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Original Research

Becoming One with Nature: A Nature Intervention for Individuals Living with Cancer Participating in a Ten-Week Group Exercise and Wellness Program

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ABSTRACT

International Journal of Exercise Science 14(3): 498-518, 2021. Positive outcomes for psychological and physiological health have resulted from a nature experience. However, evidence is limited for nature-based interventions and their effect on a cancer population. The purpose of this mixed-methods study was to determine if incorporating the One Nature Challenge (ONC) into a ten-week group exercise program (WE-Can) for individuals living with cancer could offer additional psychological and/or physiological benefits to those previously observed in WE-Can. For this study, two separate ONCs were implemented throughout two seasons (summer and winter) to formulate a ONC group (n = 18; 60 ± 12yrs). Previous WE-Can graduates were used as a control group (n = 160; 59 ± 11yrs) for this study. Psychological and physiological assessments were administered in a pre- and post-test. In addition, nature relatedness (NR; ones' relationship with nature) was measured at the beginning, middle, and end of WE-Can. Following five weeks, the ONC began and participants tracked the days they experienced nature for at least thirty-minutes (24 ± 6 days), for a thirty-day period. The ONC finished concurrently with WE-Can where post-evaluations and focus groups were administered immediately following. No additional gain in overall health was found between groups. However, aerobic fitness and fatigue significantly improved for the ONC group. This was supported by frequent activities and self-reported restoration of the mind while experiencing nature. In conclusion, the lack of overall improvement could be limited by sample size and the high level of NR prior to ONC, indicating participants were already 'one with nature.'

KEY WORDS: Nature-based therapy, chronic disease, psychology, physiology, natural environment, mixed-methods study

INTRODUCTION

A disconnection from nature in modern society is evident based on increased urbanization (59, 60) and decreased time spent in nature associated with technology-dependent lifestyles (3, 14, 49). For the older cohort, time spent performing activities outside has also declined due to increasing physical disability related to the aging process (12, 16). It is predicted this

disconnection from nature will become even more prevalent as the world's population over 60 years of age will double (22%) between 2015 and 2050 (71). Studying interventions that promote engagement in outdoor activity may offer preventative measures towards age-related increases in physical and cognitive disability (45).

A large array of literature has indicated that nature interventions are widely accessible and cost-effective for improving human health (36). The David Suzuki Foundation claims that nature is ubiquitous and is comprised of many natural elements (10). Due to this, discrepancies in literature arise due to the various definitions of nature, its elements examined and its direct influence on physiological and psychological well-being in nature interventions (20). Whether being physically active in a biophilic-dense environment (i.e. green exercise) (50) or having a scenic view out a window (62), positive effects from interaction with nature have resulted. For the scope of this study, nature was defined as interacting directly or indirectly with a blue, green, or white textured environment comprised of biological entities. Direct interaction involved actual immersion in the outdoor environment and indirect interaction involved looking out a window at a natural landscape.

The modern human has only existed for approximately two-hundred thousand years, with civilization emerging around six thousand years ago and industrialization around two-hundred years ago (23). It is apparent that the "brain evolved in a biocentric world, not a machine-regulated world" (63, p.32). Dating back to ancestral behaviours, hunters and gatherers relied on crucial elements from the environment such as food, water, and shelter for survival (21). More specifically, humans could instinctually extract and process living biota detected within the environment (29). This has been and continues to be an instrumental part of how modern humans experience the environment and is known as biophilia (70). Biophilic connections exist in a diversity of landscapes (56), however, natural environments seem to require less attentional processing (fewer cognitive resources), compared to man-made areas (35, 64). Attention restoration theory posits that reduced attentional strain brought about by soft (i.e. interest-driven) fascination is affiliated with a nature-based experience and ultimately, can mitigate fatigue and stress (28). Exposure to nature appears to have potential for improving human health and well-being.

The David Suzuki Foundation's One Nature Challenge (ONC) encourages individuals to experience nature for a minimum of 30 minutes for 30 consecutive days (10). Although this type of nature intervention warrants greater investigation, according to a technical report for the David Suzuki Foundation, it was found to improve mood, vitality and environmental concern amongst a large sample of healthy individuals (41). Determining an optimal dosage (e.g. 30 minutes a day) for experiencing nature may be effective as both a health promotion and rehabilitation tactic to enhance well-being (2, 55, 57). Associated with an aging demographic, increased prevalence of chronic diseases such as cancer contribute to the population's debilitating health (72). Although exposure to nature has been correlated with improvements in health and well-being (20), there is little evidence of the efficacy of nature-based interventions for improving healthcare practices in vulnerable populations, specifically individuals living with cancer (34, 52).

WE-Can® is a wellness and exercise program for individuals living with cancer offered by Thunder Bay Regional Health Sciences Centre and supporting community partners in Northwestern Ontario. The program offers individuals who are in active cancer treatment or up to five-years post-active cancer treatment, an opportunity to participate in two one-hour group-based exercise classes per week, for ten-weeks. Conducting three sessions a year, WE-Can® started as a research project in 2010 and has since been collecting pre- and post-program data to evaluate how exercise can improve quality of life for the cancer population. Significant improvements in both psychological and physiological well-being were observed regardless of cancer type, cancer treatment, gender, and age (34). Enhancements in quality of life measures for individuals living with cancer have also been detected following the completion of nature-based therapy interventions (5, 38, 39, 53, 58, 66). Therefore, this exploratory study aimed to determine if there is any additional gain in cancer-based health outcomes (i.e. psychological and physiological well-being) when incorporating a 30-day nature intervention (ONC) into the WE-Can® program. In addition to the exercise portion of the program, it was assumed that increasing the nature-connectedness of individuals living with cancer may optimize quality of life by improving and/or managing their current state of health (2).

Nature relatedness is positively correlated with time spent experiencing nature (41). This study hypothesized that nature relatedness would increase when adding the ONC to the WE-Can® program. Seasonal affects were also considered for this study. Longer daylight hours evident throughout the summer season increased engagement with the outdoor environment and overall time spent outside (31). This study hypothesized that individuals who completed the ONC in the summer would be more successful at completing the ONC and as a result, perceive a greater benefit from nature compared to individuals who completed the ONC in the winter. Specifically, individuals would perceive a greater psychological benefit from the ONC and physiological benefit from the WE-Can® program.

METHODS

Participants

The researchers collaborated with the WE-Can® program and recruited their participants that were willing to partake in a nature intervention in addition to the exercise program. Participants had to be in active-treatment for cancer or within five years of active-treatment and referred by an oncologist or their primary healthcare provider. This study recruited a total of 19 participants for the ONC group. Within this group, 11 participants completed the ONC in the summer session of the WE-Can® program and 8 participants completed the ONC in the winter session of the WE-Can® program. No participants dropped out of this study. The control group consisted of secondary data representing 160 past graduate participants of the WE-Can® program. Sample sizes for the control group (n=160) were substantially less when sense of coherence (50%, n = 80) and blood pressure (48.75%, n = 78) were evaluated due to previous application in the WE-Can® research program. The average age for this group (M = 58.95; SD = 10.879) did not significantly differ ($p > 0.05$) from the ONC group (M = 60.33; SD = 11.971). Similarly, the mean number of WE-Can® classes attended for the control group (M = 16.48; SD = 2.766) did not

significantly differ ($p > 0.05$) from the ONC group (M = 16.83; SD = 2.455). Females made up the majority of both the ONC (72.2%) and control (85%) groups. Both the control and ONC groups were primarily comprised of individuals with breast cancer (60.0% and 38.9%, respectfully). Participants of both the control (61.2%) and ONC (58.9%) group were either currently receiving cancer treatment or within one-year-post treatment.

Protocol

This study used a quasi-experimental mixed-methods design. More specifically, the mixed-methods design was sequential-explanatory- meaning that quantitative data (pre- and post-test measures) were prioritized and complemented by a qualitative component (9). Recruitment of participants and the design of the study gained ethical approval from the Thunder Bay Regional Health Sciences Research Ethics Board (REB# 2010113). This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (40). The first session was conducted in May 2019 and the second session was conducted in September 2019 (Figure 1).

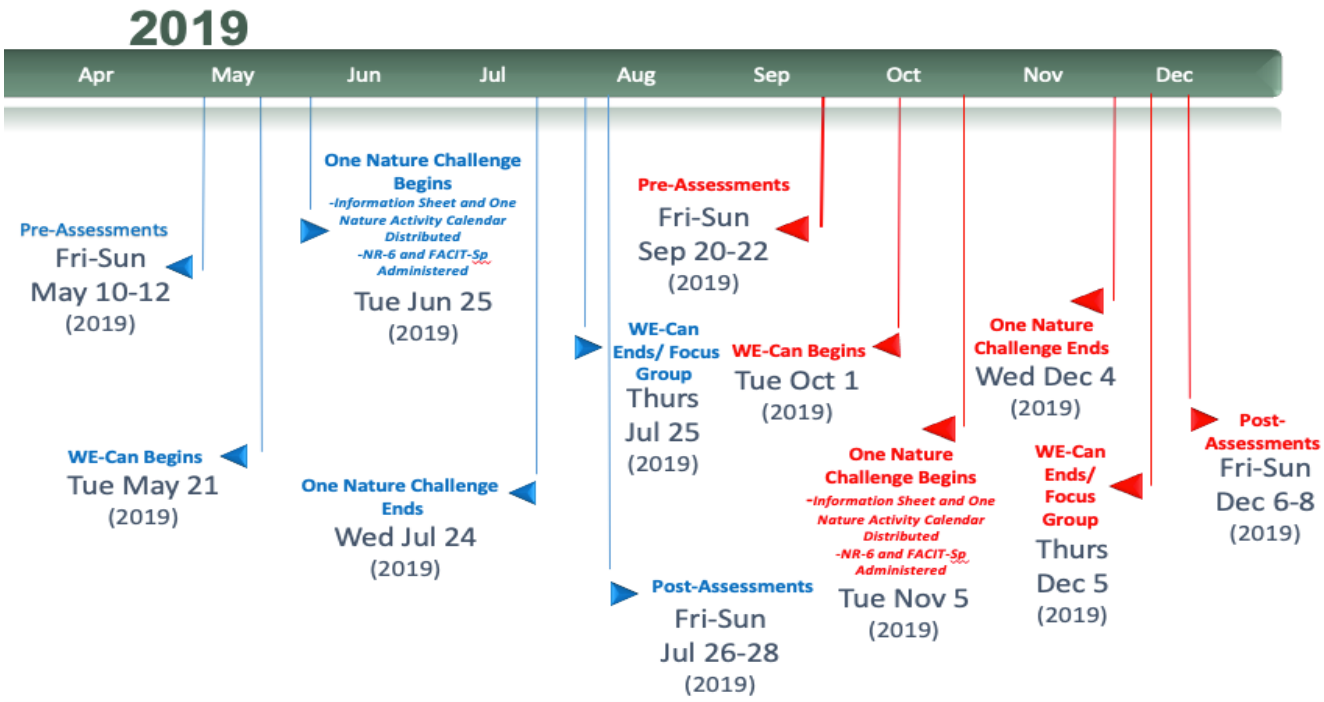

Figure 1. Annual timeline of study where the nature intervention was implemented throughout two WE-Can® programs. The first intervention was administered in the summer season and the second intervention was administered in the winter season.

Each WE-Can® session began with an introductory meeting before pre-program assessments took place. At this time participant letters, consent forms and psychological questionnaires were administered for the WE-Can® program. These questionnaires had been administered in previous WE-Can® sessions and consisted of: Short Form Health Survey version 2 (SF-36 v2) (67); Functional Assessment of Chronic Illness Therapy- Fatigue Measure (FACIT-F) (7); Brief Fatigue Inventory (BFI) (37); Patient-Specific Functional Scale (PSFS) (61); and Orientation to

Life Questionnaire (1). Following the introduction to WE-Can®, the One Nature Challenge (ONC) research project was introduced and offered to participants. Willing participants were provided with an additional ONC information letter and consent form and completed the Short-Form Nature Relatedness Scale (NR-6) to assess their subjective connection with nature (42). Completed questionnaires (both psychological measures and the NR-6) and consent forms were collected at each participants' pre-assessment.

During the pre-assessment, a physiotherapist reviewed medical history and assessed each individual to determine any possible contraindications to exercise. The assessments involved the evaluation of anthropometric measurements including height, weight, and limb girth, length, and active range of motion. These collected data acted as precautionary information only; it was used by the WE-Can® program staff to ensure that no participants were at increased risk during exercise. Specifically, fluctuations in weight and limb girth are common when receiving treatment for cancer and as a result, can increase risk for developing co-morbid conditions (65). Thus, these measures were not able to support how participants would respond to an exercise and/or nature intervention but acted as primary indicators for risk of co-morbidities such as lymphedema.

Following the examination, a Seniors' Fitness Test and a handgrip strength test were administered to determine average flexibility, strength, aerobic fitness and handgrip. The WE-Can® exercise program commenced within two-weeks of the pre-assessments.

Prior to each WE-Can® exercise class, vitals were taken between 10:30am and 10:50am every Tuesday and Thursday. Gauging blood pressure was one of the precautionary measures employed before each exercise class to determine whether a participant was cleared to exercise for the day. Blood pressure data collected from a participant's first and last exercise class served as pre-and post-blood pressure data. The level of intensity for the exercises administered in WE-Can® increased as the program progressed (Figure 2 and Figure 3).

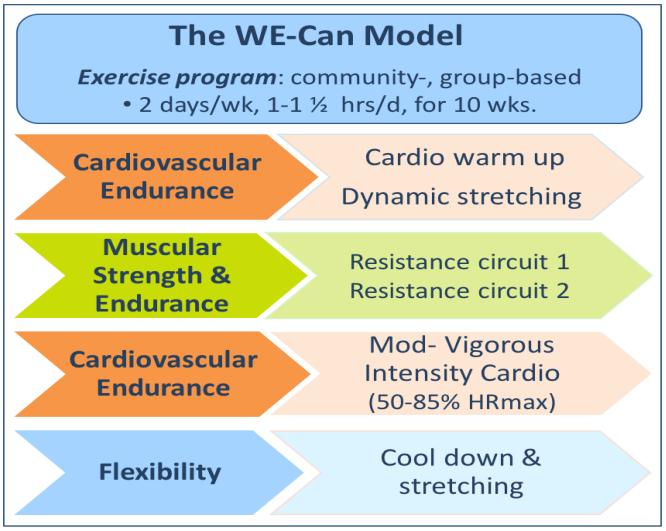

Figure 2. Overview of the WE-Can® program model. This model represents the protocol administered for one exercise class in the WE-Can® program.

Those participants who were part of the ONC intervention were asked to experience nature for a minimum of 30-minutes for 30 consecutive days during the last four weeks of the WE-Can® program. During the first exercise class of the sixth week, participants were given an information sheet on how to experience nature in the region and a self-report calendar (One Nature Calendar) to track the number of days they experienced nature out of the total thirty. In addition, the calendar was designed to track whether each interaction with nature was spent being physically active or resting. Immediately following the exercise class, the ONC commenced. The ONC was implemented into the final four weeks of WE-Can® to ensure that the participants had built up enough physical strength and confidence to take on and successfully complete the additional challenge. A qualitative inquiry was conducted at the end of the WE-Can® (and ONC) session (Figure 4).

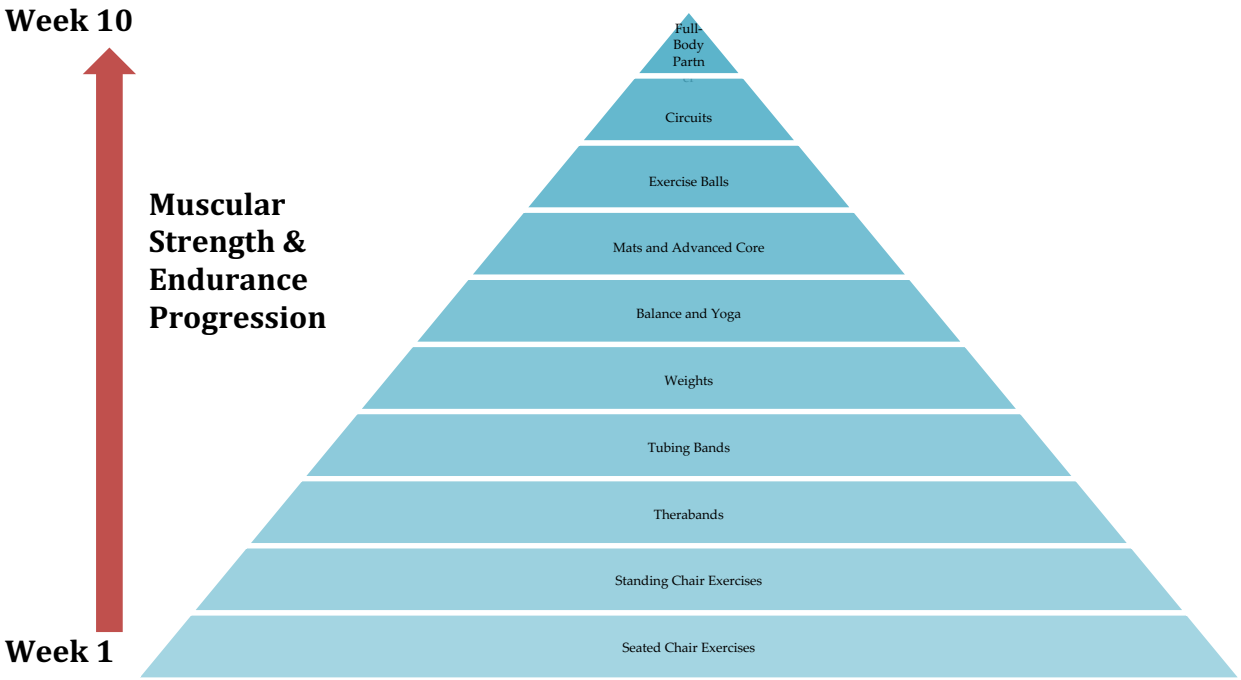

Figure 3. Summary of the muscular strength and endurance progression throughout the 10 weeks of WE-Can®. This model elaborates on the resistance circuits employed during the exercise classes each week.

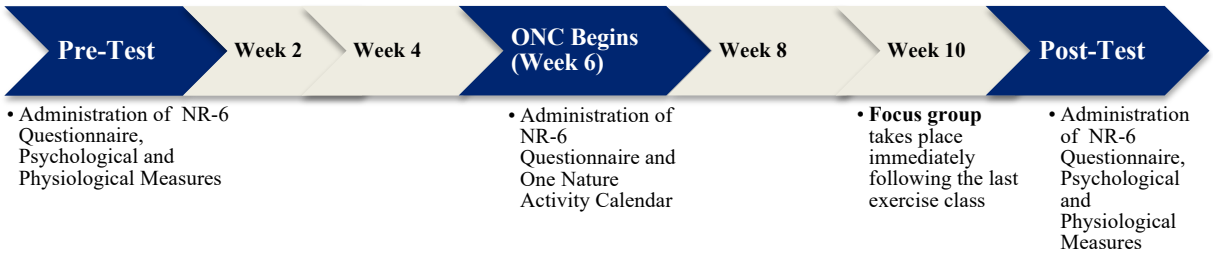

Figure 4. Procedure for implementation of One Nature Challenge throughout the course of one WE-Can® program. This entire procedure was conducted twice throughout the study.

The qualitative inquiry involved two focus groups (one for each WE-Can® session) and was conducted immediately following the last exercise class. Before the group discussions commenced, the researcher reviewed the purpose of the focus group and reiterated that the participants' involvement was optional. Dialogs were recorded on an iPhone and each focus group lasted for approximately 25 to 30 minutes. The semi-structured questions led conversations regarding individual experiences of the ONC and how they differed from the WE-Can® program to address the positive and negative aspects associated with their experiences and living with cancer. More specifically, questions asked provided more depth to the results for the One Nature Activity Calendar data to determine what participants did while resting or being active during their 30-minutes of nature exposure. Audio recordings were transcribed, and the information was preliminarily coded based on the phenomenological concepts of nature, WE-Can®, and living with cancer.

Statistical Analysis

Psychological and physiological well-being measures were computed into average change scores and multiple independent-samples t-tests were conducted using Statistical Package for Social Sciences (SPSS v25). A Bonferroni correction was applied to the psychological and physiological well-being analyses. Nature relatedness was also analyzed using a repeated-measures ANOVA to indicate change in their connection to nature prior to the WE-Can® program, ONC, and following the completion of both interventions. Independent t-tests were employed to compare sample characteristics between the two groups.

Qualitative data (i.e. notes from participants' One Nature Activity Calendar and transcribed focus group discussions) were thematically analyzed to support the quantitative findings. Key themes were extracted using inductive and deductive techniques and frequency scores to provide more clarity regarding how the participants engaged with nature and how it differed from their WE-Can® experiences. Triangulation of multiple theories, methods of data collection, and researchers conducting a thematic analysis were employed to ensure trustworthiness of data.

The final analysis was conducted combining the transcribed codes from the qualitative analysis with the statistical products computed from the quantitative analysis - the Pillar Integration Process (PIP). The PIP is a rigorous technique that transparently integrates qualitative and quantitative evidence in a joint display method (25). Three PIP displays were created to demonstrate findings for the following variables of interest: cancer-related physiological well-being; cancer-related psychological well-being; and nature relatedness.

RESULTS

Quantitative Results: When compared to control, the ONC had no additional gain for overall physiological well-being. However, the ONC group's aerobic fitness significantly differed (d = 0.843) based on the Bonferroni correction. More specifically, the ONC group exemplified a greater average improvement (14.86%) compared to the control (9.22%). No statistically

significant differences in flexibility, strength, handgrip, and blood pressure were detected between the groups (Table 1).

Table 1. Summary of independent-samples t-tests comparing groups on physical health indicators.

		t	df	Sig.	Mean Difference (% Change)	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
Aerobic Fitness		-3.117*	167	.002	-5.63926	1.80927	-9.25515	-2.06727
Flexibility		-0.419	175	.676	-3.06644	7.31670	-17.50676	11.37388
Strength		-0.594	175	.553	-1.34581	2.26381	-5.81369	3.12208
Handgrip		-0.376~	18.07	.711	-0.86232	2.29235	-5.67713	3.95249
Systolic BP	Total	-0.212	78	.832	-0.43011	2.02586	-4.46329	3.60307
	Control	0.039	49	.969	0.09596	2.46607	-4.85979	5.05171
Diastolic BP	Total	-0.628	78	.532	-1.01180	1.61045	-4.21796	2.19436
	Control	-0.924	49	.360	-2.03835	2.20637	-6.472222	2.39552

Note: ~ indicates that 'equal variances not assumed' was employed for statistical analysis. * indicates significance when $p < 0.00625$ using a two-tailed test. Negative mean difference value indicates ONC was greater than control.

Similarly, based on the Bonferroni correction applied, no psychological measures statistically differed at the $p < .0083$ level (two-tailed) between groups (Table 2). However, the ONC group had marginally (but non-significant, $p > .0083$) greater average improvements in both acute (6.46%) and chronic (7.72%) fatigue compared to the control group.

Nature relatedness was measured at three time points during the study. From their pre-assessment (time 1) and prior to the commencement of the ONC (time 2) was considered as the baseline measure of participants' connectedness with nature. This was compared to the time from which the ONC began (time 2) and the ONC ended (time 3). A repeated-measures ANOVA did not reveal a significant change in nature relatedness over time (p =.140, η_p^2 = .109).

Table 2. Summary of independent-samples t-tests comparing groups on psychological and social health indicators.

		t	df	Sig.	Mean Difference (% Change)	Std. Error Difference	95% CI of the Difference	
							Lower	Upper
Mental Component		-1.197	161	.233	-2.75212	2.29829	-7.29079	1.78656
Physical Component		0.067	162	.946	0.13117	1.94800	-3.71558	3.97791
Patient Functional Scale		0.734	153	.464	0.65726	0.89582	-1.11252	2.42704
Sense of Coherence		0.072~	78	.943	0.15926	2.22315	-4.26668	4.58520
Fatigue	Acute	-1.133	173	.259	-6.45964	5.70368	-17.7174	4.7981
	Chronic	-0.899	168	.370	-7.71933	8.58794	-24.67352	9.23486

Note: ~ indicates that 'equal variances not assumed' was employed for statistical analysis. Negative mean difference value indicates ONC was greater than control.

For the ONC group, average change in both psychological and physiological well-being were compared between seasons in which the ONC was completed to determine if the weather had any influence on improvement scores. Overall average change scores for physiological well-being was greater for participants in the winter (12.83%, n = 8) compared to the summer (9.96%, n=11) group. However, the overall average change in psychological health was slightly larger

for the participants who completed the ONC in the summer (11.90%, n = 11) compared to the winter (10.18%, n = 8).

Qualitative Results: Data collected for the ONC was limited to reduce burden on those participanting in two research studies simultaneously. Therefore, qualitative inquiry helped reinforce quantitative findings. Through use of inductive and deductive techniques, patterns within the focus groups and One Nature Activity Calendars were identified as themes that represented the phenomena of experiencing nature, contrasts of WE-Can® and living with cancer. Common codes detected within the data represented overarching themes and their corresponding sub-themes (Table 3).

Table 3. Overview of overarching themes and corresponding sub-themes.

Overarching Themes	**Sub-Themes**		
Strong Nature Relatedness	Concern for living beings and the environment	Accessibility to natural landscapes	Experiencing nature was nothing new, but still breath-taking
The Challenges of a Cancer Experience	Lack of support from cancer centre on coping with diagnosis and impact of WE-Can®	Altered perspective and support from WE-Can®	Functional limitations enhanced by weather conditions
Facilitation of Nature in Confronting Cancer	Experiencing nature enables a shift of the mind	Perceived effort in the nature experience	Nature offers a social context

Participants' comments and characteristics exemplified components associated with having a high level of nature relatedness. Nature relatedness is not just understanding nature and how it can be experienced but accepting how one is part of and connected to the natural world (43). ONC participants demonstrated a strong concern for the living beings and the environment, lived in close proximity to natural landscapes and engaged in nature experiences on a daily basis. Through conversations and self-reports, it was obvious that the majority of participants were avid nature lovers and that completing the ONC was perceived as nothing new or challenging. However, experiencing cancer was a barrier that impeded participants' daily lives. Participants enjoyed the WE-Can® program for additional support and education pertaining to their health and wellness. In addition, participants expressed altered outlooks on life caused by their cancer diagnosis and how extreme weather conditions were a limitation to their cancer experiences. However, the ONC facilitated a positive experience for participants through eliciting restoration, improving fatigue (i.e. a shift of the mind) and making their ONC experiences seem effortless. Participants enjoyed the camaraderie of partaking in both a group-based exercise program and experiencing nature with family and friends. Through these qualitative findings, experiencing nature was found to alleviate the hardships such as consequences of therapy, fear instilled by a diagnosis, and psychological and physical stress and anxiety endured when living with cancer.

Mixed-Methods Results: Statistical differences between the control and ONC groups were contrasted with qualitative findings regarding physiological well-being. The findings were

cross-validated and organized in a parallel fashion (Table 4). Statistically significant improvements in aerobic fitness for the ONC group (5.64 ± 1.81%) were supported by the various engagements pursued during the ONC, making it quite probable that this additional gain was caused by the nature intervention. Although not statistically significant, the greater changes observed by the ONC group compared to the control group, suggest that the active pursuits experienced when in nature had some effect on physiological improvements. However, this could have been limited based on weather conditions experienced between the two ONC interventions (i.e. summer and winter).

Table 4. Mixed-methods analysis for cancer-related physiological well-being using PIP

Mean Diff. % (ONC - Control) 95% CI of Diff.	**Quantitative Categories**	**Pillar Conclusion**	**Qualitative Categories**	**Qualitative Findings for Nature**	**Qualitative Findings for WE-Can**
↑ 5.64** (-9.26; -2.07)	A significant difference was detected for Aerobic Fitness ONC > control	**Increased aerobic fitness aligned with the frequent activity conveyed.**	For ONC, majority of activities engaged in were physically active. Participants expressed that they were outside on an almost regular basis being physically active.	I spend lots of time gardening and hiking and is it different then before? No (F, Summer) I go to camp, and that is very nice… and there is a woods across the street that's an old trail. So I walk in there…and climb the trail (F, Summer) Yeah, backyard with my dog… we're outside a bunch of times during the day (M, Winter) I spent more time outside. Yard work… I looked after the gardens a little bit better (M, Summer)	Well I never thought I was going to make 10 minutes on that bike (F, Summer) Like oh my god, look at that [points to newly formed biceps] (F, Winter) This is way better than any pill they will give you (M, Winter) And you either push yourself or you don't push yourself. So it's up to you. But here, you push here, and it's good (F, Winter)
↑ 3.07 (-17.51; 11.37)	No significant difference was detected for Flexibility ONC > control	**Although perceived to benefit from WE-Can®, additional gain is plausible based on daily engagement in various exercise-driven activities performed outdoors. This can also explain other increases that were observed but did not significantly differ from the control group.**			
↑ 1.35 (-5.81; 3.12)	No significant difference was detected for Strength ONC> control		For WE-Can, participants felt like they were able to achieve endurance goals and gain strength.		
↑ 0.86 (-5.68; 3.95)	No significant difference was detected for Handgrip ONC > control				
↓ 0.10 (-4.86; 5.05)	No significant difference was detected for Systolic BP ONC < control				
↑ 2.04 (-6.47; 2.40)	No significant difference was detected for Diastolic BP ONC > control				
Stats for Focus Groups (n= 16)			Some limitations on weather conditions were expressed.		
41.2% mentioned weather impacted nature experience 76.5% reported that they walked 70.6% mentioned that they felt stronger from WE-Can		**Extreme weather mostly mentioned in winter conditions could have limited nature contact compared to summer group.**	Participants expressed greater intensity for WE-Can.	But I do go for careful, I do go for careful walks but not that long, it's just too cold (F, Winter)	

Note: F indicates female and M indicates male. Summer indicates ONC participant partook in the summer intervention and Winter indicates ONC participant partook in the winter intervention.

Improvements in psychological well-being was illustrated using PIP (Table 5). Again, the qualitative data was divided into codes for the ONC and codes for WE-Can® program to better decipher what may have caused the increased improvements, or lack thereof, observed for the ONC group. Improvements in both acute and chronic fatigue for the ONC group was supported by participant experiences regarding decreased attentional demand when experiencing nature, especially for the summer group. It is plausible that the improvements detected for mental health were supported by both the nature challenge and WE-Can® program. Furthermore, the participants perceived to gain more physical benefits from the WE-Can® program and this is reflected by the lack of change observed between groups in subjective physical health and functionality.

Table 5. Mixed-methods analysis for cancer-related psychological well-being using PIP

Mean Diff. % (ONC - Control) 95% CI of Diff.	**Quantitative Categories**	**Pillar Conclusion**	**Qualitative Categories**	**Qualitative Findings for Nature**	**Qualitative Findings for WE-Can**
↑ 2.75 (-7.29; 1.79)	No significant difference was detected for Mental Health ONC > control	**Happiness and social interaction mentioned by WE-Can® experience, which as a result pushed them more physically.**	WE-Can® participants felt more comfortable performing physical activity.	And some places, there's a beautiful place where you're up a little higher, and you can see the view. And it always makes you pause and say, 'this is so beautiful here.' (F, Winter)	I think I missed two classes …I stood at the door, what was that? … And everyone's faces were different, totally different. Happy, talking, laughing, everything (F, Summer)
↓ 0.13 (-3.72; 3.98)	No significant difference was detected for Physical Health ONC < control			I did, yeah [walk].	
↓ 0.66 (-1.11; 2.43)	No significant difference was detected for Functional Scale ONC < control	**Participants of ONC mentioned nature acted as support for overcoming adversity.**	New appreciation indicates overcoming adversity of cancer experience	And like I said going to it everyday, going through chemo, I found it really helpful…. a whole new appreciation for most everything in my life (F, Winter)	I'm not as depressed as I was. I was pretty depressed. I was pretty pissed off at everything. And I never thought I was going to make it through the whole ten weeks (F, Winter)
↓ 0.16 (-4.27; 4.59)	No significant difference was detected for Sense of Coherence ONC < control	**Although no significant differences between groups, the ONC experience aligned with the attention restoration theory findings, supporting the increased improvement in fatigue.**	ONC expressed an ease and rejuvenation when in nature.	Quiet time. Just to clear my mind, enjoy the weather, the sun (F, Summer)	
↑ 6.46 (-17.72; 4.80)	No significant difference was detected for Acute Fatigue ONC > control		A mind shift can be energizing and improve fatigue.	If things aren't so great one day and I go outside, I'm energized.	And, I wanted to come and get comfortable working out and pushing myself.
↑ 7.72 (-24.67; 9.23)	No significant difference was detected for Chronic Fatigue ONC > control	**Mind shift was mostly mentioned by summer group.**	It felt natural for them to experience nature.	I find my, I call it a mind shift, keep me going…it puts me in a really peaceful and quiet place (F, Summer)	And uh, this has done it within a week (F, Summer)
Stats for Focus Groups (n= 16)		**Gain in confidence and comradery in We-Can could attribute to mental health.**	Participants gained confidence from the exercise and others that were in WE-Can®	The challenge wasn't very difficult, because I'm so busy, it was naturally more than half an hour every day (F, Summer)	People, positive people. And, that's what made me come here. (F, Winter)
64.7% mentioned a mind shift or change in mood					You do gain confidence because you go, 'oh well, can I do this? Should I do this (F, Winter)
58.8% mentioned that nature was effortless					
70.6 % mentioned they gained confidence from WE-Can®					

Note: F indicates female and M indicates male. Summer indicates ONC participant partook in the summer intervention and Winter indicates ONC participant partook in the winter intervention.

The final joint display was created to determine how participants connected to nature and how it impacted their experience throughout the ONC when it was implemented in the summer versus the winter season. Mean differences were calculated between the three time points (i.e. time 1 to 2 represented no ONC and time 2 to 3 represented ONC). A positive mean difference value indicated an increase in nature relatedness over time. The change scores were also separated into nature relatedness outcomes for the summer group and winter group, respectively (Table 6). The emergence of data displayed in the middle column conceptualized that the combination of strong nature relatedness traits and lack of significant changes detected over time make it probable that nature contact was already an integral part of the participants' lives. This was especially prevalent for the summer group, indicating potential influence on seasonal variation experienced in Northwestern Ontario and how it can foster the connection one has with nature.

Table 6. Mixed-methods analysis for nature relatedness using PIP

Mean Diff. Between Time 2-1	**Mean Diff. Between Time 3-2**	**Quantitative Categories**	**Pillar Conclusion**	**Qualitative Categories**	**Qualitative Findings for Nature**
Total ↑ 0.16 *Summer* ↑ 0.15 *Winter* ↑ 0.18 **Stats for Focus Groups** (n= 16)	*Total* ↑ 0.01 *Summer* 0.00 *Winter* ↑ 0.02	No significant difference was detected for Nature Relatedness Time 2 > 1 Time 3 > 2 Change in Winter was larger than Summer Group	**Participants were identified to portray strong traits that support the physical, cognitive and affective relationship one has with nature.** **Statistically the summer group demonstrated a smaller change. It is plausible the weather or just the participants themselves embody a stronger NR and that is why it did not change over time.**	Participants conveyed that they interacted with nature to feel better. They situate or live in areas that are richly diverse with nature and away from urbanization. Participants describe nature as a positive interaction. Even in winter, they can bring light to the beauty of the changes and snow. Participants physically interacted with nature and emphasized their concern for endangerment of living species.	I mean like I love, like I live in a beautiful, beautiful area (F, Winter) Because we are close to, not the marsh, but the, you know the rivers (F, Winter) I'm always aware of the trees and um, you know the changes, beautiful snow (F, Winter) Yeah, talk about the beauty in the water… the freshness of the water (F, Summer) Back then water was different colour than normal Lake Superior because you could see every rock (F, Summer) We're outside a bunch of times during the day. And the only thing I noticed around is there are not many birds around anymore (M, Winter) I started a garden for the monarch butterflies, I spend lots of time on it… I count them everyday… I seen something on tv, there's not much place for these little guys (M, Summer)
64.7 % mentioned a concern for other living beings and entities 70.6% mentioned nature being accessible 76.5% mentioned ONC was not a new experience for them		Nature was convenient and experienced on a regular basis.			

Note: F indicates female and M indicates male. Summer indicates ONC participant partook in the summer intervention and Winter indicates ONC participant partook in the winter intervention.

DISCUSSION

The ONC was successfully completed by participants who were already partaking in a group-based exercise program for individuals living with cancer. The main objective was to determine

if the additional nature intervention would elicit greater improvements in cancer-related health outcomes. Although the David Suzuki One Nature Challenge has been reported to improve well-being for the general population (41), this was, to the researcher's knowledge, the first investigation with the cancer population.

Quantitative Findings: There was no overall improvement on cancer-related physiological health for the ONC group when compared to control. However, the ONC group experienced a greater average change than the control group in aerobic fitness, indicating the additional improvement was associated with the nature intervention. This finding is consistent with other literature measuring aerobic fitness and nature experiences in healthy middle-aged (26), elderly (51), and cardiac cohorts (17). For example, an outdoor resistance training program prescribed twice a week, for six-weeks, enhanced aerobic fitness through improved time to exhaustion, and number of steps taken per day based on a self-worn tracking device (26). A self-report instrument can help reinforce autonomous motivation, improving adherence and overall impact of the nature intervention (26). In our study, the One Nature Activity Calendar data was successfully completed and revealed physical health benefits.

Average improvements in flexibility, strength, and handgrip strength, did not significantly differ between groups, however, greater average changes were observed by the ONC group for each outcome. Nature-based interventions vary greatly and can be accessible as a backyard garden. A ten-week horticultural therapy program significantly improved upper and lower limb flexibility and number of bicep curls for seniors with mental health problems (18). Other gardening interventions also enhanced handgrip strength (47) and muscle activation (46) in older adults. The small sample size in the current study may have limited the ability to detect flexibility and strength improvements.

Our null-results for diastolic and systolic blood pressure measures are congruent with recent findings - inconsistencies following exposure to various outdoor environments for middle-aged women (44). Although walking or viewing conditions in a forest has been found to improve blood pressure (48), this study's small sample size and the confounds of medication and treatment for cancer on blood pressure may have reduced the ability to determine how nature impacts physical health in this population.

We expected a greater improvement in cancer-related psychological well-being for the ONC group compared to the control group. Although there was no statistically significant difference between groups, the ONC group had noticeably larger improvement scores for both acute and chronic fatigue when compared to control. These findings are consistent with empirical evidence for Attention Restoration Theory regarding nature's effect on reduced attentional demands (19, 24, 28, 32, 35, 56, 64), and improved fatigue specific to the cancer population (27, 39, 53). A larger improvement in perceived mental well-being was also observed for the ONC group, but again, statistical significance was not met. This is contradictory to evidence on improved well-being associated with virtual nature (36), perceived greenness around the home (22), and horticultural therapy for cancer patients (69). Finally, the groups did not differ on perceived physical well-being, perceived functional capacity, and sense of coherence. Again, these findings contradict

the research indicating increased nature contact can improve autonomy, depressive symptoms and mitigate fear of falling for the elderly (30).
Nature relatedness for the ONC group did not significantly improve over time, however, incremental increases were still observed. Although the connection one has to nature has been found to increase following a thirty-day challenge in the UK (54) and Canada (41), greater improvement was more evident for individuals that had lower scores to begin. In this study, a ceiling effect could be responsible for the lack of increase in ONC participants' nature connectedness.

Qualitative Findings: It was evident that participants had a strong connection to nature. Participants enjoyed the challenge and discussed common themes that embodied nature relatedness. Participants had a passion for sustaining the environment, as they often negatively emphasized a perceived change in the environment or living species due to the recent development of the land. Some participants actively engaged in behaviours to support their environment by making a garden for endangered species or biking and/or walking to destinations instead of driving. Indeed, researchers in the UK found that individuals with higher nature relatedness have greater social cohesion and more frequently pursue activities in the natural environment (8). ONC participants had access to several natural landscapes and for some, their backyard was their own nature-rich oasis. Participants reported actively pursuing a nature experience to improve their current mental state and well-being, especially during their cancer experience. They generally provided no explicit rationale for pursuing a nature experience, they just knew it would make them feel better. This is suggestive of the innate biophilic tendencies to interact and thrive in the natural world (18), and through familiarization, the environment in which people frequently experience reinforces this satisfaction (4). In addition, participants' perspectives on weather conditions in the winter was not portrayed as negative, as snow and ice were still perceived as beautiful and part of their daily lived experiences. Relatedly, cooperation with the environment has been expressed through a deep fascination with nature (73). For most participants, their fascination was identified as greater than just the superficial elements nature can portray (39), reflecting a strong sense of nature relatedness.

Although the ONC was not seemingly onerous to participants, they still emphasized the daily struggles experienced when living with cancer. There is an urgency for therapeutic support for cancer as not enough resources are readily available based on the disease's increasing prevalence (11). Participants expressed gratitude for being involved in the WE-Can® program and ONC as they gained a newfound confidence to once again engage in activities that were part of their daily lives prior to their diagnosis. Individuals living with cancer have to combat outcomes of treatment such as distress and fatigue (33). Attending the exercise class or visiting a place in nature helped mitigate these symptoms. However, extreme weather conditions often limited their pursuits such as engaging in physical activity or experiencing nature. Notably, even in healthy populations, severe weather conditions may limit time spent in nature and negatively impact how people feel while doing so (15). In contrast, elderly Minnesotans described their positive experiences in white conditions classified as snow, however, extra precautionary measures are needed (13). For most ONC participants, dealing with a cancer

diagnosis was an everyday struggle, although this became what was considered a new normal for them.

Experiencing nature helped facilitate the cancer experience by relieving hardships such as treatment symptoms endured. The ONC alleviated stress and fatigue through a perceived shift of the mind. This mentally restorative response is coherent with Attention Restoration Theory (28). Furthermore, individuals living with cancer that were frequent gardeners also expressed a sense of ease and tranquility (58). This was similar to our participants' experiences, as for one person, something as laborious as kayaking was perceived to be effortless and healing. Through these positive interactions, nature was identified as a hospitable support structure for the participants. Whether alone or with others, participants used the natural environment to enhance their well-being. Similarly, children living with cancer felt supported by the environment after immersed in an adventure therapy program in the woods (69). Similar to the safe context nature can provide for terminally ill patients (5), participants felt empowered and protected, voicing that nature allowed them to express emotion or pain without any apprehension. Nature has been described as a retreat and enhancing one's sense of coherence for life satisfaction (68). The positive impact of a nature experience was emphasized through ONC participants' described experiences, as it no longer was perceived as just a place, but a restorative escape from the negative outcomes that transpire from a cancer diagnosis.

The nature intervention was strengthened by qualitative inquiry; however, its lack of structure and self-reporting still limit inferences made. Although being physically active was the most commonly reported type of activity engaged in while experiencing nature, the type, duration, and intensity were not reported in this study.

Mixed-Methods Findings: Both the quantitative and qualitative processes employed in this study played integral roles on deciphering how experiencing nature can affect individuals living with cancer. The pillar conclusions established through the emergence of the two methods helped confirm or deny the study's predictions.

The ONC intervention did not offer an additional improvement in both cancer-related physiological and psychological well-being when compared to control. However, the additional gain in aerobic fitness was supported by the participants' reported activity while completing the ONC - especially for those who completed the ONC in the summer. Experiencing the outdoors highly motivates adults to engage in physical activity (6). It is possible that the health benefits were due to the ONC, however, it seems likely that improvements in strength and flexibility were due to the WE-Can® program. A strong inference was also made that the ONC elicited additional improvements for both acute and chronic fatigue, especially for those who completed the ONC in the summer. This indicates that nature interventions can have a positive effect on mitigating cancer-related fatigue, however, repeated-measures and a larger sample size are necessary to replicate these findings. The findings of this study were also limited by seasonal nature exposure. Longer daylight hours throughout summer months have greater effect on engagement with natural landscapes, physiological, and psychological health (31). Intuitively, it seems summer would be easier than winter for participants to experience nature. Contact was

similar between seasons, however, the summer group reported greater benefits for psychological health than the winter group and were observed to have much larger improvement scores for both acute and chronic fatigue as a result.

Somewhat unexpectedly, the ONC did not result in nature relatedness increases. Nature experiences were already common for the majority of participants, however. It is plausible that the season in which the ONC was completed impacted the findings, as a ceiling effect was more prevalent in the summer group. In this sample, the benefits from nature were probably gained prior to the study. This illustrates the need for research on nature-deprived individuals to determine whether nature may benefit those who are more disconnected.

Limitations exist based on the study being exploratory and employing a unique methodological approach. Due to the collaboration with the WE-Can® program, inferences made were limited to the potential effects of both the exercise intervention and nature intervention, making it hard to conclude that the ONC caused the additional improvements. To our knowledge, no study has been conducted that tests the effects of a nature challenge intervention on those living with cancer. Self-selection limits some conclusion as the study potentially only attracted avid nature lovers and those already willing to go outside. In addition, these findings cannot be generalized to all individuals living with cancer as desire to experience nature may vary greatly within the cancer cohort. Another drawback was the differences between the two groups compared. The control group comprised of secondary data from previous years. There is no way to know how much these participants were actively interacting with nature while they were partaking in WE-Can®. The lack of significant additional improvements in this study on health-based outcomes are attributed to a small sample size and lack of power reported in the statistical analyses.

The study findings provide a general overview on how nature can benefit and be experienced by individuals living with cancer. Further investigation using both qualitative and quantitative techniques on cancer patients need to be considered to better refine how nature can be applied as an adjunct therapy in the cancer care context. To begin, a more structured nature intervention such as one that mimics the WE-Can® protocol, but an outdoor (versus indoor) setting would help to distinguish benefits unique to each of these interventions. In addition, more objective measures such as energy expenditure and actual time spent experiencing nature could reveal a greater dose-response effect. This will further support the efficacy of a nature-based therapy program as a continuum of care for cancer. When considering the aging population, it is also critical to evaluate nature exposure's effect within cohorts. Experiencing nature may be more feasible and enjoyable compared to an exercise program for older cohorts within the cancer population, supporting the value of a nature therapy program. Furthermore, the study should be conducted in multiple geographical locations to better decipher the potential effects on climate and availability of natural landscapes. Although this study was conducted in a semi-urbanized area in Northwestern Ontario, perspectives on experiencing nature and benefits gained may differ between rural and urban settings, warranting further investigation.

This was the first study to examine the ONC in a rehabilitation setting, specifically an exercise oncology program. The use of a mixed-methods approach rendered a large depth of data that

can help translate into alternative therapies in exercise oncology or other chronic disease contexts. The study's participants did not find it difficult to complete the additional nature intervention in conjunction with a group-based exercise program. The nature challenge did not elicit an overall greater improvement on psychological, physiological, and social health amongst individuals living with cancer. However, the participants who completed the ONC demonstrated greater improvements on aerobic fitness and fatigue compared to individuals who only partook in the exercise program. It is plausible that the additional intervention motivated participants to be more physically active throughout their time completing the WE-Can® program. Qualitative inquiry also added to these findings. Most themes that emerged from the group discussions were associated with psychological factors such as reduced fatigue and perceived well-being. Similar to other literature evaluating morbid populations, experiencing nature provided the participants with a safe place to self-reflect and cope with negative outcomes derived from living with a chronic disease such as cancer. The lack of improvements in nature relatedness are likely a result of participants already experiencing nature on a daily basis and receiving benefits prior to completing the ONC. Although it was anticipated that the nature challenge would enable individuals living with cancer to become one with nature, perhaps these individuals had already done so. To conclude, the study was able to direct future avenues of research on nature-based interventions in healthcare applications for aging populations.

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