Environment International 190 (2024) 108801

Contents lists available at ScienceDirect

Environment International

journal homepage: www.elsevier.com/locate/envint

Full length article

Nature-based social prescribing programmes: opportunities, challenges, and facilitators for implementation

Siân de Bell [a,1,*], Julius Cesar Alejandre [b,1], Claudia Menzel [c,1], Rita Sousa-Silva [d,e], Tanja M. Straka [f], Susanne Berzborn [g], Max Bürck-Gemassmer [h], Martin Dallimer [i], Chris Dayson [j], Jessica C. Fisher [k], Annette Haywood [l], Alina Herrmann [m,n], Gisela Immich [o,p], Christian S. Keßler [q,r], Kristin Köhler [s], Mary Lynch [t], Viola Marx [u], Andreas Michalsen [q,r], Pierpaolo Mudu [v], Hendrik Napierala [w], Maximilian Nawrath [x], Sharon Pfleger [y], Claudia Quitmann [m], Jonathan P. Reeves [z], Kevin Rozario [aa,ab,ac,ad], Wolfgang Straff [ae], Katie Walter [af], Charlotte Wendelboe-Nelson [ag], Melissa R. Marselle [ah,2], Rachel Rui Ying Oh [ab,ac,2], Aletta Bonn [aa,ab,ac,2]

[a] *Exeter HSDR Evidence Synthesis Centre, University of Exeter, 79 Heavitree Rd, Exeter EX2 4TH, United Kingdom*
[b] *University of Edinburgh, Edinburgh, United Kingdom*
[c] *Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau, Landau, Germany*
[d] *Young Academy for Sustainability Research, Freiburg Institute for Advanced Studies, University of Freiburg, Albertstraße 19, 79104 Freiburg im Breisgau, Germany*
[e] *Institute of Environmental Sciences, Department of Environmental Biology, Leiden University, P.O. Box 9518, 2300 RA Leiden, the Netherlands*
[f] *Institute of Ecology, Technische Universität Berlin, 12165 Berlin, Germany*
[g] *Black Forest National Park, Schwarzwaldhochstraße 2, 77889 Seebach, Germany*
[h] *KLUG (German Alliance for Climate Change and Health), Hainbuchenstr. 10a, 13465, Berlin, Germany*
[i] *Imperial College London, London, United Kingdom*
[j] *Centre for Regional Economic and Social Research, Sheffield Hallam University, Sheffield S1 2LX, United Kingdom*
[k] *Durrell Institute of Conservation and Ecology, University of Kent, Canterbury CT2 7NR, United Kingdom*
[l] *Sheffield Centre for Health and Related Research (SCHARR), School of Medicine and Population Health, University of Sheffield, Sheffield S1 4DA, United Kingdom*
[m] *Heidelberg Institute of Global Health (HIGH), Faculty of Medicine and University Hospital, Heidelberg University, Heidelberg, Germany*
[n] *Institute for General Practice, University Hospital Cologne, Medical Faculty University of Cologne, Cologne, Germany*
[o] *Chair of Public Health and Health Services Research, Faculty of Medicine, LMU Munich, Germany*
[p] *Pettenkofer School of Public Health, Munich, Germany*
[q] *Institute of Social Medicine, Epidemiology and Health Economy, Charité – Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt-Universität zu Berlin, 10117 Berlin, Germany*
[r] *Department of Internal Medicine and Nature-based Therapies, Immanuel Hospital Berlin, Berlin, Germany*
[s] *Institut für Gesundheit in Natur, Leipzig, Germany*
[t] *Faculty of Nursing & Midwifery, Royal College of Surgeons in Ireland, Dublin, Ireland*
[u] *Dundee City Council, Dundee, United Kingdom*
[v] *WHO Regional Office for Europe, European Centre for Environment and Health, Bonn, Germany*
[w] *Institute of General Practice and Family Medicine, Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin and Humboldt Universität zu Berlin, Charitéplatz 1, 10117 Berlin, Germany*
[x] *Norwegian Institute for Water Research, Økernveien 94, 0579 Oslo, Norway*
[y] *NHS Highland, Inverness, United Kingdom*
[z] *Wildfowl & Wetlands Trust (WWT), Slimbridge, United Kingdom*
[aa] *Friedrich Schiller University Jena, Institute of Biodiversity, Dornburger Straße 159, 07743 Jena, Germany*
[ab] *Helmholtz Centre for Environmental Research - UFZ, Department of Ecosystem Services, Permoserstr. 15, 04318 Leipzig, Germany*
[ac] *German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstraße 4, 04103 Leipzig, Germany*
[ad] *Leipzig University, Wilhelm Wundt Institute for Psychology, Neumarkt 9, 04109 Leipzig, Germany*
[ae] *Umweltbundesamt (German Environment Agency), Wörlitzer Pl. 1, 0684 Dessau-Roßlau, Germany*
[af] *Ullapool Medical Practice, NHS Highland, Ullapool, United Kingdom*
[ag] *University of Edinburgh, Edinburgh, United Kingdom*

Abbreviations: **GP**, **general practitioner**; **KLUG**, **German Alliance for Climate Change and Health**; **NBHI**, **nature-based health intervention**; **NBSP**, **nature-based social prescribing**; **NHS**, **National Health Service**; **SCBA**, **social cost benefit analysis**; **SROI**, **social return on investment**; **SWOT**, **Strengths, Weaknesses, Opportunities, and Threats**; **WWT**, **Wildfowl & Wetlands Trust**.

* Corresponding author at: Exeter HSDR Evidence Synthesis Centre, University of Exeter, 79 Heavitree Rd, Exeter, EX2 4TH, United Kingdom.
E-mail address: s.c.de-bell@exeter.ac.uk (S. de Bell).

https://doi.org/10.1016/j.envint.2024.108801
Received 1 February 2024; Received in revised form 26 April 2024; Accepted 3 June 2024
Available online 6 June 2024
0160-4120/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

[ah] Environmental Psychology Research Group, School of Psychology, University of Surrey, Guildford, United Kingdom

ARTICLE INFO

Keywords:
Green social prescribing
Nature-based social prescribing
Environment
Health
Policy
Natural environments
Public health

ABSTRACT

Background: Evidence on the health benefits of spending time in nature has highlighted the importance of provision of blue and green spaces where people live. The potential for health benefits offered by nature exposure, however, extends beyond health promotion to health treatment. Social prescribing links people with health or social care needs to community-based, non-clinical health and social care interventions to improve health and wellbeing. Nature-based social prescribing (NBSP) is a variant that uses the health-promoting benefits of activities carried out in natural environments, such as gardening and walking. Much current NBSP practice has been developed in the UK, and there is increasing global interest in its implementation. This requires interventions to be adapted for different contexts, considering the needs of populations and the structure of healthcare systems.

Methods: This paper presents results from an expert group participatory workshop involving 29 practitioners, researchers, and policymakers from the UK and Germany's health and environmental sectors. Using the UK and Germany, two countries with different healthcare systems and in different developmental stages of NBSP practice, as case studies, we analysed opportunities, challenges, and facilitators for the development and implementation of NBSP.

Results: We identified five overarching themes for developing, implementing, and evaluating NBSP: *Capacity Building*; *Accessibility and Acceptability*; *Networks and Collaborations*; *Standardised Implementation and Evaluation*; and *Sustainability*. We also discuss key strengths, weaknesses, opportunities, and threats for each overarching theme to understand how they could be developed to support NBSP implementation.

Conclusions: NBSP could offer significant public health benefits using available blue and green spaces. We offer guidance on how NBSP implementation, from wider policy support to the design and evaluation of individual programmes, could be adapted to different contexts. This research could help inform the development and evaluation of NBSP programmes to support planetary health from local and global scales.

1. Introduction

Currently, healthcare systems across the world tend to focus on the treatment of diseases rather than health promotion or prevention, with the use of pharmaceuticals the most common intervention in healthcare (NICE, 2015). A large proportion of national healthcare budgets are allocated to pharmaceutical costs (EFPIA, 2022); in 2021, in Germany and the UK, they made up 13.87 % and 9.46 % of total health spending respectively (OECD, 2023). With increased spending on pharmaceutical interventions to treat ill-health, their effectiveness, costs, and impacts on the climate, environment, and biodiversity are of rising concern (Deblonde and Hartemann, 2013; European Commission, xxxx). The carbon emissions of the pharmaceutical industry are more than that of the automotive industry (Belkhir and Elmeligi, 2019), and their use correlates with the concentration of active pharmaceutical ingredients in terrestrial and aquatic environments (European Commission, xxxx; Gworek et al., 2021). For these reasons, non-pharmaceutical health interventions and measures to support health and wellbeing are needed to help reduce the pressures of pharmaceutical consumption on planetary health (Helwig et al., 2023) (Box 1).

1.1. Social prescribing – An intervention for health promotion

Social prescribing could complement the use of pharmaceuticals, helping to prevent overprescribing (Department of Health and Social Care, 2023) and, by promoting health, potentially reduce ongoing reliance on pharmaceutical use (Helwig et al., 2023). While there is work in progress to establish a common definition for social prescribing (Muhl et al., 2023), it is usually considered to be a process by which people with health and/or social care needs are connected with community-based services and activities provided by the local voluntary and community sector (Box 1). There is growing global interest in social prescribing, with its implementation in a range of countries and support emerging at the international level (Muhl et al., 2023; Social prescribing around the world [Internet], 2023). For example, the Global Social Prescribing Alliance, an independent group of international partners from over 20 countries, was formed in 2021 to facilitate knowledge exchange on social prescribing (GSPA, 2022).

Social prescribing has been used to address health needs ranging from anxiety and depression to diabetes (Morse et al., 2022). In the UK, it is considered particularly suitable for people with one or more long-term conditions, low-level mental health issues, who are socially isolated, or who have complex social needs (e.g. homelessness, refugee status, substance misuse) (NHS England, 2024). Social prescribing aims to address social determinants of health (Morse et al., 2022), meaning its relevance is growing with rising rates of non-communicable diseases – for which the modification of lifestyle factors is considered to be a key part of treatment and management – seen globally (Helwig et al., 2023; Vos et al., 2020). However, it should be noted that whilst social prescribing can target certain health conditions, it aims to move beyond the biomedical model of health, giving people the skills and confidence to manage their own health, and facilitate collaboration between the health, social and community sectors at a societal level (Morse et al., 2022).

Typically, the process of social prescribing involves an 'identifier', who recognises a person with a health or social care need (referred to as a service user or patient), and a 'connector' (who may also be the identifier), who refers them to a community-based service or activity with the aim of improving their health and wellbeing (Muhl et al., 2023; Husk et al., 2020). These identifiers and connectors differ between healthcare systems (Social prescribing around the world [Internet], 2023). Identifiers might work in a clinical setting (e.g., as a primary care physician) or in the community. In a direct referral pathway, they are also the connector, or they may refer the service user to a connector (e.g., a link worker pathway) (Muhl et al., 2023; Husk et al., 2020) (Box 1). The agency of the service user is key throughout the process – social prescribing is guided by person-centred values and self-determination (i.e., an individual's ability to make choices) (Morse et al., 2022) – but particularly when the connector and service user explore the service user's priorities and needs to match them with a compatible activity or service (Muhl et al., 2023; NIHR ARC South West Peninsula, 2022). These could range from information, advice, or support services to

[1] shared first-authorship.
[2] shared senior-authorship.

physical, arts, or nature-based activities (Haywood et al., 2023).

Nature-based social prescribing (Box 1) is a specific form of social prescribing that involves a person being referred to an activity taking place in nature (Leavell et al., 2019; Marselle et al., 2019). These activities may include active connection with nature, such as walking or gardening, or a passive one (e.g., receiving a talking therapy outdoors). The activities aim to utilise the health benefits that have been found to be linked with spending time in nature (see below). Co-benefits could include restoring and maintaining ecosystems and biodiversity (e.g., conservation-based programmes), increasing people's connection with nature and their social connections (e.g. people who visited gardens were found to be more likely to have a strong sense of social cohesion (Oh et al., 2022)), and the development or improvement of pro-environmental behaviours (Robinson and Breed, 2019).

1.2. The benefits of time spent in nature

Numerous mechanisms have been proposed for how nature might affect health and wellbeing (for a recent analysis of data from 18 countries, see (Elliott et al., 2023)). Whilst research unpicking these mechanisms and other factors influencing the relationship between nature and health is still ongoing, studies on the outcomes of time spent in nature have shown associations with a multitude of physical, mental, and social health and wellbeing benefits (Gascon et al., 2015; Twohig-Bennett and Jones, 2018). These include improved mental health and wellbeing, positive effects on cardiovascular, respiratory and metabolic outcomes, sleep, and immunity (Twohig-Bennett and Jones, 2018; Lovell et al., 2018).

Nature's contribution to public health is increasingly being recognised (Bratman et al., 2019; Hunter et al., 2023; van den Bosch and Ode, 2017), with consideration of the types and characteristics of green spaces and the spatial provision and maintenance of natural environments (Ghofrani et al., 2017; Regional Office, 2021). These environmental set-ups are important both close to people's homes and elsewhere for recreational visits (Marselle et al., 2019; Marselle et al., 2021; Browning and Lee, 2017). However, the incorporation of proactive nature-based health interventions (NBHI, Box 1), such as NBSP, into healthcare systems is not (yet) widespread.

1.3. Current implementation of nature-based social prescribing programmes

Currently, there is no common definition for NBSP, but universal definitions and terms in local languages are essential both for commissioning and providing NBSP, as well as for communication with service users. There are some examples of the use of NBSP under different names. Some of the earliest studies come from New Zealand, where the Ministry of Health developed 'green prescriptions' in 1997 to increase physical activity outdoors (Fixsen and Barrett, 2022), and the United States, where there are over 75 'park prescription' programmes (Kondo et al., 2020). In Germany, treatments at a spa or a sanatorium, such as Kneipp therapy or climatotherapy, can be considered NBHIs (Ortiz et al., 2023). In some cases, they are reimbursable by statutory health insurance as part of rehabilitation or prevention programmes; they are, however, part of a distinct tradition in healthcare (health resort medicine). Although social prescribing is not a formalised practice in Germany (Social prescribing around the world [Internet], 2023), Germany's first social prescription service was established in 2017 (Golubinski et al., 2020). With increasing interest in the development of NBSP and wider social prescribing practice, Germany offers a case study for a model of NBSP in an early developmental stage.

The UK, in contrast, was the first country to integrate social prescribing, with programmes including nature-based activities (Leavell et al., 2019; Marselle et al., 2019; Marselle et al., 2021), into its national

Box 1
Definitions related to nature-based social prescribing.

- **Nature** is defined as physical features and non-human processes (e.g., weather), including "living nature" (e.g., plants, animals), and the landscapes (e.g., forest, river, lake, urban green park) that comprise these (Hartig et al., 2014). These landscapes, or natural environments, might also be referred to as **green spaces**, or where they include water (e.g. rivers, lakes, canals), **blue spaces** (White et al., 2020).
- **Direct nature contact** is being physically present in a natural environment, while **indirect nature contact** is experiencing nature without being physically present in it (e.g., window view, virtual nature) (Marselle et al., 2021).
- **Planetary health** is "the achievement of the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to the human systems—political, economic, and social—that shape the future of humanity and the Earth's natural systems that define the safe environmental limits within which humanity can flourish" (p. 1978, (Whitmee et al., 2015).
- **Prescribing** is a formal clinical or pharmacological intervention, usually evidence-based and provided by a trained and licensed healthcare provider (i.e., **identifier**; e.g., doctor, psychotherapist, pharmacist, nurse prescriber) to patients with the aim of treating or preventing an illness, according to clinical guidelines, national rules, and legislation.
- **Social prescribing** is a process through which service users with an identified health and/or social care need are connected from a healthcare or community setting to non-clinical services, with the aim of improving their health and wellbeing and strengthening their community connections. This process is person-centred, with the social prescription co-produced by the service user and the person who connects them with the non-clinical service (Muhl et al., 2023; Alejandre et al., 2023). Non-clinical services are commonly delivered by voluntary sector or community-based organisations and include a range of activities (e.g. arts, physical activity, information/advice/support) (Haywood et al., 2023).
- **Link worker (social prescribing) pathway** employs the services of a **link worker** (i.e., a **connector**, sometimes known by other names such as 'community navigators'), a care professional usually employed in a primary care setting. They spend time with service users who are usually referred by a member of the primary healthcare team (i.e. the identifier, e.g., general practitioners [GPs], nurses) to identify their needs and preferences to make appropriate referrals to community activities (Social prescribing around the world [Internet], 2023; Husk et al., 2020; Moffatt et al., 2017).
- **Nature-based health intervention (NBHI)** are programmes or strategies that engage people with nature to improve their health and wellbeing. NBHI might include changes to the natural environments where people live and work, or activities that take place in nature, such as therapeutic fly-fishing or forest bathing (Shanahan et al., 2019).
- **Nature-based social prescribing (NBSP) (or nature prescription, green prescription, blue prescription)** is a type of social prescribing and a type of NBHI. Service users are prescribed to activities that are carried out in nature, utilising the health-promoting benefits of time spent in nature. Activities might include walks, gardening, surfing, or simply spending time in natural environments (Leavell et al., 2019; Irvine et al., 2020).

health policy (Morse et al., 2022). While the initial development of NBSP was bottom-up, there is now top-down investment happening across the UK. In England, the UK Government has invested in the expansion of NBSP through a cross-sectoral initiative with a range of national partners, including the Department for Environment, Food and Rural Affairs, NHS England, Sport England, and the National Academy for Social Prescribing (NIHR ARC South West Peninsula, 2022), with similar investment in Scottland through coordination between national organisations – NatureScot, Scottish Forestry, Public Health Scotland, Transport Scotland – and local partners (NatureScot, 2020).

Specific examples from the UK, operating at the local level, include Green Health Prescriptions, which were developed in Scotland under the Green Health Partnership, and aim to reduce obesity and promote mental and physical health (Marx and More, 2022). In Dundee, for instance, Green Health Prescriptions allow healthcare professionals to refer service users to a green health worker; service users can then access one of over 60 local nature-based community activities (Marx and More, 2022). Blue spaces (Box 1) are also being used for NBSP, with activities including surfing, kayaking, and canoeing (Alejandre et al., 2023). In England, the Blue Prescribing Project, which is run by the Wildfowl & Wetlands Trust (WWT) and The Mental Health Foundation, provides structured wetland experiences for individuals experiencing mental health problems (Knight-Markiegi, 2023; Maund et al., 2019; Wildfowl and Wetlands Trust). The UK provides a case study for a possible advanced model of NBSP development and implementation, with ongoing evaluation through the UK Government's Green Social Prescribing test and learn pilots monitoring its effectiveness and further supporting the use of NBSP in the healthcare system (NatureScot, 2020).

1.4. Aims and objectives

Despite increasing global interest, successful implementation of NBSP in different countries requires adaption to fit different contexts (Husk et al., 2020; Garside et al, xxxx), considering the demographics and needs of the population, the local health and social care systems, and the accessibility and suitability of natural environments. In this paper, we address opportunities, challenges, and facilitators for the development and implementation of NBSP. We focus on two countries with different NBSP models: the UK, which has a relatively advanced model of NBSP, and Germany, which represents an initial development stage.

We present perspectives from a trans- and interdisciplinary expert group workshop of health and environmental practitioners, researchers, and policymakers, mainly from the UK and Germany. The workshop allowed knowledge exchange, sharing of best practices in NBSP, and exploration of the potential for its development and implementation internationally. We aimed to answer three questions:

1. What are the opportunities for NBSP and likely health and wellbeing outcomes?
2. What are the challenges to implementing NBSP programmes?
3. What is needed to implement a pragmatic NBSP programme?

We synthesise the findings and provide recommendations that could inform healthcare providers, social prescribing practitioners, policymakers, and other stakeholders in developing and evaluating NBSP programmes in different contexts (e.g., healthcare settings and systems, countries, regions, or cities) to support planetary health at local and global scales.

2. Methods

To understand the current landscape of NBSP and to identify opportunities, challenges, and ways forward for implementation, we held a two-day interdisciplinary and participatory expert group workshop in November 2022 in Berlin, Germany.

2.1. Participant selection

The workshop was organised by a team of 10 researchers in the fields of public health, environmental psychology, and ecology. It was attended by 29 experts (excluding the organisers) from both the health and environmental sectors, with representation of research, policy, and practice organisations in the UK, Germany, and other European countries (Table 1). Workshop participants were invited by identifying relevant organisations and representatives through professional networks and targeted online searches. They represented organisations that are or could be involved in commissioning, developing, implementing, and evaluating interventions that involve nature and health.

We aimed for, and achieved, a gender-balanced workshop, but it should be noted that the majority of attendees were white and that there was a lack of representation from those with lived experience of disability. The findings should be read with awareness that biases may have resulted from this representation, and whilst the workshop procedure (as described below) was designed to minimise differences between attendees from different sectors and career stages, these dynamics may still have influenced the expressions of views and opinions. Additionally, Germany and the UK are suitable case studies with regard to the extent of implementation of NBSP, as well as differing in terms of social norms (e.g. on definitions of ill health and seeking healthcare) and their healthcare system and infrastructure, but have some similarities (e.g. environmental characteristics). Views relevant to countries with different cultural and environmental characteristics are likely underrepresented (e.g., countries dominated by deserts will have different challenges in running NBSP activities).

2.2. Workshop procedure

We used participatory knowledge-sharing approaches, which

Table 1
Organisations represented in the expert workshop on nature-based social prescribing.

Sectors	UK	Germany
Health and social care sector (e.g., physicians, pharmacists, psychotherapists, coordinators of NBSP programmes)	Ullapool Medical Practice (Highland), Dundee City Council, NHS Highland, and Scotland's Green Health Partnership	Germany Society of General and Family Medicine (DEGAM), Charité Universitätsmedizin Berlin, Immanuel Krankenhaus Berlin, German Alliance for Climate Change and Health, and Institut für Gesundheit in Natur
Environment sector (e.g., NBSP providers, governmental and non-governmental environmental organisations)	WWT	Federal Agency for Nature Conservation, Stiftung Naturschutz, Black Forest National Park, German Environment Agency
Academia (e.g., public health, environmental psychology, ecology)	University of Exeter, University of Sheffield, Sheffield Hallam University, University of Leeds, Glasgow Caledonian University, and University of the West of Scotland	Technische Universität Berlin, Ludwig Maximilians University Munich, University of Freiburg, RPTU Kaiserslautern-Landau, German Centre for Integrative Biodiversity Research, Helmholtz-Centre for Environmental Research, Heidelberg University, University of Cologne, and Friedrich Schiller University Jena, Pettenkofer School of Public Health, Munich
Other key organisations involved	British Council, Norwegian Institute for Water Research, and World Health Organisation Regional Office for Europe	

NHS = National Health Service, WWT = Wildfowl & Wetlands Trust

included a mix of presentations, panel discussions, and breakout sessions (i.e., World Cafés). The workshop was divided into four sessions: Evidence and Current Practice, Environment and Sustainability, Health and Wellbeing, and Policy and Financing (see Supplementary Material 1 for the detailed workshop programme). Presentations were intended to share best practice and create a mutual understanding of NBSP, thereby providing context for the panel discussions and World Cafés.

Between the sessions, we facilitated three World Cafés, each based on one of our aims (as stated above, for more detail see Supplementary Material 1). In each World Café session, participants were divided into four sub-groups with assigned moderators and documenters to allow in-depth discussion and knowledge exchange in smaller groups (Involve, 2018; Löhr et al., 2020). Each sub-group then focused on one of four topic areas: 1) existing and required evidence to capture the effectiveness of NBSP; 2) existing and required policies to implement NBSP; 3) existing and potential NBSP interventions; and 4) supporting and hindering factors of the healthcare system for NBSP. Each sub-group discussed their initial topic area for approximately 20 min before all except the moderator and documenter moved to the next topic area. Sub-groups varied in terms of gender, career stages and sectors for each of the three World Cafés to facilitate diversity in the discussions. The discussions and ideas raised in the World Cafes were used to formulate recommendations for implementing pragmatic NBSP programmes in different contexts. By pragmatic, we mean the development of NBSP by building on current practice and working within existing parameters, such as existing policy and healthcare system structures. Results of each discussion were captured on posters (Supplementary Material 2).

To allow for an open discussion, we followed the Chatham House Rules in all workshop discussions, which states that: *"the participants are free to use the information received, but neither the identity nor affiliation of the speaker(s), nor that of any other participant, may be revealed"* (Chatham House, 2023). This also enabled us to effectively "*bring people together, break down barriers, generate ideas, and agree solutions*" (Chatham House, 2023).

2.3. Data analysis

We analysed and synthesised discussions from each World Café using (inductive) coding with thematic analysis (Braun and Clarke, 2006). Outputs from each of the three World Cafés were initially analysed by one team member (SdB, JA, CM), then double-checked by a different team member (SdB, JA, CM). The analysis involved reading the notes and discussion from the World Café (information captured on posters in the workshop was transferred to an online interactive whiteboard for collaborative working) to identify descriptive themes (codes) from the workshop data. Three team members (SdB, JA, CM) then generated overarching (analytical) themes in group discussions by identifying and grouping similar descriptive themes occurring in all World Cafés. The themes and the codes were visualised using Google Jamboards (Supplementary Material 3).

Finally, to investigate more specifically the key strengths of current NBSP, weaknesses (i.e., challenges or problems with current approaches), future opportunities for the application of NBSP, and threats regarding the development and implementation of NBSP, we categorised Strengths, Weaknesses, Opportunities, and Threats (SWOT matrix) (Helms and Nixon, 2010) within the overarching themes. The results of the thematic and SWOT analyses were presented to all workshop participants in an initial paper draft, giving everyone the opportunity to provide feedback on the synthesis, validate the findings, and ensure the accuracy and relevance of identified themes and their categorisation in the SWOT matrix.

3. Results and discussion

We identified five overarching themes from the World Café outputs (see Supplementary Material 3 for detailed results):

1) *Capacity building*, which relates to the ability of NBSP to deliver benefits to society, and the need for the development of the workforce to deliver NBSP;
2) *Accessibility and acceptability*, which is concerned with the design and delivery of NBSP suitable for groups with different social and demographic characteristics;
3) *Networks and collaborations*, which discusses how cross-sectoral networks at different levels are needed to support NBSP;
4) *Standardised implementation and evaluation*, which details the need for the development of typical (but adaptable) processes and procedures for delivering and evaluating NBSP; and
5) *Sustainability of the intervention*, which considers factors such as funding which are required for the continued delivery of NBSP.

Points raised by workshop participants were further categorised using a SWOT analysis (Fig. 1, Table 2), to provide specific recommendations for the delivery of pragmatic NBSP programmes in different contexts within each of the five themes.

Below, we present a combined results and discussion section so that examples of current practice and research shared by workshop participants can be understood in context. This section is structured by the five themes identified.

3.1. Capacity building

Building capacity for NBSP within the healthcare system is important to introduce and develop NBSP programmes that support and improve health and wellbeing at a population level. Evidence suggests that participation in NBSP can improve both physical and mental health. A recent *meta*-analysis showed reductions in blood pressure as well as anxiety and depression scores among service users (Nguyen et al., 2023); see also (Rueff and Reese, 2023) for related findings), while another recent review suggested that NBSP can improve social connectedness and mental wellbeing (Leavell et al., 2019). Regarding health service delivery, NBSP may lead to reductions in the use of health services (e.g., fewer visits to the GP (Kimberlee et al., 2022)) with associated economic and environmental benefits.

Challenges discussed by participants relating to current capacity to deliver NBSP mirrored those recently identified for social prescribing in integrated care (Kurpas et al., 2023). Capacity building is needed within three main areas. Firstly, education and training are necessary to equip professionals with the knowledge, skills, and competencies to deliver quality care. Depending on the NBSP pathway used, the professionals involved may include primary and secondary care practitioners (e.g., nurses and GPs) and community workers (e.g., nature-based activity managers, volunteers delivering activities). Participants discussed how some of these care practitioners (e.g., link workers and community connectors) may not need a medical qualification, but they should be trained in relevant skills and competencies (e.g., in behaviour change methods, motivational interviewing, safeguarding, coping strategies for themselves), as their role is crucial to the success of the referral, with many service users opening up more to them than to other healthcare professionals. This could be achieved through formal education programmes, specialised and accredited training courses, and/or continuous professional development to stay updated with the latest developments. This is likely to be context-specific as different countries have different professional training requirements. In the UK, for example, training might be adapted from cognitive behavioural therapy, as these courses have previously been developed to train a non-professional workforce (Fullam et al., 2021).

Secondly, there is a need for workforce expansion. Increasing NBSP provision means more professionals will be necessary to meet the growing demand for services (e.g., there is currently unmet demand for NBSP in the UK) (Haywood et al., 2023). This may involve the creation of new professional roles. Whilst UK-based link workers connect service users with appropriate nature-based activities, this role could be taken

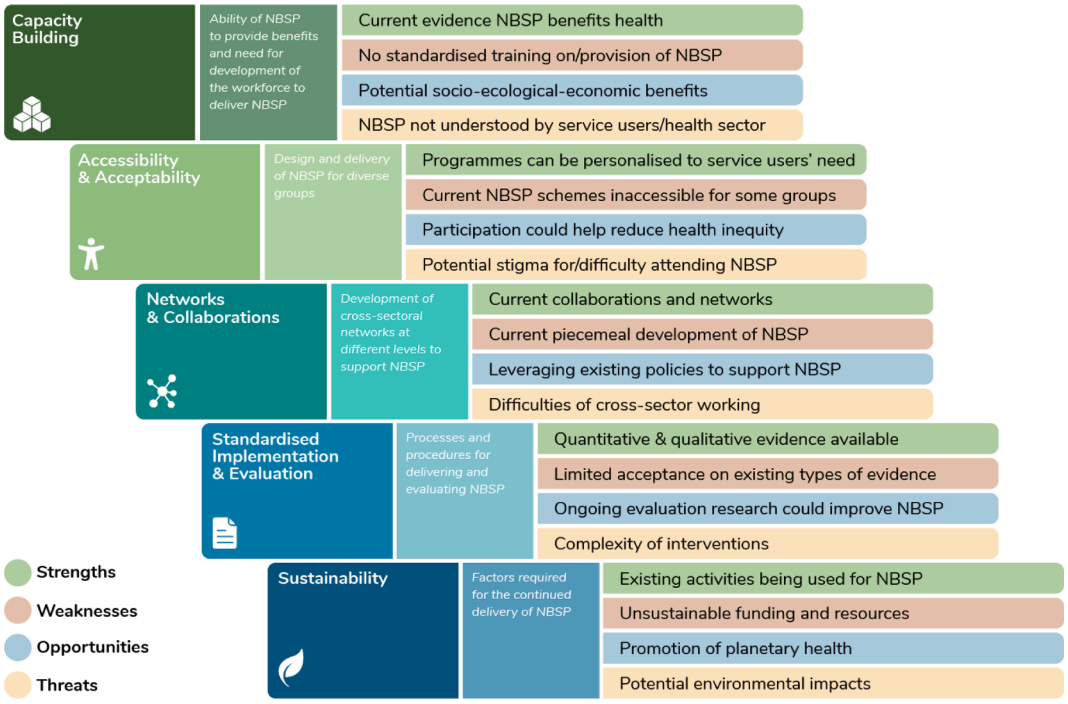

Fig. 1. Summary of strengths, weaknesses, opportunities, and threats of Nature-Based Social Prescribing programmes categorised within the overarching themes: Capacity building; Accessibility and acceptability; Networks and collaborations; Standardised implementation and evaluation; Sustainability.

by other healthcare staff. In Germany, it could be fulfilled by GPs or social workers. Other countries employ similar roles to link workers, such as the Netherlands with wellbeing coaches, Singapore with well-being coordinators, and the Philippines with village health workers and nutrition scholars (Social prescribing around the world [Internet], 2023; Mallari et al., 2020; Querri et al., 2020). Participants also discussed strategies to recruit and retain staff (e.g., the provision of appropriate training and support). In the UK, there is currently high turnover in some roles because, for example, staff feel unsupported when service users share difficult stories (National Association of Link Workers, 2020).

Addressing the needs of an expanding workforce for knowledge may help foster a broader understanding of the benefits of nature through education on planetary and public health (e.g., through school and medical university curricula). In Germany, planetary health is not mandatory in medical training and education. However, education options are growing: for example, the German NGO "KLUG" has introduced online courses that address these issues within their own "Planetary Health Academy" (Planetary Health Academy, xxxx). Also, the Chair of Public Health and Health Services Research has developed an online planetary health course for students for the "Virtual University of Bavaria" (CLASSIC vhb – Das Kursangebot für Studierende der Trägerhochschulen [Internet]. no date [cited, 2023). Both programmes were funded by the German Government via the German Environment Agency. There is the potential for further development in this area; for example, there are ongoing clinical studies investigating the efficacy of nature and forest therapy at different German institutions, which could contribute materials for dissemination. While planetary health and sustainability are taught by many medical schools in the UK, teaching does not necessarily reflect current knowledge in these fields and is not mandatory (Bevan et al., 2023).

Thirdly, alongside workforce development, there is a critical need to establish infrastructure and processes that support the presence of staff such as link workers, enabling the provision of NBSP in all health and social care facilities. For example, the UK is ensuring that everyone can access social prescribing through their GP by employing a sufficient number of link workers (NHS, 2019). However, expansion of NBSP will require these professionals being aware of available NBHI in their communities as insufficient communication across sectors can be a barrier (see also *Networks and collaborations*). Currently, policymakers tend to give NBSP and other public health prevention programmes insufficient priority as their potential health-related benefits and environmental co-benefits have not yet been communicated effectively or are difficult to communicate due to the long timeframes until effects are visible. Developing good communication campaigns about nature's health benefits could facilitate this acceptance (e.g., by land owners), and facilitate capacity building and the development of infrastructure and processes.

Related to finding effective communication strategies for policy makers, knowledge dissemination could also lead to increased service user acceptance, as they may have limited trust in NBSP due to a lack of understanding of the benefits of social prescribing (Pescheny et al., 2018) and NBSP (Haywood et al., 2023). In this context, potential stigma for attending NBSP was discussed. Expectations and knowledge of service users are important as the beneficial effects of social prescribing programmes can be hindered when the aims, expectations, and/or interest of service users do not meet those of link workers or other people involved in the programme (Liebmann et al., 2022). The use of social marketing strategies (e.g., with buzz words) might help raise awareness amongst key audiences (cf. (Hyder et al., 2010; Oliver and Cairney, 2019).

3.2. *Accessibility and acceptability*

The benefits of nature exposure are often greater for deprived groups (Rigolon et al., 2021), meaning NBSP offers opportunities to address health inequalities. Whilst these benefits are less likely to be utilised for health promotion in countries without formalised NBSP practice, participants identified challenges relating to access and acceptability that exist both in countries with existing structures for the implementation or regulation of NBSP, and those without (Social prescribing around the world [Internet], 2023).

Equity is a key issue, meaning that NBSP should be universally accessible to the population, particularly vulnerable groups. This would require equity to be addressed in each phase of implementation of NBSP

Table 2
Analysis of strengths, weaknesses, opportunities, and threats related to implementation of NBSP in the UK and Germany identified during the expert workshop, organised by overarching theme.

Overarching themes	Strengths	Weaknesses	Opportunities	Threats
Capacity building – the ability of NBSP to provide benefits and need for development of the workforce to deliver NBSP	• Evidence that NBSP leads to health and social benefits	• Poor communication of scientific evidence to decision makers and healthcare providers • No standardised information/training for those delivering NBSP • Limited national/ international definitions and models of NBSP	• NBSP has the potential to provide additional health and economic (e.g., healthcare costs) benefits • NBSP could improve nature connection, which is associated with increased wellbeing and pro-environmental behaviours	• Lack of understanding from potential service users (i.e., desire for pharmaceuticals, a culture of 'pill for every ill') • Limited understanding of links between nature and health, and planetary health (i.e., not yet included in school or medical school curriculum)
Accessibility and acceptability – design and delivery of NBSP for diverse groups	• NBSP can target the public or specific groups with clinical needs	• There is no universal coverage (e.g., through statutory health insurance)	• NBSP programmes can be adapted and offer a variety of activities to suit a range of needs and contexts	• Stigma or prejudices associated with attending NBSP
	• NBSP can be accessed through a range of routes (e.g., pharmacies, community settings); and modes (e.g., online or through the phone as well as in person) • Variety of activities can be included in NBSP programmes so that individual preferences and needs can be addressed	• Programmes are not accessible to all (e.g., age, culture, region, socio-economic status, mobility status)	• NBSP could lead to increased exposure to natural spaces for participants • With special targeting, NBSP could decrease health inequity as disadvantaged groups generally benefit more from nature exposure	• Provision of natural spaces is not yet fully integrated into development and planning (i.e., in urban or medical settings)
Networks and collaborations – development of cross-sectoral networks at different levels to support NBSP	• Existing collaborations and partnerships between health, environment, and third sector organisations	• Piecemeal/non-systematic approach to setting up NBSP	• Policies that support NBSP (e.g., health in all policies, social determinants of health, community wealth)	• Current focus on treatment not prevention • More responsibilities and time constraints for current healthcare workers (e.g., when GPs must do link worker tasks)
		• Lack of co-design with community/potential users	• Create job opportunities in health and environment sectors (e.g., link workers or equivalents, park rangers, surfing coach)	• Difficulties of *trans*-agency/-ministerial/-departmental/-sectoral collaborations to facilitate flows of funding • Unrealistic expectations of GPs, services users, and other relevant actors
Standardised implementation and evaluation – processes and procedures for delivering and evaluating NBSP	• Qualitative and case study evidence available	• Lack of scientific evidence that is acceptable to decision makers (e.g., quantitative from RCTs, *meta*-analyses, systematic reviews) • No best practice guidelines or standards for implementation	• Ongoing monitoring would allow iterative adaptations to improve delivery and evaluation	• Lack of acceptance of different forms of evidence (e.g., qualitative, pragmatic, and transdisciplinary evaluations, not only 'standard' controlled trials)
		• No or limited implementation of standards for evidence collection or evaluation framework • Limited resources to collect data or analyse existing data	• Ongoing monitoring would provide observational evidence for evaluation	• Complexity and diversity of outcomes and interventions
Sustainability – factors required for the continued delivery of NBSP	• Existing services (e.g. health promoting spas or curative health resort programmes in Germany; pilot blue and green social prescribing programmes in the UK) can be adapted to be NBSP and scaled up for national implementation	• Funding is not long-term	• Promotes planetary health (e.g., by increasing nature connectedness, and by potentially reducing pharmaceutical use and/or the number of visits to the doctor)	• Potential for environmental degradation and biodiversity loss due to overuse
		• Schemes are not sustainable (i.e., need time-bound exit strategies) • Lack of coordination in responsibilities and funding across sectors (i.e., health vs. environment)	• Schemes to incentivise implementation and service users (e.g., reduced tariffs, which could also support interventions financially)	

Note. NBSP = nature based social prescribing. RCTs = randomised controlled trails. GP = general physician.

activities, and consideration of the provision of prescriptions and referrals both at the individual and systems level. When developing an NBSP programme, a Health Equity Impact Assessment (Povall et al., 2014) might be useful in order to identify how the programme could reduce health inequalities and consider the perspective of individuals accessing NBSP and their specific needs.

Programmes need to be inclusive of different individuals and population groups (e.g., people of different ages, cultural backgrounds, or with time and accessibility constraints). Individual characteristics and values associated with connecting to nature are important in understanding the many ways in which people are motivated to interact with the environment to successfully promote health and pro-environmental

behaviours (Dallimer et al., 2014; Gatersleben et al., 2014; Ihemezie et al., 2021). There is little data available on people's preferences for NBSP; however, a local evaluation of social prescribing in Rotherham, UK, indicated that people tend to access more than one type of activity through a social prescription (e.g., they might access a nature-based activity, alongside an information and advice service) (Dayson and Bashir, 2014). In the UK, the Green Social Prescribing evaluation report found that targeting NBSP for specific groups could help reduce health inequities (Haywood et al., 2023). This could be achieved through a varied service provision (e.g. with activities that stimulate different senses or that provide fun for people who are not intrinsically motivated by nature). Key to this may be taking a values-based approach to the provision of NBSP. Values such as person-centred care identify general principles for providers to consider, rather than specific actions to take. This means the provision of care is focused on the service user i.e. giving them agency and choice by exploring their wants and needs.

Practical factors are also integral to accessibility, such as providing transport or considering the format of the activity. Integrating safe green and blue spaces in urban planning and hospital design could help to facilitate access to nature-based activities for both the general population and those with specific needs. When physical access is not possible (e.g., for people with mobility issues), experiencing nature indirectly (e.g., virtually) can also provide benefits (Koivisto and Grassini, 2022; van Houwelingen-Snippe et al., 2020). In Scotland, the COVID-19 pandemic facilitated the development of virtual nature-based activities such as virtual health walks (Marx and More, 2022). In Germany, NBHI are also being delivered online (e.g., the Re.Connect Programme provides eco-psycho-social transformation activities (VERDE, 2022)).

Universal access to healthcare programmes largely depends on the resources, particularly financial, of the healthcare system. Differences in financial resources and approaches between healthcare systems (e.g., publicly funded or insurance-based) might hinder the implementation of NBSP (see also (Kurpas et al., 2023) for social prescribing in integrated care). In England, the government supports access to social prescribing by employing link workers (NHS, 2019), whereas in Scotland, there is limited funding to employ link workers; in both countries, NBSP activity providers are reliant on charitable and donor organisations. In contrast to the UK, implementing NBSP in Germany would involve integrating it into the complex interplay of existing medical and social care provision. In Germany, citizens are mandated to have health insurance coverage (either statutory or private) against illnesses, accidents, and other health concerns. Different German statutory and private insurance policies typically incorporate preventive strategies, mainly oriented to the prevention of specific diseases or risk factors, for example, by funding certain sports classes. Even though the benefits of spending time in nature are promoted by some German insurance companies (e.g., their websites have recommendations on 'micro-adventures in nature' (AOK. So gelingt ein Mikroabenteuer, 2023) and forest bathing (Gesundheit and Waldbaden, 2022)), health insurance policies do not usually cover nature-based prevention strategies. This may also explain why the uptake of NBSP in Germany has been slow, as there is no national champion to advocate for its mainstreaming in the healthcare system yet. Providers of health and social services could work together to make the case for NBSP to stakeholders.

There are specific routes that could be used to enable broad access to NBSP in Germany and elsewhere, such as funding link workers (or health professionals with similar roles) through statutory health insurances instead of obtaining individual funding through social enterprises. If a link worker structure was developed, it would be critical for their work to be coordinated with local primary care physicians. Service users who are regularly seen by secondary care physicians like cardiologists or endocrinologists (i.e., specialists) could also benefit from NBSP by either having link workers in secondary and tertiary settings (specialised care settings, often in hospitals) or by sending service users back to their primary care practitioners. Expanding the type of professionals who make NBSP referrals (i.e., identifiers) to, for example, pharmacists or secondary health care professionals could reach a wider range of people in both countries, as some groups might be more likely to visit a pharmacy or a community centre than their GP. In Germany, NBSP referrals could also be provided in government-funded health kiosks ('Gesundheitskiosk'), which are aimed at offering low-threshold counselling to people in socially disadvantaged districts.

3.3. Networks and collaborations

Enabling universally accessible NBSP programmes requires support from established interdisciplinary networks and collaborations integrated across multiple sectors (especially health and environment government agencies, academia, and third-sector organisations). Whilst there are examples of partnerships that support or deliver NBSP, a major barrier to embedding and scaling up these collaborations currently is the low priority given to public health promotion and prevention programmes by policymakers in general. In many countries, including Germany and the UK, pharmaceutical treatment prevails as the most common form of healthcare intervention (WHO, 2020). Prioritising prevention would require a shift in mindset among stakeholders, needing a whole systems approach (e.g., planetary health) and the insight that nature conservation is a prerequisite for health. Internationally, policies that are based on the planetary health approach could support NBSP, including the WHO Global Strategy on Health, Environment and Climate Change, Montreal-Kunming Global Biodiversity Framework, IUCN Global Standard for Nature-based Solutions, and the COP26 Health Programme (WHO, 2020; CBD, 2022; IUCN, 2020; WHO, 2023).

Further challenges relate to the dominance of siloed thinking (i.e., a focus on sectoral priorities) and a resulting lack of collaboration and flow of funding across sectors. In this workshop, for example, there was limited representation from some sectors (e.g., health insurance companies and politicians), although we invited representatives. In the UK, despite a 'health in all policies' approach, cross-sectoral policymaking is still challenging (e.g., due to the focus on treatment rather than preventative interventions in the health sector (Local Government Association, 2016). Policymaking should support inter-agency and −sectoral collaborations with shared action plans and goals. This top-down approach would need to be complemented by a bottom-up approach, to allow meaningful engagement and community co-creation, and ensure that NBSP programmes are fully integrated into the healthcare system.

Networks and collaborations need strategies for knowledge exchange and sharing best practice. In the UK, 'champions' advocate for the 'health in all policies' approach and include both local authority and healthcare staff (Local Government Association, 2016). These champions could similarly support NBSP, both as a voice in the community, promoting NBSP as part of supporting service users to take a self-care approach to their health, and by gaining support from policymakers, who have the power to make institutional change to enable NBSP.

3.4. Standardised implementation and evaluation

Despite the quantity of research on the links between nature contact and health in general showing the benefits of NBSP for health, more evidence is needed to support standardised implementation and evaluation. Randomised controlled trials and systematic reviews based on these are seen as the 'gold standard' in the medical sciences. Without them, it is difficult to convince healthcare professionals and policymakers to commission NBSP, as decision-makers from the health sector, such as the German Joint Federal Committee which specifies the services that are reimbursed by statutory health insurance funds, rely heavily on these study designs. However, randomised controlled trials are expensive and often difficult to conduct in the case of NBSP, as they are complex interventions (Haywood et al., 2023) with multiple interacting components (e.g. multiple activities happening in multiple locations)

(Moore et al., 2015). Feasibility trials are needed to ensure that full trials are appropriate, with an example recently funded in the UK (University of Plymouth, xxxx). Any randomised controlled trial should include in-depth process evaluation to identify causal mechanisms as well as factors which cause variations in outcomes for participants (Moore et al., 2015). Interdisciplinary and mixed methods approaches might be more appropriate for evaluating NBSP programmes.

Although evidence based on well-designed studies is needed, previous research indicates that health policymakers tend to make decisions based on other factors, such as personal contacts, timeliness, and research containing easy-to-understand policy recommendations (Innvær et al., 2002); see also (Hyder et al., 2010), so the quality or type of scientific evidence might not be as significant a barrier as expected. High-quality research is still important, but consideration should be given to suitable communication too (e.g., through personal contact and readable summaries (Oliver and Cairney, 2019)).

The complexity and diversity of NBSP programmes and the range of relevant outcome variables are challenging, and so is providing and interpreting the evidence. Standardised implementation and evaluation of NBSP will generate reliable evidence. In the UK, the implementation of social prescribing began locally and existed for many years before some aspects (e.g., funding of link workers) were embedded in NHS policies. NBSP has developed similarly in Canada (Social prescribing around the world [Internet], 2023), while in other countries, such as Austria, implementation of NBSP has been top-down (Social prescribing around the world [Internet], 2023). Whichever approach is taken, knowledge of the local context is important. Standardised national guidelines for implementation should be developed; there are certain aspects of NBSP, such as the referral process and training and education of providers, where standardisation is important. However, guidelines should also consider where standardisation of interventions may not be suitable and identify areas where individual programmes should make adaptations using local knowledge, such as the availability of suitable nature spaces and activity providers, to ensure they meet service user needs. This information could be collected through local assessments (e.g., conducting SWOT analysis, health needs analysis, or mapping of existing resources).

In addition, standardised but flexible and adaptable monitoring and evaluation frameworks, tools, and performance indicators should be developed. Whilst NBSP programmes may differ in their target populations, agreement on the measurement of certain outcomes (health and wellbeing, socio-economic, and environmental/ecosystem services) and potential mediators (e.g., social or nature connectedness), using validated scales, could be based on the mechanisms thought to be behind NBSP (e.g. social connectedness) and allow comparison between interventions. Whilst there are data security issues and reluctance by service users to provide (health) data that prevent analyses of available data, routine data could be used to develop a wider evidence base for NBSP. Furthermore, there is the potential for citizen science approaches and service user evaluation schemes to further help data collection. Regular and transparent programme monitoring will lead to ongoing quality control and assurance and ensure the identification of best practices in specific contexts by making the data freely accessible. It would also provide data to evaluate the impact of NBSP for a given service user in the long term (e.g., on healthcare utilisation) and help confirm or disprove hypotheses on how NBSP works (e.g. whether carrying out an activity in nature has an additive effect and whether these benefits are dependent on an individual's preferences). This in turn would feed into standardised guidelines on best practice, including consideration of the impact of NBSP on the environment and a competency framework for link workers.

Making NBSP part of clinical or prescribing guidelines would have benefits for its mainstreaming and delivery in different health and social care settings as it could help establish a tiered approach to delivering NBSP with other therapies such as talking therapy and medications. Currently, there is no accepted evaluation framework that would allow appropriate comparison of the effectiveness of NBSP programmes in improving health outcomes with existing clinical interventions (i.e., pharmaceuticals). Clinical interventions are usually evaluated using a straightforward cost-effectiveness analysis under the biomedical model of health. However, NBSP programmes are complex interventions, stemming from the social model of health, which are more appropriately evaluated by a holistic evaluation mechanism. In the UK, various government acts (Welsh Government, 2015; Public Services: Social Value Act [Internet]., 2012; Scottish Government. Scotland: The Procurement Regulations [Internet]., 2016) require commissioning and delivery organisations to be accountable for and consider how their NBSP programmes improve social, cultural, environmental, and economic wellbeing, with Social Cost Benefit Analysis (SCBA) recommended for the evaluation of public health interventions (Treasury, 2022). SCBA can determine whether the benefits of a programme offset the costs and convert this into monetary terms (Treasury, 2022). Methodologically, Social Return on Investment (SROI) evaluation, when incorporated into a co-designed and co-produced approach from the outset (Makanjuola et al., 2023), can be used to calculate monetary values for a wide range of outcomes of NBSP programmes, whether these already have a financial value or not. SROI analysis produces a description of how a NBSP programme generates value for key stakeholders and provides a Social Value Ratio, indicating how much social value (in £) is generated for every £1 of investment. For every £1 invested in a preventation-focused NBSP, the social values generated range from £4.90 to £9.30, along with enhancing social cohesion and improving levels of health, wealth, and wellbeing (Knight-Markiegi, 2023; Makanjuola et al., 2023).

Ultimately, NBSP programmes should be evaluated depending on their aim, to either prevent illnesses or to treat them. NBSP, and social prescribing in general, can be complementary to clinical interventions, with each having standalone benefits, meaning they could provide multiple benefits if used together. In Germany, current research projects on NBHI are being conducted with the aim to determine their treatment efficacy for different diseases. This provides a preliminary step towards possible implementation.

3.5. *Sustainability of the intervention*

Limited resources hinder sustainable implementation of NBSP in both Germany and the UK. This includes resources for the delivery of NBSP (e.g., staff, time, opportunities for co-production of new NBSP programmes, follow-up support for vulnerable service users) and for evaluation. Currently, the implementation and evaluation of NBSP programmes often depend on funding from the third sector. Research shows this is a real barrier to NBSP in the UK (Haywood et al., 2023) and in general (Kondo et al., 2020; Kurpas et al., 2023). In Germany, the challenge of nationally upscaling the implementation of social prescribing relates to the fragmentation of health and social care finances across different sectors (Social prescribing around the world [Internet], 2023).

Integration and mainstreaming of NBSP in existing systems were considered important for programme sustainability. In the initial phase of NBSP programme development, resources already available in the community need to be identified (e.g., drawing on existing community assets was found to be important by the UK Green Social Prescribing evaluation report (Haywood et al., 2023). This knowledge allows the development of a long-term action plan supported by a theory of change (a description of how the NBSP programme will benefit service users, with specifics of inputs, activities, outcomes, and impacts). In Germany, there are four major prevention themes (diet, stress/resource management, addiction, physical exercise) financed by health insurance funds (GKV-Spitzenverband, 2022), in which some NBHI are already implemented (e.g., Nordic Walking or Tai Chi outdoors). In addition, highly specialised German health resorts offer traditional treatment programmes (called 'Kur') for various diseases based on available natural

remedies. Whilst there are new initiatives to develop recreational and therapeutic forests across Germany, such as forest therapy initiatives that aim to enhance people's wellbeing through immersive experiences in the forest (Immich and Robl, 2023; Schuh and Immich, 2019), German health insurance companies do not yet fund forest therapy directly. However, the number of rehabilitation clinics incorporating forest therapy into their clinical setting has increased in recent years and could be extended to develop a community-based approach to NBSP.

In the UK, NBSP programmes tend to last between 6 and 12 weeks, while German health prevention seminars usually last 8 weeks (and can be up to 12 weeks); the ideal length of a programme depends on service users' health status, needs, and other characteristics. There is limited evidence on whether, or for how long, the benefits of NBSP are maintained after finishing a programme, but there are some studies suggesting participation has a beneficial long-term impact. An evaluation of a nature-based mindfulness course found that most participants had continued to practice mindfulness at least occasionally, and 35 % still experienced improved cognitive functioning after six months (Lymeus et al., 2022), with similar sustained cognitive outcomes found in elderly participants in a horticultural therapy programme (Sia et al., 2020). In a qualitative exploration of a sail training programme, participants described how they developed new skills and confidence for the future (White et al., 2016). Exit strategies are needed to support those leaving NBSP in maintaining benefits received from the programme by continuing activities and behaviours developed during the programme independently.

Ultimately, a long-term action plan for the sustainability of NBSP should back investment in initiatives for prevention rather than reactive interventions. This might include incentivising both service providers and service users in a country-specific and appropriate way through, for example, extra payments, refunds, or reduced health insurance tariffs. Explicitly linking NBSP to the wider social determinants of health and highlighting its potential benefits to health, climate, biodiversity, and environment (e.g., by reducing pharmaceutical pollution) in relation to cross-sectoral policies and programmes, might help policymakers to prioritise their use of resources, including those from non-health sectors, so that NBSP can be funded long-term.

Another barrier to the sustainability of NBSP programmes may be the availability and quality of green and blue spaces (Haywood et al., 2023). Collaborations between the health, environment, and urban planning sectors as well as landowners are needed to ensure the availability and high quality of natural space for NBSP activities. Potential damage of natural spaces due to unsustainable use of nature in NBSP programmes could also be problematic, as indicated by high usage of green spaces during the COVID-19 pandemic (Derks et al., 2020; Yap et al., 2022) being associated with various forms of damage, such as off-trail walking, littering, and increased disturbance to wildlife (Bates et al., 2020; McGinlay et al., 2020). This emphasises the importance of fostering responsible behaviour regarding proper usage of natural spaces in NBSP programmes (e.g., explaining potential restrictions in certain areas to safeguard wildlife or fragile ecosystems) and the necessity for allocating consistent funding to preserve the ecological integrity and long-term sustainability of natural spaces amid heightened demand. It is noteworthy that human wellbeing (esp. positive affect and meaningfulness), environmental education, ecological restoration, and pro-nature behaviour can go hand in hand (e.g. (de Bell et al., 2018; Richardson et al., 2020; Wyles et al., 2017) and can therefore be considered together when planning NBSP programmes. This relates also to the evidence of nature contact leading to nature connectedness (Sheffield et al., 2022), which is associated with pro-environmental behaviour (Mackay and Schmitt, 2019; Whitburn et al., 2020). When planned well, NBSP programmes can promote human health and wellbeing, as well as nature connectedness and pro-environmental actions, likely leading to environmental benefits in the long run.

3.6. Suggestions for policy, practice, and research

In summary, while NBSP programmes are increasingly recognised as a beneficial health intervention, work is still needed to ensure their effectiveness at different phases of development and scales of implementation (e.g., in the community and at the national level). Future implementation of NBSP in different contexts should build on the strengths and opportunities offered by current NBSP practice while considering its weaknesses and related threats (Fig. 1, Table 2). Based on our workshop findings, we identified three key areas to progress NBSP:

- **Policy** should establish and expand cross-sectoral networks and collaborations (especially spanning the health and environment sectors) and incorporate actors from research, policy, and practice. This will enable cross-sectoral cooperation, shared understanding, standardised approaches, and co-funding opportunities to create the base needed to support sustainable NBSP.
- **Practice** should advance the development of standardised implementation and competency frameworks. These will enable the adaptation, accessibility, and evaluation of NBSP in different countries and contexts.
- **Research** should expand the evidence base to include a wider range of study designs and outcomes (e.g., socio-economic and ecological benefits), which could be used to better communicate the benefits of NBSP to different audiences, as well as identify factors crucial for successful implementation (in general and in specific contexts).

4. Conclusions

There is growing global interest in NBSP as a health intervention that could yield broader societal and environmental benefits, including a contribution to tackling the multiple crises facing the planet (Richardson et al., 2023). In addition to promoting the physical, mental, and social health of individuals, participation in NBSP programmes could benefit healthcare systems by reducing demands for health services and pharmaceutical use, with associated reductions in healthcare expenditure. NBSP programmes could also benefit environmental conservation, fostering greater nature connection and pro-environmental behaviours (Sheffield et al., 2022; Whitburn et al., 2020). However, NBSP faces a number of implementation challenges across different settings. While research shows the importance of nature for health, data on NBSP remain limited due to the complexity of interventions and outcomes. Moreover, the available evidence is often poorly communicated to service users, practitioners, and policymakers. Effective NBSP programmes require cross-sectoral collaboration, but competing priorities and governance structures hinder prioritisation and funding of NBSP.

The characteristics of a pragmatic NBSP programme depend on different factors at macro- (e.g., environmental crises), meso- (e.g., governance structures, healthcare system, society and culture, population health), and micro- (e.g., individual health and wellbeing status, preference for nature-based activities) levels. Nevertheless, there are common aspects that should be considered to facilitate adaptation. Developing pragmatic NBSP programmes requires capacity building, for example, by training providers and establishing structures for engaging with service users in different healthcare systems. The implementation of NBSP must address universal access, including practical aspects such as transport to activity locations. Networks and collaboration across sectors are essential in this process. While NBSP programmes need to be context-specific, standardised and adaptable protocols for implementation and evaluation will ensure that all relevant factors are considered when adapting and evaluating programmes. This will support effective and sustainable implementation of NBSP, fostering nature-based solutions for public health and wellbeing.

Open access.

For the purpose of open access, the authors have applied a Creative Commons Attribution (CC BY) licence to any Author Accepted

Manuscript version arising from this submission.

Ethics approval and consent to participate.

Not applicable.

Consent for publication

Not applicable.

Funding.

This work was supported by a Researcher Links Challenge Grants UK-Germany Public Health workshops grant from the British Council's Going Global Partnerships programme. The programme builds stronger, more inclusive, internationally connected higher education and TVET systems.

CRediT authorship contribution statement

Siân de Bell: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Julius Cesar Alejandre:** Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Claudia Menzel:** Writing - review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Rita Sousa-Silva:** Writing – review & editing, Investigation, Conceptualization. **Tanja M. Straka:** Writing – review & editing, Investigation, Conceptualization. **Susanne Berzborn:** Writing – review & editing. **Max Bürck-Gemassmer:** Writing – review & editing. **Martin Dallimer:** Writing – review & editing. **Chris Dayson:** Writing – review & editing. **Jessica C. Fisher:** Writing – review & editing. **Annette Haywood:** Writing – review & editing. **Alina Herrmann:** Writing – review & editing. **Gisela Immich:** Writing – review & editing. **Christian S. Keßler:** Writing – review & editing. **Kristin Köhler:** Writing – review & editing. **Mary Lynch:** Writing – review & editing. **Viola Marx:** Writing – review & editing. **Andreas Michalsen:** Writing – review & editing. **Pierpaolo Mudu:** Writing – review & editing. **Hendrik Napierala:** Writing – review & editing. **Maximilian Nawrath:** Writing – review & editing. **Sharon Pfleger:** Writing – review & editing. **Claudia Quitmann:** Writing – review & editing. **Jonathan P. Reeves:** Writing – review & editing. **Kevin Rozario:** Writing – review & editing. **Wolfgang Straff:** Writing – review & editing. **Katie Walter:** Writing – review & editing. **Charlotte Wendelboe-Nelson:** Writing – review & editing. **Melissa R. Marselle:** Writing – review & editing, Supervision, Resources, Methodology, Investigation, Funding acquisition, Conceptualization. **Rachel Rui Ying Oh:** Writing – review & editing, Supervision, Resources, Methodology, Investigation, Funding acquisition, Conceptualization. **Aletta Bonn:** Writing – review & editing, Supervision, Resources, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: [JA – member of the Steering Group of the Scottish Social Prescribing Network; associate member of the One Health Breakthrough Partnership; and member of the Pharma Pollution Hub. ML – director of Social Prescribing Evidence Hub in Ireland and author of the first social prescribing book. GI – scientific and therapeutic interest in NBSP, its implementation into the German health system to foster nature-based intervention for prevention and therapy. KK – offers nature-based and sustainable interventions in the field of prevention and therapy at VERDE in Leipzig, Germany. SP – co-founder of One Health Breakthrough Partnership in Scotland, and advisor to the Pharma Pollution Hub in England. JR – active and ongoing interest in NBSP, its implementation, and how NBSP can benefit wetland conservation. KW – Clinical Supervisor for the Active Health Link Worker Project, Velocity Cafe & Bicycle Workshop social enterprise, funded by NHS Highland and Transport Scotland.].

Data availability

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Acknowledgements

We thank the British Council and the British Embassy for hosting the workshop in Berlin, particularly A. Kienberger (Head of Education) and K. Robinson (Science & Innovation Officer). We also thank our workshop participants, many of whom are co-authors of this paper, those who contributed their knowledge and expertise ((F. Mayer, A. Villegas, C. Glahe, J-S. Baxter, and M. Eichinger), and Kitkat Carmona at Kubo Creatives for her help with the figure.

AB and RRYO acknowledge the support of the German Centre for Integrative Biodiversity Research (iDiv) funded by the German Research Foundation (DFG-FZT 118, 202548816). JA acknowledges the support of Glasgow Caledonian University and the Hydro Nation Scholars Programme funded by the Scottish Government. RSS acknowledges the support from the Eva Mayr-Stihl Foundation. PM is staff member of the WHO, but the authors alone are responsible for the views expressed in this publication, and they do not necessarily represent the views, decisions, or policies of the WHO or their organisations.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.envint.2024.108801.

References

Alejandre, J.C., Chastin, S., Irvine, K.N., Georgiou, M., Khanna, P., Tieges, Z., et al., 2023. Contextual factors and programme theories associated with implementing blue prescription programmes: a systematic realist review. Health Soc Care Community. 2023, e6551521.

Global Social Prescribing Alliance. Global Social Prescribing Alliance: Supporting SDG3 Good Health and Wellbeing [Internet]. 2022 [cited 2023 Aug 23]. Available from: https://www.gspalliance.com/.

AOK. So gelingt ein Mikroabenteuer [Internet]. 2023 [cited 2023 Nov 22]. Available from: https://www.aok.de/pk/magazin/wohlbefinden/entspannung/die-besten-tipps-fuer-mikroabenteuer-in-deutschland/.

Bates, A.E., Primack, R.B., Moraga, P., Duarte, C.M., 2020. COVID-19 pandemic and associated lockdown as a "Global Human Confinement Experiment" to investigate biodiversity conservation. Biol Conserv. 1 (248), 108665.

Belkhir, L., Elmeligi, A., 2019. Carbon footprint of the global pharmaceutical industry and relative impact of its major players. J Clean Prod. 214, 185–194.

Bevan, J., Blyth, R., Russell, B., Holtgrewe, L., Cheung, A.H.C., Austin, I., et al., 2023. Planetary health and sustainability teaching in UK medical education: A review of medical school curricula. Med Teach. 3 (45), 623–632.

Bratman, G.N., Anderson, C.B., Berman, M.G., Cochran, B., de Vries, S., Flanders, J., et al., 2019. Nature and mental health: an ecosystem service perspective. Sci Adv. 5, eaax0903.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual Res Psychol. 1 (3), 77–101.

Browning, M., Lee, K., 2017. Within what distance does "greenness" best predict physical health? a systematic review of articles with GIS buffer analyses across the lifespan. Int J Environ Res Public Health. 14, 675.

CBD. United Nations Biodiversity Conference CBD/COP/DEC/15/4 [Internet]. Montreal: CBD; 2022. Available from: https://www.cbd.int/conferences/2021-2022/cop-15/documents.

CLASSIC vhb – Das Kursangebot für Studierende der Trägerhochschulen [Internet]. no date [cited 2023 Aug 23]. CLASSIC vhb – Das Kursangebot für Studierende der Trägerhochschulen. Available from: https://kurse.vhb.org/VHBPORTAL/kursprogramm/kursprogramm.jsp.

Dallimer, M., Davies, Z., Irvine, K., Maltby, L., Warren, P., Gaston, K., et al., 2014. What personal and environmental factors determine frequency of urban greenspace use? Int J Environ Res Public Health. 11, 7977–7992.

Dayson, C, Bashir, N. (2014) The social and economic impact of the Rotherham Social Prescribing Pilot: Main evaluation report [Internet]. 2014 [cited 2024 Apr 12]. Available from: https://shura.shu.ac.uk/18961/1/Dayson-SocialAndEconomicImpact-Rotherham(VoR).pdf.

de Bell, S., Graham, H., White, P.C.L., 2018. The role of managed natural spaces in connecting people with urban nature: a comparison of local user, researcher, and provider views. Urban Ecosyst. 1 (21), 875–886.
Deblonde, T., Hartemann, P., 2013. Environmental impact of medical prescriptions: assessing the risks and hazards of persistence, bioaccumulation and toxicity of pharmaceuticals. Public Health. 1 (127), 312–317.
Department of Health and Social Care. National green social prescribing delivery capacity assessment: final report [Internet]. 2023 [cited 2024 Apr 5]. Available from: https://www.gov.uk/government/publications/national-green-social-prescribing-delivery-capacity-assessment/national-green-social-prescribing-delivery-capacity-assessment-final-report#introduction.
Derks, J., Giessen, L., Winkel, G., 2020. COVID-19-induced visitor boom reveals the importance of forests as critical infrastructure. For Policy Econ. 1 (118), 102253.
Elliott, L.R., Pasanen, T., White, M.P., Wheeler, B.W., Grellier, J., Cirach, M., et al., 2023. Nature contact and general health: testing multiple serial mediation pathways with data from adults in 18 countries. Environ Int. 178, 108077.
NHS England. Social prescribing [Internet]. no date [cited 2024 Apr 5]. Available from: https://www.england.nhs.uk/personalisedcare/social-prescribing/.
European Commission, Directorate-General for Environment. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL AND THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE European Union Strategic Approach to Pharmaceuticals in the Environment [Internet]. 2019 Report No.: Document 52019DC0128. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0128&qid=1605854880622.
European Federation of Pharmaceutical Industries and Associations. The pharmaceutical industry in figures. Key data [Internet]. 2022 [cited 2023 Aug 23]. Available from: https://www.efpia.eu/media/637143/the-pharmaceutical-industry-in-figures-2022.pdf.
Fixsen, A., Barrett, S., 2022. Challenges and approaches to green social prescribing during and in the aftermath of COVID-19: a qualitative study. Front Psychol. 13, 861107.
Fullam, J., Hunt, H., Lovell, R., Husk, K., Byng, R., Richards, D., et al., 2021. A handbook for Nature on Prescription to promote mental health. University of Exeter. Version 1.
Garside R, Orr N, Short R, Lovell R, Husk K, McEachan R, et al. 2020. Therapeutic Nature: Nature-based social prescribing for diagnosed mental health conditions in the UK [Internet]. Available from: https://arc-swp.nihr.ac.uk/wp/wp-content/uploads/2021/06/15139_TherapeuticNature-ResearchBriefing.pdf.
Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forns, J., Plasència, A., et al., 2015. Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. Int J Environ Res Public Health. 22 (12), 4354–4379.
Gatersleben, B., Murtagh, N., Abrahamse, W., 2014. Values, identity and pro-environmental behaviour. Contemp Soc Sci. 2 (9), 374–392.
DAK Gesundheit. Wellness-Trend Waldbaden [Internet]. 2022 [cited 2023 Aug 23]. Available from: https://magazin.dak.de/darum-tut-uns-der-wald-so-gut/.
Ghofrani, Z., Sposito, V., Faggian, R., 2017. A comprehensive review of blue-green infrastructure concepts. Int J Environ Sustain. 6, 15–36.
GKV-Spitzenverband. Präventionsangebote der Krankenkassen [Internet]. 2022. Available from: https://www.gkv-spitzenverband.de/service/versicherten_service/praeventionskurse/primaerpraeventionskurse.jsp.
Golubinski, V., Wild, E.M., Winter, V., Schreyögg, J., 2020. Once is rarely enough: can social prescribing facilitate adherence to non-clinical community and voluntary sector health services? empirical evidence from Germany. BMC Public Health. 30 (20), 1827.
Gworek, B., Kijeńska, M., Wrzosek, J., Graniewska, M., 2021. Pharmaceuticals in the soil and plant environment: a review. Water Air Soil Pollut. 8 (232), 145.
Hartig, T., Mitchell, R., de Vries, S., Frumkin, H., 2014 Mar. Nature and health. Annu Rev Public Health. 18 (35), 207–228.
Haywood, A., Dayson, C., Garside, R., Foster, A., Lovell, R., Husk, K., et al., 2023. National evaluation of the Preventing and Tackling Mental Ill Health through Green Social Prescribing Project: Interim Report – September 2021 to September 2022. Department for Environment, Food and Rural Affairs, London.
Helms, M.M., Nixon, J., 2010. Exploring SWOT analysis – where are we now?: a review of academic research from the last decade. J Strategy Manag. 10 (3), 215–251.
Helwig, K., Niemi, L., Stenuick, J.Y., Alejandre, J.C., Pfleger, S., Roberts, J., et al., 2023. Broadening the perspective on reducing pharmaceutical residues in the environment. Environ Toxicol Chem [internet]. Available from: https://setac.onlinelibrary.wiley.com/doi/abs/10.1002/etc.5563.
Chatham House. Chatham House rule [Internet]. 2023 [cited 2023 Aug 23]. Available from: https://www.chathamhouse.org/about-us/chatham-house-rule.
Hunter, R.F., Nieuwenhuijsen, M., Fabian, C., Murphy, N., O'Hara, K., Rappe, E., et al., 2023. Advancing urban green and blue space contributions to public health. Lancet Public Health. 1 (8), e735–e742.
Husk, K., Blockley, K., Lovell, R., Bethel, A., Lang, I., Byng, R., et al., 2020. What approaches to social prescribing work, for whom, and in what circumstances? a realist review. Health Soc Care Community. 28, 309–324.
Hyder, A.A., Corluka, A., Winch, P.J., El-Shinnawy, A., Ghassany, H., Malekafzali, H., et al., 2010. National policy-makers speak out: are researchers giving them what they need? Health Policy Plan. 26, 73–82.
Ihemezie, E.J., Nawrath, M., Strauß, L., Stringer, L.C., Dallimer, M., 2021. The influence of human values on attitudes and behaviours towards forest conservation. J Environ Manage. 15 (292), 112857.
Immich, G., Robl, E., 2023. Development of structural criteria for the certification and designation of recreational and therapeutic forests in Bavaria. Germany. Forests. 14, 1273.
Innvær, S., Vist, G., Trommald, M., Oxman, A., 2002. Health policy-makers' perceptions of their use of evidence: a systematic review. J Health Serv Res Policy. 7, 239–244.
Involve. World Cafe [Internet]. 2018 [cited 2023 Aug 23]. Available from: https://involve.org.uk/resources/methods/world-cafe#:~:text=The%20World%20Cafe%20is%20a,Image%20by%20itupictures.
Irvine, K.N., Marselle, M.R., Melrose, A., Warber, S.L., 2020. Group outdoor health walks using activity trackers: Measurement and implementation insight from a mixed methods feasibility study. Int J Environ Res Public Health. 17, 2515.
IUCN, 2020. Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS, First edition. IUCN, Gland, Switzerland.
Kimberlee, R., Bertotti, M., Dayson, C., Asthana, S., Polley, M., Burns, L., et al., 2022. The economic impact of social prescribing. National Academy for Social Prescribing, London.
Knight-Markiegi A. Social Return on Investment (SROI) evaluation of Blue Prescribing at WWT Steart Marshes [Internet]. Birmingham: M·E·L Research; 2023. Available from: https://www.wwt.org.uk/uploads/documents/2023-03-07/wwt-sroi-of-blue-prescribing-evaluation-final-report.pdf.
Koivisto M, Grassini S. Mental imagery of nature induces positive psychological effects. Curr Psychol [Internet]. 2022; Available from: https://doi.org/10.1007/s12144-022-04088-6.
Kondo, M.C., Oyekanmi, K.O., Gibson, A., South, E.C., Bocarro, J., Hipp, J.A., 2020. Nature prescriptions for health: a review of evidence and research opportunities. Int J Environ Res Public Health. 17, 4213.
Kurpas, D., Mendive, J.M., Vidal-Alaball, J., Petrazzuoli, F., Morad, M., Kloppe, T., et al., 2023. European perspective on how social prescribing can facilitate health and social integrated care in the community. Int J Integr Care. 23, 13.
Leavell, M.A., Leiferman, J.A., Gascon, M., Braddick, F., Gonzalez, J.C., Litt, J.S., 2019. Nature-based social prescribing in urban settings to improve social connectedness and mental well-being: a review. Curr Environ Health Rep. 6, 297–308.
Liebmann, M., Pitman, A., Hsueh, Y.C., Bertotti, M., Pearce, E., 2022. Do people perceive benefits in the use of social prescribing to address loneliness and/or social isolation? a qualitative meta-synthesis of the literature. BMC Health Serv Res. 19 (22), 1264.
Local Government Association. Health in All Policies - a manual for local government. London: Local Government Association; 2016.
Löhr, K., Weinhardt, M., Sieber, S., 2020. The, "World Café" as a participatory method for collecting qualitative data. Int J Qual Methods. 19 (1609406920916976).
Lovell R, Depledge M, Maxwell S. Health and the natural environment: A review of evidence, policy, practice and opportunities for the future. [Internet]. DEFRA; 2018. Available from: https://ore.exeter.ac.uk/repository/bitstream/handle/10871/36923/Health%20and%20the%20Natural%20Environment_Full%20Report.pdf?sequence=1&isAllowed=y.
Lymeus F, White MP, Lindberg P, Hartig T. Restoration Skills Training in a Natural Setting Compared to Conventional Mindfulness Training: Sustained Advantages at a 6-Month Follow-Up. Front Psychol [Internet]. 2022;13. Available from: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2022.763650.
Mackay, C.M.L., Schmitt, M.T., 2019. Do people who feel connected to nature do more to protect it? A Meta-Analysis. J Environ Psychol. 65, 101323.
Makanjuola, A., Lynch, M., Hartfiel, N., Cuthbert, A., Edwards, R.T., 2023. Prevention of poor physical and mental health through the green social prescribing opening doors to the outdoors programme: a social return on investment analysis. Int J Environ Res Public Health. 20, 6111.
Mallari, E., Lasco, G., Sayman, D.J., Amit, A.M.L., Balabanova, D., McKee, M., et al., 2020. Connecting communities to primary care: a qualitative study on the roles, motivations and lived experiences of community health workers in the Philippines. BMC Health Serv Res. 11 (20), 860.
Marselle MR, Stadler J, Korn H, Irvine KN, Bonn A, editors. Biodiversity and health in the face of climate change [Internet]. Cham: Springer International Publishing; 2019 [cited 2023 Mar 27]. Available from: http://link.springer.com/10.1007/978-3-030-02318-8.
Marselle, M.R., Hartig, T., Cox, D.T.C., de Bell, S., Knapp, S., Lindley, S., et al., 2021. Pathways linking biodiversity to human health: a conceptual framework. Environ Int. 150, 106420.
Marx, V., More, K.R., 2022. Developing Scotland's first green health prescription pathway: a one-stop shop for nature-based intervention referrals. Front Psychol. 13, 817803.
Maund, P.R., Irvine, K.N., Reeves, J., Strong, E., Cromie, R., Dallimer, M., et al., 2019. Wetlands for Wellbeing: Piloting a nature-based health intervention for the management of anxiety and depression. Int J Environ Res Public Health. 16, 4413.
McGinlay, J., Gkoumas, V., Holtvoeth, J., Fuertes, R.F.A., Bazhenova, E., Benzoni, A., et al., 2020. The impact of COVID-19 on the management of European protected areas and policy implications. Forests. 11, 1214.
Moffatt, S., Steer, M., Lawson, S., Penn, L., O'Brien, N., 2017. Link Worker social prescribing to improve health and well-being for people with long-term conditions: qualitative study of service user perceptions. BMJ Open. 1 (7), e015203.
Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ [Internet]. 2015; 350. Available from: https://www.bmj.com/content/350/bmj.h1258.
Morse, D., Sandhu, S., Mulligan, K., Tierney, S., Polley, M., Giurca, B.C., et al., 2022. Global developments in social prescribing. BMJ Glob Health. 7 (5), e008524.
Muhl, C., Mulligan, K., Bayoumi, I., Ashcroft, R., Godfrey, C., 2023. Establishing internationally accepted conceptual and operational definitions of social prescribing through expert consensus: a Delphi study. BMJ Open. 13, e070184.
National Association of Link Workers. Care for the carer: Social prescribing link workers views, perspectives, and experiences of clinical supervision and wellbeing support [Internet]. 2020. Available from: https://www.nalw.org.uk/wp-content/uploads/2020/07/NALW_Care-for-the-Carer_-Report_8th-July-2020-Final.pdf.

NatureScot. Green Health Partnerships [Internet]. 2020. Available from: https://www.nature.scot/professional-advice/contributing-healthier-scotland/our-natural-health-service/green-health-partnerships.
Nguyen, P.Y., Astell-Burt, T., Rahimi-Ardabili, H., Feng, X., 2023. Effect of nature prescriptions on cardiometabolic and mental health, and physical activity: a systematic review. Lancet Planet Health. 1 (7), e313–e328.
NHS. The NHS Long Term Plan [Internet]. London: Department for Health and Social Care; 2019. Available from: https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf.
NICE. Medicines optimisation: the safe and effective use of medicines to enable the best possible outcomes [Internet]. 2015. Report No.: NICE guideline [NG5]. Available from: https://www.nice.org.uk/guidance/ng5/chapter/introduction#:~:text=Medicines%20prevent%2C%20treat%20or%20manage,Organization's%20world%20health%20report%202003).
NIHR ARC South West Peninsula. Defra Green Social Prescribing Evaluation [Internet]. 2022 [cited 2023 Aug 23]. Available from: https://arc-swp.nihr.ac.uk/research/projects/green-social-prescribing/.
OECD. Pharmaceutical spending (indicator) [Internet]. 2023 [cited 2023 Nov 23]. Available from: https://data.oecd.org/healthres/pharmaceutical-spending.htm.
Oh, R.R.Y., Zhang, Y., Nghiem, L.T.P., Chang, C. chen, Tan, CLY., Quazi, SA., et al., 2022. Connection to nature and time spent in gardens predicts social cohesion. Urban for Urban Green. 1 (74), 127655.
Oliver, K., Cairney, P., 2019. The dos and don'ts of influencing policy: a systematic review of advice to academics. Palgrave Commun. 19 (5), 21.
Ortiz, M., Koch, A.K., Cramer, H., Linde, K., Rotter, G., Teut, M., et al., 2023. Clinical effects of Kneipp hydrotherapy: a systematic review of randomised controlled trials. BMJ Open. 1 (13), e070951.
Pescheny, J., Randhawa, G., Pappas, Y., 2018. Patient uptake and adherence to social prescribing: a qualitative study. BJGP Open. 2.
Planetary Health Academy [Internet]. no date. Available from: https://planetary-health-academy.de/en/.
Povall, S.L., Haigh, F.A., Abrahams, D., Scott-Samuel, A., 2014. Health equity impact assessment. Health Promot Int. 1 (29), 621–633.
Public Services: Social Value Act [Internet]. 2012. Available from: https://www.gov.uk/government/publications/social-value-act-information-and-resources/social-value-act-information-and-resources.
Querri, A.G., Ohkado, A., Kawatsu, L., Bermejo, J., Vianzon, A., Recidoro, M.J., et al., 2020. Assessment of the role of community health volunteers in delivering primary health care in Manila, the Philippines. Kokusai Hoken Iryo J Int Health. 35, 15–25.
WHO Regional Office for Europe,. Green and blue spaces and mental health: new evidence and perspectives for action [Internet]. Copenhagen: WHO Regional Office for Europe; 2021 [cited 2023 Nov 10]. Available from: https://iris.who.int/bitstream/handle/10665/342931/9789289055666-eng.pdf?sequence=1.
Richardson, M., Passmore, H.A., Barbett, L., Lumber, R., Thomas, R., Hunt, A., 2020. The green care code: How nature connectedness and simple activities help explain pro-nature conservation behaviours. People Nat. 2, 821–839.
Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S.E., Donges, J.F., et al., 2023. Earth beyond six of nine planetary boundaries. Sci Adv. 9, eadh2458.
Rigolon, A., Browning, M.H.E.M., McAnirlin, O., Yoon, H.(Violet), 2021. Green space and health equity: a systematic review on the potential of green space to reduce health disparities. Int J Environ Res Public Health. 18, 2563.
Robinson, J.M., Breed, M.F., 2019. Green prescriptions and their co-benefits: integrative strategies for public and environmental health. Challenges. 10, 9.
Rueff, M., Reese, G., 2023. Depression and anxiety: a systematic review on comparing ecotherapy with cognitive behavioral therapy. J Environ Psychol. 90, 102097.
Schuh, A., Immich, G., 2019. Waldtherapie - das Potential des Waldes für Ihre Gesundheit. Springer, Berlin, p. 142 p.. Sachbuch.
Scottish Government. Scotland: The Procurement Regulations [Internet]. 2016. Available from: https://www.legislation.gov.uk/sdsi/2016/9780111030868.
Shanahan, D.F., Astell-Burt, T., Barber, E.A., Brymer, E., Cox, D.T.C., Dean, J., et al., 2019. Nature–based interventions for improving health and wellbeing: the purpose, the people and the outcomes. Sports. 7, 141.
Sheffield, D., Butler, C.W., Richardson, M., 2022. Improving nature connectedness in adults: a meta-analysis, review and agenda. Sustainability. 14, 12494.
Sia, A., Tam, W.W.S., Fogel, A., Kua, E.H., Khoo, K., Ho, R.C.M., 2020. Nature-based activities improve the well-being of older adults. Sci Rep. 10 (1), 18178.
Social prescribing around the world [Internet]. 2023 [cited 2023 Aug 23]. Available from: https://socialprescribingacademy.org.uk/media/4lbdy5ip/social-prescribing-around-the-world.pdf.
HM Treasury. The Green Book Central Government Guidance on Appraisal and Evaluation [Internet]. 2022. Available from: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020.
Twohig-Bennett, C., Jones, A., 2018. The health benefits of the great outdoors: a systematic review and meta-analysis of greenspace exposure and health outcomes. Environ Res. 166, 628–637.
University of Plymouth. Nature on Prescription for Mental Health: Feasibility Stage for the 'greENGAGE' Trial Stage [Internet]. no date. Available from: https://www.plymouth.ac.uk/research/primarycare/social-prescribing/nature-on-prescription-for-mental-health-feasibility-stage-for-the-greengage-trial-stage.
van den Bosch, M., Ode, S.Å., 2017. Urban natural environments as nature-based solutions for improved public health – a systematic review of reviews. Environ Res. 158, 373–384.
van Houwelingen-Snippe, J., van Rompay, T.J.L., Ben, A.S., 2020. Feeling connected after experiencing digital nature: a survey study. Int J Environ Res Public Health. 17, 6879.
VERDE. RE.CONNECT to nature. Das gratis Programm für suffiziente öko-psycho-soziale Transformation [Internet]. 2022 [cited 2023 Sep 1]. Available from: https://verde-gesund.de/re-connect.
Vos, T., Lim, S.S., Abbafati, C., Abbas, K.M., Abbasi, M., Abbasifard, M., et al., 2020. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet. 396 (10258), 1204–1222.
Welsh Government. Wales: Well-being of Future Generations Act [Internet]. 2015. Available from: https://gov.wales/well-being-of-future-generations-wales.
Whitburn, J., Linklater, W., Abrahamse, W., 2020. Meta-analysis of human connection to nature and proenvironmental behavior. Conserv Biol. 34, 180–193.
White, R., Abraham, C., Smith, J.R., White, M., Staiger, P.K., 2016. Recovery under sail: Rehabilitation clients' experience of a sail training voyage. Addict Res Theory. 24 (5), 355–365.
White, M.P., Elliott, L.R., Gascon, M., Roberts, B., Fleming, L.E., 2020. Blue space, health and well-being: a narrative overview and synthesis of potential benefits. Environ Res. 191, 110169.
Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A.G., de Souza Dias, B.F., et al., 2015. Safeguarding human health in the anthropocene epoch: report of the rockefeller foundation-lancet commission on planetary health. The Lancet. 14 (386), 1973–2028.
WHO. WHO global strategy on health, environment and climate change: the transformation needed to improve lives and well-being sustainably through healthy environments. Geneva: World Health Organization; 2020.
WHO. COP26 Health Programme [Internet]. 2023 [cited 2023 Aug 30]. Available from: https://www.who.int/initiatives/alliance-for-transformative-action-on-climate-and-health/cop26-health-programme.
Wildfowl and Wetlands Trust. Blue prescribing [Internet]. no date [cited 2023 Aug 23]. Available from: https://www.wwt.org.uk/our-work/projects/blue-prescribing/.
Wyles, K.J., Pahl, S., Holland, M., Thompson, R.C., 2017. Can beach cleans do more than clean-up litter? comparing beach cleans to other coastal activities. Environ Behav. 49, 509–535.
Yap, K.K.L., Soh, M.C.K., Sia, A., Chin, W.J., Araib, S., Ang, W.P., et al., 2022. The influence of the COVID-19 pandemic on the demand for different shades of green. People Nat. 1 (4), 505–518.