ISSN: 1648-6897 / eISSN: 1822-4199

VILNIUS TECH
Vilnius Gediminas Technical University

JOURNAL of ENVIRONMENTAL ENGINEERING & LANDSCAPE MANAGEMENT

2025
Volume 33
Issue 1
Pages 55–71
https://doi.org/10.3846/jeelm.2025.22944

THE EFFECT OF NATURE-BASED LANDSCAPE DESIGN ON HUMAN HEALTH AND WELL-BEING: A THEMATIC SYNTHESIS

Qiuxia ZHU[1, 2]✉, Pinyi YAO[3], Jiexu LI[2]

[1]*Faculty of Art, Lanzhou University of Finance and Economics, Lanzhou, Gansu, China*
[2]*Faculty of Design and Architecture, University Putra Malaysia, Serdang, Selangor, Malaysia*
[3]*College of Business, Nanning University, Nanning, China*

Highlights:

- exploring the research trends and future studies' direction by adopting a thematic analysis approach;
- the quantitative results show the research trends on the topic;
- six main themes emerged from the subsequent qualitative analysis: (1) Approach, (2) Health-promoting design, (3) Human-Nature interactions, (4) Landscape intervention, (5) Perceived preferences and perceived restorativeness, and (6) Sustainability;
- the resulting framework serves to guide landscape designers, urban planners, and researchers to improve the effectiveness of public social, physical, and mental health with feasible measures and designs approach.

Article History:

- received 23 May 2023
- accepted 23 October 2024

Abstract. Population growth, high-density living situations, and rapid urbanization lead to environmental change that affects ecosystems, human behavior, and well-being. To design health-promoting urban landscapes, it is necessary to conduct more detailed studies of landscape features. However, there is a lack of review articles discussing specific approaches and factors of landscape design for human well-being in evidence-based landscape research. Therefore, this review aims to explore the research trends and future studies' direction by adopting a thematic analysis approach. Using ATLAS.ti 23 software, we analyzed 40 literature articles on landscape design and human well-being published between 2018 and 2022. The article attribute findings show the research trends on the topic. Six main themes emerged from the subsequent qualitative analysis: (1) Human-nature Interactions, (2) Health-promoting Design, (3) Integrative Strategies, (4) Landscape Intervention, (5) Perceptions and Restorativeness, and (6) Sustainability. The resulting framework serves to guide landscape designers, urban planners, and researchers to improve the effectiveness of public social, physical, and mental health with feasible measures and design approaches.

Keywords: landscape design, well-being, urban green space, intervention, sustainability, ATLAS.ti.

✉Corresponding author. E-mail: *qxzhu826413@gmail.com*

1. Introduction

Urbanization and mental health are global issues (McEwan et al., 2019). Currently, cities are home to more than 55% of the world's population, resulting in rapid urbanization, especially in developing countries (UN Department of Economic and Social Affairs, 2018). Population growth, high-density living conditions, and rapid urbanization have contributed to significant worldwide health issues (Giles-Corti et al., 2016), while urban development and the expansion of urban areas have led to environmental changes. This spatial shift is particularly noticeable in urban green spaces and affects ecosystems and human activities, including ecological functions (Forman, 1995) and human well-being (leBrasseur, 2022; Millenium Ecosystems Assessment, 2005).

It is estimated that approximately 30% of the world's population currently suffers from varying degrees of mental disorders (Steel et al., 2014), indicating a global mental health crisis that requires effective interventions. One promising approach is exposure to natural environments as human health and well-being can be improved by exposure to natural images and sounds. The combination of visual and auditory stimuli has a positive impact on the restorative potential and aesthetic preferences of urban green spaces (Deng et al., 2020), which means that exposure to natural environments, including urban green spaces, residential landscapes, and office landscapes, can benefit physical health, psychological well-being, and social belonging among the public. Urban green spaces have therapeutic value in enabling city inhabitants to relax and interact with nature. However, new landscape patterns are

Copyright © 2025 The Author(s). Published by Vilnius Gediminas Technical University

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (*http://creativecommons.org/licenses/by/4.0/*), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

emerging as urban and rural landscapes are changing use due to the severe fragmentation of habitat brought about by urbanization (Nikologianni et al., 2022; Von Thaden et al., 2021; Zhang, 2019). Also, increasing heat islands and global climate change reduce human health and thermal comfort in urban outdoor spaces (Liu et al., 2019). To mitigate these negative impacts, urban greenways facilitate have become one way to perceive restoration and physical health (Y. Wu et al., 2022). Urban public green spaces are integral to daily city life and access to nature for people (Campagnaro et al., 2020), improving their life quality, mental health, and overall well-being of the urban public (Olszewska-Guizzo et al., 2022b).

On the other hand, as complex socio-ecological landscape systems, cities face enormous challenges such as intensive urbanization, demographic aging, climate change, and natural resource exhaustion (Burkhard et al., 2010; McPhearson et al., 2014; Pickett et al., 2001). Biodiversity and people's interaction with nature are threatened by urbanization, so it is necessary to pay more attention to that gradual isolation from the natural world since it affects human attitudes and behaviors toward nature and the health and well-being of its inhabitants (Colléony et al., 2019). Giusti and Samuelsson believe cities should create public environments that promote a healthy population and a sustainable biosphere to address their significant global environmental challenges (Giusti & Samuelsson, 2020). Natural outdoor environments of urban green (vegetated open spaces) and blue (water bodies) have been incorporated into cities due to the growing understanding of how nature can improve human well-being (Tan et al., 2021). Moreover, urban parks offer various cultural ecosystem services (Dade et al., 2020); urban green space can also positively impact a city's residents' attitudes, health, and well-being while reducing some of the adverse effects of the urban lifestyle (Cameron et al., 2020).

In recent years, researchers have become increasingly interested in the link between green spaces and health. Numerous rigorous scientific publications have elucidated the mechanisms linking green space and health, in areas ranging from neuroscience to immune function to physiological impacts; however, accurately describing these complex interactions, desirable as they may be, is not the only measure of the value of this work. Nature-based solutions have grown into an overarching concept that includes ecosystem approaches, blue/green/natural infrastructure, and ecosystem services. The core is learning from nature and using it, promoting human well-being by creating sustainable social-ecological systems (Dick et al., 2019). The potential benefits of urban green space are well-documented, but realizing these benefits depends on good design and ongoing maintenance. Therefore, planning and management expertise of urban green space should ideally begin with the same concepts that motivate beneficiaries to meet the needs and preferences of users (Ugolini et al., 2022).

A large body of research supports the idea that nature positively impacts health. Still, few theoretical and conceptual frameworks explain how human health and well-being can be promoted by the natural environment without defining spatial landscape elements and specific physical, which might be a guideline for health-promoting design in urban green spaces (Olszewska-Guizzo et al., 2022b; Brymer et al., 2020). Researchers have also emphasized that little is known about landscape quality in evidence-based design (Fuller et al., 2007; Olszewska-Guizzo et al., 2022b; Thompson et al., 2010). According to the World Health Organization, achieving the acknowledged benefits of urban green spaces for health, society, and the environment depends on understanding the methods of designing and delivering effective urban green space interventions (World Health Organization Regional Office for Europe, 2017). Hence, there is a need to establish better links between human needs elements and ecology to optimize landscape design.

These inconsistent results show that a more detailed examination of landscape characteristics is needed if urban green areas that promote health are designed. But the impact on public health has yet to be formalized in a green infrastructure design framework (Rai et al., 2019). It remains debatable whether all types of green space are similarly helpful and, conversely, what forms or critical features of the landscape optimize the required well-being (Cameron et al., 2020). In addition, to the extent that these studies address different landscape scenarios and physical attributes, design styles, and maintenance qualities, which may offer different degrees of well-being potential, they may be ambiguous in the conclusions. This review consolidates findings from empirical studies spanning 2018 to 2022, detailing how various landscape designs affect human well-being. We draw from broad disciplines to map out prevailing themes and discernible trends to formulate a conceptual framework of landscape design to enhance human well-being.

2. Literature review

An extensive literature spanning multiple disciplines discusses the impact of landscape design on human well-being, which exhaustively reviews the various connections between humans and nature or green spaces in the literature.

Most of the earlier studies on the benefits of the landscape for health and well-being contrasted the impacts of nature and urban environments, with "nature" having a broad definition – for example, fountains and trees (Rout & Galpern, 2022), agroforestry (Elbakidze et al., 2021), avian (Cameron et al., 2020) and other landscapes with natural features. Urban green spaces comprise gardens, parks, greenways, wetlands, forests, green walls, and green roofs (Douglas, 2007). Among them, urban greenways are recreational, biodiverse, and preserve cultural heritage, which are public resources that enhance the multi-functions of

urban green spaces (Y. Wu et al., 2022). Overall, green open spaces are any vegetated areas seen in the urban landscape, such as parks, urban forests, lawns, home gardens, and street trees (Ciftcioglu & Aydin, 2018). Other studies analyze landscape typologies to enhance health and well-being, including office landscapes (Cobaleda Cordero et al., 2020), community gardens (Abramovic et al., 2019), domestic gardens (Chalmin-Pui et al., 2021; de Bell et al., 2020), therapeutic landscapes (Elantary et al., 2021; Iswoyo et al., 2020), and campus landscapes (Rout & Galpern, 2022).

To define human well-being, the World Health Organization states that an individual or group must have the capacity to meet needs, fulfill aspirations, and adapt to or cope with their environment to achieve overall physical, mental, and social wellness. As a result, rather than being the goal of life, health is considered a resource for daily living. A healthy idea emphasizes physical capacity and social and personal resources (World Health Organization, 1986) and well-being is a personal trait of an inherent positive state, i.e., happiness. Well-being is commonly described in terms of health, quality of life, happiness, or material conditions (Durand, 2015; Linley et al., 2009) and is often applied to evaluate the life and office environment (Arif et al., 2016; Bridger & Brasher, 2011; Cobaleda Cordero et al., 2020; Danielsson, 2016; Kamarulzaman et al., 2011). A multidimensional, broad conception of well-being considers its construct as a collection of all good feelings and performance of people, which comes from positive psychology, emphasizes what makes people and communities thrive (Seligman & Csikszentmihalyi, 2000), and indicates the presence of positive life experiences and their optimal function (Baumeister et al., 2013; Cobaleda Cordero et al., 2020; Deci & Ryan, 2006; Grant et al., 2009; Huppert & So, 2013; Tov, 2018). Cited from Yarcheski et al. (p. 288), Colombo defined well-being as "A multidimensional construct incorporating mental/psychological, physical, and social dimensions" (Colombo, 1984; Pollard & Lee, 2003; Yarcheski et al., 1994).

Previous studies have focused on how urban green spaces, natural environments, or urban landscapes affect human health and well-being. However, streetscapes, intimately related to inhabitants' daily lives and can influence their psychological well-being, have yet to attract widespread attention from researchers. For instance, although residential gardens comprise 30% of urban space in the United Kingdom, their part in the health and well-being agenda remains underappreciated compared to other green space types (Chalmin-Pui et al., 2021). Besides, while policymakers are increasingly aware of the benefits of urban green space for health and well-being, there are challenges regarding the type and location of urban green spaces included in urban planning. This study therefore aims to fill these gaps by investigating the impact of urban green spaces such as street views and residential gardens on mental health, to provide insights for urban planning to improve human well-being.

3. Materials and methods

Thematic synthesis is similar to the analysis of primary qualitative data sets, which entails the systematic coding of data and the product of both descriptive and analytical themes (Nicholson et al., 2016). This paper employs a thematic analysis approach that was first proposed by Clarke and Braun. It is a process of identifying patterns and constructing themes through an in-depth reading of the articles. This approach contributes to understanding research trends in landscape design for human well-being. Thematic analysis is a practical and adaptable research tool that can provide an informative and thorough yet elaborate description of the data and "recipes" and terms for thematic analysis in a methodologically and theoretically sound manner (Braun & Clarke, 2006; Clarke & Braun, 2013). This review aims to interpret and analyze an overview of the current literature on landscape design and its impact on human well-being. The issue has gained more attention in recent years. However, not much current research can be used to inspire landscape design recommendations specifically for promoting human well-being. Therefore, a thematic review follows the procedure introduced by Zairul (2020) to capture critical data related to the research questions through themes representing some measure of patterned responses or meaning in the dataset (Braun & Clarke, 2006; Zairul, 2020). Question formation was first performed, followed by literature scanning and searching, and finally, literature screening was carried out on specific exclusion and inclusion criteria, then further extracted and synthesized.

This study focuses on analyzing and interpreting the examination outcomes and making recommendations for a grounded theory of landscape design for human well-being in the future. The documentation was based on the following criteria: (1) published from 2018 to 2022, (2) having at least "landscape design" and "human well-being " as keywords, (3) identifying the impact factors of landscape design on human well-being, and (4) articles are limited to English.

The literature search was conducted using the Web of Science and SCOPUS databases. Based on the reviewed exclusion and inclusion criteria, the initial search yielded 90 articles on the Web of Science and 48 on SCOPUS. However, some articles were dropped due to inconsistency with the expected results of this topic (n = 85), and others were incomplete or inaccessible with fragmented links (n = 2). In addition, several duplicates were in the metadata (n = 11). The final papers to be reviewed were reduced to 40 and uploaded as primary files to ATLAS.ti 23, which were categorized by author, journal, volume and issue number, year of publication, and publisher for further analysis (Table 1 and Figure 1).

To ensure the reliability of the coding process, we used the Cohen's Kappa statistic to assess the reliability between the raters. Two authors coded the data separately and conductive the categories and themes. The resulting

Table 1. Search strings from Scopus and WoS

SCOPUS	TITLE-ABS-KEY (landscape AND design) AND TITLE-ABS-KEY (human AND well-being) AND LANGUAGE (English) AND PUBYEAR > 2018 AND (LIMIT-TO (DOCTYPE, "ar")	48 results
WoS	landscape design (All Fields) AND Human Well-being (All Fields) AND 2018-2023 (Year Published) AND English (Language) and Article (Document Types)	90 articles

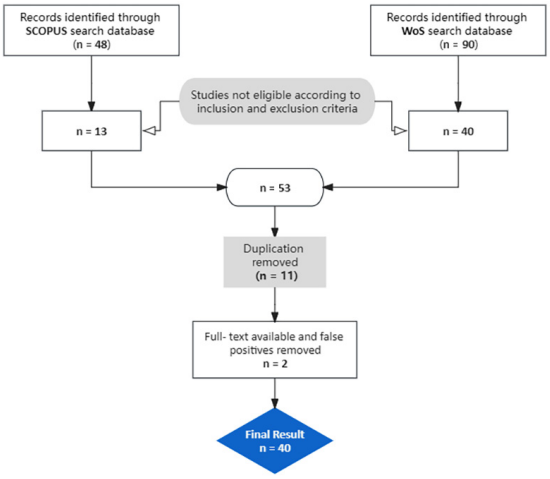

Figure 1. Inclusion and exclusion criteria in the thematic review

Kappa value was k = 0.75, indicating substantial agreement between raters (Landis & Koch, 1977) and a proportion of agreement that exceeds what would be expected by chance.

4. Results and discussion

This section describes the significant outcomes of the thematic review. The quantitative and qualitative analysis of the selected 40 papers answers the research questions. The quantitative section draws results from a mathematical perspective, while the qualitative part extracts codes from these papers, inducts themes, and finally formulates a conceptual framework.

4.1. Article attributes

The attributes of the articles reveal an evolving scholarly interest in the contribution of landscape design to human well-being, and their distribution, popularity, and publication trends provide insight into the dynamics of scholarship in the field.

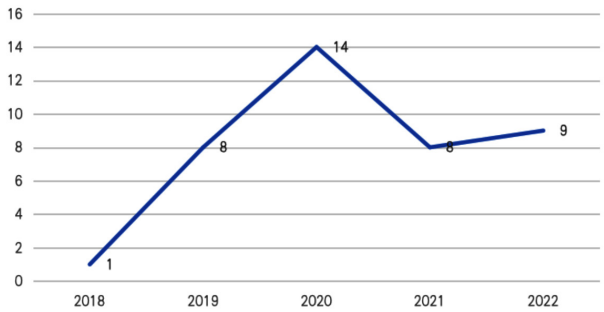

Figure 2. Year of publication

Figure 2 shows the number of publications related to this topic, with an upward trend of related studies. The number of relevant published articles increased unexpectedly from 1 to 8 between 2018 and 2019 but returned to 8 in 2021 after peaking at 14 in 2020. It indicates that the related topic quickly evolves into a hot topic, and then returns to a stable development stage. The peak in 2020 likely reflects an intensified research focus during the pandemic, with subsequent stabilization indicating a return to pre-pandemic publication trends.

As far as the distribution of the countries or regions studied is concerned. Regarding the number of publications, landscape design for human well-being is more prevalent in the United Kingdom, Australia, the United States, Canada, China, and Sweden. The pattern of regional distribution suggests that research is concentrated in countries with rich landscape resources and relatively developed economies and focuses on the role of landscape design in promoting human well-being.

An analysis of the published literature shows that landscape researchers favor journals in the ecology and landscape categories. Figure 3 shows Urban Forestry & Urban Greening, Landscape and Urban Planning, International Journal of Environmental Research and Public Health, and Sustainability as the top four options for researchers.

Figure 3. Reviewed articles based on journals and year

In sum, this section provides an understanding of research trends on how landscape design contributes to human well-being through quantitative results, reflecting some extent, the possibilities for the development of landscape design theory. A more detailed thematic analysis will be shown in the following.

4.2. Thematic results

After reviewing selected articles, the qualitative section coded landscape design factors on human well-being. The initial codes were recoded, merged, and re-categorized in several rounds, and codes that were not frequently used and could not be grouped into any theme were removed, resulting in the identification of six themes that were widely considered and studied by researchers: (1) Human-nature Interactions, (2) Health-promoting Design, (3) Integrative Strategies, (4) Landscape Intervention, (5) Perceptions and Restorativeness, and (6) Sustainability. These themes may overlap between articles and do not stand alone.

Table 2. Authors according to themes

	Article titles	Health-promoting Design	Human-nature Interactions	Integrative Strategies	Landscape Intervention	Perceptions and Restorativeness	Sustainability
Chalmin-Pui et al. (2021)	"It made me feel brighter in myself"– The health and well-being impacts of a residential front garden horticultural intervention				√		
Rai et al. (2019)	A novel computational green infrastructure design framework for hydrologic and human benefits			√			
McEwan et al. (2019)	A smartphone app for improving mental health through connecting with urban nature				√		
Cervera et al. (2021)	Transdisciplinary approach to recovering natural and cultural landscape and place identification: A case study of Can Moritz Spring (Rubí, Spain)			√	√	√	
Rout and Galpern (2022)	Benches, fountains and trees: Using mixed-methods with questionnaire and smartphone data to design urban green spaces			√			
Zhao et al. (2020)	Characteristics of urban streets in relation to perceived restorativeness					√	
Hoyle (2021)	Climate-adapted, traditional or cottage-garden planting? Public perceptions, values and socio-cultural drivers in a designed garden setting		√				
Brymer et al. (2020)	Conceptualizing the human health outcomes of acting in natural environments: An ecological perspective		√				
Nikolo-gianni et al. (2022)	Contribution of conceptual-drawing methods to raise awareness on landscape connectivity: Socio-environmental analysis in the regional context of Trentino (Italy)		√				√
Liu et al. (2019)	Effect of landscape microclimates on thermal comfort and physiological wellbeing		√				
Deng et al. (2020)	Effects of integration between visual stimuli and auditory stimuli on restorative potential and aesthetic preference in urban green spaces					√	
Abramovic et al. (2019)	Entangled recovery: Refugee encounters in community gardens					√	
Wu et al. (2022)	Factors influencing users' perceived restoration while using treetop trails: The case of the Fu and Jinjishan Forest Trails, Fuzhou, China					√	
Olszewska-Guizzo et al. (2022b)	Features of urban green spaces associated with positive emotions, mindfulness and relaxation	√	√				

Continued Table 2

	Article titles	Health-promoting Design	Human-nature Interactions	Integ-rative Strategies	Landscape Inter-vention	Perceptions and Resto-rativeness	Sustain-ability
Cobaleda Cordero et al. (2020)	Feel well and do well at work: A post-relocation study on the relationships between employee wellbeing and office landscape		√				
Taylor et al. (2020)	Focus groups identify optimum urban nature in four Australian and New Zealand cities		√				
Campag-naro et al. (2020)	General, stress relief and perceived safety preferences for green spaces in the historic city of Padua (Italy)					√	
Dick et al. (2019)	How are nature based solutions contributing to priority societal challenges surrounding human well-being in the United Kingdom: A sys-tematic map protocol			√			
Xiang et al. (2022)	Indicator selection combining audio and visual perception of urban green spaces		√				
leBrasseur (2022)	Linking human wellbeing and urban greenspaces: Applying the SoftGIS tool for analyzing human wellbeing interaction in Helsinki, Finland		√				
Wu (2019)	Linking landscape, land system and design approaches to achieve sustainability		√				√
Robinson et al. (2021)	Nature's role in supporting health during the COVID-19 pandemic: A geospatial and socioecological study		√				
He et al. (2022)	Negotiating complexity: Challenges to implementing community-led nature-based solutions in England pre- and post-COVID-19			√			
Elbakidze et al. (2021)	Perceived benefits from agroforestry landscapes across North-Eastern Europe: What matters and for whom?					√	
Stoltz and Grahn (2021)	Perceived sensory dimensions: An evidence-based approach to greenspace aesthetics			√		√	
Hoyle and Sant' Anna (2020)	Rethinking "future nature" through a transatlantic research collaboration: Climate-adapted urban green infrastructure for human wellbeing and biodiversity			√			
Paraskevo-poulou et al. (2022)	Runners experience lower heart rate, increased speed, and joy/calm on routes with trees, by the sea and through parks: Implications for climate change design	√	√				
Shaker et al. (2020)	Showcasing relationships between neighborhood design and wellbeing Toronto indicators	√	√				√
de Bell et al. (2020)	Spending time in the garden is positively associated with health and wellbeing: Results from a national survey in England		√				
Dade et al. (2020)	The effects of urban greenspace characteristics and socio-demographics vary among cultural ecosystem services		√				

End of Table 2

	Article titles	Health-promoting Design	Human-nature Interactions	Integ-rative Strategies	Landscape Inter-vention	Perceptions and Resto-rativeness	Sustain-ability
McEwan et al. (2020)	The good things in urban nature: A thematic framework for optimising urban planning for nature connectedness		√				
Colléony et al. (2019)	The influence of spending time outside on experience of nature and environmental attitudes		√				
Giusti and Samuelsson (2020)	The regenerative compatibility: A synergy between healthy ecosystems, environmental attitudes, and restorative experiences					√	
Tan et al. (2021)	The right mix: Residential urban green-blue space combinations are correlated with physical exercise in a tropical city-state	√					√
Iswoyo et al. (2020)	Therapeutic landscape: Its virtue and suggestion for its application	√					
Ugolini et al. (2022)	Understanding the benefits of public urban green space: How do perceptions vary between professionals and users?		√				
Bell et al. (2020)	Urban blue acupuncture: A protocol for evaluating a complex landscape design intervention to improve health and wellbeing in a coastal community				√		
Ciftcioglu and Aydin (2018)	Urban ecosystem services delivered by green open spaces: An example from Nicosia City in North Cyprus			√			
Elantary et al. (2021)	User's perspective of landscape existence in healthcare buildings	√					
Cameron et al. (2020)	Where the wild things are! Do urban green spaces with greater avian biodiversity promote more positive emotions in humans?	√					

Figure 4 below illustrates the themes, trends, and patterns involved in the selected literature. The initial 14 coded attributes were reorganized and merged. The codes were inducted into six main themes, namely the meaning of Human-nature Interactions, Health-promoting Design, Integrative Strategies, Landscape Intervention, Perceptions and Restorativeness, and Sustainability, which will be analyzed in detail later in the qualitative section. Some explored themes are relatively focused, while others are novel topics. Part of the studies in the selected articles focuses on how landscape design enhances human health and well-being; some focus more on the relationship between urban green spaces/nature and human well-being, and the rest focus on health promotion aspects of landscape design or user perceptions of restoration and preferences, which are also addressed in several studies since sustainability is a goal of landscape development (see Table 2).

The following section discusses these themes separately and may cite results outside the articles reviewed to respond appropriately to the research questions and then formulate a conceptual framework of landscape design for human well-being.

RQ: What are the current trends on human well-being impacts of landscape design discussed in the literature from 2018 to 2022?

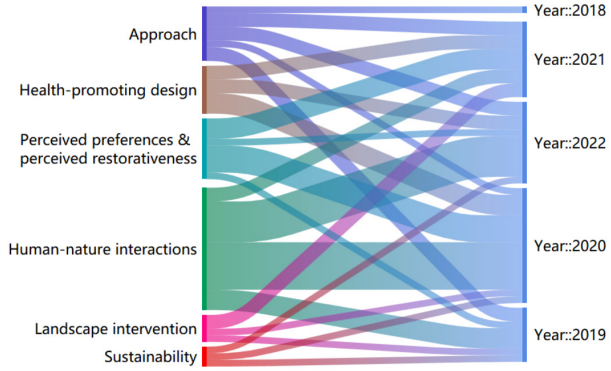

Figure 4. Type of issues discussed in the literature

4.2.1. Theme 1: human-nature interactions

Psychological and physiological benefits of nature exposure

The current corpus of research reveals a robust correlation between exposure to nature and enhanced psychological and physiological well-being (Bratman et al., 2019). It has been indicated that the sight of nature, immersion in nature, physical activity in nature, interaction with nature, and even a sense of connection with nature may enhance health (Brymer et al., 2020). An evidence-based study by Liu et al. (2019) corroborates that landscaped spaces effectively improve microclimate and, as a result, substantially improve human thermal comfort and health, both physically and psychologically. It is beneficial for urban planners to design healthier and more sustainable urban areas utilizing landscape microclimates.

In terms of physiological impacts, studies underscore the health benefits of physical activity within natural settings. For example, running on a tree-lined route, through a park, or near the sea will lead to a heart rate drop, the speed will rise, and people will have the experience of being happy and calm (Paraskevopoulou et al., 2022). The treatment of hospital patients and workers is greatly influenced by the building's landscape surroundings. Regular landscaping and treatment facility settings significantly impact patients' psychological, physical, and social well-being. There is evidence from some respondents' comments that gardens and other natural elements contribute to patient satisfaction with healthcare practitioner performance and higher standards of care (Elantary et al., 2021).

Socio-cultural and community engagement in urban green spaces

Urban nature serves as a common platform for natural interactions, vital to the cultural and emotional fabric of city life. According to evolutionary and cultural theories, human perceptions and preferences for nature come from innate and acquired nurture (Ugolini et al., 2022). The most common source of natural interactions for humans is and will continue to be urban nature (Giusti & Samuelsson, 2020). It is particularly critical to consider the impact of research on the human-nature relationship for people living in urban environments, for there is a strong association between a place's biodiversity level and humans' emotional response to that site (Cameron et al., 2020). However, the challenge lies in assessing human behaviors in the setting and how urban green spaces contribute to human health and the well-being of the people involved (Hansen & Pauleit, 2014). Nikologianni et al. (2022) used a series of drawing and visualization workshops, community engagement methods, and participatory tools to identify the connections of communities and decision-makers to the surrounding landscape and the influence of landscape connectivity on health and well-being.

Urban planning and policy for enhanced nature interactions

The structuring of urban landscapes is instrumental in advancing ecosystem functions and services that support human well-being. J. Wu (2019) assumes that ecosystem function, biodiversity, ecosystem services, and human well-being are primarily influenced by the configuration and composition of landscapes and areas or the structure of land systems. Moreover, a study in the Helsinki urban area of Finland by leBrasseur (2022) reinforces the notion that the link between greenspaces and the advantages of psychological, physical aspects and social human well-being attained through interaction. The findings show that interaction with the various aspects of urban green spaces in the area supports a variety of human well-being; however, moderately maintained with loose or "wild" vegetation, large size, woodland typology, and few amenities like structures and benches, are the urban green spaces that contribute the most to human well-being. To maximize the potential for creating healthier cities, urban green space should respond effectively to notions of human well-being.

Nature-based solutions, urban green spaces, green infrastructure, or simply nature in cities, such as urban gardens and parks, could be promising agents for addressing the negative mental health results of living in high-density urban areas (Olszewska-Guizzo et al., 2022b). Green and blue spaces have significant positive effects on human wellness. For example, private gardening and its use positively impact physical activity levels and well-being (de Bell et al., 2020). Another research from Robinson et al. (2021) highlights the tremendous value of human engagement and connection with nature during the COVID-19 pandemic, which changed patterns of access to nature, with people spending more time in and visiting nature more often. People see nature for health and well-being because nature helped them through the pandemic. Considering recent pandemics of infectious diseases, this study offers fresh perspectives on the usefulness of the natural environment- For people to sustain their health and well-being, their communities must have high-quality natural environments. Overall, having a mutually beneficial relationship has never been more crucial for humans and the larger ecosystem. Resilient communities are thus maintained, and the earth's health is enhanced by protecting and restoring nature. Yet, the conception of nature as a stand-alone entity for health remedies is insufficient. There can be conflicting views although the interactions between city dwellers and nature are often positive (Taylor et al., 2020). Some perspectives problematically treat nature as an isolated entity–a kind of prescription for emerging health issues–without fully exploring how the nuanced and beneficial aspects of human-nature relationships are incorporated into practical interventions. This approach can be limiting because it overlooks the complexities of how these relationships contribute to health and well-being in urban settings.

For urban design to be effective, it must account for both the presence and perception of natural elements. Design practices and policies can facilitate the successful integration of humans with nature, and urban design can ensure that citizens interact with nature in their cities. It seems important to consider natural perceptions rather than their presence to comprehend how humans and nature interact. By using the species indigenous to the site, the integrated design can achieve a high level of urban nature to ensure that even if only through the landscape, the entire city is exposed to nature and can keep citizens together (Taylor et al., 2020). Therefore, to design meaningful studies and interventions, a more in-depth understanding of the process that underlies the observed benefits of the human-nature relation is necessary (Brymer et al., 2020).

4.2.2. Theme 2: health-promoting design

Design for mental well-being and physical activity

The definition of "health design" in landscape architecture is that consciously designing green spaces and gardens so that they promote health processes in certain way and lead to improved health outcomes (Stigsdotter, 2015). Historically, urban green space has been considered a place where urban residents may go for fresh air and relaxation. The research implores landscape architects and urban planners to prioritize mental health in their design and maintenance of green spaces. The lack of evidence-based guidelines to enhance mental health, positive affect, and well-being in green space designs and maintenance programs is challenging for landscape architects and urban planners. Hence, the urban planning and design fields should acknowledge the tremendous mental health benefits of contact with properly planned and maintained green spaces. Urban green space planning should incorporate strategies for focused psycho-physiological responses within domestic mental health promotion strategies (Olszewska-Guizzo et al., 2022b). The significance of appealing landscapes in hospital settings for the recovery and well-being of patients has been validated by Iswoyo et al. (2020). Whether or not landscape designers have any hospital landscape design experience, they know the benefits of therapeutic landscaping. Most of these designers have or will consider therapeutic elements in the design of hospitals and health care units. Landscaping has become a primary consideration for sites focused on restoration and healing since greenery and landscaping are essential in human sensory and botany. It influences human well-being and can improve health (Elantary et al., 2021).

The integration of cultural ecosystems and urban nature remain pivotal to the well-being of urban residents. According to Dade et al. (2020), urban parks should be centered on serving cultural ecosystems that are looking to increase provisioning. In doing so, urban gardens can ensure the cultural services required to keep the well-being of growing urban inhabitants. Considering the benefits to health and eco-friendly behavior, it is essential to integrate aspects of urban nature that people enjoy with intervention design, activity planning, and the views of urban planners and policymakers on how cities can best be designed and grown (McEwan et al., 2020). Therefore, Tan et al. (2021) suggest that to better respond to public health issues of great interest, urban planners should integrate ecological knowledge into urban landscape design.

Landscape designers need more interdisciplinary education and community-specific training, and the outreach of the landscape to the general public is limited by its complexity being a participatory cultural artifact (Cervera et al., 2021). Psycho-physiological feedback strategies for urban green space planning should be incorporated into national mental health promotion programs by urban planning and design sectors, which should also be aware of the significant mental health benefits that can be attained via visibility to well-maintained and well-designed green spaces (Olszewska-Guizzo et al., 2022b).

Healing and therapeutic design

Recognizing and addressing the practical needs of users from the initial stages of landscape planning and designing to the day-to-day management and maintenance of the shared facilities is critical if the services and benefits of green space are to be maximized (Ugolini et al., 2022). Due to the design process' increased consideration of the demands of the inhabitants and enhancement of the quality of life through the planning of potential generations' health, urban design and vegetation in all kinds of structures have gained popularity for the globe developed. Landscape design becomes a crucial element of any building component, which can enhance the well-being of individuals and have a variety of effects on how they behave and feel about space. The importance of greenery in sensory experiences and its influence on health outcomes has transitioned from being a secondary consideration to a primary one in hospital settings (Elantary et al., 2021). Therapeutic gardens in urban environments can have therapeutic potential by producing beneficial changes in mood and brain activity in adult patients with depression, thereby influencing the design of mental health support in built form Consider (Olszewska-Guizzo et al., 2022a).

Design for ecosystem services and urban well-being

Incorporating natural elements into the built environment can be a powerful tool for improving public health and highlights the need for built forms to incorporate natural contemplative spaces that contribute to physical and mental health. World Health Organization Regional Office for Europe (2016) reports on the available evidence on the beneficial effects of urban green spaces on human minds and bodies, discusses urban green space characteristics associated with specific mechanisms leading to health benefits, and measures or indicators of green space availability, accessibility and use used in previous surveys. Health and climate resilience can be addressed simultaneously through strategic green space design at the neigh-

borhood level, thereby directly linking natural features to functional urban planning (Barron et al., 2019). Findings from Ward Thompson et al. (2019) suggest that pathways to nature can reduce stress, increase physical activity, and enhance community cohesion, which informs urban design strategies that can help integrate green spaces for the well-being of deprived areas. Kellert (2018) proposes conditions for satisfying biophilia in the built environment. Biophilic design fulfills the intrinsic connection between humans and the natural world effectively instead of simply applying natural elements to the built environment.

4.2.3. Theme 3: integrative strategies

The implementation and measurement approaches of landscape design are intimately related to the promotion of human health and well-being. Researchers have used different techniques and measures to conduct research on this topic.

Computational green infrastructure design framework

A new methodology for creating computation green infrastructure (GI) for hydrological and human advantages is proposed by Rai et al. (2019). The GI design framework combines criteria for human well-being with stormwater treatment standards. A machine-learning supervised model was developed to pinpoint specific patterns in urban green spaces that enhance human well-being. The new framework used in the Dead Run watershed of Maryland shows how picture techniques can easily catch crucial aspects of user interests that can improve GI design. Additionally, the results demonstrate the considerable hydrologic advantages of tree-based characteristics, indicating that more incredible urban tree cover and a more integrated GI design strategy can vastly boost both human and hydrologic benefits.

Transdisciplinary approach

A Can Mortiz case study from Cervera et al. (2021) proposes an interdisciplinary approach to restoring nature, place identity, and cultural landscapes. This study demonstrates the potential of integrating methods and methodologies to create tactical, participative, and affordable "urban acupuncture" interventions. As the actions produced by procedures that combine the fields of environmental epidemiology and landscape architecture are easily replicable in various metropolitan environments, the project's key advantages are its ability to be low-cost, replicated, and overall efficacy.

Mixed methods with a questionnaire and smartphone data

Another approach that Rout and Galpern (2022) introduced is the mixed methods incorporating smartphone data and questionnaire results to develop urban green spaces. The study compares how students utilize outdoor design elements to explain human behavior in detail. This method aids campus designers in creating spaces with features that individuals often need and believe to be good for their health. However, there are few mixed-method approaches for researchers that want to employ smartphone spatiotemporal data, likewise considering users' perspectives to find valuable and fine-scale green space features in high-density areas.

Nature-based solutions

A systematic map protocol in which Dick et al. (2019) investigate how nature-based solutions contribute to priority social challenges around human well-being in the United Kingdom. By generating sustainable social-ecological systems, Nature-based solutions (NBS) centered on learning from and employing nature to improve human well-being. It is an all-inclusive concept that includes ecosystem approaches, green/blue/nature infrastructure, and ecosystem services. Since the COVID-19 pandemic increased the burden on healthcare, green social prescribing (GSP) in NBS offers sustainable approaches to promoting health and well-being. There is no complete and accurate outline to relate NBS interventions to the numerous human well-being of positive and negative consequences, despite the multiple reviews and evidence that have been found on NBS to specific facets of human well-being, especially urban green space and health (He et al., 2022).

Evidence-based approach

Green spaces and infrastructure provide numerous solutions to problems caused by increasing density and urbanization. It has long been acknowledged that the aesthetics of green spaces are crucial for promoting human health and wellness. Nevertheless, to help practitioners, such as urban planners/designers and landscape architects, it is necessary to satisfy citizens' needs best. An evidence-based viewpoint on greenspace aesthetics could be included in various design and planning processes as well as in transcriptional and multidisciplinary work contexts with the support of the investigation of the perceived sensory dimensions. Stoltz and Grahn (2021) believe that more sustainable solutions could be achieved if evidence-based viewpoints were gradually integrated into the environmental planning and design processes. It can facilitate the integration and communication of evidence-based perspectives on the aesthetics of green space from an interdisciplinary research view.

Urban Green Infrastructure (UGI)

The need for urban green infrastructure (UGI) is growing now. Hoyle and Sant'Anna (2020) rethink the "nature of the future" through a trans-Atlantic study collaborating on climate-adapted urban green infrastructure to promote biodiversity and human well-being. The study highlights the need for cross-scale decision-making, cross-sector collaboration, and identifying trade-offs and synergies between biodiversity, climate adaptation, and human well-being goals. Such case studies yield transferable experiences to designers, planners, and managers of the versatile "nature of the future" in city regions worldwide.

Urban Ecosystem Services (UESs)

A study focusing on urban ecosystem services (UESs) provided by green open spaces (GOSs), using the city of Nicosia in Northern Cyprus as a case, aimed to draw the key GOSs of the chosen locations for defining the plant species and to assess the main UESs provided by the GOSs and the benefits to the well-being components. Under the scope of sustainable urban landscape planning and human development, the identification and sustainable management of UESs are significant challenges everywhere. Urban ecosystems can be maintained locally and globally sustainably by policymakers, designers, planners, and landscape architects by mapping them and incorporating their values into urban and landscape plans (Ciftcioglu & Aydin, 2018).

4.2.4. Theme 4: landscape intervention

Horticultural intervention

As our world becomes more urbanized, the mental health of the residents is becoming a new crisis in an urbanizing world. One of the quickest, most cost-effective, and most accessible ways to improve human well-being is to increase human connection and engagement with the natural environment through interventions, which are becoming more widely accepted to solve our mental health issues (McEwan et al., 2020). In other words, interventions that expand the connection and engagement of the natural environment with humans are cost-effective and widely accessible solutions to reduce health inequities and improve human well-being (Bragg & Atkins, 2016).

Chalmin-Pui et al. (2021) investigated the effects of a residential front garden horticultural intervention on health and well-being in 38 formerly bald front gardens in an economically deprived area of North England, United Kingdom, where ornamental plants were introduced. However, although total subjective well-being scores did not grow remarkably, all residents gained one or more sociocultural benefits from the front garden planting. The findings suggest that including a small number of ornamental plants in the front gardens of poor urban communities can positively impact some aspects of individuals' stress regulation and subjective well-being, such as increased positive emotions, motivation, enhanced relaxation, and a sense of pride in place. This study emphasizes the value of front gardens for promoting human health and well-being. As a result, they benefit from the discussion of natural capital, urban densification, and urban planning.

Technology-enhanced nature engagement

McEwan et al. (2019) contributed a novel perspective by utilizing technology to strengthen the connection between humans and nature. They evaluate a smartphone app-based well-being intervention, delivering the first controlled experimental demonstration of the real clinical potential of noticing urban nature's benefits as a health intervention and social prescription. The study shows that positive psychology-based interventions focus on finding the pleasant things surrounding an individual to enhance well-being, which can be improved by using nature as an essential option. This approach underscores the utility of digital tools in promoting well-being and underscores their potential as a cost-effective and broadly accessible method for health interventions and social prescriptions, facilitating a deeper engagement with nature in the urban milieu.

Urban green and blue spaces

Urban green and blue spaces have emerged as critical components in the pursuit of sustainable urban development, intertwined with ecological, educational, and health-related benefits. Therefore, interventions supporting sustainable city development should concurrently focus on urban ecology, environmental education, and human health. Such methods are essential to transforming sustainability from a compartmentalized and static viewpoint to a dynamic, holistic, and regeneration-focused one (Giusti & Samuelsson, 2020). For this purpose, designers and planners are increasingly expected to collaborate with evaluators to offer information on the "return on investment" of interventions (Bell et al., 2020). These interventions not only serve ecological purposes but also significantly contribute to human well-being by providing vital spaces for relaxation, exercise, and social interactions within urban ecosystems.

4.2.5. Theme 5: perceptions and restorativeness

Kaplan et al. (1998) suggest that the key to successful landscape design is meaningful community and stakeholder engagement. In designing restorative environments, it is suggested that spaces should promote understanding of one's own environment, encourage exploration, be restful and pleasurable, and have meaningful engagement. These principles emphasize the importance of integrating knowledge from different fields, such as environmental psychology and landscape architecture, to create spaces that resonate with inherent human needs and preferences.

Landscape perception

Restorative environment research has identified characteristics of landscapes that possess the high restorative potential to improve people's mental health. However, little is known about understanding the key factors and characteristics of restorative environments that reduce mental stress. The restorative capacity of everyday landscapes, such as streetscapes, can alleviate adverse psychological reactions. Vegetation is an essential factor in improving the restoration quality of urban streets (Zhao et al., 2020). The key to the relationship between the community and place identification can be the perception of green and blue spatial quality. The Can Mortiz spring case study, conducted by Cervera et al. (2021), examines methodological limitations concerning resolving visual preferences underlying landscape identification and tests the relationship between perception and increased landscape awareness. The study proved that a landscape architecture planning

approach involving residents and other stakeholders could help prioritize and co-design interventions. Multisensory processes and transdisciplinary collaboration is essential in the design of health-oriented environments. Their findings illustrate the intrinsic value of participatory design in crafting spaces that resonate with community identity and preference, ultimately fostering a deeper connection to the landscape.

Restorative qualities of place environments

Deng et al. (2020) argue that restorative environments in urban green spaces can be achieved by integrating visual stimuli, auditory stimuli, and human activities, which provide new insights into identifying the primary auditory-visual attributes and traits of restorative human experiences. And the quality of treetop trails could enhance visitors' connection to their surroundings and recovery of their senses. Therefore, constructing treetop trails can be reinforced by enriching trail perception enhancement, such as improving trail facilities, optimizing trail design, and promoting trail landscape quality, to enhance the impact mechanism of treetop trails on users' perception recovery (Y. Wu et al., 2022).

Cultural and social considerations in green space design

Community gardens are salient in the discourse on therapeutic landscapes, especially for marginalized groups. Because of the ability of community garden activities to form social connections, achieve self-worth, and the supposed benefits of being "present" in nature for members of vulnerable or disadvantaged groups, such as refugees, is often considered a therapeutic landscape capable of supporting recovery and well-being. However, while community gardens may be able to support the recovery and well-being of refugees and migrants, they may, in turn, be exclusionary spaces capable of reinforcing negative experiences and results (Abramovic et al., 2019). Planning and designing urban green areas require a thorough knowledge of user preferences and choice variability to maximize the quality of life. In designing and planning urban green spaces, the variety of vegetation and features related to human usage are crucial considerations (Campagnaro et al., 2020). The sensory dimensions of perception are the general aesthetic needs of individuals for urban green spaces. Stoltz and Grahn (2021) contends that articulating and identifying a modest range of design principles based on characteristics people believe to be of general value is an effective method for approaching evidence-based green space aesthetics.

Exposure to nature has well-known restorative effects and creates the urgent need for human habitats that promote both human well-being and ecological sustainability. Healthy ecosystems are more crucial for restorative experiences than simply being in nature. Healthy ecosystems and environmental attitudes work together synergistically to initiate restorative processes. In transitioning to a healthy urban system and an environmentally sustainable, regenerative compatibility seems to be an essential leverage point (Giusti & Samuelsson, 2020).

4.2.6. Theme 6: sustainability

Sustainable cities are not only about environmental degradation and the climate crisis but an agent for tackling socio-economic barriers and enhancing the health and well-being of our communities. Nikologianni et al. (2022) identified the landscape connection to play a significant part in creating a vision of a sustainable future. Sustainability science aims to develop actionable knowledge that can be implemented into practice to promote human well-being while preserving long-term environmental integrity. It is a place-based, use-inspired, and interdisciplinary enterprise (J. Wu, 2019). By advocating for place-based, use-inspired research, this approach presents a compelling narrative for engaging diverse stakeholders in the pursuit of sustainable urban development, reinforcing the notion that sustainability is not merely an environmental issue but one that permeates all aspects of urban life.

Cities are a crucial landscape component to accomplishing local, regional, and global sustainability. Policymakers encourage scholars to explore or develop management strategies for paired human-environment systems critical to local and regional sustainability strategy in response to the growing impact of urbanization (Shaker et al., 2020). A specific example from Ciftcioglu and Aydin (2018) shows that the green open space of the city of Nicosia is not strategically designed due to the absence of a national landscape planning strategy in Northern Cyprus. A national landscape planning strategy is mainly required for sustainable management and conservation of the urban landscape, related services, and ecosystems in North Cyprus. The same problems and situations are faced in other countries as well.

Despite the advancements, no one-size-fits-all tool exists for achieving sustainability at the regional or local planning scales. According to earlier research on sustainable urbanization, landscape configuration measurements can complement other indicators of urban well-being. However, few of these measures have been compared to regional well-being indicators or published in public data dashboards (Shaker et al., 2020).

4.2.7. A conceptual framework of landscape design to enhance human well-being

Following the analysis and review of the articles, a conceptual framework was formulated to provide recommendations for further research. Figure 5 provides three main components of enhancing human well-being with landscape design, which are landscape dimensions, approach dimensions, and human well-being dimensions. This framework is presented to help researchers further explore relevant pathways, discover specific connections between these aspects, gain insight into the needs of inhabitants, and help designers or planners deploy landscape strategies. It also describes the theories and concepts of land-

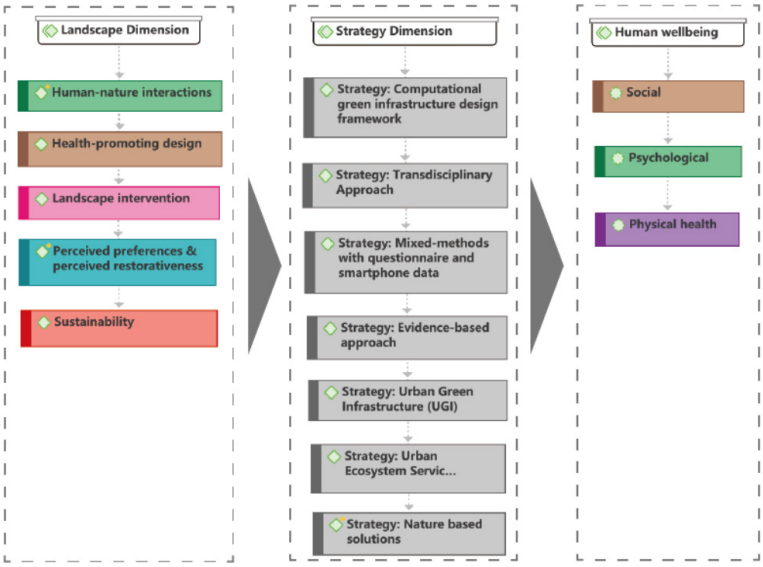

Figure 5. A conceptual framework of landscape design to enhance human well-being

scape dimensions, the application of the approach, and the knowledge of physiological, psychological, and socially relevant human well-being, respectively.

Firstly, landscape dimension. The landscape dimension in urban design and planning reflects the role of natural environments in enhancing human well-being. Interaction with nature in daily life can improve mental and physical health. Health-promoting design strategically shapes these environments to maximize their therapeutic potential. Landscape interventions involve specific changes to the physical environment aimed at health improvement. This dimension also includes individual preferences for landscape features and the perception of environments as restorative, which can significantly impact health outcomes. Sustainability within this context ensures that the benefits to human health are balanced with maintaining ecological integrity for the future. Together, these components form a comprehensive approach to integrating natural elements into urban living for improved health and well-being.

Secondly, strategic dimensions. An overview of seven approaches proposed in the literature that can help provide tools for landscape design practice and research. The strategic dimension in landscape design encompasses seven key approaches to enhance ecological and human health. Computational models optimize green infrastructure, while interdisciplinary methods solve complex health-related issues. Mixed-methods research, combining questionnaires and smartphone data, reveals user interactions with green spaces. An evidence-based approach applies research to landscape management, ensuring health-promoting efficacy. Urban Green Infrastructure and Ecosystem Services focus on providing beneficial services to urban residents. Lastly, nature-based solutions utilize natural processes to address broad socio-economic and environmental challenges, underlining the synergy between sustainability and urban well-being.

Thirdly, landscape aspects of human well-being are primarily concerned with the current social, psychological, and physical health issues humanity faces. In the social domain, the layout and character of the landscape were scrutinized for its ability to promote community participation and strengthen social bonds. The psychological side focused on how green spaces influence mental states, promote emotional stability and relieve stress. On the physical side, the design and accessibility of landscapes were correlated with their impact on activity levels, fitness, and overall health indicators, emphasizing the role of well-designed natural environments in promoting overall public health.

The framework argues that strategic, well-designed interventions in the landscape can improve social, mental, and physical health outcomes. This holistic view recognizes the complexity of landscape impacts on human well-being. It promotes integrated, informed, and adaptive strategies to enhance the health of individuals and communities in urban ecosystems.

5. Conclusions

This paper reviews 40 publications on landscape design for enhancing human well-being between 2018 and 2022 to provide the current research situation and its patterns. This paper applies a thematic review method using ATLAS.ti 23 software. The Article Attributes presents current trends in landscape design and human well-being, objectively reflecting the theoretical development of the topic that nature-based urban or rural landscapes are positive in enhancing human health and well-being. They are of high interest not only in the field of landscape ecology but also in the psychological sciences. The Thematic Results identify the pathways and factors of landscape design that researchers have focused on to affect human well-being. The results revealed six themes: (1) Human-nature Interactions, (2) Health-promoting Design, (3) Integrative Strategies, (4) Landscape Intervention, (5) Perceptions and Restorativeness, and (6) Sustainability. Implications of this

research include methods and measures for multifunctional design and strategic management of landscapes, where landscape design is committed to elements of human well-being to achieve sustainable, better ecosystem services to benefit people and nature. The practical contribution of this research is to help designers and planners more effectively understand the links between landscape design and human health and well-being, providing them with further research and design guidance.

Research limitations and future directions

This research has set the stage for a comprehensive understanding of the role of landscape design in promoting human health and well-being. Our review was limited to studies published in the last five years. While we made every effort to cover references relevant to the topic for significant resources, it is possible to omit some meaningful publications. Also, because our analysis was based on current literature, additional elements of human health and well-being promotion could be discerned, but also beyond the scope of landscape design. Our transdisciplinary team comes from both design and human ecology disciplines, allowing us to focus more on topics in related fields. However, our task in the research process is to minimize such limitations and biases.

The review also suggests potential future research directions based on the multifaceted effects of urbanization on physical and mental health. Future research can be approached from various perspectives. With urbanization and population explosion, human beings will face more physical and psychological problems in the future and improving human well-being through the landscape is a feasible and effective way. Urban green spaces can contribute to positive emotions, mindfulness, and relaxation of residents (Olszewska-Guizzo et al., 2022b). Hoyle (2021) emphasizes that there is a need to consider new scientific communication strategies beyond official educational pathways if the public is aware of the challenges of climate change and its effects on urban green infrastructure. Multisensory and multidisciplinary design can address the contradiction between health restoration needs and urban park design. It has great potential to improve the aesthetic quality and restoration value of urban green spaces so that environmental design can integrate sound, vision, and human interaction in the future (Deng et al., 2020).

Furthermore, to achieve higher levels of general visitor satisfaction, landscape or auditory elements can be used in the venue to compensate for the lack of perceived dimension (Xiang et al., 2022). To boost the health advantages connected with these spaces, further research is required to comprehend better the elements and processes responsible for delivering garden benefits (de Bell et al., 2020). To promote this interdisciplinary synthesis, sustainable geo-design, or geo-design based on the science of sustainability, aims to be a technologically cutting-edge and scientifically comprehensive platform. Therefore, combining geography, ecology, and design is more critical than ever. Although a significant challenge is involved, there are also several opportunities and exciting possibilities (J. Wu, 2019).

In summary, it is suggested that future research should address the complex relationship between landscape characterization and human health outcomes from multiple perspectives.

Funding

This research received no external funding.

Disclosure statement

The authors report there are no competing interests to declare.

References

Abramovic, J., Turner, B., & Hope, C. (2019). Entangled recovery: Refugee encounters in community gardens. *Local Environment*, *24*(8), 696–711. https://doi.org/10.1080/13549839.2019.1637832

Arif, M., Katafygiotou, M., Mazroei, A., Kaushik, A., & Elsarrag, E. (2016). Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature. *International Journal of Sustainable Built Environment*, *5*(1), 1–11. https://doi.org/10.1016/j.ijsbe.2016.03.006

Barron, S., Nitoslawski, S., Wolf, K. L., Woo, A., Desautels, E., & Sheppard, S. R. J. (2019). Greening blocks: A conceptual typology of practical design interventions to integrate health and climate resilience co-benefits. *International Journal of Environmental Research and Public Health*, *16*(21), Article 4241. https://doi.org/10.3390/ijerph16214241

Baumeister, R. F., Vohs, K. D., Aaker, J. L., & Garbinsky, E. N. (2013). Some key differences between a happy life and a meaningful life. *The Journal of Positive Psychology*, *8*(6), 505–516. https://doi.org/10.1080/17439760.2013.830764

Bell, S., Mishra, H. S., Elliott, L. R., Shellock, R., Vassiljev, P., Porter, M., Sydenham, Z., & White, M. P. (2020). Urban blue acupuncture: A protocol for evaluating a complex landscape design intervention to improve health and wellbeing in a coastal community. *Sustainability*, *12*(10), Article 4084. https://doi.org/10.3390/su12104084

Bragg, R., & Atkins, G. (2016). *A review of nature-based interventions for mental health care* (Natural England Commissioned Report No. 204). Natural England.

Bratman, G. N., Anderson, C. B., Berman, M. G., Cochran, B., de Vries, S., Flanders, J., Folke, C., Frumkin, H., Gross, J. J., Hartig, T., Kahn, P. H., Kuo, M., Lawler, J. J., Levin, P. S., Lindahl, T., Meyer-Lindenberg, A., Mitchell, R., Ouyang, Z., Roe, J., … Daily, G. C. (2019). Nature and mental health: An ecosystem service perspective. *Science Advances*, *5*(7). https://doi.org/10.1126/sciadv.aax0903

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1057/978-1-137-35913-1

Bridger, R. S., & Brasher, K. (2011). Cognitive task demands, self-control demands and the mental well-being of office workers. *Ergonomics*, *54*(9), 830–839. https://doi.org/10.1080/00140139.2011.596948

Brymer, E., Araujo, D., Davids, K., & Pepping, G.-J. (2020). Conceptualizing the human health outcomes of acting in natural environments: An ecological perspective. *Frontiers in Psychology*, *11*, Article 1362. https://doi.org/10.3389/fpsyg.2020.01362

Burkhard, B., Petrosillo, I., & Costanza, R. (2010). Ecosystem services – Bridging ecology, economy and social sciences. *Ecological Complexity*, *7*(3), 257–259. https://doi.org/10.1016/j.ecocom.2010.07.001

Cameron, R. W. F., Brindley, P., Mears, M., McEwan, K., Ferguson, F., Sheffield, D., Jorgensen, A., Riley, J., Goodrick, J., Ballard, L., & Richardson, M. (2020). Where the wild things are! Do urban green spaces with greater avian biodiversity promote more positive emotions in humans? *Urban Ecosystems*, *23*(2), 301–317. https://doi.org/10.1007/s11252-020-00929-z

Campagnaro, T., Vecchiato, D., Arnberger, A., Celegato, R., Da Re, R., Rizzetto, R., Semenzato, P., Sitzia, T., Tempesta, T., & Cattaneo, D. (2020). General, stress relief and perceived safety preferences for green spaces in the historic city of Padua (Italy). *Urban Forestry & Urban Greening*, *52*, Article 126695. https://doi.org/10.1016/j.ufug.2020.126695

Cervera, M., Bell, S., Muñoz, F., Mishra, H. S., Fleming, L. E., Grellier, J., Carrasco-Turigas, G., Nieuwenhuijsen, M. J., Vert, C., & Gascon, M. (2021). A transdisciplinary approach to recovering natural and cultural landscape and place identification: A case study of Can Moritz spring (Rubí, Spain). *International Journal of Environmental Research and Public Health*, *18*(4), Article 1709. https://doi.org/10.3390/ijerph18041709

Chalmin-Pui, L. S., Roe, J., Griffiths, A., Smyth, N., Heaton, T., Clayden, A., & Cameron, R. (2021). "It made me feel brighter in myself"- The health and well-being impacts of a residential front garden horticultural intervention. *Landscape and Urban Planning*, *205*, Article 103958. https://doi.org/10.1016/j.landurbplan.2020.103958

Ciftcioglu, G. C., & Aydin, A. (2018). Urban ecosystem services delivered by green open spaces: An example from Nicosia City in North Cyprus. *Environmental Monitoring and Assessment*, *190*(10), Article 613. https://doi.org/10.1007/s10661-018-6985-8

Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, *26*(2), 120–123. https://doi.org/10.4135/9781412963909.n451

Cobaleda Cordero, A., Babapour, M., & Karlsson, M. A. (2020). Feel well and do well at work: A post-relocation study on the relationships between employee wellbeing and office landscape. *Journal of Corporate Real Estate*, *22*(2), 113–137. https://doi.org/10.1108/JCRE-01-2019-0002

Colléony, A., White, R., & Shwartz, A. (2019). The influence of spending time outside on experience of nature and environmental attitudes. *Landscape and Urban Planning*, *187*, 96–104. https://doi.org/10.1016/j.landurbplan.2019.03.010

Colombo, S. A. (1984). *General well-being in adolescents: Its nature and measurement*. Saint Louis University.

Dade, M. C., Mitchell, M. G. E., Brown, G., & Rhodes, J. R. (2020). The effects of urban greenspace characteristics and socio-demographics vary among cultural ecosystem services. *Urban Forestry & Urban Greening*, *49*, Article 126641. https://doi.org/10.1016/j.ufug.2020.126641

Danielsson, C. B. (2016). Office type's association to employees' welfare: Three studies. *Work*, *54*(4), 779–790. https://doi.org/10.3233/WOR-162361

de Bell, S., White, M., Griffiths, A., Darlow, A., Taylor, T., Wheeler, B., & Lovell, R. (2020). Spending time in the garden is positively associated with health and wellbeing: Results from a national survey in England. *Landscape and Urban Planning*, *200*, Article 103836. https://doi.org/10.1016/j.landurbplan.2020.103836

Deci, E. L., & Ryan, R. M. (2006). Hedonia, eudaimonia, and well-being: An introduction. *Journal of Happiness Studies*, *9*, 1–11. https://doi.org/10.1007/s10902-006-9018-1

Deng, L., Luo, H., Ma, J., Huang, Z., Sun, L.-X., Jiang, M.-Y., Zhu, C.-Y., & Li, X. (2020). Effects of integration between visual stimuli and auditory stimuli on restorative potential and aesthetic preference in urban green spaces. *Urban Forestry & Urban Greening*, *53*, Article 126702. https://doi.org/10.1016/j.ufug.2020.126702

Dick, J., Miller, J. D., Carruthers-Jones, J., Dobel, A. J., Carver, S., Garbutt, A., Hester, A., Hails, R., Magreehan, V., & Quinn, M. (2019). How are nature based solutions contributing to priority societal challenges surrounding human well-being in the United Kingdom: A systematic map protocol. *Environmental Evidence*, *8*(1), Article 37. https://doi.org/10.1186/s13750-019-0180-4

Douglas, A. (2007). Green infrastructure: Linking landscapes and communities. *Natural Areas Journal*, *27*(3), 282–283. https://doi.org/10.3375/0885-8608(2007)27[282:GILLAC]2.0.CO;2

Durand, M. (2015). The OECD better life initiative: How's life? and the measurement of well-being. *Review of Income and Wealth*, *61*(1), 4–17. https://doi.org/10.1111/roiw.12156

Elantary, A. R., Alansari, A., & Alawirdhi, A. (2021). User's perspective of landscape existence in healthcare buildings. *HBRC Journal*, *17*(1), 519–532. https://doi.org/10.1080/16874048.2021.2000248

Elbakidze, M., Surová, D., Muñoz-Rojas, J., Persson, J. O., Dawson, L., Plieninger, T., & Pinto-Correia, T. (2021). Perceived benefits from agroforestry landscapes across North-Eastern Europe: What matters and for whom? *Landscape and Urban Planning*, *209*, Article 104044. https://doi.org/10.1016/j.landurbplan.2021.104044

Forman, R. T. T. (1995). Some general principles of landscape and regional ecology. *Landscape Ecology*, *10*(3), 133–142. https://doi.org/10.1007/BF00133027

Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters*, *3*(4), 390–394. https://doi.org/10.1098/rsbl.2007.0149

Giles-Corti, B., Vernez-Moudon, A., Reis, R., Turrell, G., Dannenberg, A. L., Badland, H., Foster, S., Lowe, M., Sallis, J. F., Stevenson, M., & Owen, N. (2016). City planning and population health: A global challenge. *The Lancet*, *388*(10062), 2912–2924. https://doi.org/10.1016/S0140-6736(16)30066-6

Giusti, M., & Samuelsson, K. (2020). The regenerative compatibility: A synergy between healthy ecosystems, environmental attitudes, and restorative experiences. *PLoS ONE*, *15*(1), 1–20. https://doi.org/10.1371/journal.pone.0227311

Grant, S., Langan-Fox, J., & Anglim, J. (2009). The big five traits as predictors of subjective and psychological well-being. *Psychological Reports*, *105*(1), 205–231. https://doi.org/10.2466/PR0.105.1.205-231

Hansen, R., & Pauleit, S. (2014). From multifunctionality to multiple ecosystem services? A conceptual framework for multifunctionality in green infrastructure planning for urban areas. *Ambio*, *43*(4), 516–529. https://doi.org/10.1007/s13280-014-0510-2

He, Y., Jorgensen, A., Sun, Q., Corcoran, A., & Alfaro-Simmonds, M. J. (2022). Negotiating complexity: Challenges to implementing community-led nature-based solutions in england pre- and post-COVID-19. *International Journal of Environmental Research and Public Health*, *19*(22), Article 14906. https://doi.org/10.3390/ijerph192214906

Hoyle, H. E. (2021). Climate-adapted, traditional or cottage-garden planting? Public perceptions, values and socio-cultural drivers in a designed garden setting. *Urban Forestry & Urban Greening*, *65*, Article 127362. https://doi.org/10.1016/j.ufug.2021.127362

Hoyle, H. E., & Sant'Anna, C. G. (2020). Rethinking 'future nature' through a transatlantic research collaboration: Climate-adapted urban green infrastructure for human wellbeing and biodiversity. *Landscape Research*, *48*(4), 460–476. https://doi.org/10.1080/01426397.2020.1829573

Huppert, F. A., & So, T. T. C. (2013). Flourishing across Europe: Application of a new conceptual framework for defining well-being. *Social Indicators Research*, *110*, 837–861. https://doi.org/10.1007/s11205-011-9966-7

Iswoyo, H., Brahmi Yanti, C. W., & Jackson, S. (2020). Therapeutic landscape: Its virtue and suggestion for its application. *Enfermería Clínica*, *30*, 279–284. https://doi.org/10.1016/j.enfcli.2019.10.019

Kamarulzaman, N., Saleh, A. A., Hashim, S. Z., Hashim, H., & Abdul-Ghani, A. A. (2011). An overview of the influence of physical office environments towards employee. *Procedia Engineering*, *20*, 262–268. https://doi.org/10.1016/j.proeng.2011.11.164

Kaplan, R., Kaplan, S., & Ryan, R. (1998). *With people in mind: Design and management of everyday nature*. Island Press.

Kellert, S. R. (2018). *Nature by design: The practice of biophilic design*. Yale University Press. https://doi.org/10.12987/9780300235432

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

leBrasseur, R. (2022). Linking human wellbeing and urban greenspaces: Applying the SoftGIS tool for analyzing human wellbeing interaction in Helsinki, Finland. *Frontiers in Environmental Science*, *10*, Article 950894. https://doi.org/10.3389/fenvs.2022.950894

Linley, P. A., Maltby, J., Wood, A. M., Osborne, G., & Hurling, R. (2009). Measuring happiness: The higher order factor structure of subjective and psychological well-being measures. *Personality and Individual Differences*, *47*(8), 878–884. https://doi.org/10.1016/j.paid.2009.07.010

Liu, B., Lian, Z., & Brown, R. D. (2019). Effect of landscape microclimates on thermal comfort and physiological wellbeing. *Sustainability*, *11*(19), Article 5387. https://doi.org/10.3390/su11195387

McEwan, K., Ferguson, F. J., Richardson, M., & Cameron, R. (2020). The good things in urban nature: A thematic framework for optimising urban planning for nature connectedness. *Landscape and Urban Planning*, *194*, Article 103687. https://doi.org/10.1016/j.landurbplan.2019.103687

McEwan, K., Richardson, M., Sheffield, D., Ferguson, F. J., & Brindley, P. (2019). A smartphone app for improving mental health through connecting with urban nature. *International Journal of Environmental Research and Public Health*, *16*(18), Article 3373. https://doi.org/10.3390/ijerph16183373

McPhearson, T., Hamstead, Z. A., & Kremer, P. (2014). Urban ecosystem services for resilience planning and management in New York City. *Ambio*, *43*(4), 502–515. https://doi.org/10.1007/s13280-014-0509-8

Millenium Ecosystems Assessment. (2005). *Ecosystems and human well-being: Wetlands and water synthesis* (Vol. 5, Issue 1). World Resources Institute, Washington, DC.

Nicholson, E., Murphy, T., Larkin, P., Normand, C., & Guerin, S. (2016). Protocol for a thematic synthesis to identify key themes and messages from a palliative care research network. *BMC Research Notes*, *9*(1), 1–5. https://doi.org/10.1186/s13104-016-2282-1

Nikologianni, A., Betta, A., & Gretter, A. (2022). Contribution of conceptual-drawing methods to raise awareness on landscape connectivity: Socio-environmental analysis in the regional context of Trentino (Italy). *Sustainability*, *14*(13), Article 7975. https://doi.org/10.3390/su14137975

Olszewska-Guizzo, A., Fogel, A., Escoffier, N., Sia, A., Nakazawa, K., Kumagai, A., Dan, I., & Ho, R. (2022a). Therapeutic garden with contemplative features induces desirable changes in mood and brain activity in depressed adults. *Frontiers in Psychiatry*, *13*, 1–14. https://doi.org/10.3389/fpsyt.2022.757056

Olszewska-Guizzo, A., Sia, A., Fogel, A., & Ho, R. (2022b). Features of urban green spaces associated with positive emotions, mindfulness and relaxation. *Scientific Reports*, *12*(1), Article 20695. https://doi.org/10.1038/s41598-022-24637-0

Paraskevopoulou, A. T., Chletsou, M., & Malesios, C. (2022). Runners experience lower heart rate, increased speed, and joy/calm on routes with trees, by the sea and through parks: Implications for climate change design. *Sustainability*, *14*(23), Article 16280. https://doi.org/10.3390/su142316280

Pickett, S. T. A., Cadenasso, M. L., Grove, J. M., Nilon, C. H., Pouyat, R. V., Zipperer, W. C., & Costanza, R. (2001). Urban ecological systems: Linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. *Annual Review of Ecology and Systematics*, *32*, 127–137. https://doi.org/10.1007/978-0-387-73412-5_7

Pollard, E. L., & Lee, P. D. (2003). Child well-being: A systematic review of the literature. *Social Indicators Research*, *61*, 59–78. https://doi.org/10.1023/A:1021284215801

Rai, A., Minsker, B., Sullivan, W., & Band, L. (2019). A novel computational green infrastructure design framework for hydrologic and human benefits. *Environmental Modelling & Software*, *118*, 252–261. https://doi.org/10.1016/j.envsoft.2019.03.016

Robinson, J. M., Brindley, P., Cameron, R., MacCarthy, D., & Jorgensen, A. (2021). Nature's role in supporting health during the COVID-19 pandemic: A geospatial and socioecological study. *International Journal of Environmental Research and Public Health*, *18*(5), Article 2227. https://doi.org/10.3390/ijerph18052227

Rout, A., & Galpern, P. (2022). Benches, fountains and trees: Using mixed-methods with questionnaire and smartphone data to design urban green spaces. *Urban Forestry & Urban Greening*, *67*, Article 127335. https://doi.org/10.1016/j.ufug.2021.127335

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist, 55*(1), 5–14. https://doi.org/10.1037/0003-066X.55.1.5

Shaker, R., Aversa, J., Papp, V., Serre, B., & Mackay, B. (2020). Showcasing relationships between neighborhood design and wellbeing Toronto indicators. *Sustainability*, *12*(3), Article 997. https://doi.org/10.3390/su12030997

Steel, Z., Marnane, C., Iranpour, C., Chey, T., Jackson, J. W., Patel, V., & Silove, D. (2014). The global prevalence of common mental disorders: A systematic review and meta-analysis 1980-2013. *International Journal of Epidemiology*, *43*(2), 476–493. https://doi.org/10.1093/ije/dyu038

Stigsdotter, U. (2015). Department of geosciences and natural resource management. *Alam Cipta (International Journal on Sustainable Tropical Design Research and Practice)*, *8*(2), 89–96.

Stoltz, J., & Grahn, P. (2021). Perceived sensory dimensions: An evidence-based approach to greenspace aesthetics. *Urban Forestry & Urban Greening*, *59*, Article 126989. https://doi.org/10.1016/j.ufug.2021.126989

Tan, C. L. Y., Chang, C.-C., Nghiem, L. T. P., Zhang, Y., Oh, R. R. Y., Shanahan, D. F., Lin, B. B., Gaston, K. J., Fuller, R. A., & Carrasco, L. R. (2021). The right mix: Residential urban green-blue

space combinations are correlated with physical exercise in a tropical city-state. *Urban Forestry & Urban Greening*, *57*, Article 126947. https://doi.org/10.1016/j.ufug.2020.126947

Taylor, L., Leckey, E. H., & Hochuli, D. F. (2020). Focus groups identify optimum urban nature in four Australian and New Zealand cities. *Urban Ecosystems*, *23*(1), 199–213. https://doi.org/10.1007/s11252-019-00910-5

Thompson, C. W., Aspinall, P., & Bell, S. (2010). *Innovative approaches to researching landscape and health: Open space: People space 2*. Routledge.

Tov, W. (2018). Well-being concepts and components. In *Handbook of subjective well-being* (pp. 1–15). Noba Scholar.

Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Krajter Ostoić, S., Marin, A. M., Pearlmutter, D., Saaroni, H., Šaulienė, I., Vuletić, D., & Sanesi, G. (2022). Understanding the benefits of public urban green space: How do perceptions vary between professionals and users? *Landscape and Urban Planning*, *228*, Article 104575. https://doi.org/10.1016/j.landurbplan.2022.104575

UN Department of Economic and Social Affairs. (2018). *2018 revision of world urbanization prospects: United Nations*. UN Department of Economic and Social Affairs.

Von Thaden, J., Badillo-Montaño, R., Lira-Noriega, A., García-Ramírez, A., Benítez, G., Equihua, M., Looker, N., & Pérez-Maqueo, O. (2021). Contributions of green spaces and isolated trees to landscape connectivity in an urban landscape. *Urban Forestry and Urban Greening*, *64*, Article 127277. https://doi.org/10.1016/j.ufug.2021.127277

Ward Thompson, C., Elizalde, A., Cummins, S., Leyland, A. H., Botha, W., Briggs, A., Tilley, S., Silveirinha de Oliveira, E., Roe, J., Aspinall, P., & Mitchell, R. (2019). Enhancing health through access to nature: How effective are interventions in woodlands in deprived urban communities? A quasi-experimental study in Scotland, UK. *Sustainability*, *11*(12), Article 3317. https://doi.org/10.3390/su11123317

World Health Organization Regional Office for Europe. (2016). *Urban green spaces and health*. https://www.who.int/europe/publications/i/item/WHO-EURO-2016-3352-43111-60341

World Health Organization Regional Office for Europe. (2017). *Urban green space and health: Intervention impacts and effectiveness*. https://www.who.int/europe/publications/m/item/urban-green-space-and-health--intervention-impacts-and-effectiveness

World Health Organization. (1986). *The Ottawa charter for health promotion*. https://www.who.int/teams/health-promotion/enhanced-wellbeing/first-global-conference

Wu, J. (2019). Linking landscape, land system and design approaches to achieve sustainability. *Journal of Land Use Science*, *14*(2), 173–189. https://doi.org/10.1080/1747423X.2019.1602677

Wu, Y., Li, Q., Zheng, H., Luo, S., Liu, Q., Yan, Z., & Huang, Q. (2022). Factors influencing users' perceived restoration while using treetop trails: The case of the Fu and Jinjishan Forest Trails, Fuzhou, China. *International Journal of Environmental Research and Public Health*, *19*(4), Article 2242. https://doi.org/10.3390/ijerph19042242

Xiang, Y., Hedblom, M., Wang, S., Qiu, L., & Gao, T. (2022). Indicator selection combining audio and visual perception of urban green spaces. *Ecological Indicators*, *137*, Article 108772. https://doi.org/10.1016/j.ecolind.2022.108772

Yarcheski, A., Scoloveno, M. A., & Mahon, N. E. (1994). Social support and well-being in adolescents: The mediating role of hopefulness. *Nursing Research*, *43*(5), 288–292. https://doi.org/10.1097/00006199-199409000-00006

Zairul, M. (2020). A thematic review on student-centred learning in the studio education. *Journal of Critical Reviews*, *7*(2), 504–511. https://doi.org/10.31838/jcr.07.02.95

Zhang, Y. (2019). Sustainable design of cultural creative products based on museum cultural derivatives. *IOP Conference Series: Materials Science and Engineering*, *573*(1), Article 012035. https://doi.org/10.1088/1757-899X/573/1/012035

Zhao, J., Wu, J., & Wang, H. (2020). Characteristics of urban streets in relation to perceived restorativeness. *Journal of Exposure Science and Environmental Epidemiology*, *30*(2), 309–319. https://doi.org/10.1038/s41370-019-0188-4