A Scoping Review and Insights of the Affordance of Blue Spaces During Childhood for Promoting Mental Health and Well-being

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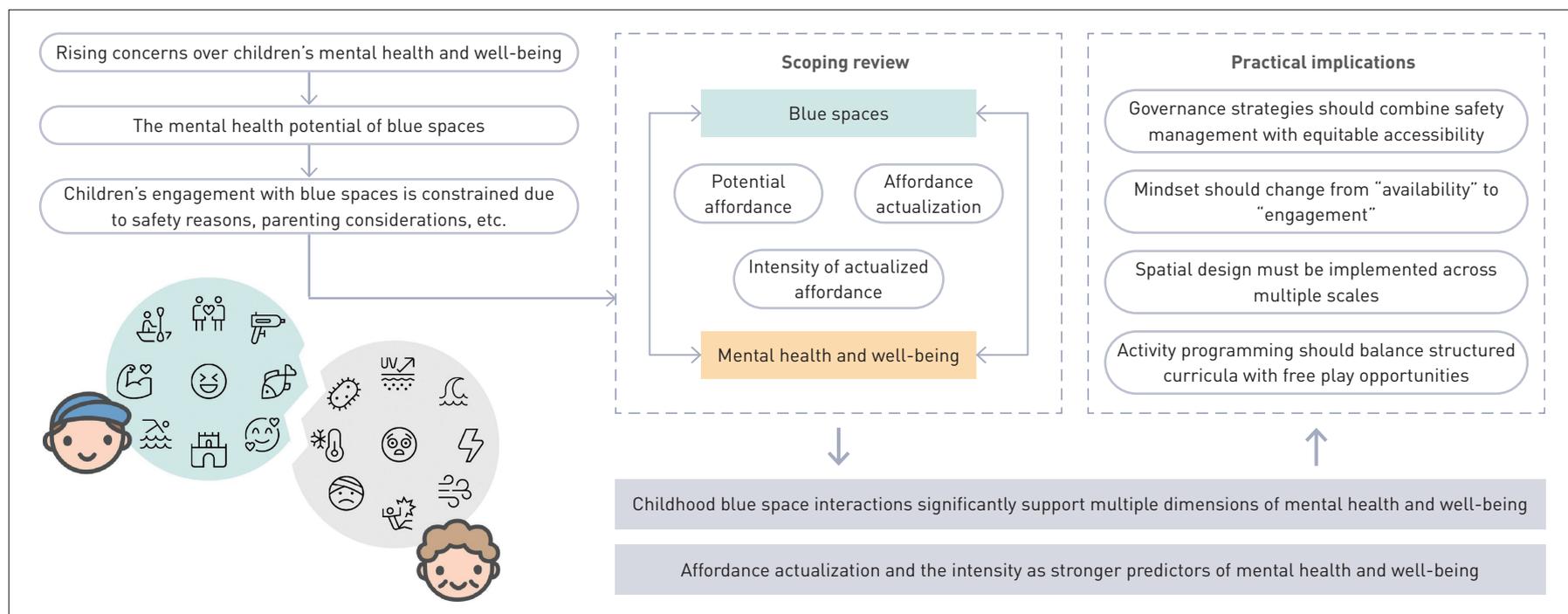
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GRAPHICAL ABSTRACT

ABSTRACT

Blue spaces have attracted increasing attention for their potential to promote children's well-being due to their strong appeal. However, existing evidence remains fragmented and lacks systematic synthesis. Using the *PRISMA-ScR* framework, this scoping review identified 21 eligible studies from databases including Web of Science, Scopus, PsycINFO, MEDLINE, etc. Guided by affordance theory, this review first examined how childhood interactions with blue spaces influence different dimensions of mental health and well-being, and then analyzed whether and how affordance actualization and intensity shaped these outcomes. The findings indicated that childhood engagement with blue spaces significantly enhanced overall mental health, resilience, social functioning, self-confidence and self-efficacy, as well as emotional and behavioral functioning. Compared with green spaces, blue spaces demonstrated distinct advantages in promoting social functioning, emotional regulation, and self-confidence, although potential risks

must be carefully managed. Importantly, these benefits largely depended on the affordance actualization and intensity—that is, whether children were able to perceive, access, and actively engage with water-based opportunities. This process was further moderated by socio-economic status, urbanization degree, and other contextual factors. Based on these findings, the review proposes related practical implications, covering governance strategies, mindset change, spatial design, and program upgrades. By synthesizing fragmented evidence, this study presents the first comprehensive overview of the mental health and well-being of childhood blue space exposure, provides a theoretical lens to interpret inconsistencies across studies, extends the application of affordance theory to health-promoting landscapes, and offers actionable directions for urban planning of healthy cities.

KEYWORDS

Landscape Perception; Affordance; Children; Mental Health; Well-being; Blue Space; Aquatic Activity

HIGHLIGHTS

- Introduces the affordance levels to explain children's interaction with blue spaces
- Childhood interaction with blue spaces enhances multiple aspects of mental well-being
- Blue spaces may better support children's self-confidence, self-efficacy, etc., than green spaces
- Affordance actualization and intensity of blue spaces strongly predict children's positive mental health and well-being
- Multiple factors shape children's perception and use of blue spaces, influencing related health benefits

1 Introduction

The topic of mental health and well-being have received increasing attention in the context of global urbanization[1–2]. Specifically, the concept encompasses a range of psychological conditions, including both clinical assessments and self-reported evaluations of life quality and emotional states[3]. Childhood (ages 0 ~ 18) is a critical stage in one's mental health development, where positive experiences can yield long-lasting benefits[4–5]. Previous research has shown that increased exposure to public open spaces significantly contributes to improved mental health and well-being among children, where natural environments plays a key role in this process[6–10]. However, most studies have focused on green spaces[7,11–13], while the influence of blue spaces for children's mental health remains underexplored.

Broadly defined, blue spaces refer to natural or man-made water-dominated environments, including oceans, rivers, lakes, wetlands, ponds, outdoor swimming pools, and decorative water features such as fountains[14–15]. Research on the potential psychological benefits of blue spaces dates back to the late 20th century, when Attention Restoration Theory proposed that such environments could provide psychological or physical "escape" from cognitively demanding settings, thereby restoring attention capacity[16]. Subsequent empirical studies have demonstrated that blue spaces can also promote psycho-social well-being[17–20]. Even when not intentionally designed for play, children are able to identify and engage with the diverse activity opportunities offered by blue spaces, which may trigger intrinsic motivation and enhance their mental health and well-being[15,21].

Children tend to perceive their surroundings as a set of activity opportunities[22]. However, the supporting extent to health-promoting behaviors depends on the interaction between environmental features, socio-cultural context, and individual choices[23–24]. In reality, children's physical engagement with blue spaces is often restricted by external factors such as safety regulations, which may limit their ability to gain mental health benefits. The concept of "affordance," proposed by James Jerome Gibson, describes the action possibilities provided by the environment[23]. Affordances can be understood as a hierarchy—potential, perceived, utilized, and shaped—based on the degree of interaction between individuals and their surroundings[25] (Fig. 1). This framework offers a useful lens to understand the mechanisms of health-related outcomes. This study adopted this four-level framework to describe children's interaction with water, defined as: 1) potential affordance, referring to the mere presence of water
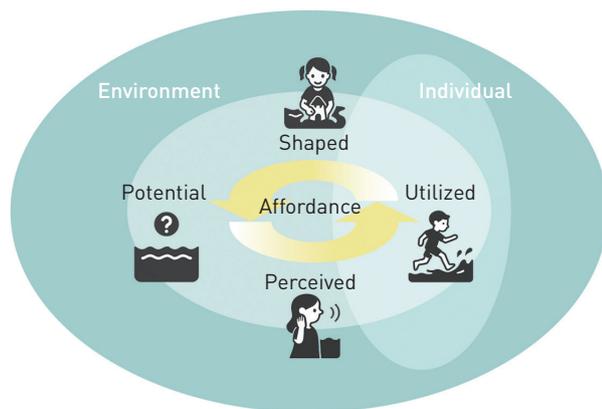
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Fig. 1
Transformational relationships across different levels of affordance (adapted from Ref. [25]).

1

that has not yet been noticed by the child; 2) perceived affordance, where water features are recognized and acknowledged; 3) utilized affordance, involving direct engagement or use of water bodies; and 4) shaped affordance, where children modify water environments (e.g., building sand structures), potentially generating new opportunities for interaction.

Building on the blue space affordance framework, this scoping review aims to: 1) examine existing literature by analyzing the alignment of research designs across different affordance levels;

2) explore whether and how children's interaction with blue spaces during childhood enhance their mental health and well-being; and 3) analyze how affordance actualization and intensity influence the realization of mental health benefits. The study seeks to reveal the promoting mechanisms through which blue spaces support children's mental health and well-being, broaden the research lens on the role of urban green and blue spaces to residents' mental health, and provide a theoretical and evaluation foundation for future planning and design practices.

2 Methods

2.1 Literature Search

This scoping review was conducted throughout 6 databases: Web of Science (WoS), Scopus, PsycINFO, MEDLINE, Garden, Landscape & Horticulture Index (GLHI), and China National Knowledge Infrastructure (CNKI). The search targeted peer-reviewed journal articles with keywords related to "children," "blue space," and "mental health" (Table 1). WoS used topic-based search; Scopus used the TITLE–ABS–KEY–AUTH field; PsycINFO, MEDLINE, and GLHI used full-text fields; and CNKI used subject headings.

Table 1: Keywords used for literature search

Category of search terms	Chinese keyword	English keyword
Children	婴儿；新生儿；幼儿；儿童；青少年；童年；学生；学校	Infant*/pediatric*/paediatric*/neonatal*/baby/babies/toddler/boy*/girl*/juvenile*/child/children/kids/student*/schoolchild/schoolchildren/adolescent*/teen/youth/young adult*/young people/young person/preschool*/elementary school*/kindergarten*/day care/high school*/pre-pubescent*/prepubescent*/senior school*/secondary school*
Blue space	蓝色空间；蓝绿空间；水景；滨水；池塘；喷泉；溪；湿地；河；江；湖；海；水上运动；游泳；帆船；冲浪	Blue-green space*/green-blue space*/blue space*/blue-green infrastructure/green-blue infrastructure/water/waterscapes/freshwater/aquatic environments/ponds/fountains/rivulets/wetlands/river/riparian/lake/sea/beach/oceans/coast*/marine/game waterfall*/artificial water/watersports/swim/swimming/sail/sailing/surf/surfing
Mental health	心理健康；幸福感；康复；疗愈；注意力；恢复	Mental health/mental well-being/social well-being/subjective well-being/mental hygiene/mental disorders/*psychology/psychological/healing /therapeutic landscape/*well-being/attention/restoration/resiliency/ADD/tourette/bipolar disorder/obsessive compulsive disorder/ADHD/anxiety/anxious/stress/posttraumatic stress/acute stress disorder/schizo*/somat* disorder/hypochondriasis/dissociative amnesia/dissociative disorder/emotion*/mood/aggression/aggressive/happiness/pleasure/dysthymic disorder/cyclothymic disorder/panic disorder/agoraphobia/phobia/depressive/depression/autism/distress/cognitive function/personality/self-esteem/self-confidence/depersonalization disorder/obsessive-compulsive disorder

NOTE
In the table, "*" functions as a truncation symbol, which allows for the retrieval of all word variants beginning with a given keyword, thereby enhancing the coverage of the search results.

The search was completed on February 9, 2023, yielding a total of 72,845 records.

2.2 Literature Screening

Three criteria were applied to screen eligible studies.

1) Participants should be aged 0 to 18 years. If participants' age was not explicitly reported, they were required to be identified as kindergarten, primary, secondary, or high school students. If adults were involved, the average age of the participants had to be below 13 years old, or at least 80% of the participants younger than 15[①][8,26–28]. Studies involving adults recalling their childhood experiences with blue spaces in relation to mental health outcomes were also included.

2) Participants had to engage in certain interaction forms with water features in blue spaces, including in-water, on-water, nearby, or perceptual use of water.

3) Studies had to assess mental health and well-being using either quantitative measures or qualitative descriptions.

The screening followed the guideline by the *PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation*[29], and the process is illustrated in Fig. 2. All retrieved records were imported into EndNote for duplicate removal. The de-duplicated references were then uploaded into Rayyan[②] for independent screening on the titles and abstracts by two reviewers (who are the authors to this paper). An additional 15 studies were identified using snowballing. After full-text assessment, finally 21 articles were selected for this study[30–50].

2.3 Extraction of Key Information of the Literature

Key information from the 21 included studies were extracted and summarized (Table 2), including study design, age of participants, characteristics of blue space exposure, and mental health and well-being outcomes.

3 Results

3.1 Categories of the Associations Between Blue Space Indicators or Interventions and Levels of Affordance

Among the 21 studies, 19 were published after 2018, while the other two published between 2013 and 2018. Geographically, the studies were predominantly conducted in Europe (N = 10), Oceania (N = 5), North America (N = 3), and Africa (N = 2); and one study included data from 18 countries or regions. To date, no study has been conducted in China.

In terms of methodological approaches, psychological health

① This study adopted a literature screening strategy commonly used in scoping reviews on the health benefits of green spaces for children [e.g., Refs. [8,26-28]]. Although some of such studies involved adult participants, the majority of participants remained aged 0 to 18. This criterion ensured the relevance of selected studies and effectively excluded those targeting exclusively adult populations.

② Rayyan is a free online platform developed by the Qatar Computing Research Institute (QCRI) to support systematic review workflows. It facilitates efficient literature screening and collaboration among researchers.
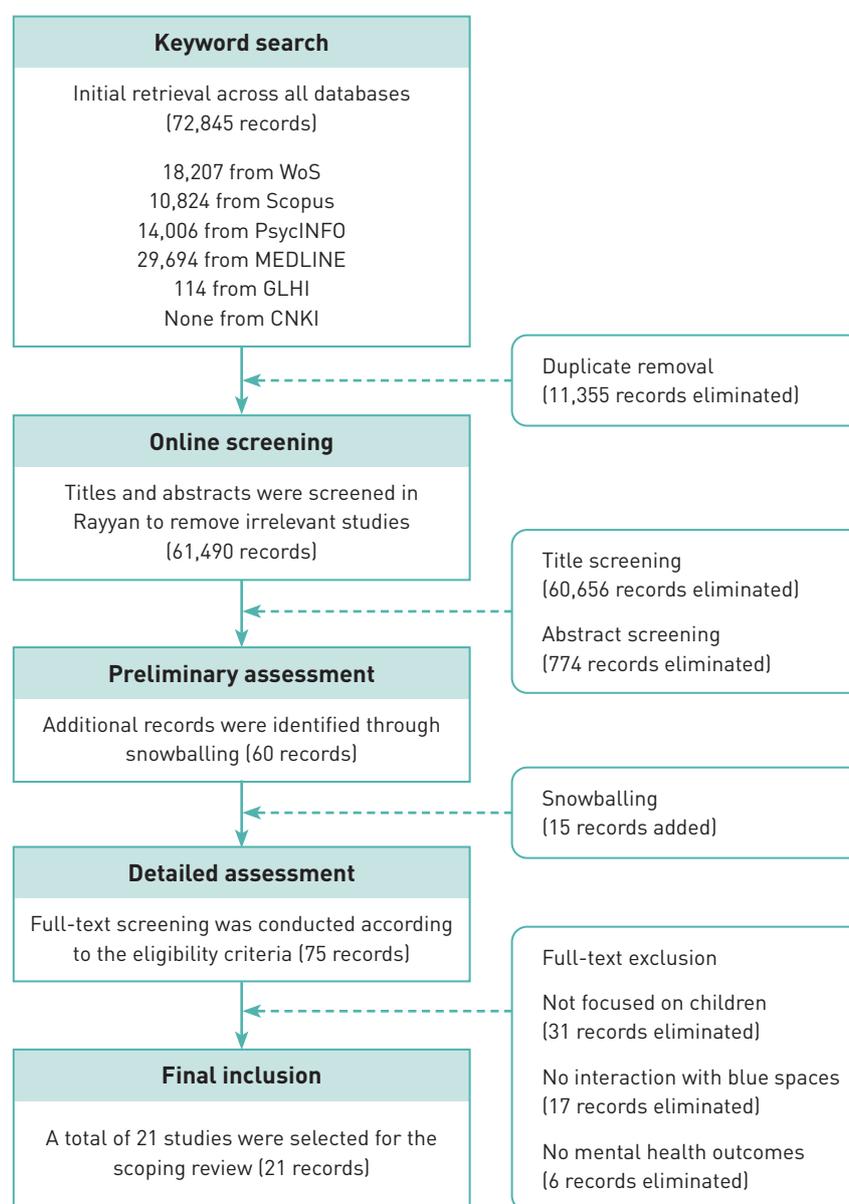

Fig. 2 Literature screening process.

was assessed using standardized psychometric scales in 15 studies. Other methods included semi-structured or focus group interviews (N = 4), national mental health records (N = 1), self-reports (N = 1), and physiological measurements (N = 1). Among these studies, mental

Reference	Study design | methodological approach | age of participants (years) | country | sample size	Blue space-related variables | data analysis method	Mental health and well-being outcomes | measurement tools or methods
[30]	Cohort study | quantitative | 10 | Denmark | *N* = 908,553	The coverage ratio of blue spaces in the residential neighborhood | e	Intellectual disability, psychiatric disorder, borderline-type personality disorder, mood disorders, specific personality disorder, obsessive-compulsive disorder, single and recurrent depressive disorder | ICD-10
[31]	Cohort study | quantitative | 10 | Denmark | *N* = 66,194	The coverage ratio of blue spaces in the residential neighborhood | e	General mental health and emotional well-being level | SF-12
[32]	Cross-sectional study | quantitative | 11 ~ 16 | Canada | *N* = 17,249	The coverage ratio of blue spaces in the residential neighborhood | e	Subjective life satisfaction | Cantril Ladder
[33]	Cross-sectional study | quantitative | primarily 13 ~ 1 | New Zealand | *N* = 4,575	The coverage ratio of blue spaces in the residential neighborhood | e Whether the residence was located within 1,600 m from the coastline | e	Subjective psychological well-being | WHO-5; depressive symptoms | RADS-SF
[34]	Cross-sectional study | quantitative | 8 ~ 14 | Canada | *N* = 851	The coverage ratio of blue spaces in the residential neighborhood | e	Health-related quality of life | PedsQL; adopted emotional regulation strategies | ERQ-CA
[35]	Cross-sectional study | quantitative | 17 ~ 23 | USA | *N* = 9,385	The coverage ratio of blue spaces in the residential neighborhood | e The distance from home or school to the nearest blue space | e	Depression level | MRFS
[36]	Cohort study | quantitative | 0, 4, 7, 10 | Portugal | *N* = 3,827	The distance from school to the nearest marine area | e The walking time from home to the nearest blue space | e The distance from school to the nearest river | e The distance from home to the nearest river | e The distance from school to any type of blue spaces | e The distance from home to any type of blue spaces | e	Intellectual ability | WISC-III
[37]	Cross-sectional study | quantitative | 0 ~ 17 | Germany | *N* = 12,624	The walking time to the nearest blue space from home | e	Total difficulties score comprising four dimensions—emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems—as well as the severity of emotional symptoms, conduct problems, peer relationship problems, prosocial behavior, and hyperactivity/inattention | SDQ

(Continued)

Reference	Study design | methodological approach | age of participants (years) | country | sample size	Blue space-related variables | data analysis method	Mental health and well-being outcomes | measurement tools or methods
[38]	Cohort study | quantitative | 2 ~ 5 | Australia | N = 2,396	The distance from home to the nearest beach | e	Depression level | SMFQ; anxiety level | SCAS
[39]	Randomized controlled trial (pre–post) | quantitative | 11 | Portugal | N = 190	Surfing programs | b	Personal aspirations, self-confidence, and social integration | WEMWBS
[40]	Descriptive study | combined methods | 15 | Portugal | N = 595 (children who completed questionnaire), N = 14 (children who participated in interview), N = 16 (caregivers who participated in interview), N = 5 (teachers who participated in interview)	Nautical activities | a	Well-being | self-administered questionnaire; well-being, social behavior, self-esteem, and stress relief | focus group interviews
[41]	Randomized controlled trial (pre–post) | combined methods | 14 ~ 17 | Australia | N = 9	Surfing programs | a	Self-esteem | RSES; self-care ability, self-confidence, and sense of control | semi-structured interviews; resilience | BRS; depressive symptoms | PHQ-A; emotional regulation and stress coping, capacity for healthy relationships | semi-structured interviews; social connectedness | SCS-R and semi-structured interviews
[42]	Randomized controlled trial (pre–post) | combined methods | 7 ~ 22 | Sierra Leone | N = 58	Surfing programs | d	Happiness | PARCHISY; depressive symptoms | BPHS-Y; self-awareness, emotional regulation, empathy, and social competence | SEAL; stress management, emotional regulation, confidence building, and social network development | individual interviews
[43]	Descriptive study | qualitative | 9 ~ 13 | UK | N = 2 (organization representatives), N = 4 (sailing coaches), N = 22 (children), N = 3 (school teachers), N = 2 (charity staff), N = 2 (sailors), N = 3 (other sailing organization representatives)	Dinghy sailing | a	Well-being, general mental health, self-confidence, sense of achievement, resilience, problem-solving and decision-making abilities, emotional and behavioral functioning, and social skills | focus groups and semi-structured interviews
[44]	Randomized controlled trial (pre–post) | quantitative | 8 ~ 18 | The Netherlands | N = 84 (children with Down syndrome, autism, or ADHD)	Surfing programs | c	Psychological well-being and social support | Kidscreen-27
[45]	Descriptive study | qualitative | 13 ~ 17 | South Africa | N = 45	Surfing programs | a	Confidence and self-identity, peer relationships, and positive emotional experiences | focus groups with parents, caregivers, teachers, and occupational therapists, observational data from surf therapy instructors, and child-led participatory tools
[46]	Descriptive study | qualitative | average 12.8 | Australia | N = 18 (youth), N = 18 (mentors), N = 1 (coordinator)	Surfing programs | a	Self-efficacy and sense of control, emotional improvement, cognitive development, and social skills | focus groups and semi-structured interviews
[47]	Randomized controlled trial (pre–post) | quantitative | 7 ~ 17 | Portugal | N = 73	Surfing programs | c	Health-related quality of life | Kidscreen, completed by both children and caregivers; self-esteem | RSES, completed by children; total difficulties score | SDQ, completed by both children and caregivers; anxiety and depression | RCADS and RCADS-A by child self-reports; emotional regulation | ERQ-CA by child self-report; social connectedness | SCS-r; prosocial behavior | SDQ ProSoc by caregiver reports; cognitive control and executive function | "Go–No-Go" and "Opposite World" subtests

Reference	Study design | methodological approach | age of participants (years) | country | sample size	Blue space-related variables | data analysis method	Mental health and well-being outcomes | measurement tools or methods
[48]	Cohort study | quantitative | 0 ~ 16 | 18 countries and regions | N = 15,743	A composite assessment on both the frequency and autonomy of children's visits to blue spaces | e, f	Subjective psychological well-being | WHO-5
[49]	Descriptive study | qualitative | 2 ~ 10 (children), unspecified (parents) | Australia | N = 45 (children), N = 25 (parents)	A comprehensive evaluation on the frequency, autonomy, depth, and perceived quality of children's visits to blue spaces | a	Emotional regulation, self-confidence, self-awareness, resilience, and social behavior | semi-structured interviews
[50]	Cross-sectional study | quantitative | 7 ~ 10 | Spain | N = 2,111	The annual frequency of beach visits | e	Total difficulties score, prosocial behavior, peer problems, emotional and behavioral symptoms, and hyperactivity/inattention | SDQ, ADHD/DSM-IV

NOTES

1. ADHD/DSM-IV is the diagnostic criteria for Attention Deficit Hyperactivity Disorder as defined in the *Diagnostic and Statistical Manual of Mental Disorders* (4th Edition); BPHS-Y is the Behavioral and Psychological Symptoms Scale for Youth; Cantril Ladder is the Cantril Self-Anchoring Scale for life satisfaction; ERQ-CA is the Emotion Regulation Questionnaire for Children and Adolescents; ICD-10 is the 10th revision of the International Classification of Diseases; Kidscreen is the Health-Related Quality of Life Questionnaire for Children and Adolescents; MRFS is the Mood and Family Relations Scale; PARCHISY is the Parenting Style and Child Outcomes Inventory; PedsQL is the Pediatric Quality of Life Inventory; PHQ-A is the Patient Health Questionnaire for Adolescents; RCADS and RCADS-A are the revised versions of Children's and Adolescents' Anxiety and Depression Scale, respectively; RSES is the Rosenberg Self-Esteem Scale; SCAS is the Spence Children's Anxiety Scale; SCWS is the Social Communication Withdrawal Scale; SCS-R is the Self-Compassion Scale (revised version); SDQ is the Strengths and Difficulties Questionnaire; SDQ ProSoc is its Prosocial Behavior subscale; SMFQ is the Short Mood and Feelings Questionnaire; WEMWBS is the Warwick–Edinburgh Mental Well-being Scale; WHO-5 is the WHO-Five Well-being Index; and WISC-III is the Wechsler Intelligence Scale for Children (3rd Edition).

2. a stands for descriptive analysis; b stands for t-test; c stands for analysis of variance (ANOVA); d stands for non-parametric test; e stands for regression analysis; f stands for structural equation modeling (SEM).

health and well-being were conceptualized across 10 dimensions (Table 3).

Based on the associations between blue space indicators or interventions and the levels of affordance, the included studies can be categorized into three groups, among which the degree of affordance actualization and intensity increases.

1) Potential affordance (PA): These studies assessed the availability of blue spaces, highlighting the possibility for affordance actualization and its relations to mental health. Key indicators included the presence and coverage of blue spaces near the residence or school, as well as proximity to the nearest blue space, in the participants' childhood.

2) Affordance actualization (AA): These studies focused on the affordances already actualized through children's interactions with blue spaces, capturing short-term mental health outcomes. Interventions such as surfing programs, dinghy sailing, and nautical activities served as indicators/interventions of actualized affordances. Partly, additional qualitative data were gathered through interviews with children or adult caregivers.

3) Intensity of actualized affordance (IA): These studies examined the frequency and determinants of affordance realization and their associations with mental health and well-being.

There were notable differences in the number of studies, sample sizes, and study designs across the three groups.

1) PA studies (N = 9) involved the largest samples (851 ~ 908,533) and spanned the full age range of childhood. Cohort studies examined the long-term effects of proximity to blue spaces on children's mental health outcomes[30–31,36,38], while cross-sectional studies explored current associations[32–35,37]. However, the lack of detailed residential histories limited the precision of exposure duration estimates and the ability to distinguish short- and long-term impacts.

2) AA studies (N = 9) had the smallest sample sizes (9 ~ 190), focusing mainly on adolescents aged 13 to 17. Four descriptive studies assessed perceived benefits from aquatic programs[40,43,45–46], while five experimental studies included pre–post designs[39,41–42,44] or control groups[47]. Due to the lack of follow-up in these studies, it is not possible to determine the durability of the mental health

Table 3: Categories of mental health and well-being and the corresponding definitions

Category	Definition
Quality of life and well-being	General psychological perception of one's own life circumstances
Overall mental health	Integrated capacity to manage emotions, thoughts, and behaviors
Individual expectation	Subjective anticipation of future events or outcomes
Self-confidence and self-efficacy	Confidence in one's abilities and belief in achieving goals
Self-awareness and self-esteem	Capacity to understand one's own emotions and thoughts, and to recognize self-worth
Resilience	Ability to cope with stress and adversity
Emotional and behavioral functioning	Composite ability to regulate emotions and control behavior
Social functioning	Capacity to fulfill social roles and meet interpersonal expectations
Attention	Ability to concentrate on specific tasks or stimuli
Intelligence and cognitive development	General intelligence and capacity for learning, information processing, and the adaptation to the environment

benefits. Although intervention volume was described—intervention length ranged from 6 weeks to 4 years, frequency was typically once or twice per week, and session duration ranged from 0.75 to 3 hours—these factors were not analyzed as independent variables among the included AA studies, suggesting limited attention to the dose–response relationship between aquatic activity and mental health.

3) IA studies (N = 3) had moderate sample sizes (115 ~ 15,743) and covered ages 0 to 16. For example, Elmira Amoly et al. used the number of days a child visited blue spaces within a year as a proxy for intensity[50]. Phoebe George et al. examined visit frequency, accessibility, and parental permission to assess overall exposure to blue spaces[49]. Valeria Vitale et al. further analyzed the depth and quality of children's engagement in different types of blue spaces through parental interviews[48].

3.2 Effects of Blue Space Affordances on Different Dimensions of Mental Health and Well-Being

Figure 3 illustrates the associations between blue space affordances and ten dimensions of mental health and well-being. Overall, stronger evidence was found for overall mental health, resilience, social functioning, self-confidence and self-efficacy, and emotional and behavioral functioning, while the remaining five categories received relatively limited empirical support.

3.2.1 Quality of Life and Well-Being

Three studies examined quality of life, with mixed findings. Regarding PA, two Canadian studies explored the effect of water body coverage. Quynh Huynh et al. investigated the percentage of water area within a 5 km radius around the school and found no significant association with current life satisfaction[32]. In contrast, Suzanne Tillmann et al. found a significant positive association between water area coverage within 500 m of the residence and multidimensional quality of life, including physical, psychological, social, and academic domains[34]. Regarding AA, the study by Ana I. Pereira et al. reported that caregivers perceived surfing therapy as beneficial for children's quality of life across multiple dimensions—physical health, mental health, self-perception, family relationships, financial resources, peer support, school environment, and social acceptance. However, the children themselves did not report significant improvements[47].

Six studies investigated subjective well-being, also yielding inconsistent results. Two studies focused on PA but found no significant associations between subjective well-being and either the proportion of nearby water area or the distance to blue spaces[32–33]. However, four studies examining AA or IA found significant improvements in children's subjective well-being following participation in surfing programs[42], dinghy sailing[43], and nautical activities[40], as well as through caregiver permission to access blue spaces and children's perceived accessibility[48].

3.2.2 Overall Mental Health

Five out of seven studies confirmed significant positive effects of childhood exposure to blue spaces on overall mental health. Regarding PA, walking distance from the residence to a blue space was significantly associated with children's current mental health status[37]. A large cohort study found that while children raised near blue spaces did not report better overall mental health, they exhibited a lower incidence of mental disorders[30–31]. In terms of AA, participation in boating activities was found to significantly enhance children's overall mental health[43]. Although children themselves
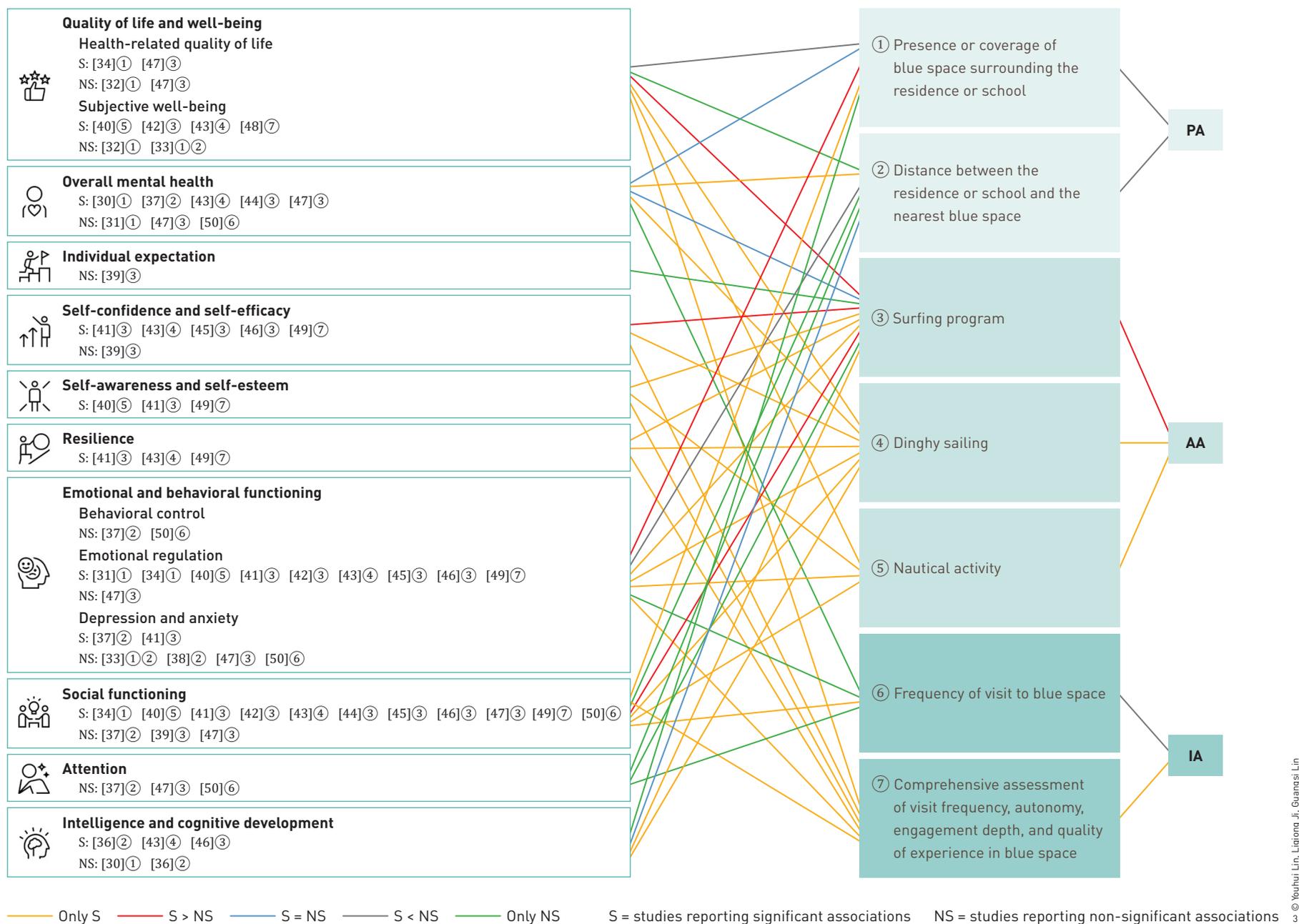
Fig. 3 Different evidence bases related to affordance actualization and intensity ([N] refers to Ref. [N]).

perceived fewer mental health benefits from surfing programs than their caregivers did[47], both children and their guardians reported notable improvements when the children had Down syndrome, Autism Spectrum Disorder (ASD), or Attention-Deficit/Hyperactivity Disorder (ADHD)[44]. However, the frequency of beach visits, an IA indicator, was not significantly associated with overall mental health outcomes[50].

3.2.3 Individual Expectation

Only one study investigated the effect of AA on children's individual expectation. Although a slight improvement was observed following participation in surfing activities, the effect did not reach statistical significance[39].

3.2.4 Self-confidence and Self-efficacy

Five out of six studies confirmed a significant positive effect of AA on children's self-confidence and self-efficacy. Caregivers often regarded beaches as safe environments where children could build confidence through engaging in adventurous activities[49]. Boating and surfing programs were found to potentially contribute to the

development of these traits, though insufficient confidence was reported as a common challenge during the early stages of such participation[41,43,45]. However, one study conducted by Bruno Silva et al. reported only limited improvements in self-confidence as a result of participating surfing programs[39].

3.2.5 Self-awareness and Self-esteem

All three studies examining this dimension demonstrated that AA significantly enhanced children's self-awareness and self-esteem. Regarding self-awareness, caregivers in coastal communities generally emphasized that beaches offered valuable opportunities for young children to develop self-understanding through daily experiences, environmental awareness, and cultural identity formation[49]. While one study found no significant effects of surfing on self-esteem, others identified potential benefits of both sailing activities and surfing programs. For instance, school-based maritime programs—including surfing, rowing, and sailing—were found to promote self-esteem by helping children overcome fear and challenges, thereby achieving self-transcendence[40]. Additionally, significant improvements in self-esteem were observed following an eight-week surfing intervention[41].

3.2.6 Resilience

Three studies confirmed a positive relationship between AA and children's resilience. These studies particularly emphasized that beaches served as safe, exploratory spaces that supported moderate risk-taking, emotional regulation, and risk management when children faced challenges[41,43,49].

3.2.7 Emotional and Behavioral Functioning

Blue spaces were more consistently associated with emotional regulation than with behavioral control. Two studies found no significant associations between blue space exposure and improvements in behavioral regulation among children[37,50]. In contrast, nine out of ten studies supported a positive relationship between blue spaces and emotional regulation, spanning all three categories of affordance actualization and intensity. Specifically, children who lived near blue spaces[34], received parental permission to access them, or visited beaches more frequently[49] exhibited better emotional regulation. Moreover, individuals who had lived near blue spaces throughout childhood reported higher emotional well-being in adulthood[31]. Aquatic activities were found to enhance children's and adolescents' positive affect[42], emotional regulation[40–41,43,45,47], emotional stability[46], and overall

emotional well-being[41] in the short term. However, one study did not find statistically significant improvements in emotional regulation following surfing interventions[47].

The effects of blue spaces on alleviating anxiety and depression in children remained inconclusive. Among six studies, only two reported significant positive effects, while three found no significant associations with accessibility[33], frequency of visit[50], or coastal residence[38]. Notably, one study suggested that children from socioeconomically disadvantaged backgrounds experienced stronger benefits from blue space exposure[37]. Additionally, results varied across studies using different psychological assessment scales[41,47].

3.2.8 Social Functioning

Two studies focusing on PA yielded mixed results regarding children's social functioning. While proximity to blue spaces was significantly associated with better social skills[34], distance to the nearest blue space was not[37]. In contrast, ten of eleven studies reported significant positive associations between AA—and the corresponding IA—and children's social competence. Aquatic activities were shown to provide abundant opportunities for social engagement. Through shared play, team-based tasks, challenging experiences, and environmental involvement, these activities enhanced prosocial behaviors, peer relationships, and social skills, while also promoting teamwork, confidence in social interactions, and a sense of social responsibility[49–50]. Surfing, in particular, helped improve social adaptability[46–47] and socialization[39] by facilitating interactions with peers and instructors. It also helped build stable social support networks[42] and fostered belonging and social connectedness[40], especially among adolescents with social challenges such as ASD[44–45]. Boating activities were found to strengthen communication, leadership, and collaboration skills[43], while school-based sailing programs encouraged children's engagement in civic and environmental initiatives[40].

3.2.9 Attention

All three studies found no significant associations between blue spaces and children's attention. Neither the presence of blue spaces near the residences nor the frequency of beach visits was linked to improved attention levels[37,50]. Surfing also failed to show statistically significant effects[47].

3.2.10 Intelligence and Cognitive Development

Among four studies, three reported that blue space exposure

positively influenced children's intelligence and cognitive development. These studies focused on AA, suggesting that aquatic activities supported executive function and cognitive flexibility by requiring rapid decision-making and environmental adaptation[43,46]. However, two other studies found no significant effects of the presence of water bodies in everyday settings—such as near the residences or schools—on cognitive development[30,36].

In summarizing the associations between blue space exposure and the ten dimensions of mental health and well-being across different categories of affordance actualization and intensity, notable differences in strength emerged:

1) PA were weakly associated with mental health and well-being. The most consistent finding was their significant link to overall mental health[30,37], while associations with specific dimensions remained limited. Some evidence supported positive relationships with quality of life and well-being[34], social functioning[34], and emotional and behavioral functioning[34,37], but more studies reported no significant effects.

2) AA showed stronger associations, especially in dimensions such as self-confidence and self-efficacy, self-awareness and self-esteem, resilience, emotional and behavioral functioning, social competence, and cognitive development.

3) IA was most strongly associated with mental health and well-being outcomes, particularly in social functioning and emotional and behavioral functioning[49–50]. Although some studies also reported benefits for aspects of subjective well-being[48], self-confidence, self-awareness, and resilience[49], the supporting evidence was comparatively limited.

3.3 Association Between the Affordance Actualization and Intensity and Mental Health and Well-Being Benefits

The mental health and well-being benefits of blue spaces vary substantially depending on the affordance actualization and intensity.

1) PA are influenced by both the spatial distribution of environmental resources and individual characteristics. Several studies have suggested that the access to high-quality blue spaces is unequally distributed, shaped by family socio-economic status and the level of urbanization in residential areas[32–35,37–38]. Childhood proximity to blue spaces may have lasting effects on the mental health, emotional well-being, and cognitive development in adulthood. Although some researchers controlled for confounding variables such as urbanization, socio-economic status of family and neighborhood, parental age, and family history of mental disorders, they still called for consideration of

additional moderating factors such as current stress levels and social connectedness[30,36]. Beyond the quantity of blue spaces, attention should also be paid to their quality and children's actual perception and use[30].

2) AA tend to generate more immediate positive effects on children's mental health and well-being. Aquatic activities offer a "challenge–support" environment, where children can explore and gain experience within a safe setting, enhancing their self-awareness, self-confidence, and self-efficacy[43,45,47]. Social interaction and cooperation during such activities not only strengthen social skills and cognitive empathy, but also reinforce peer relationships, social bonds, and shared values[41,44,47], contributing to both short-term emotional improvement and long-term emotional well-being[41–47]. Importantly, these activities provide emotionally supportive contexts for children with prior social, emotional, or behavioral difficulties, serving as alternative or complementary psychosocial interventions[41].

3) IA appears to further enhance the mental health benefits of blue spaces but is more dependent on the frequency and continuity of engagement, as well as participants' socioeconomic conditions. Although frequent beach visits have been associated with improvements in prosocial behaviors and peer relationships, these benefits are moderated by household financial status and transportation accessibility[50]. Childhood interactions with blue spaces also contribute to greater well-being in adulthood, partially mediated by current nature exposure, physical activity levels, and intrinsic motivation to visit natural spaces[48]. However, these associations vary across countries/regions and population groups. Children from lower socio-economic backgrounds are often disadvantaged in accessing blue spaces during childhood, which may result in compounding effects of nature deprivation and reduced mental well-being in later life.

4 Discussion

This scoping review highlights that the most consistent and robust benefits of childhood exposure to blue spaces are found in emotional and behavioral functioning, self-confidence and self-efficacy, and social functioning. These benefits increase as the degree of affordance actualization deepens, with IA being particularly critical. Factors such as socio-economic status, parental permission, and perceived safety not only influence the degree of affordance actualization but also help explain discrepancies among previous study findings. By extending the scope of the review to 75 rigorously evaluated studies, this

research comparatively examines the health-promoting effects of blue spaces versus green spaces, and identifies IA as the key to understanding how blue spaces support children's mental health and well-being.

4.1 Differences Between Blue Spaces and Green Spaces in Promoting Mental Health and Well-Being

The immersive and socially engaging nature of blue spaces may encourage children to participate more actively, thereby enhancing their mental health and well-being. The frequency of use of both green and blue spaces has been linked to prosocial behaviors, peer relationships, and reduced behavioral problems of children[50]. In the context of blue spaces, social interactions and shared experiences have been identified as primary motivations and perceived benefits of visitation[51–52]. Moreover, blue spaces appear to offer stronger effects than green spaces in emotional regulation and emotional well-being. Often perceived as emotional refuges[53], blue spaces may reinforce repeated visits through their relaxing and stress-reducing qualities[17].

Blue spaces may also play a more prominent role in fostering children's positive self-development, which may be attributed to their unique challenges and rich experiential opportunities. Among the inherent risks of blue spaces, drowning is a direct safety concern, whereas external conditions such as inclement weather may also influence children's opportunities for engagement. Both types of challenges, when properly managed, can provide valuable opportunities for enhancing children's self-confidence, self-efficacy, and self-esteem. In contrast, although schoolyard greening increases opportunities for outdoor activity, it has shown limited effects on improving self-esteem[54].

4.2 The Critical Role of Affordance Actualization in Promoting Mental Health and Well-Being

Previous studies have emphasized the role of individual motivation in engaging with blue and green spaces as a key determinant to mental health and well-being[15,55]. However, this scoping review—through the lens of affordance theory—identifies the affordance actualization and intensity as the central mechanism by which children benefit from blue spaces. Compared with PA, AA and the corresponding IA more effectively predict mental health outcomes. In other words, the mental health and well-being of blue spaces largely depend on whether children can truly access and engage with the opportunities provided.

Children's perception and use of blue spaces are shaped by multiple factors that affect the extent of affordance actualization.

Environmental attributes such as seasonality[21], spatial quality[15,56], aesthetic appeal[57], and biodiversity[58] influence their experience quality of water bodies. Perceived safety further strengthens the willingness of children and their caregivers to visit these spaces, thereby reducing subjective barriers and increasing the likelihood of engagement[57,59]. Although the challenges and occasional negative experiences encountered during safe aquatic activities can foster self-awareness, self-confidence, and self-efficacy[60], traumatic events such as hurricanes and floods during childhood may lead to anxiety disorders or post-traumatic stress[61–62]. Therefore, appropriate risk management in blue spaces is essential to mitigate potential harms and ensure that such environments remain conducive to children's well-being.

5 Practical Implications

Childhood engagement with blue spaces can be regarded as a "health prescription." However, the maximum benefits of such environments can only be realized when potential activity opportunities are transformed into experiences that are perceivable, accessible, and of sufficient intensity. Based on the review findings, this paper proposes four actionable recommendations for urban managers, landscape planners and designers, and educators.

First, governance strategies should combine safety management with equitable accessibility. A child-centered safety assessment system should be established, covering the full cycle from design to construction and operation. This includes implementing a dual care model that integrates on-site safety monitors with smart surveillance technologies. A graded risk classification and dynamic closure mechanism for blue spaces should be developed to issue timely warnings during extreme weather or flood events. Furthermore, the integration of public transit and active transport networks should be optimized to reduce the limitations that socio-economic disparities place on affordance actualization.

Second, a shift from "availability" to "engagement" is essential. The core value of blue spaces for children's mental health and well-being lies in opportunities for emotional resonance, social interaction, active exploration, and moderate risk-taking. Given adult concerns about safety[63], it is crucial to promote a positive education about risk at the societal level—one that supports safe yet challenging play experiences. This shift can improve caregiver acceptance of spontaneous aquatic activities and foster a sociocultural environment conducive to affordance actualization.

Third, affordance-oriented spatial design must be implemented across multiple scales. At the micro-scale, shallow pools, misting devices, interactive fountains, and permeable pavements that temporarily retain rainwater can be embedded within school campuses, community parks, and street corners. Incorporating elements such as moldable sand or gravel, wadeable vegetation, and movable components provides opportunities for short-term, everyday interactions with water. At the meso-scale, the visual quality of riverfronts, lakeshores, and coastal zones can be enhanced to increase public perceptual value and overall attractiveness[64]. At the macro-scale, urban blue–green corridors should link with natural wetlands, floodplain parks, and outdoor classrooms. This network can promote environmental equity by improving connectivity and access for socio-economically disadvantaged groups.

Fourth, activity programming should balance structured curricula with free play opportunities. Modular courses integrating water sports, environmental education, and psychological support can be developed. In communities with rich blue space resources, regular shared events—centered on team-based or cultural activities—can foster social connection. Meanwhile, more open time and sufficient open spaces should be reserved for unstructured, creative, and child-initiated water play that encourages their exploration and interaction with blue spaces.

6 Conclusions

This study innovatively introduced a conceptual framework based on levels of affordance to enhance the understanding of how children's interactions with blue spaces influence mental health and well-being. By extending the theoretical application of affordance theory to health-promoting environments, the study systematically reviewed existing literature and highlighted the central role of affordance actualization in realizing the mental health benefits by childhood blue space experiences. The key conclusions are as follows:

1) Overall, childhood interactions with blue spaces significantly contribute to various dimensions of mental health and well-being, including general mental health, resilience, social functioning self-confidence and self-efficacy, and emotional and behavioral functioning.

2) Despite being influenced by sociodemographic characteristics, household economic conditions, and urbanization levels of the living area, the actualization of affordances remains the core determinant of mental health benefits. Compared with potential affordances, the opportunities for children to perceive, engage with, and shape blue spaces are particularly critical.

3) By identifying the comparative advantages of blue spaces over green spaces—especially in promoting social functioning, emotional regulation, and self-confidence—this study enriched the theoretical foundation for understanding the relationship between urban nature and mental health. It also provides scientific evidences for incorporating blue spaces into public health interventions in urban environments.

Several limitations should be acknowledged. First, the number of included studies remains limited, with a predominant focus on Western contexts. The lack of Chinese-language literature and the underdevelopment of local research constrain the applicability of these findings across diverse socio-geographic settings. Second, existing research often treats blue and green spaces undifferentiated, overlooking the distinctive mental health and well-being of blue spaces. In addition, some studies that did not distinguish between indoor and outdoor environments (e.g., swimming-related research) were excluded in this scoping review, which may have resulted in the omission of relevant evidence. Finally, the initial search retrieved an excessively large number of papers. Future research should employ more precise search terms tailored to the specific research theme to save research effort.

In addition, four directions are recommended here for future research that adopts child-centered designs and leverages the affordance framework to strengthen empirical evidence.

1) Expand the definition of blue spaces. From the child's perspective, water-related play spaces are not limited to large natural bodies of water. Future research should consider everyday water features—such as interactive fountains, splash pads, and small artificial streams—as target blue spaces.

2) Examine spatial features that support water-related activities. Research should identify which design attributes (e.g., form, accessibility, adjacent vegetation) most effectively stimulate children's engagement with water, and analyze the affordance resources that enrich their aquatic experiences.

3) Deepen empirical research on affordance actualization. Future research should focus on clarifying the mechanisms through which affordance actualization and intensity, shapes children's mental health and well-being. In addition, longitudinal studies combined with quantitative evaluation methods are warranted to investigate the enduring effects of childhood water-related experiences on mental health and well-being in adulthood.

4) Advance the explanatory framework for multi-level

affordances. Existing research tends to emphasize the role of physical environmental support. Future studies should integrate sociocultural contexts and children's subjective emotional experiences to examine how multiple factors shape their engagement with blue spaces. Moreover, potential negative affordances and risks should be explored to fully understand the dual impacts of blue space exposure.

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童年蓝色空间可供性对心理健康福祉的影响：范围综述及启示

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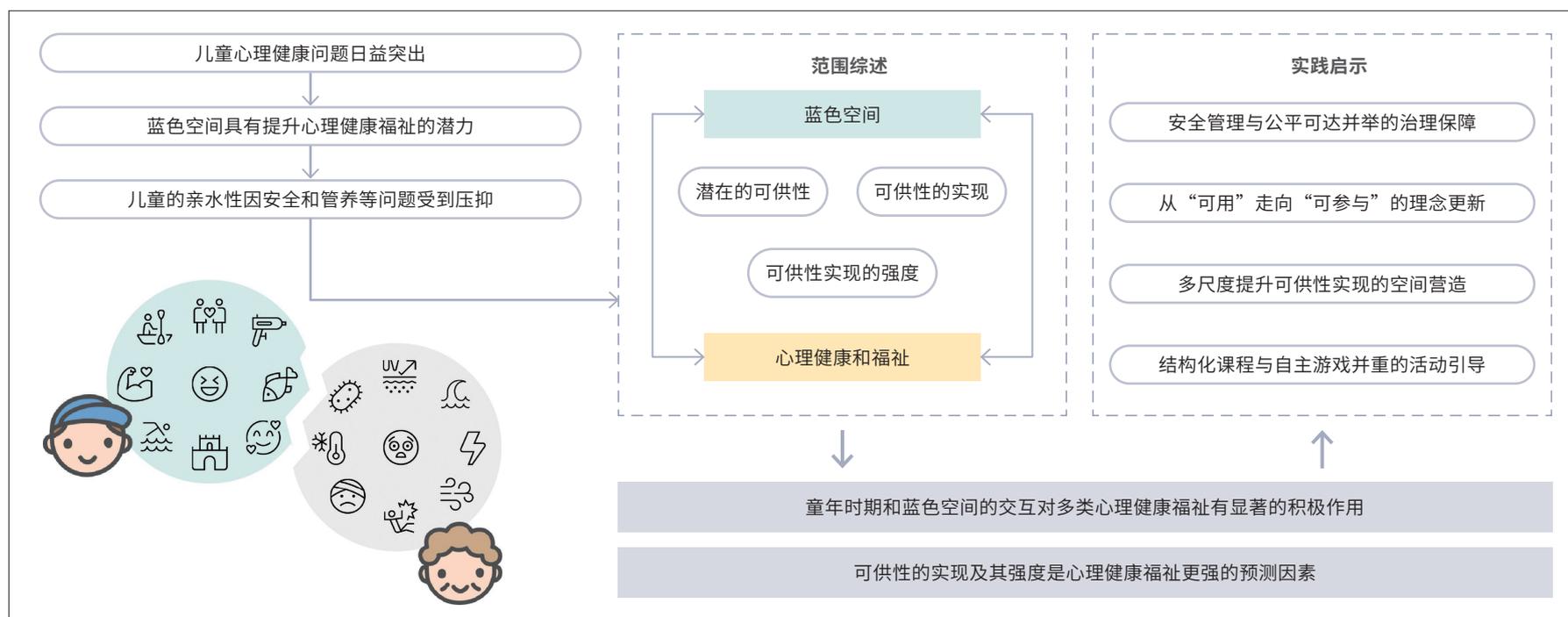3 东南大学建筑学院景观学系，南京 210096
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图文摘要

摘要

蓝色空间因其对儿童的强烈吸引力，被认为在促进儿童心理健康福祉方面具有重要作用。然而，当前已有研究较为零散，缺乏系统梳理。本文采用《系统综述和荟萃分析优先报告的范围综述扩展指南：清单与解释》范围综述方法，从Web of Science、Scopus、PsycINFO、MEDLINE等数据库筛选并分析了符合纳入标准的21篇文献。基于可供性理论，本文首先梳理了童年时期与蓝色空间交互对心理健康福祉的影响，进而探讨了可供性的实现及其强度是否影响以及如何影响这一作用过程。研究结果表明，童年时期的蓝色空间交互可显著提升整体心理健康、恢复力、社交能力、自信和自我效能、情绪和行为能力；相比绿色空间，蓝色空间在促进儿童社交能力、情绪调节和自信提升等维度更具优势，但需合理控制潜在风险；儿童在蓝色空间中获得心理健康福祉的过程依赖于可供性的实现及其强度，即儿童是否能有效感知、使用和体验蓝色空间，体验的深度与质量如何，以及受到社会经济因素、城市化水平等诸多因素的何种影响。最后，本文基于上述研究结论，从治理保障、理念更新、空间营造、活动引导等方面提出实践启示。研究首次集中呈现了童年蓝色空间交互

对心理健康福祉的潜在效益，为解释不同研究结果差异提供了理论视角，拓展了可供性理论在健康景观研究中的外延，并为健康城市规划提供了可操作路径。

关键词

景观感知；可供性；儿童；心理健康；福祉；蓝色空间；水上活动

文章亮点

- 引入可供性的层级以诠释儿童和蓝色空间的交互
- 童年和蓝色空间的交互增强了心理健康福祉的诸多方面
- 蓝色空间在提升儿童自信和自我效能等方面可能比绿色空间更有优势
- 蓝色空间可供性的实现及其强度是积极的心理健康福祉的重要预测因素
- 多重因素影响儿童对蓝色空间的感知与利用，进而影响健康效益

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1 研究背景

心理健康福祉是当前城市化进程中日益受到关注的话题[1-2]。具体来说，心理健康福祉涵盖一系列心理健康状况，不仅包括医学评估，还包括自我报告的生活质量和心理健康状况[3]。童年时期（0~18岁）是心理健康发展的关键阶段，这一时期可能对心理健康福祉产生的积极影响将带来持久的效益[4-5]。已有研究表明，增加儿童与公共开放空间的接触能够显著提升其心理健康福祉，自然环境在这一过程中发挥了重要作用[6-10]。然而，现有研究主要关注绿色空间[7,11-13]，较少探讨蓝色空间对儿童心理健康的潜在价值。

广义的蓝色空间包括海洋、河流、湖泊、湿地、池塘等以水体为显著特征的自然或人造水域[14]，以及室外游泳池、喷泉等建成环境中的人造水景[15]。学界对于蓝色空间潜在心理疗愈作用的认知始于20世纪末提出的注意力恢复理论。该理论认为，蓝色空间通过带来"逃离"心理或物理上远离需要持续集中注意力的情境的体验，帮助个体从日常压力和认知疲劳中暂时抽离、恢复注意力[16]。随后的实证研究进一步表明，蓝色空间在促进心理社会福祉方面也发挥着显著作用[17-20]。即便水景并非专为儿童游戏而设，儿童仍能识别并利用其中丰富的活动机会，进而激发内在动机并获得心理健康福祉[15,21]。

儿童倾向于将环境视为不同的活动机会[22]，而环境所支持的有益于健康的活动行为与特定的社会文化环境、物理环境及个人选择密切相关[23-24]。在现实中，儿童对蓝色空间的身体探索行为常受到安全管理等外在因素的限制，这可能影响儿童从中获得心理健康福祉。詹姆斯·杰罗姆·吉布森提出"可供性"（affordance）的概念，用于指代环境中支持个体行动的可能性[23]。根据个体行动的实现程度，可供性可被划分为一系列递进的层级——潜在、感知、使用和塑造的可供性[25]——这被认为是理解心理健康效益的关键视角（图1）。因此，本研究引入这4个层级来描述儿童对水体的接近性与互动强度，并将其分别定义为：潜在的可供性，即水体存在但尚未被察觉；感知的可供性，即识别并觉察水体存在；使用的可供性，即通过直接接触使用水体；塑造的可供性，即对水体环境进行改造（如建造沙堡），这些改造可能创出新的可供性。

基于蓝色空间可供性的层级框架，本研究旨在通过范围综述，1）审查既有文献的研究设计，根据可供性层级分析其研究侧重；2）探索童年和蓝色空间的交互作用是否会增强童年时期的心理健康福祉；3）分析可供性的实现及其强度是否影响及如何影响心理健康福祉效益的产生。该研究将有助于揭示蓝色空间对儿童心理健康福祉的促进机制，拓展城市蓝绿空间与心理健康福祉之间的研究视野，并为未来空间优化实践提供理论基础和评估框架。

2 研究方法

2.1 文献检索

本研究在Web of Science、Scopus、PsyclNFO、MEDLINE、Garden Landscape & Horticulture Index（GLHI）、中国知网6个数据库中，以"儿童""蓝色空间"和"心理健康"三类检索词对经同行评审的研究型论文（article）进行检索（表1）。其中，Web of Science使用"主题"检索；Scopus使用"检索字符串"（TITLE-ABS-KEY-AUTH）检索；

表 1：文献检索关键词

检索词类别	中文检索词	英文检索词
儿童	婴儿；新生儿；幼儿；儿童；青少年；童年；学生；学校	Infant*/pediatric*/paediatric*/neonatal*/baby/babies/toddler/boy*/girl*/juvenile*/child/children/kids/student*/schoolchild/schoolchildren/adolescent*/teen/youth/young adult*/young people/young person/preschool*/elementary school*/kindergarten*/day care/high school*/pre-pubescent*/prepubescent*/senior school*/secondary school*
蓝色空间	蓝色空间；蓝绿空间；水景；滨水；池塘；喷泉；溪；湿地；河；江；湖；海；水上运动；游泳；帆船；冲浪	Blue-green space*/green-blue space*/blue space*/blue-green infrastructure/green-blue infrastructure/water/waterscapes/freshwater/aquatic environments/ponds/fountains/rivulets/wetlands/river/riparian/lake/sea/beach/oceans/coast*/marine/game waterfall*/artificial water/watersports/swim/swimming/sail/sailing/surf/surfing
心理健康	心理健康；幸福感；康复；疗愈；注意力；恢复	Mental health/mental well-being/social well-being/subjective well-being/mental hygiene/mental disorders/*psychology/psychological/healing /therapeutic landscape/*well-being/attention/restoration/resiliency/ADD/tourette/bipolar disorder/obsessive compulsive disorder/ADHD/anxiety/anxious/stress/posttraumatic stress/acute stress disorder/schizo*/somat* disorder/hypochondriasis/dissociative amnesia/dissociative disorder/emotion*/mood/aggression/aggressive/happiness/pleasure/dysthymic disorder/cyclothymic disorder/panic disorder/agoraphobia/phobia/depressive/depression/autism/distress/cognitive function/personality/self-esteem/self-confidence/depersonalization disorder/obsessive-compulsive disorder

注

在文献检索中，"*"为截词符（也称为"通配符"），其作用是匹配某关键词的所有相关词汇变体，从而提高检索的全面性。

Psyclnfo、MEDLINE、GLHI使用"全文字段"检索；知网使用"主题"检索。检索时间为2023年2月9日，共检索到72 845篇相关文献。

2.2 文献筛选

文献筛选主要依据以下3个原则：

1）研究参与者的年龄应为0～18岁；若无明确说明参与者的年龄，则参与者的身份应为幼儿园、小学、初中或高中学生；若参与者涉及成人，则参与者平均年龄应低于13岁，或至少80%的参与者年龄小于15岁[8,26-28]；若参与者是成人，但研究旨在引导参与者回忆其童年时与蓝色空间的交互情况，探讨其对成年后心理健康的益处，则也被纳入综述范围。

2）参与者应有机会与蓝色空间中的水体进行互动，这种互动可以是多种形式：可以在水中、在水面上、靠近水体或远距离通过感知和使用水体进行互动。

3）研究应使用定量测量或定性描述的方法探究参与者的心理健康福祉的状态或变化。

文献筛选过程遵循《系统综述和荟萃分析优先报告的范围综述扩展指南：清单与解释》[29]，筛选过程详见图2。首先将所有检索所得文献导入到EndNote中，删除重复项；然后将去重后的文献导入Rayyan平台②，由两名研究人员（本文作者）根据上述筛选标准独立审查，根据文献的标题和摘要筛选文献；随后，通过滚雪球的方式补充纳入15篇文献；最终，通过全文评估排除不符合要求的文献，共获得21篇有效文献[30-50]。

2.3 文献关键信息提取

研究对21篇文献进行数据提取，各项研究的研究设计、参与者年龄、蓝色空间相关因素、心理健康福祉测度内容等详细的关键信息如表2所示。

① 本研究参考了聚焦绿地之于儿童健康效益的范围综述中常使用的文献筛选方式（如参考文献[8,26-28]）。虽然此类综述纳入的文献常涉及成人参与者，但其主要研究对象仍是0～18岁的儿童。该文献筛选条件能够合理地将这类研究纳入综述，有效排除研究对象为成人的研究。

② Rayyan 是一款由卡塔尔计算研究院开发、专门为系统综述工作流程设计并向学者免费开放的在线文献筛选与协作平台。

参考文献	研究设计类型／研究方法类型／ 参与者年龄（岁）／国家／样本量	蓝色空间相关因素／数据分析方法	心理健康福祉测度内容／测度工具或方法
[30]	队列研究／定量方法／10／丹麦／ N=908 553	居住地周围蓝色空间的覆盖率／e	智力残疾、精神疾病、边缘型人格障碍、情绪障碍、特定人格障碍、强迫症、单次发作和复发性抑郁障碍／ICD-10
[31]	队列研究／定量方法／10／丹麦／ N=66 194	居住地周围蓝色空间的覆盖率／e	整体心理健康水平、情绪幸福感水平／SF-12
[32]	横断面研究／定量方法／11～16／ 加拿大／N=17 249	居住地周围蓝色空间的覆盖率／e	主观生活满意度／Cantril Ladder
[33]	横断面研究／定量方法／主要为13～17／ 新西兰／N=4 575	居住地周围内陆水域的覆盖率／e 是否居住在距海岸线1 600 m范围内／e	主观心理幸福感水平／WHO-5；抑郁程度／RADS-SF
[34]	横断面研究／定量方法／8～14／ 加拿大／N=851	居住地周围蓝色空间的覆盖率／e	健康相关生活质量／PedsQL；情绪调节策略使用情况／ERQ-CA
[35]	横断面研究／定量方法／17～23／ 美国／N=9 385	居住地周围蓝色空间的覆盖率／e 居住地或学校至蓝色空间的距离／e	抑郁程度／MRFS
[36]	队列研究／定量方法／0、4、7、10／ 葡萄牙／N=3 827	学校至最近海域的距离／e 居住地到蓝色空间的步行时间／e 学校至最近河流的距离／e 居住地至最近河流的距离／e 学校至任意类型蓝色空间的距离／e 居住地至任意类型蓝色空间的距离／e	智力水平／WISC-III
[37]	横断面研究／定量方法／0～17／ 德国／N=12 624	居住地到蓝色空间的步行时间／e	包括情绪症状、品行问题、多动症或注意力缺陷、和同伴关系问题4个维度的总困难评分，以及情绪症状、行为问题、同伴关系问题、亲社会行为、多动或注意力不集中的程度／SDQ
[38]	队列研究／定量方法／2～5／ 澳大利亚／N=2 396	居住地到海滩的距离／e	抑郁程度／SMFQ；焦虑程度／SCAS
[39]	随机对照试验（前后测）／定量方法／ 11／葡萄牙／N=190	冲浪项目／b	个人期望、自信程度、社会化程度／WEMWBS
[40]	描述性研究／混合方法／15／葡萄牙／ N=595（填写问卷的儿童），N=14（参与访谈的儿童），N=16（参与访谈的监护人），N=5（参与访谈的教师）	航海活动／a	幸福感／自制问卷；幸福感、社交行为、自尊水平、压力缓解／焦点小组访谈

表 2：纳入文献的关键信息提取 （接上表）

参考文献	研究设计类型／研究方法类型／参与者年龄（岁）／国家／样本量	蓝色空间相关因素／数据分析方法	心理健康福祉测度内容／测度工具或方法
[41]	随机对照试验（前后测）／混合方法／14～17／澳大利亚／*N*=9	冲浪项目／a	自尊水平／RSES；自我照护能力、自信程度和掌控感／半结构访谈；恢复力／BRS；抑郁程度／PHQ-A；情绪调节和压力缓解、健康关系的培养／半结构访谈；社会联系／SCS-R 和半结构访谈
[42]	随机对照试验（前后测）／混合方法／7～22／塞拉利昂／*N*=58	冲浪项目／d	幸福感／PARCHISY；抑郁程度／BPHS-Y；自我意识、情绪调节能力、同理心和社交能力／SEAL；压力缓解和情绪调节、自信提升、社交支持网络建立／个别访谈
[43]	描述性研究／定性方法／9～13／英国／*N*=2(机构代表)，*N*=4（帆船教练），*N*=22（儿童），*N*=3（学校教师），*N*=2（慈善基金会工作人员），*N*=2（水手），*N*=3（其他相关帆船组织的代表）	小船航行／a	幸福感水平、整体心理健康、自信程度和成就感、恢复力、解决问题和决策的能力、情绪和行为功能、社交能力／焦点小组及半结构访谈
[44]	随机对照试验（前后测）／定量方法／8～18／荷兰／*N*=84（患有唐氏综合症、自闭症或注意力缺陷、多动障碍的儿童）	冲浪项目／c	心理幸福感、社会支持／Kidscreen-27
[45]	描述性研究／定性方法／13～17／南非／*N*=45	冲浪项目／a	自信与自我认同程度、同伴关系、积极情绪体验／与父母、照护者、教师、职业治疗师的焦点小组访谈，冲浪治疗导师在冲浪治疗课程中的观察，以及利用包容性工具引导儿童分享
[46]	描述性研究／定性方法／12.8（青少年）／澳大利亚／*N*=18（青少年），*N*=18（导师），*N*=1（协调员）	冲浪项目／a	自我效能感与掌控感、情绪改善、认知发展、社交技能／焦点小组及半结构访谈
[47]	随机对照试验（前后测）／定量方法／7～17／葡萄牙／*N*=73	冲浪项目／c	健康相关生活质量／儿童和照护者各自填写的 Kidscreen；自尊水平／儿童填写的 RSES；总困难评分／儿童和照护者各自填写的 SDQ；焦虑和抑郁程度／儿童填写的 RCADS 和 RCADS-A；情绪调节／儿童填写的 ERQ-CA；社会联系／SCS-r；亲社会行为／照顾者填写的 SDQ ProSoc；认知控制和执行功能／"走－停"子测验与"相反世界"子测验
[48]	队列研究／定量方法／0～16／18 个国家和地区／*N*=15 743	对访问蓝色空间的频率、自由度的综合评估／e, f	主观心理幸福感／WHO-5
[49]	描述性研究／定性方法／2～10(儿童)，未提及(家长)／澳大利亚／*N*=45（儿童），*N*=25（父母）	对访问蓝色空间的频率、自由度、深度与质量的综合评估／a	情绪调节、自信程度、自我意识、恢复力、社交行为／半结构访谈
[50]	横断面研究／定量方法／7～10／西班牙／*N*=2 111	海滩年访问频率／e	总困难评分、亲社会行为、同伴关系问题、情绪症状和行为问题、多动症或注意力不集中／SDQ、ADHD/DSM-IV

注

1. ADHD/DSM-IV 即注意缺陷多动障碍诊断标准（《精神障碍诊断与统计手册》第四版）；BPHS-Y 即儿童与青少年行为与心理症状量表；Cantril Ladder 即坎特里尔生活满意度阶梯量表；ERQ-CA 即儿童与青少年情绪调节问卷；ICD-10 即国际疾病分类第十版；Kidscreen 即儿童生活质量问卷；MRFS 即家庭情绪量表；PARCHISY 即亲子互动风格与青少年结果量表；PedsQL 即儿童生活质量量表；PHQ-A 即青少年患者健康问卷；RCADS 即修订版儿童焦虑抑郁量表；RCADS-A 即修订版青少年焦虑抑郁量表；RSES 即罗森伯格自尊量表；SCAS 即斯彭斯儿童焦虑量表；SCWS 即社交沟通与退缩量表；SCS-R 即自我慈悲量表修订版；SDQ 即儿童长处与困难问卷；SDQ ProSoc 即儿童长处与困难问卷亲社会行为分量表；SMFQ 即短期情绪与感受问卷；WEMWBS 即华威－爱丁堡心理健康量表；WHO-5 即世界卫生组织五项幸福感指数；WISC-III 即韦氏儿童智力测验第三版。

2. a 表示描述性分析；b 表示 *t* 检验；c 表示方差分析；d 表示非参数检验；e 表示回归分析；f 表示结构方程模型。

3 研究结果

3.1 蓝色空间研究设计与可供性关系分类

在21项研究中，除2项发表于2013～2018年间，其余均发表于2018年之后。这些研究主要在欧洲（10项）、大洋洲（5项）、北美洲（3项）和非洲（2项）开展，1项研究纳入了来自18个国家的数据，暂时没有研究在中国开展。

在评估方法方面，除了15项研究所使用的心理健康量表外，半结构访谈或焦点小组访谈（4项）、全国性心理健康记录数据集（1项）、自我报告（1项）和生理测量（1项）等方法也被采用。本研究将这些研究中涉及的心理健康福祉的内涵总结归纳为10个维度（表3）。

通过分析各项研究中的蓝色空间评价指标或干预条件与可供性层级的关联性，研究设计与可供性的关系被分为3类，可供性的实现及其强度依次递增。

1）潜在的可供性研究：聚焦蓝色空间资源的充沛程度，即潜在的可供性，显示了可供性实现的可能性与心理健康福祉的关联；相关指标包括童年时期家庭或学校周边水体存在与否、覆盖率，以及家庭／学校和周围最近水体的距离。

表3：心理健康福祉类别及其内涵

类别	内涵
生活质量与幸福感	个体对生活状态的总体心理感知
整体心理健康	个体对自身情绪、思维和行为的整体调节能力
个人期望	对未来事件或结果的主观期待
自信与自我效能	对自我能力的信心及达成目标的信念
自我意识与自尊	了解自我情绪与想法的能力及对自我价值的认可
恢复力	应对压力与逆境的能力
情绪与行为能力	调节情绪与控制行为的综合能力
社交能力	扮演社会角色并满足人际期望的能力
注意力	聚焦特定任务或刺激的能力
智力与认知发展	智力测试中的一般智力，以及学习、信息处理、适应环境等能力

2）可供性的实现研究：聚焦已通过互动实现的可供性，揭示其带来的短期心理健康福祉；这些实验性研究的干预条件，例如冲浪项目、小船航行、航海活动等，代表着蓝色空间对儿童活动的可供性；另有部分研究通过面向成人的半结构访谈或面向儿童的焦点小组访谈补充了儿童和蓝色空间交互的细节信息。

3）可供性实现的强度研究：相比于第二类研究仅呈现蓝色空间为儿童提供活动机会前后的心理状况变化，此类研究考虑可供性实现的频率及影响因素，即进一步考察可供性实现的强度和心理健康福祉的关联性。

此三类研究的数量、样本量和研究设计均呈现出较大差异。

1）潜在的可供性。此类研究数量较多（9项），样本量最大（851～908 533），覆盖全年龄段儿童。其中，队列研究探索了居住地或学校周围蓝色空间对儿童心理健康的长期影响[30-31,36,38]，横断面调查则探索了这些指标与当前心理健康状态的关联性[32-35,37]。然而，由于此类研究缺乏儿童详细的居住历史信息，限制了对儿童蓝色空间暴露的持续时长及其长短期影响的精确估计。

2）可供性的实现。此类研究数量也较多（9项），但样本量最小（9～190），主要聚焦于13～17岁的青少年。4项描述性研究收集了儿童对水上活动项目的心理健康效益的感知，或通过监护人和水上活动项目的相关工作人员了解儿童在干预前后的心理健康效益变化[40,43,45-46]。随机对照实验包含4项前后对照实验[39,41-42,44]和1项设置了无干预的对照实验[47]。由于这些研究缺乏后续随访，同样无法确定蓝色空间所产生的心理健康效益的持久性。在此类研究中，干预周期、干预频率和干预时长被用于定量描述水上活动的干预时间量——干预周期为6周至4年不等，干预频率皆为每周1~2次，干预时长为0.75～3 h——但这些参数并未被用作研究中的自变量，而仅作为描述参数。这反映出目前学者们暂时未关注到水上活动的干预时间量对心理健康效益的潜在影响。

3）可供性实现的强度。此类研究数量最少（3项），样本量适中（115～15 743），覆盖年龄段为0～16岁。其中，艾尔米拉·阿莫利等以儿童一年内实际访问蓝色空间天数作为实现强度评估指标[50]。菲比·费罗等的研究不仅涉及访问频率，也使用可达性、访问频率，以及监护人对儿童在蓝色空间活动的许可作为童年接触蓝色空间的总体指标[49]。瓦莱里娅·维塔莱等则进一步通过访谈监护人以了解育儿家庭进入和使用不同类型蓝色空间的方式[48]。换言之，后两项研究不仅涉及访问频率，还反映了儿童可与蓝色空间交互的自主性或外部约束，以及儿童在各类蓝色空间活动的深度与质量。

3.2 蓝色空间的可供性对不同心理健康福祉维度的影响

此21项研究的研究结果与10个心理健康福祉维度的对应关系如图3所

示。总体而言，整体心理健康、恢复力、社交能力、自信和自我效能、情绪和行为能力这几类的证据相对充足，而其余5类的证据相对较弱。

3.2.1 生活质量和幸福感

有3项研究探讨了生活质量，但结论不一。在潜在的可供性方面，2项加拿大的研究均探究了水体面积占比的作用：琼·黄等考察了学校周围5 km范围内水体面积占比，未发现其与当前生活满意度的显著关联[32]；而苏珊娜·蒂尔曼等考察了居住地500 m范围内水体面积占比，发现其与包含儿童身体、心理、社交、学业在内的多维度生活质量显著相关[34]。在可供性的实现方面，安娜·I. 佩雷拉等的研究显示，照护者认为冲浪治疗对儿童在身体健康、心理健康、自我感受、家庭关系、经济资源、同伴支持、学校环境和社会接受度多维度生活质量方面有积极影响，但儿童自身的报告未显示有显著改善[47]。

有6项研究探讨了幸福感，结论同样不一。其中，2项研究关注潜在的可供性，但均未发现居住地周围水体面积占比与蓝色空间的距离对幸福感存在显著影响[32-33]。然而，另外4项关注可供性的实现的研究发现，参与冲浪[42]、小船航行[43]、航海活动[40]，以及监护人对儿童进入蓝色空间的许可和儿童对蓝色空间可达性的感知[48]均显著提升了儿童幸福感。

3.2.2 整体心理健康

有7项研究中的5项证实了童年接触蓝色空间对整体心理健康的显著积极影响。对于潜在的可供性，居住地至蓝色空间的步行时间与当前整体心理健康水平显著相关[37]。大样本队列研究表明，在蓝色空间周围成长的儿童虽然没有报告更积极的整体心理健康水平[31]，但精神疾病的发病率更低[30]。在可供性的实现方面，参与小船航行能显著提升儿童的整体心理健康[43]。尽管儿童对冲浪项目的心理健康改善感知不如监护人明显[47]，但对于患有唐氏综合症、自闭症谱系障碍或注意力缺陷多动障碍的儿童而言，无论是儿童自身还是其监护人，都报告了冲浪项目对整体心理健康的显著改善[44]。此外，在可供性实现强度方面，海滩访问频率与儿童整体心理健康未显示显著关联[50]。

3.2.3 个人期望

仅一项研究调查了可供性的实现对个人期望的影响，发现儿童的个人期望在参与冲浪后有所提升，但效果未达到统计显著水平[39]。

3.2.4 自信与自我效能

在6项研究中有5项证实了可供性的实现对自信与自我效能的显著积极影响。海滩被监护人视为儿童通过参与各种冒险活动建立信心的安全场所[49]。小船航行和冲浪项目在发展自信与自我效能维度具有潜在贡献，尽管自信不足可能在参与项目的初期成为儿童的一大挑战[41,43,45]。不过，布鲁诺·席尔瓦等的研究显示，冲浪对儿童自信的提升作用较为有限[39]。

3.2.5 自我意识与自尊

有3项研究都证实了可供性的实现能显著提升儿童自我意识和自尊水平。对于自我意识而言，沿海社区的家长普遍认为，海滩在日常体验、环境保护意识及文化认同等多重维度上，都为幼儿提供了建立自我意识的重要机会[49]。有研究未发现冲浪对儿童自尊水平的显著提升作用，但也有研究证实了航海活动和冲浪干预的潜在积极影响。例如，学校航海活动（包括冲浪、划船和帆船等）通过帮助儿童克服恐惧与挑战、实现自我超越，从而提升自尊[40]；冲浪治疗8周后，儿童的自尊水平亦显著提升[41]。

3.2.6 恢复力

该3项研究均证实了可供性的实现对儿童恢复力的积极作用，这些研究特别强调，在儿童面对挑战时，海滩为其提供了一个允许适度冒险、支持风险管理和情绪调节的安全探索空间[41,43,49]。

3.2.7 情绪和行为能力

蓝色空间更倾向于支持儿童的情绪调节，而非加强其行为控制能力。有2项研究均否定了蓝色空间对儿童行为控制能力的提升作用[37,50]，而10项研究中有9项证实了蓝色空间对情绪调节能力的积极作用，这些研究广泛触及了有关可供性的实现及其强度的3个类别。对于蓝色空间的情绪调节作用，研究发现居住地邻近蓝色空间[34]、获得监护人进入许可、海滩访问频率较高[49]的儿童表现出更好的情绪调节能力，且长期生活在蓝色空间附近的个体在成年后报告了更高的情绪幸福感[31]。研究发现水上活动能在短期内提升儿童和青少年的积极情绪[42]、情绪调节能力[40-41,43,45,47]和情绪稳定性[46]，增强情绪幸福感[41]，但仍有1项研究未发现冲浪对儿童情绪调节能力的显著提升作用[47]。

蓝色空间对缓解儿童焦虑和抑郁的作用仍存在争议。在6项研究中仅有2项发现显著积极影响，而3项未发现蓝色空间的可达性[33]、访问频率[50]或沿海居住[38]的改善作用。此外，有研究发现，蓝色空间的积极影响在低社会经济背景群体中更为显著[37]，且采用不同评价量表的实验研究[41,47]的结论不尽相同。

3.2.8 社交能力

有2项聚焦潜在可供性的研究就社交能力维度得出了不同的结论。居住地附近的蓝色空间与社交能力[34]显著相关，但居住地至最近的蓝色空间的距离则与儿童社交能力无显著关联[37]。相较而言，11项研究中的10项表明，可供性的实现及其强度对儿童社交能力具有显著积极作用。水上活动不仅提供丰富的社交机会，还能够通过共享游戏、团队合作、挑

战性活动和环境参与，提升亲社会行为、同伴关系和社交技能，增强团队合作精神、社交自信及社会责任感[49-50]。其中，冲浪通过儿童与同伴或教练的互动，能够提高社交适应能力[46-47]和社会化程度[39]，帮助建立稳固的社交支持网络[42]，并增强归属感和社交连结[41]，对面临社交挑战（如自闭症谱系障碍）的青少年尤为有效[44-45]。小船航行可提升儿童的沟通、领导和团队合作能力[43]，而学校航海活动则可促进儿童参与环保等社会公共事务，带来更大的社会效益[40]。

3.2.9 注意力

仅有的3项研究均未发现蓝色空间对儿童注意力水平的提升作用。居住地周边的各类蓝色空间和海滩访问频率均与儿童注意力水平无显著关联[37,50]，且冲浪也未显示统计显著效果[47]。

3.2.10 智力与认知发展

有5项研究中的3项证实了蓝色空间对儿童智力与认知发展的提升作用，它们共同聚焦可供性实现，发现水上活动通过提供要求儿童快速决策和适应环境的成长性体验，提高了儿童的执行能力和认知灵活性[43,46]。然而，另有两项研究表明，居住地、学校等为日常生活空间中水体存在与否对此并无显著影响[30,36]。

通过进一步总结蓝色空间与上述10类心理健康福祉效益和可供性的实现及其强度的关联证据，可发现这些关联强度存在显著差异：

1）潜在的可供性与心理健康福祉的关联性整体较弱，现有研究主要发现其与整体心理健康水平存在显著关联，而与具体心理健康维度的关联尚不充分[30,37]。对于其他心理健康福祉类别，虽然有少量证据支持其生活质量和幸福感[34]、社交能力[34]、情绪和行为能力[34,37]的显著关联，但更多的研究发现它们并无关联。

2）可供性的实现与心理健康福祉的关联性较强，尤其是在自信与自我效能、自我意识与自尊、恢复力、情绪与行为功能、社交能力、智力和认知发展维度。

3）可供性实现的强度与心理健康福祉的关联性最强，尤其是在社交能力、情绪与行为功能维度[49-50]。虽有研究证实了其对主观幸福感[48]、自信、自我意识、恢复力[49]等方面的影响，但证据量较小。

3.3 可供性的实现及其强度与心理健康福祉效益的关联

蓝色空间对心理健康福祉的效益，因可供性的实现及其强度的差异而呈现显著变化。

1）潜在的可供性对心理健康福祉的促进受环境资源空间分布与个体特征的共同影响。研究表明，家庭社会经济地位和居住地城市化水平可能影响儿童获得优质蓝色空间的机会[32-35,37-38]。童年时期蓝色空间的可达性对成年后心理健康、情绪幸福感和智力水平的持续影响可能包含多种因素。尽管既有研究已控制了城市化水平、家庭和城市社会经济地位、父母年龄和精神疾病家族史等协变量，但它们依然呼吁关注更多社会人口特征（如当前压力水平、社交联系）的潜在调节作用[30,36]。此外，应在测量蓝色空间数量的基础上关注其质量，以及个体对蓝色空间的实际感知和使用情况[30]。

2）可供性的实现对儿童心理健康福祉具有更即时的积极影响。水上运动可通过"挑战—支持"的模式，使儿童在安全环境内进行探索、积累经验，从而提升自我认知、自信与自我效能[43,45,47]。活动中的社交互动与合作不仅可拓展儿童的社交技能与社会认知[43,46]，还能强化同伴关系、社交连结和共享价值观[41,44,47]，改善短期情绪状态和长期情绪健康[41-47]。值得注意的是，这类活动为曾经历社交、情绪或行为困扰的儿童提供了通过表达与获取共鸣而得到情感支持的情境[41]，成为了一种替代性或补充性心理干预途径。

3）可供性实现的强度对心理健康福祉的促进作用更加依赖于对蓝色空间的访问频率、持续性及参与者的社会经济条件。儿童的海滩访问频率虽能显著促进亲社会行为和同伴关系，但这一效应也受到家庭经济条件与交通便利性的影响[50]。童年时期与蓝色空间的交互经验可显著促进成年后的幸福感，在这一过程中，当前自然接触频率、身体活动水平，以及前往自然空间的内在性动机起到部分中介作用[48]。同时，这些关联性在不同国家和社会群体中存在差异，社会经济地位较低者因童年获得蓝色空间机会有限，成年后更可能呈现自然接触不足与心理健康福祉较低的叠加影响。

4 讨论

上述综述结果表明：童年蓝色空间对儿童最稳定、最一致的积极影响主要体现于情绪与行为功能、自信与自我效能、社交能力等维度；这些效益随可供性实现程度的深入而增强，其中可供性的实现强度尤为关键；社会经济条件、家长许可、安全感知等因素既影响了可供性的实现，也解释了不同研究结论的差异。本研究通过将综述范围拓展至75篇详细评估文献，在比较蓝色空间与绿色空间在健康促进差异的基础上，继而围绕可供性的实现强度这一核心，解析蓝色空间对儿童心理健康福祉效益的影响。

4.1 蓝色空间和绿色空间对心理健康福祉影响的差异

蓝色空间的沉浸式体验和社交特性吸引儿童主动参与，从而促进心理健康福祉。绿色空间和蓝色空间的使用频率都与儿童的亲社会行为、同伴关系和行为问题显著相关[50]。就蓝色空间而言，研究还发现，与他人共度时光、共享体验是人们访问蓝色空间的主要动机和益处[51-52]。此外，相较于绿色空间，蓝色空间在情绪调节和情绪幸福感维度更具优

势。蓝色空间常被视为情绪庇护所[53]，其放松和缓解压力的作用可进一步激励人们的持续访问[17]。

蓝色空间支持儿童积极自我发展的作用或许较绿色空间更为突出，这可能与其独特的挑战性和丰富的体验机会有关。在蓝色空间的固有风险中，溺水是最直接的安全隐患；而像恶劣天气这样的外部条件也可能影响儿童的参与机会。在妥善管理下，这两类挑战都能够成为促进儿童自信、自我效能和自尊的重要契机。相比之下，虽然对校园操场的绿化提供了更多户外活动机会，但就自尊提升作用而言，并未显示出更显著的效果[54]。

4.2 可供性的实现对蓝色空间发挥心理健康福祉效益的关键作用

既往研究认为，个体与蓝绿空间交互的主观意愿是影响心理健康福祉的关键因素[15,55]。然而，本综述基于可供性视角，发现可供性的实现及其强度是影响儿童在蓝色空间中获得心理健康效益的核心因素。与潜在可供性相比，实现的可供性和可供性实现的强度更能有效预测心理健康福祉。换言之，蓝色空间的心理健康效益在很大程度上取决于儿童是否能够真正利用和体验其所提供的活动机会。

儿童对蓝色空间的感知与利用受多重因素影响，进而影响可供性的实现程度。例如，季节[21]、蓝色空间的品质[15,56]、吸引力[57]及生物多样性[58]等环境因素会影响儿童的水体互动体验；对蓝色空间的安全感知可增强儿童及监护人的访问信心，帮助儿童克服主观障碍，提高进入蓝色空间的可能性[57,59]。尽管儿童在安全环境中参与水上活动时面临的挑战性任务及负面经历有助于提升自我认知、自信和自我效能[60]，但童年时期经历飓风、洪水等自然灾害可能导致焦虑障碍或创伤后应激障碍[61-62]。因此，应合理控制蓝色空间的风险，将潜在负面影响维持在可控范围内。

5 实践启示

童年与蓝色空间的交互可以被视为一种"健康处方"，但只有将潜在活动机会真正转化为可感知、可使用且具有一定强度的体验，蓝色空间才能实现其最大效益。基于综述结果，本文面向城市管理者、规划设计师与教育工作者提出以下4项可操作的实践启示。

第一，安全管理与公平可达并举的治理保障。建立覆盖设计－建造－运营全周期的儿童安全评估体系，引入一种集成现场安全监测与智能监控技术的双重保障模式；制定蓝色空间风险分级与动态关闭机制，在极端天气、洪水预警时及时发布警示；优化公共交通驳接与慢行网络，缩小社会经济差距对蓝色空间可供性实现的限制。

第二，从"可用"走向"可参与"的理念更新。蓝色空间对于儿童心理健康福祉的核心价值在于儿童能否在情感共鸣和社会互动中主动探索、承担适度风险并获得成长体验。考虑到成人对安全的担忧[63]，应在社会层面倡导积极看待风险的教育观，在保证游戏安全的前提下，允许适度挑战，从而提升监护人对儿童自主亲水行为的接受度，为可供性实现营造积极的社会文化环境。

第三，多尺度空间营造，提升可供性实现。在小微尺度上，可在校园、社区公园及街角嵌入浅水池、雾森、互动喷泉与雨后滞水铺装等装置设施，采用可塑沙质/砾石、可涉水植物、可移动构件等元素，为日常短时亲水提供机会；在中尺度上，可提升沿河、滨湖与海岸带视觉质量，增强公众感知价值及整体吸引力[64]；在大尺度上，可在城市蓝绿廊道体系中串联自然湿地、生态滞洪区与户外课堂等节点，通过提升交通连贯性和可达性保障低社会经济背景群体的环境公平。

第四，结构化课程与自主游戏并重的活动引导。将水上运动、环境教育与心理辅导有机结合，设置模块化课程；蓝色空间资源丰富的社区可定期组织共享性活动，通过团队协作、文化共享等方式强化社会联结；预留充足的自由时段与开放场地，支持儿童通过自发式、创造性的亲水游戏探索蓝色空间。

6 结论

本研究创新性地引入可供性层级的概念框架，为理解儿童—蓝色空间交互过程如何影响心理健康效益提供了新的分析视角，扩展了可供性理论在环境促进健康研究中的理论外延。研究系统梳理了既有文献，并揭示了童年时期蓝色空间的可供性实现对心理健康福祉的核心作用。本文的主要研究结论包括：

1）总体而言，童年时期与蓝色空间的交互在提升整体心理健康、恢复力、社交能力、自信与自我效能、情绪与行为功能等维度均发挥了显著作用。

2）尽管受到社会人口特征、家庭经济状况、居住地的城市化水平等因素的影响，儿童在蓝色空间中的可供性实现仍然是决定心理健康福祉的核心——相比于潜在可供性，儿童能够真正感知、使用和塑造蓝色空间的机会才是其中关键。

3）通过揭示蓝色空间相较绿色空间在社交能力、情绪调节和自信提升等维度的优势，丰富了城市蓝绿空间与心理健康福祉关系的理论基础，为将蓝色空间纳入更具实操性的城市公共健康干预路径提供了科学依据。

本研究也存在若干局限。首先，纳入的研究数量有限，且多集中于欧美国家，中文文献尚属空白，该领域在本土实践与研究上的滞后限制了当前结论在多元文化和地域背景下的解释力与适用性。其次，既有研究往往将蓝色空间与绿色空间等同处理，缺乏对蓝色空间独特的心理健康福祉的精准识别。此外，部分研究由于未区分室内外环境

而未被纳入此次范围综述（如关于游泳的研究），可能导致部分关键证据遗漏。最后，本文中使用的检索式初次检索到的论文数量过大，未来的研究可以根据研究主题使用更加精准的检索词，以节省研究精力投入。

未来研究应继续整合儿童视角优化研究设计，并基于可供性理论深入剖析研究结论，以为相关实践应用提供更多的实证依据。

1）拓展蓝色空间的研究范畴。儿童亲水游戏的空间远不局限于传统的大型自然水体，未来可从儿童视角重新定义"蓝色空间"，将游戏场中的小型水景、可交互喷泉等日常亲水设施纳入研究对象。

2）关注支持亲水行为的空间特征。应深入识别哪些空间设计特征（如空间形态、亲水性、周边绿植配置）能有效激发儿童的亲水行为，并通过梳理有关蓝色空间的可供性资源，为丰富儿童亲水体验提供设计依据。

3）深化可供性实现的实证研究。聚焦可供性实现及其强度对儿童心理健康福祉的影响机制，并结合长期追踪与定量评估方法探究童年亲水经验对成年后心理健康福祉的持续作用。

4）完善基于可供性层级理论的解释框架。现有研究多聚焦蓝色空间物理环境的支持作用，未来可结合社会文化语境、儿童主观情感体验等因素，探讨在多维因素的影响下，儿童如何通过感知和利用蓝色空间增进心理健康福祉。此外，也应借助负面的可供性探索蓝色空间可能带来的潜在负面影响。

图 1. 不同层级可供性的转化关系（改绘自参考文献 [25]）
图 2. 文献筛选流程
图 3. 与可供性的实现及其强度关联的不同的证据基础