








## Research Article

# Co-Creating a Nature-Based Social Prescription Intervention in Urban Socioeconomically Deprived Neighbourhoods: A Case Study from RECETAS Project in Barcelona, Spain

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Active citizen participation in research is important to generate societal impact of outcomes. Even so, many times, the community input in these processes is limited or non-existent, and co-creation processes are often not documented. This paper describes a structured and systematised protocol to co-create a nature-based social prescribing intervention addressed to face loneliness in urban deprived neighbourhoods. As a result, a nature-based social prescription menu was co-developed with stakeholders from health, social prescription, nature, associative, and research sectors. The menu consists of open spaces and nature activities and will be offered to the participants of a randomised controlled trial to test actions for social prescribing in natural spaces.

## 1. Background

Loneliness is a growing public health concern and has been associated with morbidity and mortality [1]. Among other strategies, social prescribing (SP) has shown to be a useful tool to address this phenomenon from a salutogenic perspective [2]. It provides physicians, nurses, social workers, and other licensed professionals with non-medical referral options that work with existing treatments to support social connection and therefore mental well-being, health behaviours, and physical health [3]. Particularly, nature-based social prescribing (NBSP) consists of care professionals and people who experience loneliness identifying activities related to nature that can improve their health and well-being. This innovative approach can be a therapeutic pathway and can improve the overall quality of life of urban

citizens [4]. SP interventions have the ability to encourage inter-sectoral action, which is a relevant element in addressing inequalities resulting from socioeconomic deprivation [5]. In addition to institutions and administrations, involving citizens in the various steps of public health interventions, for example, such as via priority setting, design, implementation, evaluation, dissemination, and decision making, has been a topic of growing interest in academic literature [6–8]. Co-productive and co-design approaches within health challenges the current model of patient healthcare challenge the prevailing model of patient care, which perceives patients as passive users, by considering their views as equal to those of professionals. Therefore, those are approaches that can transform health service into patient-centered benefits.

Among others, barriers and facilitators for the implementation of SP have been related to engagement,

relationships, and communication between partners and stakeholders [9]. SP strategies need to consider user perceptions of facilitators and barriers to adapt interventions to the specific context, as each community possesses unique socioeconomic and environmental characteristics that influence their well-being. Ideally, this should be identified through a participatory process. However, there is a low proportion of studies proposing a co-produced or co-designed approach to the development of an SP intervention aimed at improving well-being within a community setting [10]. Furthermore, although the inclusion of nature as a health asset is gaining value in recent times, with several published evaluations of nature-based prescriptions, research on evaluating nature-based interventions and social connection is limited [3]. In this regard, and to the best of our knowledge, there have been no approaches to the co-creation of NBSP interventions thus far that could take into account the additional challenges that this type of intervention may pose in specific contexts, as access to green and blue spaces is limited for people living in the most socioeconomic disadvantaged urban areas [11, 12]. Hence, there is a need for a co-creation approach to identify nature-based solutions to address loneliness, as well as the development of a systematised and structured protocol to streamline and optimize the process in different contexts.

The co-creation process presented in this paper is part of an ongoing Horizon 2020 European Commission funded project: RECETAS (Re-imagining Environments for Connection and Engagement: Testing Actions for Social Prescribing in Natural Spaces), that aimed to test and evaluate NBSP across Europe, Latin America, and Australia [4]. It integrates a pilot participatory approach in Les Roquetes neighbourhood (Barcelona, Spain) to co-create a nature-based social intervention to address loneliness. Roquetes is a neighbourhood included in the Nou Barris district of Barcelona and located on the slopes of the Collserola mountain range, in the northern side of the city. In terms of socioeconomic context, Roquetes is known to be a working-class neighbourhood, with lower-income residents and a relatively high population density. Historically, it was a rural area outside the city of Barcelona until the mid-20th century. The increasing number of immigrants from southern Spain searching for better economic opportunities led to a rapid urbanization and expansion of Roquetes. Traditionally, the neighbourhood has faced socioeconomic challenges, including higher unemployment rates compared to other areas of Barcelona and issues related to social inequality, although efforts have been made to improve the situation through urban regeneration projects and social programs. Consequently, the neighbourhood has experienced some urban development and revitalization efforts over the years, including improvements to public spaces, transportations, and infrastructure. In recent years, there have been initiatives to develop community centers, cultural activities, and educational programs aimed at empowering residents and promoting social integration. Nevertheless, Les Roquetes has a strong sense of community, with active neighbourhood associations and organisations working to address the needs of its residents. These groups collaborate

with local authorities and health and social services to advocate for improvements and provide support to vulnerable individuals and families [13].

RECETAS convened and facilitated citizen-based work processes to develop the menu of activities that the study participants will undergo in the intervention by combining techniques traditionally used in social sciences for qualitative analysis with others more oriented to moments of dynamization and participation [14]. The co-creation process has been informed by a previous social network analysis piece, based on a survey which was answered by cross-sectoral professionals in the Barcelona province to understand NBSP practices, nature-based solutions (NBS), and related policies in the area. We have held working sessions to promote plural engagement and shared learning about how people experience and express loneliness, how they manage it, use of the outdoors and preferences for specific design elements, and opportunities and barriers to engaging with others and engaging in nature-based settings. This process involved multiple stakeholders and community members, including health professionals, primary care centers, nature-based activity groups, civil organisations, and local citizens in the initiation and design process of this tool to enhance health through empowerment, to understand how social relations are articulated [15], strengthen social networks and mutual respect, and provide a sense of purpose and meaning [16, 17]. As a result, we co-developed a menu for NBSP, that is, a list of activities, resources, and spaces related to nature that could be used as a public resource to tackle loneliness. Within this paper, we describe a simplified and operative methodology to co-create a NBSP menu, applicable to different contexts, and that will inform the clinical trial in the different target areas within the project. We present the results obtained of each session and activity and the benefits and challenges of the process.

## 2. Methods

This research adopts and adjusts the RECETAS “Protocol for NBSP Menu development” designed by the University of Cuenca [18] as a methodological guide for the study cases of the RECETAS project. This protocol proposes participatory methodologies to co-create a menu of nature activities in natural spaces that could be used as a common asset to tackle loneliness via three levels of participation. It is based on Participatory Action Research (PAR) framework, which is used as an instrument of involvement, decision making, and collective protagonism, which are used as an instrument of involvement, decision making, and collective protagonism [14, 15], and these differ from most other approaches to public health research because they are based on reflection, data collection, and action that aim to involve the people who, in turn, take actions to improve their own health [19]. The protocol includes methodological guidelines and ethical considerations that aim to facilitate the development of the participatory process in a manner that is accessible to diverse participants. It is crucial to ensure that the groups of participants are heterogeneous and guided by intersectionality criteria, which analyse the various inequalities experienced by

the participants in an articulated manner, while avoiding situations of victimization or exclusion. The progressive and reflexive analysis proposed aims to generate knowledge and self-knowledge through collective construction. In the case of participatory workshops, each group engages in debates facilitated by a researcher, who will remind them of the objectives of their work, manage time, and facilitate synthesis. In relation to the information provided and informed consent of the participants, the objectives of the project and the different actions carried out were communicated at each stage through written documents (presentations and documents) during and after the actions, and orally during the actions. Audio or video recording of the participants was authorized through written informed consent. The results obtained from each action and participatory session were shared with the participants after collection, through minutes and summary documents for their validation. Participants voluntarily provided e-mails and contact numbers through a written form, with prior written and oral information provided about the purpose of collecting those data.

The local adaptation of the protocol maintains the proposed phases (diagnosis, participatory diagnosis, and co-creation) and adds a final evaluation step in order to obtain information that allows for improvement of the process when replicated in other territories. The selection of the different tools used was decided throughout the project based on the progressively acquired knowledge of the territory, the reality of the organisations involved, and the previous experience with NBSP. A detailed summary of the steps that have been followed can be seen in Figure 1. These are explained in the adjoining sections.

Therefore, the adjusted protocol consists of four different phases: diagnosis, participatory diagnosis, co-creation of the menu of activities, and evaluation. The three first phases imply a different level of involvement and integrate contributions from quantitative and qualitative approaches, according to the ladder of participation proposed by Arnstein [20]. Firstly, the informative level implies gathering information through tools such as questionnaires or surveys. With a higher degree of involvement there is the consultative level, which gathers citizen opinion and promotes discussion through tools such as interviews or informal discussions. At the fullest level of participation, the engagement level seeks to promote citizen involvement through tools such as co-creation dynamics, among others [20]. The diagnosis combines the informative and consultative levels, the participatory diagnosis was developed fundamentally at the consultative level, and the menu co-creation was developed mainly at the engagement level. An additional evaluation phase was added to the framework in order to assess the process and implement improvements in future steps. A detailed list of phases, aim of each phase, and tools used in each phase are detailed in Table 1.

**2.1. Diagnosis.** The diagnosis phase aimed to know the dimensions and characteristics of loneliness and social isolation in Barcelona; to have an approximation of the problem and those more affected; to survey pre-existing

NBSP experiences; and to identify key actors to be involved in the co-creation process. The date obtained was useful to get a first approach that was adjusted in the subsequent steps in hand with the stakeholders from the specific neighbourhood where the co-creation was developed.

In November 2021, the RECETAS Project partner Visible Network Labs (VNL) invited 131 organisations in Catalonia to participate in a social network analysis of their current organisational partnerships as part of the RECETAS research project. Eighty-one organisations responded to the survey (61.8% response rate), and resulting data were used to better understand how stakeholders in the Barcelona province were addressing mental health, well-being, and loneliness through SP and nature-based (NB) activities [21]. In lockstep, literature review and contact with some other initiatives made it possible to identify relevant additional organisations in line with NBS. With this information, a relational sample—a list of relevant stakeholders for the co-creation process—was created. This list included (1) organisations interested in taking part in the co-creation process and (2) relevant actors in the fields of biodiversity and ecology, engineering, medicine, social work, or public health among others and (3) those stakeholders that had a higher connection rate. Those were involved in different parts of the process according to their expertise.

Next, possible geographic areas of intervention for the case study were screened. The following inclusion criteria were applied: (1) to have fully implemented a SP program, (2) to be actively prescribing at the moment of the study, (3) to have a community plan (CP) or health community coordination strategy, and (4) to be a socioeconomic deprived area, defined either by the ISC (Composite Socioeconomic Index, Catalan acronym) [22]. More information about what a CP is can be found in Table S1.

**2.2. Participative Diagnosis.** The participative diagnosis aimed to socialise and promote the appropriation of the diagnosis results by all participants as well as to consolidate the involvement of the various stakeholders. It also helped to obtain an overview of the context of social prescription and natural spaces and to identify concrete needs and challenges in Barcelona, notably in the neighbourhood of Les Roquetes. The relational sample was screened to constitute the first working group: the monitoring committee (MC). This committee had the role of supervising the co-creation process by attending regular work meetings, discussing the results of the diagnosis, and providing feedback for all the project intervention areas. The MC was mainly shaped with stakeholders that met the agreed criteria specified in methodology and were part of city, provincial, and regional organisations. An official online presentation for the MC was organised, where the overall aim of the project, the different work packages, relevant findings of the diagnosis, and the objectives of the co-creation process were explained. Relevant suggestions and information provided by the MC were contemplated in the workplan.

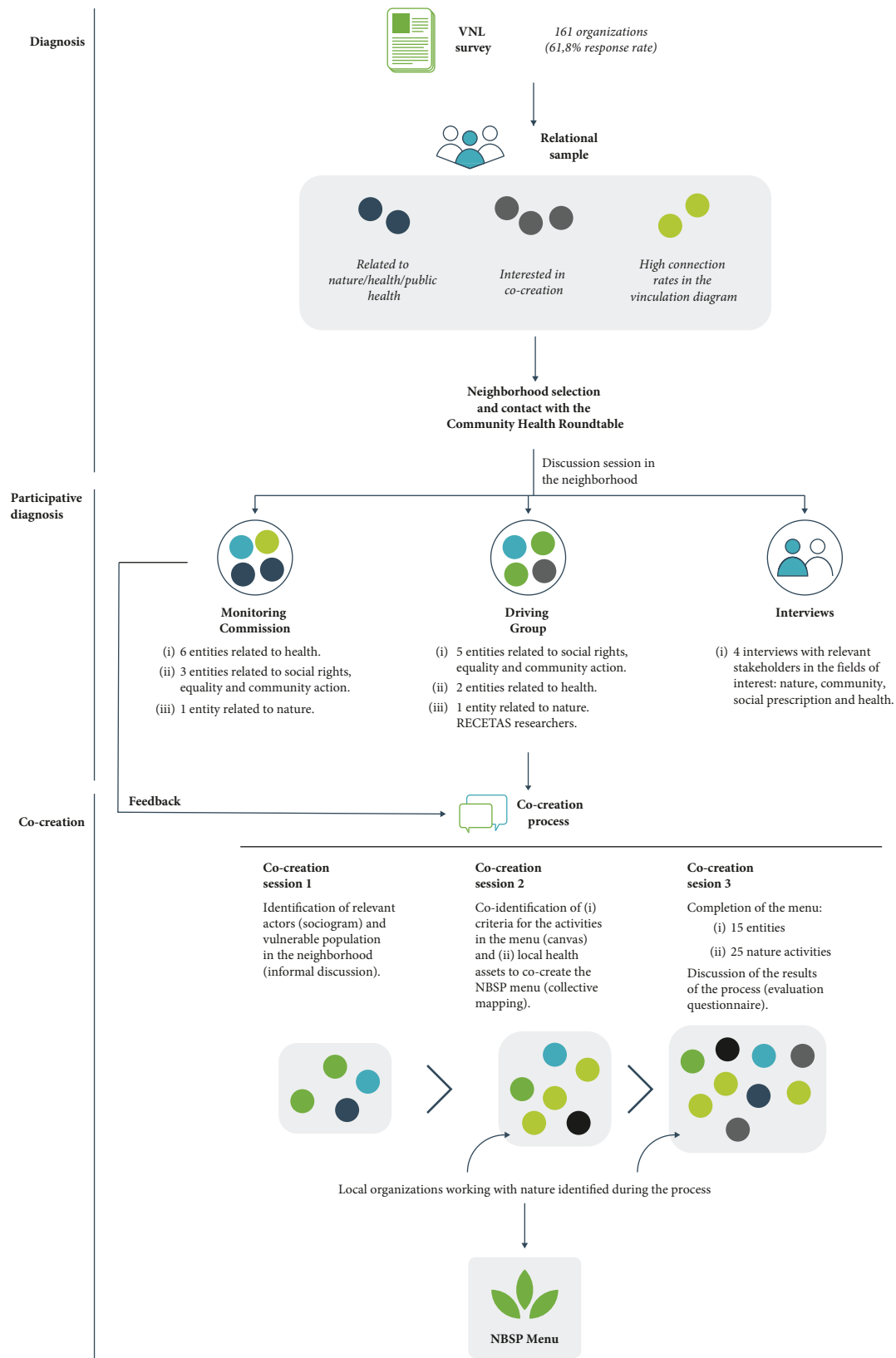


FIGURE 1: Summary of complete process to co-create a NBSP menu.

TABLE 1: Phases, aims, and tools involved in the co-creation process case study in Les Roquetes.

Phase	Aim	Tool
Diagnosis	To create a relational sample To select the area of intervention	Analysis of the VNL online survey and informal discussions Group discussion and online research
Participative diagnosis	To involve the selected area stakeholders in the project To conform the working groups To socialise and deepen the results of the diagnosis and to consolidate the involvement of the various stakeholders	Group discussion Online official presentation and group discussion Interviews
Co-creation of the NBSP menu	To identify vulnerable populations To identify local actors to be involved in the project To identify a list of criteria and indicators for the activities of the menu To co-identify the NBSP activities and areas	Official presentation, informal discussions, and online research Sociogram Participation canvas Collective mapping
Evaluation	To get feedback from the actors participating in the co-creation process	Group discussion and online surveys

In parallel, the selected neighbourhood was contacted to organise a discussion session to introduce RECETAS and to assess its possible involvement in the project. This contact with the territory was done through the community health roundtable (CHR), a local structure coordinated by the CP of Les Roquetes. More information about the CHR can be found in Table S1. In this session, the driving group (DG) was also constituted as a second working group, being in charge of promoting the co-creation process in Les Roquetes. This group was composed of RECETAS researchers and participants of the CHR that wanted to lead the process in the neighbourhood. Group members were required to be involved during the co-creation and intervention development, helping with the designing and implementation of the participatory dynamics, reflecting and disseminating results, and helping contacting other relevant entities in the neighbourhood. Implementation possibilities in the neighbourhood were also discussed and allowed the research team to explore the needs and expectations of the neighbours and the challenges of implementing RECETAS in Les Roquetes and helped to connect with some other relevant entities. Participation in two sessions in Les Roquetes during the process was a requirement for new entities to be included in the DG. The complete list of stakeholders involved in the MC and the DG can be found in Table S2.

As the last step of the participative diagnosis, a consultative process was arranged, in which four stakeholders in the field of SP, community work, nature, and loneliness in Barcelona were interviewed with the aim of socialising and deepening the results of the diagnosis and to consolidate the involvement of the various stakeholders. One relevant stakeholder of each field of interest was selected: nature, community action, SP and health, and loneliness, and designed a script for the interviews to guide the conversation. The script template can be found in Tool Template 1.

None of the stakeholders that were involved in the participatory diagnosis process received monetary compensation for their collaboration. Instead, compensation was provided through the inclusion of their entities' names and logos in various project-related products. The members of the DG are acknowledged in the co-created NBSP menu, which is distributed to intervention participants in their respective areas and will be made available to the community one year after the intervention concludes. Furthermore, DG members were offered the opportunity to undergo training as facilitators of the Friends in Nature methodology, a community health tool centered around group interventions to alleviate loneliness. Friends in Nature is an adaptation of Circle of Friends in RECETAS context (open to many target groups) that utilises the key elements found in the studies of the Circle of Friends (which is based in older adults) [23, 24]. This methodology is implemented in the subsequent phase of the project and utilises the co-created NBSP menu as a supportive resource.

**2.3. Co-Creation of the NBSP Menu.** The co-creation process of the NBSP menu had the aim to generate a list of nature-based local activities that could be offered as a public

resource to tackle loneliness in Les Roquetes. The process lasted from March 2022 until August 2022 and was conducted based on three meetings: (1) one introductory session to identify relevant actors and vulnerable populations in the neighbourhood, (2) one session to co-identify a list of criteria for the activities in the menu and to identify health local assets (activities and spaces for the menu), and (3) one to complete the menu and discuss the results of the process.

The first workshop aimed to deepen into the co-creation process, explaining the expected results to the participants and discussing with them how to adapt the project to the reality of the neighbourhood. The session was organised with stakeholders of the CHR of Les Roquetes. Together with participants, vulnerable populations that could be suffering from loneliness in Les Roquetes were co-identified through an informal discussion. In order to identify relevant actors in the territory who could assist in reaching vulnerable populations and facilitate the co-creation of the NSBP menu, a sociogram was conducted. The sociogram aimed to comprehend the connections between these actors, assess their level of influence, and understand their respective interests [25]. The template used to dynamize the sociogram can be found in Tool Template 2.

The second workshop aimed to (1) co-identify a list of criteria and indicators for the activities of the menu and to co-create the NBSP menu and (2) co-identify health local assets in the neighbourhood. The session was organised with stakeholders of the CHR of Les Roquetes, entities identified in the sociogram during the first co-creation session, and other grassroots organisations that manage natural resources in Barcelona and that emerged as relevant in the VNL survey, showing a high number of collaborations with other entities in the territory. To co-identify relevant criteria and indicators for the nature activities, a canvas was employed to discuss intrapersonal, interpersonal, and environmental criteria. In addition, some specific issues within these categories that had already been mentioned in the previous interviews or sessions were provided as an example to stimulate discussion. The participatory canvas can be found in Tool Template 3. We then divided the ideas between criteria *per se* and indicators of these criteria. To identify the local health assets in the neighbourhood, a community participatory mapping was done using a map of the territory, where the participants identified and localised activities, spaces, and resources that could be included in the NBSP menu. The participants localised the assets with stickers and described the asset with sticky notes. The same colour categories from the sociogram were used. The map used can be found in Tool Template 4.

A third workshop was organised with the aim of completing the NBSP menu and to analyse the results of the co-creation process with the participating actors. Template documents were provided to nature activity organisations in order to gather details and specific requirements of the activities proposed and can be found in Tool Template 5. For those that could not attend the meeting, contact was done by e-mail. Lastly, a group discussion was facilitated in order to analyse the results of the co-creation process. At the end of the process and before using the menu with the participants

of the intervention, it was shared with all the organisations involved for a final validation.

**2.4. Evaluation.** An external evaluation was conducted to obtain feedback from the different working groups (MC and DG). In total, three meetings with the MC were distributed along the whole process. Regarding the DG, in addition to the information gathered from the co-creation sessions, participants conducted an evaluation survey. The complete list of questions can be found in Table S3.

### 3. Results

**3.1. Diagnosis.** Taking into account the previously agreed criteria, we selected the neighbourhood of Les Roquetes to implement the co-creation process, as it met the aforementioned inclusion criteria with an ISC score of 75.64 in 2018. Moreover, the area showed interest to participate in the project after a first contact.

A member of the research team contacted the CHR to plan a first meeting with other entities of the CP and the neighbourhood. Once they agreed to participate in RECETAS as the case study, we categorised the entities from the relational sample into three topic areas and contacted them. Other stakeholders that we did not include in the working groups were invited as participants of the different sessions. The complete list of stakeholders of each group can be found in Supplementary Material.

**3.2. Participative Diagnosis.** The online MC session was attended by seven representatives from various administrations, including the Community Action, Social Rights, Global Justice, Feminisms, and LGBTBI Directorate of the Barcelona City Council. In addition, representatives from the Health Promotion General Sub-Directorate and Public Health General Sub-Directorate of the Barcelona Public Health Agency, as well as the Equality and Social Sustainability Area of the Barcelona Provincial Council, were present. The overall aim of the project, structure of the different grant-related objectives and activities, relevant findings of the diagnosis, and other discussed aspects of the implementation of the co-creation process were shared. Relevant feedback and suggestions were incorporated into the workplan and in the diagnosis report.

Ten entities attended the first DG discussion session organised with the CHR in Les Roquetes, including health professionals, municipal equipment managers, representatives of civil organisations, and individual neighbours. In the presentation with the monitoring committee, different stakeholders pointed out the need to take into account the different vulnerability factors in loneliness when looking for participants and pointed out the importance of community facilities or grassroots organisations (not only primary care centers (PCC)) to reach vulnerable people. In the discussion with the CHR, they highlighted their experience with social prescription but not with the nature perspective, so the project could promote a new approach to social prescription in the territory. Sessions were held during COVID-19 pandemic, with the only requirement for in-person meetings

during the duration of the process being the mandatory use of face masks. Face masks were utilised in all face-to-face meetings, particularly when vulnerable individuals were in attendance. The complete information provided in these two meetings is summarised in Table 2.

In order to deepen this preliminary participative diagnosis, four relevant stakeholders in the fields of health, SP, and nature-based solutions in Barcelona and Les Roquetes were interviewed. In addition, they provided documents about previous experiences related to mental health and SP in their field of work. This information was useful to understand how RECETAS could contribute to previous work in Les Roquetes and what existing resources could be helpful for the co-creation process. Through these interviews, we could see that both the city (Barcelona's loneliness strategy) and some neighbourhoods already drive different social prescription initiatives, but not with the nature perspective. Moreover, these initiatives usually aim to target the elderly, who are already known to be vulnerable to loneliness, but other vulnerable groups, such as single-parent women, migrants, or unemployed people, are left out. The complete information from the interviews is summarised in Table 3.

**3.3. Co-Creation of the NBSP Menu.** Representatives of local associations and administrative health agencies, civil organisations, social services, and community entities attended the first co-creation workshop. After explaining and discussing the expected outcomes of the co-creation process, we started an informal conversation to identify vulnerable groups in the neighbourhood and to examine the reasons for this vulnerability. Participants mentioned four main vulnerable groups: young people, elderly, unemployed adults, and informal caregivers. "*Young people were isolated at home because of the COVID-19 pandemic. They still do not have mental health problems now but may develop them*" said one of the participants from the health sector and pointed out that the economic consequences of the COVID-19 pandemic may have exacerbated this situation. Regarding unemployed adults, participants mentioned that "*their situation has worsened because of the COVID-19 pandemic and it has led to their social isolation.*" The third group identified, informal caregivers "*do not present any type of network beyond the sick person they are caring for*", according to one participant. This lack of social connections can often result in feelings of loneliness among them. Finally, the elderly "*became more isolated after the pandemic caused by COVID-19 and found it difficult to resume activities or relate to other people,*" several participants pointed out.

Participants also co-identified stakeholders that could contribute to the menu through the sociogram tool. Among the actors identified, there were stakeholders identified related to natural spaces and activities, libraries, education, community action, cooperatives, and civil organisations (Figure 2). We contacted and invited them to the second co-creation session.

New stakeholders attended the second co-creation workshop (nature activity organisations, civil organisations, education sector, and health sector). Together, we co-identified several issues the participants pointed to as

TABLE 2: Information provided in the group discussion with the CHR and the MC.

Level	Activity	Information provided
Barcelona province	Official presentation to the MC	<ol style="list-style-type: none"> <li>(1) Including other indicators rather than the socioeconomic level of the neighbourhood was mentioned to be taken into account when selecting territories (e.g., high inequality indexes, large vulnerable groups, or lack of green spaces)</li> <li>(2) Seeking equilibrium between Barcelona neighbourhoods and other territories in the province included in the study is important to ensure a heterogeneous sample</li> <li>(3) Recruitment of participants for the case study should be carried out by different institutions, not only PCC, as there is a need of acquiring a diverse sample</li> </ol>
Les Roquetes neighbourhood	Group discussion with the CHR	<ol style="list-style-type: none"> <li>(1) There was a need to integrate efforts with other social prescription and nature activities in the neighbourhood</li> <li>(2) Social prescription had already been introduced in the neighbourhood and many organisations and associations recognized the term, even though nature-based activities were not as extended</li> <li>(3) The youth and the elderly were highlighted as vulnerable populations</li> </ol>

TABLE 3: List of interviewees and information provided.

Actor	Area	Information provided
Barcelona Environmental Equipment Network-Equipment of Sagrada Familia	Nature	<p>The elderly and migrant populations are especially vulnerable to loneliness. Within this last-mentioned group, women, caregivers, and households suffer greater loneliness.</p> <p>It is well known that older people suffer from loneliness and public institutions have already been organising activities to mitigate the situation, but very limited resources are devoted to migrants, which are also affected by precarious living conditions, and therefore they lack time for social gathering. Previous but limited actions have been taken to improve migrant women's situation (i.e., mutual support and co-parenting groups).</p> <p>Nature-based activities could be a solution, but there are few green spaces available within some neighbourhoods.</p> <p>Moreover, lack of financial or social resources and time constraints prevent people from going to other neighbourhoods or asking for help in public services. Social prescription is being conducted in a few neighbourhoods in Barcelona, but there is a need to do so at a city level, which would help engage all relevant actors.</p>
Roquetes CP and CHR	Community action	<p>Les Roquetes has been built by neighbours with a community perspective. Social prescription has been working for some years and they use tickets for tracking. CHR organises different spaces with neighbours.</p> <p>Isolation and loneliness have become a problem in the neighbourhood after the COVID-19 pandemic. Young people and informal caregivers are the most affected.</p>
Barcelona Public Health Agency	Social prescription and health	<p>Nou Barris is a neighbourhood where neighbours are heavily involved with educational projects.</p> <p>RECETAS would be a great opportunity to boost these early initiatives, as the territory has high potential but no experience in the field.</p> <p>Barcelona's loneliness strategy establishes broad objectives and a workplan for the whole city but also takes into account territorial scope, working closely with each of the city districts, which in turn develop their specific strategies. There is also a science advisory board and a loneliness observatory. There is a catalogue of available resources which includes different local entities and voluntary activities in their website.</p>
Childhood, Youth, and Elderly Services	Loneliness	<p>However, there is still a lack of information about the most vulnerable groups, given the difficulty in accessing specific populations. Loneliness is also widely spread between children and youths as involving this population with social services is complex.</p> <p>In the current loneliness strategy, there is no involvement with nature, but many of the activities that are already designed could be adapted to be nature related.</p>

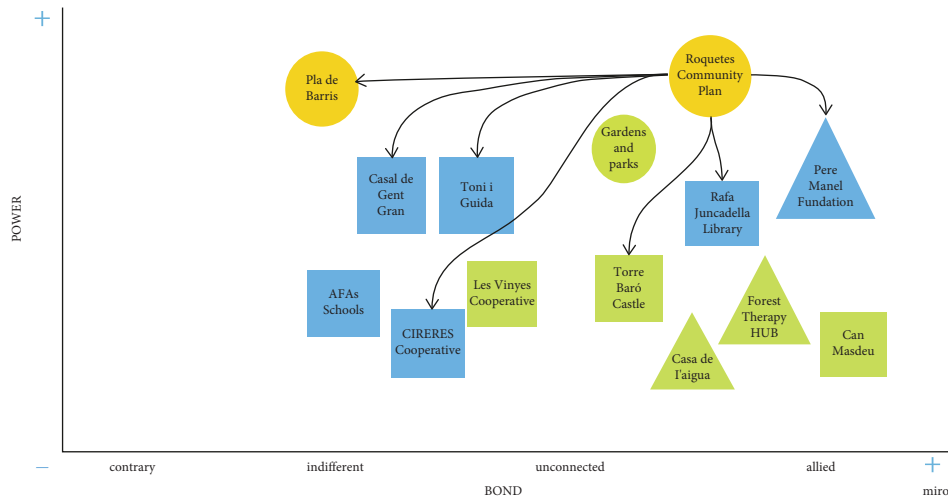


FIGURE 2: Sociogram of the stakeholders identified in Les Roquetes. Stakeholders identified in the first co-creation session through the sociogram are represented in blue, yellow, and light green (see Methods). Arrows indicate those entities that had previous connections.

essential when specifying the conditions of the activities of the menu by using the participation canvas. Some of the most relevant aspects discussed were the need for the activities to be free of charge for the participants, given their economic vulnerability, in order to facilitate their permanence in the group; it was proposed to explore an intergenerational group, valuing positively the presence of people of different ages in the group, and it was pointed out that a common language among the participants would help the creation of bonds. All the criteria and indicators discussed and agreed upon in the working meeting can be found in Table 4.

Based on these co-identified criteria for the activities, we aimed to map local health assets to co-create the NBSP menu. For that, we performed a collective mapping in which participants identified spaces, entities, and activities that could provide resources for the menu, always adapted to the vulnerable populations, and that could fulfil the co-identified criteria (Figure 3(A)). They were identified according to three categories: nature, SP/health, and civil organisations. Participants also proposed new relevant stakeholders and 39 different resources that included open and freely accessible nature areas, current activities in nature promoted by government or grassroots organisations, and new activities that could be organised specifically for the RECETAS Project (Figure 3(B)).

For the third workshop, we contacted those entities in charge of the activities identified in the second workshop and invited them. New stakeholders (nature) came and some others expressed their interest in the project but could not attend the session. For the last ones, we used online communication by e-mail or by phone. At the end of the co-creation process, 15 entities provided detailed information about 25 nature activities and spaces that conformed to the NBSP menu, which can be found in Table S4. With this information, we created a printable NBSP menu with an attractive format that could encourage the group's interest in the territory's activities and adherence to the intervention (Figure 4).

**3.4. Evaluation.** The feedback from the MC was related to the recruitment process, the areas of intervention, and the viability to reach lonely people with some limitations for the clinical trial (reduced mobility, vulnerable socioeconomic situation, and so on). These last suggestions were brought to the neighbourhood meetings, and the opinions related to the areas of intervention were considered when deciding the rest of the areas for the clinical assay (in addition to Les Roquetes). Regarding the questionnaire sent to the DG and to all participants of the co-creation sessions, 11 entities answered the questionnaire (55% of response rate). Participants were mostly satisfied with how the project was implemented in the territory, the information given and how it was communicated, the number of sessions and how their content helped to achieve the objectives, and how the project sought synergies with the work already being done in the neighbourhood. In addition, some entities volunteered to help with the dissemination of the project and with the recruitment of participants for the intervention. The complete results from the evaluation questionnaire can be viewed in Table S5.

## 4. Discussion

This paper describes a case study embedded in the ongoing Horizon 2020 European Commission funded project RECETAS and aimed to co-create a menu for nature-based social prescribing interventions addressed to face loneliness in urban deprived neighbourhoods. This menu will be used in a randomised controlled trial ( $n=316$ ) that includes group-based outdoor interventions to address loneliness among adults (18+) from socioeconomically deprived areas in the Barcelona province. RECETAS partners will recruit individuals from primary care settings, community groups, and volunteer organisations who screen for loneliness. Each of the intervention groups will collectively decide which of the nature-based activities they would like to enjoy as a group, selected from the menu of nature-based options developed by community members in co-creation sessions

TABLE 4: Criteria and indicators agreed in the second co-creation session.

Criteria	Indicators	Category
The activity must be accessible	The activity will take place on weekday mornings	Basic condition of the clinical trial
	The activity will be free for the participant and, should there be a cost, this will be met by the project	
	The resource will be accessible on foot or by public transport	Intrapersonal
	If accessible by public transport, the latter must be free or very cheap as well as nearby (surrounding neighbourhoods). This cost will not be covered by participants but by the project.	
	The activity must be accessible to older people, although it is accepted that it will require a minimum level of physical capability, so people with reduced mobility will be excluded	
The activity cannot include the attendance of children, so care services (explored by RECETAS or community plans) will be used in case participants have children under 3 years old	Interpersonal	
The activity must be intergenerational	The members of the group must be over 18 years old	Basic condition of the clinical trial
	The group will be intergenerational, with a wide range of ages ruled out. Priority will be given to adults and older people as most vulnerable young people are under the age of 18.	
The group should be gender-balanced	In the case of a mixed gender group, there should be a gender balance, i.e., at least two men or two women	Interpersonal
A common language should be used in the activity	Participants must be able to speak Catalan and/or Spanish	Basic condition of the clinical trial
Include a gender perspective in the facilitation of the activity	The facilitation of the activity must include a gender perspective to ensure that there are no leadership or care roles which reproduce gender roles in the group	Interpersonal



FIGURE 3: Pictures of the participants during the collective mapping (A) and the map with co-identified nature activities and spaces (B) in the neighbourhood of Les Roquetes. Legend in the figure: green = nature; yellow = social prescribing; blue = civil organisation.

described above. Participants from the control group will also receive the NBSP menu, which will be explained by a facilitator, but will not participate in the group-based intervention.

The co-creation process that has been detailed in the present article is based on the “Protocol for NBSP Menu development” that was designed by the University of Cuenca [18]. It has been applied not only in Barcelona (Spain) but also in five other pilot cities that are part of the RECETAS Project: Cuenca (Ecuador), Helsinki (Finland), Prague (Czech Republic), Marseille (France), and Melbourne (Australia). This protocol is a standardised guide that allows to reproduce and co-create new local NBSP menus, enriching and empowering community networks and the use of urban green spaces in other places. In Barcelona, this

protocol was adapted taking into account the local reality that could be known in detail through the process of diagnosis and participatory diagnosis. The co-creation process included collective mapping to identify the NBSP activities and to tailor the future intervention to the needs and expectations of participants. As a result, a NBSP menu with a variety of different nature-based activities was developed and tailored to the area after obtaining a complete understanding of the territory by all the stakeholders involved. This process is now being replicated and adapted to other areas of intervention in the city and province.

Research has shown how cultural and contextual factors can significantly affect the results of a co-creation process. A recent systematic review aimed to assess the evidence in developing social prescribing interventions [10] identified



### WHAT IS THIS MENU?

It is a list of resources related to nature that exist in the neighbourhood of Les Roquetes and the surrounding area.

It contains information on spaces, facilities, organisations and activities related to nature that are available to the public.

You can consult the location, opening hours, information about the activity and the contact details.

**How was it created?**

Through a process of co-creation, different stakeholders and administration from the mental health, welfare and wellbeing, social prescription and nature sectors have shared their knowledge, resources and information about activities and programmes related to nature.

The aim is to include them in a nature based social prescription programme.

You can consult the list on the other side of the leaflet.

We hope you enjoy it!

Would you like to consult the location of the spaces and activities?

*"We are nature and to think of life outside the biosphere is simply an erroneous and illusory cultural construct"*

Yayo Herrero



Entities that have collaborated in the creation of this menu

- Vall de Can Masdeu
  - Associació Sim del Barrí
  - PES Cruïlla / Ke Teller
  - Humus Therapy (THWB)
  - Cobalitzage CIBRES
  - Fundació Els Tres Turons
  - SCM NATURA
  - Biblioteca Les Roquetes - Rafa Juncadella
  - Casa de l'Aigua de Trinitat Nova
  - Cooperativa Tarpona
  - Castell de Torre Baró
  - CREAF
  - Associació Esportiva Santarri Sant Genesí
  - Parcs i Jardins
  - CAP Roquetes
  - Agència de Salut Pública de Barcelona
  - Serveis socials
  - Canal de Sant Eulri
  - Tori i Guida
  - APA de Turó de Enganyer
  - Escola Bressol Municipal i Espacio Familiar R1 Torred
- Promoting team
- Fundació Social i Desenvolupament UAB
  - ISGlobal Institut de Recerca Global
  - Agència de Salut Pública
  - Consell de BarCELONA
  - Generalitat de Catalunya

**Gardens**  
Bibliohort  
Les Roquetes - Rafa Juncadella Library  
Schedule to be defined  
Contact: rjuncadella@biblia.cat

Weekly meetings to take care of a small garden created in grow tables and arranged in one of the library's yards.

**Community Gardens**  
Vall de Can Masdeu  
Schedule to be defined  
Contact: canmasdeu@canmasdeu.net  
More information: <https://www.canmasdeu.net/horts-comunitaris/>

Community Gardens is a project formed by a group of 50 people who work horticultural plots in the valley. They draw an organic farming and community engagement.

**Dijous el Hort**  
Vall de Can Masdeu  
Every Thursday at 10h  
Contact: canmasdeu@canmasdeu.net  
More information: <https://www.canmasdeu.net/participa/dijous-oberts/>

We will learn and share how to run an organic garden.

**Planting and care of fruit trees**  
Els Tres Turons Foundation  
Can Soler, from 10h to 12h, monthly.  
Contact: maria.garcia@elstreturons.org

Activity about the recovery of fruit crops through planting, pruning and irrigation.

**Horticulture**  
Els Tres Turons Foundation  
Can Soler, from 10h to 12h, monthly.  
Contact: maria.garcia@elstreturons.org

A session where you can learn what a vegetable garden is and find about some aromatic plants and plant propagation techniques.

**The vegetable garden at the Vall d'Herbon and Teixonera marketplace**  
Cooperativa Tarpona  
Tuesdays, Wednesdays or Thursdays, 9:30h - 12h, Saturdays, 10h to 14h, Fridays, 15:30h-18:30h.  
Contact: info@tarponacoop.org

Community urban vegetable garden promoting agroecology and food sovereignty to natural and contribute to a faster, healthier more united and resilient and more sustainable city.

**Urban vegetable garden**  
Collabage CIBRES  
Schedule to be defined  
Contact: info@eres.asstresivic.cat

Collaborate with an organic agriculture and urban green areas project: terraces, vertical vegetable gardens and urban vegetable gardens on roofs.

**Exercise and relaxation**  
Reconnect with nature  
Trinitat Nova Casa de l'Aigua  
Every two months.  
Contact: casadelaigua@gmail.com  
Reservations are required

Quiet walk to enhance perceptions and the senses.

**Nature, presence and emotion**  
Castell de Torre Baró  
Circular activity around the Torre Baró Castle, Saturdays 10h-10:30h to 12:30h - 12h, During week days under demand.  
Contact: castell\_torrebaro@bcn.cat

Sessions to broaden your connection with yourself and your emotional expression through several activities that keep you in touch with nature.

**Forest bathing**  
Humus Therapy (THWB)  
Schedule to be defined  
Contact: humustherapy@gmail.com

Activity designed to awaken the senses in a natural environment to work on health in various areas (mental, social, spiritual and physical) through a number of activities.

**Caminaires**  
Roquetes Community Plan  
Monday and Wednesday from 9:30h to 11:30h

Group of walkers led by a sports instructor.

**Forest bathing**  
Els Tres Turons Foundation  
Can Soler, from 10 am to 12 noon, occasional activity.  
Contact: maria.garcia@elstreturons.org

Emotional control session where mindfulness, awareness and sensory work techniques will be learned, conscious a fireball seminar.

**Bicycle route**  
PES Cruïlla / Ke Teller  
Schedule to be defined.  
For bike repair: Wednesday from 17h to 18h  
Contact: pablo.arrañal@salesians.cat

Bicycle route led by volunteers from the organization. The route and the library will be tailored to the group.

**Activate yourself at the park**  
Barcelona City Council  
Plaça de la Quadrada: Monday 10h to 11h; Tai chi and Chi gung (Wednesday 10h to 11h) Motor functions and memory.

Registration at the place of the activity. More information: <https://ajuntament.barcelona.cat/esports/espores-en-el-espacio-public/activate-en-los-parques>

Physical exercise and health programme that is practiced in different parks and gardens in Barcelona, and which aims to encourage physical exercise, maintain an active life psychologically and socially, be in better condition, and reduce the risk of illness while enjoying the city's green spaces.

**Workshops and guided tours**  
Centre Social Pies  
Vall de Can Masdeu  
Two Sundays per month  
Contact: canmasdeu@canmasdeu.net  
More information: <https://www.canmasdeu.net/spic/>

It is an event open to all where we run a range of activities. An ideal time to learn about suggestions from groups related to social, artistic, political and health topics.

**Collserola unseen**  
Torre Baró Castle  
Circular activity around Tower Baró castle, Saturdays 10h- 10:30h to 12:00h  
Contact: castell\_torrebaro@bcn.cat

Itinerary that runs through the sun-bathed surroundings of the Castle to know species of the Mediterranean vegetation adapted to the shortage of water.

**Visits and Agroecological Education**  
Vall de Can Masdeu  
Monday, Tuesday, Wednesday, Friday or Saturday. Visits last between 2 and 3 hours.  
Contact: canmasdeu@canmasdeu.net

The project runs guided tours through the valley along with educational games and practical workshops to help participants deepen their understanding of different topics.

**The signs and traces of our neighbourhoods**  
Trinitat Nova Casa de l'Aigua  
Every two months  
Contact: casadelaigua@gmail.com  
Reservations are required

Discovering tracks and traces of our animals' neighbourhoods. We will also make a trail track.

**The Castle's environment**  
Torre Baró Castle  
Circular activity around Torre Baró Castle, 10h-10:30h to 12h.  
Once per season and also available under demand.  
Contact: castell\_torrebaro@bcn.cat

Itinerary where walkers are invited to discover several landscapes and to notice the human impact thereupon, specially where nature and city merge into each other.

**Climatic change and adaptations**  
Torre Baró Castle  
Circular activity around the Torre Baró Castle, from 10h-10:30h to 12h.  
Once per season and also available under demand.  
Contact: castell\_torrebaro@bcn.cat

Itinerary where walkers are invited to discover several landscapes and to notice the human impact thereupon, specially where nature and city merge into each other.

**From the Castle to the Mugenera Spring**  
Torre Baró Castle  
Circular activity around the Torre Baró Castle, Saturdays 10h-10:30h to 12:30h.  
Once per season and also available under demand.  
Contact: castell\_torrebaro@bcn.cat

Itinerary through the shady side of Collserola. Walkers will discover and enjoy the beautiful and calm path leading to the Mugenera spring and to identify the main threats to the area: the fire and invasive species.

**Crafts and natural recycling workshop**  
Som del Barrí Association / Centre Tori i Guida  
2 hours: morning and/or afternoon  
Contact: somdelbarri@gmail.com

Finding materials in nature and creating a piece of craftwork.

**Green spaces**  
Rodrigo Caro Gardens  
From 18 November to 31st March, every day from 10h to 19h.  
From 1 April to 31 October, every day from 10 to 21h.

This gardens have an extremely wide range of plant specimens from the Mediterranean to the various climatic regions. In contrast to the city's other green-spaces the plants are arranged along the banks to they adapt to the land's profile and hilly terrain.

**Parc de Josep Maria Serra Martí**  
Free access  
This green space, highly popular with local residents, is not just a park but also a thoroughfare and a square.

**Parc del Pla de Fornells**  
Free access  
Consisting of the foothills of Collserola, Pla de Fornells is a park that combines an eminently forest character with a very modern layout. There are several facilities nearby, notably the Rogelio Sierra (crisis school).

**Serra de Collserola**  
Free access  
One of the largest metropolitan parks in the world.

**INaturalist**  
CREAF and GISP Spain  
Anywhere, any time, with any frequency  
Contact: p.guzman@creaf.uab.cat, l.fores@crf.uab.cat

INaturalist is a platform to register observations of biodiversity. Observations are made up by a photo, the date, the hour and the place where the spotting of a plant or animal occurred. With these data provided by citizens, scientists can study existing flora and fauna. You only need a mobile telephone, the downloading of the application INaturalist and to take pictures of nature indicating which behaviour is suitable. INaturalist helps identify animals or plants observed that are sent to the project. These types of observations help study and understand climatic change and its effects on nature.

**RitmeNatura**  
CREAF and Meteorological Service of Catalonia  
All round the year, especially in the spring/autumn months / Observations must be sent ideally once per week but frequency may be adapted to participants' availability.  
Contact: p.guzman@creaf.uab.cat, l.fores@creaf.uab.cat

RitmeNatura is a scientific project relying on civic collaboration to register the behaviours of the natural beings as modified by climate (phenology), such as return of the swallows, the blossoming of plants or the fall of leaves in the autumn. Science obtains plenty of information about how climate change may change the rhythm of plants and animals thanks to the observation of nature. Did this year swallows return before than generally? When did the almond tree in the park bloom last year? Has the falling of leaves of the banana tree been delayed?

FIGURE 4: Printable version of the NBSP menu for Les Roquetes neighbourhood (Barcelona) (translated from the original version in Catalan).

factors related to values and norms, language and communication, community structures and dynamics, socio-economic status, and physical environment. For example, three different studies argued that the success of co-creation processes could vary according to which extent the different partners were able to share their norms and values [26–28]. The same studies highlighted the importance of effective leadership to support equitable relationships and promote collaboration. Some of these researchers also fostered the importance of communication for the long-term sustainability of the co-created social prescribing intervention and to involve all stakeholders in each stage of both the development and the delivery of the intervention. Moreover, social, political, and power structures of each community influence the co-creation process. For example, giving individuals the sense of control and the opportunity to co-create social prescribing with intervention providers encouraged their participation in the process [29]. Finally, contextual factors such as the physical environment can become barriers which prevent individuals from being involved in the co-creation process. Two studies mentioned lack of transportation as one of most important obstacles [30, 31].

As has been previously stated, loneliness is a critical public health challenge nowadays that could be addressed by involving not only public health sector institutions but also organisations and resources from outside of it. Specifically in the design of NBSP interventions, community engagement helps ensure that the intervention is responsive to the concerns of the community and it is conducted in a respectful and culturally appropriate way, thus being welcomed by the target population. Moreover, citizen participation can help to build trust between the research community and society, both increasing willingness of society members to participate in future projects and ensuring that the results generated by research studies are widely disseminated within target communities. However, public engagement involves an upfront investment for projects and may shift the locus of control but, together with other barriers, may prevent researchers and public health practitioners from implementing citizen science initiatives.

Barcelona is a city with a previous sensitivity and experience with SP, which is exemplified both through specific programs in the different neighbourhoods and through a municipal plan against loneliness. Even though neighbourhoods have a rich network of local non-governmental organisations, which makes it significantly easier to reach different population profiles, working on NBSP in Les Roquetes promoted the creation of additional connections between people and entities in the neighbourhood with a new perspective on SP. This has been achieved through two key aspects. First, the creation of new nodes has been necessary due to the participation of stakeholders from different parts of the city. Second, there has been collaborative effort to explore alternative uses of existing green public spaces. Local entities, during the co-creation sessions, have recognized innovative ways to view the surrounding small green spaces as natural settings for various activities, potentially revitalizing them. Some of the activities that were proposed arose from the fact

that they had to happen in green spaces, so this made entities think about new possibilities that differed from the activities they were regularly offering in closed spaces.

RECETAS managed to involve various entities and groups in the co-creation process initially thanks to the survey that was shared and that helped to compile a list of relevant stakeholders. However, it was also of vital importance to attend the session from the CHR in Roquetes, who helped the team to connect with the local environment of actors. These people were invited to take part in the project through an open invitation and include citizens and grassroots organisations, health and SP specialists, private entities, and administration. As it has been previously stated in this paper, Roquetes is very active when it comes to community life, and therefore, some entities representing different neighbour collectives are involved in the CHR. However, after the first session in the CHR in Les Roquetes, we likely failed to include unorganised citizens who might have been interested or who could have been potential beneficiaries of the intervention, mainly due to the time consumption it would have taken to include this group properly. A possible solution to this limitation could have been to organise less technical sessions where diverse topics could be addressed that could help to enrich the process, e.g., participants could help to broaden the vision of what is considered a nature activity, where the topics of greatest interest could be chosen or even define criteria of inclusivity for the activities. However, the capacity of the team was limited and this option was disregarded.

The menu of activities is meant to be used not only in the next steps of the RECETAS project but will also remain in the neighbourhood as a community resource. Hence, one of the limitations is its sustainability. Some of the activities that appear in the menu were newly created, *newly* by entities, because of the project, so it may become a challenge to keep offering them as a resource for the future. In addition, the resulting menu will not be offered to the community until the RECETAS intervention is finished, to avoid any study bias. Therefore, there may be issues regarding the relevance and seasonality of the activities offered because of this dissemination delay.

Based on our process, we would recommend future similar processes to invest resources into the generation of a preliminary network analysis that helps to inform the first steps of co-creation. To facilitate this, involving public agencies as project partners can result in ground-breaking outcomes. From a public health perspective, optimization of resources and sustainability of projects is a major concern. The strategic view of a co-creation process implies exploring what already exists and works in a community and connects identified needs with opportunities offered by the RECETAS Project. Searching for these synergies helps to integrate new practices and knowledge in daily practice and gain sustainability of interventions.

Structured proceedings, as the one presented in this paper, generate an accurately described co-creation process which ensures that proceedings are reliable, consistent, and comparable across locations, times, and populations. Especially for health professionals used to managing

quantitative data, these proceedings facilitate the development of participatory initiatives by offering a clear framework for researchers to engage citizens in a way that promotes meaningful participation.

## 5. Conclusion

This paper describes a structured and systematised protocol to co-create a nature-based social prescribing intervention addressed to face loneliness in urban socioeconomically deprived areas. As a result, a nature-based social prescription menu was co-developed with stakeholders from health, social prescription, nature, associative, and research sectors. The menu consists of green open spaces and nature activities that will be offered to the participants of a randomised controlled trial to test actions for social prescribing in natural spaces. Despite some limitations such as the lack of representativeness of non-organised community neighbours, the co-creation process has promoted an open and deliberative process to favour the creation of collaborative links between the different stakeholders with the aim of identifying which vulnerable populations could benefit from the intervention, defining criteria and indicators for the appropriateness of the intervention for this population, and identifying nature-based resources to address loneliness in the territory. The framework described in this paper can be used by health and community practitioners to facilitate the development of participatory initiatives to engage citizens and promote meaningful participation. The co-created menu is intended to remain in the neighbourhood as a community resource.

## Abbreviations

MC:	Monitoring committee
DG:	Driving group
NBSP:	Nature-based social prescription
CHR:	Community health roundtable
CP:	Community plan
SP:	Social prescribing
NB:	Nature-based
NBS:	Nature-based solutions.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Additional Points

**Highlights.** (1) There is a lack of systematised and structured protocols to simplify participatory processes to co-design intervention in health-related projects. (2) Nature-based social prescribing strategies need to consider user perceptions of facilitators and barriers to adapt interventions to the specific context, which ideally should be identified through a participatory process. (3) Although there are different examples of participatory processes to co-design interventions in health projects, this is a novel context-specific

co-creation process aimed to identify nature-based solutions to address loneliness. (4) The co-creation process has been applied not only in Barcelona (Spain) but also in five other pilot cities that are part of the RECETAS Project: Cuenca (Ecuador), Helsinki (Finland), Prague (Czech Republic), Marseille (France), and Melbourne (Australia).

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Acknowledgments

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## Supplementary Materials

Tool Template 1: example of the interview outline (English translation from the original version). Tool Template 2: sociogram canvas (English translation from the original version). Tool Template 3: identification of criteria canvas (English translation from the original version). Tool Template 4: map for gathering health assets in Les Roquetes. Tool Template 5: template for gathering nature activities and resources (English translation from the original version). Table S1: detailed description of the community plan (CP) and the community health roundtable (CHR). Table S2: list of organisations that were part of the MC and the DG. Table S3: list of questions from the evaluation survey (English translation from the original version). Table S4: detailed information about the nature activities and spaces that conformed to the NBSP menu. Table S5: results from the evaluation survey (English translation from the original version). (*Supplementary Materials*)

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