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OCCUPATIONAL THERAPY INTERVENTIONS IN NATURAL ENVIRONMENTS FOR CHILDREN WITH NEURODEVELOPMENTAL DISORDERS: A HEALTH PROMOTION PERSPECTIVE

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ABSTRACT

This paper examines the contribution of pediatric occupational therapy in natural environments for children with neurodevelopmental disorders (NDDs). Occupational therapy, as a health profession focused on meaningful occupations, aims to enhance a child's autonomy and functionality, utilizing play as an important therapeutic medium. While occupational therapy interventions can be conducted in structured indoor settings, nature emerges as a dynamic "partner" in rehabilitation, offering rich sensory stimuli and opportunities for risk-taking and creativity. The research questions of this study focus on identifying the main motor, cognitive, social, and emotional outcomes reported following occupational therapy interventions in nature for children with neurodevelopmental disorders, as well as investigating the occupational therapy models used when applied in natural settings. The methodology was based on a systematic review of international literature in the databases Scopus and PubMed for the period 2015–2025. Two camp-based studies reported positive changes in individualized occupational performance goals, assessed through parent ratings or adolescent self-ratings using the COPM. Particular emphasis is placed on environments such as therapeutic camps, where integrated occupational therapy may support participation. However, the research highlighted limited empirical evidence on occupational therapy interventions in natural environments; the included studies do not establish comparative model effectiveness or the specific contribution of nature. From a health promotion perspective, nature-based occupational therapy may support children's meaningful participation in everyday life. Its potential contribution to functional autonomy and psychosocial well-being warrants further investigation within inclusive, person-centred approaches connecting occupational therapy, child health promotion and environmental health.

Keywords: Occupational therapy, Neurodevelopmental disorders, Children, Natural environment, Systematic review.

1 INTRODUCTION

1.1 Occupational Therapy as a Profession, Science and Practice

The professional association now known as the American Occupational Therapy Association was founded in 1917 by a group of professionals from different disciplines in the United States. However, the concept of occupation had already appeared in the literature since the beginning of the 20th century (Turpin, Garcia and Iwama, 2024). In Greece, occupational therapy is closely linked to the development of rehabilitation and psychiatry. The first therapeutic

programs in Greece began after the Second World War, within the context of the rehabilitation of injured soldiers. Occupational therapy is the science and art that enables people of all ages to engage in life through occupation. According to the World Federation of Occupational Therapists, occupational therapy promotes health and well-being by supporting participation in meaningful occupations that people want, need, or are expected to do (WFOT, 2025). Human occupations refer to everyday activities that people engage in and that have meaning and purpose (AOTA, 2020). Occupational therapy enables people to participate in meaningful daily occupations by making the best possible use of their abilities. The aim is for the individual to be functional, autonomous, and capable of achieving desired goals. Occupation gives meaning to human life and is a determining factor for health and well-being (Turpin, Garcia and Iwama, 2024). Health is much more than the absence of disease and, according to the World Health Organization, is defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 1948). People have the right to choose their occupations and the right to participate in society. The third edition of the Occupational Therapy Practice Framework identified eight areas of occupation: activities of daily living, instrumental activities of daily living, rest and sleep, education, work, play, leisure, and social participation. According to the Occupational Therapy Practice Framework: Domain and Process, Fourth Edition, health management was added as an area of occupation (AOTA, 2020).

Occupational therapists work with people of all ages who have physical, neurological, mental, developmental, learning and/or emotional disorders and/or environmental barriers that limit their participation in daily life as they wish. They assess the person's condition while considering the environment in which the person lives, as well as their customs and values. They then establish therapeutic goals to help the person regain, develop and/or maintain skills, or they intervene in the environment in which daily activities take place in order to facilitate participation (AOTA, 2020). The aim is to support the person’s participation in meaningful daily occupations, with appropriate assistance or environmental adaptations where needed. Occupational therapy practice involves the therapeutic use of everyday activities (occupations) with individuals or groups in order to support participation in roles and situations at home, at school, in the workplace, in the community and in other environments (AOTA, 2020). It includes clinical reasoning and professional judgment for assessment, analysis and goal setting, in addition to intervention. The OTPF-4 describes five aspects of the occupational therapy domain that are of equal value and exist in a dynamic, interrelated relationship: (1) occupations, (2) contexts, (3) performance patterns, (4) performance skills, and (5) client factors (AOTA, 2020). For each aspect of the occupational therapy domain, the OTPF-4 includes tables providing detailed definitions, explanations and examples. Within the theoretical structure of occupational therapy, 'models' are used as conceptual systems through which theory is linked with practice and the model guides practice. The way in which theory is applied to practice is referred to as a 'frame of reference' because it provides theory-based principles for assessment and intervention.

1.2 Occupational Therapy in the Pediatric Population

Children constitute a large proportion of occupational therapy service users. Pediatric occupational therapy refers to occupational therapy practice with children. Pediatric occupational therapy focuses on the effects of disorders and the environment on a child's ability to function successfully in everyday settings (home, school and playground) and roles (family member, student, etc.). The diagnostic categories of children vary. The occupational therapist aims to maximize children's functioning and participation in everyday occupations such as play, self-care and education. The therapist analyzes the body functions and structures required, as well as the performance skills needed for each occupation or activity, and aims to develop them. Assessment includes observation and the use of tools addressing occupational participation, performance and developmental skills. Intervention methods vary, but the activities carried out should be meaningful and purposeful for the child. Occupations have the capacity to support or promote other occupations. For example, children engage in play to develop skills that later facilitate participation in leisure and work (AOTA, 2020). Another example is the development of imagination and ideation, which is associated with higher cognitive functions related to problem solving and may contribute to critical thinking.

1.3 Neurodevelopmental Disorders

Neurodevelopment refers to the continuous process of anatomical and functional maturation of the nervous system (NS), which begins in the womb and continues most intensively throughout the first years of life (Costa, Souza and Fiamoncini, 2026). Neurodevelopmental disorders (NDDs) may arise from a complex interaction of genetic, environmental and epigenetic factors that influence brain development. They constitute a group of disorders with a neurobiological basis that emerge during the early developmental period and are characterized by deficits in the acquisition and execution of specific cognitive, motor, language or social functions, affecting functioning. Neurodevelopmental disorders (NDDs) form a heterogeneous group of conditions associated with neurodevelopmental dysfunction (Sabariego-Navarro et al., 2022). In the DSM-5 (American Psychiatric Association, 2013), neurodevelopmental disorders are defined as a group of conditions with onset during the developmental period, producing deficits that result in functional impairment. Neurodevelopmental disorders include intellectual disability (ID), communication disorders, autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), motor disorders (including developmental coordination disorder, stereotypic movement disorder and tic disorders),

and specific learning disorder. Autism spectrum disorder: Autism spectrum disorder (ASD) is a multifaceted neurodevelopmental disorder. Individuals with ASD have persistent difficulties in social communication and interaction, alongside restricted, repetitive patterns of behavior, interests or activities (American Psychiatric Association, 2013). They display heterogeneity in their clinical presentation and in the severity of difficulties, as each individual with ASD, like every other person, is unique. The clinical picture includes many additional characteristics and deficits in other areas; however, these are the core features.

A useful framework for describing functioning and disability associated with these disorders is the World Health Organization's International Classification of Functioning, Disability and Health (ICF; WHO, 2001). In the ICF, functioning and disability are multidimensional concepts. The ICF conceptualizes a person's level of functioning as a dynamic interaction between their health condition, environmental factors and personal factors. It is a biopsychosocial model of disability based on an integration of the social and medical models of disability. Parents, children and sometimes professionals may hesitate to accept neurodevelopmental diagnoses for a variety of reasons. Concerns about 'labelling' a child should not be underestimated, because these diagnoses are powerful terms that can change social expectations for a child (Li et al., 2019).

1.4 The Concept of Play and Play in Natural Environments

Play is a right of every child (Tremblay et al., 2015). Occupational therapists use play in various ways, including for learning and socialization, but also as an end in itself, supporting the development and enrichment of play according to developmental stages and types of play. The way children play changes according to their culture, religion and environment (natural and built), while it is also influenced by the continuously evolving concept of play in the 21st century, including virtual and alternative realities. Through play, children develop their skills, interests and abilities. Since a primary goal of occupational therapy is to enable participation in meaningful occupations, play is a major occupation of childhood (AOTA, 2020). Occupational therapists promote and enable children and young people to participate in play as a meaningful occupation and facilitate development and learning (Mynatt, Wood and Harper, 2023). Occupational therapists work to ensure a balance among activities of daily living, instrumental activities of daily living, health management, rest and sleep, education, work, social participation, leisure and play (American Occupational Therapy Association, 2020). Children's play develops and changes over time. During the early years, sensorimotor and exploratory play predominate, while functional, constructive and social play progressively develop. Children learn to play with others for longer periods, in larger groups, and to participate in games with increasingly complex rules. The position statement by Tremblay et al. (2015) supports access to active outdoor play in nature, including opportunities for age-appropriate challenges. However, according to Kalpogianni, opportunities for children to play outdoors, both during and after preschool hours, have declined in recent years, a trend associated with several factors. Findings from research in Greece highlighted the limited time children spend outdoors in preschool settings (Kalpogianni, 2019). In a scoping review, Morgenthaler et al. (2024) classified the characteristics of outdoor play spaces, offering several advantages for occupational therapy practice because this classification can serve as a shared environmental terminology.

Concluding, we emphasize the significance the play in environment as well as the positive synergistical contribution of digital technologies in the field of education and intervention, which is highly effective and productive, facilitates and improves assessment, intervention, and training procedures via mobile devices that bring educational activities everywhere [16], various ICTs applications that are the main supporters of education [17,18,30], and AI, STEM, and ROBOTICS that raise educational procedures to new performance levers [19,25,26,30]. Additionally, the development and integration of ICTs with theories and models of metacognition, mindfulness, meditation, and the cultivation of emotional intelligence [20-23], as well as with environmental factors, accelerates and improves more the rehabilitation practices and results.

1.5 The Concept of Environment and the Benefits of Engagement

In this paper, natural outdoor environments refer to outdoor environments in which human activity or materials are not intensive and nature dominates the environmental context. Gardening, including horticultural therapy, has been associated with health and well-being benefits (Soga, Gaston and Yamaura, 2017). In the qualitative study by Li et al. (2019), 22 parents and caregivers of children with autism spectrum disorder were interviewed about perceived benefits and barriers associated with exposure to nature. Three main categories emerged: sensorimotor, emotional and social benefits. Specifically, parents reported that their children showed increased sensory engagement in natural environments. Parents described their children as learning to tolerate and process information from multiple sensory modalities, including visual, auditory and tactile stimuli (Li et al., 2019). Parents also noted that outdoor spaces provided opportunities for activity and for the development of fine and gross motor skills. Compared with other types of urban space, such as streets or commercial plazas, parents described parks as providing a safer environment in which children could participate in a variety of activities perceived to support gross and fine motor skills. Parents also reported that play with sand, mud, water and other soft natural materials was highly motivating and was perceived to contribute to their children's motor development.

1.6 Conceptual Framework for Occupational Therapy Interventions and Benefits in Natural Environments

Nature is a dynamic, sensory-rich environment that allows children to explore a wide range of sensations and creates opportunities for them to learn about their bodies and brains (Harper, Mynatt and Wood, 2023). It provides information to more than one sensory system and offers vestibular, proprioceptive, visual, olfactory, tactile, gustatory and auditory stimuli. Nature can provide opportunities for children to engage with developmentally appropriate risks and challenges, explore sensations, engage in active play, use imagination and creativity, experience adventure and freedom, develop in healthy ways, and learn responsibility. By engaging in unstructured free play that includes natural risks and challenges, children can develop problem-solving skills. Using only what is available in the natural environment, children draw on imagination, increase creativity and learn through self-directed play. Nature-based activities may provide opportunities to practice responsibility for oneself and others and support self-regulation, self-efficacy and self-esteem. Engagement with nature may contribute to physical, emotional, social, cultural and mental well-being (Isham et al., 2025). Pediatric occupational therapy services usually take place indoors, such as in clinics, homes or schools, where professionals use manufactured materials and the built environment to facilitate therapy sessions. In contrast, nature-based services take place outdoors and bring children into contact with elements of nature, such as trees, plants, animals and soil, as a central part of the therapeutic process (Mynatt, Wood and Harper, 2023). Although this is not always feasible because of each child's unique needs, nature-based occupational therapy is supported by an emerging and growing body of research suggesting that nature-based activities may support client factors and performance skills described in the Occupational Therapy Practice Framework: Domain and Process, 4th edition (OTPF-4) (AOTA, 2020). Categories of nature-based therapies, beyond animal-assisted interventions, include forest therapy, adventure therapy, horticultural therapy, and water-based therapies such as surfing. The most common forms identified were horticultural therapy and forest therapy (Bonham-Corcoran et al., 2022). Existing research highlights the benefits of nature for children's health (Chiumento et al., 2018). Nature-based practices in occupational therapy are not yet clearly defined, and the terminology used to describe them varies considerably. Although informal information suggests that many pediatric therapists are interested in nature-based approaches with their clients, the term 'nature-based occupational therapy' is not common in the occupational therapy literature. While the literature contains several studies showing that time spent in nature or participation in nature-based interventions provides multiple benefits for children, including children with developmental differences, most of these studies are not specifically about occupational therapy. Many articles describe the unique skills and knowledge that occupational therapists can apply in nature-based practice. Whereas nature-based mental health treatment may focus on the person and their environment, nature-based occupational therapy is specifically driven by occupation and participation, as well as access to activities and natural environments (Burke et al., 2024a). According to Park Figueroa et al. (2025), the Ecology of Change in Outdoor Therapy Model was developed for children aged 0–12 years with disabilities. According to this model, nature-based pediatric occupational therapy includes complex interactions among four distinct factors: nature, the occupational therapy practitioner, the child, and caregivers, and it proposes six iterative phases as potential mechanisms of change in the pediatric occupational therapy intervention process as experienced jointly by therapist and child. Thomas et al. (2025) reported that occupational therapists working in school settings but delivering interventions in outdoor school spaces containing natural features (hills, ponds, wooded areas, trails) or constructed environments (playgrounds, swings, climbing structures, compost bins, musical features, interactive equipment and greenhouses) described nature as taking a leading role in their outdoor practice and as naturally creating the context for skilled intervention. Some occupational therapists worked individually with special education students, while others worked with groups of students. Some therapists used a more structured approach, whereas others adopted a more child-directed intervention style. All therapists described nature as a rehabilitation partner in their outdoor practice and as a powerful ally supporting intervention. The therapists also reported that nature-based environments strengthened the therapeutic relationship between therapist and student and enabled practitioners to incorporate unconventional interventions that supported students' goals and curriculum concepts. Perceived benefits for students were primarily related to regulation, participation and engagement (Thomas et al., 2025).

2 METHODOLOGY

2.1 Aim of the Research

The aim of the present study is to understand and investigate programs that include occupational therapy practice in natural environments for children with neurodevelopmental disorders. Based on this aim, the following research questions were formulated, and a specific methodological procedure was then followed:

- What are the main motor, cognitive, social and emotional benefits reported from occupational therapy interventions in natural environments for children with NDDs?
- Which occupational therapy intervention models are described in natural environments for children with NDDs, and what outcomes are reported?

2.2 Sources and Search Strategy

The study was conducted using a systematic review methodology. The search was carried out in December 2025. The Scopus and PubMed databases were used, while additional literature was identified through manual searching of the references of included articles. The keywords used in the Boolean search were as follows:

(("occupational therapy") AND ("children" OR pediatric* OR adolescent) AND ("nature-based" OR "outdoor" OR "forest" OR "playground" OR "natural enviroment" OR "adventure therapy")).

2.3 Inclusion Criteria

- Peer-reviewed journal articles
- Published from 2015 to 2025
- Studies published in English
- Samples involving children aged 0–18 years with a diagnosis of ADHD, autism spectrum disorder, intellectual disability, or developmental coordination disorder
- Field studies using specific occupational therapy intervention protocols

2.4 Exclusion Criteria

- Studies involving adults
- Interventions that did not include occupational therapy protocols
- Interventions involving pharmacological treatment
- Studies involving animal-assisted therapy
- Studies focusing only on hospital/clinical environments
- Articles without empirical data
- Studies involving students with communication disorders and specific learning difficulties
- Studies reporting only the views of parents, teachers and occupational therapy professionals

During the review, a related scoping review published in 2024 was identified; it included 12 articles, 10 of which were gray literature (Burke et al., 2024a).

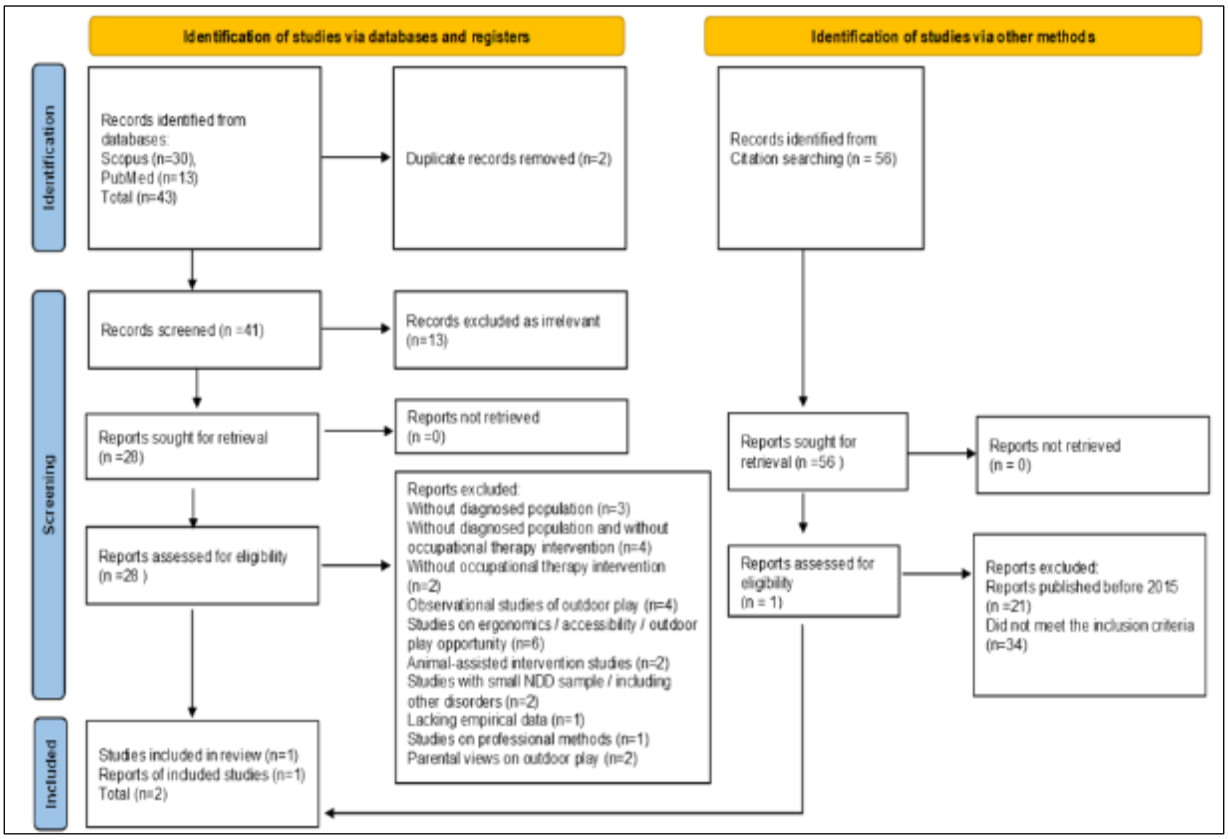


Figure 1: PRISMA Flow Diagram for the review

3 RESULTS

3.1 The initial Scopus search yielded 30 articles

From the outset, the search was restricted to the document type 'Article', publications in English, and the publication period 2015–2025. In PubMed, using publication-date filters for 2015–2025 and restricting results to Classic Article, Clinical Trial, and Randomized Controlled Trial in English, 13 articles were identified, two of which overlapped with the Scopus search. No article from PubMed met all inclusion criteria. After removal of two duplicate records from the 43 database records, 41 records remained, 13 were considered ineligible or unrelated to the topic at the outset. Of the remaining 28, studies that did not focus on a diagnosed population (n=3) or that included neither a diagnosis nor any form of occupational therapy intervention (n=4) were excluded, as were studies in which an exclusively occupational therapy intervention was absent (n=2). In addition, studies limited to observation of outdoor play (n=4) or focusing exclusively on ergonomics, accessibility and general opportunities for play (n=6) were excluded. Animal-assisted interventions (n=2) were also excluded. With regard to samples and data, studies with very small numbers of participants with NDDs or mixed samples including other conditions (n=2), as well as studies without empirical data (n=1), were removed. Finally, the review excluded studies focusing on professional methods (n=1) and those reporting only parents' views regarding outdoor play (n=2). One article met all criteria. A further article that also met the criteria of the present review was identified from its reference list.

3.2 Analysis of Studies on Occupational Therapy in Camp Environments

The two studies analyzed provide preliminary evidence regarding outcomes of integrated occupational therapy in camp environments. Both interventions took place in intensive camp settings; the Stackhouse et al. program also offered non-residential options. Occupational therapists provided individualized support in both studies. The therapists facilitated a sense of autonomy and personal competence for participation in meaningful and goal-directed activity. The theoretical foundations of both studies derive from pediatric occupational therapy, with a focus on regulation, sensory processing and the promotion of participation. Both studies used the Canadian Occupational Performance Measure (COPM). A close relationship between the two studies is evident from the presence of shared authors and international institutional collaboration.

The study by Stackhouse et al. (2023) focused on a sample (n=82) of children aged 4 to 13 years (mean age 8.36 years). The camp lasted 5 days, with 4 overnight stays for children who remained on site. For very young children (under 6 years of age) or those who were not ready for overnight stays, a 'Day Camp' option or a 'Long Day' option was available, while the total duration of the program remained 5 days. The population was characterized by regulation and/or sensory-processing differences. The intervention was based on the principles and frames of reference of Ayres Sensory Integration (ASI) and DIR (Developmental, Individual-differences, and Relationship-based) and on typical camp activities such as kayaking, flying fox and tie-dyeing. Goal setting was parent-defined using the COPM. Functional goals were determined with parents three months before the camp. The reported mean change in COPM Performance from immediately before to one month after camp was 1.704 points, below the 2-point threshold cited for clinically important change. Improvements in parent-rated scores remained stable three months after the end of camp. Repeated-measures ANOVA indicated that the change in parent-rated occupational performance from immediately before to one month after camp exceeded the change during the preceding three months. Improvements in parent-rated scores remained stable at three months; these ratings do not independently establish acquisition or maintenance of specific skills.

The study by Burke et al. (2024b) targeted adolescents (n=10) aged 12 to 16 years (mean age 13.92 years). The population was described as neurodivergent adolescents in a transition period with regulation and sensory-based challenges. The program was exclusively residential; all adolescents stayed at the camp for the full five days because living away from home and managing self-care tasks such as cooking and cleaning formed part of the Life Skills intervention. The Burke et al. intervention (LS/AT program) combined Life Skills and Adventure Therapy. Life Skills activities included instrumental activities of daily living, such as setting tables and cleaning shared spaces, while Adventure Therapy included outdoor activities such as a high-ropes course, zip line and rock climbing. Therapists' reasoning was guided by the model described by Stackhouse et al. (2023). The model includes the development of collaborative relationships between campers and therapists, as well as among campers, to support motivation toward achieving goals. Although the intervention principles differ to some extent, the adolescent study represents a thematic extension and development of the broader camp-based occupational therapy model. Goal setting was self-determined by the adolescents themselves in collaboration with a therapist using the COPM. This supports adolescent involvement in goal setting and the central role of the adolescent, both of which are critical for a transition-age population. Mean COPM Performance change scores were 3.72 points (SD = 1.39) immediately after the intervention and 2.40 points (SD = 1.19) from baseline to three months after the intervention. Qualitatively, adolescents reported high acceptance of the program and benefits related to developing a sense of purpose and a sense of belonging.

Table: Comparison Stackhouse et al. (2023) vs Burke et al. (2024b)

Characteristic	Stackhouse et al. (2023)	Burke et al. (2024b)
Participant Ages	Children aged 4–13 years.	Adolescents aged 12–16 years.
Intervention Principles	Integrated Occupational Therapy Camp Model. Occupational therapy was intentionally embedded throughout the camp experience.	Combined Life Skills/Adventure Therapy Program (LS/AT).
Means/Activities (Environment & Frames)	Environment: Nature-based camp. Activities: Typical camp activities (e.g., kayaking, flying fox). OT frames: Ayres Sensory Integration (ASI®) and Developmental, Individual-differences and Relationship-based model (DIR®).	Environment: 5-day/4-night camp. Activities: Life Skills: instrumental activities of daily living (e.g., setting tables). Adventure Therapy: outdoor activities (e.g., high-ropes course, zip line, rock climbing).
Participant Diagnoses (Main)	Children typically presented regulation or sensory-based difficulties. Autism Spectrum Disorder (ASD): 68% (n=56). ADHD: 20% (n=16). Multiple diagnoses: n=26 (percentage requires verification).*	Adolescents had regulation and sensory-based differences. Autism Spectrum Disorder (ASD): n=6. ADHD: n=6. Anxiety/Generalized Anxiety Disorder: n=3. Sensory Processing Disorder: n=3. **
Use of COPM	Used to establish individualized parent-defined goals. Parents re-rated goals at four time points (3 months before, immediately before, 1 month after, and 3 months after).	A modified version of the COPM was used to create and evaluate self-determined goals by adolescents. Performance and Satisfaction were assessed at three time points (before, immediately after, and 3 months after the intervention).

* Additional diagnoses/comorbidities were also reported, including auditory processing disorder, oppositional defiant disorder, blindness, obsessive-compulsive disorder, phobia, dyslexia, oculomotor apraxia, epilepsy, cerebral palsy, speech delay, and others.** Most participants had multiple diagnoses. Other diagnoses reported by caregivers included developmental coordination disorder, learning delay, Down syndrome, oppositional defiant disorder, avoidant/restrictive food intake disorder, and others.

4 ANALYSIS AND DISCUSSION

4.1 Main Benefits of Occupational Therapy Intervention in Natural Environments

The integration of occupational therapy into natural environments, such as camp settings, for children and adolescents with neurodevelopmental differences, including regulation and sensory-processing difficulties, ADHD and autism, is associated with a range of important benefits across several domains. According to Stackhouse et al. (2023), parents reported improved occupational performance in relation to individualized goals, as assessed with the COPM, and these score changes were maintained for three months after the intervention. These categories describe individualized goal areas, rather than independently measured improvements in each underlying sensory, motor or cognitive function. The parent-defined goals in which progress was recorded were related to:

- Emotional/Regulatory:

Emotion Regulation

Sensory Modulation

Self-Esteem

- Social:

Social Participation

- Functional/Cognitive/Motor:

Praxis

Activities of Daily Living

Executive Function

Posture

Communication

Spatial Organization

According to Burke et al. (2024b), the data showed positive changes in adolescents' self-rated occupational performance and satisfaction with goals they had set themselves. Specifically:

- Functional/Motor:

The greatest change scores were observed in goals related to participation in functional activities, such as instrumental activities of daily living and pre-vocational tasks.

- Emotional/Cognitive:

Changes related to mindfulness

Sense of competence/self-efficacy

Unexpected learning related to being present in the moment and finding a sense of purpose.

- Social:

Sense of belonging

Participants reported forming friendships and developing social skills.

4.2 Models of Occupational Therapy Intervention in Natural Environments

The included programs integrate occupational therapy principles into camp environments; the available evidence does not establish which model is most effective. The COPM is an outcome measure and was used in both studies as a fundamental, individualized, client-centred assessment tool, focusing on perceived improvement in performance and satisfaction in activities that the person considers meaningful. The Canadian Occupational Performance Measure (COPM) is a semi-structured interview designed to identify problems in occupational performance. It was developed to correspond with the Canadian Model of Occupational Performance (CMOP) and is also compatible with the Canadian Model of Occupational Performance and Engagement (CMOP-E). Within this framework, the goal of the therapeutic relationship is to facilitate personal and social change through the lens of meaningful occupation. The COPM enabled individualization and allowed the studies to record perceived change across a broad range of functional goals rather than restricting assessment to predetermined, generic outcomes. Positive changes in COPM scores provided preliminary quantitative evidence of changes in perceived occupational performance and satisfaction, rather than proof of intervention effectiveness. Since the COPM is based on the Canadian model, it is worth noting that although the model itself was not used as the intervention model, both studies relied on its assessment instrument. Stackhouse et al. (2023) evaluated a model for addressing individual goals in children with regulation/sensory-processing difficulties: the Integrated Occupational Therapy Camp Model. It incorporates Ayres Sensory Integration as a frame of reference and a foundation for adaptive behavior, together with the Developmental, Individual-differences and Relationship-based model (DIR®). These provided the foundations for the occupational therapy intervention implemented at the camp. The model includes the formation of collaborative relationships between campers and therapists, as well as among campers, to support motivation toward goal achievement. Therapists facilitate a sense of autonomy and personal competence for participation in meaningful and goal-directed activity. Campers also have dedicated time to reflect together, with therapist support, on their transition into roles involving greater responsibility, their membership in the wider camp community, and any personally relevant issues. The study by Burke et al. (2024b) drew on the theoretical foundation and clinical reasoning of the Stackhouse et al. (2023) model.

Engagement with nature has been shown to be beneficial for human health and well-being. Nature-based therapeutic programs largely disappeared from medical practice during the 20th century, although some continued to serve and support children (Crnic and Kondo, 2019). In recent years, however, physicians have increasingly recommended engagement with nature. In children specifically, engagement with nature supports the development of a wide range of skills and abilities. According to the WFOT, sustainability in occupational therapy is defined as the ability to choose and participate in healthy and meaningful occupations without threatening the ability of future generations to do the same,

with environmental sustainability considered in occupational therapy practice (WFOT, 2018). Nevertheless, interventions in nature should be conducted with respect so that natural resources are not depleted. Although occupational therapy can take place in a variety of settings because it focuses on participation in occupation, and although the literature recognizes that the use of natural environments offers significant benefits, formal research and documented protocols for applying occupational therapy in natural environments for children with neurodevelopmental disorders remain limited and constitute an emerging field. In practice, occupational therapists intervene within the community and the environment. However, the review revealed a critical paradox: while preliminary benefits have been reported, this review identified only two empirical studies of occupational therapy interventions for children with neurodevelopmental disorders in natural environments. The need to integrate natural elements into the everyday lives of children with NDDs is further supported by contemporary epidemiological research, such as the cross-sectional study by Yang et al. (2019), which found that greater greenness around schools and kindergartens was associated with lower odds of ADHD symptoms. This association provides contextual support for considering green environments in child health; it does not establish a causal effect or the effectiveness of nature-based occupational therapy.

The findings should be interpreted cautiously. The included studies used repeated-measures or exploratory mixed-methods designs, with parent-rated or self-rated outcomes. They do not isolate the contribution of the natural environment from occupational therapy, peer interaction or other camp components. Differences in participants, goal setting and outcome reporting also limit comparisons between programs (Stackhouse et al., 2023; Burke et al., 2024b).

5 CONCLUSION

There is, therefore, an urgent need to develop protocols and deepen interventions that incorporate natural environments, ensuring that children with disabilities have the fundamental right to access environments that promote health and participation, in accordance with WHO principles. Future research should bridge Occupational Science with Environmental Health by using appropriate, validated outcome measures to assess longer-term outcomes of nature-based interventions on quality of life and social inclusion, while also making practical use of the 'materials' of nature. Nature should no longer be viewed as a luxury, but as a potentially valuable therapeutic context within a holistic and person-centred approach to neurodevelopmental disorders, particularly when occupational therapists often purchase materials for sessions that already exist freely in nature, such as sand or pine cones, or use simulators reproducing natural sounds and textures. According to Taff et al. (2025), integrating the ecological environment into therapeutic interventions or sessions is recommended through the provision of services in outdoor green spaces, the use of materials from nature, such as leaves, branches and pine cones, in activities, and the consideration of environmental sustainability during activity analysis. The same authors note that, given the historical influence of the United States on the global profession, the slower pace of the American Occupational Therapy Association (AOTA) in addressing climate-related issues can be recognized, particularly because profit-based reimbursement models may limit occupational therapy practitioners' ability to engage in necessary discussions about sustainability and climate. From a health promotion perspective, these programs may offer opportunities for meaningful participation; their effects on functional autonomy and psychosocial well-being require further investigation (Stackhouse et al., 2023; Burke et al., 2024b).

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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