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Review

Immersed in Motion: A Narrative Review on Physical Activity Intensity and Mental Health Benefits in Blue Spaces

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Abstract

Blue spaces (BS) are increasingly recognized for their potential to support mental health and well-being, yet the specific role of physical activity (PA) within these environments remains underexplored. This narrative review aimed to synthesize empirical evidence on the relationship between different types and intensities of PA in BS and mental health outcomes. Twenty studies published since 2010 were included, selected based on validated psychological measures and clearly reported PA types. Literature research in PubMed, Web of Science, and Scopus was conducted, and methodological quality was assessed using the Effective Public Health Practice Project (EPHPP) tool. Data extraction captured study characteristics, PA type and intensity (categorized according to the 2024 Compendium of Physical Activities, where no direct measurements were taken), and mental health outcomes. The results indicate that PA in BS is generally associated with improved psychological well-being. Light-intensity activities showed consistent positive effects on restorative and affective outcomes, while moderate- to vigorous intensity activities demonstrated variable results. Mechanisms underlying these benefits appear multifactorial, including neurobiological responses, social interactions, and cultural attachment to water. These findings underscore the contribution of both the type and intensity of PA in BS to mental health outcomes.

Keywords: urban blue spaces; therapeutic landscapes; physical activity; metabolic equivalent task values; mental health; well-being

1. Introduction

Therapeutic landscapes refer to environments that promote health and well-being through their physical, social, and symbolic attributes. Since its introduction in 1992, the concept has expanded from natural to urban contexts, emphasizing the dynamic ways in which places shape human health [1]. In today's fast-paced world, the need to better understand the links between place and health has become even more pressing. While quality of life has improved, the prevalence of chronic non-communicable diseases (such as cardiovascular diseases, cancers, diabetes, and mental disorders) has risen, posing significant public health challenges [2,3]. At the same time, urban overpopulation requires new, innovative approaches to urban planning to foster public health and sustainability.

Over the last decade, the role of urban nature, particularly green and blue spaces, has gained significant attention in academic literature. Green spaces (GS), such as parks, green corridors, and gardens, are widely recognized for their beneficial effects on physical and mental health, including reduced mortality rates, chronic disease prevention, and enhanced well-being [4–9]. However, blue spaces (BS)—natural and man-made surface water—are

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emerging as equally important for mental and general health. Indoor and outdoor water environments have health-promoting benefits [10]. They are linked to nutritious food resources [11], better general health [12], reduced obesity and lower mortality rates [13].

Similarly, contact with BS, such as rivers and meadows, fosters our psychological health [14] through reduced psychological distress [15] and increased well-being [16]. Blue features enhance restorative experiences in urban environments [17], while proximity to freshwater and oceanic bodies reduces anxiety and mood disorder hospitalization rates [18]. BS are also beneficial across all age populations: Refs. [19,20] found that visits to BS result in better mental health for elderly groups, Ref. [21] proved BS associations with enhanced well-being in adults, while in younger populations, BS support behavioral development and reduce attention deficit hyperactivity disorder symptoms [22].

Key pathways linking BS to health include social interaction, physical activity (PA), restoration, and environmental qualities [23]. For example, blue care programs positively affect mental health and well-being [24]. Neighborhood water elements have the same effects via increased social capital [25], though these effects are influenced by other factors such as socio-economic attributes, perceptions, personal preferences or landscape design [26,27]. With respect to PA, evidence demonstrates that the type, intensity, and scale of natural settings shape PA patterns [28], and that walking and other on-land activities mediate the positive effects of coastal proximity on mental health [29]. BS use is a stronger predictor of mental well-being [30], and specific configurations of green and/or blue environments support different types of exercise [31]. Among older adults, engagement with parks and BS enhances physical and mental health [32] and visits to inland waterways increase life satisfaction, PA, and well-being, although usage is shaped by socio-economic inequalities [33]. Moreover, sports in aquatic environments support children's social and emotional development [34]. Water-based activities such as surfing or sea swimming further contribute to emotional restoration and resilience [35–37]. Systematic reviews confirm consistent benefits of BS exposure for mental health and PA [38].

Additional studies highlight structured interventions and sensory pathways, with the most common examples being barefoot walking on beaches [39] and soundscapes [40], which encourages recovery. Also, different BS environments foster place attachment with islands gaining more attention due to their natural and cultural elements and urban beaches promoting restorative experiences [41].

Collectively, this evidence illustrates that BS support health through environmental features, recreational opportunities, social engagement, and PA. However, important gaps remain. Although several reviews have examined associations between exposure to natural environments, PA, and mental health [31,42–48], most treat PA as a single construct and therefore offer limited insight into how its specific components contribute to these relationships. Existing syntheses often combine green and blue settings, even though recent work has moved beyond this traditional dichotomy [49–52], do not differentiate among heterogeneous activity types [42,53,54], and rarely consider PA intensity as a potential mechanism, mediator, or effect modifier. Moreover, findings from green-exercise research cannot be assumed to generalize to BS contexts, which involve distinct environmental affordances (e.g., water-based activities, coastal microclimates, sensory stimuli) [55,56] that shape both the intensity and the psychological impact of PA. As a result, current evidence cannot determine whether, and under which conditions, PA intensity influences mental health outcomes in BS settings.

By focusing on this aspect, the present review aims to synthesize evidence on how different types and intensities of PA in BS contribute to mental health and well-being. To achieve this, the study adopts a narrative review approach which permits the adoption of selected components such as predefined eligibility criteria, multi-database searching,

and structured quality appraisal—while maintaining flexibility for qualitative analysis of emerging research areas with limited and heterogeneous evidence bases. Using this approach, we examine twenty relevant studies, categorizing PA by type and intensity and summarizing associated psychological outcomes. We highlight gaps in current evidence and challenges in identifying clear associations between activity intensity and well-being, providing directions for future research on the therapeutic potential of BS. Importantly, we also consider how these insights can inform urban planning and public health strategies, situating BS as components of resilient and health-supportive urban systems.

2. Materials and Methods

2.1. Eligibility Criteria

The present review includes quantitative or mixed studies that examine the relationship between BS, PA, and mental health. To ensure the reliability of the findings, only studies that measured psychological outcomes using validated tools were considered. We included peer-reviewed articles published in English since 2010. Another important criterion was that papers included measurements of PA intensity or clearly stated the type of PA. Accordingly, exclusion criteria referred to records that did not analyze results on BS separately from other outdoor settings, protocols involving artificial exposure to BS, and PA type described in ways that would not permit intensity classification. Interviews, narrative documents, and conference papers were also excluded.

2.2. Search Strategy

The literature search was conducted in PubMed, Scopus, and Web of Science between January and March 2025. The search strategy focused on the term "blue spaces", widely used in environmental health and nature-health research as an umbrella concept encompassing coastal, marine, river and lake environments, including those located within or near urban areas [13,42]. The initial search string employed in all cases was: "blue spaces" AND ("mental health" OR restoration OR mood OR wellbeing OR stress OR anxiety OR emotion*) AND (swimming OR rafting OR kayaking OR fishing OR jogging OR running OR "physical activit* OR walking OR diving OR snorkeling OR sailing OR "water sports" OR surfing OR exercis*)". To broaden the scope and avoid excluding potential environmental settings, a second search was conducted in December 2025 (for the same period: January 2010–March 2025). The search string was expanded to: ("blue spac*" OR beach OR coast OR riparian OR marine OR sea OR ocean OR river OR lake OR wetland OR fountain OR "swimming pool") AND ("mental health" OR restoration OR mood OR wellbeing OR stress OR anxiety OR emotion*) AND (swimming OR rafting OR kayaking OR fishing OR jogging OR running OR "physical activit*" OR walking OR diving OR snorkeling OR sailing OR "water sports" OR surfing OR exercis*). In both rounds, two reviewers independently screened titles, abstracts, and full texts, with disagreements resolved through discussion.

2.3. Quality Assessment

The methodological rigor and risk of bias in the selected studies were evaluated using the Effective Public Health Practice Project (EPHPP) tool. The EPHPP is a comprehensive and widely recognized framework for assessing various study designs, including randomized controlled trials, cohort studies, and case–control studies [57,58]. The tool evaluates multiple domains, such as selection bias, study design, confounders, blinding, data collection methods, and participant attrition. Each domain is rated as strong, moderate, or weak, and these ratings are combined to generate an overall score for the study. Studies were classified as "strong" if no domains were rated weak, "moderate" if one domain was weak, and "weak" if two or more domains received weak ratings. To ensure consistency and

minimize bias, two reviewers independently assessed the studies and reached a unanimous agreement on the final ratings. Criteria for selecting quality categorization were used based on the analysis of Ding et al., 2024 [59].

2.4. Data Extraction

Data extraction involved collecting information on study characteristics, including author names, year of publication, geographical context, and study design. Demographic data such as sample size, participant characteristics, gender distribution, and age range were also recorded. Detailed methodological descriptions were provided, highlighting protocols and tools used to measure PA levels. For those studies that did not report objective or relative intensity measures, activity intensities were classified using the 2024 Compendium of Physical Activities, a resource widely used in exercise science to classify activities by energy expenditure expressed in Metabolic Equivalent of Task (MET) values [60–62]. The Compendium assigns MET scores either from measured energy expenditure (indirect calorimetry) or from validated analogs with similar biomechanical and metabolic demands [63]. These values therefore represent standardized estimates of typical exertion under defined conditions, rather than the dose or intensity achieved within a specific intervention context. Each activity is described with detailed parameters (pace, terrain, movement pattern), allowing consistent classification into established intensity bands: sedentary (1.0–1.5 METs), light (1.6–2.9 METs), moderate (3.0–5.9 METs), and vigorous ($\geq$6.0 METs).

To ensure that our classification reflected the typical exertion associated with the reviewed papers' reported activities, we mapped each activity to the closest corresponding Compendium entry based on two guiding principles. Firstly, we considered activity content, environment, and typical exertion level, selecting entries that best represented the actual conditions under which the activity was performed, participants' skill level or other characteristics when mentioned, and the setting (e.g., indoor or outdoor). Secondly, we used the assigned MET values to classify intensity, applying widely accepted thresholds for light, moderate, and vigorous activity. In the absence of specific information, the mean MET of all relevant entries was used (Table A2).

This approach provided a transparent and reproducible classification of intervention content, facilitating cross-study comparison and interpretation of potential associations with mental health outcomes. Each PA type was analyzed during different screening phases, ensuring precision in classification. Finally, the extracted data included outcome variables, the tools used to measure these outcomes, and key findings on the relationship between BS activities and psychological health.

3. Results

Our initial search resulted in 397 documents (Scopus n = 143, Web of Science n = 201, PubMed n = 53). However, the second round of literature research increased the total records to 36,859. After duplicate removal, 29,366 papers were left for screening. During the title and abstract reading, 29,346 articles were excluded. Through full-text evaluation, 20 records were identified as compatible with eligibility criteria (Figure 1).

3.1. Design Study and Characteristics

The twenty studies included in this review employed diverse research designs: five were cross-sectional [64–68], primarily employing survey data to explore the effects of BS exposure on mental health indicators. Two studies adopted within-subject experimental designs [69,70]. Field experiments were conducted by [40,71], with the first incorporating a randomized crossover protocol. One study utilized a non-randomized prospective

cohort design [72], while Ref. [73] performed a feasibility study with a pre-post-cohort design. Additional study designs included a randomized controlled trial (RCT) [74], a randomized crossover clinical trial [75], and a randomized single-blinded controlled pilot study [76]. Other methodological approaches comprised a retrospective, non-randomized pilot trial [77], an uncontrolled feasibility study [78], two pilots [79,80], an intervention study [81], and a randomized crossover design [82].

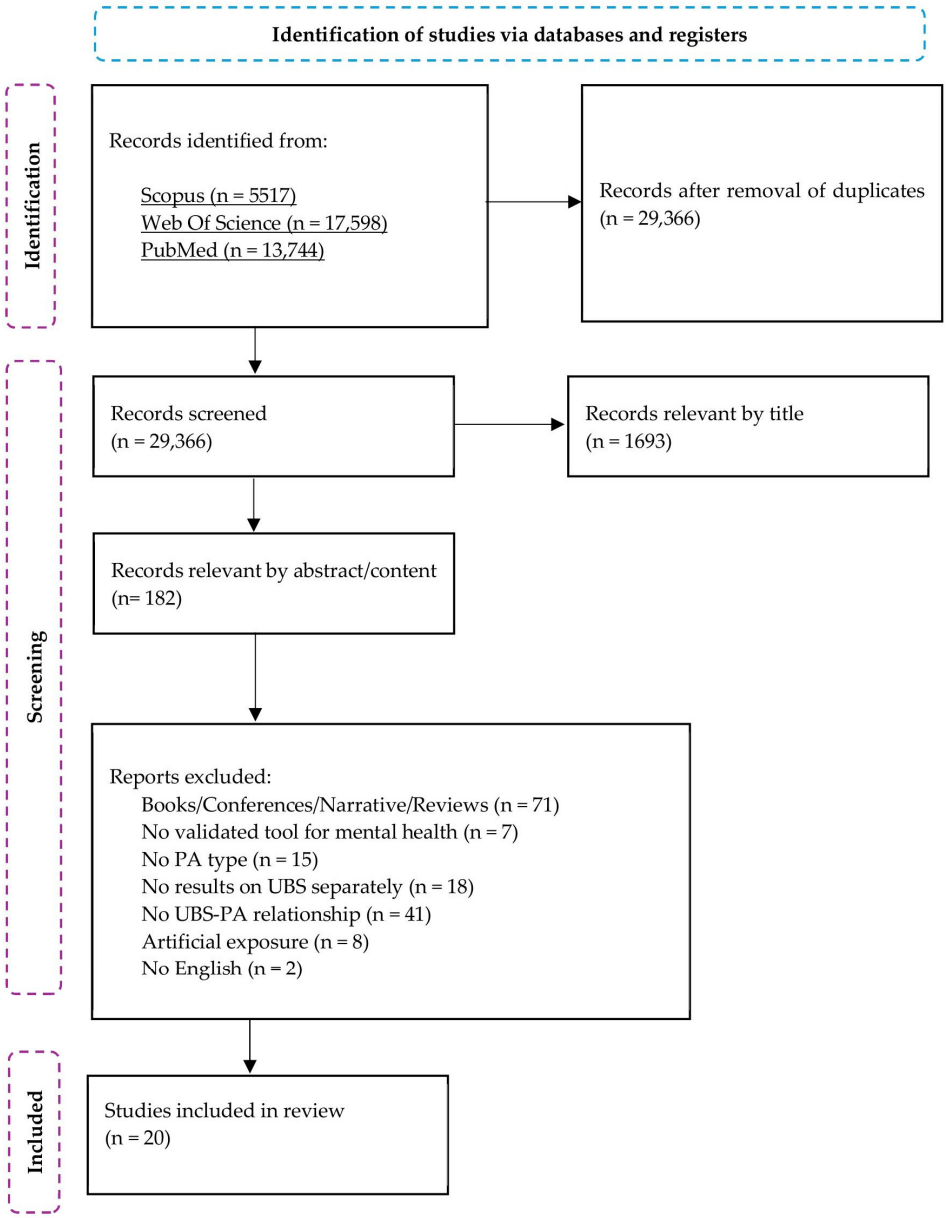

Figure 1. Flow diagram of literature search.

From a geographical perspective, most studies were conducted in Spain [64,68,74,79,82], United Kingdom [66,72,78,80,81] and the USA [67,73,77]. The rest were carried out in Canada [70], Italy [40], Brazil [75] and Asia, specifically Korea [76], Indonesia [65], Japan [71] and Taiwan [69]. Apart from [67,70,73,77,80–82], the remaining publications were made from 2020 onwards.

A total of 4054 participants were involved across the studies, with sample sizes ranging from a minimum of 11 to a maximum of 1752 participants. Most studies focused on adults, with three specifically targeting young adults around 20–26 years old [40,69,71] and Ref. [81] focusing on adolescents with a mean age of 14 years old. Regarding gender, one study

exclusively included male participants [66]. Ref. [76] recruited females exclusively, while the others had mixed gender samples. In terms of health status, most studies recruited healthy participants. However, several studies focused on specific clinical or vulnerable populations. For instance, Ref. [79] used individuals with various types of cancer, Ref. [66] a mixed sample of both healthy individuals and those with psychological disorders, and Refs. [78,80,82] patients self-reporting depression, anxiety and distress or diagnosed with these disorders. Moreover, some studies targeted populations with particular social or health-related characteristics: Refs. [73,77] recruited military veterans experiencing medical, psychiatric, substance abuse, and post-traumatic stress syndrome, while Ref. [81] students at risk of school exclusion. All details regarding study characteristics and design are summarized in Table 1.

3.2. Quality Assessment

The methodological quality of the included studies was mixed. Out of the twenty studies assessed, three were rated as strong, seven studies were considered moderate, and ten were rated weak. A common limitation across studies was study design, with many employing cross-sectional, pre-post, or non-randomized approaches. Such designs inherently limit the ability to draw causal inferences and reduce internal validity. Selection bias was generally moderate, reflecting some efforts to recruit participants representative of the target populations, though a few studies relied on convenience or targeted sampling approaches, which may have limited generalizability.

Control of potential confounders varied considerably across studies. Some of them adequately addressed confounding variables, earning strong ratings in this domain. In contrast, other studies exhibited limited control, indicating that observed effects may be influenced by uncontrolled variables. Blinding was frequently not applicable due to the nature of the interventions or study designs, particularly for field based and self-reported measures. Four studies received moderate ratings, reflecting partial blinding or procedural steps to reduce bias, while the rest were rated weak or N/A.

Data collection methods were consistently a strength across the majority of studies, with validated and reliable instruments employed to measure both psychological and physiological outcomes. Withdrawals and dropouts were generally well reported, enhancing the transparency of participant flow, though some studies did not fully report initial recruitment numbers or attrition, resulting in weak ratings in this domain. Table A1 summarizes the qualitative evaluation anonymously, without linking assessments to specific authors, to focus on methodological considerations rather than individual work.

3.3. Psychological Outcomes and Physical Activity

3.3.1. Demographic Observations of Reviewed Studies

Certain demographic factors influenced the relationship between BS, PA and psychological outcomes. Gender differences were reported in Refs. [74,75], where women experienced greater well-being improvements or anxiety reduction than men ($p = 0.02$; $p < 0.05$). Health status also emerged as a significant variable: Ref. [74] suggested that individuals in poorer initial health may show greater psychological responses from BS exposure ($p < 0.05$). Furthermore, age was identified as a potential moderating factor in Ref. [66], where older anglers exhibited lower levels of anxiety and depressive symptoms compared to younger participants. The same applies for educational level which was positively correlated with reduced perceived stress ($p < 0.05$) [68]. However, demographic variations were not consistently analyzed across all studies, representing a literature gap. These associations are included in Table 2, along with the rest psychological outcomes and PA information and results.

Table 1. Study characteristics and design.

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[40]	Nicolosi et al.—2020	Italy	Field experiment with random crossover design	63	Undergraduate students	Mixed	20.4	Participants engaged in a walk within a coastal and urban environment. Pre-and post-measurements were made for evaluating perceived restoration and sound
[64]	Carreño et al.—2020	Spain	Cross-sectional	246	Total sample	Mixed		Participants engaged for 1 h in either scuba diving or beach activities. The scuba diving group participated in two different diving experiences designed to minimize environmental impact. Pre-and post-mental health measurements were taken
				70 (BU)	Control group: beach users for leisure		50 (BU)	
				176 (SD)	Main interest group: scuba divers		43 (SD)	
				73 (GA)	Group A: 15 divers or fewer, diving with an instructor, complete (>10 min) pre-dive briefing		39 (GA)	
				103 (GB)	Group B: 15 divers and more, diving without an instructor, short (>10 min) pre-dive briefing		44 (GB)	
[65]	Maharja et al.—2023	Indonesia	Cross-sectional	308	General population	Mixed	42.2	Survey of 3 sections (demographics, interactions with the marine environment and general, MH
[66]	Wilson et al.—2023	United Kingdom	Cross-sectional	1752	Healthy and with psychological disorders	Male	N/A	Participants completed an online survey about their angling habits, mental health and demographics

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[67]	Amrhein et al.—2016	USA	Cross-sectional	100	Surfers	Mixed	29.71 (surfers)	Survey with five sessions for examining the relationship between surfing, depression, anxiety and spirituality
				120	Normative sample of college students			
				127	Normative sample of non-depressed adults seeking therapy			
				65	Normative sample of college students			
				142	Normative sample of medical students			
				36	Normative sample of non-student adults			
				189	Normative sample of adults			
[68]	Pita et al.—2022	Spain	Cross-sectional	244	Members of the fishing community	N/A	55	Self-administered questionnaire providing information on participants' recreational fishing activity (fishing effort), other physical activities, diet, perceived stress, negative affect, and night sleep quality
[69]	Yin et al.—2023	Taiwan	Within-subject experiment	20	Young healthy adults	Mixed	20–26	Participants would be exposed to 4 different environments (nature with water, nature *w/o* water, urban with water, urban *w/o* water) for a 30 min walk. Pre-and post-measurements were made for physiological and psychological indices

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[70]	Garg et al.—2010	Canada	Within-subject correlational study with repeated measures	186	General population	Mixed	38	Participants engaged in 4 h river rafting trips, based on route level of difficulty. Post-trip measurements were made to identify if higher levels of perceived restoration are associated with higher restorative benefits, along with 35 days follow-up for examining restorative differences between the river rafting environment and everyday residential settings
[71]	Luo et al.—2023	Japan	Field experiment	41	Students	Mixed	26.8	Participants engaged in 2 types of exposure behaviors: 15 min viewing the BS, 15 min walking the BS. All four experimental sites were visited in random order and on random days. Pre-post measurements were made (ROS and SVS control room and post-viewing and walking, PANAS control room and post-walking)
[72]	Massey et al.—2020	United Kingdom	Non-randomized prospective cohort study	86 (total)	General population	Mixed	43	Participants underwent a 10-week introductory outdoor swimming course (10 sessions—1 h each). Post measurements done on session 1 (pool), pre-and post-POMs done on session 4 (1st sea swimming), pre-post POMs and SWEMWBS done at session 10 (last sea swimming)

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[73]	Rogers et al.—2013	USA	Feasibility study with pre-post cohort design	11	Veterans with post-traumatic stress disease	Mixed	24–30	Participants engaged in a 5-sessions ocean therapy program (4 h each session). Post traumatic stress disease and depression levels were assessed prior to the first session and following the last one
[74]	Vert et al.—2020	Spain	Randomized controlled trial	59	Office workers	Mixed	29	Participants were randomly assigned to walk in different environments (seafront, urban route, control site-room) for 20 min per day, 4 d a week, over 3 weeks. T0: control demographics, T1: pre exposure measurements (SWB, POMS, SF12-general health, life satisfaction, eudaimonic wellbeing), T3: post-exposure measurements (SWB, WHO-5, POMS, general health, life satisfaction, eudaimonic wellbeing), T4: short follow-up (online questionnaire for vitality and mental health), T5: long-term follow up (SWB, general health, life satisfaction. eudaimonic wellbeing)
[75]	de Freitas et al.—2024	Brazil	Randomized crossover clinical trial	22	Beach tennis players	Mixed	35 (female) 26 (male)	Participants completed four sessions with 24–72 h intervals, including single beach tennis matches (one-on-one), double beach tennis matches (two-on-two), and a non-exercise control session. Pre-and post-session measurements were made to determine state and trait anxiety, enjoyment, affective responses, heart rate, and cardiorespiratory fitness between females and males

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[76]	Shin et al.—2022	Korea	Randomized single-blinded controlled pilot study	24	Caregivers of people with severe physical disability	Female	52.1 (marine therapy group)	Participants were randomly assigned to either a marine therapy group (beach), or an urban control group. Both groups participated in the same intervention: meditation and stabilization exercise for 60 min, twice a day, 8 sessons in total. Outcomes were assessed at three time points: before the intervention (pre-), immediately after the last session (post-intervention, PI), and four weeks later (follow-up, FU)
[77]	Marchand et al.—2018	USA	Retrospective, non-randomized pilot trial	44	Veterans with medical, psychiatric and substance abuse	Mixed	45.22 (interven-tion group)	Veterans participated in a substance use disorder treatment program. The intervention group participated in a sailing adventure therapy (SAT) in addition to treatment as usual (TAU), while the control group received only TAU. Within-group comparisons were made to assess the short-term effects of SAT and between-group comparisons were conducted to examine completion treatment rates, psychiatric hospitalizations, and treatment readmissions within 12 months

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[78]	Burlingham et al.—2022	United Kingdom	Uncontrolled, feasibility study	53	Patients with depression and/or anxiety	Mixed	18–84	Participants engaged in an 8-session sea swimming course. Activities included cold-water acclimatization, walking/running into water, dolphin dives, body surfing and short swims with lifeguard support. Measurements were made at baseline, post-course and 3-month follow-up. Free text descriptions were provided to give insight on participants' experiences.
[79]	Carreño et al.—2023	Spain	Pilot	16	Patients with various types of cancer	Mixed	54	Participants engaged in a 12-session program involving 3 types of sea-based activities: walking along the beach, beach activities and snorkeling. Each activity was performed 4 times (30 min each). In addition to the sea-based activities, participants also engaged in 4 sessions of a control activity for comparison. After completing the intervention, participants underwent the same assessment as at baseline to evaluate physical and MH changes
[80]	Maund et al.—2019	United Kingdom	Pilot	16	Diagnosed with anxiety and/or depression	Mixed	18–84	Participants engaged in a structured six-week nature-based intervention (NBI) within a wetland environment, attending one session per week for two hours. Pre-and post-intervention self-reported questionnaires assessed mental wellbeing, perceived stress, anxiety symptoms, and positive/negative

Table 1. *Cont.*

Numerical Citation	Author and Year	Country	Study Design	Sample (N)	Sample Characteristics	Gender	Age	Procedure
[81]	Hignett et al.—2017	United Kingdom	Intervention study	58	Students with social, emotional and behavioral trouble or at risk of exclusion difficulties	Mixed	14.25	Pre– post-intervention design to evaluate a 12-week surfing program targeting adolescents excluded from, or at risk of exclusion from, mainstream schooling. Baseline data (T1) (physiological measurements, wellbeing, connectedness, environmental knowledge, program assessment and teachers' observations) were collected approximately one week before the intervention. Post-intervention data (T2) were collected one week after program completion.
[82]	Triguero-Mas et al.—2017	Spain	Randomized case-crossover	26	With psychological distress	Mixed	44.32	Participants were exposed to three different urban, green, and blue environments in a randomized case-crossover design. Each exposure session included short-term (30 min) and mid-term (180 min) periods in the assigned environment. Psycho-physiological outcomes—including mood, attention, stress (cortisol), heart rate, heart rate variability, and blood pressure—were measured at multiple time points before, during, and after exposures. Physical activity, restoration, air pollution and social interactions were assessed as mediators

Table 2. Psychological Outcomes and Physical Activity.

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[40]	Nicolosi et al.—2020	Walking	N/A	Moderate	Perceived restoration	SRRS		walking in coastal environment	↑	β = 0.616; $p < 0.01$
								walking in urban environment	↑	β = 0.355 $p = 0.03$
					Sound level and quality	Self-reported items		N/A		
[64]	Carreño et al.—2020	Non-specified leisure activity	N/A	N/A	Mental Health	POMS	Anger-hostility	beach users vs. scuba divers	↓	Rate = 0.6; $p < 0.05$
							Fatigue	beach users vs. scuba divers	↓	Rate = 2.0; $p < 0.05$
							Depression	beach users vs. scuba divers	↓	Rate = 0.4; $p < 0.05$
							Vigor	beach users vs. scuba divers	↑	Rate = 93.2; $p < 0.05$
		Scuba diving		Vigorous				participants taking regular medication	↑	IRR = 1.26 (95%CI = 1.08, 1.48); $p < 0.01$
							Total mood disturbance	beach users vs. scuba divers	↓	Rate = 93.2; $p < 0.05$
								participants taking regular medication	↓	IRR = 0.91 (95%CI = 0.85, 0.97); $p < 0.01$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[65]	Maharja et al.—2023	Go to shoreline for recreation	Subjective item about nr of days engaged in each activity	N/A	Mental wellbeing	MCS	swimming or snorkeling	↑	F = 5.58; p = 0.0042; η^2 = 0.04
		Swimming or snorkeling		Moderate			higher income levels	↑	F = 7.23; p = 0.0076; η^2 = 0.02
							higher ages	↑	F = 6.21; p = 0.01; η^2 = 0.02
[66]	Wilson et al.—2023	Angling	Subjective item about frequency	Light	Well-being	WEMWBS	higher frequency in angling	↑	β = −0.507 (95% CI: −0.690 to −0.324); p < 0.01
					Sub-clinical depression	BDI	higher frequency in angling	↓	β = 0.881 (95% CI: 0.541 to 1.220); p < 0.01
					Sub-clinical anxiety	BAI	higher frequency in angling	↓	β = 0.556 (95% CI: 0.157 to 0.954); p < 0.01
							longer angling sessions	↑	β = −1.246 (95% CI: −2.359 to −0.134); p = 0.028

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[67]	Amrhein et al.—2016	Surfing	N/A	Moderate	Depression	BDI	surfers vs. normative sample of college students	↓	M = 4.43; t = −8.09; $p < 0.01$
							surfers vs. normative sample of non-depressed adults seeking therapy	↓	M = 4.43; t = −4.73; $p < 0.01$
					Anxiety	BAI	surfers vs. normative sample of college students	↓	M = 5.63; t = −4.14; $p < 0.01$
							surfers vs. normative sample of medical students	↓	M = 5.63; t = −3.56; $p < 0.01$
							surfers vs. normative sample of non-student adults	↓	M = 5.63; t = −1.86; $p = 0.06$
					Spirituality	SAS	surfers vs. normative sample of adults	↓	M = 137.27; t = −0.99; $p = 0.32$
					Spiritual Surfing Experience	SSEQ	N/A		

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[68]	Pita et al.—2022	Fishing	Subjective item on fishing effort (hrs/month over the last 3 months) and Activity index extracted from Baecke Physical Activity Questionnaire (for confounders measurement)	Light	Perceived stress	PSS		higher fishing effort	↓	Coef = −0.0156 (95% CI: −0.003, −0.029; $p < 0.05$)
								higher education level	↓	Coef = −0.9951 (95% CI: −1.7955, −0.1948; $p < 0.05$)
					Negative affect	BDI		higher fishing effort	↓	Coef = −0.0051 (95% CI: −1.0140, −0.0038; $p > 0.05$)
[69]	Yin et al.—2023	Walking	N/A	Light	Mood	POMS	Tension-anxiety	natural vs. urban environment	↓	β2 =—0.32; $p = 0.050$
							Fatigue	natural vs. urban environment	↓	β2 =—0.42; $p = 0.046$
							Esteem	natural vs. urban environment	↑	β2 = 0.86; $p = 0.015$
								water vs. no water	↑	β1 = 0.39; $p = 0.001$
								urban w/ water vs. natural w/ water	↑	β3 = −0.35; $p = 0.034$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[69]	Yin et al.—2023	Walking	N/A	Light	Mood	POMS	Vigor	natural vs. urban environment	↑	β2 = 0.33; $p = 0.016$
								water vs. no water	↑	β1 = 0.36; $p = 0.009$
								urban w/ water vs. natural w/ water	↑	β3 = −0.46; $p = 0.017$
					Restoration	RCS	Being away	natural vs. urban environment	↑	β2 = 1.98; $p < 0.001$
								water vs. no water	↑	β1 = 0.71; $p = 0.018$
							Extent	natural vs. urban environment	↑	β2 = 0.96; $p = 0.002$
							Fascination	natural vs. urban environment	↑	β2 = 1.41; $p < 0.001$
						Physiological measurements (heart rate variability, arterial pressure)	Quantitative Heart Rate Variability software (Medeia Ltd. Bulgaria)		N/A	

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[70]	Garg et al.—2010	Rafting	N/A	Moderate	Perceived Restorative-ness	PRS	rafting river experience vs. everyday residential setting (overall)	↑	M = 4.05; $p < 0.01$
							rafting river experience vs. everyday residential setting (low risk)	↑	M = 4.08; $p < 0.01$
							rafting river experience vs. everyday residential setting (intermediate risk)	↑	M = 3.93; $p < 0.01$
							rafting river experience vs. everyday residential setting (high risk)	↑	M = 4.18; $p < 0.01$
						GRS	rafting river experience vs. everyday residential setting (overall)	↑	M = 4.03; $p < 0.01$
							rafting river experience vs. everyday residential setting (low risk)	↑	M = 4.08; $p < 0.01$
							rafting river experience vs. everyday residential setting (intermediate risk)	↑	M = 3.89; $p < 0.01$
							rafting river experience vs. everyday residential setting (high risk)	↑	M = 4.15; $p < 0.01$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[70]	Garg et al.—2010	Rafting	N/A	Moderate	Perceived Restorative-ness	Coherence Subscale	rafting river experience vs. everyday residential setting (low risk)	↑	M = 4.09; $p < 0.01$
							rafting river experience vs. everyday residential setting (intermediate risk)	↑	M = 4.07; $p < 0.01$
							rafting river experience vs. everyday residential setting (high risk)	↑	M = 4.27; $p < 0.01$
[71]	Luo et al.—2023	Walking Viewing	N/A	Light Sedentary	Restoration	ROS	T3, T2 > T1	↑	F = 18.695; $p < 0.001$; $\eta^2 = 0.072$
							UR, UL > UC > CG	↑	F = 23.603; $p < 0.001$; $\eta^2 = 0.129$
							Place × time	↑	F = 6.046; $p < 0.001$; $\eta^2 = 0.070$
					Vitality	SVS	T3, T2 > T1	↑	F = 6.297; $p = 0.002$
							T2 vs. T1	↑	M = 4.37; $p < 0.05$
							T3 vs. T1	↑	M = 4.46; $p < 0.01$
							UR, UC, UL > CG	↑	F = 4.605; $p = 0.003$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome		Outcome	Effect *	Statistical Data
[71]	Luo et al.—2023	Walking Viewing	N/A	Light Sedentary	Positive and negative affect	PANAS POS		UR, UL, UC vs. CG	↑	F = 5.812; $p = 0.001$; $\eta^2 = 0.052$
								T3 vs. T1	↑	F = 21.686; $p < 0.001$; $\eta^2 = 0.063$
								Place × time	↑	F = 2.667; $p < 0.048$; $\eta^2 = 0.024$
						PANAS NES		T3 vs. T1	↓	F = 14.375; $p < 0.001$; $\eta^2 = 0.043$
								CG > UR, UL, UC	↓	F = 3.031; $p = 0.030$; $\eta^2 = 0.028$
								Place × time	↓	F = 4.876; $p < 0.002$; $\eta^2 = 0.044$
[72]	Massey et al.—2020	Swimming	N/A	Moderate	Mood	POMS	Tension-anxiety	swimmers at sessions 1, 4 and 10	↓	d = 1.6–2.2; $p < 0.001$
								swimmers for session 1 vs. 10	↓	d = 0.6; $p = 0.009$
								swimmers for session 4 vs. 10	↓	d = 0.6; $p = 0.008$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[72]	Massey et al.—2020	Swimming	N/A	Moderate	Mood	POMS	Tension-anxiety	control at sessions 1 and 4	↓	d = 0.2; p = 0.00. and d = 0.9; $p < 0.001$
								controls for session 1 vs. 10	↑	d = 1.1; $p < 0.001$
								control for session 4 vs. 10	↑	d = 0.07; $p < 0.001$
								swimmers vs. controls at sessions 1, 4 and 10	↓	d = 0.6–3.8 $p < 0.001$
							Depression	swimmers at sessions 1 and 10	↓	d = 0.6; p = 0.001 and d = 1.0; $p < 0.001$
								swimmers for session 1 vs. 10	↓	d = 0.5; p = 0.016
								swimmers for session 4 vs. 10	↓	d = 0.8; p = 0.001
								scores swimmers vs. controls at sessions 1, 4 and 10	↓	d = 0.2–1.6; p < 0.001–0.23

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[72]	Massey et al.—2020	Swimming	N/A	Moderate	Mood	POMS	Anger-hostility	swimmers at sessions 1, 4 and 10	↓	d = 0.4–0.6; $p < 0.001$
								swimmers for session 4 vs. 10	↓	d = 0.6; $p = 0.034$
								swimmers at sessions 1, 4 and 10	↓	d = 0.7; $p = 0.012$
								swimmers vs. controls at sessions 1, 4 and 10	↓	d = 0.3–0.6; $p < 0.001$–0.11
							Fatigue	control at sessions 1, 4 and 10	↓	d = 0.2; $p < 0.05$
								swimmers at sessions 1 and 10	↓	d = 1.3; $p < 0.001$
								swimmers for session 4 vs. 10	↓	d = 1.0; $p < 0.001$
							Confusion	swimmers at sessions 1, 4 and 10	↓	d = 0.6; $p < 0.001$
								swimmers for session 1 vs. 4	↓	d = 0.5; $p = 0.016$
								swimmers for session 1 vs. 10	↓	d = 0.9; $p < 0.001$
								swimmers vs. controls at sessions 1, 4 and 10	↓	d = 0.3–0.6; $p < 0.001$–0.21

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[72]	Massey et al.—2020	Swimming	N/A	Moderate	Mood	POMS	Esteem	swimmers at sessions 1, 4 and 10	↑	d = 0.6–1.4; $p < 0.001$
								swimmers vs. controls at sessions 1, 4 and 10	↑	d = 1.0–1.8; $p < 0.001$
							Vigor	swimmers at sessions 1 and 10	↑	d = 0.5; $p = 0.11$ and d = 0.7; $p < 0.001$
								swimmers vs. controls at sessions 1, 4 and 10	↑	d = 0.9–1.8; $p < 0.001$
							Total mood disturbance	swimmers at sessions 1, 4 and 10	↓	d = 1.1–1.7; $p < 0.001$
								swimmers for session 1 vs. 10	↓	d = 1.0–1.7; $p < 0.001$
								swimmers for session 4 vs. 10	↓	d = 0.8; $p < 0.001$
								swimmers vs. controls at sessions 1, 4 and 10	↓	d = 0.5–2.5; $p < 0.001$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[72]	Massey et al.—2020	Swimming	N/A	Moderate	Mental wellbeing	SWEMWBS	swimmers for session 1 vs. 10	↑	r = 0.75; $p < 0.001$
							swimmers for session 4 vs. 10	↑	r = 0.53; $p < 0.001$
							controls for session 1 vs. 10	↑	r = 0.43; $p < 0.019$
							post-scores swimmers vs. controls at session 10	↑	r = 0.23; $p < 0.034$
[73]	Rogers et al.—2013	Surfing	N/A	Moderate	Post-traumatic stress disorder symptomology	PCL-M	session 5 vs. session 1	↓	Median Δ = 18.18; $p < 0.0005$
							session 5 vs. session 1	↓	z = 2.633; $p = 0.0085$
							session 5 vs. session 1	↓	z = 2.571; $p = 0.0101$
							session 5 vs. session 1	↓	z = 2.263; $p = 0.0635$
					Depression	MDI	session 5 vs. session 1	↓	Median Δ = 11.31; $p < 0.028$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[74]	Vert et al.—2020	Walking	Vector magnitude	Light	Subjective well-being	2 items from UK's Office of National Statistics questionnaire			Non-significant effects
					Well-being	WHO-5	blue space vs. control (T3—scenario 1)	↑	IRR = 1.32 (95% CI: 1.25, 1.38); $p < 0.01$
							blue space vs. urban (T3—scenario 2)	↑	IRR = 1.34 (95% CI: 1.27, 1.40); $p < 0.01$
							for women compared to men (T3—scenario 1)	↑	IRR = 1.35 (1.27, 1.43); $p = 0.02$
							for non-healthy participants (T3—scenario 1)	↑	IRR = 1.62 (1.32, 1.99); $p < 0.05$
					Mood	POMS	Anger-hostility: blue space vs. control (T3—scenario 1)	↓	IRR = 0.51 (0.40, 0.66); $p < 0.05$
							urban vs. control (T3—scenario 1)	↓	IRR = 1.32 (1.09, 1.60); $p < 0.05$
							blue space vs. urban (T3—scenario 2)	↓	IRR = 0.36 (95% CI: 0.28, 0.47); $p < 0.01$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[74]	Vert et al.—2020	Walking	Vector magnitude	Light	Mood	POMS	Fatigue	blue space vs. control (T3—scenario 1)	↓	IRR = 0.55 (95% CI: 0.46, 0.66); $p < 0.01$
								blue space vs. urban (T3—scenario 2)	↓	IRR = 0.68 (95% CI: 0.56, 0.82); $p < 0.01$
							Vigor	blue space vs. control (T3—scenario 1)	↑	IRR = 1.08 (95% CI: 1.06, 1.11); $p = 0.02$
								blue space vs. urban (T3—scenario 2)	↑	IRR = 1.07 (95% CI: 1.04, 1.09); $p = 0.02$
							Total mood disturbance	blue space vs. control (T3—scenario 1)	↓	IRR = 0.94 (95% CI: 0.92, 0.96); $p < 0.01$
								blue space vs. urban (T3—scenario 2)	↓	IRR = 0.97 (95% CI: 0.95, 0.99); $p < 0.01$
					Vitality and mental health	SF-36 Health Survey Manual	Vitality	blue space vs. control (T3—scenario 1)	↑	IRR = 1.08 (1.06, 1.11); $p = 0.02$
							Mental Health	blue space vs. urban (T3—scenario 2)	↑	IRR = 1.08 (1.05, 1.10); $p = 0.04$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[74]	Vert et al.—2020	Walking	Vector magnitude	Light	Vitality and mental health	SF-36 Health Survey Manual	Vitality	blue space vs. control (T3—scenario 1)	↑	IRR = 1.07 (1.04, 1.09); $p = 0.02$
							Mental Health	blue space vs. urban (T3—scenario 2)	↑	IRR = 1.05 (1.03, 1.08); $p = 0.04$
					Life satisfaction	1 item from UK's Office of National Statistics questionnaire	N/A			
					Eudaimonic well-being	Self-reported question	N/A			
						Somatization	Four-Dimensional Symptom Questionnaire		N/A	
						Sleep characteristics	Pittsburg Sleep Quality Index		N/A	
						General heath	Physical and Mental Health Summary Scale		N/A	
						Physiological measurements (blood pressure, pulse rate, heart rate variability)	Monitor and Wearable Monitoring Device		N/A	

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[75]	de Freitas et al.—2024	Beach tennis	%HRmax	Vigorous	Anxiety	STAI	session effect for women	↓	F(2, 20) = 3.377, p = 0.054, ω2 = 0.019
							time effect for women	↓	F(1, 10) = 11.706, p = 0.007, ω2 = 0.054
							Time × session effect for women	↓	F(2, 20) = 9.059, p = 0.002, ω2 = 0.034
							post- vs. pre- single session for women	↓	d = −0.744; p = 0.0007
							post- vs. pre- double session for women	↓	d = −0.720; p = 0.010
							post- vs. pre- control session for women	↓	d = 0.051; p = 1.000
							single vs. control session for women	↓	d = 0.777; p = 0.0002
							session effect for men	↑	F(2, 20) = 0.515, p = 0.605, ω2 < 0.001,
							time effect for men	↑	F(1, 10) = 1.874, p = 0.201, ω2 = 0.013
							time × session effect for men	↑	F(2, 20) = 0.446, p = 0.646, ω2 < 0.001
							post- vs. pre- single session for men	↑	d = 0.456; p = 1.000

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[75]	de Freitas et al.—2024	Beach tennis	%HRmax	Vigorous	Anxiety	STAI	post- vs. pre- double session for men	↑	d = 0.175; $p = 1.000$
							post- vs. pre- control session for men	↑	d = 0.233; $p = 1.000$
							time points × interventions for women		X2(5) = 29.065; $p < 0.001$; Kendall's W = 0.528
							post double session vs. post-control for women	↑	$p < 0.001$
							pre-control session vs. post-control for women	↑	$p < 0.001$
							post single session vs. post-control for women	↑	$p < 0.001$
					Affective Response	Affective Valence Scale	time points × intervention for men		X2(5) = 16.328; $p < 0.006$; Kendall's W = 0.297
							post single session vs. post-control for men		M = 5.0; $p = 0.016$
							post-double session vs. post-control for men		M = 5.0; $p = 0.028$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[75]	de Freitas et al.—2024	Beach tennis	%HRmax	Vigorous	Affective Response	Affective Valence Scale	double vs. single sessions for women	↑	Δ = −1.36; 95% CI, −5.32; 2.60; t(10) = −0.766; p = 0.461; d = −0.23 (95% CI −0.82; 0.37)
							double vs. single sessions for men	↑	Δ = −2.09; 95% CI, −5.41; 1.23; t(10) = −1.401; p = 0.191; d = 0.165 (95%CI, −1.03; 0.20)
					General Health		N/A		
[76]	Shin et al.—2022	Meditation Stabilization exercise	N/A	Moderate	Depression	K-HDRS	pi scores vs. pre-scores in marine therapy group	↓	M = 11.00; p = 0.018
							pi scores vs. pre-scores in control group	↓	M = 12.20; p = 0.042
							follow-up scores vs. pre-scores in marine therapy group	↓	M = 11.89; $p < 0.05$
							follow-up scores vs. pre-scores in control group	↓	M = 13.00; $p < 0.05$
							time interaction	↓	F = 13.312, η^2 = 0.44; $p < 0.05$
							between-group interaction	↓	F = 0.781, η^2 = 0.04; p = 0.389
							time × group interaction	↓	F = 0.131, η^2 = 0.01; p = 0.877

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[76]	Shin et al.—2022	Meditation Stabilization exercise	N/A	Moderate	Pain intensity	100 mm-Visual Analog Scale	N/A		
					Pain pressure threshold	Digital Algometer	N/A		
					Tactile spatial acuity	Esthesiometer	N/A		
					Muscle characteristics	Handheld myotonometer	N/A		
					Muscle strength	Digital dynamometer	N/A		
					Dynamic balance	Time Up and Go	N/A		
					Pain intensity		N/A		
[77]	Marchand et al.—2018	Sailing	N/A	Moderate	Anxiety	SSTA-6	post-sailing vs. pre-sailing	↓	M = 37.0; p = 0.144
					Positive and negative affect	PANAS POS	post-sailing vs. pre-sailing	↑	M = 32.3; p = 0.351
						PANAS NES	post-sailing vs. pre-sailing	↓	M = 15.6; p = 0.605
					Psychological inflexibility	Acceptance and Action Questionnaire–II	post-sailing vs. pre-sailing	↑	M = 35.5; p = 0.036
					Mindfulness	Five Facet Mindfulness Questionnaire	post-sailing vs. pre-sailing	↑	M = 108.4; p = 0.580
					Subjective experience of sailing	Self-reported survey	N/A		

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[77]	Marchand et al.—2018	Sailing	N/A	Moderate	Residential SUD treatment program	Successful completion of the residential SUD treatment program	Number of psychiatric hospitalizations within the 12 months following program completion	intervention group vs. control group		X2 = 5.34; DF = 1; r = 0.35; p = 0.02
							Readmission to the residential SUD program within 12 months of program completion			
[78]	Burlingham et al.—2022	Stretching, jogging or walking	N/A	Vigorous	Depression	PHQ-9		baseline vs. post-course	↓	d = 1.4 (95% CI: −10.0, −5.7)
		Running/ Walking into the water						baseline vs. 3-month follow-up	↓	d = 1.2 (95% CI: −9.1, −2.8)
		Body surfing						post-course vs. 3-month follow-up	↑	d = 0.2 (95% CI: —1.1, 4.9)

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[78]	Burlingham et al.—2022	Swimming	N/A		Anxiety	GAD-7		baseline- vs. post-course	↓	d = 1.7 (95% CI: −8.8, −5.5)
								baseline vs. 3-month follow-up	↓	d = 1.4 (95% CI: −9.0, −4.2)
								post-course vs. 3-month follow-up	↑	d = 0.1 (95% CI: −1.8, 2.9)
					Functioning	WAS		baseline- vs. post-course	↓	d = 1.1 (95% CI: −11.8, 5.5)
								baseline vs. 3-month follow-up	↓	d = 0.8 (95% CI: −11.2, 0.0)
								post-course vs. 3-month follow-up	↑	d = 0.1 (95% CI: −2.5, 8.5)
						Participants experiences	Diary		N/A	
[79]	Carreño et al.—2023	Seaside walking	Smartwatches	Moderate	Mental Health	POMS Smartwatches	Fatigue	control vs. walking	↑	Rate = 1.21 (95%CI: 0.74–1.97); $p = 0.03$
								walking vs. swimmers	↓	Rate = 0.87 (95%CI: 0.53–1.41); $p = 0.01$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome		Effect *	Statistical Data
[79]	Carreño et al.—2023	Swimming	Smartwatches	Moderate	Mental Health	POMS Smartwatches	Fatigue	walking vs. snorkeling	↓	Rate = 0.85 (95%CI: 0.52–1.38); $p = 0.01$
		Snorkeling Sitting		Moderate Sedentary			Tension-anxiety	control vs. swimming	↓	Rate = 0.60 (95%CI: 0.49–0.74); $p = 0.02$
								control vs. snorkeling	↓	Rate = 0.60 (95%CI: 0.48–0.74); $p = 0.02$
							Anger-hostility	control vs. swimming	↓	Rate = 0.53 (95%CI: 0.40–0.70); $p = 0.03$
								walking vs. swimming	↓	Rate = 0.53 (95%CI: 0.40–0.70); $p = 0.03$
							Vigor	control vs. snorkeling	↑	Rate = 1.11 (95%CI: 0.99–1.25); $p = 0.04$
							Physiological measures (HR, quality of sleep)		N/A	

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[80]	Maund et al.—2019	Walking and bird watching Walking and canoeing	Light		Mental wellbeing	WEMWBS	post- vs. pre- intervention	↑	M = 41; $p = 0.009$
					Stress	PSS	post- vs. pre- intervention	↓	M = 10.28; $p = 0.002$
			Moderate		Anxiety	GAD-7	post- vs. pre- intervention	↓	M = 22.35; $p = 0.041$
					Positive and negative affect	PANAS POS	post- vs. pre- intervention	↑	M = 30.57; $p = 0.012$
						PANAS NES	post- vs. pre- intervention	↓	M = 27.71; $p = 0.025$
[81]	Hignett et al.—2017	Surfing	N/A	Moderate	Well-being	BPHS-Y	T2 vs. T1 for satisfaction with appearance	↑	t(35) = 2.17; $p = 0.037$
							T2 vs. T1 for satisfaction with friendship	↑	t(35) = 1.83; $p = 0.076$
							T2 vs. T, for satisfaction with schoolwork, school or life	↑	all t's < 1.235; all p's > 0.225
					Connectedness	Adapted version of Inclusion of Nature in the Self Scale	T2 vs. T1 for connectedness towards school	↑	t(35) = 2.39; $p = 0.023$
							T2 vs. T1 for connectedness towards friendship	↑	t(35) = 1.72; $p = 0.095$
							T2 vs. T1 for connectedness towards family, nature, local community, beach, the world	↑	(all t's all t's < 1.582; all p's > 0.122)

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[81]	Hignett et al.—2017	Surfing	N/A	Moderate	Physiological measures (heart rate, blood pressure)	Pressure Monitor	N/A		
					Mood and attitudes towards surfing	Interview	N/A		
						Parent–Child Interaction System	N/A		
					Environmental knowledge	Interview	N/A		
					Global program evaluation	Interview	N/A		
					Teacher observations	Social and Emotional Aspects of Learning	N/A		
[82]	Triguero-Mas et al.—2017	Non-specified	Smartwatch application	Light	Mood	TMD	T7 vs. T5	↓	Coef = −4.53 (95% CI: −7.57, −1.49); $p < 0.01$
							restoration (ROS) as mediator	↓	Coef = −4.13 (95% CI: −7.24, −1.03); $p = 0.01$
							% time of vigorous PA for TMD	↓	Coef = −1.19 (95% CI: −1.50, −0.89); $p < 0.01$

Table 2. *Cont.*

Numerical Citation	Author and Year	PA Type	Tool to Estimate PA	Intensity of PA	Outcome Measured	Tool to Estimate Outcome	Outcome	Effect *	Statistical Data
[82]	Triguero-Mas et al.—2017	Non-specified	Smartwatch application	Light	Mood	TMD	% time of vigorous PA as mediator of BS-TMD	↓	Coef = 1.31 (95% CI: −1.64, 4.25); $p = 0.39$
					Attention capacity	BDSP	T7 vs. T5		Coef = 0.19 (95% CI: −0.39, 0.77); $p < 0.05$
					Stress	Salivary cortisol	T7 vs. T5		Coef = −0.12 (95% CI: −0.25, 0.01); $p = 0.06$

* ↓: negative effect, ↑: positive effect.

3.3.2. Measurement Tools for Psychological Outcomes and Physical Activity

The reviewed studies used a variety of validated tools to measure psychological outcomes (Table 2). The Profile of Mood States (POMS) was widely used to measure mood disturbances or mental health [64,69,72,74,79,82], while the WHO-5 Well-Being Index [74], the Warwick–Edinburgh Mental Well-being Scale (WEMWBS) [66,72,80], items from the British Panel Household Survey (BPHS-Y) [81], and the Mental Component Summary (MCS) [65] provided broader assessments of psychological well-being. Cognitive or perceived restoration were assessed using the Restorative Outcome Scale (ROS) [71], the Perceived Restorativeness Scale (PRS) and General Restorative Subscale (GRS) [70], the Short Version of Revised Restoration Scale (SRRS) [40] and the Restorative Components Scale (RCS) [69]. Vitality was measured by [71] with the Subjective Vitality Scale (SVS) and [74] with the SF-36 Health Survey Manual.

Other emotional benefits, such as positive and negative feelings, life satisfaction, and sub-clinical depression and anxiety, were explored by employing the Positive and Negative Affect (PANAS) [71,77,80] or the Affective Valence Scale [75], the UK's Office of National Statistics Questionnaire [74], the Major Depression Inventory (MDI) [73], the Beck Depression Inventory (BDI), the Hamilton Depression Rating Scale (K-HDRS), the Beck Anxiety Inventory (BAI) [66–68], the Patient Health Questionnaire (PHQ-9) [78], the Generalized Anxiety Disorder Assessment (GAD-7) [78,80], the Perceived Stress Scale (PSS) [68,80] and the Spielberger State-Trait Anxiety Inventory (SSTA-6) [75,77]. Additional constructs that were explored refer to spirituality measured by the Spirituality Assessment Scale (SAS) [67], functioning measured by the Work and Social Adjustment Scale (WAS) [78], coherence (Coherence Subscale) [70], mindfulness (Five Facet Mindfulness Questionnaire (FFMQ)) and psychological inflexibility (Acceptance and Action Questionnaire–II (AAQII)) [77]. For evaluating post-traumatic stress disorder symptomology, [73] employed the Post Traumatic Stress Disorder Checklist Military Version (PCL-M). Enjoyment, connectedness and attention capacity were measured with the Physical Activity Enjoyment Scale (PACES), an adapted version of the Inclusion of Nature in the Self Scale and the Backwards Digit-Span Task (BDSP) [75,81,82].

Collectively, these tools assess a broad spectrum of psychological responses, ranging from instruments evaluating momentary affect (POMS, PANAS, Affective Valence Scale) to broader indicators of well-being, mindfulness and vitality, (WHO-5, SWEMWBS, FFMQ, SF-36, SVS, BPHS-Y), cognitive restoration (ROS, RCS, PRS, GRS, SRRS), and subclinical symptoms (BDI, BAI, PHQ-9, GAD-7, SSTA-6, MDI, PCL-M, K-HDRS, PSS). This diversity suggests that BS PA influences multiple dimensions of psychological functioning. At the same time, the predominance of short-term measures indicates that the observed effects should be interpreted as acute, context-dependent improvements [74]. On the other hand, theoretical assumptions embedded in restoration-focused tools and differences in timescales across instruments limit direct comparability between studies [23]. Consequently, while the evidence supports multi-dimensional psychological benefits of PA in blue environments, caution is warranted when generalizing these findings to long-term mental health or clinical populations [83].

Across the included studies, only a small number directly quantified PA intensity during BS exposure. Two studies employed standardized methods to assess PA intensity, while several additional studies collected PA-related data primarily to characterize participants rather than to examine intensity as an exposure variable. Ref. [82] quantified PA intensity using a smartphone application that integrates accelerometer data to estimate activity levels expressed in METs. The system provided environment-specific estimates of activity, including median MET values for each exposure condition. In addition, the application quantified the median percentage of time participants spent in sedentary, light,

moderate, and vigorous activity categories during each exposure period. Ref. [75] assessed PA intensity using heart rate monitoring during beach tennis sessions. Exercise intensity was classified according to the percentage of maximal heart rate (%HRmax).

Several studies employed tools capable of capturing PA metrics, although these measurements were not used to directly identify PA intensity in relation to BS activities. Ref. [79] used smartwatches to collect activity-related data during intervention sessions, including heart rate and session characteristics, but these measurements were primarily used for physiological monitoring and participant characterization rather than intensity classification. Ref. [68] assessed PA using the Baecke Physical Activity Questionnaire (BPAQ), generating an activity index reflecting participants' general PA levels across work, sport, and leisure domains. Recreational fishing engagement was determined separately through fishing effort (hours per month over the previous three months), but this index was included as a baseline participant measurement. Other proxies include self-reported activity logs [65,66], accelerometers [74], or indirect physiological indicators [69], but as in previous cases, these metrics were used for providing a detailed background on the sample population. The rest of the studies did not measure PA intensity directly. To cover this gap, we categorized activities based on their MET values using the 2024 Compendium of Physical Activities [60], and the context provided by the reviewed papers in terms of activity or intervention description, environmental conditions and participants' characteristics. Across the included studies, BS PA encompassed a heterogeneous range of recreational and lifestyle activities. Most interventions matched with moderate intensity METs related to surfing [67,73,81], snorkeling [65,79], swimming [65,79], sailing [77], meditation and stabilization exercise [76] and rafting [70]. Angling scored rates within the range of light intensity [66,68]. However, intensity levels of the same type of activity varied depending on the context: walking was generally classified as light intensity [69,71,74] but rated as moderate in the field experiment of Ref. [40] and the pilot study of Ref. [79].

Similarly, swimming was identified as moderate in Refs. [65,79], but almost reached vigorous levels in Ref. [72]. Scuba diving and beach tennis were evaluated as vigorous intensity PA [64,75]. In Ref. [78], a more complex intervention was employed, combining multiple PA (e.g., warm-up, paddling, wave riding, swimming, or resting phases) reflecting complex exposure profiles. A similar approach was followed in [80], as participants were engaged in walking, bird watching and canoeing, indicating light intensity levels. In Ref. [82], the mean MET value (METmean = 2.8) indicated a light intensity exposure, even though the study did not provide details of the engagement. Sedentary activities ranged from passive viewing to sitting in control rooms or experimental sites [69,71,72,74,79]. Overall, the classification highlights substantial variability in both activity type and intensity, with most studies emphasizing recreational, non-competitive, and guided PA rather than structured exercise training paradigms.

3.3.3. Relationship Between Physical Activity and Psychological Outcomes

Findings from this analysis support the positive impact of BS exposure for psychological well-being, with PA often amplifying these benefits. For instance, Ref. [64] found that scuba diving—which involves full water immersion and physical and mental focus—was linked to reductions in Total Mood Disturbance (TMD) scores (R = 93.2, $p < 0.05$) and the POMS subscales of anger-hostility (R = 0.6, $p < 0.05$), fatigue (R = 2.0, $p < 0.05$) and depression (R = 0.4, $p < 0.05$). Both diving experiences (group A and B) yielded similar benefits despite the differences in environmental respect protocols they followed. On the other hand, beach activities, which were less physically demanding, had no statistically significant effect. Also, Ref. [79] compared three sea-based activities (walking alongside the beach, swimming and snorkeling) and observed that those demanding contact with water had a

greater positive impact than seaside walking. Swimming and/or snorkeling stood out as the most advantageous activities for mental health, providing significant improvements in fatigue (walking vs. swimming: $p = 0.01$, walking vs. snorkeling: $p = 0.01$), tension-anxiety (control vs. swimming: $p = 0.02$, control vs. snorkeling: $p = 0.02$), anger-hostility (control vs. swimming: $p = 0.03$, walking vs. swimming: $p = 0.03$) and vigor (control vs. snorkeling, $p = 0.04$).

Recreational swimming or snorkeling for 1–3 days per week was associated with higher mental well-being scores [65] (F = 5.58, η2 = 0,04, $p < 0.0042$), although more frequent participation offered a limited additional advantage, suggesting a dose–response relationship. Furthermore, Ref. [72] who examined the psychological effects of a 10-week swimming program documented declining trends in negative mood states of novice swimmers and an increase in vigor and esteem scores. At the same time, a large effect was observed in TMD (d = 1.1–1.7, $p < 0.001$). These responses were sustained over time as shown by the comparisons between the swimming sessions of weeks 1, 4 and 10 (Table 2). Also, between-group comparisons demonstrated better overall mood and well-being. Surprisingly, the control group experienced some healing effects too, as shown by the shifts in two POMS subscales (tension-anxiety: $p < 0.001$, fatigue: $p < 0.05$) and SWEMWBS of week 10 in relevance with week 1 (d = 0.02, $p = 0.019$). Thus, this study provides evidence that swimming enhances mood and well-being, but since limited results were found in the control group as well, the improvements cannot be attributed to exercise alone.

Complementary evidence to this observation offers [70] who showed that white rafting, regardless of the level of risk, elicited perceived restorativeness ($p < 0.01$), coherence ($p < 0.01$) and general restoration ($p < 0.01$), underscoring the beneficial effects of aquatic experiences. Similarly, [40] proved that walking at a moderate pace for 15 min enhances perceived restoration in both coastal (β = 0.616; $p < 0.01$) and urban environments (β = 0.355; $p = 0.03$). Reductions in depression symptoms were offered by the meditation and stabilization sessions of caregivers, regardless of the setting they were performed (blue: M = 11.00; $p = 0.018$ and urban: M = 12.20; $p = 0.042$) [76].

Surf-based and sailing interventions yielded more mixed effects. Surfing was associated with reductions in depressive ($p < 0.01$) and anxiety symptoms ($p < 0.01$) in Ref. [67], and with reductions in PTSD symptomatology (MedianΔ = 18.18; $p < 0.0005$) in military veterans in Ref. [73], whereas recreational sailing showed modest or non-significant changes in anxiety and affective outcomes but improvements in psychological flexibility (M = 35.5; $p = 0.036$) and treatment related indicators in individuals with substance use disorders (X2 = 5.34; DF = 1; r = 0.35; $p = 0.02$). Refs. [77,78] reported that a multicomponent surf therapy program combining stretching, water-based walking or running, body surfing and swimming produced short-term reductions in depression (d = 1.4 (95% CI: −10.0, −5.7)), anxiety (d = 1.7 (95% CI: −8.8, −5.5)) and functional impairment (d = 1.1 (95% CI: −11.8, −5.5)), although partial attenuation of effects was observed at three-month follow-up. Reference [81] identified limited effects of a surfing intervention on adolescents' well-being (satisfaction with appearance: t(35) = 2.17; $p = 0.037$, connectedness towards school: t(35) = 2.39; $p = 0.023$). Mixed results were observed for the land-based vigorous activity of beach tennis, which produced stress-alleviating effects for women only, significant affective responses for both groups (females and males), but no significant changes in levels of enjoyment [75].

Outcomes for activities described as light intensity varied as well. Ref. [69] proved that walking in BS was beneficial for tension anxiety, esteem, fatigue, vigor and overall restoration. Frequent angling in Ref. [66] was associated with better well-being (β = −0.507, $p < 0.01$) and lower levels of depression (β = 0.881, $p < 0.01$) and anxiety (β = 0.556, $p < 0.01$). However, higher fishing effort in [68] managed to reduce perceived stress (Coef = −0.0156

(95% CI: −0.003, −0.029; $p < 0.05$)), but not depression (Coef = −0.0051(95% CI: −1.0140, −0.0038; $p > 0.05$)) and longer angling sessions in Ref. [66] increased anxiety ($p = 0.028$). In Ref. [71] both passive viewing and walking enhanced restoration (F = 18.695; $p < 0.001$) and vitality (F = 6.297; $p = 0.002$) without significant differences between the two groups. Walking maintained statistically significant scores for positive and negative mood states, as indicated by PANAS POS (F = 21.686; $p < 0.001$) and PANAS NEG (F = 14.375; $p < 0.001$) [71]. These results, when combined with the ones referring to the different experimental sites (urban lake, urban river, urban canal, and control site), support the idea of the "natural health dose", e.g., the cumulative benefits of repeated exposure to restorative environments, analogous to the "mental health dose" concept in exercise science [84].

In the same context, a 20 min walking intervention improved well-being, mood and vitality when compared to a rest site [74] and a structured six week program of walking in wetlands, bird watching and canoeing delivered positive outcomes for a variety of scales such as well-being (M = 41; $p = 0.009$), stress (M = 10.28; $p = 0.002$), anxiety (M = 22.35; $p = 0.041$) and affect (PANAS POS: M = 30.57; $p = 0.012$, PANA NEG: M = 27.71; $p = 0.025$). Nonetheless, the fact that no significant relationships were found for PA levels assessed with vector magnitude—a measurement to quantify movement intensity—indicates that positive effects were not due to movement, but due to the BS environments as well. A complex light to moderate intensity program including walking, bird watching and canoeing improved all psychological outcomes (well-being: $p = 0.090$, stress: $p = 0.002$, anxiety: $p < 0.041$, affect $p < 0.05$). Finally, Ref. [82] demonstrated that BS exposure was associated with improvements in mood ($p < 0.01$) and attentional capacity ($p < 0.05$), with self-perceived restoration experience mediating the relationship between BS exposure and mood ($p = 0.01$). Although stress was also assessed using salivary cortisol, no significant effects were observed. Furthermore, while overall vigorous PA was significantly associated with mood, it did not explain the relationship between BS exposure and mood outcomes.

4. Discussion

The present review examined the relationship between PA intensity, BS and mental health outcomes. Overall, the findings indicate a positive association between PA engagement in blue environments and psychological well-being, with most studies reporting improvements in mental health and well-being, or reductions in negative psychological measurements. This tendency toward beneficial outcomes aligns with the broader literature highlighting the positive mental health effects of exposure to natural environments, including aquatic settings.

Nevertheless, our analysis did not reveal a clear relationship between PA intensity and mental health outcomes, even among studies employing objective measures of PA intensity. For instance, Ref. [82] quantified PA intensity using accelerometer-derived data expressed in METs and time spent across different intensity categories. Although improvements in mood were observed following BS exposure, PA intensity did not appear to mediate these effects. Similarly, Ref. [75] classified exercise intensity based on percentages of %HRmax during beach tennis sessions. Their findings indicated reductions in anxiety among women, but not among men, while affective responses showed improvements in both groups.

Interestingly, several studies suggest that light intensity activities may be associated with beneficial affective and restorative outcomes, including improvements in mood, positive affect, perceived restorativeness, and broader indicators of mental health and well-being [66,69,71,74,82], instead of sub-clinical indicators like anxiety, stress and depression [66,68,82]. Still, given the mixed methodological rigor or the reviewed studies and the absence of direct measurements for PA intensity, this possible association should be

viewed as suggestive and be further examined in future research to understand if light PA intensity in BS interacts better with these mental health outcomes.

Focusing on studies examining moderate intensity activities, we see that they produce variable results. Refs. [40,65,79,80] yielded immediate benefits in mental health, well-being, mood, depression, anxiety and perceived stress, while Ref. [70] showed that positive effects could be sustained over time. On the other hand, Ref. [67] did not identify significant relationships for all measured outcomes, particularly spirituality, Ref. [77] did not observe a clear association between the sailing program and anxiety or affective outcomes, and in Ref. [81], even though the well-being effects of a surfing program in students facing school exclusion were examined, benefits could be observed solely for the index of self-appearance. Additionally, Ref. [76] observed a decrease in self-reported depression levels both in the marine and urban group undertaking the meditation and stabilization sessions. Likewise, Ref. [64] found that vigorous PA (scuba diving) resulted in better mental health than general on-shore recreation, but Ref. [78] reported non-significant effects on depression, anxiety, and functioning when comparing three-month follow-up measures with post-swimming session levels. We should also take into consideration that PA did not account for all effects. Meaningful psychological benefits were documented even when participants were sedentary—e.g., viewing a BS setting or the training swimming program—which in turn implies that other pathways influence this association as well.

One possible explanation for the absence of a clear intensity outcome pattern relates to the fact that most studies did not primarily aim to examine the role of PA intensity. Instead, most papers focused on the broader experience of interacting with blue environments through recreational activities such as swimming, surfing, walking along the shoreline or participation in structured BS programs [64,67,70,78]. As a result, PA intensity was rarely measured directly and could only be inferred from activity descriptions. To facilitate the comparison across studies, the present review classified activity intensity using MET values derived from the 2024 Compendium of Physical Activities. While this approach enabled a categorization of activity intensity, it may not fully capture the actual exertion experienced by participants. Energy expenditure during BS activities can vary considerably depending on environmental conditions (e.g., waves, currents, terrain), individual fitness levels, and the duration or context in which the activity is performed. Consequently, this approach should be interpreted with caution when examining potential relationships between PA intensity and mental health outcomes.

Additionally, there are multiple pathways influencing the relationship between BS and overall well-being, with the most prominent examples referring to neurobiological functions, social interaction, cultural attachment, and restorative attributes of natural environments. PA, in general, facilitates the release of endorphins, serotonin, dopamine, and brain-derived neurotrophic factor, promoting neuroplasticity and emotional resilience [85,86]. Exercise also exerts anti-inflammatory effects, which can regulate mood states and contribute to positive behavioral outcomes, including improvements in sleep quality and daily routine [83]. Alternative factors that might have worked are social interaction [87] and collective experiences [35,88,89] or cultural and psychological attachment to water elements [90–96]. In some regions, water-based activities are deeply embedded in local traditions, influencing perceptions of safety, relaxation, and connectedness to nature [97–103]. So, in cases that water-based activities are embedded in everyday routines or community customs, participants may perceive water as familiar, safe, and emotionally meaningful [97–102]. This could explain why certain populations experience stronger psychological benefits from BS exercise compared to others. Finally, restorative environmental attributes interact with PA to enhance outcomes. The application of the attention restoration theory (ART) suggests that natural environments, particularly BS, replenish depleted

attentional resources through effortless fascination [104], whereas stress recovery theory (STR) indicates that exposure to natural elements reduces physiological stress responses, including cortisol levels and autonomic regulation [105]. Together, these mechanisms provide a comprehensive understanding of how PA in BS can enhance mental well-being across different intensity levels.

In respect to BS, the studies included in this review covered a range of aquatic environments, although a clear emphasis was placed on coastal and marine settings. Activities conducted in open sea or coastal environments were frequently associated with improvements in mood, well-being, or psychological functioning [64,67,72,73,78]. These improvements could also be influenced by additional moderators discussed in the BS–mental health literature, such as individual tolerance to water immersion, environmental conditions, or levels of psychological arousal associated with aquatic exposure [46]. Furthermore, coastal walking environments produced beneficial effects in vitality, mood, and perceived restoration [40,74], suggesting that sensory exposure to shoreline dynamics—including wave sounds, rhythmic water movement, open views, and the presence of blue–green elements—may contribute to cognitive recovery and nature connectedness [39,40,106].

Inland BS, such as rivers, canals, lakes, or wetlands, were less represented in the analyzed literature, although several studies still reported restorative benefits in these environments [69–71,77,80]. Notably, in some cases, these benefits were observed even under low-intensity PA or sedentary conditions, indicating that the psychological effects may be influenced by environmental exposure itself rather than the activity performed [69–71]. Therefore, while all BS types in our review were linked to positive mental health outcomes, they appear to operate through qualitatively distinct mechanisms that need to be taken into consideration collectively in future studies.

Taken all together, the reviewed studies provide limited direct evidence on the pathways promoting well-being following a BS exposure and PA. Except for Ref. [82] none directly tested neurobiological mechanisms as mediators, nor did they incorporate physiological biomarkers or neural measures that could create biological pathways. Evidence for social interaction also remained limited; for instance, Ref. [78] identified the feeling of community belonging as a possible pathway solely through the participants' notes on the sailing experience, and Ref. [81] reported improvements in participants' perceived connectedness toward school following the surfing program. Qualitative accounts from the same intervention also suggested that participants experienced increased social bonding and camaraderie while learning to surf, highlighting the potential role of group dynamics in shaping well-being outcomes. Similarly, focus group interviews in Ref. [80] revealed that participants perceived reduced feelings of social isolation and valued the opportunity to interact with others in a supportive group environment.

On the other hand, although the swimming programs and diving protocols were conducted in group settings, psychological outcomes were analyzed at the individual level and social connectedness was not modeled as a contributing mechanism. Likewise, the opportunity for learning new skills afforded by BS was suggested by Refs. [77,78,81] only through qualitative findings. Cultural attachment to water was also absent as a measured construct, even though angling participation [56] and habitual sea engagement [55] could hypothetically reflect cultural or identity-driven interaction with BS, this was neither operationalized nor statistically examined.

In contrast, restorative environmental attributes, consistent with ART/SRT, appeared more clearly embedded. Studies measuring restoration, affective results, vitality, "being away" or fascination [60,107] align conceptually with ART-based attentional recovery, whereas reductions in tension-anxiety, fatigue, or TMD in swimmers and divers are compatible with SRT-based stress-reduction pathways [55,57,58,108]. Findings derived from

interviews further support this interpretation, with participants describing aquatic environments as calming, peaceful, and providing an "escape" from everyday stressors [80], experiences that closely reflect the restorative constructs proposed within ART and SRT. Therefore, among the mediators examined, restorative mechanisms are the only pathway that emerges, while neurobiological, social, and cultural mediators remain theoretically plausible yet empirically untested within this evidence base.

The discussion about PA and natural environments has practical implications for the design and management of BS in cities. Urban planners can maximize population-level mental health benefits by prioritizing features that reliably facilitate light intensity engagement—such as well-connected walking paths, shaded seating, and accessible waterfront viewpoints—while also accommodating infrastructure for more demanding activities. At the same time, infrastructure for more vigorous activities, including uninterrupted running and cycling routes, swimming zones, or kayaking areas, can support a wider range of users and provide additional opportunities for mental and physical stimulation, even if the specific psychological responses vary across individuals and contexts [109]. Complementary features, including safe access points, clear signage, and accessibility improvements, further strengthen the capacity of BS to deliver mental health benefits across user groups [110]. Importantly, integrating BS with surrounding green infrastructure—through measures such as riparian vegetation, shade provision, biodiversity corridors, and stormwater management—helps build environmental resilience and reinforces the restorative potential of these spaces [111–113]. Integrating these considerations fosters inclusive, adaptable, and resilient urban design that promotes sustainable mental health benefits.

5. Strengths and Limitations

To the best of our knowledge, this is the first narrative review examining how the intensity of PA influences the psychological benefits derived from BS exposure. In contrast to earlier reviews that broadly describe activity types without standardization, this review categorized activities using MET values to enable a structured indication of intensity patterns. We recognize that intensity classifications are approximate estimates, yet in the absence of validated assessment tools, they provided an organized way to examine how PA intensity may shape psychological outcomes in BS interventions. Third, the review extends beyond documenting mental health outcomes to offer policy-relevant recommendations grounded in urban public health, environmental equity, and behavioral inclusion. Finally, it highlights conceptual and methodological gaps in existing studies, such as the conflation of environmental and PA effects, thereby charting a clear agenda for future empirical work.

However, this review comes with some limitations as well. Firstly, the included studies come with wide heterogeneity in study designs, which limits our ability to conduct a more conclusive analysis and draw stronger, generalizable conclusions. Secondly, although the intensity-oriented categorization offers added structure, the MET values assigned in this review represent approximate estimates of typical intensity for the reported intervention content. These estimates do not reflect session-level exertion or intervention dose, as such parameters were not reported in all studies. Therefore, caution is warranted when interpreting the intensity classifications in relation to actual participant effort. The scope of the review is confined to BS: expanding future work to include wilderness or remote blue environments could enable more meaningful comparison between urban and non-urban settings and help identify setting-specific moderators (e.g., sensory immersion, perceived safety, accessibility, cultural symbolism). In addition, we followed a narrative approach rather than a meta-analysis, which limits the ability to quantify the overall effect size of PA in BS. As a result, comparisons across studies remain descriptive rather than statistically synthesized.

6. Conclusions

The studies reviewed confirm that PA in BS improves psychological well-being, reduces stress, enhances mood, and increases vigor. Light intensity activities produce predictable benefits for affective and restorative outcomes, whereas moderate to high-intensity activities produce variable results, influenced by environment, context, and population characteristics. Urban planners should consider inclusive designs accommodating a spectrum of activity intensities, with attention to environmental safety, accessibility, and multisensory engagement.

To better support policy and practice, future research should aim to refine methodologies and expand the scope of investigations regarding PA in BS. Objective measures of exercise intensity should be incorporated, such as accelerometers, heart rate monitors, or VO2 max assessments, to overcome the limitations of self-reported activity levels. Comparative analyses of PA intensities would help determine if psychological outcomes differentiate based on exercise volume. This approach would shed light on how ART functions in the context of BS activities, given that the theory is well investigated in low-intensity activities, but it remains unclear how it extends to high-intensity or group-based water sports. Longitudinal studies are needed to assess whether the psychological benefits of BS PA persist over time, as most existing research captures only short-term effects. Understanding these interactions more deeply could pave the way for more effective and evidence-based interventions for mental well-being.

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Abbreviations

The following abbreviations are used in this manuscript:

BS	Blue spaces
PA	Physical activity
GS	Green spaces
EPHPP	Effective Public Health Practice Project
MET	Metabolic Equivalent of Task
POMS	Profile of Mood States
WEMEBS	Warwick-Edinburg Mental Health Well-being Scale
BPHS-Y	British Panel Household Survey
SWEMEBS	Short Warwick-Edinburg Mental Health Well-being Scale
MCS	Mental Component Summary
ROS	Restoration Outcome Scale
PRS	Perceived Restorativeness Scale
GRS	General Restorative Subscale
SRRS	Shor Version of Revised Restoration Scale
RCS	Restoration Component Scale
SVS	Subjective Vitality Scale

PANAS	Positive and Negative Affect Scale
MDI	Major Depressive Inventory
BDI	Beck Depression Inventory
K-HDRS	Hamilton Depression Rating Scale
BAI	Beck Anxiety Inventory
PHQ-9	Patient Health Questionnaire
GAD-7	Generalized Anxiety Disorder Assessment
PSS	Perceived Stress Scale
SSTA-6	Spielbrger State Trait Anxiety Inventory
SAS	Spirituality Assessment Scale
WAS	Work and Social Adjustment Scale
FFMQ	Five-Facet Mindfulness Questionnaire
AAQII	Acceptance and Action Questionnaire
PCL-M	Post-Traumatic Stress Disorder Checklist Military Version
PACES	Physical Activity Enjoyment Scale
BDSP	Backwards Digit Span Task
TMD	Total Mood Disturbance

Appendix A

Table A1. Review the quality assessment.

A/A	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Drop-Outs	Overall Scores
1	-	-	-		++	++	WEAK
2	-	-	-	-	+	++	WEAK
3	+	-	++		++	++	MODERATE
4	+	-	++	-	++	+	WEAK
5	++	++	++	+	++	+	STRONG
6	-	-	-	-	++	++	WEAK
7	+	-	-	-	+	-	WEAK
8	+	+	++		++	++	STRONG
9	-	-	+		++	-	WEAK
10	+	+	++	-	++	+	MODERATE
11	+	+	-	+	++	++	MODERATE
12	++	-	-	-	++	++	WEAK
13	-	++	+		+	++	MODERATE
14	+	-	++		++	+	MODERATE
15	-	+	-	-	++	++	WEAK
16	++	++	++	+	++	++	STRONG
17	+	-	++		++	++	MODERATE
18	++	++	-	+	++	++	MODERATE
19	+	-	-		++	++	WEAK
20	-	-	-		++	-	WEAK

Studies were classified as weak (red color & -), moderate (yellow color & +), or strong (green color & ++) according to predefined rules. Selection bias: based on the representativeness of the sample and participation rate. Study Design: ++: CTs/CCTs; +: cohort or case–control designs; -: all other designs. Confounders: ++: if both assessors and participants were blinded; +: if only one was blinded or not clearly described; -: if no blinding. Data Collection Methods: ++ if tools were both valid and reliable; + if valid but reliability not reported; -if neither validity nor reliability were established. Withdrawals/Dropouts: ++ for ≥80% follow-up; + for 60–79% or when not applicable; - for <60% or not reported.

Table A2. Methodological process for physical activity intensity classification.

Procedure Description	Findings
Step 1 Details on activities performed, participants' characteristics, environments in which the activities took place and measurements that could be used to estimate PA intensity	• [40]: **Activity description**: walking in two different environments for 0.6 miles, 10 to 15 min with an assumed walking speed of 3 miles per hour. **Participants' characteristics:** healthy undergraduate students. **Environment:** urban sidewalk and coast. Weather measurements (sunny conditions, 50 degrees Fahrenheit temperature, 2.6 mph windspeed. **PA Intensity Measurements**: N/A). • [64]: **Activity description**: non-specified leisure activity on the beach and 1 h of two types of scuba diving experiences. (a) receiving (>10 min) pre-dive briefing and diving with a diving instructor and (b) receiving short (<10 min) pre-dive briefing and diving without a diving instructor. **Participants' characteristics:** scuba divers and beach users. • [65]: **Activity description**: Recreational activities in BSs, particularly sea swimming or snorkeling and going to the shoreline for recreation. **Participants' characteristics:** general population. **Environment:** district of Bontosikuy, Indonesia. **PA Intensity Measurements**: N/A • [66]: **Activity description**: angling in general (no specific details were provided). **Participants' characteristics:** healthy and with psychological disorders. **Environment:** N/A. **PA Intensity Measurements**: subjective survey item for measuring angling frequency and duration. • [67]: **Activity description**: surfing is defined as the act of paddling on one's stomach on a surfboard as an ocean wave approaches and pushing oneself into a standing position as the wave begins to break and the momentum of the wave begins to propel the surfboard and surfer. Surfers riding various surfboard models, such as longboards, shortboards, and fish models, were included as potential participants. **Participants' characteristics:** surfers. **Environment:** ocean. **PA Intensity Measurements**: N/A • [68]: **Activity description**: Fishing from boats or the shore, with the majority of participants using hook and line, and fewer practicing spear fishing. **Participants' characteristics:** recreational fishers. **Environment:** N/A. **PA Intensity Measurements**: h/month. Physical activity of participants was included as a confounder and measured by an index of activity from 4 to 154, reflecting activity frequency of four intensity levels. • [69]: **Activity description**: 30 min walking sessions (close to water and away from the water in a natural and urban setting). **Participants' characteristics:** healthy young students. **Environment:** two different environments (natural/urban), each with and without the presence of a canal. Environmental conditions in the experimental sites included length of route (km), elevation (m), wind speed (m/s), temperature (°C), humidity %, Negative ion (pcs/cc). Mean scores per site: nature w/water: 2.1; 140–180; 1003.7; 2.6; 17.4; 64.3; 202.5, nature *w/o* water: 1.7; 140–180; 1002.2; 1.4; 16.9; 67.7; 371.7, urban w/water: 2.4; 0–3; 1014.3; 2.5; 22.2; 77.0; 509.2; urban *w/o* water: 2.1; 0–3; 1014.4; 2.1; 77.3; 590.0, **PA Intensity Measurements**: N/A • [70]: **Activity description**: river rafting in three different routes based on risk level. All rafting sessions lasted approximately 4 h. Route 1 had an easy, clear passage with only minor obstructions. Route 2 had a moderately difficult flow with mainly clear passages and frequent rapids. Route 3 showed a consistent forceful nature by having more obstacles and numerous bigger rapids. **Participants' characteristics:** people who engage in rafting. Selected from established rafting companies. **Environment:** river. **PA Intensity Measurements**: N/A

Table A2. *Cont.*

Procedure Description	Findings
Step 1 Details on activities performed, participants' characteristics, environments in which the activities took place and measurements that could be used to estimate PA intensity	• [71]: **Activity description:** sitting in a chair in the field for 15 min to observe the environment of the site, followed by a 15 min slow walk led by a research assistant to ensure that all groups walked the same route (approximately 550 m long at each location) at the same speed. Participants were asked to walk in a line, maintaining at least two meters between each other to avoid interfering with each other. **Participants' characteristics:** students. **Environment:** urban river, urban lake, urban canal, urban setting (mainly buildings). Environmental factors measurements considered temperature, humidity, absolute illumination and noise levels without differences in the mean of the four experimental sites. **PA Intensity Measurements**: N/A • [72]: **Activity description**: 10-session swimming program. Three weeks of pool-based followed by 7 weeks of coached outdoor swimming; all participants wore wetsuits during sea swims and fully participated in all sessions. The duration of stay in the sea was self-determined and subject to the weather and sea conditions. The controls either sat or stood watching the swimmers (from a balcoy or the beach). **Participants' characteristics:** novice swimmers who could swim 400 m in a heated swimming pool. **Environment:** swimming pool/beach/open sea. **PA Intensity Measurements**: N/A. • [73]: **Activity description**: ocean therapy program consisting of structured surfing sessions and instructional, active, and reflective components over 4 h. Main activities included stretching, on-land surf practice, paddling, wave riding, balance, and repeated transitions between rest and exertion. **Participants' characteristics:** veterans with post-traumatic stress disorder. **Environment:** ocean. **PA Intensity Measurements**: N/A. • [74]: **Activity description**: walking in two different environments (blue and urban). **Participants' characteristics:** should be able to walk for 20 min at a constant moderate pace. **Environment:** seafront and urban setting. **PA Intensity Measurements**: physical indexes such as blood pressure, pulse rate and heart rate variability, participants' BMI, and vector magnitude for estimating weekly levels of PA and PA during the experimental exposure. • [75]: **Activity description**: 2 beach tennis sessions (single and double) and a control session (resting without exercise). All sessions had a total duration of 56 min. Each beach tennis session included a 5 min warm-up comprising technical drills, including volleys, short balls, smashes, hooks, lobs, and serves. All matches lasted 15 min. with recovery intervals of 2 min. **Participants characteristics:** healthy beach tennis players. **Environment:** beach. Temperature and relative humidity were recorded pre each session (pre-single session median temperature: 24.9 °C (IQR, 3.4 °C; min–max, 21.0–31.8 °C) and median relative humidity: 51.0% (IQR, 17.7%; min–max, 35.1–72.0%), pre-double session median temperature: 23.2 °C (IQR, 2.8 °C; min–max, 21.0–32.0 °C), and median relative humidity: 58.0% (IQR, 27.7%; min–max, 35.0–85.0%). **PA Intensity Measurements**: HRmax. • [76]: **Activity description**: 35 min of meditation (5 min diaphragm breathing exercise,20 min meditation, 10 min closing with discussion) with a warm-up including diaphragm breathing and light stretching. 25 min of stabilization exercise (stability of the trunk and movement of limbs while maintaining a neutral spine position) with a warm-up including plank, bridge, bird dog, dead bug, side plank (5 min per exercise). **Participants' characteristics:** female family caregivers of people with severe physical disabilities experiencing mild to moderate low back or neck pain and confirmed caregiver stress. **Environment:** beach and rehabilitation center. **PA Intensity Measurements**: N/A.

Table A2. *Cont.*

Procedure Description	Findings
Step 1 Details on activities performed, participants' characteristics, environments in which the activities took place and measurements that could be used to estimate PA intensity	• [77]: **Activity description**: 2 h of sailing activity. Veterans participated in the activity by taking turns at various positions on the boat under the guidance of the skipper. These positions were helm (steering the boat), mainsheet (line used to control the mainsail) and the starboard (right) and port (left) jib sheets (line used to control the jib, which is the sail set forward of the mast and mainsail). Additionally, participants assisted with keeping watch for other boats and leaving and returning to the dock. Finally, some participants assisted in the basic steps of rigging and derigging the sailboats, such as hoisting and dousing the mainsail and unfurling and furling the jib. **Participants' characteristics:** veterans diagnosed with medical, psychiatric and substance abuse. **Environment:** lake. **PA Intensity Measurements**: N/A. • [78]: **Activity description**: eight swimming sessions. Each session started with a 5 min of gentle stretching, followed by a small jog or walk depending on the participant; Main activities included over the week: cold-water acclimatization; running/walking into the water, out to a lifeguard, round the lifeguard and back (water up to the waist); repeating the same exercise but introducing dolphin dives; repeating the same exercise but now going deeper and possibly out over head height (depending on competence of swimmer and conditions); teaching the technique of body surfing; going for a short swim (with 2 lifeguards on rescue boards). **Participants' characteristics:** with self-reported low levels of mood and/or anxiety. **Environment:** beach. **PA Intensity Measurements**: N/A • **Environment:** sea/coast. Depth, sea and air temperature measurements taken for each experience (group a mean scores: depth: 2.3, sea temperature: 23.0, air temperature: 26.2, group b mean scores: depth: 2.3, sea temperature: 23.8, air temperature: 26.4). **PA Intensity Measurements**: N/A • [79]: **Activity description**: walking: participants completed a 30 min low-demanding walking itinerary along the seafront with sea views at all times; swimming: relax or swim in the sea for 30 min, but without swimming goggles; snorkeling: swim and observe the ecosystem with snorkel masks and a wetsuit if required, following a low-demanding pre-defined route and always accompanied by a member of the research team and a diving instructor; control sessions: sit and relax in a comfortable office without views for 30 min. **Participants characteristics:** should know how to swim. Participants were diagnosed with various types of cancer. **Environment:** sea/coast. **PA Intensity Measurements**: smartwatches for monitoring position, elevation gain, steps, HR. • [80]: **Activity description**: a six-week nature-based intervention performed two times. Week 1 included a 0.5 km guided walk tour and bird feeding. Week 2 included a 0.8 km guided walk tour, bird watching, bird species identification, and otter watching. Week 3 included a 1.5 km guided walk tour and bird watching. Week 4 included a 1 km guided walk tour and canoeing. Week 5 included a 2.5 km guided walk tour, free time, and bird watching. Week 6 included a 1 km guided walk tour and bird watching. **Participants' characteristics:** with anxiety and/or depression disorders. **Environment:** wetland. **PA Intensity Measurements**: N/A. • [81]: **Activity description**: surfing session, mainly introductory lessons. **Participants' characteristics:** students with social, emotional and behavioral or at-risk-of-exclusion difficulties. **Environment:** beach. **PA Intensity Measurements**: N/A • [82]: **Activity description**: N/A. **Participants' characteristics: with psychological distress. Environment:** Delta River Beach. Temperature (C): M = 20.71, relative humidity (%): M = 50.33, wind speed (m/s) M = 1.07, pressure (mbars): M = 1017 records were taken. **PA Intensity Measurements**: Calfit application.

Table A2. *Cont.*

Procedure Description	Findings
Step 2 Identification of major heading in 2024 Compendium of Physical Activities	• Inactivity • Conditioning exercise • Fishing and hunting • Walking, water activities
Step 3 Identification of relevant/available entries in 2024 Compedium of Physical Activities, and their MET values	• Angling: Fishing, general (3.5 METs); Fishing from river bank and walking (4.0 METs); Fishing related, digging worms, with shovel; Fishing from boat or canoe, sitting (2.0 METs); Fishing from river bank, standing (Taylor Code 660) (3.5 METs); Fishing in stream, in waders (Taylor Code 670) (6.0 METs); Fishing, ice, sitting (2.0 METs); Fishing, jig or line, standing, general (1.8 METs); Fishing, dip net, setting net and retrieving fish, general (3.5 METs); Fishing, set net, setting net and retrieving fish, general (3.8 METs); Fishing, fishing wheel, setting net and retrieving fish, general (3.0 METs); Fishing with a spear, standing (2.3 METs) • Beach tennis: N/A as PA intensity was measured with HRmax • Marine therapy program: Meditating (1.0 MET); Calisthenics, light or moderate effort, general (e.g., back exercises), going up and down from floor (Taylor Code 150) (3.5 METs) • Nature based intervention: Walking, less than 2.0 mph, level, strolling, very slow (2.3 METs); Walking, 2.0 to 2.4 mph, level, slow pace, firm surface (2.8 METs); Walking for pleasure (Taylor Code 010) (3.5 METs); Walking, 2.5 mph, firm, level surface (3.0 METs); bird watching, walking and stopping (2.5 METs); Canoeing, rowing for pleasure, general (Taylor code 250) (3.5 METs) • Rafting: Whitewater rafting, kayaking, or canoeing (5.0 METs) • Running/walking in the water, level water up to the waist/with dolphin dives/level water up to the head: Water jogging, vigorous effort (9.8 METs); Water walking, light effort, slow pace (2.5 METs); Water walking, moderate effort, moderate pace (4.8 METs); Water walking, vigorous effort, brisk pace (6.8 METs); Whitewater rafting, kayaking, or canoeing (5.0 METs); Water running, 30 steps/min, slow (6.5 METs); Water running, 40 steps/min, moderate (7.5 METs); Water running, 50 steps/min, fast (8.5 METs); Water running, 60 steps/min, very fast (9.8 METs) • Sailing: Sailing, boat and board sailing, windsurfing, ice sailing, general (Taylor Code 235) (3.0 METs); Sailing, in competition, general (4.5 METs); Sailing, in competition, high effort (9.3 METs); Sailing, Sunfish/Laser/Hobby Cat, Keel boats, ocean sailing, yachting, leisure (3.3 METs); Sailing, dingy (2.0 METs) • Scuba diving: Skindiving, scuba diving, general (Taylor Code 310) (7.0 METs); Scuba diving, general, light effort (5.3 METs); Scuba diving, general, moderate effort (5.8 METs); Scuba diving, professional diver (5.5 METs); Scuba diving, recreational diver (6.8 METs) • Sitting: Sitting quietly, general (1.0 MET) • Small jog/walk: Jog/walk combination (jogging component of less than 10 min) (Taylor Code 180) (6.0 METs) • Snorkeling: Snorkeling (Taylor Code 320) (5.0 METs) • Seaside walking: Walking, normal pace, plowed field or sand (4.5 METs)

Table A2. *Cont.*

Procedure Description	Findings
Step 3 Identification of relevant/available entries in 2024 Compedium of Physical Activities, and their MET values	• Surfing: Surfing, body or board, general (3.0 METs); Surfing, body or board, competitive (5.0 METs); Surfboard, paddling (6.8 METs); Stand up paddle boarding, general (6.5 METs); Stand up Paddleboard, standing, 10–19 strokes/min (2.8 METs); Stand up Paddleboard, standing, 20–29 strokes/min (3.8 METs); Stand up Paddleboard, standing, 30–39 strokes/min (5.0 METs); Stand up Paddleboard, standing, 40–49 strokes/min (9.8 METs); Stand up Paddleboard, standing, 50–69 strokes/min (11.0 METs) • Swimming: Swimming laps, freestyle, fast, vigorous effort (9.8 METs); Swimming laps, freestyle, slow, recreational (5.8 METs); Swimming, backstroke, training or competition (9.5 METs); Swimming, backstroke, recreational (4.8 METs); Swimming, breaststroke, general, training or competition (10.3 METs); Swimming breaststroke, recreational (5.3 METs); Swimming, butterfly, general (13.8 METs); Swimming, crawl, fast speed, ~75 yards/minute (10.5 METs); Swimming, crawl, medium speed, ~50 yards/minute, vigorous effort (8.0 METs); Swimming, crawl, slow speed, 30–45 yards/minute, moderate effort (5.8 METs); Swimming, crawl, elite swimmers, competition, >90 yards/min (14.5 METs); Swimming, lake, ocean, river (Taylor Codes 280, (6.0 METs); Swimming, leisurely, not lap swimming, general (6.0 METs); Swimming, sidestroke, general (7.0 METs); Swimming, synchronized (8.0 METs); Swimming, treading water, fast, vigorous effort (9.8 METs); Swimming, treading water, moderate effort (3.5 METs) • Walking: Walking, less than 2.0 mph, level, strolling, very slow (2.3 METs); Walking, 2.0 to 2.4 mph, level, slow pace, firm surface (2.8 METs); Walking for pleasure (Taylor Code 010) (3.5 METs); Walking, 2.5 mph, firm, level surface (3.0 METs); Walking, 2.5 mph, downhill (3.3 METs); Walking, 2.8 to 3.4 mph, level, moderate pace, firm surface (3.8 METs); Walking, 3.5 to 3.9 mph, level, brisk, firm surface, walking for exercise (4.8 METs); Walking, 4.0 to 4.4 mph (6.4 to 7.0 km/h), level, firm surface, very brisk pace (5.5 METs); Walking, 4.5 to 4.9 mph, level, firm surface, very, very brisk (7.0 METs); Walking, 5.0 to 5.5 mph (8.8 to 8.9 km/h), level, firm surface (8.5 METs); Walking, self-selected speed, indoor track or outdoors, firm surface (4.0 METs); Walking, grass track (4.8 METs); Walking, normal pace, plowed field or sand (4.5 METs)
Step 4 Selection of the best matching entries according to activity description, participants' characteristics and environmental context	• [40]: Walking, 2.8 to 3.4 mph, level, moderate pace, firm surface. Rationale behind the selections: 3 mph walking, 10–15 min • [64]: Skindiving, scuba diving, general; scuba diving, recreational diver. Rationale behind the selections: recreational, non-professional scuba diving in shallow depth • [65]: Swimming laps, freestyle, slow, recreational; swimming, backstroke, recreational; swimming breaststroke, recreational; swimming, leisurely, not lap swimming, general; Swimming, treading water, moderate effort snorkeling. Rationale behind the selections: inclusion of all types of leisure/recreational swimming and snorkeling • [66]: Fishing, general; Fishing, jig or line, standing, general; rationale behind the selections: description of activity as angling in general • [67]: Surfing, body or board, general; Surfboard paddling. Rationale behind the selections: heterogeneous PA focused on paddling and standing. No competitive context mentioned. • [68]: Fishing, general; Fishing from boat or canoe, sitting (2.0 METs); Fishing from river bank, standing (Taylor Code 660); Fishing, jig or line, standing, general; Fishing with a spear, standing

Table A2. *Cont.*

Procedure Description	Findings
Step 4 Selection of the best matching entries according to activity description, participants' characteristics and environmental context	• [69]: Walking, less than 2.0 mph, level, strolling, very slow; Walking, 2.0 to 2.4 mph, level, slow pace, firm surface; Walking, 2.5 mph, firm, level surface; Walking, 2.8 to 3.4 mph, level, moderate pace, firm surface. Rationale behind the selections: controlled intervention at a moderate pace for 30 min. • [70]: Whitewater rafting, kayaking, or canoeing. Rationale behind the selections: single entry containing the term "rafting" • [71]: Sitting quietly, general; Walking, 2.0 to 2.4 mph, level, slow pace, firm surface. Rationale behind the selections: duration of the exposure in relation to the walked distance • [72]: Swimming, lake, ocean, river (Taylor Codes 280, 295); Swimming, crawl, slow speed, 30–45 yards/min, moderate effort. Rationale behind the selections: guided sessions in indoor and outdoor environments for novice swimmers • [73]: Surfing, body or board, general; Surfboard, paddling. Rationale behind the selections: the activity components of stretching, paddling, wave riding, repeated exertion/rest • [74]: Walking, less than 2.0 mph, level, strolling, very slow; Walking, 2.0 to 2.4 mph, level, slow pace, firm surface; Walking, 2.5 mph, firm, level surface; Walking, 2.8 to 3.4 mph, level, moderate pace, firm surface. Rationale behind the selections: controlled intervention for 20 min. • [75]: N/A • [76]: Meditating; Calisthenics, light or moderate effort, general (e.g., back exercises), going up and down from floor (Taylor Code 150) • [77]: Sailing, boat and board sailing, windsurfing, ice sailing, general; Sunfish/Laser/Hobby Cat, Keel boats, ocean sailing, yachting, leisure. Rationale behind the selections: not competitive, guided, mixed static and light dynamic sailing tasks • [78]: Jog/walk combination (jogging component of less than 10 min); Walking normal pace, plowed field or sand; Water walking, light effort, slow pace; Water walking, vigorous effort; Water jogging, vigorous effort; Swimming, lake, ocean, river (Taylor Codes 280); Rational behind the selections: heterogenous session with progressive level of difficulty • [79]: Sitting quietly, general; Walking, normal pace, plowed field or sand; Swimming laps, freestyle, slow, recreational; swimming, backstroke, recreational; swimming breaststroke, recreational; swimming, leisurely, not lap swimming, general; swimming, treading water, fast, vigorous effort; Snorkeling. Rationale behind the selections: description of activity, e.g., walking along the beach, relaxing or swimming in the sea, snorkeling, comment of authors that activities should be considered as "low demanding" • [80]: Walking, less than 2.0 mph, level, strolling, very slow; Walking, 2.0 to 2.4 mph, level, slow pace, firm surface; Walking for pleasure (Taylor Code 010); Walking, 2.5 mph, firm, level surface; bird watching, walking and stopping; Canoeing, rowing for pleasure, general (Taylor code 250) • [81]: Surfing, body or board, general • [82]: N/A as no description was given for physical activity

Table A2. *Cont.*

Procedure Description	Findings
Step 5 Physical intensity classification	• [40]: MET score = 3.8, moderate • [64]: average MET score = 6.9, vigorous • [65]: for swimming average MET score = 5.1, moderate; for snorkeling MET score = 5.0, moderate • [66]: average MET score = 2.7, light • [67]: MET score = 4.9, moderate • [68]: average MET score = 2.6, light • [69]: average MET score = 2.9, light • [70]: MET score = 5.0, moderate • [71]: for sitting MET score = 1.0, sedentary; for walking MET score = 2.8, light • [72]: average MET score = 5.9, moderate • [73]: average MET score = 4.1, moderate • [74]: average MET score = 2.9, light • [75]: vigorous (based on HRmax) • [76]: average MET score = 3.0, moderate • [77]: average MET score = 3.1, moderate • [78]: for warm-up average MET score = 2.5, light; for running/walking in the water average MET score = 6.0, Vigorous; for surfing MET score = 3.0, moderate; for short swim MET score = 6.0, vigorous. Assessed altogether as vigorous. • [79]: for sitting MET score = 1.0, sedentary; for walking MET score = 4.5, moderate; for swimming average MET score = 5.1; moderate; for snorkeling MET score = 5.0; moderate • [80]: weeks with walking/animal watching: average MET score = 2.8, light; weeks with walking/canoeing average MET score = 3.0, moderate • [81]: MET score = 3.0, moderate • [82]: average MET score = 2.8, light

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