Article

Experiencing forest therapy in the Italian landscape: bathing in the Selva of Castelfidardo

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Abstract: According to several evidence, forest environmental seems able to provide beneficial effects on functional and psychological parameters, related to cardiovascular, metabolic, respiratory functions as well depression and anxiety. The aim of this study is to investigate the effect of a one-day forest walking in Selva di Castelfidardo (AN, Italy) on 37 participants aged 21-68, most of them living in either urban or suburban areas of large cities. We observed a statistically significant effect on sympathovagal balance by the means of heart rate, systolic and diastolic blood pressure, body temperature, skin temperature, skin conductance, HRV parameters (AVNN, SDNN, rMSSD, pNN50, LF, HF, LF/HF ratio), oxygen oximetry, PEF, FEV1. A significant difference was also detected on the Perceived Stress Scale responses (19.27 pre vs 13.81 post-immersion, $p < 0.05$; -28,3% variation). Our data contribute to increase the body of literature about the effect of forest walking, adding data on an Italian area qualified for forest bathing.

Keywords: forest bathing; forest medicine; human health

1. Introduction

In the last decades, several evidence suggest that being exposed to nature, such as walking in the forest or near waterfall, visiting or just looking at natural environments seems able to provide salutogenic effects on human health [1]. According to the latest studies, functional and psychological parameters, such as cardiovascular, metabolic, respiratory functions and depression, stress, anxiety seems to improve after natural exposure, known as "forest bathing" [2–4]. This expression originates in Japan, and it was called "Shinrin-yoku" in Japanese. A forest bathing trip involves a short and leisurely visit to forest for relaxation and recreation while breathing in volatile substances, mostly wood essential oils called phytoncides, which are organic compounds obtained from trees, such as α -pinene and limonene [5]. It seems that the positive effects revealed after this trip could be attributed to the indirect effects of the organic compound, combined with an increased physical activity level, social interactions and exposure to sunlight [6]. More in deep, after the growing interest in ecology and health worldwide, a few studies have reported that natural and green spaces promote modern human health, increasing people quality of life [7-9]. The term "forest therapy," or better "forest medicine", describes the medically proven health effects resulting from exposure to forests. Latest studies evidenced that the direct contact with nature, such as viewing natural landscapes or walking in the forest,

seem to increase parasympathetic nervous activity and suppresses sympathetic nervous activity [10,11]. The Heart Rate Variability (HRV) is the non-invasive index of autonomic controls of the heart [12]. This parameter can provide objective evaluation about stress offering some advantages over alternative physiological measurements. In fact, HRV can be recorded continuously in a non-invasive manner [13]. The positive effect of nature exposure on this parameter is supported by studies that evidenced how negative emotions such as anxiety, depression, and tension are reduced, while positive emotions increase, as well as the psychological relaxation enhanced [14]. It seems that these relaxing effects of forest, and natural landscape, are produced by gaining information about the physical environment, such as air temperature, humidity, illuminance, sounds, etc., as well as about chemical environments such as phytoncides of forest through our five senses [15]. As far as we know, most of the studies that evidence the positive effect of forest-bathing on people quality of life have been performed in Asia, mostly Japan, and north Europe. The aim of this study is to investigate the effect of a one-day forest walking in Selva di Castelfidardo (AN, Italy) on 37 people. This pilot study will contribute to increase the body of literature about the effect of forest walking, adding data on an Italian area qualified for forest bathing.

2. Materials and Methods

This prospective, single-group, single-centre pilot study was approved by the University of Rome "Foro Italico" Committee (n. CAR 83/2021) and by Scientific Committee of ACS ASOMI College of Sciences - Higher Education Institution, Malta. Thirty-seven participants, both male and female, were enrolled by the Associazione Italiana di Medicina Forestale (A.I.Me.F.). Written informed consent was prepared and drafted encompassing the risk and the nature of the research that was signed by participants before being involved in the study.

2.1. Study Site

The Selva di Castelfidardo is a site of 36 hectares covered by sub-Mediterranean deciduous forests that extends over the hills of the Conero Riviera, in the province of Ancona. It covers the north side of the Monte Oro hill rising from an altitude of 15 meters above sea level to the summit, at an altitude of 120 m. The microclimate, hot and arid in the top area, cooler and more humid in the lower area, has allowed the development of a biodiversity which, compared to other ecosystems, make the site a unique natural heritage in all of Europe. This supported the choice to qualify it from A.I.Me.F. as a "Forest Bathing Center", inspired by the scientific literature and previous experiences described by various authors over the last 20 years, in particular by Japanese colleagues who have been doing research on Forest Medicine for some time. The qualification procedure allows to demonstrate in a precise and scientific manner that spending time in a wooded and qualified natural area produces therapeutic effects that can be highlighted through biological and biopsychosocial investigations and tests. There are three steps (Phases) to qualify a site as a "Forest Bathing Center".

2.1.1. Phase 1

It is the evaluation of the places (built and natural) of the location, using 10 indicators, each of which is assigned a variable index from 0 to 5 based on the presence or absence of quality characteristics for each indicator: air quality, water quality, quality of the earth, presence of trees / woods, presence of paths (easy to walk), gps coverage and telephone network coverage, overnight possibility, possibility of eating meals, area dedicated to forestry medicine, presence of paths (disabled and minors). The site was found to be suitable for the assessments carried out in Phase 1, so it was subjected to the more specific assessments of Phase 2.

2.1.2. Phase 2

It is the evaluation of the Environmental Suitability of the Location for Human Health, recording specific Environmental and Occupational Medicine instruments: the Quality of the Air, Water, Ground, the level of noise pollution, the presence of particulate matter and Electromagnetic Fields and Radians, parameters of plant neurobiology. After this phase, the Selva di Castelfidardo was found to be suitable for the assessments. To complete and receive the "Forest Bathing Center" Appropriate Location Qualification, there is also a Phase 3, which involves an experience of Shinrin-yoku/Forest bathing with at least 30 participants, on which specific parameters are recorded in and out, to ascertain and quantify the therapeutic effects of Forest Therapy in this specific location.

2.1.3. Forest Immersion

The Forest Immersion for Phase 3 of the "Forest Bathing Center" Qualification was carried out on Sunday 12 July, from 10:00 to 18:00, all specific steps were reported in Table 1.

Table 1. Forest Immersion Schedule in Selva di Castelfidardo.

Phase	Activity	Duration
Participants Arrival	Registration and signature of the informed consent form; ID code assignment; PSS completion	30 minutes
Data Collection	At the beginning: Vital signs, HRV, PEF, FEV1, autonomous nervous system testing and oximetry	1 hour
Greeting to the Dojo of Nature	People are guided to the entrance to the Selva, where the "Greeting to the Dojo" is read and commented on	15 minutes
First Bath	First slow walk inside the Selva (500-600mt). People are invited to observe nature	30 minutes
First Stop	First stop with a simple guided meditation paying attention to breath- ing. People find a place lying or sitting next to the trees	10 minutes
Second Bath	Second slow walk inside the Selva (500-600mt). People are invited to observe nature and are provided more detailed information on plant recognition, plant neurobiology and phytosociology of the forest	30 minutes
Second Stop	Read of the "Eulogy of Silence".	10 minutes
Third Bath	Participants are invited by the Tutors to take a walk slowly and silently in the Selva, without distraction (500-600mt)	30 minutes
Third Stop	Description of the "Meditation of the 5 Senses"	10 minutes
Fourth Bath	Participants are invited by the Tutors to take a walk slowly and silently in the Selva, without distraction (500-600mt)	10 minutes
Fourth Stop	Short briefing and description of the emotions / sensations experienced. Then the participants are invited to look for a Tree and get in direct contact: reading the "Meditation on the Trees"	15 minutes
Lunch break	Lunch break inside the Selva. Smoking (including e-cigarettes), coffee and alcohol are not allowed. Listening to the "Music of the Plants" with practice of the techniques of the "Plantfulness®" method and briefing	1 hour
Fifth Bath	Participants walking, heading towards the starting point but following another path (500-660mt)	30 minutes
Fifth Stop	Historical and botanical description of the forest and its seasonal biodiversity	15 minutes
Sixth Bath	The participants walk always guided by the Tutors to notice the rich biodiversity	30 minutes
Sixth Stop	Guided practice of Yoga exercises, Barefooting, Grounding, Mindfulness etc.	30 minutes
Seventh Bath	participants walk to the exit of the Selva (500-600mt)	

Seventh Stop	Outside the Selva participants read and comment on “Thanksgiving to Pachamama”	10 minutes
Post-bathing collection	At the end: Vital signs, HRV, PEF, FE1, autonomous nervous system testing and oximetry; PSS completion	1 hour

2.2. Immersion steps

At the entrance and leaving from the forest we propose a brief thanksgiving to the Forest to acknowledge your presence and respectfully greet other practitioners. The 5 senses meditation helps people to connect to the present moment using sense of sight, sound, touch, taste and smell. We opted for use this meditation to ground participants in the here and now to avoid and to distance unwanted thoughts, feeling physical discomfort or uncomfortable emotions. Walking in silence, people are invited to focusing attention to the micro-cosmos all the way around, enhancing the contact with nature. Sharing emotional experiences with others is encouraged from the tutors to reactivate the emotion at a more symbolic level, all taking place as part of ensuing interpersonal interactions in the group, implementing bonding, to become closer to others and reduce feelings of loneliness, empathy and receiving attention from others, possibly also to entertain engaging others and facilitate social interactions inside the group. At the same way, we propose activities, games or exercises to carry out in group. Insights on biodiversity, herbal curiosities and other advise on plant, trees and biological compounds are provided from the experts in forest medicine from A.I.Me.F staff. Barefooting or walking in minimalist shoes without risk of injury is recommended during immersion due to several benefits of walking barefoot, including a better control of foot position when it strikes the ground, an improvement in balance, proprioception, and body awareness, which can help with pain relief and to stronger leg muscles. If it meets the feeling of the group, tutor can finally act a greeting to Pachamama, a personification of the Mother Earth in Inca mythology, to underline prosperity, fertility and wondering Nature.

2.3. Measurements

Before and after the one-day walking in Selva di Castelfidardo, all participants performed the following physiological measurements to evaluate sympathetic and parasympathetic nervous system activity, and sympathovagal balance: heart rate (HR), systolic and diastolic blood pressure, body temperature, skin temperature, skin conductance, HRV parameters (AVNN, SDNN, rMSSD, pNN50, LF, HF, LF/HF ratio), oxygen oximetry, PEF, FEV1, catching data in a few minutes by portable and easy to use instruments. We used Mir Smart one (portable spirometer, individually setted with single-use tube for expiratory act); Hylogy – digital upper arm blood pressure monitor; Lovia digital portable oximeter; Mindfield e-Sense Pulse to measure HRV parameters; Mindfield eSense Skin Response to measure skin conductance and Mindfield eSense Temperature - Biofeedback for cutaneous temperature variations. In the pretest phase, all participants filled out a questionnaire, which included demographic information and questions regarding emotional status: the Perceived Stress Scale (PSS) from Sheldon Cohen, the most widely used psychological instrument for measuring the perception of stress. It is a measure of the degree to which situations in one’s life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress. The PSS was designed for use in community samples with at least a junior high school education. The items are easy to understand, and the response alternatives are simple to grasp. Moreover, the questions are of a general nature and hence are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last month. PSS scores are obtained by reversing responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then summing across all scale items. A short 4 item scale can be made from questions 2, 4, 5 and 10 of the PSS 10 item scale.

2.4. Statistical Analysis

The SPSS® version 23.0 for Windows (IBM Corp., released 2015) was used to analyse the data. The Kolmogorov-Smirnov test was applied, before analysis, to test the normal distribution of data. Due to the normal distribution, parametric paired t-tests were performed to all variables, whilst mean and standard deviation scores were chosen as appropriate descriptors of measures of central tendency.

3. Results

3.1. Demographic data

The demographics of the 37 participants are reported in **Table 2**. Overall, 15 men (40.5%) and 22 women (59.4%) participated, with 6 people aged 21–30 years (16.2%), 7 aged 31–50 years (18.9%), 18 aged 51–65 years (48.6%), and 6 aged 66 years and older (16.2%). The mean age was 54.8 years, with a standard deviation of 12.7 years. Nearly 83% of participants had a college degree. Most of the participants lived in either urban or suburban areas of large cities.

Table 2. Demographics of participants (n=37). Values are reported as mean $\pm$ standard deviation (SD).

Age	54,8 $\pm$ 12,7
Weight (kg)	66,1 $\pm$ 10,6
Height (cm)	166,1 $\pm$ 6,9
Gender	22 F; 15 M
Smokers	49%

3.2. Physiological responses

The pre-and-post immersion measures of physiological responses are reported in **Table 3** and displayed in figures.

Table 3. Pre- and post-immersion measures of physiological responses (Values are reported as mean, $\pm$ SD and % of variation between pre and post data).

Parameters	Before (T0)	After (T1)	Var %	p-value
HR	71,03 $\pm$ 11,39	75,51 $\pm$ 13,05	6,3%	0,001
SBP	112,16 $\pm$ 18,53	112,03 $\pm$ 15,97	-0,1%	0,954
DBP	65,73 $\pm$ 11,67	65,95 $\pm$ 10,35	0,3%	0,883
Temperature min	30,04 $\pm$ 1,18	29,44 $\pm$ 0,91	-2,0%	0,002
LF/HF	1,08 $\pm$ 0,89	0,73 $\pm$ 0,33	-32,2%	<0,05
rMSSD/AVNN	0,04 $\pm$ 0,018	0,04 $\pm$ 0,017	-0,6%	<0,05
PEF	385,56 $\pm$ 129,7	429,67 $\pm$ 121,18	11,4%	0,000
FEV1	3,11 $\pm$ 0,80	3,39 $\pm$ 0,61	8,9%	0,000
Oximetry	95,76 $\pm$ 1,44	97,14 $\pm$ 1,03	1,4%	0,000
PSS	19,27 $\pm$ 5,87	13,81 $\pm$ 5,42	-28,3%	<0,05

In particular, regarding the HR of participants (**Figure 1**), they exhibited significantly higher post-test HRs than pre-test HRs median value (71.03 vs 75.51, $p = 0.001$).

Despite the changes in blood pressure were not significant (112,16 vs 112.03 for SBP, $p=0.954$; 65.73 vs 65.93 for DBP, $p=0.883$), we observed a trend to normalize values (highest values versus normal range in particular) (**Figures 2 and 3**).

Regarding body temperature (**Figure 4**), we found significance only for Tmin (30.04 vs 29.44, $p=0.002$).

The group showed significant pre-post-test difference in autonomic balance (LF/HF 1.08 vs 0.73, -32,2%, $p<0,05$) (**Figure 5**).

Considering the HR analysis, rMSSD/AVNN ratio showed a variation (-0,6%) with $p<0,05$ (Figure 6).

Ventilatory parameters showed an improvement in PEF (385.56 vs 429.67, +11.4%) and FEV1 (3.11 vs 3.39, +8.9%), both statistically significant (Figures 7 and 8).

The same observation arises for oximetry (95.76 vs 97.14, +1.4%) (Figure 9).

Finally, a significant difference on PSS responses median value during the post-immersion phase was detected (19.27 vs 13.81, -28,3% variation) (Figure 10).

Figure 1. Results for Heart Rate before (T0) and after (T1) the test.

Figure 2. Results for Systolic Blood Pressure before (T0) and after (T1) the test.

Figure 3. Results for Diastolic Blood Pressure before (T0) and after (T1) the test.

Figure 4. Results for minimum Temperature before (T0) and after (T1) the test.

Figure 5. Results for Low Frequency to High Frequency ratio before (T0) and after (T1) the test.

Figure 6. Results for rMSSD to AVN ratio before (T0) and after (T1) the test.

Figure 7. Results for Peak Expiratory Flow before (T0) and after (T1) the test.

Figure 8. Results for Forced Expiratory Volume in 1 second (T0) and after (T1) the test.

Figure 9. Results for Oximetry before (T0) and after (T1) the test.

Figure 10. Results for the Perceived Stress Scale before (T0) and after (T1) the test.

4. Discussion

Data from this single-day, accessible to everyone bathing in the Selva of Castelfidardo has confirmed the beneficial effect immediately perceived of Shinrin-Yoku on human health. Results from previous studies showed convincing data explaining the relationship between the natural environment and the relaxation effects on humans (e.g., decrease in blood pressure and pulse rates, inhibition of sympathetic nervous activity, enhancement of parasympathetic nervous activity, and decrease in cortisol concentration levels) [3,4,5]. Our observations confirmed that walking in a nature reserve fosters biological changes, indicating stress reduction involving fundamentally two physiological axes: the sympathetic adrenal-medullary and the hypothalamic-pituitary-adrenal one, as previously argued [5,16], with positive impact on potentially disabling chronic medical conditions [3]. In fact, results of previous studies performed on the physiological effects of the traditional Shinrin-Yoku showed how forest environments could lower concentrations of cortisol, lower pulse rate, lower blood pressure, increase parasympathetic nerve activity, and lower sympathetic nerve activity, in particular whereas citizens are involved in occasional or continuing forest bathing approaches with the aim of reducing stress [4,17,18]. In our study, the PSS Scores was significantly lower after walking in the forest, demonstrating the psychological benefits of forests, consistently with previous findings of the effects of viewing forest scenery or walking in forests [19,20,21]. A previous study, in agreement with our observation, found that participants with initially high blood pressure showed a decrease in blood pressure after walking in a forest, whereas those with initially low blood pressure showed an increase, suggesting that a forest environment can be used to help achieve an appropriate blood pressure, showing a truly person-oriented intervention [22]. Further studies, performed on Italian sites, are needed to better understand the positive impact of forest bathing on these parameters.

5. Conclusions

Despite the heterogeneity of the sample and the small number of participants, our study contributes to underline the importance and beneficial effect of the forest medicine, which may be used to develop new strategies in particular regarding primary and secondary level strategies in the field of preventive medicine. Promoting a usual and consistent approach to forest therapy may implement institutional and local resources to avoid or reduce an incorrect lifestyle encouraging health promotion and chronic disease prevention, as interestingly demonstrated in a program involving a young population affected by cancer complicated by a syndrome called by the authors "connection deficit disorder" due to the actual COVID-19 pandemic [23]. According to these observations, our future purpose will be to demonstrate that forest therapy is potentially effective in alleviating mental health issues related to the COVID-19 pandemic by restoring psychological wellbeing. Another point that we consider valuable to underline is the significance that

studies, such as the one presented in this article, may have to contribute to the dissemination of awareness among citizens of the health, preventive and therapeutic value of the woods and national parks in Italy. A.I.Me.F. will continue to propose similar researches, aimed at identifying and qualifying naturalistic places, defined as "Forest Bathing Center", both urban and extra-urban, in all Regions of Italy, helping to create a database of places where it is possible to carry out Shinrin-yoku and experiences of forest immersion with the scientific certainty of obtaining benefits for one's health (www.forestbathingcenter.com). Hoping in this way to contribute to the protection of naturalistic places in the Italian regions and in particular of the biodiversity represented by forest trees.

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Informed Consent Statement: this study was approved by the University of Rome "Foro Italico" Committee (n. CAR 83/2021). Written informed consent has been obtained from the patients to publish this paper.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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