1 **POSTPRINT**

2
3 **To cite this article:** Mathias, S., Daigle, P., Dancause, K.N. & Gadais, T. (2020). Forest
4 bathing: a narrative review of the effects on health for outdoor and environmental education
5 use in Canada. *Journal of Outdoor and Environmental Education* 23, 309–321.
6 <https://doi.org/10.1007/s42322-020-00058-3>

7
8 **Title of manuscript: Forest bathing: a narrative review of the effects on health for the**
9 **use outdoor and environnemental education**

10
11 **Authors:**

12 **Sandrine Mathias**

13 Clinical nurse in perinatalité at the CLSC Pierrefonds (CIUSSS ODI);
14 Member of the International Society of Nature and Forest Medicine (INFOM) in Japan;
15 sandrine.ferfache@yahoo.fr

16
17 **Patrick Daigle Ph.D (c)**

18 Lecturer in the Department of Physical Activity Sciences at the Université du Québec à
19 Montréal (program in outdoor intervention);
20 Outdoor physical educator at Collège Jean-de-Brébeuf;
21 Daigle.patrick@uqam.ca

22
23 **Kelsey Needham Dancause, Ph.D.**

24 Professor
25 Département des sciences de l'activité physique
26 Université du Québec à Montréal
27 141, Avenue du Président Kennedy
28 Montréal (Québec), Canada, H2X 1Y4
29 Tel : 514-987-3000 #5263
30 needham-dancause.kelsey@uqam.ca

Tegwen Gadais, Ph.D. (corresponding author)

Professor

Département des sciences de l'activité physique

Université du Québec à Montréal

141, Avenue du Président Kennedy

Montréal (Québec), Canada, H2X 1Y4

Tel : 514-987-3000 #3704

gadais.tegwen@uqam.ca

Author Contributions: S.M. and P.D. conducted the first articles researches and analyze, they conceived and designed the first draft of the paper; T.G. helped to analyze and complete the data, he rewrote and rearranged the draft in order to publication; K.N.D contributed reagents/materials/analysis and gave expert critics to complete and improve the quality of the paper.

Conflicts of Interest: "The authors declare no conflict of interest."

Title of manuscript: Forest bathing: a narrative review of the effects on health for outdoor and environmental education use in Canada

Key words (5-6)

Forest bath; Shinrin Yoku; interventions; Literature review; physiology; psychology.

Abstract

Education and health professionals from a range of disciplines seek alternatives to promote well-being through nature. Shinrin Yoku, originating from Japan, means “forest baths” or “taking in the forest atmosphere” and provides the opportunity to reconnect with nature and its benefits, with great potential in Canada. This brief review aims to highlight the potential for the use of Shinrin Yoku in the Canadian context of education and healthcare. We conducted a narrative literature review including a search of four French and English databases (Google Scholar, Pubmed, Scopus, Cairn) from 1985 to 2017. Then, we classified 26 articles according to three main categories that emerged from the first reading of the abstracts. Benefits of Shinrin Yoku have been classified into physiological, psychological, and environmental categories. We analyzed the potential for use of this alternative intervention by educators and health professionals in Canada. A growing body of research suggests that Shinrin Yoku can have benefits on many aspects of an individual's health and well-being. Given the resources already available in Canada, Shinrin Yoku could be integrated into existing programs and interventions, and could provide another option to educators and healthcare professionals seeking low-risk educational and intervention alternatives for their students and patients.

Introduction

Stress has widespread mental and physical health implications for individuals and societies, and has become a major public health priority (Lovallo 2015). An increasing lack of contact with nature is one currently discussed factor underlying psychosocial stress among children and adults today (Cardinal 2010; Bowler et al. 2010). Youth who lack contact with nature have the tendency to remain disconnected from nature as adults (Larouche et al. 2016; Bowler et al. 2010). Thus, there is an interest and need for the development and promotion of alternative interventions that help to connect youth with nature.

Many educators, health professionals and social scientists, from a range of disciplines, seek alternatives to traditional interventions or therapies to promote well-being (Blanchet-Cohen and Elliot 2011; Bierle and Singletary 2008; Gatzemann et al. 2008; Gadais et al. 2017). One such alternative named differently, *sylvotherapy*, *forest therapy* or *Shinrin Yoku*, translates to “forest baths” and can also be interpreted as “taking in the forest atmosphere” or “care by the forest.” Sylvotherapy was born in Japan decades ago (Tsunetsugu et al. 2010), and the country has established training and research programs on the practice. It is part of the emerging trend of natural therapies that promote a rediscovery of the benefits of nature. Sylvotherapy provides the opportunity to reconnect with our true nature by removing ourselves for a time from the performance requirements of the modern life (Papillon and Dodier 2011).

Shinrin Yoku

In theory, the idea of Shinrin Yoku or forest bathing is simple: a person simply visits a natural area and walks in a relaxed way. Practitioners leave aside their phone, camera or any other distractions to be fully present in the experience. They pause from time to time to look more closely at a leaf or to notice the sensation of the path beneath their feet. These leisurely walks under a forest canopy can be combined with guided activities to help a person to open their senses, hone their intuition and experience the forest as they never have before. Sessions of Shinrin Yoku are essentially designed by incorporating mindfulness meditation practices and techniques of deep nature connection mentoring.

102 The calming, rejuvenating and restorative benefits of forest bathing have perhaps
103 always been known intuitively, but in recent decades scientific studies have gone some
104 way to revealing how simply being in wild areas has healing effects. A number of studies
105 from Japan and South Korea have demonstrated health benefits of spending time under the
106 canopy of the living forest (Han et al. 2016; Hansen et al. 2017; Kim et al. 2009; Lee et al.
107 2011; Li 2010; Li and Kawada 2011; Li et al. 2008). However, more investigation is
108 required. A systematic review conducted by Kamioka et al. (2012) showed the difficulty
109 of comparing results across studies because of poor methodological quality and a lack of
110 description in reports, while another conducted by Oh et al. (2017) focused on the benefits
111 of spending time in forests and highlighted positive health effects, but not enough to
112 generate clinical practice guidelines.

113 A training guide exists for Shinrin Yoku in Japan, but it is not translated into other
114 language and is thus not widely used internationally. The Association of Nature and Forest
115 Therapy Guides and Programs (Association of Nature and Forest Therapy Guides and
116 Programs 2019) offers some regular week-long training sessions in Europe and the United
117 States; and the first guides trained through this association are beginning to practice in
118 North America. However, research on the health effects of Shinrin Yoku remains limited
119 in Western countries (Morita et al. 2007; Hansen et al. 2017), and opportunities to practice
120 Shinrin Yoku and its potential to offer a positive intervention is still not widely known
121 among educators and health professionals in North America. However, given the public
122 interest in forest bathing, its simplicity and limited risk, and the potential for applying it in
123 Canada, a brief review to familiarize outdoor and environmental professionals with this
124 natural intervention is timely.

125
126 *The emerging development of an intervention with high health potential in Canada*

127 In Canada, the context and environment both seem well adapted to use Shinrin
128 Yoku. Forest and nature opportunities are vast in all Canadian provinces. Forests and
129 wooded areas constitute 40% of Canada's land area, and 92% of this is publicly owned
130 (Sustainable Forest Management in Canada 2019). Furthermore, forests have been and
131 remain an important part of Canada's economy and tradition, and are viewed as an integral
132 part of Canadian culture and lifestyle (Sustainable Forest Management in Canada 2019;

Parks Canada 2019). As such, an extensive infrastructure exists to promote public access to forests, such as Parks Canada, which manages a nationwide system of natural areas across 39 natural regions (Parks Canada 2019); and provincial organizations such as the Société des établissements de plein air du Québec (SÉPAQ, Society of outdoor recreation establishments of Quebec), which manages its own system of 24 provincial parks, in collaboration with Parks Canada (SÉPAQ 2019). These organizations are responsible for both conservation of natural spaces, as well as promoting access to visitors, and provide an existing network within which Shinrin Yoku could be implemented and promoted.

Even within urban areas, parks and green spaces are widely accessible in Canada. Results from the 2013 “Households and the Environment Survey” showed 85% of Canadian households report that they lived close to a park or green space (Statistics Canada 2019). Practitioners could capitalize on these spaces to offer more regular opportunities for Shinrin Yoku within cities. Finally, the growth of educational programs at all levels specifically focused on environmental and outdoor education, and government support for these programs, highlights not only the strong public interest in promoting access to natural spaces, but is also resulting in a new growth of professionals trained to offer and adapt these opportunities to a diverse clientele (Canadian Environmental Grantmakers' Network 2006).

We are currently witnessing the timid emergence of the practice of forest bathing, promoted by organizations such as Shinrin Yoku Québec (Shinrin Yoku Quebec 2019) and similar organizations offering holistic health workshops (Domaine VieNergie 2019). Public interest in the practice is growing; in 2016, the journal *La Presse* published a popular article on Shinrin Yoku (Allard 2016) and in 2017, Radio Canada published an interview with the founder of Shinrin Yoku Québec (Radio Canada 2017). Some provincial parks management organizations, such as Ontario Parks, have even begun to specifically discuss forest bathing in their marketing and outreach campaigns (Ontario Parks 2019). The arguments put forward by Japanese practitioners in favor of Shinrin Yoku seem to fit the reality of Canadian provinces and the interests of education and healthcare professionals to seek intervention alternatives.

Aim of the paper

An exhaustive review of research on sylvotherapy and human health has been recently published, highlighting the benefits of sylvotherapy on multiple health outcomes, as well as its limitations (Hansen et al. 2017). Here, we strive to synthesize some key physiological and psychological benefits of the therapy to promote its incorporation into interventions, and to highlight the potential for the use of sylvotherapy in Canada. We hope this review could help professionals in Canadian provinces to consider Shinrin Yoku as an alternative to promote health and well-being throughout the country, outside of or in collaboration with existing interventions in school, hospital or healthcare networks.

Literature Review Methods

A narrative literature review was conducted because it is a comprehensive, critical and objective analysis of the current knowledge on a topic. This kind of review helps to establish a theoretical framework and focus or context for our research on Shinrin Yoku topic. This narrative literature review was developed based on methods used in systematic reviews (Cooper et al. 2018) and was conducted in two stages. The first stage consisted of an exhaustive search (Step 1a; Table 1) of four French and English databases (Google Scholar, Pubmed, Scopus, Cairn) for the period from 1985 to 2017. Databases were chosen to cover a broad range of research across health sciences and education, to maximize the likelihood of finding relevant articles. Searches were conducted using the following key words: Sylvotherapy, Shinrin Yoku, tree therapy, forest baths, tree care, tree health, forest health, forest therapy, forest care, nature care, nature therapy, stress and trees, stress and nature, stress and forest. In total, 2194 articles were identified at this stage. Then (Step 1b), a first review of the titles and abstracts was completed by the first two authors of this article in order to screen for relevant articles based on the inclusion criteria. Inclusion criteria were articles: a) published between 1985 up to 2017, b) peer-review, c) on Shinrin Yoku or Forest bath topic, d) open access online. We included peer-reviewed English-language articles published after 1985 and before 2017. Articles that were not peer-reviewed, and those not specifically focused on Shinrin Yoku or forest bathing, were excluded. Excluding duplicates, 23 articles were selected and 3 were added from other databases from recommendation of the third and the fourth authors of this paper. One of these included a non-peer-reviewed work (Plaisance 1985) that we retained in the current

review because of its importance in promoting awareness of potential health benefits of forest bathing in Western countries. Thus, a total of 26 articles met the objectives of this research and were included in this narrative review.

Table 1. (Step 1a) Preselection on four databases (2194 results)

Data bases	Google Scholar	PubMed	Scopus	Cairn
Period	1985-2017	1985-2017	1985-2017	1985-2017
Results	799	74	106	1215

In a second stage, articles selected in Step 1b were classified according to three main categories (physiological, psychological, and environmental benefits) that emerged from the first reading of the abstracts. These categories were chosen because of their relevance to the potential to apply Shinrin Yoku for health and education purposes. The first and second authors conducted this classification.

Claimed Effects of Shinrin Yoku

Our review of the full text of articles highlighted three main categories of potential benefits of Shinrin Yoku relevant to health professionals and educators. These included physiological, psychological, and environmental benefits. Table 2 summarizes the results of scientific studies demonstrating the effects of sylvotherapy.

Table 2. Effects of silvicultural therapy according to the scientific literature

Benefits related to the environment
Limited presence of microbes and decreased pollutants
Exposure to better air quality (oxygen enriched air)
Liberation of antibiotic molecules by trees
Emission of essential oils
Colors and natural forms
Natural ambient sounds
Physiological effects
Strengthening the immune system
Strengthening the respiratory system
Decreased level of cortisol
Decreased heart rate and blood pressure
Increased number and activity of anti-cancer cells (NK)
Strengthening the activity of the nervous system
parasympathetic
Decreased activity of the sympathetic system
Psychological effects
Decrease of stress
Improved nervous balance (control of emotions)
Decreased aggressiveness
Improved mood
Improved intellectual performance (memory)
Relaxation

213

214 *Claims of health benefit related to the environment*

215 Many benefits of sylvotherapy are thought to stem from direct contact with the
216 natural environment. First, the forest atmosphere is highly oxygenated and is largely free
217 of many of the environmental pollutants found in urban environments (Plaisance 1985;
218 Karjalainen et al. 2010; Escuté-Gasulla et al. 2015), as the deposition of pollutants to the
219 canopy and the reduction of air temperature through shading and transpiration in woodland
220 areas can improve air quality (Karjalainen et al. 2010; Nowak 2002).

221 Furthermore, trees naturally secrete antibiotic molecules that are found in the forest
222 atmosphere, including phytoncides, which are volatile antibiotic substances with
223 antimicrobial effects (Plaisance 1985). Recent studies show that phytoncides can induce

lymphocyte activity in humans (Li et al. 2006; Karjalainen et al. 2010), which might represent an underlying mechanism linking forest bathing to enhanced immune function (Li 2010). Also, exposure to negative ions in the forest atmosphere has been thought to hold beneficial effects for human health (Plaisance 1985; Monce 2018). Recent studies show few effects of negative ions on anxiety, mood, relaxation, and comfort, but show some evidence that exposure to high-density negative air ionization predicts lower depressive symptoms (Perez et al. 2013), which warrants further research.

Physiological effects

Sylvotherapy has long been thought to hold physiological benefits, strengthening the respiratory system and cardiac function and helping to lower levels of cortisol and blood pressure (Plaisance 1985). Recent studies have begun to confirm these benefits (Lee et al. 2011; Li 2010; Li and Kawada 2011; Park et al. 2010). For example, one study compared the effects of Shinrin Yoku and natural aromatherapy on immune function (Li 2010). It was found that the activity and number of NK cells (natural killer cells: lymphocytes in the same family as T and B cells) were significantly higher in the blood after a stay in the forest, than in control samples. These benefits could last up to 30 days after a stay in the forest of three days and two nights. Similar studies in cancer patients have achieved similar results (Nakau et al. 2013). Interventions combining forest therapy, horticultural therapy, yoga, and meditation in an urban green space showed improvements in NK cell activity following sylvotherapy (Nakau et al. 2013). The conclusions highlight the applicability of incorporating nature therapy into interventions, even in an urban environment.

Studies of physiological effects of sylvotherapy indicate relationships with broad indicators of stress. For example, some studies have indicated decreases of levels of the stress hormone cortisol in saliva, arterial pressure, and heart rate following sylvotherapy (Park et al. 2007; Park et al. 2010; Tsunetsugu et al. 2007; Tsunetsugu et al. 2010). Similarly, the concentration of adrenaline in the urine was significantly lower after a session of sylvotherapy (Li 2010). Exposure to the sounds of the forest may be one underlying mechanism in this regard. Studies performed in a virtual forest in which sounds specific to this environment were reproduced demonstrated that these sounds had a

beneficial effect on stress (Annerstedt et al. 2013). Finally, brain activity in the prefrontal region is significantly lower (suggesting a relaxing effect) in people who practice Shinrin Yoku, unlike those who were offered the same activity – a walk – in urban areas (Park et al. 2007).

Psychological effects

Many benefits of sylvotherapy are also demonstrate on a psychological level. Environmental factors, such as the decrease in luminosity (particularly favorable for meditation), the colors and forms of the natural environment, visual calm, and the attenuation of “artificial” noises seem to have favorable repercussions for psychosocial health (Plaisance 1985; Tsunetsugu et al. 2007). For example, studies in Japan show that aggressiveness and depression scores measured using a mood scale decreased and vigor increased following forest therapy. The higher the stress level before therapy, the more effective the therapy on psychological outcomes (Morita et al. 2007). Results of a study using the Profile of Mood States scale indicated that vigor scores increased, while scores of anxiety, depression, and anger appeared diminished following sylvotherapy (Li et al. 2007; Li et al. 2008). Others have shown that spending two nights and three days in the forest resulted in an increase in positive affect scores and a decrease in negative affect (Lee et al. 2011). With a similar time period, studies comparing a group of participants who stayed in the forest to a group that spent a stay in an urban area (Mao et al. 2012) showed a significant improvement in mood and decreased stress among participants who were in the forest. Others showed that subjects were in a more relaxed state following sylvotherapy (Ochiai et al. 2015). One study demonstrated that a walk in an arboretum resulted in a significant increase in memory, as well as better mood, than the group participating in an urban walk (Berman et al. 2012).

The forest environment might provide an important addition to existing therapies for patients with mental health disorders. For example, in the case of major depressive disorders, the therapeutic effect of cognitive-behavioral treatments might be increased when therapy is practiced in the forest (Kim et al. 2009). One study proposed a nine-day Shinrin Yoku camp to assess depressive symptoms in a population of people with alcoholism. It was found that depressive symptoms improved as a result of the therapy, and

that participants with severe depression had an even greater improvement in their condition (Shin et al. 2012). These findings were corroborated by another study that also found a sharp decrease in depression and a significant improvement in quality of life related to health status following forest therapy (Han et al. 2016). Whether used among healthy individuals for the prevention of pathologies, or for patients already suffering from health problems, current research is helping to put into perspective the potential benefits of this therapy for psychological health.

4. Discussion

In this article we have presented the findings of a review of literature related to Shinrin Yoku or forest bathing, also referred to as sylvotherapy. Shinrin Yoku appears to be an alternative intervention aimed at reconnecting populations with nature, which has benefits for stress reduction and other health outcomes. Because two recent reviews of research on sylvotherapy and human health have been recently published (Hansen et al. 2017; Oh et al. 2017), our focus was to synthesize some key benefits of Shinrin Yoku to promote its incorporation into interventions, and to highlight the potential for its use in Canada to promote well-being and healthy lifestyles.

Based on these findings, we highlight two examples for using Shinrin Yoku that could present new avenues for future research, but more studies are needed. Most people could likely benefit from the stress reduction and health effects associated with Shinrin Yoku, but impacts might be even greater at certain stages of life.

First, sylvotherapy could be implemented in school or community contexts with young people. A number of successful initiatives offering outdoor activities (e.g., forest, park, local community, farm) in schools have been shown to hold health benefits, and help to connect youth to nature (Cardinal 2010; Louv 2008). Examples include the popular Scandinavian school movement Udeskole (Bentsen and Jensen 2012; Waite et al. 2016); the Education Outside The Classroom (EOtC) (Beames et al. 2012) movement in the United States (Kuo et al. 2018); the Learning in Natural Environment Program (Edwards-Jones et al. 2018) and the Forest Schools (Waite et al. 2016) program in Great Britain; and the Draussenschule in Germany (Becker et al. 2017; Sahrakhiz 2018).

Several studies also show academic benefits of such programs. Outdoor education

promotes intrinsic motivation for students (Bølling et al. 2018), such that students are more attentive and require less attention-related reinforcement following an outdoor learning context (Kuo et al. 2018). Relationships between students are more positive and generally supported by cooperative activities (Sahrakhiz 2018; Mygind 2009), and teachers have also noted that outdoor education helps to develop more refined teacher-student relationships (Barfod 2018).

Within the Canadian context, teachers seeking opportunities to plan nature education or to teach outdoors tend to use pre-established nature programs such as Forest schools (MacEachren 2013), Outward Bound (Lowan 2009), Outdoor Education (Henderson and Potter 2001), or environmental education (Charland et al. 2009; Sauvé 2002). Both urban and more remote forest areas are used in these practices; for example, nature schools and environmental education tend to take advantage of parks and natural spaces within the community for students in primary schools, whereas programs for secondary school or college students often include longer expeditions of up to a few days in more remote areas (Pedretti et al. 2012). Some studies have highlighted similarities between Japanese and Canadian teacher's views on science and nature, and cultural views of humankind's relationship to nature (Aikenhead and Otsuji 2000). Given this context, Shinrin Yoku appears relevant for being combined with other pedagogies that are already in use by Canadian teachers. But more research on those potential effects are necessary.

Second, Shinrin Yoku could be very useful for working with populations of pregnant women. The pregnancy period is a crucial moment that can have short, medium and long term consequences for foetus and mother, both of whom are highly subject to stress and environmental disruptions (Delassus 2011; Molénat and Roegiers 2011). Interventions to reduce or to better manage stress during pregnancy could thus benefit well-being of both mother and unborn child. Prenatal interventions focused on improving maternal psychosocial health, such as mindfulness interventions (Dhillon et al. 2017) and meditation and relaxation yoga (Gong et al. 2015), have been shown to reduce stress, anxiety, and depression during pregnancy and potentially postnatally.

Shinrin Yoku could offer another low-risk intervention alternative to health professionals working on the promotion of perinatal health (Molénat and Roegiers 2011). Past research shows that exposure to green space is associated with reduced stress among

the general population, and that among pregnant women, exposure to green space is associated with lower risk of preterm birth and low birthweight (Twohig-Bennett and Jones 2018). Thus, forest bathing on its own, or in combination with other stress reduction therapies, might have measurable effects on both maternal stress and on infant well-being. It could be a method accessible at any stage of pregnancy, requiring relatively flat and marked terrain to ensure that the activity takes place in safe conditions (Kuo 2015; Iwata et al. 2016), but little in terms of equipment or experience. Because it is low risk, perinatal nurses could implement Shinrin Yoku interventions early in pregnancy, and these might provide an alternative that would be attractive to some patients who might not seek other forms of treatment.

Following the Association of Nature and Forest Therapy Guides (Association of Nature and Forest Therapy Guides and Programs 2019), many individual studies do promote health benefits of forest therapy or forest bathing. However, more research on Shinrin Yoku and on the adaptation of training sessions for various fields of intervention is required. The adaptation and application of Shinrin Yoku to the Canadian context requires increased research attention in order to support better understanding: 1) amongst the public in terms of the efficacy of this intervention; 2) of the practices of forest therapy; 3) of the design of sites required for Shinrin Yoku activities such as walking and meditation; and 4) how training and certification may help support future practitioners. We hope this review could help professionals from education and healthcare in Canada, to better understand or consider Shinrin Yoku as a possible alternative to promote health and well-being, in collaboration with existing interventions in school, hospital or healthcare networks.

5. Conclusion

A growing body of research suggests that Shinrin Yoku can have benefits on many aspects of an individual's health and well-being. This brief review aims to highlight new perspectives for education and medicine related to outdoors and nature, and to familiarize professionals with this therapy. This intervention approach appears realistic in the Canadian context but more specific research on the topic is needed. In fact, it is likely possible to incorporate Shinrin Yoku into many interventions in semi-natural spaces that are already available near schools or health centers with carefully adaptations. Above all,

379 it is hoped that by familiarizing health professionals, educators and researchers with
380 Shinrin Yoku, we might promote more detailed research on its incorporation into existing
381 interventions, its underlying mechanisms, and groups of patients that might particularly
382 benefit from this therapy.

6. References

- Aikenhead, G. S., & Otsuji, H. (2000). Japanese and Canadian science teachers' views on science and culture. *Journal of Science Teacher Education*, 11(4), 277-299.
- Allard, S. (2016). Shinrin-yoku: prendre un bain de forêt. *La Presse*. 10 May 2016.
- Annerstedt, M., Jönsson, P., Wallergård, M., Johansson, G., Karlson, B., Grahm, P., et al. (2013). Inducing physiological stress recovery with sounds of nature in a virtual reality forest—Results from a pilot study. *Physiology & behavior*, 118, 240-250.
- Association of Nature and Forest Therapy Guides and Programs (2019). <https://www.natureandforesttherapy.org/>.
- Barfod, K. S. (2018). Maintaining mastery but feeling professionally isolated: experienced teachers' perceptions of teaching outside the classroom. *Journal of Adventure Education and Outdoor Learning*, 18(3), 201-213.
- Beames, S., Higgins, P., & Nicol, R. (2012). *Learning outside the classroom: Theory and guidelines for practice*: Routledge.
- Becker, C., Lauterbach, G., Spengler, S., Dettweiler, U., & Mess, F. (2017). Effects of regular classes in outdoor education settings: a systematic review on students' learning, social and health dimensions. *International journal of environmental research and public health*, 14(5), 485.
- Bentsen, P., & Jensen, F. S. (2012). The nature of udeskole: outdoor learning theory and practice in Danish schools. *Journal of Adventure Education & Outdoor Learning*, 12(3), 199-219.
- Berman, M. G., Kross, E., Krpan, K. M., Askren, M. K., Burson, A., Deldin, P. J., et al. (2012). Interacting with nature improves cognition and affect for individuals with depression. *Journal of affective disorders*, 140(3), 300-305.
- Bierle, S., & Singletary, T. J. (2008). Environmental education and related fields in Idaho secondary schools. *The Journal of Environmental Education*, 39(3), 19-31.
- Blanchet-Cohen, N., & Elliot, E. (2011). Young children and educators engagement and learning outdoors: A basis for rights-based programming. *Early education & development*, 22(5), 757-777.
- Bølling, M., Otte, C. R., Elsborg, P., Nielsen, G., & Bentsen, P. (2018). The association between education outside the classroom and students' school motivation: Results from a one-school-year quasi-experiment. *International Journal of Educational Research*, 89, 22-35.
- Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., & Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC public health*, 10(1), 456.
- Canadian Environmental Grantmakers' Network (2006). Environmental education in Canada. Toronto.
- Cardinal, F. (2010). *Perdus sans la nature-Pourquoi les jeunes ne jouent plus dehors et comment y remédier*. Montréal: Québec Amérique.
- Charland, P., Potvin, P., & Riopel, M. (2009). L'éducation relative à l'environnement en enseignement des sciences et de la technologie: Une contribution pour mieux Vivre ensemble sur Terre. *Éducation et francophonie*, 37(2), 63-78.
- Cooper, C., Booth, A., Varley-Campbell, J., Britten, N., & Garside, R. (2018). Defining the process to literature searching in systematic reviews: a literature review of guidance and supporting studies. *BMC Med Res Methodol*, 18(1), 85,

- doi:10.1186/s12874-018-0545-3.
- Delassus, J.-M. (2011). *Penser la naissance*: Dunod.
- Dhillon, A., Sparkes, E., & Duarte, R. V. (2017). Mindfulness-Based Interventions During Pregnancy: a Systematic Review and Meta-analysis. [Review]. *Mindfulness (N Y)*, 8(6), 1421-1437, doi:10.1007/s12671-017-0726-x.
- Domaine VieNergie (2019). <http://www.vienergie.ca/forettherapeutique>. Accessed September 1 2019.
- Edwards-Jones, A., Waite, S., & Passy, R. (2018). Falling into LINE: school strategies for overcoming challenges associated with learning in natural environments (LINE). *Education 3-13*, 46(1), 49-63.
- Escuté-Gasulla, X., Izquierdo, S., & Rafa, M. (2015). Evidències de l'efecte del contacte amb els espais naturals sobre la salut de les persones. *Butlletí de la Institució Catalana d'Història Natural*, 115-118.
- Gadai, T., Boulanger, M., Trudeau, F., & Rivard, M.-C. (2017). Environments favorable to healthy lifestyles: A systematic review of initiatives in Canada. *Journal of Sport and Health Science*.
- Gatzemann, T., Schweizer, K., & Hummel, A. (2008). Effectiveness of sports activities with an orientation on experiential education, adventure-based learning and outdoor-education. *Kinesiology*, 40(2), 146-152.
- Gong, H., Ni, C., Shen, X., Wu, T., & Jiang, C. (2015). Yoga for prenatal depression: a systematic review and meta-analysis. *BMC Psychiatry*, 15, 14, doi:10.1186/s12888-015-0393-1.
- Han, J.-W., Choi, H., Jeon, Y.-H., Yoon, C.-H., Woo, J.-M., & Kim, W. (2016). The Effects of Forest Therapy on Coping with Chronic Widespread Pain: Physiological and Psychological Differences between Participants in a Forest Therapy Program and a Control Group. *International journal of environmental research and public health*, 13(3), 255.
- Hansen, M. M., Jones, R., & Tocchini, K. (2017). Shinrin-Yoku (Forest Bathing) and Nature Therapy: A State-of-the-Art Review. *Int J Environ Res Public Health*, 14(8), doi:10.3390/ijerph14080851.
- Henderson, B., & Potter, T. G. (2001). Outdoor Adventure Education in Canada: Seeking the Country Way In. *Canadian Journal of Environmental Education*, 6, 225-242.
- Iwata, Y., Dhuháin, Á. N., Brophy, J., Roddy, D., Burke, C., & Murphy, B. (2016). Benefits of group walking in forests for people with significant mental ill-health. *Ecopsychology*, 8(1), 16-26.
- Kamioka, H., Tsutani, K., Mutoh, Y., Honda, T., Shiozawa, N., Okada, S., et al. (2012). A systematic review of randomized controlled trials on curative and health enhancement effects of forest therapy. *Psychology research and behavior management*, 5, 85.
- Karjalainen, E., Sarjala, T., & Raitio, H. (2010). Promoting human health through forests: overview and major challenges. *Environmental health and preventive medicine*, 15(1), 1.
- Kim, W., Lim, S.-K., Chung, E.-J., & Woo, J.-M. (2009). The effect of cognitive behavior therapy-based psychotherapy applied in a forest environment on physiological changes and remission of major depressive disorder. *Psychiatry investigation*, 6(4), 245-254.

- 475 Kuo, M. (2015). How might contact with nature promote human health? Promising
476 mechanisms and a possible central pathway. *Frontiers in psychology*, 6, 1093.
- 477 Kuo, M., Browning, M. H., & Penner, M. L. (2018). Do lessons in nature boost subsequent
478 classroom engagement? Refueling students in flight. *Frontiers in psychology*, 8,
479 2253.
- 480 Larouche, R., Garriguet, D., Gunnell, K. E., Goldfield, G. S., & Tremblay, M. S. (2016).
481 *Outdoor time, physical activity, sedentary time, and health indicators at ages 7 to*
482 *14: 2012/2013 Canadian Health Measures Survey*: Statistics Canada.
- 483 Lee, J., Park, B.-J., Tsunetsugu, Y., Ohira, T., Kagawa, T., & Miyazaki, Y. (2011). Effect
484 of forest bathing on physiological and psychological responses in young Japanese
485 male subjects. *Public health*, 125(2), 93-100.
- 486 Li, Q. (2010). Effect of forest bathing trips on human immune function. *Environmental*
487 *health and preventive medicine*, 15(1), 9-17.
- 488 Li, Q., & Kawada, T. (2011). Effect of forest therapy on the human psycho-neuro-
489 endocrino-immune network. *Nihon eiseigaku zasshi. Japanese journal of hygiene*,
490 66(4), 645-650.
- 491 Li, Q., Morimoto, K., Kobayashi, M., Inagaki, H., Katsumata, M., Hirata, Y., et al. (2008).
492 A forest bathing trip increases human natural killer activity and expression of anti-
493 cancer proteins in female subjects. *J Biol Regul Homeost Agents*, 22(1), 45-55.
- 494 Li, Q., Morimoto, K., Nakadai, A., Inagaki, H., Katsumata, M., Shimizu, T., et al. (2007).
495 Forest bathing enhances human natural killer activity and expression of anti-cancer
496 proteins. *Int J Immunopathol Pharmacol*, 20(2 Suppl 2), 3-8,
497 doi:10.1177/03946320070200S202.
- 498 Li, Q., Nakadai, A., Matsushima, H., Miyazaki, Y., Krensky, A. M., Kawada, T., et al.
499 (2006). Phytoncides (wood essential oils) induce human natural killer cell activity.
500 *Immunopharmacol Immunotoxicol*, 28(2), 319-333,
501 doi:10.1080/08923970600809439.
- 502 Louv, R. (2008). *Last child in the woods: Saving our children from nature-deficit disorder*:
503 Algonquin Books.
- 504 Lovallo, W. R. (2015). *Stress and Health: Biological and Psychological Interactions*, 3rd
505 Edition. London: Sage Publications.
- 506 Lowan, G. (2009). Exploring place from an Aboriginal perspective: Considerations for
507 outdoor and environmental education. *Canadian Journal of Environmental*
508 *Education (CJEE)*, 14, 42-58.
- 509 MacEachren, Z. (2013). The Canadian forest school movement. *Learning Landscapes*,
510 7(1), 219-233.
- 511 Mao, G. X., Lan, X. G., Cao, Y. B., Chen, Z. M., He, Z. H., Lv, Y. D., et al. (2012). Effects
512 of short-term forest bathing on human health in a broad-leaved evergreen forest in
513 Zhejiang Province, China. *Biomedical and Environmental Sciences*, 25(3), 317-
514 324.
- 515 Molénat, F., & Roegiers, L. (2011). *Stress et grossesse: quelle prévention pour quel*
516 *risque?*
- 517 Monce, L. (2018). *Ces arbres qui nous veulent du bien: A la découverte des bienfaits de la*
518 *sylvothérapie*. Paris: Dunod.
- 519 Morita, E., Fukuda, S., Nagano, J., Hamajima, N., Yamamoto, H., Iwai, Y., et al. (2007).
520 Psychological effects of forest environments on healthy adults: Shinrin-yoku

(forest-air bathing, walking) as a possible method of stress reduction. *Public health*, 121(1), 54-63.

Mygind, E. (2009). A comparison of childrens' statements about social relations and teaching in the classroom and in the outdoor environment. *Journal of Adventure Education & Outdoor Learning*, 9(2), 151-169.

Nakau, M., Imanishi, J., Imanishi, J., Watanabe, S., Imanishi, A., Baba, T., et al. (2013). Spiritual care of cancer patients by integrated medicine in urban green space: a pilot study. *Explore: The Journal of Science and Healing*, 9(2), 87-90.

Nowak, D. J. (2002). The effects of urban trees on air quality. Syracuse, NY: USDA Forest Service.

Ochiai, H., Ikei, H., Song, C., Kobayashi, M., Miura, T., Kagawa, T., et al. (2015). Physiological and psychological effects of a forest therapy program on middle-aged females. *International journal of environmental research and public health*, 12(12), 15222-15232.

Oh, B., Lee, K. J., Zaslawski, C., Yeung, A., Rosenthal, D., Larkey, L., et al. (2017). Health and well-being benefits of spending time in forests: systematic review. *Environmental health and preventive medicine*, 22(1), 71.

Ontario Parks (2019). Healing in the forest: a guide to forest bathing. <https://www.ontarioparks.com/parksblog/guide-forest-bathing/>. Accessed September 1 2019.

Papillon, P., & Dodier, R. (2011). Les forêts périurbaines: des usages récréatifs à l'espace prophylactique. *Journal of Alpine Research/ Revue de géographie alpine*(99-3).

Park, B. J., Tsunetsugu, Y., Kasetani, T., Hirano, H., Kagawa, T., Sato, M., et al. (2007). Physiological effects of shinrin-yoku (taking in the atmosphere of the forest)—using salivary cortisol and cerebral activity as indicators—. *Journal of Physiological Anthropology*, 26(2), 123-128.

Park, B. J., Tsunetsugu, Y., Kasetani, T., Kagawa, T., & Miyazaki, Y. (2010). The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. *Environmental health and preventive medicine*, 15(1), 18-26.

Parks Canada (2019). National Parks. <https://www.pc.gc.ca/en/pn-np/introduction>.

Pedretti, E., Nazir, J., Tan, M., Bellomo, K., & Ayyavoo, G. (2012). A Baseline Study of Ontario Teachers' Views of Environmental and Outdoor Education. *Pathways: The Ontario Journal of Outdoor Education*, 24(2), 4-12.

Perez, V., Alexander, D. D., & Bailey, W. H. (2013). Air ions and mood outcomes: a review and meta-analysis. *BMC Psychiatry*, 13, 29, doi:10.1186/1471-244X-13-29.

Plaisance, G. (1985). *Forêt et santé: guide pratique de sylvothérapie: découvrez les effets bienfaisants de la forêt sur le corps et l'esprit*: Éditions Dangles.

Radio Canada (2017). Le shinrin-yoku, ce « bain de forêt » thérapeutique antistress: Entrevue avec Bernadette Rey.

Sahrakhiz, S. (2018). The 'outdoor school' as a school improvement process: empirical results from the perspective of teachers in Germany. *Education 3-13*, 46(7), 825-837.

Sauvé, L. (2002). L'éducation relative à l'environnement: possibilités et contraintes. *Connexion, La revue d'éducation scientifique, technologique et environnementale de l'UNESCO*, 27(1/2), 1-4.

- SÉPAQ (2019). Société des établissements de plein air du Québec.
https://www.sepaq.com/pq/index.dot?language_id=1.
- Shin, W. S., Shin, C. S., & Yeoun, P. S. (2012). The influence of forest therapy camp on depression in alcoholics. *Environmental health and preventive medicine*, 17(1), 73-76.
- Shinrin Yoku Quebec (2019). <http://www.shinrin-yoku-quebec.org>. Accessed September 1 2019.
- Statistics Canada (2019). Canadians and Nature: Parks and green spaces, 2013. <https://www150.statcan.gc.ca/n1/pub/16-508-x/16-508-x2015002-eng.htm>. Accessed September 1 2019.
- Sustainable Forest Management in Canada (2019). Canada's Forests. <https://www.sfmcanada.org/en/>. Accessed September 1 2019.
- Tsunetsugu, Y., Park, B.-J., Ishii, H., Hirano, H., Kagawa, T., & Miyazaki, Y. (2007). Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) in an old-growth broadleaf forest in Yamagata Prefecture, Japan. *Journal of Physiological Anthropology*, 26(2), 135-142.
- Tsunetsugu, Y., Park, B.-J., & Miyazaki, Y. (2010). Trends in research related to “Shinrin-yoku”(taking in the forest atmosphere or forest bathing) in Japan. *Environmental health and preventive medicine*, 15(1), 27.
- Twohig-Bennett, C., & Jones, A. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environ Res*, 166, 628-637, doi:10.1016/j.envres.2018.06.030.
- Waite, S., Bølling, M., & Bentsen, P. (2016). Comparing apples and pears?: a conceptual framework for understanding forms of outdoor learning through comparison of English Forest Schools and Danish udeskole. *Environmental Education Research*, 22(6), 868-892.