

Developing a Theory-of-Change linking Nature-based Therapies and Mental Health and Wellbeing Equity: An eDelphi Study

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Abstract

Background: Mental health disorders, and a lack of access to adequate mental health care, disproportionately affect marginalized groups, leading to health inequities. Growing scientific evidence shows that nature-based therapies (NBTs) can improve adult mental health and wellbeing. However, less is known about how NBTs may impact health equity at the population level. We aimed to develop a theory-of-change (ToC) informed by a diverse group of NBT stakeholders to better understand the mechanisms by which NBTs may improve adult mental health and wellbeing equity.

Methods: We used a two-stage eDelphi approach to elicit knowledge about how NBTs work and the contextual factors that influence whether an NBT is effective in improving adult mental health and wellbeing equity. Respondents were researchers, NBT practitioners, and policy makers from the Global North. Participants first answered open questions structured around the ToC components and identified definitions, enablers and challenges influencing who benefits from NBTs. After creating a list of unique responses organized by ToC component, respondents were then asked to rate each response in terms of importance and relevance. Final agreement scores were calculated and the final ToC was informed by those statements on which respondents agreed were both important and relevant.

Results: Respondents conceptualize NBTs as having potential positive impacts at the individual and population levels, including improved environmental awareness and resilience and social cohesion. Respondents identified pathways operating at individual, community, and system levels, highlighting accessibility, facilitator training, public funding, and healthcare integration as key determinants of equitable benefit. Respondents agreed on several key challenges which may preclude NBTs from benefiting all population groups including misconceptions among healthcare providers and potential beneficiaries and a lack of recognition of NBTs as a legitimate form of healthcare, as well as more tangible challenges such as accessibility and funding.

Conclusions: Despite diverse expertise and cultural backgrounds, respondents reached strong agreement on the pathways by which NBTs are understood to improve adult mental health, wellbeing, and equity. Further, NBTs face several challenges that preclude them from reaching their full potential in terms of impact on mental health and wellbeing equity.

Contributions to the Literature

- Experts use different words and concepts to describe “nature-based therapies” (such as horticultural therapy, forest therapy, outdoor therapy, and others). This study reports on what aspects of nature-based therapies are important in defining this type of therapy.
- This study reports the aspects of nature-based therapies for mental health (such as what types of activities, what types of resources, and how they are designed) that experts agree are needed.
- Nature-based therapies may help improve mental health equity, but only if all people have can access it. This study shows what things might help or hinder access to nature-based therapies for all.

Background

Mental health disorders, the most common of which are depression and anxiety, currently affect over 84 million people in Europe and over a billion people worldwide (1, 2). Certain marginalized groups such as women, people with low socioeconomic status, those from minority ethnic or indigenous populations, and people identifying as LGBTIQ+ continue to suffer at a higher rate from such conditions (3). Mental health equity refers to the commitment to eliminate disparities in mental health care and to ensure that all individuals regardless of race, ethnicity, socioeconomic status, gender, geographic location, or cultural background have the opportunity to achieve optimal mental wellbeing (4). Current statistics regarding the burden of mental health disorders are likely lower than the actual burden. Many people go undiagnosed due to stigmatization or due to a lack of training and competency in mental health among frontline care providers (5).

Furthermore, up to one in three people who are diagnosed with a mental health disorder do not receive the care they need (6). Those with low incomes, lower levels of education, and those living in rural areas are more likely than others to have unmet mental health needs (7). Health care systems struggle to provide mental health care to all due to a shortage of mental health providers and lack of funding and other resources necessary to provide prompt and free mental health services (5). Mental health and wellbeing may also be supported by ensuring healthy living environments, but key aspects of health living environments such as adequate amounts of high quality green and blue spaces not equitably distributed (8).

Exposure to nature (operationalized in a variety of ways) has been linked to better mental health and wellbeing outcomes (9–12), where exposure to nature may occur in our everyday lives, the provision of nature-based health promotion activities (such as community gardening or outdoor exercise programs in parks), and the more targeted and tailored approach of nature-based therapies (NBTs) (13). Interventions involving contact with nature, such as NBTs, may generate benefits that extend beyond individual mental health outcomes, including enhanced social cohesion, environmental stewardship, resilience, and more equitable conditions for wellbeing (14–18). This broader perspective highlights the importance of examining not only whether NBTs improve individual mental health and wellbeing, but also how they may contribute to mental health and wellbeing equity at community and population levels (19). Because NBTs can potentially be delivered in community settings, integrated into public services, and made available at relatively low cost, they have been proposed as a promising approach for reducing inequities in access to mental health support.

Despite promising results, more robust evidence is still needed to support broader implementation; to demonstrate their overall effectiveness, and to understand the mechanisms by which NBTs work (16, 20–23). Although increasing evidence supports the effectiveness of NBTs for improving mental health and wellbeing, less is known about the mechanisms through which they operate, the contextual factors that shape their effectiveness, and the conditions under which they may contribute to mental health equity (24–26). Recent evidence syntheses suggest that the benefits of interactions with natural environments may arise through multiple psychological, social, physical, and environmental mechanisms, including

stress reduction, attentional restoration, social connectedness, physical activity, and increased nature connectedness. However, the relative importance of these pathways, and the conditions under which they contribute to mental health and wellbeing equity, remain insufficiently understood (27). Given the complexity of NBTs and the multiple individual, social, environmental and system-level pathways through which they may operate, approaches that explicitly map mechanisms and contextual influences are needed. Furthermore, a broader integration into mainstream healthcare systems is still lacking (28). Integrating NBTs in health care systems requires structured planning; particularly to ensure equitable benefit across diverse populations by understanding first the nuances around who might not be able to access or benefit from such interventions and why.

Theories of Change (ToCs) provide a structured approach for conceptualising how and why specific health interventions are expected to produce desired outcomes, ToC is accomplished by mapping the relationships between activities, mechanisms, and contextual factors (29). This approach is particularly relevant for NBTs, as it operates across individual, social, and environmental levels and are shaped by a wide range of system-level conditions. In contrast to ToCs focused on individual-level outcomes, a ToC for health equity requires a broader, systems-oriented perspective that accounts for structural determinants, differential access, and contextual factors, shaping who benefits from an intervention. While ToCs are increasingly used to strengthen intervention design and evaluation, their application in this context may help clarify pathways through which NBTs influence outcomes and identify factors that enable or constrain equitable impact across populations. Thus to understanding how NBTs may contribute to mental health and wellbeing equity .

To our knowledge, no published Theory of Change has specifically examined the mechanisms by which NBTs improve mental health equity at the population level. Although one ToC developed by Kondo et al discusses the potential of greening interventions to reduce health inequities among adolescents, it stops short of including this as a stated intended impact (30). This study explores how NBTs may strengthen adult mental health and wellbeing while also addressing the broader issue of inequity. We focus specifically on three types of NBTs to focus on those that are most common (horticulture-based therapies), those that are increasing in popularity (forest-based therapies such as forest bathing, and similar interventions involving contact with forests) and promising but not as frequent (those involving blue space). Using a ToC approach, we aimed to identify the mechanisms, pathways, and contextual factors through which these interventions may improve adult mental health, wellbeing, and mental health equity. We also sought to identify the resources, assumptions, and external factors that may influence their implementation and impact.

Methods

This study was developed within Horizon Europe project (i.e. GreenME, ref. 101084198) which intends to scale up the use of NBTs and a broader green care framework in the Global North, in part by providing more robust evidence on the effectiveness and cost-effectiveness of NBTs through the evaluation of seven case studies in four countries.

Theory of change (ToC) approach

Theories of Change (ToC) provide a structured framework for planning and evaluating health and care interventions by illustrating how and why an intervention can produce a long-term improvement in health or wellbeing (29, 31). A ToC is generally presented as a chart or diagram and accompanied narrative that outlines the pathways by which various aspects of an intervention are thought to lead to a long-term desired outcome or goal. To do so, a ToC breaks down the processes by which an intervention works to delineate essential inputs (resources to implement the program or project), activities (actions taken using the inputs), outputs (immediate, tangible service or products delivered by the program or project), and outcomes (measurable short- to medium-term effects that occur due to the outputs), necessary to achieve long-term impact (long-term change that the program or project aims to achieve). A ToC also states the context (the problem that the program or project intends to address) and the assumptions and external factors (any aspect of the context in which the program or project operates that may affect whether or not it works effectively) (32, 33).

There is no standard method for developing a ToC although most reports highlight the importance of stakeholder input—from intervention participants to practitioners and researchers—through consultation, interviews, focus groups, or other forms of engagement to establish objectives and ensure that the context is relevant (32, 34, 35). Firstly, the intended impact, or long-term aims, of the program are defined, alongside the conditions required to achieve them. Then the ToC is formed by thinking backwards to identify pathways that link the other components of the ToC from inputs, activities, outputs and outcomes, leading finally to the intended impact.

ToCs tend to focus on the mechanisms and processes by which a program may affect individual-level health or wellbeing. An individual health ToC typically focuses on behaviour change, access to services, or treatment outcomes for a person or group. It often involves direct interventions like education, clinical care, or lifestyle support which can be later used to support clinical guidelines. In contrast, a health equity ToC takes a systems-level approach, examining how structural factors such as socioeconomic inequality, racism, policy constraints, and unequal access to care shape wellbeing. By making these determinants explicit, a ToC that focusses on health equity may support the design of interventions that challenge existing inequities and foster an inclusive approach that can be more responsive to marginalized populations.

Terminology

Here we focus specifically on NBTs, which we initially defined broadly as “a therapeutic intervention that utilizes exposure and interaction with nature to enhance individuals’ health and wellbeing”. However, we acknowledge the variation in terminology used across disciplines and countries to refer to similar interventions, such as nature-based interventions, green care, or others. Further, within the study of NBTs, we are aware of many terms (i.e, horticultural therapy vs gardening therapy vs therapeutic horticulture, or forest therapy vs forest bathing, to name a few) used to refer to interventions which we would consider to

be NBTs, and which have in common the type of setting and activities which they include. Thus, here we intentionally use broad and less specific terms (i.e., “gardening-related”, “forest-related”, and “blue-related”, see below) to refer to the different types of NBTs with which our various consortium members and respondents work. Our intent was to use these broad descriptive terms to draw together interventions based on similar theoretical assumptions regarding the therapeutic benefits of nature for mental health, and not to enter into debate about which terms are “correct”.

The eDelphi Method

We employed an iterative eDelphi process (see Fig. 1) to elicit knowledge about the mechanisms, processes and context by which participation in NBTs may improve mental health and wellbeing equity. This methodology has become popular in health and social science research (29–31). It is an iterative consensus-building method that combines group expert opinions based on the principle that the determinations of a group are more accurate than those of individuals. The eDelphi survey was designed by members of the GreenME consortium during a series of three meetings held in summer 2024. The group included seven researchers and one NBT practitioner, and included members from all consortium partner countries where NBT evaluations are being conducted (Spain, the United Kingdom, Italy and Sweden).

The eDelphi survey was designed to understand: 1) how NBT can improve individual adult mental health and wellbeing, and 2) how the NBT may impact mental health and wellbeing equity at a population level.

The eDelphi process is summarized in Fig. 1.

eDelphi: Round 1 Survey

The Round 1 Survey was designed to elicit unique responses to a series of questions regarding various components of the Theory-of-Change; respondent demographics and roles in administering NBT of respondents (level and type of experience with NBT); and two questions to set the stage for the topic of the survey (one on the definition of “nature-based therapy” and the other on the intended impact of NBT). Responses to these items were used to compare across disciplines, to define the purpose of the ToC and to refine the (intended) “Impact” section of the ToC.

The final section of the Round 1 survey aimed to elicit the understandings of respondents regarding how and why nature-based therapies work to improve adult mental health and to impact mental health equity. Thus, we designed a set of questions responding to each of the standard components of a ToC (i.e. contextual factors, inputs, activities, outputs, outcomes, impact- to complement what was already agreed upon regarding the intended impact of such interventions).

We specified the three types of NBTs on which we focused (as described above): “gardening-related” (horticulture-based, such as horticultural therapy and similar), “forest therapy/forest bathing” (forest bathing, and similar) and “blue therapy” (those involving blue space). We first asked respondents to report

whether they had experience or expertise regarding each type independently, adding an “other type of nature-based therapy” category to capture any expertise related to an NBT type we had not explicitly included. We then elicited responses for the set of questions independently for each type of therapy as the mechanisms by which each may work may be different. Only those who answered “yes” to having experience or expertise for each type were then asked to answer questions regarding that respective type of NBT. Those who reported experience or expertise in more than one type of NBT were asked the set of questions separately for each type, directing the respondent clearly to think only about one type of NBT at a time.

To address the second goal of understanding how NBT may impact mental health and wellbeing equity, two additional questions in the eDelphi Round 1 survey informed the ToC components of assumptions and external factors. These were: 1) "What are the enablers for all populations to be able to access and benefit from [NBT TYPE]?" and 2) "What are the challenges that may preclude some population groups from accessing and benefiting from [NBT TYPE]?"

In September 2024, the Round 1 survey was first piloted by distributing it only to one representative from each of the case studies being evaluated in the parent project (n = 7). After improving the survey according to pilot participants comments, in October 2024, we distributed the invitation to participate, including a link to the Round 1 survey, by email to members of GreenMe and similar ongoing projects (RESONATE, NatureLAB and RECETAS). We sent 3 reminder emails to the consortia before considering recruitment to be complete.

The Inclusion criteria included being a member of the GreenME or similar ongoing project consortia, being an adult, and having professional experience in nature and health/wellbeing. This study was approved by the ethics committee of Universitat Autònoma de Barcelona with approval number CEEAH 7146. The participants provided written informed consent. All methods/study procedures were carried out in accordance with the Declaration of Helsinki. All participants were informed about the purpose of the study, assured of confidentiality, and provided written consent prior to participation. Participation was voluntary, and respondents could withdraw participation at any time without consequence.

eDelphi: Round 1 Analysis

Upon conclusion of Round 1, the data was compiled and analyzed. Responses for each question were grouped and reviewed for similarity. HVSC and EZE led this work, but any responses difficult to interpret and the final list of statements were reviewed by the whole research team.

eDelphi: Round 2 Survey

The Round 2 survey was constructed using the individual statements received in response to the Round 1 survey, as described above. The Round 2 survey was organized in the same way as the first, but items consisted of statements to be rated for importance (on a scale of 1-least to 5-most important) and relevance (on a scale of 1-least to 5-most relevant). The resulting list of statements included: suggestions

for how to change the definition of NBT to make it more accurate, suggestions for ways to further clarify the intended impact of NBT, and a list of responses corresponding to each of the components of the standard ToC, which together are understood to lead to the intended impact (i.e. contextual factors, inputs, activities, outputs, and outcomes), and two questions to better understand how the use of NBT may be related to health equity (enablers and challenges). The list of statements for the first two items (definition and impact) was formulated as a multiple-response question asking respondents to select the statements they agreed with to improve the definition and intended impact. The list of statements was organized by component with each component presented as a sub-survey. The full Round 2 survey is available in Annex 2.

In November 2024, we invited all respondents from the Round 1 survey to participate in the Round 2 survey by email, again sending 3 reminders in order to elicit as many responses as possible.

eDelphi: Round 2 Analysis

The first two questions on the Round 2 survey, which asked participants to vote on which suggested changes to the definition of NBT and the intended impact of NBT they agreed with, were analyzed by calculating a percentage of respondents voting for each change. We then identified the changes with votes from at least 35% of the respondents and incorporated them into the final definition and intended impact.

For the remaining survey items we followed the methods used in past (e)Delphi studies (37, 39). Specifically, for each item indicating a specific suggestion from respondents to the Round 1 survey in each of the categories included, we calculated the average importance and relevance scores, where importance and relevance were scored on a scale of 1 to 5 with 5 indicating the most important or relevance. We then calculated a composite score using the formula: $\text{Composite} = (\text{Importance} \times 0.6) + (\text{Relevance} \times 0.4)$. To assess the extent to which respondents agreed on each item, we calculated the coefficient of variance of the composite score for each item: $\text{Coefficient of variance} = (\text{standard deviation of the composite score} / \text{mean composite score})$. We considered items to be important, relevant, and agreed upon if the mean composite score was 3.5 or greater and if the coefficient of variance was less than 0.25. Conversely, items with a composite score below 3 and a coefficient of variance of less than 0.25 were considered not important and relevant by respondents. We also identified items where respondents strongly disagreed on importance and/or relevance as those where coefficients of variance were greater than 0.45 (37, 39).

Finally, based on the statements where respondents agreed on a high level of importance and relevance, we formulated the theory-of-change.

Results

Survey Respondents

In all, we received responses from 25 participants for the Round 1 survey (see Table 1). A large majority of our Round 1 respondents were women, mostly aged > 54 years or older and with a doctoral degree or equivalent. Almost all working in Europe (only 8% from outside Europe, including US and United Arab Emirates). Most of them worked on research or evaluation of NBT. Most had less than 10 years of experience in the field of green care and worked in urban settings. Overall, 56% of our Round 1 respondents worked in outdoor settings (garden, forest or in an urban green setting) and the rest worked indoors in a diversity of settings. The majority (76%) worked in the research/evaluation sector with others working in related fields such as communication, education, training, administration, policy and the implementation of nature-based therapies.

Table 1
Demographic characteristics of the Round 1 respondents

Total Round 1 Responses	N	%
	25	
Age		
25–34 years	7	28
35–44 years	4	16
45–54 years	2	8
55–64 years	12	48
Gender		
Woman	21	84
Man	4	16
Highest Level of Education		
Less than Master's Degree or equivalent	1	4
Master's Degree or equivalent	11	44
Doctoral Degree or equivalent	14	56
Experience*		
More than 20 years	5	20
Between 10 and 20 years	5	20
Between 5 and 10 years	5	20
Less than 5 years	10	40
Country		
France	1	4
Germany	3	12
Italy	2	8
Poland	3	12
Portugal	2	8
Spain	3	12
*Results are included here for years of experience following the categories included on the original survey. We acknowledge an error in the categories such that they are not mutually exclusive.		

Total Round 1 Responses	N	%
	25	
Age		
Sweden	2	8
United Arab Emirates	1	4
United Kingdom	7	28
United States	1	4
Setting		
Urban	18	72
Peri-urban	3	12
Rural	1	4
All	2	8
No particular setting	1	4
Work Environment		
Garden	7	28
Forest	3	12
Urban green/urban planning	4	16
University/Education	3	12
Office	3	12
Indoor space	1	4
No specific work environment	1	4
All of the above	3	12
Sector		
Research or evaluation	19	76
Communication including communication via public awareness campaigns or to the media	2	8
Environmental Protection/ Nature conservation	2	8
Nature-based intervention provider	4	16
*Results are included here for years of experience following the categories included on the original survey. We acknowledge an error in the categories such that they are not mutually exclusive.		

Total Round 1 Responses	N	%
	25	
Age		
Education, training or professional development	9	36
Advocacy	2	8
Administration, including promotion or policy change	1	4
Social services	1	4
Territory planning	2	8
Consulting, knowledge exchange or experience exchange	3	12
*Results are included here for years of experience following the categories included on the original survey. We acknowledge an error in the categories such that they are not mutually exclusive.		

[INSERT Table 1]

There were only four completed responses regarding forest-related, three completed responses for blue-related and three responses for other types of NBTs (each reporting on a distinct type of NBT). Of those responding for each type of NBT, one respondent referred back to their responses for gardening-related NBT, leaving only one or two unique sets of responses for each non-gardening type NBT. This would have been too few to reach consensus among the respondents, therefore we only included “gardening-related” NBT statements on the Round 2 survey.

A total of 19 respondents completed the Round 2 survey, of which 11 responded only to the first two sections (definition and intended impact) due to not having specific expertise or experience in “gardening-related” types of NBTs.

Refining the definition of Nature-based Therapies

Regarding suggestions for modifying the initial definition of nature-based therapy provided in the Round 1 of the eDelphi (i.e., “a therapeutic intervention that utilizes exposure and interaction with nature to enhance individuals’ health and wellbeing.”), 10 respondents did not suggest any changes to the proposed definition. Changes suggested by the remaining 15 respondents were distilled into 9 unique statements to include on the Round 2 survey by combining statements that were similar or the same in meaning. Table 2 includes the number and % of Round 2 respondents agreeing with each suggested change to the original definition. The suggested changes are listed in Table 2.

Table 2
Suggested changes to the proposed definition of Nature-based Therapy.

Suggested Change	N	%
...a therapeutic intervention that utilizes exposure and interaction with nature to enhance individuals' physical and mental health and well-being.	8	42.1
...a therapeutic intervention directed by a trained facilitator that utilizes exposure and interaction with nature to enhance individuals' health and well-being.	8	42.1
...a therapeutic intervention in an indoor or outdoor setting that utilizes exposure and interaction with nature to enhance individuals' health and well-being.	7	36.8
...a therapeutic intervention that utilizes exposure and connection with nature to enhance individuals' health and well-being.	5	26.3
...a therapeutic intervention that utilizes exposure and interaction with nature to support and/or enhance individuals' health and well-being.	4	21.1
...a therapeutic intervention that utilizes exposure and interaction with nature to enhance individuals' health and well-being in a context of promoting a relationship with nature and with other human beings.	3	15.8
...a therapeutic intervention that utilizes exposure and interaction with nature to treat disease and/or enhance individuals' health and well-being.	2	10.5
...a therapeutic intervention that utilizes bespoke exposure and interaction with nature to enhance individuals' health and well-being.	2	10.5
...a therapeutic intervention that utilizes exposure and interaction with nature and plants to enhance individuals' health and well-being.	2	10.5
No change	2	10.5

We selected as statements to include the three specific changes for which over 35% of respondents voted. These included: the need to specify both physical and mental health, the need to add a phrase about a trained facilitator, and the need to specify that NBTs can be conducted either outdoors or indoors. The final revised definition, incorporating these top voted changes is: *"a therapeutic intervention directed by a trained facilitator in an indoor or an outdoor setting that includes exposure to and interaction with nature to enhance individuals' physical and mental health and well-being."*

Clarifying the Intended Impact of NBT

Regarding suggestions for clarifying the initial intended impact of NBTs (i.e. "a contribution to adult mental health and wellbeing equity"), 12 respondents did not suggest any changes to the proposed expected impact. From the remaining 13 respondents, we received 7 unique responses (accounting for the same or similar suggestions made by multiple respondents) which were later distilled into 5 unique statements to include on the Round 2 survey by combining statements that were similar or the same in meaning. These statements are listed in Table 3.

Table 3

Suggested changes to the **intended impact** of Nature-based Therapy and votes in support of each change from the Round 2 survey.

Suggested Change	N	%
...a contribution to adult mental health and wellbeing equity and to environmental health, conservation, awareness, and resilience, and to community and social cohesion.	9	47.4
...(1) a contribution to adult mental health and wellbeing and (2) a contribution to mental health and wellbeing equity.	8	42.1
...a contribution to adult mental health and wellbeing equity, a method to realize cost effective self-care, and a method to maintain health benefits even after the intervention has ended.	6	31.6
... a contribution to both individual and population-level adult mental health and wellbeing equity.	5	26.3
None of the above, the original wording is best.	3	15.8

Similar to the results for the definition, few respondents (only 16%) felt that no change was needed to the initially suggested impacts of NBTs. Meanwhile, 2 suggestions received a relatively high number of votes (greater than 35%). Specifically, almost half of the respondents felt that the impact should include the potential of nature-based therapies to contribute to broader societal and environmental phenomena by adding “environmental health, conservation, awareness, and resilience and to community and social cohesion.” Over 40% also felt that it was important to separate the contribution to individual health and wellbeing to the contribution to health and wellbeing equity. Taking this into account, the revised understanding of the aim of Nature-based Therapies expands to be *“in addition to improving the mental health and wellbeing of individual adult participants, NBTs aim to contribute to adult mental health and wellbeing equity, environmental health, conservation, awareness, and resilience, and to community and social cohesion.”*

Gardening-related NBT Responses

We received responses from 11 respondents who reported having experience or expertise with gardening-related NBTs. Responses about contextual factors that contribute to whether or not an NBT is successful for improving adult mental health related to the following themes: time spent in the NBT, physical characteristics of the setting of the NBT, social characteristics of the setting of the NBT, misconceptions or preconceptions regarding NBT, funding and policy priorities, characteristics of NBT facilitators, access and programming of NBTs. A high level of importance and relevance was reported and agreed upon for nine suggested contextual factors while for two of the statements there was substantial disagreement between participants. The responses are listed in Table 4.

Table 4

Composite importance/relevance scores from the round two survey for suggested **contextual factors** affecting gardening-related therapies.

Contextual Factors	N	Mean	Std.	Min	Max	Coef. of Variance
Gardening-related therapy can be affected by the amount of time participants have to participate.	8	4.0	0.974	2.6	5.0	0.243*
Gardening-related therapy should be conducted outdoors	8	2.5	1.238	1.0	4.0	0.495 [†]
Gardening-related therapy should include work that changes or impacts the physical setting used for the therapy.	8	2.8	1.517	1.0	5.0	0.537 [†]
Those engaged in gardening-related therapy should have agency over the physical setting used for the therapy.	8	3.5	1.166	2.0	5.0	0.333
Gardening-related therapy can be affected by lack of quiet spaces.	8	4.2	1.278	1.6	5.0	0.304
Gardening-related therapy can be affected by weather.	8	2.9	1.106	1.6	5.0	0.378
Gardening-related therapy should include taking care of a plant.	8	3.8	1.202	2.0	5.0	0.314
Gardening-related therapy can be affected by the availability of healthcare settings that use it.	8	3.8	0.941	2.0	5.0	0.246*
Gardening-related therapy should include working with others.	8	3.7	0.986	2.4	5.0	0.266
Gardening-related therapy can be affected by hierarchy, whether real or perceived, among participants.	7	3.6	1.169	2.0	5.0	0.322
Gardening-related therapy is affected by misconceptions from health professionals and/or potential participants.	8	3.9	0.755	3.0	5.0	0.192*
Gardening-related therapy is affected by its lack of recognition as a legitimate form of health care.	8	4.4	0.693	3.2	5.0	0.157*
Gardening-related therapy is affected by lack of funding.	8	4.6	0.789	3.2	5.0	0.172*
Gardening-related therapy is affected by public health priorities and/or policies.	7	4.5	0.929	3.0	5.0	0.208*
Gardening-related therapy is affected by availability of therapy facilitators or healthcare	8	4.2	0.696	3.2	5.0	0.165*
*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.						
[†] Indicates items for which a high level of disagreement was found between participants.						

Contextual Factors	N	Mean	Std.	Min	Max	Coef. of Variance
professionals.						
Gardening-related therapy is affected by the therapy facilitators' welcoming attitude and ability to accommodate the needs of participants.	8	4.9	0.238	4.4	5.0	0.049*
Gardening-related therapy is affected by ease of access to healthcare sites.	8	4.4	0.904	3.0	5.0	0.204*
Gardening-related therapy is affected by diversity of facilitated programs or activities.	8	3.7	1.233	1.0	5.0	0.333
*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.						
†Indicates items for which a high level of disagreement was found between participants.						

[INSERT Table 4]

Responses about activities that are important for understanding how NBTs work to improve adult mental health, included the following themes: activities that involve some type of physical activity or actions (particularly those that involve person-garden/plant interactions such as sowing seeds, watering, etc.), activities done in groups, the structure of activities involved in NBTs, mindfulness activities, individual activities, and learning activities. A high level of importance and relevance was reported and agreed upon for seven suggested activities whereas for two of the statements, there was substantial disagreement between participants. The responses are listed in Table 5.

Table 5
Composite importance/relevance scores from the round 2 survey for suggested **activities** forming part of gardening-related therapies.

Activities	N	Mean	Std.	Min	Max	Coef. of Variance
Physical activity that requires concentration	8	3.28	1.053	1.0	4.4	0.321
Physical activity that materially changes a gardening-related therapy site	8	2.45	0.906	1.0	4.0	0.370
Activities such as: sowing or propagating seeds, watering, cleaning tools, and/or harvesting	8	4.55	0.499	4.0	5.0	0.110*
Walking through a gardening-related therapy site	8	4.00	1.069	2.0	5.0	0.267
Group activity	8	4.00	0.786	3.0	5.0	0.196*
Observing others engaged in gardening-related therapy	8	2.80	1.126	2.0	5.0	0.402
Scheduled activity.	7	4.00	1.000	3.0	5.0	0.250*
Activity conducted under the supervision of a trained facilitator	8	4.38	0.744	3.0	5.0	0.170*
Activity that has a goal	8	4.38	0.916	3.0	5.0	0.209*
Individualized activity (e.g., activity tailored to a specific participant's needs)	8	4.38	0.744	3.0	5.0	0.170*
Auditory activity (e.g., listening to the sounds of a gardening-related therapy site)	8	3.70	0.763	3.0	5.0	0.206*
Meditating	8	2.88	1.356	1.0	5.0	0.472 [†]
Breathing exercises	8	2.85	1.321	1.0	5.0	0.464 [†]
Researching horticulture and agriculture	7	2.66	1.136	1.0	4.6	0.427

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

[†]Indicates items for which a high level of disagreement was found between participants.

Responses about the resources needed (i.e., inputs) for NBTs included: physical space, staffing, funding, policies, awareness and tools. A high level of importance and relevance was reported and agreed upon for eight suggested resources. The responses are listed in Table 6.

Table 6

Composite importance/relevance scores from the round two survey for suggested **resources needed (i.e., inputs)** to conduct a gardening-related therapy program.

Resources	N	Mean	Std.	Min	Max	Coef. of Variance
Intentionally-designed physical space	8	3.5	1.121	1.0	4.6	0.323
People who initiate activities and tend the gardening-related therapy site all year round	8	4.4	0.729	3.0	5.0	0.165*
Community members	8	4.5	0.709	3.0	5.0	0.158*
Ongoing funding	8	4.9	0.354	4.0	5.0	0.073*
Risk management policies	8	4.8	0.463	4.0	5.0	0.097*
Health and safety policies	8	4.9	0.354	4.0	5.0	0.073*
Guidelines and standards	8	4.7	0.465	4.0	5.0	0.100*
Mental health first aid	8	4.7	0.370	4.0	5.0	0.079*
Promotion to raise awareness	8	4.2	0.682	3.0	5.0	0.164*

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

Tangible, measurable outcomes related to NBTs included: effects on individuals, social impacts, cost-savings, and cultural changes. A high level of importance and relevance was reported and agreed upon for four tangible, measurable results. The responses are listed in Table 7.

Table 7

Composite importance/relevance scores from the round two survey for suggested tangible, measurable results (i.e., **outputs**) of gardening-related therapies.

Results	N	Mean	Std.	Min	Max	Coef. of Variance
Increase of the number of participants in gardening-related therapy	8	4.1	0.997	2.0	5.0	0.243*
Increase in the number of people gardening	8	3.8	1.232	2.0	5.0	0.328
Increase in participants' gardening skills	8	3.4	1.236	1.6	5.0	0.369
Self-reported improvement in participant's mental health and wellbeing (e.g., decrease in stress and anxiety)	8	4.9	0.354	4.0	5.0	0.073*
Increased interest in rethinking possible uses for green spaces	7	3.9	1.274	1.6	5.0	0.323
Increase in participants socializing and sharing experience or skills with other participants	8	4.8	0.385	4.0	5.0	0.080*
Increase in socialization between a participant and their wider community	8	4.2	0.935	3.0	5.0	0.224*

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

Longer term outcomes suggested included: effects on individuals including specific measurable aspects of mental health and wellbeing, effects on social interactions, effects on society, and effects on the therapy program itself. A high level of importance and relevance was reported and agreed upon for 11 broader, longer-term impacts (referred to as outcomes in the theory-of-change literature). The responses are listed in Table 8.

Table 8

Composite importance/relevance scores from the round two survey for suggested broader, longer-term impacts (i.e., **outcomes**) of gardening-related therapies.

Longer-term Outcomes	N	Mean	Std.	Min	Max	Coef. of Variance
Participants feeling more connected to others and/or developing an increased sense of belonging	8	4.7	0.465	4.0	5.0	0.100*
Participants being more able to function in wider society	8	4.1	0.623	3.0	5.0	0.151*
Participants developing an affinity for gardening	8	4.0	0.621	3.0	5.0	0.157*
Participants feeling more connected to nature	7	4.3	1.045	2.2	5.0	0.242*
Participants engaging in more pro-environmental behaviors	8	3.7	0.925	2.2	5.0	0.248*
Participants increasing their physical activity	8	4.5	0.731	3.0	5.0	0.164*
Reduction in the prevalence or impact of health inequalities and social inequalities	8	4.1	0.991	3.0	5.0	0.240*
Reduction in the demand for other healthcare services	8	4.3	0.709	3.0	5.0	0.164*
Increased awareness about the benefits of NBT from healthcare professionals, the government, and/or other institutions	8	4.6	0.731	3.0	5.0	0.161*
Increased awareness by the general public of gardening-related therapy programs	8	4.6	0.454	4.0	5.0	0.099*
Increase in the number of referred/self-referred participants	8	4.2	0.935	3.0	5.0	0.224*

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

Non-Gardening Related NBT Responses

Here we describe responses received relating to NBTs of all categories not relating to horticultural/gardening (i.e., forest therapy/forest bathing, blue therapy, and those responding in the “other” category). Of the 25 respondents, five reported having experience or expertise in forest-related NBTs, and three reported having experience or expertise in blue-related NBTs. However of those, one did not respond to further questions in these categories and one respondent referred back to their answers for gardening-related therapy for the majority of answers. This left three valid responses for forest-related NBT and one for blue-related NBT.

Answers relating to the contextual factors for forest-related therapies included the (increased) need for forest-related therapies, such as higher levels of stress-related disorders, hectic urban environments, lack

of understanding about the effectiveness of forest-based therapies and overburdened primary care, and supporting factors such as the existence of natural areas and laws supporting forest accessibility.

Specific activities mentioned for forest-related NBT included those activities specifically led by professional guides, the existence of trails with signage for guided activities, activities that are physical in nature (such as walking), social activities (such as chatting), and activities that involve multisensorial input. Other suggestions include the need for activities to be adapted to individual participants' needs and conducted in a safe and structured environment. Resources needed for forest-related NBT included funding, trained professional guides, space to conduct forest-related NBTs, integration in healthcare systems and the existence of health and safety risk assessments and mental health first aid policies, and the existence of clinical recommendations for participating in forest-related therapies

Measurable results from forest-related NBTs included individual-level physical changes, individual-level changes in mental health or wellbeing, and societal changes such as an increase in the number of people participating in forest-related NBTs and the existence of more forest-related therapy programs. Meanwhile, long-term outcomes and impacts from forest-related NBTs included individual-level measures of mental health or wellbeing like improved self-esteem, improved mental health or wellbeing symptoms, greater physical activity, and better ability to function in society. Other expected long-term outcomes and impacts included both individual impacts, such as having a better overall sense of nature-connectedness, and community or societal impacts, such as there being more participants in forest-related NBT programs, and a decrease in the burden on primary health care providers (due to participants receiving needed care via participation in NBT programs).

Responses regarding blue-related NBT included contextual factors such as the importance of a lack of understanding by the general public and healthcare providers about the effectiveness of blue-related NBTs for treating mental health, a lack of available accessible treatment for mental health conditions in general due to a lack of funding and an over-burdened primary care system. Other contextual factors related to the setting itself, including issues related to the cleanliness of blue space, safety measures, and the availability of rest facilities.

Specific activities that are part of blue-related NBTs included specific physical activities that engaged with water such as swimming, fishing, boating, and surfing. They also included aspects of the activities such as the need to be adapted for participants' individual needs and to be conducted in safe and structured environments. Resources mentioned by respondents that are needed for blue-related NBTs included funding, trained professionals to deliver the therapy, safe and accessible (free) blue facilities, and policies and procedures regarding health and safety and mental health first aid.

Measurable results for blue-related NBT reported by respondents included individual-level changes such as improvements in mental health, generally positive feelings, and willingness to continue participating, as well as improvements in physical health outcomes. These also included societal changes such as there being more people participating in forest-related therapies, more people actively involved with blue-related activities and spending time in nature. Long-term outcomes and impacts for blue-related NBT included

individual-level measures of mental health or wellbeing like improved self-esteem, improved mental health or wellbeing symptoms, greater physical activity, and better ability to function in society. Other expected long-term outcomes and impacts included societal impacts such as there being more participants in blue-related NBT programs and a better sense of nature-connectedness.

In addition, three respondents provided answers about NBTs that did not fall into the three broad categories (specifically, wilderness therapy, social farming, and landscape immersion therapy). Only the respondent reporting about landscape immersion therapy provided details for each aspect of the theory-of-change, largely commenting on how specifically designed landscapes, for example in urban areas, could provide a form of NBT even if viewed passively by those living or passing through the area. As the richness of data on other types of NBT was very limited we are only including gardening, forest- and blue-related NBTs in the ToC presented in this study.

Linking NBT to Health Equity

We assessed the link between NBT and health equity on a population scale with two items: enablers and challenges to ensuring that all populations are able to access and benefit from NBT. Responses about enablers for all populations to be able to access gardening-related NBTs included suggestions related to: ease of access, funding, awareness, promotion and programming, and facilitator characteristics. A high level of importance and relevance was reported and agreed upon for 11 enablers. The responses are listed in Table 9.

Table 9

Composite importance/relevance scores from the round two survey for suggested **enablers** for all populations to be able to access and benefit from gardening-related therapy.

Enablers	N	Mean	Std.	Min	Max	Coef. of Variance
The gardening-related therapy program having no age or health restrictions	8	4.5	0.717	3.0	5.0	0.160*
The gardening-related therapy program being located in close proximity to centers of population	8	4.2	0.767	3.0	5.0	0.181*
A participant having access to transportation	8	4.7	0.465	4.0	5.0	0.100*
A participant having access to health care that prescribes the therapy	8	4.5	0.701	3.2	5.0	0.155*
A participant having priority access to a gardening-related therapy site if it is otherwise public (e.g., community garden)	8	4.1	1.155	2.0	5.0	0.285
A participant receiving funding to attend the therapy	8	4.9	0.278	4.4	5.0	0.057*
Gardening-related therapy being low cost or no cost	8	3.8	1.232	2.0	5.0	0.328
Integration of the therapy in publicly-funded institutions	8	4.3	0.882	3.0	5.0	0.205*
Gardening-related therapy being recognized as a viable treatment	8	4.8	0.463	4.0	5.0	0.097*
A healthcare system having a holistic view of healthcare at large	8	4.6	0.499	4.0	5.0	0.110*
Continuity of programming/activities and staffing for the gardening-related therapy program	8	4.3	0.886	3.0	5.0	0.209*
Promotion (e.g., advertisements, public awareness campaigns)	8	4.1	0.438	3.4	5.0	0.108*
Facilitators that empower patients to feel confident in the space	8	4.5	0.535	4.0	5.0	0.119*

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

Meanwhile, statements about challenges that may preclude some populations from accessing gardening-related NBTs included statements related to challenges around: funding/finances, physical/environmental qualities, cultural norms, perceptions, pre-existing social or health conditions, transportation, aspects of the programming or facilitators, and the complexity of NBTs. A high level of importance and relevance was reported and agreed upon for 10 challenges. The responses are listed in Table 10.

Table 10

Composite importance/relevance scores from the round two survey for suggested **challenges** that may preclude some population groups from accessing and benefitting from gardening-related therapy

Challenges	N	Mean	Std.	Min	Max	Coef. of Variance
Funding	8	4.8	0.385	4.0	5.0	0.080*
Inadequate space	8	4.4	0.762	3.0	5.0	0.175*
Cold weather	8	3.0	1.030	2.0	5.0	0.349
Feeling physically uncomfortable in the space	8	4.1	0.512	3.2	5.0	0.124*
Different cultural norms in relation to growing food	8	3.2	1.110	1.8	5.0	0.352
Perception that gardening-related therapy is not a viable form of treatment	8	4.3	0.785	3.0	5.0	0.182*
Unwillingness to try a non-clinical approach	8	4.4	0.560	3.6	5.0	0.128*
Mental health challenges or other special educational needs (e.g., that which may make attending a gardening-related therapy program difficult)	8	4.2	0.873	3.0	5.0	0.210*
Lack of transportation options	8	4.3	0.463	4.0	5.0	0.109*
Lack of understanding about gardening-related therapy	8	4.4	0.838	3.0	5.0	0.189*
Lack of facilitators for gardening-related therapy	8	4.6	0.648	3.4	5.0	0.142*
Lack of programming for gardening-related therapy	6	4.5	0.548	4.0	5.0	0.122*
Complexity of gardening-related therapy compared to other forms of medicine (e.g., taking a pill)	8	3.3	0.732	2.0	4.0	0.224

*Indicates items for which a high level of agreement and rating of importance and relevance was found between participants.

In terms of forest-related NBTs, enablers to support all populations to be able to access forest-related NBT included having access to forests/green space (living in close proximity, for example, or having easy transportation access), having access to mental health care, the capacity of one forest guide to serve multiple participants, and carefully planned and organized walks. Challenges that may preclude some population groups from accessing and benefitting from forest-related therapies included cultural differences around nature (such as forests being seen as unsafe or alien), complex mental health symptoms, lack of facilitators, or poorly trained facilitators, lack of access to forests and lack of resources/funding to participate.

Regarding blue-related NBTs, enablers for all population groups to access and benefit from blue-related therapies included making these therapies free to participate in. Meanwhile, challenges that may preclude some population groups from accessing or benefiting from blue-related therapies included a lack of access to blue space (the space being too far from the participants), lack of transportation options, perception that the therapy is not a viable form of care, mental health challenges which may prevent attendance, and lack of funding.

Synthesizing the Theory-of-change

After calculating the average importance, relevance and composite scores for each item on the Round 2 survey, we then selected those items with high importance and relevance (depending on the composite score) and high agreement between participants (judged by the coefficient of variance for each item) as those to include in the final theory-of-change. Two members of the research team then reviewed each item meeting these selection criteria by category to determine how they fit within the overall theory-of-change.

Although the Round 2 survey was limited to responses about gardening-related types of NBTs due to the small number of responses from those with expertise in other types of NBTs, we reviewed the Round 1 responses for forest-related NBTs and blue-related NBTs to determine how they could be incorporated in the final theory-of-change and whether the responses indicated that separate theories-of-change were justified for each broad type. As there was substantial overlap among the responses for these three types (gardening-, forest-, and blue-related), we determined that all of the responses could be combined into one theory-of-change with specifications for items related specifically to only one type of NBT. Specific activities related to blue-related therapy are specified in the final model. Of note, both blue-related therapy and forest-related therapy require access to public/free open space (blue space and forests, respectively), which can be supported by laws and other policies protecting free and open access to these environmental resources. This was less necessary for gardening-related therapy, which more often occurs in private gardens and requires far less open space.

Finally, we discussed how to incorporate impacts on health equity, and not only individual-level impacts, into the theory-of-change. Ultimately, we decided to include three levels of outputs, outcomes and impacts in the theory-of-change: individual (relating to individual level changes and outcomes among NBT participants), community and system (relating to community and system level changes, such as those which may lead to better or worse health equity).

The final Theory-of-Change is summarized in Fig. 2.

Discussion

This study set out to develop a Theory of Change (ToC) to better understand how nature-based therapies (NBTs) improve mental health and wellbeing and contribute to mental health equity. Drawing on expert consensus through an eDelphi process, and focusing on three specific types of NBTs (gardening-related, forest therapy/forest bathing, and blue therapy), our findings provide a structured account of the mechanisms, activities and contextual factors that shape the effectiveness of NBTs at both individual and

population levels. The study advances the current evidence by moving beyond questions of efficacy to clarify how NBTs are understood to work, for whom, and under what circumstances they may contribute to equitable outcomes. This helps to identify the opportunities and constraints associated with scaling up NBTs and integrating them into health systems in ways that support equity.

Defining Nature-Based Therapies

Within the parent project consortium, and among researchers and practitioners in the field of green care, contrasting opinions emerge regarding how to define NBT, and whether and how to differentiate it from other types of nature-based interventions. One key debate on this topic concerns whether or not a NBT must include the guidance of a trained therapist or facilitator (and, following this, what type and level of training must a nature-based therapist have). Past studies on the efficacy of NBT have included many distinct definitions and operationalizations of NBT, with (40, 41) and without (42, 43) the inclusion of a trained therapist or guide, which enhances the lack of consistent and robust scientific evidence on NBTs and health outcomes. Moreover, this follows from a lack of formal oversight and professionalization of NBT practitioners in many countries (44). At the same time, several systematic, or umbrella reviews, and studies discussing the mechanisms by which NBTs work conclude that facilitators' skills, approach, confidence, and knowledge of the natural environment may affect the interventions' outcomes (14, 45).

Another key debate centers on the setting or type of nature present in the NBT. Ultimately, respondents agreed that the definition of NBT should specify that the intervention can be conducted outdoors or indoors. This is in line with past studies which have found positive effects of interventions involving exposure to indoor nature-based activities, which may also be a way to include those for whom accessing outdoor areas may be difficult due to mobility limitations (46). Note that while suggesting that both indoor and outdoor environments should be included, our respondents did not mention the potential inclusion of virtual nature. Exposure to virtual nature has been tested in several studies and at least one meta-analysis found that is inferior to "real" nature in producing a positive effect on mood (47).

The NBT Theory-of-Change

Across those modalities of NBT which were the focus of this study, from gardening-related, to forest-based and blue space-related, recent research, and our ToC, report a range of long-term outcomes at individual, social, and systemic levels (28, 45). These outcomes reflect the holistic benefits of nature engagement and its influence on mental health and overall quality of life. Recent umbrella-review evidence similarly suggests that flourishing at the interface between humans and natural environments may be supported through multiple interacting mechanisms, including stress reduction, attentional restoration, social connectedness, physical activity, and nature connectedness. The pathways identified as part of our ToC are broadly consistent with this evidence and further highlight the importance of considering how these mechanisms interact across individual, community, and system levels (27). Respondents involved in the ToC process reported a heightened sense of connection to nature, which is linked to increased emotional resilience, mindfulness, and pro-social behaviour often attributed to the concept of biophilia (48, 49). Areas of disagreement, particularly regarding more structured or mindfulness-based activities (e.g.,

meditation and breathing exercises), may reflect differing theoretical orientations or contextual variations in how NBTs are implemented. In line with past research (17, 50), our analysis also highlighted the role of NBTs in promoting physical activity, whether through walking in forests, swimming in blue spaces, or gardening. This physical engagement contributes to improved physical health, which in turn supports mental wellbeing. Importantly, the ToC revealed how NBTs can enhance physical activity and social interaction, both of which are known to positively influence emotional wellbeing, strengthen social bonds, and deepen individuals' connection to nature (50). The ToC highlights that these mechanisms do not operate in isolation but are contingent on enabling conditions such as access, facilitation, and institutional support, reinforcing the need to understand NBTs as complex, context-dependent interventions.

System-Level Impact and a Health Equity Perspective

Our findings extend existing literature by offering one of the first structured, stakeholder-informed ToC linking NBTs not only to individual mental health outcomes but also to equity-related pathways at community and system levels. While previous evidence syntheses have identified several mechanisms through which interactions with nature may promote wellbeing, including psychological, social, physical, and environmental pathways (27), these mechanisms have rarely been examined from an explicit health-equity perspective. The present ToC extends this work by highlighting how factors such as accessibility, transportation, public funding, institutional recognition, and integration into healthcare systems may shape who is able to benefit from these NBTs. To assess the equity of NBT provision, we examined the resources employed by providers to enable fair and just access, and evaluated whether these approaches were culturally sensitive and addressed systemic barriers, including stigma associated with mental ill-health. Fundamentally, our aim was to understand the conditions under which NBTs foster environments where all individuals, particularly those from underserved or marginalized communities, can flourish mentally and emotionally.

Findings from the ToC support the integration of NBTs into public health and mental health equity strategies by increasing their inclusivity and accessibility. Their (perceived) cost-effectiveness, and potential to be made more accessible and saleable make them compelling options for community-based mental health support. Our respondents suggested that by offering preventative, non-clinical support, NBTs can alleviate pressure on primary care and mental health services. This was echoed in Kaleta et al.'s (2025) systematic review, which found that individuals with mild to moderate long-term conditions benefited from nature-based interventions as effective complements to traditional care (51). In order to support this effort, our respondents also advocated for improving the guidelines and standards by which NBTs operate, including the professionalization of NBT facilitation.

Our respondents mention several challenges that may preclude NBTs from reaching all who may benefit from them. For example, respondents agreed that a lack of formal recognition of NBTs as a legitimate form of healthcare, as well as misconceptions about NBTs held by both healthcare professionals and potential beneficiaries of NBT, may prohibit NBTs from inclusion in public health priorities or policies. Rigo and colleagues further highlight the challenges associated with integrating green care interventions in health care systems and policy, including the need to include policy makers from multiple dimensions as

implementing green care strategies, such as NBT, and scaling them up, requires not only input and support from the health care sector, but also from those regulating and governing in the environmental sector and others (28).

Similarly, Kaleta et al. emphasize that successful implementation of NBTs requires a systems-based approach one that not only considers resource inputs but also addresses the structural and cultural shifts necessary for sustainable integration into healthcare systems (51). Their review highlights that while NBTs are diverse and scalable, their effectiveness depends on factors such as duration, frequency, participant motivation, and environmental accessibility. Our ToC findings reinforce the need for tailored implementation strategies that reflect local contexts and population needs, which has also been highlighted in past research (45).

Strengths and Limitations

Drawing on the diversity in field and level of expertise within the GreenME and other ongoing similar projects, our theory-of-change eDelphi process included input from those working in the field in ten countries, as well as researchers and experienced practitioners in the field, providing a rich set of initial data. Notably, 40% of the participants had been working in the field for at least 10 years. A strength is the use of a structured eDelphi approach, which facilitates iterative reflection and refinement of ideas across multiple rounds. This method supports convergence of expert opinion while maintaining anonymity, thereby reducing the influence of dominant voices and group hierarchy that can bias in-person consensus processes. Importantly, we included experts involved in the implementation of NBT, rather than only from the academic/research sector, as in past similar studies (45). This allows us to capture knowledge from those at the forefront of NBT implementation and better incorporate their understanding of how NBT functions on a day-to-day basis and the challenges that might preclude certain populations from accessing it. Finally, the study contributes a structured and transparent articulation of assumed mechanisms underlying NBTs, which can serve as a foundation for future empirical testing. In this sense, the theory of change not only synthesizes existing knowledge but also helps identify gaps and generate hypotheses for subsequent evaluation studies.

However, several limitations should also be acknowledged. First, we did not include among our respondents beneficiaries of NBT, who could have further strengthened the evidence from a personal perspective. Rather, we consider the observations and experiences of those working in NBT implementation as incorporating their firsthand knowledge of how individuals experience NBTs. Second, as participants were largely drawn from related research and practice networks, there may be convergence in perspectives, potentially limiting the diversity of viewpoints captured. The study may also be subject to self-selection bias, as individuals with a stronger interest in NBTs or more favorable views toward their implementation may have been more likely to participate. This could have contributed to an overrepresentation of positive perspectives regarding the feasibility or benefits of NBTs. Furthermore, although the study included participants from several countries, some geographical regions and professional perspectives may still have been underrepresented (e.g., those working in Asia, South America, Africa or Australia did not have a representation in our sample). Consequently, the transferability

of findings to contexts not represented within the sample should be interpreted with caution. Finally, although efforts were made to capture diverse perspectives across research and practice settings, the theory-of-change framework developed in this study has not yet been empirically tested. Future research should therefore examine the proposed mechanisms and pathways in real-world implementation and evaluation studies.

Our study also acknowledges the wide range of settings and modalities in which NBTs are developed, as well as the diversity of understandings on how NBT can be defined. This allowed us to embrace the differences that might be observed in how NBTs in different settings may be similar or different in the mechanisms by which the influence mental health and wellbeing. By working with respondents from several countries, we also have incorporated those challenges and enablers which are similar or different across countries in their efforts to scale up the use of NBT.

Conclusion

This study provides a structured theory-of-change that clarifies how NBTs may improve mental health and contribute to equity across multiple levels. Whilst the findings highlight significant potential for reducing mental health inequities, their impact is unlikely to be equitable by default and instead depends on deliberate design and system-level integration. To fully realize the potential of NBTs in mental health care to promote mental health and wellbeing equity, integration must be adaptive, inclusive, and supported by robust evaluation frameworks. Those working to achieve this goal are met with a number of challenges, including a general mistrust or misconception about the potential of NBTs to be considered a legitimate form of mental healthcare. Still, NBTs have the potential to benefit not only individual mental health and wellbeing, but also to contribute to filling the gaps in healthcare which may lead to mental health and wellbeing inequities at a population level. NBTs can be a powerful tool for promoting mental health and wellbeing equity, but their success depends on deliberate, inclusive, and system-wide implementation rather than simply making them available.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. This study was approved by the ethics committee of the UAB (CEEAH 7146). All participants provided informed consent to participate.

Consent for publication

Availability of data and materials

The raw data may contain identifiable information and is thus not available.

Competing interests

JMM is a member of the University of Oxford Mindfulness Research Centre. No other authors have competing interests to report.

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Authors' contributions

The study was designed by a working group which included HVSC, MH, PAC, AA, VC, JMM, AMP, and PECW, all of whom contributed to the design of the surveys, the study protocol, and edited a version of the article. HVSC analyzed data first and second round data, and drafted the original article. MH and PC drafter portions of the introduction and methods section of the original draft and edited all subsequent versions. AP designed the phase 1 survey and survey collection instrument, and collated data. EZE analyzed data from the second phase survey, contributed to the final ToC model and edited the final draft of the paper. MTM provided edits and feedback throughout the process.

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Figures

Figure 1: Flow diagram detailing the modified eDelphi approach employed for the development of the ToC

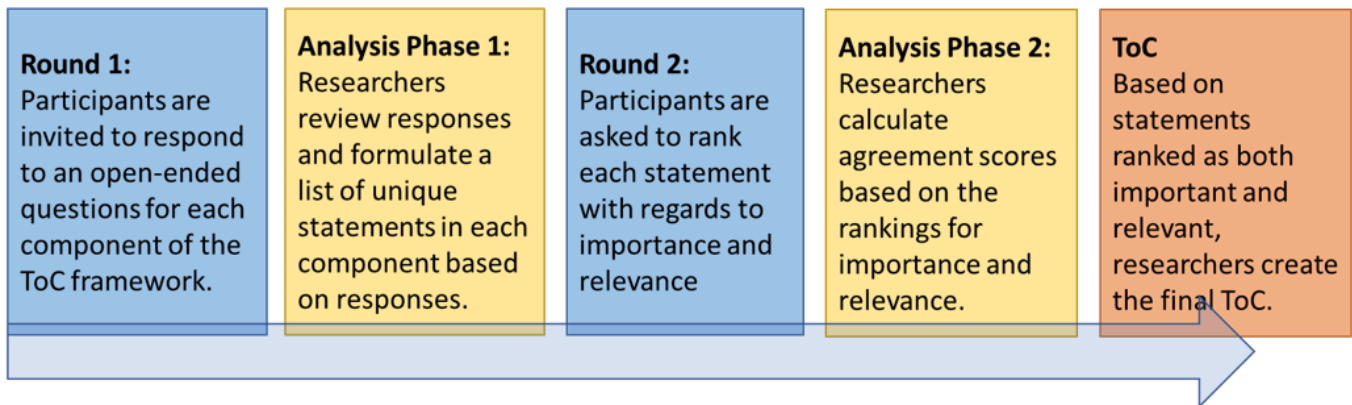
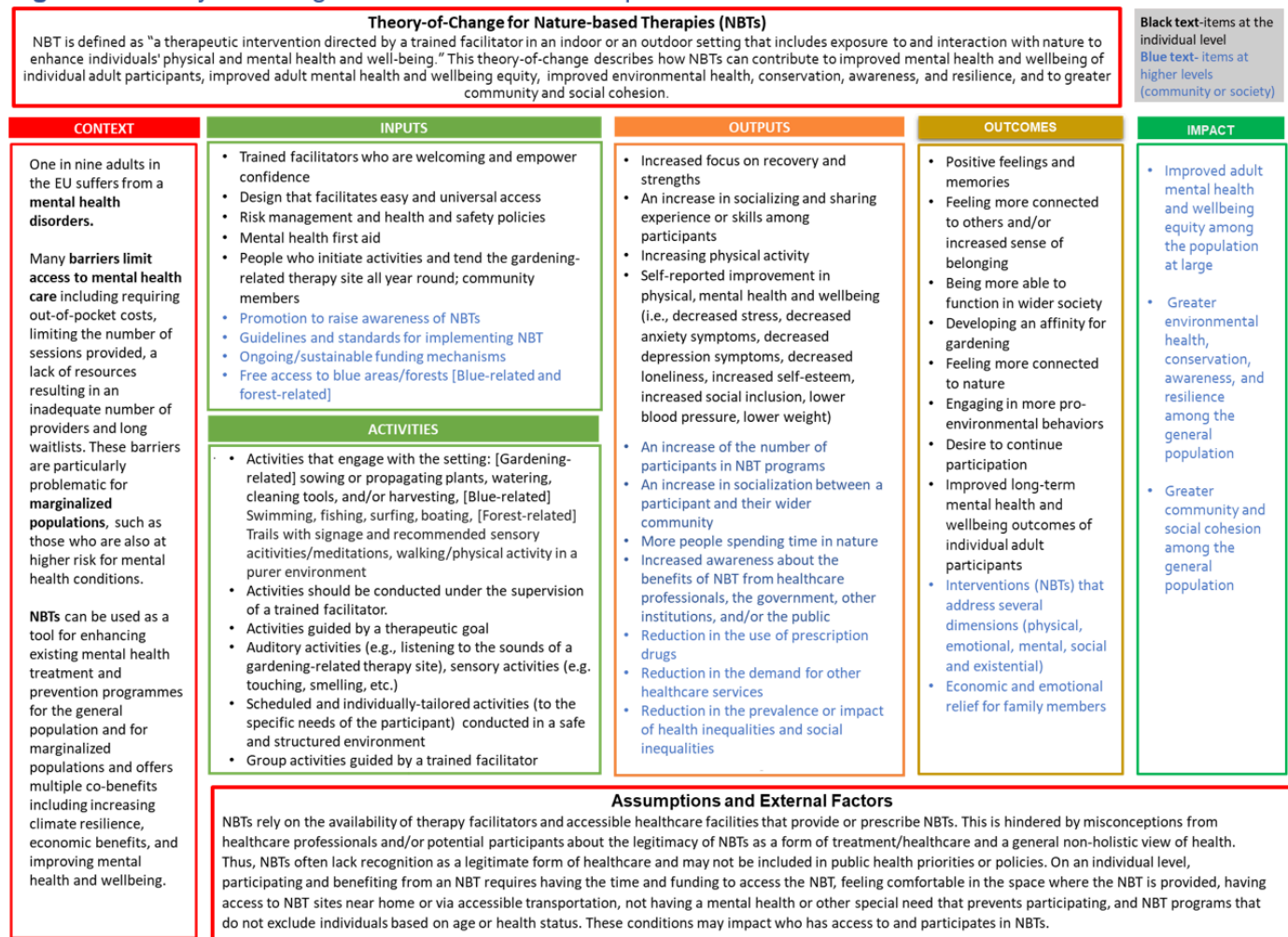


Figure 1

See image above for figure legend.

Figure 2: Theory-of Change for Nature-based Therapies



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Figure 2

See image above for figure legend.

Supplementary Files

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