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Into the wild: a mixed-methods pilot study of the mental health benefits of a nature summer camp for urban children with psychological needs

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Abstract

Research suggests that nature promotes psychological and behavioral health among children. However, children living in low-income urban communities often have less access to green spaces compared to their counterparts living in high-income neighborhoods, and limited research has investigated the impact of nature on well-being and social connectedness in children experiencing marginalization. To address this gap, this mixed-methods study examined the impact of a one-week immersive nature camp on the well-being and social connectedness of 27 children aged 6–12 years referred to a community hub in Ottawa, Canada, for complex psychosocial difficulties. One week prior to and one week after the camp, caregivers completed a survey inquiring about their child's personal well-being, social contact, loneliness, positive emotional state, and positive outlook. On the first and last days of the camp, children completed the same survey. Children also engaged in an audio-recorded focus group about their experience in the camp to inform the quantitative findings. Quantitative and qualitative responses were analyzed using paired samples t-tests and thematic analysis, respectively. Although not statistically significant, small to medium effect sizes for improved positive emotional state and positive outlook were reported by children ($p=.26$, $d=0.24$; $p=.14$, $d=0.31$) and their caregivers ($p=.12$, $d=0.37$; $p=.89$, $d=0.03$). Qualitative thematic analyses of focus groups revealed nine themes including making friends, acquiring new skills, and connecting with nature. Within the Canadian child health context, exposure to green spaces for children with complex psychological difficulties living in low-income urban communities may be associated with perceived enhancements in social connections and skills. Future research with larger sample sizes is needed.

Keywords Children, Mental health, Well-being, Social connectedness, Low-income urban communities, Marginalization, Nature, Natural environment, Green spaces, Summer camp

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Introduction

Early childhood experiences, particularly cumulative experiences of adversity, have significant implications for children's health and mental health outcomes [1]. Children who are exposed to poverty, marginalization, and/or social deprivation are at a heightened risk for experiencing health and mental health difficulties that can carry over into adulthood [1–5]. For example, children from low-income urban environments can present with especially high psychological needs [6]. Despite presenting with disproportionately higher rates of mental health needs, children and families living in poverty are less likely to be connected with high-quality mental health services and more likely to face barriers when seeking mental health services [7]. Addressing complex psychological needs during childhood can help prevent later mental health challenges and downstream healthcare costs across the life course.

Benefits of greenspace and nature on children's health and well-being

There is established evidence demonstrating the positive impact of nature and outdoor play on the mental health, emotional well-being, and cognitive development of children [8–10]. For example, interacting with nature on a consistent basis during childhood has been demonstrated to enhance mental health outcomes, including depression, anxiety, and stress, in children [11] and serve as a protective factor against the development of depression in adulthood [12]. Other studies demonstrate that regular interaction with nature and natural environments supports psychological restoration [13], improves mood [14] and attention [15], reduces stress and anxiety [16], and enhances cognitive functioning [17]. Specifically, the natural environment may provide relief and recovery from mental fatigue [13] as well as reduce stress and physiological arousal [18]. Therefore, a lack of exposure to natural environments may be associated with higher levels of stress for children living in low-income communities, leading to increased risk for mental health difficulties.

In addition to the mental and physical benefits that green spaces provide to children [19, 20], playing outdoors can enhance creative and cooperative social play [21] and improve social connectedness [22]. Indeed, previous research demonstrates a link between green spaces and strong community identity [23] and social cohesion [24]. In children specifically, recreational activities in outdoor spaces or natural environments have been shown to promote social contact between children [21]. Social connections are vital to the well-being of children insofar that they may protect against poor health outcomes in adulthood [25–27]. On the contrary, poor social relationships in childhood and early adolescence have been associated with substance abuse, depression, and anxiety

in early adulthood [30], as well as perceived social isolation and loneliness [28].

Several studies conducted in the last decade have documented increases in the prevalence rates of loneliness and social isolation among children globally [29–31], with longitudinal results from one meta-analysis showing significant mean increases in loneliness in the last two to four years compared to pre-COVID-19 pandemic estimates [29]. Considering that loneliness is a predictor of poor mental health [32] and marginalized children are at a heightened risk for poor health, it is crucial to implement nature-based programs that facilitate social connections in children living in low-income communities.

Disparities in access to greenspaces in low-income and urban communities

Individuals belonging to low-socioeconomic groups are often restricted to living in urban communities with increased crowding, exposure to industrial toxins, high rates of crime, and limited access to nature [33]. Additionally, previous research demonstrates that urban green spaces are often inequitably distributed, such that low-income communities generally have less access and exposure to green spaces and their associated benefits compared to high-income neighborhoods [34, 35]. Without proximity to local green spaces, children living in low-income urban communities may not be able to access natural environments (e.g., national parks, forests, etc.) and community programming (e.g., summer camps) or have the financial resources required for engaging with nature. Poor proximity to urban green spaces has been associated with behavioural problems in children [36] and decreased physical activity [37], in addition to negative developmental outcomes and increased health inequalities [38, 39].

Impact of the built environment on children's health and well-being

In children specifically, existing literature suggests that the physical design of a neighborhood, i.e., the built environment, can affect children's physical, social, emotional, and cognitive development [34]. Although the specific pathways by which the built environment impacts children's development are not yet well understood, evidence suggests that children growing up in low-income, densely populated urban communities may face an increased risk of behaviour problems, including oppositional and conduct disorders [40, 41], and poor socioemotional and academic outcomes [42, 43]. Thus, the built environment, especially that which incorporates elements of the natural environment, may provide exposure to sources of stimulation allowing children to explore, learn, socialize, and interact with others and their surroundings. As such, the design of the built environment has significant

implications for its residents, particularly with regards to the health, well-being, and social connectedness of children.

Limited research on the benefits of nature for children with complex psychological needs

As highlighted above, regular exposure to and interaction with nature is associated with improved health outcomes in children. For children living in low-income urban communities with complex psychological needs, the risk for poor health and mental health is compounded by the lack of accessible green spaces. Importantly, and of relevance to the present study, there is a dearth of research examining the mental health benefits of greenspaces in low-income children presenting with complex psychological difficulties [19, 44]. Research exploring the benefits of nature for children with complex psychological needs can inform programs and policies targeting children’s mental health difficulties.

Purpose of the present study

Recognizing the importance of natural environments for children’s well-being, particularly for those living in low-income urban neighborhoods, we examined the impact of a one-week immersive nature summer camp in children living in a low-income urban community and presenting with complex psychosocial difficulties. This project was a partnership between the Vanier Social Pediatric Hub (VSPH), the Canadian Museum of Nature, Out to Play Canada, and the Children’s Hospital of Eastern Ontario Research Institute.

Operating as a community program in Ottawa, Canada, the VSPH provides access to comprehensive health and social services to children and youth living or attending a school in one of the most low-income communities in the city. In Vanier, over 26% of the community reports household after-tax incomes under CAD \$40,000, which

is substantially lower than the median after-tax income of CAD \$68,400 [45]. Through the partnership with the Canadian Museum of Nature, Out to Play Canada, and the Children’s Hospital of Eastern Ontario Research Institute, children from VSPH were eligible to participate in a one-week summer camp. The main objectives of this mixed-methods pilot study were to: (1) Explore the impact of attending a one-week nature camp on the well-being and social connectedness of children living in a low-income community in Ottawa, Canada; and (2) Explore the perspectives of children and their caregivers on the impact of participating in the immersive nature experience. Taken together, findings from this pilot study may serve to support the development of child-friendly communities that include quality, affordable, and accessible green spaces, as well as improve our understanding of how interacting with nature and outdoor play contributes to the mental health and social development of children.

Materials and methods

Study design

The present study employed a convergent mixed-methods design where quantitative and qualitative data were collected and analyzed separately and simultaneously [46]. A convergent mixed-methods design was used to explore whether there was alignment or similar findings based on the two different methods. These were subsequently integrated and interpreted together. Quantitative data were collected using participants’ clinical files located at the VSPH and pre- and post-camp surveys, while qualitative data were obtained from audio recordings of focus group discussions that took place on the last day of the camp. The research design is illustrated in Fig. 1.

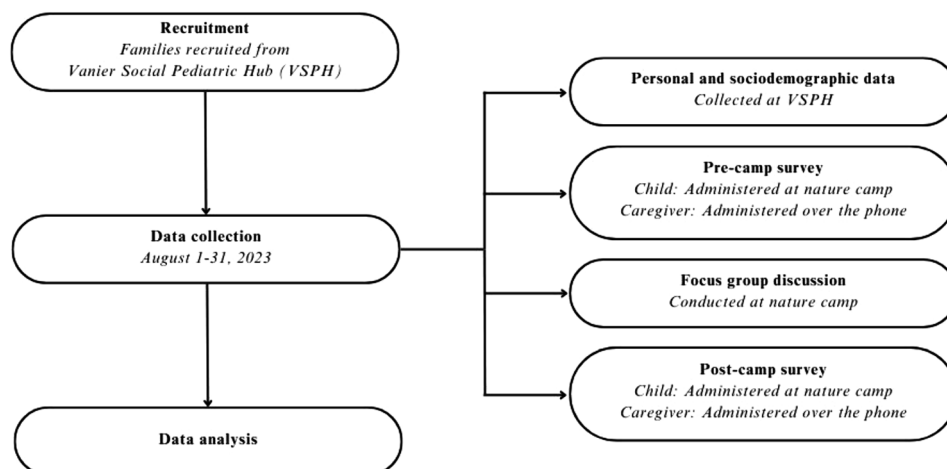


Fig. 1 Research design

Study setting

The nature camp and study took place at the Canadian Museum of Nature's Natural Heritage Campus (NHC) located in Gatineau, Quebec [47]. The NHC is the Canadian Museum of Nature's science and administration center responsible for collecting, managing, and preserving natural-history collections in a variety of fields (i.e., zoology, paleobiology, botany, mineralogy, etc.). The NHC's facility contains several laboratories where scientific research on animals, plants, fossil, and mineral materials takes place, while the NHC facility itself is located on 76 hectares of land where the materials are collected. The NHC is closed to the public for most of the year but regularly hosts open house events to encourage public interest.

The camp was delivered by Out to Play, a forest and nature school program that offers child-centered, play-based, and curiosity-led summer programs in natural environments [48]. One educator was responsible for threetofour children who guided them through the camp's activities. Each day followed a semi-structured routine of children arriving and settling into play and storytelling to root children in the space and feel a sense of connection and belonging. Afterwards, children would hike to the nearby forest where slacklines were tied up, hammocks were swung between trees, large loose parts were arranged in an inviting provocation, and science inquiry items (e.g., magnifying glasses and nature identifying books) were available for children's use. Throughout the day, educators played alongside the children and supported them in their risk assessment skills as they played. Children had the opportunity to build shelters, balance on fallen trees, pull apart rotten fallen trees, and investigate sunny patches and shady nooks. Each day ended with a closing circle, where children reflected on their learning and play and shared their reflections with each other.

The camp took place from August 7th, 2023, to August 11th, 2023, where daily transportation to and from the NHC and the VSPH, respectively, meals, equipment (e.g., backpacks), and required clothing (e.g., rain boots and rain jackets) were provided at no cost to children.

Participants

This pilot program consisted of a convenience sample of families attending the VSPH. Children aged six to twelve years inclusively, and whose first or second language was either English or French were eligible to participate in the study if they were referred for services at VSPH. This study had no exclusion criteria.

Recruitment

Families attending the VSPH were approached by VSPH staff regarding the opportunity to attend the nature

camp. Families were informed about the opportunity by staff either during an in-person clinic appointment or over the phone. For families who were interested in participating, the VSPH staff obtained permission to share their contact information with University of Ottawa research assistants, who then contacted all interested caregivers over the phone to further explain the research project and obtain consent.

Assent was obtained on the first day of the camp. The study was explained to the child participants using age-appropriate language, with an opportunity for them to ask questions. Research assistants reassured all children that their decision to not participate in the study would not affect their participation in the camp. Assent forms were signed by each child participant and collected by research assistants.

Data collection

Personal and sociodemographic information

One to two weeks prior to the start of the camp, personal and sociodemographic information was collected from the participants' clinical files located at the VSPH. Research assistants attempted to collect any missing information from the caregivers over the phone at the time of obtaining consent. Personal and sociodemographic information collected included household composition and income, reported physical and mental health issues, gender identity, citizenship status, ethnicity or racial identity, immigrant or refugee status, country of birth, and arrival in Canada.

Pre- and post-camp surveys

The pre- and post-camp surveys were administered in either English or French to the children attending the camp and their primary caregivers, both of whom answered a variety of questions regarding child well-being and social connectedness using the Personal Well-being Scale [49], the Stirling Children's Well-Being Scale [50], the Social Contact Measure [51], and the Loneliness Measure [51]. The Personal Well-being Scale, Social Contact Measure, and Loneliness Measure each consists of four items that are measured on a 4-point Likert response scale. The language of the scales was developed to be appropriate for a reading level of an 8- to 10-year-old. These measures were selected as they have been commonly used in research to address the social needs of underserved communities [49, 51]. The Stirling Children's Well-Being Scale consists of 12 items divided between two subscales – positive emotional state and positive outlook – that are measured on a 5-point Likert response scale from *never* to *all of the time*. The post-camp survey was identical to the pre-camp survey, with the post-camp survey containing two additional short-answer questions inquiring about the participants' experiences at the

camp: *what did you/your child like most about the camp?* and *what would you/your child change about the camp?*

One to two weeks before the camp, research assistants contacted caregivers over the phone to collect the pre-camp survey data. One to two weeks following the camp, caregivers were contacted again to collect the post-camp survey data.

Research assistants administered paper copies of the child participant pre- and post-camp surveys in-person at the NHC site. Children completed the pre- and post-camp surveys on the first day of the camp, August 7th, 2023, and the last day of the camp, August 11th, 2023, respectively. Children spent between 10 and 15 min completing the pre- and post-camp surveys. Research assistants provided support to child participants who requested help in reading and answering the survey items.

Focus group discussions

In addition to completing the post-camp survey on the last day, children engaged in a 30-minute audio-recorded focus group discussion. Child participants were divided into one of six groups: one French-speaking group and five English-speaking groups. Research assistants led semi-structured discussions with each group while recording the interactions. Children were asked various guiding questions about their thoughts and feelings about and experiences during the camp. Child participants' engagement in the focus group discussion was not mandatory. Each focus group recording was transcribed verbatim for the purposes of data analysis.

Analysis and interpretation

Personal and sociodemographic information and pre- and post-camp survey data were analyzed using IBM® SPSS Statistics 28 (IBM, USA). Focus group discussions were analyzed using an inductive thematic analysis method. More specifically, we employed the coding reliability paradigm of qualitative analysis whereby codes were data-driven rather than theory-driven following Braun and Clarke's guidelines [52]: (1) familiarizing oneself with the data (e.g., reading and re-reading the transcripts, making note of initial ideas), (2) generating initial codes (e.g., coding basic segments of the raw data that are interesting and will be meaningful), (3) searching for themes (e.g., grouping codes into candidate themes), (4) reviewing themes (e.g., refining themes, collating themes, and removing themes that do not have enough empirical support), (5) defining and naming themes (e.g., further refinement of each theme, identifying the 'essence' of and naming the theme), and (6) producing the report (e.g., analyzing each theme in relation to the research question(s)).

Three researchers (SN, LM, and SD) transcribed the audio-recorded focus group discussions verbatim. Five researchers (SN, LM, SD, SB¹, and SK) coded the transcripts separately for latent and semantic content, with each transcript being double coded for accuracy. Codes with the same underlying meaning were then grouped into themes and refined to produce a total of nine overarching themes (see Table 4 below). Lastly, the themes were presented to the principal investigator (NR) to verify the accuracy of the analysis.

Ethical consideration

This study was granted ethical approval from the Children's Hospital of Eastern Ontario's Research Ethics Board (Reference #23/57×2023020). This study adheres to the Declaration of Helsinki with regards to ethical and data collection compliance. All recruited participants were reassured that their intent of participation would not influence the services they receive at the VSPH. To ensure anonymity, each caregiver and child participant was assigned an identification number. All identifying participant information (e.g., name, date of birth, age, etc.) was removed from the collected data and kept in a secure Excel spreadsheet. Researchers responsible for analyzing the data only had access to the de-identified files. All signed consent and assent forms were stored in the principal investigator's locked filing cabinet. All paper and electronic data will be destroyed after seven years following the completion of the study if there is no secondary use for the data.

Results

Quantitative analyses

Response rates and demographics

Of the 27 children who attended the camp, 25 children completed the pre-camp survey, 26 children completed the post-camp survey, and 24 children completed both the pre- and post-camp surveys. Caregivers of 26 children completed the pre-camp survey, caregivers of 21 children completed the post-camp survey, and caregivers of 21 children completed both the pre- and post-camp surveys. Personal and sociodemographic information for up to 52% of participants is missing, i.e., this information was not available in up to 52% of participants' clinical files. The sample consisted of an ethnically and racially diverse group of children living in families facing multiple social and economic barriers, with 33% reporting a household income of CAD \$20,000 or less. Approximately 26% of the sample reported living in a single-parent household. Of note, 37% of the sample reported having no medical health issue, including physical, mental, or learning disability, and 22% and 30% reported excellent mental health and physical health, respectively. Additional participant characteristics are summarized in Table 1.

Table 1 Participant characteristics (N = 27)

Characteristic	N	%
Household composition		
Couple with child(ren)	10	37.0
Grandparent(s) with grandchild(ren)	1	3.7
Single parent	7	25.9
Other	2	7.4
Missing	7	25.9
Household income (CAD)		
0–14,999	4	14.8
15,000–19,999	5	18.5
20,000–24,999	2	7.4
30,000–34,999	1	3.7
40,000–59,000	1	3.7
60,000 and more	5	18.5
Prefer not to answer	2	7.4
Missing	7	25.9
Medical health issues		
None	10	37.0
Mental disability	2	7.4
Learning disability	2	7.4
Physical disability	1	3.7
Prefer not to say	1	3.7
Missing	11	40.7
Self-assessment of physical health		
Fair	1	3.7
Good	1	3.7
Very good	6	22.2
Excellent	8	29.6
Missing	11	40.7
Self-assessment of mental health		
Good	4	14.8
Very good	3	11.1
Excellent	6	22.2
Missing	14	51.8
Gender identity		
Male	7	25.9
Female	6	22.2
Missing	14	51.8
Citizenship status		
Canadian citizen	13	48.1
Permanent resident	5	18.5
Missing	9	33.3
Ethnicity/race		
East Asian	1	3.7
Southeast Asian	1	3.7
Middle Eastern	3	11.1
Black	4	14.8
White	4	14.8
Missing	14	51.8

Paired samples t-test

Paired samples t-tests were conducted to determine whether children's well-being and social connectedness levels had changed after attending the camp (see Tables 2

and 3). Across all five constructs measured (i.e., personal well-being, social contact, loneliness, positive emotional state, positive outlook), no statistically significant results emerged from either the caregiver-reported or the child-reported survey results. It is important to note that while this pilot study did not demonstrate statistically significant results, Cohen's D effect sizes were between small (0.20) and medium (0.50) in size. Additionally, our analysis of frequencies revealed no outliers.

Thematic analyses

A total of nine themes emerged from the focus group discussions, with respect to the children's thoughts, feelings, and experiences during the camp: (1) positive engagement and satisfaction with the camp experience, (2) camp fosters social connections and friendships, (3) increased knowledge and connection to nature, (4) discomfort in nature, (5) nature improves interpersonal skills, (6) applying nature-inspired lessons to home environment, (7) nature improves child health outcomes, (8) camp resources and social supports enhance child enjoyment, and (9) children provide insight on potential camp improvements. All themes and their associated codes are listed in Table 4.

Positive engagement and satisfaction with the camp experience

Several participants made positive comments regarding their experience at the camp. The participants expressed satisfaction with the camp, specifying their enjoyment with the variety of activities that took place as well as the overall camp experience. For example, one participant noted, "I also thought the camp would be a really, really boring, but then when I came it was really fun." When asked about whether other children should take part in the camp, one participant responded, "For other kids, they should do it for a trillion years".

Additionally, some children expressed enjoyment of the new atmosphere, particularly those who were new to such a large outdoor environment:

Participant 1: "Yes, because I learned new things and it was also my first time in a big forest and it was a lot of fun."

Participant 2: "Playing in the forest, that's new to me because I've never played in the forest."

During the focus group discussions, many participants reflected on their experiences at the camp and spoke of activities they most enjoyed. For example, multiple participants mentioned their interest in the museum tour, where they had the opportunity to explore the different museum exhibits. When asked if they would return, several participants expressed a desire to return to the camp in the future.

Table 2 Paired samples test (child)

	N	M		ΔM	95% CI		t	df	p	d
		Pre (SD)	Post (SD)		LL	UL				
Personal well-being	24	7.04 (2.66)	6.79 (2.17)	-0.25	-1.38	0.88	-0.46	23	0.65	-0.09
Social contact	24	5.96 (3.13)	5.71 (1.97)	-0.25	-1.62	1.12	-0.38	23	0.71	-0.08
Loneliness	24	7.50 (3.56)	7.00 (3.15)	-0.50	-2.11	1.11	-0.64	23	0.53	-0.13
Positive emotional state	23	23.52 (5.92)	24.35 (5.34)	0.83	-0.66	2.31	1.15	22	0.26	0.24
Positive outlook	24	19.21 (4.68)	20.50 (3.92)	1.29	-0.45	3.03	1.54	23	0.14	0.31
SCWBS	24	42.63 (9.88)	43.83 (10.59)	1.21	-2.30	4.72	0.71	23	0.48	0.15

Note: M=mean score; ΔM=mean difference score; SD=standard deviation; CI=confidence interval; LL=lower limit; UL=upper limit; t=Student's t-distribution; df=degrees of freedom; p=two-sided probability value; d=effect size (i.e., Cohen's d); SCWBS=Stirling Children's Wellbeing Scale

Table 3 Paired samples test (caregiver)

	N	M		ΔM	95% CI		t	df	p	d
		Pre (SD)	Post (SD)		LL	UL				
Personal well-being	21	13.57 (2.79)	13.91 (2.81)	0.33	-1.29	1.95	0.43	20	0.67	0.09
Social contact	20	13.70 (2.32)	14.55 (1.43)	0.85	-0.17	1.87	1.74	19	0.10	0.39
Loneliness	21	6.81 (3.54)	6.52 (3.24)	-0.29	-1.57	1.00	-0.47	20	0.65	-0.10
Positive emotional state	20	24.10 (5.60)	25.25 (3.89)	1.15	-0.32	2.62	1.63	19	0.12	0.37
Positive outlook	21	26.10 (5.22)	26.19 (3.53)	0.10	-1.33	1.52	0.14	20	0.89	0.03
SCWBS	21	49.05 (11.97)	51.19 (6.94)	2.14	-1.08	5.36	1.39	20	0.18	0.30

Note: M=mean score; ΔM=mean difference score; SD=standard deviation; CI=confidence interval; LL=lower limit; UL=upper limit; t=Student's t-distribution; df=degrees of freedom; p=two-sided probability value; d=effect size (i.e., Cohen's d); SCWBS=Stirling Children's Wellbeing Scale

Camp fosters social connections and friendships

The one-week nature camp fostered an environment conducive to participants building connections and making friends with one another. During the focus group discussions, one participant reflected on their achievements in making new friends: *“Cause I usually don’t make that many friends at camps or school, but now I have a lot of friends.”*

Additionally, some participants experienced a feeling of camaraderie, suggesting that they were able to create a social connection among their peers. For example, during the focus groups, one participant commented, *“I met A1, my new friend, then I saw one, two, three other friends that I already knew, and I made two new ones, A1 and A2, and uhm we played, and it was fun.”*

Finally, the camp not only provided a space where participants were able to foster connections with others, it allowed them to exchange knowledge with one another in a conversational manner:

- Participant 3: “They’re fake bones.”*
- Participant 5: “They’re not fake.”*
- Participant 3: “Are they real?”*
- Participant 5: “They’re real.”*
- Participant 5: “Became a kind of rock.”*
- Participant 2: “They’re real, gray.”*
- Participant 5: “No, they’re rocks.”*
- Participant 2: “Through time they...”*
- Facilitator: “But they started out as bones.”*
- Participant 5: “Yes.”*

Increased knowledge and connection to nature

With the summer camp primarily taking place outdoors, many participants reported an increased exposure to nature. When asked about their time outdoors, one participant commented on the knowledge they acquired during the camp activities: *“I learned about [different] kinds of flowers and at the museum we learned that there were [different] kinds of dinosaurs that lived in Canada in ancient times.”*

Other participants expressed a desire to acquire more knowledge related to what they learned at the camp. For example, one participant stated, *“I would actually want to learn about wolves like, you know, like how they go to the snow, eat meat. And I like to learn about, I wanna actually learn about owls also like we did, like we did two days ago. Like I would want to learn about more and owls and insects.”* Not only did participants reflect on what they had learned, but they also recognized the importance of nature and its significance within the environment. As an example, one participant noted, *“And I also learn that like, nature is a great part of our environment.”*

This comment and many others suggest that the child participants gained a new appreciation for nature after spending time at the camp.

Discomfort in nature

Although many participants had positive comments to share about the camp experience, some participants expressed instances of discomfort. During the camp week, children were exposed to a range of weather conditions, including heavy rain:

Table 4 Overview of the themes and codes

Theme	Code
1) Positive Engagement and Satisfaction with the Camp Experience	Recommending that other children partake in the camp
	Finding the activities/materials at the camp fun
	Participants gained new experiences
	Participant shares a positive experience of the camp
	Desire to attend the camp again in the future
	Children are excited and invested in what they are discussing
	Children express interest in the museum
2) Camp Fosters Social Connections and Friendships	Children expresses interest in nature
	Feeling of camaraderie and helping each other out
	Children show increased interest in making friends
	Children exchange about knowledge and experiences acquired at camp
3) Increased Knowledge and Connection to Nature	Newly acquired knowledge about nature
	Children appreciated learning about history
	Desire to learn more
	Realizing that nature is important
	Children make connections between previous experiences and the camp
4) Discomfort in Nature	Reflection on newfound knowledge and skills
	Children express dislike for uncertain nature elements
	Children express fear of certain nature elements
	Children express not liking unfamiliar situations
5) Nature Enhances Interpersonal Skills	Children learned conflict resolution skills
	Children learned social behavioural skills
	Diminished social fear at the end of camp
6) Applying Nature-Inspired Lessons to Home Environment	Children shared camp experience with family
	Children wished their parents attended the camp
	Children repeated some of the experiences at home
7) Nature Enhances Child Health Outcomes	Children expressed appreciation for peers and support staff
	Enjoyment of being present and focused
	Children express positive change in their personality
	Children expressed a sense of belonging
8) Camp Resources and Social Supports Enhance Child Enjoyment.	Increased confidence
	Camp provided a positive change in daily routine
	Children showed appreciation for gifts (jacket, pants, bag, etc.)
9) Children Provide Insight on Potential Camp Improvements	Children expressed appreciation for peers and support staff
	Food was a positive experience
	Children used problem solving skills to provide suggestions on how to improve a camp activity
	Children would have liked more interaction with other campers
	Children would have liked to include more outdoor play resources
	Children would have preferred a different camp environment

Facilitator: "And what if it rains?"

Participant 1: "Yuck. I would change we could go to clean places, not muddy places."

Participant 4: "I hate mud. Because it's just so muddy and it gets me wet and I don't I don't like everything, but yeah. I don't like it."

For participants with little to no experience in a large forest, the nature camp exposed them to a variety of new nature elements. Some of these elements were met with fear and were later described as negative experiences. Specifically, one participant described these fears during the focus group, stating, *"The only thing that's new is everything is scary. I'm scared. I'm scared of the poison ivy. I'm scared of the mud face first because you don't know what is in the mud"*.

Nature enhances interpersonal skills

With the children consistently engaging with one another throughout the duration of the camp, some participants reflected on certain behaviours and skills they learned. For example, during the daily commutes to and from the camp, several participants found themselves on a school bus for the first time. One participant mentioned a newly learned behaviour: *"I learned how to act on a bus."*

Additionally, other participants were able to reflect on skills they built that improved their interactions with their peers. For example, when asked what they learned during the camp, one participant responded, *"I learned that you have to listen to each other"*. These examples suggest that the summer camp was a positive opportunity for the child participants to learn new social skills. Finally, the camp provided some participants the opportunity to step outside their comfort zone and grow their social skills:

Facilitator: "What about you? Has anything changed?"

Participant 4: "The fear."

Facilitator: "The fear?"

Participant 4: "Fear of talking to others."

Applying nature-inspired lessons to home environment

To get an idea on the impact of the camp, participants were asked if they shared their camp experiences with their families. Several participants responded *"yes"*, expressing that they often shared their experiences with their families when they returned home. One participant even attempted to recreate their camp experience at home: *"I liked the movie [yesterday], and then I watched part of the movie last night in my house. And then I drew a picture of it with my brother."*

This example suggests that certain camp activities had a significant impact on the participant, to the extent that they recreated the activity at home.

Nature enhances child health outcomes

Several participants demonstrated a positive change in their personality as well as reported a sense of belonging. Some participants mentioned the positive impact that the camp had on their daily routine, stating their “boredom” was lessened while being at the camp compared to being at home. Another participant commented on how the camp changed their self-perception, as they were able to identify differently:

Facilitator: “Has anything changed for you since you came to the camp?”

Participant 1: “No, just my identity.”

Facilitator: “What changed about your identity?”

Participant 1: “I’m no longer that kid who stays home a lot.”

Additionally, participants expressed that the camp allowed them to be present and engaged while completing various activities. One participant stated, “*Things that I liked was the swing and the slack one and the seesaw because they were really fun. What I liked about the slack one was you have to focus because or else you [were] gonna fall.*” These examples suggest that the camp provided a safe space for the children to explore their interests and limits, and, as a result, improve their own mental well-being.

Camp resources and social supports enhance child enjoyment

Children were provided with a variety of material resources when they first arrived at the camp. These resources included proper rain gear (e.g., raincoat, pants, and boots), a water bottle, and a backpack. Along with the material resources, the camp had support staff available to assist with the camp activities. These resources were positively viewed by many of the participants:

Participant 3: “And you know when you’re in the mud and your shoe got stuck, people can help you.”

Participant 2: “Yeah, I like how most people could come and help others like, it was like most people were really nice.”

Moreover, the camp also provided the children meals and snacks throughout the day. When asked what they enjoyed about the camp, one participant responded: “*So I really like playing outside in the forest, but I also really like the food.*”

Children provide insight on potential camp improvements

During the focus group discussions, researchers asked all participants what they would change about the camp if they had a magic wand. One participant suggested a

change in location: “*I would change we could go to clean places, not muddy places.*” Another participant recommended increasing the interaction time between the different groups of children: “*The one thing I would change is that the two groups get to hangout more often.*”

Additionally, some participants demonstrated problem solving skills while providing suggestions on ways to improve the camp activities, such as the outdoor nature swings. Two participants in particular provided insight on a way that the swing could be improved for future campers:

Participant 1: “What I like about it is that I like to swing, but it would be a better idea with like two more sticks. You know?”

Participant 3: “Yeah, to just like make it a bit thicker so that you could fit because I would just keep slipping off.”

Discussion

This mixed-methods pilot study investigated whether children with complex psychological difficulties living in a low-income urban neighborhood in Ottawa, Ontario, experienced enhanced well-being and social connectedness levels after participating in an immersive, one-week nature camp. Statistical analyses of the caregiver-reported and child-reported survey results and thematic analysis of the post-camp focus group discussions demonstrate that attending the nature camp showed a trend towards a positive impact on the well-being and social connectedness levels of the child participants. Additionally, beyond the mental health and social impact, participating in the camp yielded several other benefits such as connecting with and learning about nature, and acquiring new skills.

As seen in the child- and caregiver-reported survey results, there was a notable increase in positive emotional state and positive outlook following participation in the camp, although it did not reach statistical significance. The small to medium effect sizes observed for positive emotional state and positive outlook, however, suggest that the results of the study have practical significance. Additionally, findings from the thematic analysis support the conclusion that the camp had a positive impact on child well-being with regards to positive emotional state and positive outlook. Pedagogical approaches that emphasize play – e.g., as seen in the current nature summer camp – can facilitate positive emotions and broaden one’s mindset [53, 54]. Play as a behaviour may further contribute to the development of being playful, which in and of itself is an unencumbered state that is associated with well-being [55, 56]. It can be postulated, then, that participating in the camp, or, more specifically, engaging in play during the camp activities, may have acted as a mechanism to improve children’s positive emotional state. Further research that aims to replicate this study needs to investigate this postulation.

Participating in the camp activities may have also functioned as a medium to shift children's perspective toward a more positive one. Previous research suggests that having a positive outlook or a growth-oriented mindset is associated with greater resilience [57–59] which itself may protect highly vulnerable children from the risks conferred by childhood adversity [60]. Resilience is important for maintaining and promoting child mental health as it acts as a buffer against potential threats to well-being. As such, for children living in low-income urban communities and concurrently presenting with complex psychological difficulties, having a positive outlook may be critical when faced with childhood adversity. What remains uncertain, however, is whether this notable increase in positive outlook resulted from participating in the camp itself, or from specific components of the camp.

Another key finding is that participation in the nature camp sparked an interest in and appreciation for natural environments and biodiversity. Thematic analyses revealed that the nature camp was an entirely new experience for many child participants, one that allowed them to explore their interests and develop a newfound appreciation for nature. Previous research demonstrates that children who spend more time in nature are more likely to form and maintain pro-environmental attitudes during childhood and adulthood, respectively [60–62]. One study examined children's willingness to display ecological behaviour following participation in a two-week sleepover summer nature camp where they engaged in several outdoor activities (e.g., hiking, swimming, biking, etc.) and learned about different environmental topics (e.g., recycling, conservation, flora and fauna specimens, etc.) [63]. The researchers found that the experience increased participants' emotional affinity towards nature, ecological beliefs, and willingness to display ecological behaviour. These findings highlight notable benefits of spending time in nature and suggest that exposure to novel stimuli has the potential to spark interest in the field being explored. A study conducted by Dopko and colleagues [64], where children participated in a four-hour nature experience, yielded similar results, i.e., participants reported more positive emotions, a closer connection to nature, and a greater willingness to protect nature. Taken together, and in line with the results of the present study, simply providing children with direct experiences of nature may contribute toward creating an emotional bond with nature and improve ecological worldviews, in addition to igniting curiosity and passion. In an era of rapidly changing climate conditions, fostering an appreciation for nature among children could be immensely beneficial insofar that it influences them to prioritize environmental care, reduce their carbon

footprint, and engage in environmental stewardship and sustainability activities.

In addition to there being a reduction in child-reported and caregiver-reported loneliness, another unique finding of the present study is that the nature camp allowed participants to develop and explore friendships. Previous research demonstrates that friendships of high quality are associated with lower levels of loneliness in children [65] and support the development of resilience later on in life in individuals exposed to childhood adversity [66, 67]. Combined with the findings from the present study, results suggest that providing children with opportunities to build friendships may help to reduce rates of loneliness and mitigate the effects of adversity experienced in adolescence and adulthood through the development of resilience. What remains unclear, however, is whether children in our study were experiencing chronic or transient loneliness, and whether participation in the camp itself or specific components of the camp led to a reduction in loneliness. As such, there is a need for further research in this area.

Limitations

Given that we were only able to recruit 27 children, the findings from this study must be cautiously interpreted. Specifically, we may have been underpowered to detect statistically significant differences; however, we were able to detect small to medium effect sizes. Additionally, some of the participants were not able to attend the camp for the entire week or on the last day when the focus group discussions took place; as such, their post-camp experiences were not captured and limits our full understanding of the camp experience. Certain methodological difficulties with the measures were noted. Some of the younger participants required additional support to complete the surveys. Furthermore, some younger participants were unable to complete the short-answer questions on the post-camp survey, further limiting our understanding of the camp experience. Lastly, while the present study shows an upward trend toward improved mental health and social connectedness levels, it remains unclear whether there were any long-term effects following participation in the camp since follow-up data was not collected. Future research should include longitudinal measurement to identify whether positive improvements are maintained or whether there are sleeper effects.

Implications of the present study

Preliminary evidence from this mixed-methods pilot study suggests that a one-week nature camp had beneficial impacts for a group of children with complex psychological difficulties living in a low-income urban community in Canada. Our findings can inform future large-scale investigations aimed at supporting children

living in poverty or struggling with psychological and behavioural difficulties. Furthermore, this study contributes to the growing body of evidence supporting the benefits of engaging with green environments in enhancing the mental, physical, emotional, and social development of marginalized children. This has significant implications for policymakers and city planners, who must prioritize the impact of the built environment on children's health and functioning [34, 68].

Conclusion

This mixed-methods pilot study is the first of its kind to explore the effects of an immersive, week-long nature camp on the well-being and social connectedness of children with complex psychological difficulties living in a low-income urban community. Although no statistically significant results emerged from the quantitative analyses, there was a positive trend toward well-being and social connectedness, such that there was a notable increase observed in both caregiver-reported and child-reported positive emotional state and positive outlook and a decrease observed in both caregiver-reported and child-reported loneliness. Qualitative analyses revealed several secondary benefits of the camp (e.g., learning new skills, acquiring knowledge, connecting with nature, etc.). Our findings suggest engagement in an immersive nature experience has several benefits for children's mental health and should, therefore, be further evaluated as an intervention on a larger scale.

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Author contributions

Conceptualization, NR and SB2; methodology, NR and SB2; investigation, SN, SK, SB1, LM, SD, NR and SB2; data curation, SN, SK, LM, SD, and SB2; quantitative analysis, SN; qualitative analysis, SN, SK, SB1, LM, and SD; writing – original draft preparation, SN, SK, SB1, LM, and SD; writing – review and editing, SN, CM, NR, and SB2; supervision, NR and SB2; project administration, SK, SB1, NR, and SB2; funding acquisition, NR and SB2. All authors have read and agree to the published version of the manuscript. (SB1 = Barriault, S.; SB2 = Bennett, S.).

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Data availability

Requests for de-identified data can be made to the senior author, NR.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Board (Reference #23/57×2023020) of CHEO's Research Institute on July 18th, 2023. Informed consent was obtained from all participants and their respective caregivers involved in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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