions of households where there are people with health issues. Source: Authors.

as alternatives to gas heating, which heat only specific spaces in the home in less time and for specific situations. Buying second-hand gas heating is a less expensive alternative.

Once again, the pressure on these households to keep the dwelling at a comfortable temperature is intensified due to the concern of those in which there are members with significant health issues, or minors, especially with children under six years of age. These households have feelings of resignation, helplessness, or fear of getting ill and consequently having to take sick leave [46].

> HOUSEHOLD WITH A SINGLE MOTHER, RECEIVING SOCIAL BONUS
> *Well, let's see. On days when it's really cold, of course, I don't take her out. I'm always afraid she'll get sick, and the day she gets sick, she misses school. And she attending school, for me, is my salvation.*

When temperatures are too high in the home during the hot months, household members suffer from them both during the day and at night, unlike the cold during the winter months that is felt mainly at night. In this case, the technological dilemma concerns the electrical systems: having to choose or alternate between using the air conditioning or fans to cope with the excess temperatures in the apartment during the summer months.

Air conditioning is used only on certain occasions, whereas fans are perceived as lower energy consumption appliances and more adaptable for cooling specific spaces in the home. These are especially used with dependent people and with minors, although they might be insufficient. This permanent search for alternatives can result in feelings of anxiety due to their inefficiency.

- *Habits and customs for coping with excessive cold or heat in the dwelling*

To alleviate low temperatures, households spontaneously mention habits such as: closing bedroom or living room doors, covering themselves with blankets, or using hot water bottles. Other behaviors are: they go to bed early at night, try not to be at home a lot (spending more time in heated places such as libraries, for example), or turn on the heat only at certain times and for a limited time.

As for when the temperatures inside the apartment are too high, they mention several habits for coping, among them sleeping on the floor, going to the second residence (in the village they are originally from) or staying in a relative's home when the heat becomes unbearable. Also indicated as household habits are showering often to cool off, spending more time in the cooler (or less hot) areas of the dwelling, or opening the windows at night (which can lead to mosquitoes coming in, as well as being a risk for security and privacy). They also mention the possibility of using the fan or air conditioning. Some households have greater difficulty coping with high temperatures in the home than they do low temperatures.

On being asked in this section by means of a list of options what the term 'unsuitable temperature' in the dwelling suggests, it is relevant that households automatically take this to mean low temperatures. Thus, they indicate that they put on several layers of clothing or go to bed early at night (which is complemented by using hot water bottles or putting on extra blankets), they turn the heating on or off to raise or lower the temperature of the dwelling when they consider it necessary (at certain times of the day or night, or only in the afternoon when people are in the apartment and awake, or when they are sleeping, or for a limited time).

Likewise, to combat the cold, older people put on several layers of clothing, an action that is one of a set of routines during winter. In situations like this, people may have feelings of stress, discomfort, shame or resignation, although these feelings may be different depending on the person.

On the other hand, they think that using portable heaters or thermostats to combat the cold is not of great use and are concerned about their possible risks (especially gas), their cost and their high-energy consumption. Doubts about the effectiveness of thermostats are evident both for heating the dwelling and saving energy.

A set of coping strategies has also been identified on which there is no single opinion, such as making moderate use of heating according to the season of the year (winter, summer…), turning on the heating in one room of the apartment only (the living room, bedrooms…), or sitting next to the radiator (Fig. 4).

- *Temperature in the dwelling, people with severe health issues and minors*

Temperature and lighting are especially relevant aspects of the

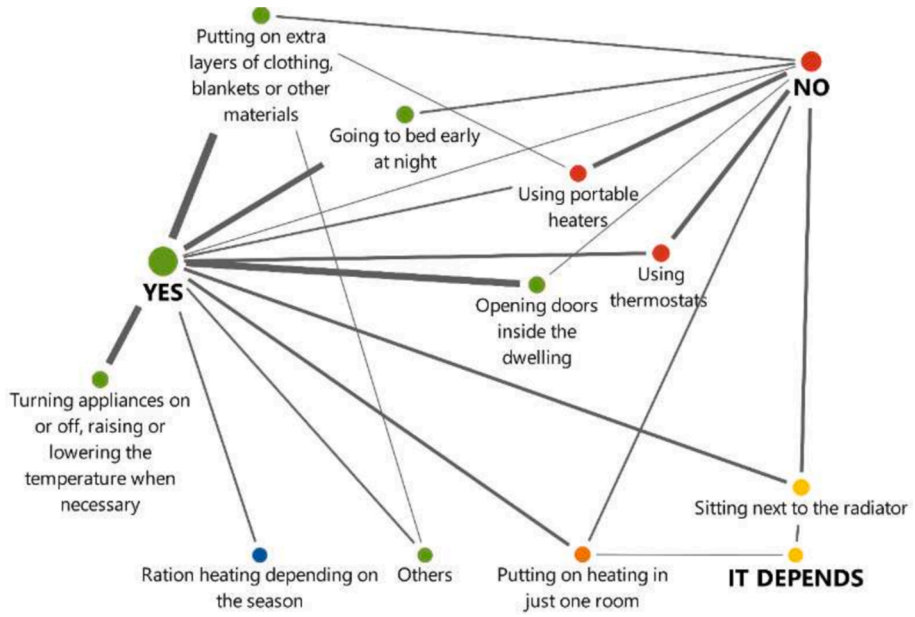

Fig. 4. Grouping chart showing coping strategies households adopt when temperatures in the dwelling are not adequate or comfortable. Source: Authors.

dwelling when there are members of the household with severe or chronic health problems due to the long periods they spend at home.

The spontaneous responses of participants to this question indicate that excess heat is better tolerated than cold and, regarding temperature, having people with health problems does not concern them as much as having minors in the home throughout the day.

HOUSEHOLD WITH SINGLE MOTHER IN A SMALL (60 m^2) RENTED DWELLING.
Sometimes I have to go to my sister's house. Last year I was pregnant, I had to go to my sister's house because I couldn't bear the heat. Besides that, I had blackouts and everything because of the temperature.

Some of those who take medication mention that people who spend most of the day at home may stop noticing the heat, even if they suffer from its effects, sometimes due to the medications they take.

Similarly, when cold in the home is excessive, the use of technologies or appliances is common both during the day and at night to take care of those in the home with health problems or minors.

HOUSEHOLD WITH WORKERS ON LOW WAGES, OWNER-OCCUPIERS, WITH MINORS, IN A SMALL (60 m^2) DWELLING
The terrible cold, the winter is just terrible. I have been here with blankets and hot water bottles and with my newborn son, with an electric radiator set at twenty-five degrees…. But hey, I was not going to leave the newborn in that situation. And that's how we lived until he was six months old.

From a list of suggested answers showing (on a card issued to interviewees), the participants say that the state of health of these people can condition their consumption habits regarding use of lighting and heating in the spaces of the dwelling. In addition, they mention their difficulty enjoying leisure and free time, as well as the importance of having sufficient support from social services.

Otherwise, they do not consider it relevant that the current heating or lighting conditions in the home are insufficient, that keeping the dwelling at a suitable or comfortable temperature or well-lit is more important than other household needs, as well as maintain the family budget balanced (Fig. 5).

3.3. The economic cost of the energy bills and the risk of being disconnected

- *Energy bills*

The most widespread opinion among the households of vulnerable origin interviewed is that the cost of the energy supply is excessively high (this is the opinion of 11 of the 15 interviewed). Frequently, when talking about the 'Social Bonus', aimed at subsidizing part of these costs, they state that it is not enough, especially when the dwelling is energy inefficient or overly spacious.

The idea that the cost of energy supply is balanced is perceived mainly among those households that receive public support to pay their

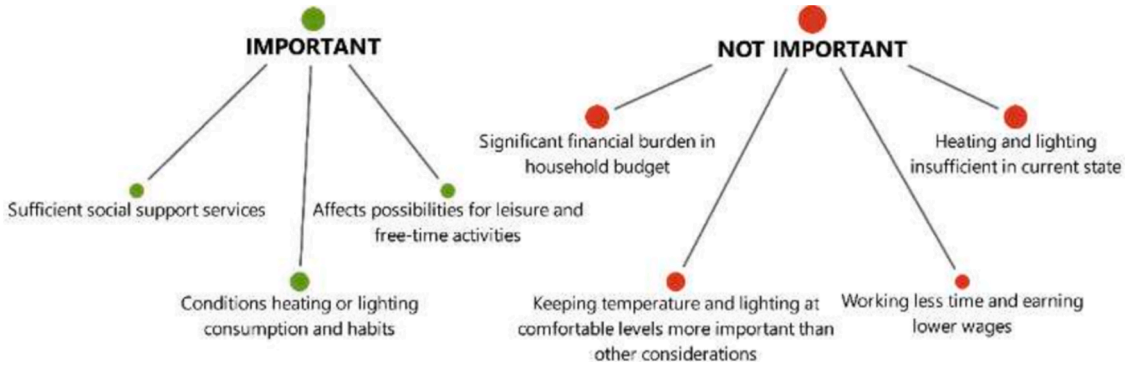

Fig. 5. Grouping chart showing the consequences of serious or chronic health issues on the households' quality of life. Source: Authors.

electricity bills, or that only have an electrical system (and not gas) installed in the home.

Thus, the participants mention ignorance or lack of understanding of the information contained in bills (those who do understand energy bills have made an additional effort to read them or find out what the details mean), the cost due to high taxes (compared to what the actual level of consumption is), bills being delivered with inconsistent frequency, or the negative image they have of the energy companies (which, they say, mislead or deceive customers) (Fig. 6).

In addition, there is the widespread view that energy prices, both for heating and electricity, are rising disproportionately. Few actually read the bill in detail, and feelings of bewilderment, helplessness, stress, anxiety and worry are common to households in their continuous struggle to curb these types of household expenses, which are a very important part of the family budget as a whole.

- *Power supply cut: being disconnected*

For households that have their energy supply cut off for lack of payment, this is a distressing experience, one that causes anguish and affects them emotionally. This is especially true when there are minors in the household, who do not understand what is happening (why, for example, they have to use candles to light the apartment). Hygiene habits (such as having a bath or showering) are also affected, although they are not a significant problem for some households.

From a list of suggested options, they report, above all, not being able to keep the apartment at a comfortable temperature (whether it is hot or cold), washing clothes and keeping up hygiene habits such as washing or showering (although these are not so much of a problem compared to the others for some households, as was indicated previously from the spontaneous responses obtained) as the main consequences of being with power disconnection. These are followed in importance by not being able to cook or keep food fresh in the refrigerator (Fig. 7).

Some households that have been cut off say that it occurred shortly after receiving the disconnection notification from the energy provider, while most of them did not reach an agreement with the company, nor did they get financial help from social services, family, friends, or banks (by means of a loan) to pay the bill. At the same time, the responses are spread between the service being restored shortly after the disconnection, receiving a penalty surcharge or fine (Table 4).

Having the power supply cut off can lead to family conflicts, and they mention that sometimes they ask family members for help paying energy

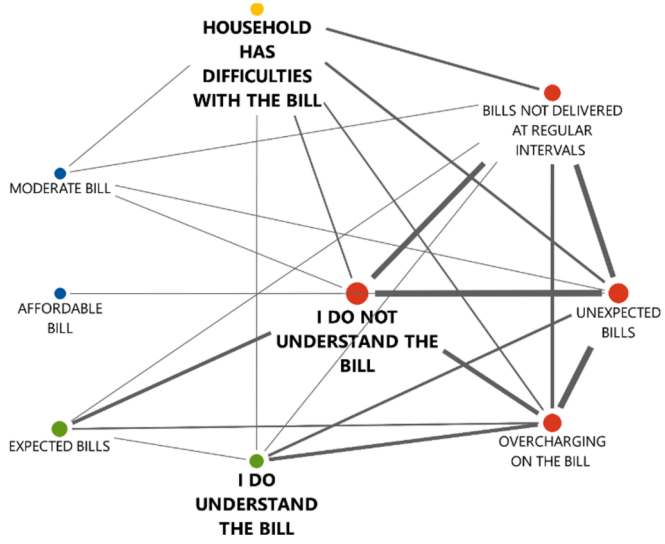

Fig. 6. Grouping chart showing opinions about rising energy prices, expected amounts and understanding the bills. Source: Authors.

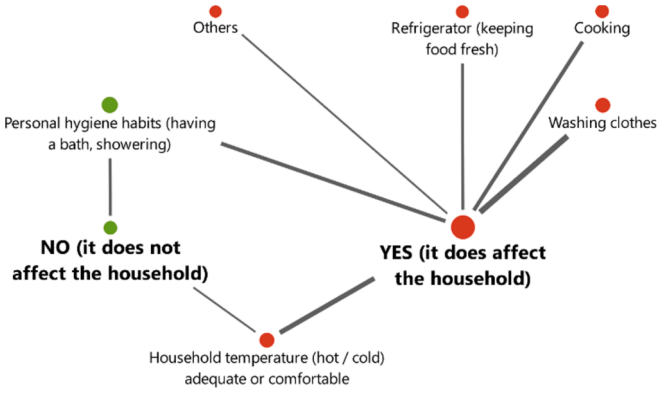

Fig. 7. Grouping chart showing aspects that affect households when the energy supply for heating or electricity is cut off. Source: Authors.

Table 4
Situation of households when having the energy supply for heating or electricity cut off.

SITUATIONS RELATING TO CUTS IN SUPPLY	YES	IT DEPENDS	NO	TOTAL	N
Supply is cut off shortly after notification of disconnection	100.0 %	0.0 %	0.0 %	100.0 %	2
Service is restored shortly after disconnection.	50.0 %	0.0 %	50.0 %	100.0 %	6
Agreement reached with provider	25.0 %	0.0 %	75.0 %	100.0 %	4
Penalty / fine	33.3 %	16.7 %	50.0 %	100.0 %	6
Received financial help to pay the bill (from social services, family or friends, bank loan…)	33.3 %	0.0 %	66.7 %	100.0 %	6
Settled debt promptly	100.0 %	0.0 %	0.0 %	100.0 %	1
Deferred payment of bills	0.0 %	0.0 %	0.0 %	0.0 %	0
Reorganize the household budget	0.0 %	0.0 %	0.0 %	0.0 %	0
Difficulties keeping dwelling at an adequate or comfortable temperature, or keeping it lit	0.0 %	0.0 %	100.0 %	100.0 %	1
Others	100.0 %	0.0 %	0.0 %	100.0 %	1

Source: Authors.

bills so as to be able to carry out basic tasks such as those relating to hygiene, laundry, or cooking. Likewise, they report that this situation prevents household appliances used for people with health issues (respirators, for example) being connected, a situation that is more complex for households when temperatures outside are low.

> HOUSEHOLD WITH OWNER-OCCUPIERS, PENSIONERS AND MINORS, NOT RECEIVING THE SOCIAL BONUS
> *A respirator or something, mind you, because my mother spent many years on the respirator. Now they cut you off, sometimes so … I think they should have given us a chance, not [cut us off] that suddenly…*

Power supply companies come in for criticism primarily because of the bureaucratic complexity involved in getting the service back and the excessive time it takes. Moreover, households feel they do not get enough support from social services, for example, to pay off outstanding

debt on bills. Feelings about being cut off cause anger, rage, and shame.

In this sense, vulnerable households may be less aware of their right to be supported by public administrations in situations such as these.

- *Changing energy service companies*

Most of the households consulted in this research indicate that on some occasion they have changed their energy service companies for gas or electricity, encouraged by a better contract. However, the idea that there are no differences between one company and another is widespread.

Thus, from a list of suggested options, in addition to mentioning the lack of clarity in the rates offered by companies, changing from one to another is a difficult decision since they do not have all the necessary information, which generates skepticism and mistrust (as they also feel that providers mislead and deceive customers).

In opposition to this, they say that the companies that they may wish to move to on a new contract newly do not usually put obstacles or difficulties in their way. Also, in some homes they report that they do not feel they are prepared to handle these situations (Fig. 8).

Households that are entitled to the 'Social Bonus' show more reluctance to change providers due to the strict requirements to qualify for this bonus.

3.4. Strategies for saving energy in the home

- *Household measures for saving energy*

To save on energy bills for heating or electricity, households, on being asked spontaneously, mention a wide range of actions they carry out, such as: turning the heating on or off at specific times of the day or night; using thermostats; using the dishwasher moderately or doing the dishes on a short program, using the washing machine at off-peak times (sometimes with resulting bad smells from clothes left in the machine overnight), using it less frequently or filling it to the maximum possible (on a short cycle so the clothes do not fade); using the tv when it is on as the only lighting in the room, turning off lights when they are not needed (they report that it is difficult to adopt this habit), buying low-consumption light bulbs; using less hot water for the bath, or reusing this water for the toilet, and heating the water for the bath in the kitchen stove.

On measures aimed at saving energy in the home, from a list of suggested options, they point out that the most effective action is to do small repairs in the home (windows or doors, sealing, covering them with curtains, blinds…). Other measures that they report as having a certain degree of effectiveness on energy saving are: controlling the time the minors spend on game consoles or computers, looking for special or second-hand offers, or readjusting the family budget to keep energy consumption at a comfort level.

Conversely, measures such as washing clothes at friends or relatives dwelling, as well as repairing furniture or household appliances, are not considered an option, although the latter is considered a good one for some.

What most divides the opinions of the participants, in terms of their perception of their degree of effectiveness, are actions such as asking friends or acquaintances for used furniture or appliances, as well as reducing energy savings on certain occasions (such as when having relatives or friends to visit, or other social events) (Fig. 9).

- *Reducing electricity consumption for lighting in the home*

On being asked, from a list of suggested options, the set of measures that households consider most effective for saving on electricity consumption for lighting the home are the following: turning off the lights when they leave a room (a habit that they are trying to get children to adopt, and that is complemented by opening the windows on clear nights in summer time), lighting only one room, which in turn helps light adjacent rooms, making small investments (buying fluorescent lamps, efficient light bulbs), using only some lighting sources (that are not considered necessary during the day, resorting to these in any case for specific spaces such as the kitchen or the living room). Nevertheless, they admitted to not being careful about energy consumption on specific social occasions (such as when friends or relatives come to visit).

Small or low-watt light bulbs are preferred only for reading or decorating the home, with no preference for white, warm, or neutral light. Thus, reducing the lighting in the home is done in any case to give the home atmosphere, since, for example, it is argued, it can especially affect people who have problems with their eyesight. While lighting only some areas of the home is something they only consider doing at night, it is thought that it may be risky for, for example, older people who get up frequently. Small investments in lighting are, in any case, reported as being made in the kitchen or living room.

They also point to the ineffectiveness of habits such as using candles (they are believed to be dangerous, above all when there are minors in the home) or having the television on to light the rest of the space (for example, as a complement to a smaller light, when the person is alone, turning it to get better lighting, and not using it for reading) (Fig. 10).

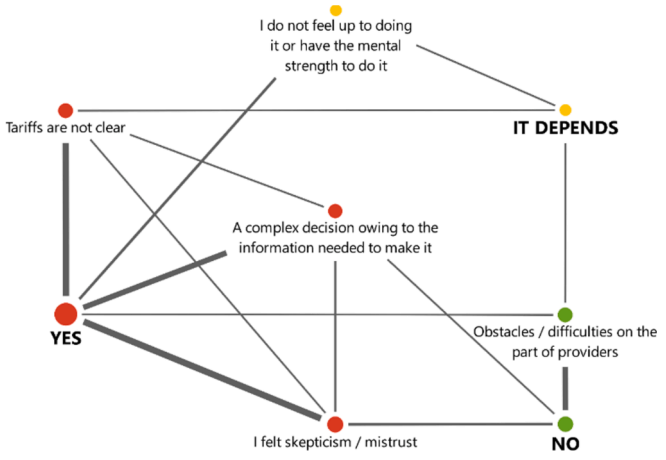

Fig. 8. Grouping chart of households' motivations for changing, or attempting to change, energy service providers. Source: Authors.

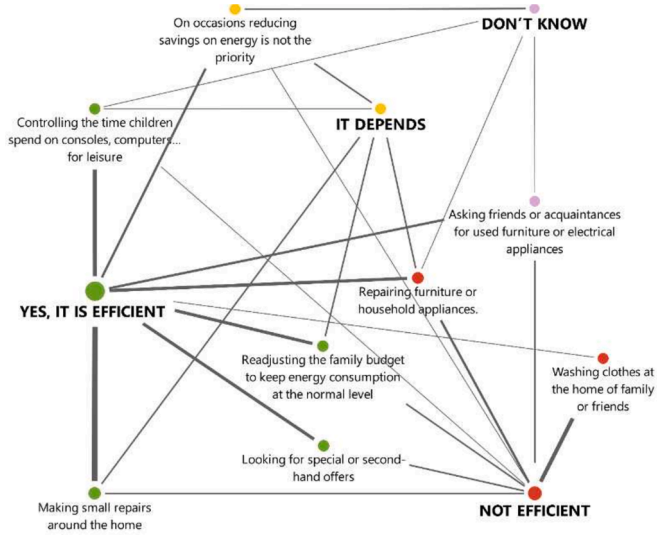

Fig. 9. Grouping chart showing estimates and specific measures taken by households to save on energy consumption for heating or electricity. Source: Authors.

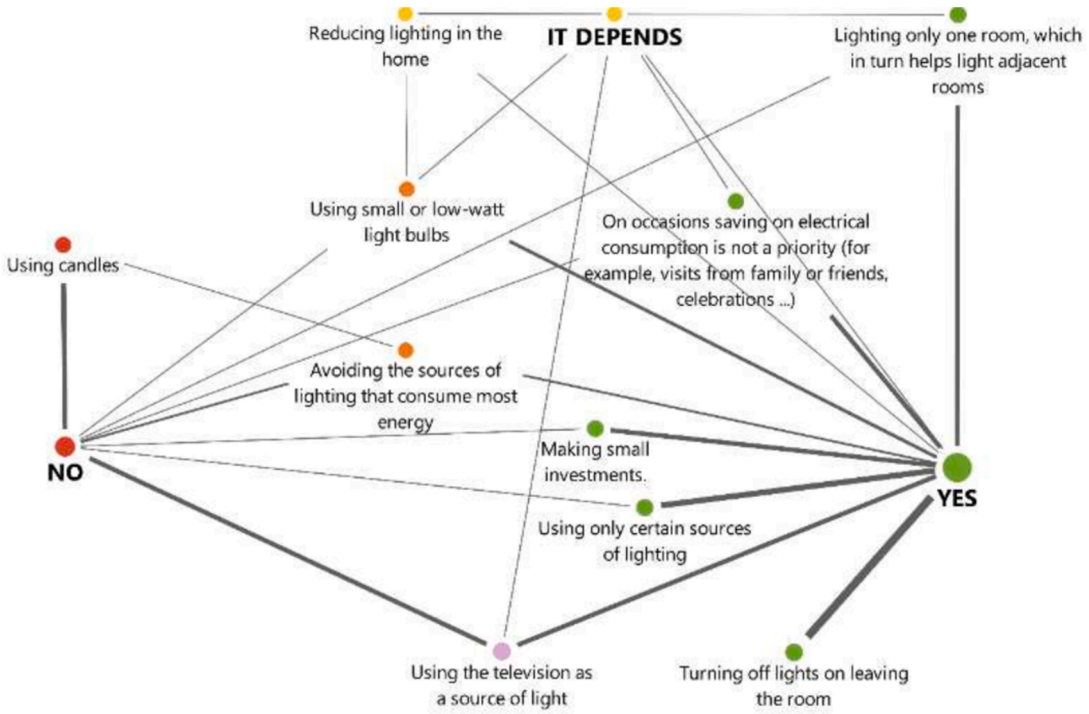

Fig. 10. Grouping chart showing household measures to reduce electricity consumption for lighting the home. Source: Authors.

- *Moving house*

Although most of the households interviewed say they have not considered moving to another dwelling to save on energy costs for heating or electricity, a group of five participants did consider it. They argue that the poor condition of the apartment and the building (mentioning, for example, the cold draft that comes in through the windows) and how it particularly affects minors, either because they do not have central heating, or prefer to have mains gas installed because it is cheaper. Despite this, other studies conclude that households may not have a clear position regarding the suitability of central heating systems and so they complement it with other appliances.

The possible desire to move to another apartment is conditioned by a feeling of having put down roots in the current home after many years of living there, as well as by their difficulties to obtain a mortgage. Also, high prices in the housing market and the low quality of second-hand dwellings are barriers to change. Considering public social housing as an option, but not necessarily the best alternative due to possible social housing providers' reluctancies to install renewable energy equipment. These households might think twice about moving if it implies an increase in energy bills, thus preferring smaller houses, but with more thermal comfort.

When this question was posed with a list of suggested answers, the above results were partially confirmed. Thus, households report as the main criteria for moving is the size, whether it has thermal insulation, the price, or its location in the city (the neighborhood it is in). On the contrary, having electrical appliances is not a relevant issue.

The perception is more ambiguous when it comes to public social housing, or other aspects such as whether the building is old but the dwelling itself is in good condition, or the condition of the doors,

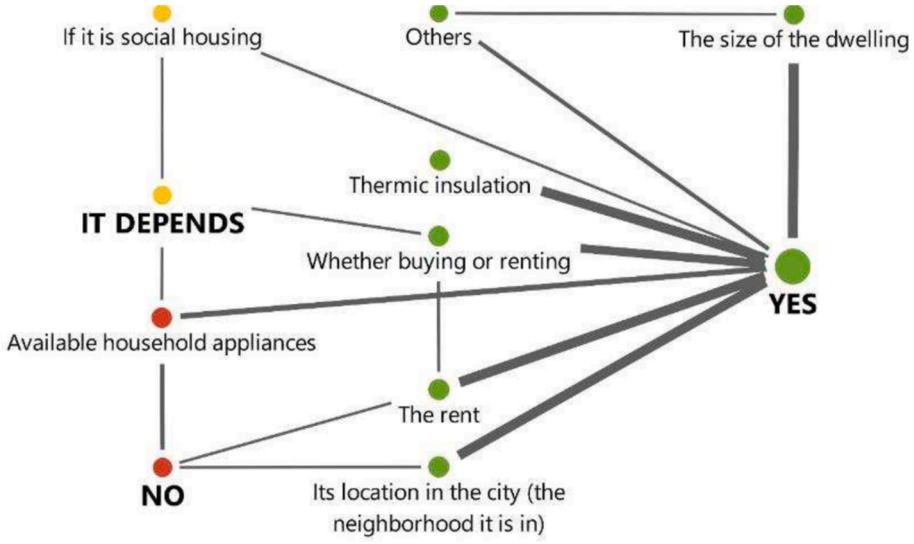

Fig. 11. Grouping chart showing criteria that condition the decision to move to another house. Source: Authors.

windows and the way the space is laid out (Fig. 11).

4. Discussion

The results of this study contribute to a greater knowledge of the daily practices of households to meet their needs for thermal comfort inside the home, a topic that has scarcely been examined [1], particularly of vulnerable dwellings [23,47,77]. Also, it highlights the importance of qualitative research to deepen the knowledge of invisible energy poverty, which is more difficult to identify with quantitative analysis techniques [73]. The contributions of this study to the existing literature on energy poverty are described in more detail in specific sections below.

4.1. Dilemmas using appliances or technologies

Vulnerable households face the continuous dilemma of having to choose between keeping the apartment at a comfortable temperature or reducing other household expenses, such as food, clothing, or paying the rent. This conclusion is supported by Grey et al. [39] and Stojilovska et al. [86]. Nonetheless, the difference with our research is that the former uses focus groups and does not differentiate the diversity of households' profiles, and the later does not consider the excess of heat during the summer (as we do in this study).

Likewise, these households experience negative feelings having to set a hierarchy of basic needs to implement budget constraints, and resignation given that these homes consider energy prices to be excessive, results also reported by Chard & Walker [18] and Snell et al. [84].

In their day-to-day lives, when using appliances or technologies to cope with the excess of cold in winter or heat in summer in the home, they must constantly make complex and difficult decisions, and sometimes with a high emotional cost due to their concern with the possible increase of energy bills. Previous studies by Drury et al. [25], Eon et al. [27,28], and Xu et al. [101] reach similar finding.

In line with KC et al. [49], Littlewood & Smallwood [54], Stojilovska et al. [86], Xu et al. [101] and Zapata-Webborn et al. [102], the inefficient use of devices such as fans brings unease, skepticism when using thermostats, or when putting on clothes to stay warm.

These households face similar experiences with the heat. Specifically, as also stressed by Chard & Walker [18], Giamalaki & Kolokotsa [35] and Stojilovska et al. [86], older people tend to spend more time at home than age groups, looking for ways of coping with uncomfortably low temperatures in the apartment. Heating on or off to raise or lower the temperature of the dwelling when they consider it necessary, at certain times of the day or night, or only in the afternoon when the family members are in the apartment, at night when they are sleeping, or for a limited time, is part of the daily habits. Previously these conclusions have been reported by Anderson et al. [2] and Chard & Walker [18].

Other studies conclude that options to accomplish thermal comfort in the home such as central heating systems are not necessarily positively valued by households as more efficient Shipworth et al. [81], and so they complement it with other appliances [18].

4.2. Thermal comfort and household members with special needs

These dilemmas are more evident when there are minors, elderly people, single mothers or family members with significant health issues living in the home who are usually in need of greater climate comfort and entail higher care costs for their members. These results are in line with finding by Giamalaki & Kolokotsa [35], but only in the case of elderly people.

As reported in this research, other studies also conclude that these families are also worried about the importance of lighting for ill members who might spend much time in the apartment [56,74]. Additionally, other studies showed that energy expenses due to the needs of people with disabilities further stress the household's budget [65,96]. Negative feelings of guilt also appear when they get sick and must be absent from work, a result previously confirmed by Hitchings & Day [46].

In line with Brunner et al. [12] and Cao et al. [15], minors also put more pressure on the family to keep the home at an adequate temperature, also concerned about limiting the youths' use of technologies for leisure [63].

4.3. The home features, building orientation and habits, customs, and lifestyles

In this paper it has been described how habits, customs, and lifestyles of households' members are conditioned by energy poverty, the use they make of the living space as well as their time management in the home – not being able to spend all the time they would need in specific rooms or at certain moments of the day. This research highlights how this aspect is closely related to how the apartment (and the building) is oriented, imposing restrictions on vulnerable households on the use of the home's space, its different rooms, by trying to keep fresh in the summer or warm in the winter. The orientation affects the temperature in different rooms, such as the bedrooms or the living room, depending on whether it is morning or afternoon, or the season of the year. When the heat is excessive, living on the top floor (with roofs without thermal insulation) may imply suffering from high temperatures throughout the home, with the thermal comfort of homes at the mercy of the weather. These findings support the conclusions of Drury et al. [25] and Petrou et al. [68].

In that sense, other studies also corroborate that having more space in the dwelling (such as an additional room) might be key for these vulnerable households' quality of life, as well as owing the home to make small repairs freely to maintain thermal comfort [12,63,67].

As stressed by Fabbri [31], the energy performance of buildings is a determinant of the households' energy consumption patterns. But, in the case of the alternative of social housing for vulnerable households, some studies have highlighted possible reluctancies of social housing providers to install renewable energy equipment [12,22]. However, others conclude that some vulnerable households would give up on having a bigger home by moving to social housing to get greater energy efficiency and lower rent [63].

4.4. Trust in public institutions and social bonus

In line with findings by Brunner et al. [12] and Middlemiss & Gillard [63], these vulnerable households may be reluctant to acknowledge that they suffer from significant economic scarcity. Similarly, other studies indicate that people with low financial resources feel stigmatized [40,86].

Further, vulnerable households distrust public institutions and energy companies. For example, Stojilovska et al. [86] register feeling such as the lack of impartiality of public administrations when allocating public aid (e.g. social bonus), or the opinion that greater financial support is needed due to the budgetary constraints of these families. This finding is further stressed in this research as well as by Barrella et al. [5] when the building needs of thermal insulation.

In addition, these households may be less aware of their right to be supported by public administrations, as reported by Walker & Day [96]. Consequently, their attitudes towards energy poverty play a determining role, along with their social support network and support from public institutions for coping with energy bills or other basic expenses. Other studies highlight the importance of having family support networks, especially among households of immigrant origin [62].

In that sense, power supply cut-off is a frequent and dramatic situation faced by these households. Though they might prefer the restoration of the service in a short time, it can lead to household debt, a dilemma has also stated by Gibbons & Singler [36] and [44].

5. Conclusions

One of the most important measures for combatting energy poverty in Spain is the social bonus (a subsidized electricity bill discount). However, only 20 % of households who are entitled to receive it (1.45 million family units) actually do so. In addition, low-income households, households of foreign origin, single-parent households or those who live in rented accommodation are less likely to receive this discount. On the other hand, large families (many of them with medium or high incomes) are more likely to benefit from this measure.

The main objective of this research is to identify the dilemmas faced by vulnerable households on a day-to-day basis and the social practices they develop to cope with thermal discomfort in the home – excess cold or heat – in Spain, and specifically in Zaragoza.

Energy poverty is a complex and multifaceted social problem involving multiple factors. Identifying invisible energy poverty in vulnerable households is particularly relevant. This study highlighted the robustness of the holistic conceptual framework to identify the meaning given to energy poverty by vulnerable households (from the bottom up, in the first person) when they interact with the three analytical dimensions of the model: the socio-technical, the socio-spatial and the socio-temporal dimensions. This approach includes analysis of external influences; that is, the experiences of these vulnerable households in their interaction with different social actors (including public institutions and energy companies).

On the one hand, this paper calls attention to the need to develop more research on thermal discomfort and the subjective perception of those who suffer from it, as well as to incorporate new indicators for its identification. Specifically, we refer to qualitative indicators that, for example, enable a better understanding of households' behaviors and attitudes in relation to invisible energy poverty. On the other hand, this study contributes to making energy poverty visible as a form of poverty, as a public issue (instead of a private one specific to the home and family life) and transversal to society, and especially vulnerable households.

Households facing poverty and social exclusion tend to suffer from greater energy inefficiency due to a deficit in the thermal insulation of homes and buildings, problems of substandard housing and unhealthiness, and the use of inefficient installations and appliances. In fact, the strategies used by these households to adapt to cold and heat raise questions about what constitute acceptable living conditions. Consequently, public institutions must promote public awareness of the importance of energy rehabilitation of buildings, and social programs addressing economic poverty as well as energy bills.

Although the limited number of interviews may be a drawback for reaching general conclusions, the exploratory results can generate wider learning and deeper understanding of the lived experience of fuel poverty in addition to hypotheses for future research. Thus, they can lead to greater insights into similar geographical and social contexts.

CRediT authorship contribution statement

Iván López: Methodology, Investigation. **José Ignacio García-Valdecasas:** Validation, Supervision. **Cristina Monge Lasierra:** Resources, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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