

Review

# The Role of Blue and Green Exercise in Planetary Health and Well-Being

Nuno Loureiro <sup>1,2,3,\*</sup> , Luís Calmeiro <sup>2,4</sup> , Adilson Marques <sup>2,5</sup> , Diego Gomez-Baya <sup>1,6</sup>   
and Margarida Gaspar de Matos <sup>1,2</sup>

- <sup>1</sup> Projeto Aventura Social, Faculdade de Motricidade Humana, Universidade de Lisboa, 1499-002 Cruz Quebrada, Portugal; diego.gomez@dpee.uhu.es (D.G.-B.); mmatos@fmh.ulisboa.pt (M.G.d.M.)
- <sup>2</sup> ISAMB, Universidade de Lisboa, 1649-028 Lisboa, Portugal; l.calmeiro@abertay.ac.uk (L.C.); amarques@fmh.ulisboa.pt (A.M.)
- <sup>3</sup> Departamento de Artes, Humanidades e Desporto, Instituto Politécnico de Beja, 7800-295 Beja, Portugal
- <sup>4</sup> School of Applied Sciences, Abertay University, Dundee DD1 1HG, UK
- <sup>5</sup> CIPER, Faculdade de Motricidade Humana, Universidade de Lisboa, 1499-002 Cruz Quebrada, Portugal
- <sup>6</sup> Department of Social, Developmental and Educational Psychology, Universidad de Huelva, 21007 Huelva, Spain
- \* Correspondence: nloureiro@ipbeja.pt; Tel.: +351-284314400; Fax: +351-284314401

**Abstract:** The World Health Organization (WHO) recognizes that health and well-being are essential to achieving the United Nations (UN) Development Agenda 2030, which includes the goal of empowering people to adopt active lifestyles while protecting the planet's health. This article aims at exploring how exercise performed in different natural settings can contribute to improving health and to a more sustainable world. We define "exercise" as a form of physical activity undertaken to increase fitness, health, and well-being, and argue for the importance of "green" and "blue" exercise as forms of physical activity that are associated with the protection and sustainability of natural settings and the promotion of planetary health. Blue and green exercise should become a focus of public policies, especially when outdoor activities are being identified as fundamental for the promotion of mental, physical, social, and spiritual health. The current paper intends to raise the awareness of political decision-makers and professionals in education, environment, and health sectors for the potential of green and blue exercise as specific exercise practices that are healthy, joyful, and environmentally friendly.

**Keywords:** ecology; environment; natural; exercise; quality of life; physical activity



**Citation:** Loureiro, N.; Calmeiro, L.; Marques, A.; Gomez-Baya, D.; Gaspar de Matos, M. The Role of Blue and Green Exercise in Planetary Health and Well-Being. *Sustainability* **2021**, *13*, 10829. <https://doi.org/10.3390/su131910829>

Academic Editors: Elena Cristina Rada and Alejandro Rescia

Received: 31 May 2021

Accepted: 27 September 2021

Published: 29 September 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Challenges to planetary health require an innovative examination of the different environments where human interactions (physical, social, affective, and digital) occur. Such interactions include efforts for individuals to adopt healthy behaviors (namely being physically active) that equally encourage environmentally protective behaviors.

From a global health perspective, the World Health Organization (WHO) recognizes that health and well-being are essential to achieving the United Nations (UN) Development Agenda 2030 and its Sustainable Development Goals (SDGs). The WHO aims at empowering people to increase control over their health by adopting active lifestyles while protecting the planet's health. Health and environment are two of the 17 goals; however, other goals are directly interrelated with the determinants of both individual and planetary health [1]. Thus, it is crucial to promote the ability and the motivation of individuals, groups, and communities to adopt active and healthy lifestyles while enjoying their planet's health and contributing to its sustainable preservation.

Health promotion is based on biological, environmental, social, and psychological sciences to promote health and prevent disease, morbidity, and premature mortality [2].

Environmental contexts influence and are influenced by individuals, and the dynamic of the interaction of individuals in different environments is complex. Within the scope of this work, we analyze a specific behavior and its interaction with the environment, notably, blue exercise and green exercise. As we will develop later, blue and green exercise refers to physical activity undertaken in and around outdoor ‘natural’ (blue and green) environments [3].

In recent years, the practice of physical activity in nature has received growing interest, and there is an expanding body of evidence supporting its impact on health. The idea of an “ecological promotion of physical activity” was identified at least since the Ottawa charter [4] and involves participation, training, and environmental action to facilitate green urban walking. The costs of physical inactivity for society are very high, amounting to at least \$67.5 billion per annum [5]; therefore, it is important to increase physical activity in natural environments not only to reduce the burden associated with the development of obesity and chronic diseases but also to maximize the potential to reduce the environmental impact of human activities on the planet. For example, physical activity has the potential to reduce transport’s major contribution to global CO<sub>2</sub> emissions [6] and to promote well-being [7].

In this article, we present an update on nature-based exercise (either blue or green) as a healthy practice that benefits the individual health and the environment (planetary health), and is supported in a careful analysis of relevant and recent articles about the theme. Thus, we also present recommendations to public policies to promote nature-based exercise as an effective and inexpensive way to increase physical activity and protecting the environment. This article aims at exploring how physical activity performed in different natural contexts contributes to improving health and a more sustainable world. In this paper, we will discuss exercise as a form of physical activity performed to increase fitness, health, and well-being [8], and examine the concepts of “green” and “blue” exercise [3,9], connecting the aim of being fit with the protection and sustainability of natural (green and blue) scenarios.

## 2. Explanatory Theories of Green and Blue Exercise in Health

Colors are used for characterizing the context in which the exercise in nature takes place. The term green exercise refers to physical activity taking place in “green” spaces (i.e., environments dominated by the presence of grass and green foliage colors). Likewise, blue exercise refers to physical activity that takes place in “blue” spaces or environments characterized by the presence of water features (either natural or artificial).

The literature to date has highlighted the benefits of green and blue exercise to physical and mental health. Regarding physical health, a recent review has shown that long-term participation in green exercise produces some benefits, such as a restorative effect on heart rate, reductions in body mass, body mass index (BMI), and body fat, and decreases in perceived exertion and fatigue associated with participation [10]. Another review concluded that green exercise facilitates a quicker recovery of post-exercise blood pressure to baseline values, and it results in lower systolic and diastolic blood pressure due to a reduction in sympathetic activation [11]. Moreover, heart rate variability increases following green exercise, which indicates a healthy autonomic nervous system function and a reduced cardiovascular disease risk. Concerning physiological responses to stress of the sympathoadrenal medullary and the hypothalamus–pituitary–adrenal axis, exposure to nature reduces endocrine markers (i.e., adrenaline, noradrenaline, and the stress hormone cortisol). This reduction in adrenaline in turn improves the immune function because of increased natural killer cell activity [11]. Furthermore, green exercise fosters higher connectedness with nature, which in turn encourages the practice of more physical activity. This is particularly important among children, adolescents, and families for promoting family activities in nature [12]. In this sense, self-reported exercise in urban green spaces was related to better self-reported general health and lower BMI in a sample of Turkish

adolescents, which suggests the need to provide cities with more trees, lawns, flowerbeds, and outdoor fitness equipment [13].

The benefits of green exercise on psychological and social well-being were also observed. Rogerson et al. [14] tested the consequences for psychological well-being of green exercise in four park run locations (i.e., beach, riverside, heritage, and grasslands) in a sample of British adults and found improvements in self-esteem and mood, and reductions in feelings of stress. In a multi-study conducted in the UK, it was revealed that medium-term green exercise interventions facilitate well-being [15], especially in participants who reported lower well-being at baseline. In another study with British adults, results indicated that participants had more social interaction during outdoor exercise compared to indoor exercise, with an average increase in interactions of three minutes. In turn, such improved social interactions predicted greater intention to perform exercise more frequently. Thus, participating in green exercise could be an effective strategy to promote long-term activity levels. In addition, social benefits, such as socializing or meeting, teamwork and companionship [16], and the development of social skills [17] were identified as consequences of participating in green exercise. It appears that it is the interaction with the environment and the social contact that are the main incentives for being active, while the health benefits derived from the exercise are often secondary outcomes [7].

In Portugal, Veloso and Loureiro [18] reported positive associations between green exercise and well-being, vitality, mindfulness, and relatedness to nature, and negative relationships with stress, depression, and anxiety. In a randomized clinical trial conducted in Iceland, Olafsdottir et al. [19] found evidence for the stress-buffering effects of green exercise. The authors compared physiological responses (i.e., salivary cortisol) and subjective experiences in a sample of sedentary undergraduates who were randomly distributed to three conditions: walking on a treadmill in a gym, walking in a semi-natural recreational area, or watching nature videos on TV. Results indicated that green exercise presented the greatest stress-reduction effect and enjoyment. In another randomized controlled trial with Taiwanese undergraduate students, Han [20] compared two types of exercise, walking or jogging, in contexts with different levels of greenness. Results showed improved mood states (fewer negative emotions and more positive emotions) and attention (as measured by the forward spatial span test and the backward digit span test of the Wechsler Memory Scale) in nature settings with at least 40% visible greenness rate. Previously, Mackay and Neill [21] performed a quasi-experimental study in a sample of Australian adults to examine the short-term effects of green exercise on state anxiety by controlling the type of exercise in nature, and the intensity, duration, and degree of greenness, in eight pre-existing outdoor exercise groups: road cycling, mountain running, orienteering, cross-country running, boxercise, mountain biking, kayaking, and walking. These authors observed a linear relationship between perceived greenness and the reduction in anxiety (especially in the activities of road cycling and boxercise), but no differences were found in intensity or duration of the activities. In children and adolescents, similar results were observed with increased attention, more health-related quality of life, self-reported health and self-esteem, more social support, and fewer antisocial interactions as a result of engagement in green exercise [22].

As observed for “green exercise”, “blue exercise” was shown to result in increases in well-being and mood after walking in a “blue space” compared to an urban walk or a control condition (rest in a room). The effects were stronger in participants who initially reported a negative health status [15]. A qualitative study by Thompson and Wilkie [23] explored how activities, such as kayaking, canoeing, paddle boarding, surfing, and open-water swimming, affected well-being. Several benefits emerged from the semi-structured interviews, such as being in nature or seeing land from another point of view, escaping from daily responsibilities, more relaxation and mindful experiences, and managing mental health without the use of prescribed medicines.

Research into “blue spaces” is particularly relevant as it has been shown that people rate scenes with large bodies of water, natural or built, more favorably. Moreover,

participants reported a greater positive effect and higher perceived restorativeness when compared to urban or green scenes without water [24]. In addition, the interaction of green and blue spaces may be associated with different forms of physical activity. For example, Tan et al. [25] reported that urban residents engaged more often in individual-based exercise in areas with a mix of high open-canopy managed vegetation and blue space cover close from home compared to urban contexts without vegetation and with water.

The health and well-being benefits of having contact with nature can be explained by several theories including Biophilia Hypothesis [26], Stress Recovery Theory [27], Attention Restoration Theory [28], Preference Matrix [28], Fractal Geometry [29], Ecosystem Service Cascade Model [30], Green Mind Theory [31], and Ecological Dynamics Perspective [32]. More details are presented in Table 1.

**Table 1.** Description and key points of the theories of green and blue exercise.

Theory	Description	Key Points
Biophilia Hypothesis [26]	Humans possess an innate tendency to seek connections with nature and other forms of life.	<ul style="list-style-type: none"> <li>– Innately attracted to nature.</li> <li>– Emotional outcomes and concomitant behavioral responses from natural stimuli are then transmitted through culture.</li> <li>– Evolution perspective.</li> <li>– Increased psychological well-being upon exposure to natural feature.</li> <li>– Limited evidence.</li> </ul>
Stress Recovery Theory [27]	Contact with some kinds of natural settings will reduce the time it takes to recover from a stressful event.	<ul style="list-style-type: none"> <li>– We are predisposed to resonate with natural surroundings.</li> <li>– Brains produce a relatively fast emotional reaction at a subconscious level that can be measured through physiological pathways.</li> <li>– Individuals can experience a decrease in stress, which involves reduced levels of negatively toned feelings and reductions in elevated. physiological conditions (such as heart rate and blood pressure).</li> <li>– Visual characteristics of restorative environments are moderate complexity; moderate depth; a focal point; deflected vistas.</li> </ul>
Attention Restoration Theory [28]	The capacity for mental attention can be depleted by activities demanding prolonged, effortful focus leading to fatigue, frustration, and inability to concentrate.	<ul style="list-style-type: none"> <li>– The inability to concentrate or focus attention is a sign of directed attention fatigue.</li> <li>– Restorative environments have four components: being away, extent, compatibility, and fascination.</li> <li>– The fascination component is fundamental.</li> <li>– Providing the opportunity for recovery from mental fatigue.</li> </ul>
Preference Matrix [28]	Assumption that the ability for aesthetic appraisal has evolved to encourage adaptation of habitat selection.	<ul style="list-style-type: none"> <li>– Foundation of environmental preferences is the desire to obtain information from the environment.</li> <li>– Humans are attracted to landscapes that provided a sense of order.</li> <li>– The four informational needs are coherence, complexity, legibility, and mystery.</li> <li>– The level of interpretation is immediate, inferred (predicted).</li> <li>– Providing the opportunity for recovery from mental fatigue.</li> </ul>
Fractal Geometry [29]	Applied fractal geometry to common natural phenomena, such as coastlines, rivers, trees, leaves, and snowflakes and are an essential tool for understanding the natural world.	<ul style="list-style-type: none"> <li>– Visual stimuli contain redundant information, due to their self-similar repeating patterns, which could contribute to the experience of easy perceptual processing by the brain.</li> <li>– Could result in restorative outcomes, such as attention restoration.</li> <li>– Lower cognitive resource demands of directed attention.</li> </ul>

Table 1. Cont.

Theory	Description	Key Points
Ecosystem Service Cascade Model [30]	Causal pathways through which biodiversity benefits human well-being through ecosystem functions and services.	<ul style="list-style-type: none"> <li>– Details the links between biodiversity and human well-being.</li> <li>– Steps that cascade into one another.</li> <li>– Represents the many ways biodiversity can contribute to human well-being.</li> <li>– Focuses on the physical health benefits from provisioning and regulating ecosystem services.</li> </ul>
Green Mind Theory [31]	Links the human mind with the brain and body and connects the body with natural and social environments.	<ul style="list-style-type: none"> <li>– The processes are reciprocal.</li> <li>– Offers opportunities for improving individual well-being whilst building towards greener and prosocial economies that could protect the planetary future.</li> <li>– Optimal mixed mode of mainly activated parasympathetic nervous system, interest, and excitement-associated mild sympathetic nervous system stimulation, and the presence of only occasional sympathetic nervous system spikes for alarm response.</li> </ul>
Ecological Dynamics Perspective [32]	That constraints are related to everyone, task, or the environment, which interact to shape behaviors, including perceptions, emotions, cognitions, and actions.	<ul style="list-style-type: none"> <li>– Takes as its unit of analysis the person–environment dynamic system.</li> <li>– Conceives the person as an agent (not passive receivers of stimuli that subsequently produce a reactive response).</li> <li>– That experience resides in the person–environment relationship.</li> <li>– The environment inhabited by humans, and other animals, is meaningful and consists of action possibilities.</li> <li>– The variability presented by nature’s environments solicits immersive interactions and attention.</li> <li>– An opportunity to develop expertise in dealing with challenging situations.</li> </ul>

The Biophilia Hypothesis proposes that a connection to nature is an innate aspect of human existence and living in urban areas increases the physical and psychological disconnection of people from nature [26]. Contact with nature stems from an evolutionary competitive advantage of having better knowledge about the natural world [33].

Research based on this theory has been conducted by Wilson [33] and demonstrated that interacting with nature results in learned emotional responses, which can range from attraction to aversion, from peacefulness to anxiety.

Two theories of restorative environments are proposed to explain the health benefits of green exercise [34]. Environments that facilitate the restoration of the individual’s depleted cognitive capacities for information processing are called restorative [35]. First, the psycho-evolutionary stress recovery theory posits that exposure to nature promotes stress reduction by providing positive distractions from daily stressors and developing feelings of calmness or interest, which may in turn foster positive affect and decrease stress [27]. For example, Lahart et al. [10] concluded that green exercise improves affect (more pleasant emotions, positive engagement, and positive affect), energy and enthusiasm (more vigor and vitality), enjoyment, and calmness; conversely, green exercise decreases the experience of tension (anxiety and worry), depression, and anger/aggression.

Second, the Attention Restoration Theory is more commonly used to explain the relationship between nature and health and describes directed attention and involuntary attention [28]. Directed attention requires mental effort and its overuse leads to fatigue [15]. Conversely, natural environments promote the use of involuntary attention directed to the context where the individual is, which requires no mental effort and provides an opportunity for recovery from mental fatigue [36]. For example, studies by Foo [37] demonstrate that individuals who spent time in forest environments experienced a sense

of being away, which was positively associated with a change in mood, which then was related to improved mental health.

Another theory is the Preference Matrix [28], which is an environmental informational model that emphasizes that the choices for environments are based on the information the environment provides. According to this framework, the foundation of environmental preferences is the desire to obtain information from the environment. The exploration of the immediate environment depends on the complexity of the stimuli (i.e., the number of different visual elements in a scene), the coherence (i.e., provides a sense of order), the legibility (i.e., easy to understand and to remember), and mystery (i.e., the promise of additional information) [35]. In this framework, we can find the study by van den Berg et al. [38], who analyzed whether perceived complexity of natural and urban scenes would explain differences in viewing times and ratings of mental restoration.

The Fractal Geometry Theory is used to describe shapes, processes, or systems that contain repeating patterns of different shapes that are reduced-size copies of the whole [29]. Fractals contain redundant information due to their self-similar repeating patterns, which could contribute to the experience of easing of the perceptual processing by the brain [29]. Therefore, applying fractal geometry to common natural phenomena, such as coastlines, rivers, trees, leaves, and snowflakes, can be an essential tool for understanding the natural world [39]. Joye and van den Berg [40] suggested that this fractal characteristic could result in restorative outcomes due to a lower cognitive resource demand of directed attention.

The Ecosystem Service Cascade Model details the links between biodiversity and human well-being [30]. In this model, biophysical structures or processes are responsible for ecosystem functions. These ecosystem functions influence ecosystem services, which, in turn, result in ecosystem benefits [35]. Therefore, the anthropocentric and utilitarian viewpoint of nature means that an ecosystem service can only be a service if humans experience that service to be useful and beneficial [30]. The exact causal pathways linking biodiversity to physical and mental health and well-being through this theory still need more research [41].

Pretty et al. [31] presented the Green Mind Theory, which describes reciprocal processes between the environment and the person, so that environments shape bodies, brains, and minds; minds change body behaviors that shape the external environment. The goal of these reciprocal processes is to develop pathways and interventions for better health through contact with nature. Thus, this theory may be suggested to understand the benefits observed in engagement in exercise in nature, because it emphasizes the individual–environment interactions and the role of task constraints to shape the behavior. Thus, the complexity of the natural environment provides opportunities to develop problem-solving skills, highlighting some functional affordances, such as climbable features, apertures, moldable material, water, flat surfaces, or graspable surfaces [42]. In addition, the presence of water is suggested to improve the affective outcomes of green exercise. Furthermore, Flowers et al. [43] indicated that the acute psychological effects of green exercise may be strengthened via expectancy modification. A promotional video on the benefits of green exercise was proven to enhance vigor and self-esteem, and more positive attitudes towards green exercise, in a sample of British undergraduates who practice cycling.

More recently, Araújo et al. [32] presented the Ecological Dynamics Perspective which adopts the person–environment system as its unit of analysis, where individuals and environments co-influence each other in a relational, transactional manner, rather than existing independently. The authors argue that the unique benefits of nature-based exercise are centered on notions of affordances and variability. That is, nature’s affordances are less constrained than manufactured affordances. Due to the variability presented by nature’s environments, acting in nature’s environments demands the holistic involvement of an individual which provides an opportunity to develop expertise in dealing with challenging situations.

### 3. Contributions of Green and Blue Exercise to Well-Being

The investment in natural environments, either by providing and regulating access to them or by integrating green spaces in urban environments, represents an investment in people's quality of life. Indeed, engagement with green environments has been shown to improve health [44], decrease anxiety [21], and increase positive moods [45] in the general population. In a population study, Astell-Burt et al. [46] found evidence that residents of neighborhoods with more green spaces were less likely to experience stress and to be sedentary than those who live in the least green areas. Interestingly, the protective effect of green space on mental health was observed in those individuals who were active, but not in those who were less active. This suggests that the effects of green spaces on mental health depend on the individuals' ability to sustain an active lifestyle. De Vries et al. [44] argued that the effect of "green activity" on health is mediated by reductions in stress and improvements in social cohesion. For example, there is evidence that more frequent and longer visits to green spaces are associated with mental health and vitality, irrespective of cultural and climatic settings [47]. Although the association is weak at the individual level, its impact on the population health may be considerable. Moreover, Van den Berg et al.'s [47] findings suggest that the effects of green spaces on well-being are stronger for lower educated groups than for higher educated groups. In addition to the available green areas (e.g., parks), the quality and quantity of the streetscape appear to be at least equally important in improving indicators of well-being [48], further emphasizing the need for urban planning and the redevelopment of underserved communities. That is, the presence of green areas is also a matter of social inequality that has repercussions on health disparities between affluent and less affluent areas. Taken together, these studies suggest that increased investment in landscaping may represent an important local-level policy strategy and has the potential to strengthen the role of green space planning as part of a broader preventive health policy. This is particularly important in urban contexts.

Another important implication of the use of green exercise is the potential to accelerate the dose-response relationship between exercise and well-being. Some authors have reflected on the dose of nature needed to enjoy the psychological benefits [7]. Barton and Pretty [49] showed different dose-response curves for the optimal duration, intensity, and types of green exercise, indicating that the strongest positive outcomes for mood and self-esteem take place during the first five minutes of exposure, although the quality and quantity of green space availability is related to more reduced risk for mental illness.

Although more research is needed to clarify the types, duration, and intensities of exercise needed to impact well-being [22], meta-analyses have found support for the positive effect of exercise on anxiety [50] and depression [51]. However, there is evidence that acute short-term exposures (<5 min) to natural environments result in benefits on well-being [49]. Therefore, future research should attempt to ascertain whether being active within natural environments may result in larger and quicker improvements in quality of life than being active in other contexts. If that is the case, community programs that provide outdoor education may be an avenue to optimize the benefits of active interaction with environments. In addition, these programs could also change people's attitudes towards nature, which in turn may result in increased individual and community support for pro-sustainability policies and practices [52] with potential impact on planetary health.

Research concerning the differential effects of the types of the natural environment (i.e., beach, riverside, grassland, heritage) suggests that the effects are similar across contexts [14]. Such similarity implies that exercise prescription may occur without specification of the types of natural environments, making it appealing to a variety of individuals. Nevertheless, Barton and Pretty [49] argue that environments that include water present the greatest benefits in self-esteem and mood. In addition, these authors suggest that these benefits are larger for those individuals who experience mental illness and that even short bouts of exercise regardless of the kind of the natural environment may have a therapeutic effect [52].

Exercise in natural environments is performed within a specific space making use of natural resources and leaving a negative environmental impact (e.g., artificial snow, pesticides, water usage) [53,54]. These issues highlight the need to promote the responsibility of individual users, as well as that of governing bodies. Managers and users of these natural resources have a shared responsibility for contributing to a sustainable environment. The visibility of sport as a global phenomenon can contribute to increased ecological awareness so that the natural resources can be used sustainably to allow future generations to enjoy them as well. Sports organizations can adopt eco-centric management principles [55] contributing to the health of the planet and serving as role models to other industries. For example, the preparation of Beijing Olympic Games involved a major restructuring of transportation infrastructures, water protection and treatment, and energy development.

However, environmental awareness does not automatically translate to environmental action (i.e., “value-action gap”) [56]; hence, intentional educational behavior change campaigns and increased opportunities to explore natural environments are necessary. Direct contact with nature might help individuals develop a close bond to environmental settings [57] and a diffusion of innovations approach has been suggested to be an effective way of communicating new ideas to members of relevant communities [53]. In addition, McCullough and colleagues [53] suggested that the collaboration with environmental agencies and local councils may result in meaningful community intervention leading to awareness and environmental behavior change (e.g., recycling and waste reduction initiatives).

Encouraging physical activity in natural environments may lead to the development of a closer connection with nature and positive attitudes and behaviors toward the environment. For example, Larson et al. [58] demonstrated that increasing opportunities for engagement in outdoor recreation was positively associated with pro-environmental behavior. According to these authors, opportunities to interact with and learn about the environment result in the development of biocentric values in which individuals value conservation, stewardship, and responsible behavior. Larson et al. [59] further demonstrated that strong connections to a place (i.e., “place attachment”) led to a more frequent commitment to place-protection behaviors. Finally, Brymer et al. [60] explored the experiences of extreme sports participants and suggested that they develop a deep sense of connection and harmony with nature, which improves commitment to sustainable practices.

As childhood outdoor recreation experiences have been associated with adult outdoor experiences [61,62], early development of positive interactions with the environment requires a systems approach to the promotion of green or blue exercise. Opportunity to develop positive attitudes towards sustainability require coordinated efforts from central and local policymakers (e.g., greener regulations, goal setting), social modeling, environmental prompts, adaptations to the school curriculum, engagement of sports organizations, and facilitated access to underserved populations [58,63].

Based on existing research, Pretty et al. [52] provide several recommendations for policymakers. Specifically, these authors suggest that barriers to access to green spaces need to be minimized to encourage a range of different segments of the population to interact with nature. Often, green spaces are perceived to be unsafe due to concerns over the occurrence of crime, perceived distance from home, or the existence of physical barriers that limit access to individuals with limited independence and mobility (e.g., children, disabled people). In addition, policies should be developed to increase the use of natural environments by groups of individuals who seem to be less likely to use them, notably young people, ethnic minorities, and disabled and low-income groups.

Therefore, research on green exercise has two main implications for policy [52]: policymakers and stakeholders should make an effort to improve provision and exposure to natural environments “to increase the number of people taking part in green exercise, including especially those social groups suffering the most ill-health through sedentary lifestyles and those currently not accessing the countryside for recreation and leisure; and to increase the rate of use by those people already participating in green exercise” (p. 227).

As suggested by Thompson and Wilkie [23], more research on “blue exercise” is needed before policy can be confidently recommended. Specifically, studies addressing the barriers to engaging in blue exercise (e.g., proximity, fear of water, equipment requirements) as well as the differential effects with “green exercise” and the role of the interaction of “green” and “blue spaces” in influencing the types of physical activity are necessary. Nevertheless, preliminary evidence suggests that combining a variety of natural outdoor environments into urban spaces may encourage active lifestyles and impact public health [26].

#### 4. Conclusions

Overall, scientific evidence reveals that natural environments are effective in promoting physical activity, reducing psychological stress, and improving well-being. In addition, it may have an important ecological impact. Thus, to have an increasingly technological modern society that is simultaneously healthier and more supportive of a sustainable world, it is important to promote an increased connection with the natural environment. In this paper, we discussed different the types of exercise in nature and showed evidence for the relationship between green and blue exercise and health and well-being. We also presented the different theories that explain the benefits obtained with green and blue exercise.

The practice of exercise in nature promotes health and well-being. Green or blue natural spaces or open spaces allow populations to engage in recreational and leisure activities, increasing levels of physical activity with lower levels of perceived exertion, reducing stress, restoring mental fatigue, improving mood and self-esteem, and enjoying life. With the increasing urbanization and motor transports, the availability of green or blue natural spaces or built open spaces has never been more important and it is necessary to ensure that all residents have easier access to these spaces.

We would like to emphasize that there are many aspects, related to the environment and exercise, that were not included in the analyses and reflections presented in this paper. However, the most relevant theories on the subject were presented and its importance for people’s health was highlighted. In the future, more research should be carried out with different groups to assess in detail the relationships between the amount of exercise performed in different natural contexts, and their health consequences. Furthermore, researchers should address the effects of different types of engagement with the natural environment.

In conclusion, the present manuscript has reviewed updated literature on the theoretical basis of blue and green exercise and on the recent empirical evidence concerning psychological and health benefits of this type of physical exercise. Importantly, this article has underlined the link between environmental and human health, through physical and sport activity. The practice of exercise in nature, in both green spaces and near/in the water, has been proven to show additional benefits for quality of life, compared to exercise in indoor spaces. Benefits for health and sport performance have been also detected in professionals’ samples. Moreover, more efforts are recommendable for the integration of the programs to promote physical activity and environmental action across the life span. Environmental health cannot be separated from human health, and vice versa, so the promotion of further caring and attachment with green and blue environments through physical exercise may foster a more ecological interaction with nature, with positive upward benefits in sustainability. Physical exercise may be the key to increasing human connectedness with nature, and consequently, to improving environmental protection in more sustainable societies.

#### 5. Key Message for Public Policies

Environmental behavioral sciences are, by definition, one of the main disciplines for individual behavioral change concerning health promotion and sustainability issues [64]. The rapid changes that are currently going on regarding climate issues and health issues require that scientific models of change accompany this trend to improve individuals’ and planetary health, that is, improving the health of individuals and the health of the

environment itself, independently of whether it is the physical environment, the social and affective environment, or even the digital environment.

Indeed, the initial focus of environmental behavior sciences on changing the human environment to increase people's health and well-being has been replaced by a focus on changing people and their behavior also to preserve their environment [65]. This change may be justified by present worries about the ongoing destruction of the human environment, but the truth is that changing the environment will also facilitate changing individual's or population's behavior, helping them to be more active, happier, and healthier [65].

Blue and green exercise, being a practice that promotes individual health and well-being as well as planetary health, would be beneficial if they become a focus for public policies. It is expected that in the coming times, outdoor activities will be privileged for promoting mental and physical health, interpersonal socialization, and environmental protection. This paper aims to raise the awareness of policy decision-makers and professionals of the education, environment, and health sectors concerning the advantages for individuals and communities in adopting green and blue exercise as healthier, joyful, and environmentally friendly practices.

**Author Contributions:** Conceptualization, N.L. and M.G.d.M.; writing—original draft preparation, N.L., L.C., A.M., and D.G.-B.; writing—review and editing, L.C., N.L., and M.G.d.M.; supervision, M.G.d.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. WHO. *World Health Statistics 2017: Monitoring Health for the SDGs, Sustainable Development Goals*; World Health Organization: Geneva, Switzerland, 2017.
2. WHO. *Health Education: Theoretical Concepts, Effective Strategies and Core Competencies. A Foundation Document to Guide Capacity Development of Health Educators*; World Health Organization, Regional Office for the Eastern Mediterranean: Cairo, Egypt, 2012.
3. Pretty, J.; Peacock, J.; Sellens, M.; Griffin, M. The mental and physical health outcomes of green exercise. *Int. J. Environ. Health Res.* **2005**, *15*, 319–337. [[CrossRef](#)] [[PubMed](#)]
4. WHO. *The Ottawa Charter for Health Promotion*; World Health Organization: Geneva, Switzerland, 1986.
5. Ding, D.; Lawson, K.D.; Kolbe-Alexander, T.L.; Finkelstein, E.A.; Katzmarzyk, P.T.; van Mechelen, W.; Pratt, M. The economic burden of physical inactivity: A global analysis of major non-communicable diseases. *Lancet* **2016**, *388*, 1311–1324. [[CrossRef](#)]
6. Bjørnarå, H.B.; Torstveit, M.K.; Stea, T.H.; Bere, E. Is there such a thing as sustainable physical activity? *Scand. J. Med. Sci. Sports* **2017**, *27*, 366–372. [[CrossRef](#)] [[PubMed](#)]
7. Barton, J.; Bragg, R.; Wood, C.; Pretty, J. (Eds.) *Green Exercise: Linking Nature, Health and Well-Being*; Routledge: London, UK, 2016.
8. Caspersen, C.J.; Powell, K.E.; Christenson, G.M. Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Rep.* **1985**, *100*, 126–131. [[PubMed](#)]
9. Gascon, M.; Triguero-Mas, M.; Martínez, D.; Dadvand, P.; Forn, J.; Plasència, A.; Nieuwenhuijsen, M.J. Mental health benefits of long-term exposure to residential green and blue spaces: A systematic review. *Int. J. Environ. Res. Public Health* **2015**, *12*, 4354–4379. [[CrossRef](#)]
10. Lahart, I.; Darcy, P.; Gidlow, C.; Calogiuri, G. The Effects of Green Exercise on Physical and Mental Wellbeing: A Systematic Review. *Int. J. Environ. Res. Public Health* **2019**, *16*, 1352. [[CrossRef](#)]
11. Gladwell, V.F.; Brown, D.K.; Wood, C.; Sandercock, G.R.; Barton, J.L. The great outdoors: How a green exercise environment can benefit all. *Extrem. Physiol. Med.* **2013**, *2*, 3. [[CrossRef](#)]
12. Ashbullby, K.J.; Pahl, S.; Webley, P.; White, M.P. The beach as a setting for families' health promotion: A qualitative study with parents and children living in coastal regions in Southwest England. *Health Place* **2013**, *23*, 138–147. [[CrossRef](#)]
13. Akpınar, A. Green Exercise: How Are Characteristics of Urban Green Spaces Associated with Adolescents' Physical Activity and Health? *Int. J. Environ. Res. Public Health* **2019**, *16*, 4281. [[CrossRef](#)]
14. Rogerson, M.; Brown, D.K.; Sandercock, G.; Wooller, J.-J.; Barton, J. A comparison of four typical green exercise environments and prediction of psychological health outcomes. *Perspect. Public Health* **2016**, *136*, 171–180. [[CrossRef](#)]

15. Rogerson, M.; Barton, J. Effects of the Visual Exercise Environments on Cognitive Directed Attention, Energy Expenditure and Perceived Exertion. *Int. J. Environ. Res. Public Health* **2015**, *12*, 7321. [[CrossRef](#)] [[PubMed](#)]
16. Peacock, J.; Hine, R.; Pretty, J. *The Mental Health Benefits of Green Exercise Activities and Green Care*; Mind: Colchester, UK, 2007.
17. Mygind, L.; Kjeldsted, E.; Hartmeyer, R.; Mygind, E.; Bølling, M.; Bentsen, P. Immersive nature-experiences as health promotion interventions for healthy, vulnerable, and sick populations? A systematic review and appraisal of controlled studies. *Front. Psychol.* **2019**, *10*, 943. [[CrossRef](#)]
18. Veloso, S.; Loureiro, A. Exercise and nature: A relevant combination to health and well-being. *Rev. Iberoam. Psicol. Ejerc. Deporte* **2017**, *12*, 313–319.
19. Olafsdottir, G.; Cloke, P.; Vögele, C. Place, green exercise and stress: An exploration of lived experience and restorative effects. *Health Place* **2017**, *46*, 358–365. [[CrossRef](#)] [[PubMed](#)]
20. Han, K. The effect of nature and physical activity on emotions and attention while engaging in green exercise. *Urban For. Urban Green.* **2017**, *24*, 5–13. [[CrossRef](#)]
21. Mackay, G.J.; Neill, J.T. The effect of “green exercise” on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study. *Psychol. Sport Exerc.* **2010**, *11*, 238–245. [[CrossRef](#)]
22. Mnich, C.; Weyland, S.; Jekauc, D.; Schipperijn, J. Psychosocial and physiological health outcomes of green exercise in children and adolescents—A systematic review. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4266. [[CrossRef](#)]
23. Thompson, N.; Wilkie, S. ‘I’m just lost in the world’: The impact of blue exercise on participant well-being. *Qual. Res. Sport Exerc. Health* **2020**, *13*, 624–638. [[CrossRef](#)]
24. White, M.; Smith, A.; Humphries, K.; Pahl, S.; Snelling, D.; Depledge, M. Blue space: The importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *J. Environ. Psychol.* **2010**, *30*, 482–493. [[CrossRef](#)]
25. Tan, C.; Chang, C.; Nghiem, L.; Zhang, Y.; Oh, R.; Shanahan, D.; Lin, B.; Gaston, K.; Fuller, R.; Carrasco, L. The right mix: Residential urban green-blue space combinations are correlated with physical exercise in a tropical city-state. *Urban For. Urban Green.* **2021**, *57*, 126947. [[CrossRef](#)]
26. Wilson, E. *Biophilia: The Human Bond with Other Species*; Harvard University Press: Cambridge, UK, 1984.
27. Ulrich, R.; Simons, R.; Losito, B.; Fiorito, E.; Miles, M.; Zelson, M. Stress recovery during exposure to natural and urban environments. *J. Environ. Psychol.* **1991**, *11*, 201–230. [[CrossRef](#)]
28. Kaplan, R.; Kaplan, S. *The Experience of Nature: A Psychological Perspective*; Cambridge University Press: Cambridge, UK, 1989.
29. Ibanez, J.; Bockheim, J. *Pedodiversity: State of the Art and Future Challenges*; CRC Press: Boca Raton, FL, USA, 2013.
30. Potschin, M.; Haines-Young, R. Ecosystem services: Exploring a geographical perspective. *Prog. Phys. Geogr.* **2011**, *35*, 575–594. [[CrossRef](#)]
31. Pretty, J.; Rogerson, M.; Barton, J. Green Mind Theory: How Brain-Body-Behaviour Links into Natural and Social Environments for Healthy Habits. *Int. J. Environ. Res. Public Health* **2017**, *14*, 706. [[CrossRef](#)] [[PubMed](#)]
32. Araújo, D.; Brymer, E.; Brito, H.; Withagen, R.; Davids, K. The empowering variability of affordances of nature: Why do exercisers feel better after performing the same exercise in natural environments than in indoor environments? *Psychol. Sport Exerc.* **2019**, *42*, 138–145. [[CrossRef](#)]
33. Kellert, S.; Wilson, E. *The Biophilia Hypothesis*; Island Press: Washington, DC, USA, 1993.
34. Ewert, A.; Overholt, J.; Alison, V.; Wang, C. Understanding the Transformative Aspects of the Wilderness and Protected Lands Experience upon Human Health. *USDA For. Serv. Proc. RMRS* **2011**, *64*, 140–146.
35. Marselle, M. Theoretical Foundations of Biodiversity and Mental Well-being Relationships. In *Biodiversity and Health in the Face of Climate Change*; Marselle, M.R., Stadler, J., Korn, H., Irvine, K.N., Bonn, A., Eds.; Springer International Publishing: Cham, Switzerland, 2019; pp. 133–158.
36. Berman, M.G.; Jonides, J.; Kaplan, S. The Cognitive Benefits of Interacting With Nature. *Psychol. Sci.* **2008**, *19*, 1207–1212. [[CrossRef](#)]
37. Foo, C. Linking forest naturalness and human wellbeing—a study on public’s experiential connection to remnant forests within a highly urbanized region in Malaysia. *Urban Urban Green* **2016**, *16*, 13–24. [[CrossRef](#)]
38. van den Berg, A.; Joye, Y.; Koole, S. Why viewing nature is more fascinating and restorative than viewing buildings: A closer look at perceived complexity. *Urban Urban Green* **2016**, *20*, 397–401. [[CrossRef](#)]
39. Mandelbrot, B. *The Fractal Geometry of Nature*; Freeman: New York, NY, USA, 1983.
40. Joye, Y.; van den Berg, A. Restorative environments. In *Environmental Psychology: An Introduction*; Steg, L., van den Berg, A., Groot, J., Eds.; BPS Blackwell: West Sussex, UK, 2013; pp. 57–66.
41. Sandifer, P.; Sutton-Grier, A.; Ward, B. Exploring connections among nature, biodiversity, ecosystem services, and human health and Well-being: Opportunities to enhance health and biodiversity conservation. *Ecosyst. Serv.* **2015**, *12*, 1–15. [[CrossRef](#)]
42. Brymer, E.; Davids, K.; Mallabon, L. Understanding the psychological health and well-being benefits of physical activity in nature: An ecological dynamics analysis. *Ecopsychology* **2014**, *6*, 189–197.
43. Flowers, E.P.; Freeman, P.; Gladwell, V.F. Enhancing the acute psychological benefits of green exercise: An investigation of expectancy effects. *Psychol. Sport Exerc.* **2018**, *39*, 213–221. [[CrossRef](#)]
44. De Vries, S.; Van Dillen, S.; Groenewegen, P.; Spreeuwenberg, P. Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. *Soc. Sci. Med.* **2013**, *94*, 26–33. [[CrossRef](#)]

45. Harte, J.; Eifert, G. The effects of running, environment, and attentional focus on athletes' catecholamine and cortisol levels and mood. *Psychophysiology* **1995**, *32*, 49–54. [[CrossRef](#)]
46. Astell-Burt, T.; Feng, X.; Kolt, G.S. Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: Evidence from 260,061 Australians. *Prev. Med.* **2013**, *57*, 601–606. [[CrossRef](#)]
47. Van den Berg, M.; Van Poppel, M.; Van Kamp, I.; Andrusaityte, S.; Balseviciene, B.; Cirach, M.; Danileviciute, A.; Ellis, N.; Hurst, G.; Masterson, D.; et al. Visiting green space is associated with mental health and vitality: A cross-sectional study in four European cities. *Health Place* **2016**, *38*, 8–15. [[CrossRef](#)]
48. Van Dillen, S.M.; de Vries, S.; Groenewegen, P.P.; Spreeuwenberg, P. Greenspace in urban neighbourhoods and residents' health: Adding quality to quantity. *J. Epidemiol. Community Health* **2012**, *66*, e8. [[CrossRef](#)]
49. Barton, J.; Pretty, J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. *Environ. Sci. Technol.* **2010**, *44*, 3947–3955. [[CrossRef](#)]
50. Petruzzello, S.J.; Landers, D.M.; Hatfield, B.D.; Kubitz, K.A.; Salazar, W. A meta-analysis on the anxiety-reducing effects of acute and chronic exercise. Outcomes and Mechanisms. *Sports Med.* **1991**, *3*, 143–182. [[CrossRef](#)] [[PubMed](#)]
51. Kvam, S.; Kleppe, C.L.; Nordhus, I.H.; Hovland, A. Exercise as a treatment for depression: A meta-analysis. *J. Affect. Disord.* **2016**, *202*, 67–86. [[CrossRef](#)] [[PubMed](#)]
52. Pretty, J.; Peacock, J.; Hine, R.; Sellens, M.; South, N.; Griffin, M. Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *J. Environ. Plan. Manag.* **2007**, *50*, 211–231. [[CrossRef](#)]
53. McCullough, B.; Pfahl, M.; Nguyen, S.N. The green waves of environmental sustainability in sport. *Sport Soc.* **2016**, *19*, 1040–1065. [[CrossRef](#)]
54. Trendafilova, S.; McCullough, B.; Pfahl, M.; Nguyen, S.N.; Casper, J.; Picariello, M. Environmental sustainability in sport: Current state and future trends. *Glob. J. Adv. Pure Appl. Sci.* **2014**, *3*, 9–14.
55. Sartore-Baldwin, M.L.; McCullough, B. Equity-based sustainability and ecocentric management: Creating more ecologically just sport organization practices. *Sport Manag. Rev.* **2018**, *21*, 391–402. [[CrossRef](#)]
56. Borne, G. Riding the sustainability wave: Surfing and environmentalism. *Environ. Sci.* **2018**, *27*, 53–57.
57. Proshansky, H.; Fabian, A.; Kaminoff, R. Place-identity: Physical world socialization of the self. *J. Environ. Psychol.* **1983**, *3*, 57–83. [[CrossRef](#)]
58. Larson, L.R.; Whiting, J.W.; Green, G.T. Exploring the influence of outdoor recreation participation on pro-environmental behaviour in a demographically diverse population. *Local Environ.* **2011**, *16*, 67–86. [[CrossRef](#)]
59. Larson, L.R.; Usher, L.E.; Chapmon, T. Surfers as environmental stewards: Understanding place-protecting behavior at Cape Hatteras National Seashore. *Leis. Sci.* **2018**, *40*, 442–465. [[CrossRef](#)]
60. Brymer, E.; Downey, G.; Gray, T. Extreme sports as a precursor to environmental sustainability. *J. Sport Tour.* **2009**, *14*, 193–204. [[CrossRef](#)]
61. Sugiyama, N.; Hosaka, T.; Takagi, E.; Numata, S. How do childhood nature experiences and negative emotions towards nature influence preferences for outdoor activity among young adults? *Landsc. Urban Plan.* **2021**, *205*, 103971. [[CrossRef](#)]
62. Bixler, R.D.; Floyd, M.F.; Hammitt, W.E. Environmental socialization: Quantitative tests of the childhood play hypothesis. *Environ. Behav.* **2002**, *34*, 795–818. [[CrossRef](#)]
63. Osbaldiston, R.; Schott, J.P. Environmental sustainability and behavioral science: Meta-analysis of proenvironmental behavior experiments. *Environ. Behav.* **2012**, *44*, 257–299. [[CrossRef](#)]
64. Ernst, A.; Wenzel, U. Bringing environmental psychology into action: Four steps from science to policy. *Eur. Psychol.* **2014**, *19*, 118–126. [[CrossRef](#)]
65. Gärling, T. Past and Present Environmental Psychology. *Eur. Psychol.* **2014**, *19*, 127–131. [[CrossRef](#)]