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PRACA POGLĄDOWA
REVIEW

The impact of forest bathing on psychological and physical well-being – review of current literature

Wpływ kąpieli leśnych na zdrowie psychiczne i fizyczne – przegląd literatury

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ABSTRACT

Forest bathing, also known as shinrin-yoku, is a nature-based wellness practice that aims to harmonize a person with forest nature. It involves various activities such as walking, watching landscapes and listening to forest sounds that can be used for preventive, treatment, and rehabilitation. Forest bathing has various confirmed and probable health benefits for both physical and mental state. It has gained global recognition for its potential to reduce stress, enhance mental clarity, and improve overall well-being. The most researched and known physical benefits contain reducing stress hormone – cortisol, lowering blood pressure, boosting immune system and improving heart rate. This narrative review aims to assess the impact of forest bathing benefits of psychological and physical well-being. We also try to highlight the potential therapeutic role of forest bathing as a complementary intervention in patients. A comprehensive literature search was conducted in the PubMed database up to 2025. The review included randomized controlled trials, case reports, and pilot studies focused on the impact of forest bathing. Several studies reinforce the premise that forest therapy has a beneficial impact on both physical and mental health across diverse populations. The most extensively studied outcomes include subjective psychological states, along with physiological indicators such as reduced blood pressure, decreased heart rate, and enhanced oxygen saturation. The impact of forest bathing is documented in various research, although further research about its long-term possible effect is needed.

KEYWORDS

forest bathing, shinrin-yoku, nature therapy, forest therapy, physical health, mental health, well-being, integrative medicine

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STRESZCZENIE

Terapia lasem, inaczej kąpiel leśna (jap. *shinrin-yoku*), to praktyka oparta na kontakcie z naturą, a jej celem jest harmonizacja człowieka z naturą. Obejmuje różnorodne aktywności, takie jak spacery, obserwowanie przyrody czy słuchanie odgłosów lasu, które mogą być wykorzystywane w profilaktyce, leczeniu, a także rehabilitacji. Kąpiel leśna ma wiele korzyści zdrowotnych, zarówno fizycznych, jak i psychicznych. Praktyka ta zyskała globalne uznanie ze względu na potencjał w redukcji stresu, poprawie samopoczucia i jasności umysłu. Do najlepiej zbadanych korzyści fizycznych należą: obniżenie poziomu hormonu stresu (kortyzolu), obniżenie ciśnienia tętniczego krwi, wzmocnienie układu odpornościowego i poprawa tętna. Celem niniejszego przeglądu jest ocena wpływu kąpieli leśnych na dobrostan psychiczny i fizyczny. Starano się również podkreślić potencjalną rolę terapeutyczną kąpieli leśnych jako interwencji uzupełniającej u pacjentów. Przeprowadzono kompleksowy przegląd literatury w bazie PubMed, obejmujący randomizowane badania kontrolowane, opisy przypadków oraz badania pilotażowe dotyczące wpływu kąpieli leśnych. Wiele badań potwierdza tezę, że terapia lasem ma korzystny wpływ na zdrowie fizyczne i psychiczne w różnych populacjach. Najdokładniej zbadane efekty obejmują subiektywne stany psychiczne, a także wskaźniki fizjologiczne, takie jak obniżone ciśnienie krwi, zwolnione tętno i zwiększona saturacja tlenem. Mimo iż wpływ kąpieli leśnych jest udokumentowany w różnych doniesieniach, konieczne są dalsze badania nad ich możliwym długoterminowym wpływem.

SŁOWA KLUCZOWE

kąpiel leśna, *shinrin-yoku*, terapia naturą, terapia lasem, zdrowie fizyczne, zdrowie psychiczne, dobrostan, medycyna integracyjna

Introduction

In the last century, intensive development and industrialization have revolutionized working conditions and given rise to new and complex challenges in daily life. Due to the demanding culture of workaholism and relentless pace, people usually struggle to find time to step aside from the daily grind to rest, relax and reflect. At the same time, advances in healthcare have extended population life expectancy as well as improved general health outcomes. However, these changes have resulted in chronic and lifestyle--related diseases, like obesity, cancers and circulatory system disorders. These conditions were less prevalent in older generations but are now among the leading health concerns. In addition to this, recent transformations in social values and behaviors have undeniably shaped modern lifestyles. These shifts are evident in the surge on the consumption of heavily processed foods, reduction in physical activity and increased dependence on various psychoactive substances. Consequently, well-being in these days requires a different approach, one which is multifaceted and proactive. Evolving challenges show the need to explore, by various communities, innovative strategies to promote health and prevent disease.

People care for their well-being in many ways, often depending on their culture, values, access to resources, and personal goals. Well-being includes physical, mental, emotional, social, and spiritual health. Mental well-being can be taken care of through mindfulness and stress-reducing practices such as meditation or journaling. Sometimes helpful can be professional help sought through psychologists. Maintaining physical well-being is commonly achieved by regular exercise, sufficient rest along with a balanced, nutritious diet and routine medical check-up attendance. Important element of protective factors is avoiding harmful substances such as alcohol, tobacco, recreational drugs and unprescribed medicine. Other important aspects are maintaining regular social interaction, such as participating in community and building supportive relationships, as well as spiritual self-development, often achieved by reflection, meditation, religious or philosophical practices.

One approach of taking care of well-being is forest bathing, also known as shinrin-yoku. It is a nature--based wellness practice, a form of connecting to nature to improve health and well-being using all five senses: vision, smell, hearing, touch, and taste [1]. It aims to harmonize a person with forest nature [2]. Forest bathing involves various activities such as walking, watching landscapes and listening to forest sounds that can be used for preventive, treatment, and rehabilitation [3]. Based on mindfulness and sensory engagement with natural environments, forest bathing has gained global recognition. Shinrin-yoku has the potential to reduce stress, improve mental health and contribute positively to overall well-being [4].

Origin of forest bathing

This dynamically developing direction began in Japan in the 1980s, where the first studies on its effectiveness were conducted. Since that time, many studies in different countries have been conducted, whose results were evaluated based on various parameters, like monitoring blood pressure, heart rate and saturation, as well as conducting questionnaires about mental state. Coming from Japan, shinrin-yoku is based on three Japanese traditional concepts of beauty: yūgen, komorebi and wabi sabi. These concepts are about being aware of the world around you (yūgen), flickering light and shadow (komorebi), and finding

beauty in unfinished, asymmetrical, imperfect, aged (wabi sabi) [5].

Benefits of participating in forest bathing

The forest constitutes an excellent environment to carry out physical activity due to its environmental characteristics, which exert a beneficial influence on the psychophysical condition of individuals. What is important is that forest bathing is not about hiking, exercising, or even meditating but about being present in the natural world and engaging your senses to connect deeply with the environment [4]. It can be achieved by slowing down, engaging all five senses, being present, letting go of goals and mindfully observing. Practising this form of spending time should begin with defining and choosing setting, time and duration, as well as what activity will be performed. Forest bathing has various confirmed and probable health benefits for both physical and mental state, regardless of age, gender, ethnicity, domicile or season. The practice can be conducted as long as environmental conditions are conducive to outdoor, nature-based activities. The most researched and known physical benefits include reducing stress hormone – cortisol, lowering blood pressure, boosting immune system and improving heart rate [6,7,8]. Many studies have been devoted to the impact of forest bathing on new medical challenges, such as increasingly diagnosed cancers – their prevention, treatment and rehabilitation [9,10,11,12]. Forest bathing encourages better sleep as well as reduces anxiety and depression, enhances mood and increases focus and creativity [8]. Some studies pointed out that even viewing natural scenery with colourfful slides can influence people's heart rate, which can relieve stress and negative emotions [13]. Among physical benefits many positive psychological outcomes were studied. It has been demonstrated that forest bathing can decrease anxiety and depression symptoms [14,15], enhances mood [16], as well as improves attention along with cognitive function [17,18]. This paper examines the impact of forest bathing on health outcomes in individuals.

Clinical evidence

The impact of forest bathing on psychological well--being has been evaluated in several clinical studies. In 2020 International Journal of Environmental Research and Public Health published a study which explored the benefits of natural environments to psychological well--being and physical health [19]. In this study 120 university volunteers – 60 males and 60 females – between the ages of 19 and 24 were randomly divided into four groups of equal size, 15 males and 15 females in each. This three-day field experiment was conducted across four selected locations: two natural bamboo forests, one bamboo forest park, and one urban environment. Participants were viewing the landscape for 15 min in the morning and then they were walking in the testing area for 15 min in the afternoon. Benefits of a three-day forest therapy session were investigated by semantic differential method questionnaires and measurement of blood pressure [20,21], oxygen saturation and heart rate [22]. Results demonstrated that, across all three types of bamboo forest environments, both viewing and walking activities had beneficial effects on participants' physiological indicators. Specifically, there were significant differences in the subjects' subjective environmental evaluation of different locations. This study shows that forest therapy can effectively relieve emotions and the pressure on the human body as well as increase energy. Furthermore, forest therapy was associated with reductions in blood pressure (both systolic and diastolic blood pressure), a deceleration of heart rate and the maintenance of peripheral oxygen saturation at elevated levels. Additionally, the three-day forest therapy appeared to be more effective for women, which was indicated by their lower systolic blood pressure and decreased heart rates relative to men. All these findings strengthen the conclusion that forest therapy helps relieve physical stress and stabilize emotions, therefore have a positive influence on both physical and mental health.

A similar study among students, but using different research methods, was the 2006 article examining the physiological effects of basic shinrin-yoku activities using salivary cortisol and cerebral activity as indicators [23]. In this study 12 male students were divided randomly into 2 groups, 6 people in each. One of two groups was sent to a forest area, whereas the second was sent to a city area. The next day there was a cross-check, which consisted of sending each group to the opposite area. The intervention consisted of walking around a given area in the morning and watching the landscapes of their area in the afternoon, both activities for 20 minutes. As physiological indices they used salivary cortisol and cerebral activity in the prefrontal area. Index of cerebral activity was measured by absolute haemoglobin concentration of the prefrontal cortex [24,25]. Measurements were conducted individually, with each participant undergoing six assessments: before and after experiment in place of accommodation, as well as before and after both activities (walking and watching area). Measurements of "comfort" and "calm" were evaluated. In terms of "comfort" in the first measurement outcomes were almost equivalent. However, the scores changed after activities and in the evening. The scores of "comfort" in the forest area were significantly higher than those for the city area. The forest area was significantly more comfortable ($p < 0.01$) than the city area. However, the results also showed that the city area was not so uncomfortable.

Scores of "calm" showed the same tendency of change as "comfort" in the morning, as well as after walking and watching. However, the study showed that in the evening participants tended to feel that the place of accommodation was more exciting than the forest area and calmer than the city area. In terms of cortisol concentration this study showed the diurnal variation of cortisol, which is at its highest in the morning and gradually decreases toward the evening. The cortisol concentration of the participants in a forest area was significantly lower than that of the subjects in an urban area. Also the measure of the average value of the total haemoglobin concentration (t-Hb) in the left prefrontal area and salivary cortisol showed that the participants who went to the forest area had significantly lower levels than participants who were scheduled to go to an urban area before the experiment, as well as after it. This result implies that shinrin-yoku has a relaxing effect, having a more comfortable and calming effect than a city area.

Both of these studies, however, had relatively small numbers of participants. On a large scale was the 2007 study that analyzed shinrin-yoku as a possible method of stress reduction by measuring outcomes of forest bathing in a large group of participants in different forest areas [26]. From 541 people who agreed to participate 498 were included in the analyses, using four questionnaires – two whilst at the forest, first before and second after walk and two on the control day. Outcomes from this study were measured by two questionnaires: the Multiple Mood Scale-Short Form (MMS-SF) [27,28] and State-Trait Anxiety Inventory A-State scale (STAI-S) [29]. The MMS questionnaire was developed for use in Japan and is used to measure eight momentary emotions, each of which is scored using five four-point items, from 1 (do not feel) to 4 (feel strongly). The STAI-S is used for measurements of anxiety. In this study two-way analysis (ANOVA) using the environment and time of completion of each survey was used. Also, exercise and ability to take part in favourite activities were involved in this study. Analysis has shown that both of them have a positive effect on stress reduction. This study showed significant beneficial effects on the forest day compared with the control day by improving acute emotions through participating in shinrin-yoku. Hostility ($p < 0.001$) and depression ($p < 0.001$) scores decreased significantly, meanwhile liveliness ($p = 0.001$) increased significantly on the forest day compared to the control day. The analysis showed that these improvements were due to the forest environment and not only by exercise or taking part in favourite activities. Also beneficial effects were observed simply by reaching the forest, so it can be suggested that positive effects will be observed even after a short forest walk. These findings indicate that stress levels are correlated with the shinrin-yoku effect, in which higher initial stress levels are associated with greater psychological benefits. While regular practice of shinrin-yoku may contribute to a reduction risk of psychosocial stress-related conditions, there is a requirement for further investigation into its long--term impacts. Despite the different numbers of study groups, the results of these three studies were similar, which confirms the beneficial effects of forest bathing on healthy humans.

Forest bathing has been widely researched among people with a variety of psychological disorders. In 2023 a crossover study was performed [30]. 22 male participants within the age group of 25 to 64, who were pathological gamblers, were randomized into 2 study groups, which were exposed to nature and city sounds. 11 participants were assigned to natural sound and the other 11 to city sound. After the assigned intervention participants were crossed over and underwent the opposite sound. For nature sounds they used recorded at about 3 am buzzing insect sounds from the riverside in Osaka in autumn and for city sound – the sound of traffic at an intersection in Shibuya, Tokyo. Both sounds fluctuated around 49,5 dB. In this study participants were maintained in a resting state, firstly in a sitting position with eyes closed for about 2 min, then it was played for them on the headphones stimuli for nature or city sounds for 60 sec. After that they answered the questionnaire. During the experiment, two kinds of measurements were performed – physiological and psychological. Subjective evaluation showed that nature sounds increased comfort, relaxation and more natural feeling compared with city sounds. Physiological measurements included near--infrared spectroscopy [31], heart rate variability [32,33] and heart rate. Near-infrared spectroscopy shown that nature sound significantly reduced the oxyhaemoglobin (oxy-Hb) concentrations in the bilateral prefrontal cortex (left prefrontal cortex: $t(18) = 2.78$, $p = 0.012$; right prefrontal cortex: $t(18) = 2.92$, $p = 0.009$), whereas listening to the city sound increased oxy-Hb concentrations (in the left prefrontal cortex: nature sounds -0.65–0.24 mM and city sounds 0.01–0.15 mM; $t(18) = 2.29$; $p = 0.034$; in the right prefrontal cortex: nature sounds -0.48–0.17 mM and city sounds -0.14–0.16 mM). As indicators of autonomic nervous activity in this study were analysed heart rate (HR) and the components of heart rate variability (HRV): low-frequency (LF; 0.04–0.15 Hz) and high-frequency (HF; 0.15–0.4 Hz). HR and HF reflect parasympathetic nervous activity, whereas LF/HF ratio – sympathetic nervous activity [34]. The HF and LF/HF ratio did not significantly differ after 1-min auditory stimulation using nature and city sounds. Subjective evaluation after intervention showed that nature sounds increased comfort, relaxation and more natural feeling compared with city sounds. Psychological activity was measured using the

modified version of the standard deviation (SD) method and the Second Edition of the Profiles of Mood States (POMS2) [35]. Modified SD method used in this study was a 13-point scale between three sets of indices: comfortable to uncomfortable, relaxed to awakening, and natural to artificial. The POMS2 score had 35 questions which followed subscales: anger––hostility; confusion–bewilderment; depression––dejection; fatigue–inertia; tension–anxiety; vigour––activity; and friendliness. Performed assessment showed that after exposure to nature sound negative subscales decreased and positive subscales increased among patients with gambling disorder, which indicates that forest bathing has a stress-reducing effect and promotes physiological relaxation.

The effect of forest bathing on mental disorders has also been studied in another study from 2019 in which 50 patients with affective and psychotic disorders participated in forest bathing therapy [36]. The study involved 27 patients with affective disorders (18 women and 9 men) and 23 with psychotic disorders (9 women and 14 men) who were hospitalized for at least two weeks in a psychiatric ward. As a form of intervention recreational walking was used in a suburban forest near the mental hospital in Olsztyn. Patients were encouraged to participate in forest walk sessions with additional exercises such as stretching or watching landscapes on 12 different occasions throughout the day. 4 to 5 patients participated in one forest therapy session. Before and after subjects filled out questionnaires – Profile of Mood States Questionnaire (POMS) and the STAI-S. POMS measure six mood states: fatigue, anger–hostility, tension–anxiety, depression–dejection and vigour, ranging from 0 to 4 [37,38]. STAI-S measures the level of anxiety in the present moment, ranging from 1 to 4 [39,40]. Experiment showed that forest therapy had a positive effect on nearly all POMS scale subscales, with the exception of anger–hostility for patients with affective disorders. The most pronounced reactions in these patients were observed in response to confusion and depression–dejection. Also, following the intervention, patients with affective disorders demonstrated a significant reduction in anxiety levels as measured by the STAI-S scale. In the case of the patients with psychotic disorders the greatest change was shown in confusion and vigour subscales as well as STAI-S scale, however there were observed no significant changes in fatigue subscale. The results of this study indicate that changes in psychological indicators correspond appropriately to the characteristic features of the disorder.

The 2016 study aimed to investigate whether forest therapy can effectively manage depression and anxiety in patients with chronic stroke [41]. In this study 59 patients, 40 men and 19 women within the age group of 36 up to 79 with chronic stroke, were randomly assigned to either a forest or an urban group. All patients in the forest group participated as one group, in a 4-day and 3-night program at a recreational forest area, meanwhile the urban group stayed in a hotel. The intervention in both groups consisted of walking activities as well as promoting positive emotion through meditation. Immediately before and after interventions evaluations were performed using Beck Depression Inventory (BDI), Hamilton Depression Rating Scale (HAMD-17) [42,43], STAI-S [44], reactive oxygen metabolite (d-ROM) levels and biological antioxidant potentials (BAPs). Before starting the program, there were no significant differences on psychological assessment measures (63.3% in forest group vs 62% in control group – depression by BDI and HAMD-17; 76.6% in forest group vs 72.4% in control group – anxiety, STAI-S), d-ROMs and BAPs (x^2, $P > 0.05$). Evaluation examined changes within-group as well as comparisons between groups. Within-group evaluation showed that both physiological scores and BAPs scores in the forest group after program participation were significantly different. Physiological scores shown significantly lower depression (BDI, HAMD-17) and anxiety (STAI-S) levels than the baseline scores (paired t-test, $P < 0.05$), whereas BAPs scores were significantly higher than baseline values (paired t-test, $P < 0.05$). In the urban group STAI-S scores increased significantly, apart from that there were no significant changes for other scales. No changes in d-ROM values were observed in either group (paired t-test, $P > 0.05$). Comparisons between groups showed that in the forest group reductions in BDI, HAMD-17 and STAI-S scores were greater compared to the urban group. BAPs increased more in the forest group than in the urban group, which indicated increased antioxidant capacity for patients with chronic strokes.

The 2022 study aimed to investigate the impact of forest bathing on burnout symptoms among physicians and other healthcare workers [45]. Using a randomized, controlled trial 34 participants were enrolled into the intervention group and 22 into the control group. As an outcome from the intervention in this study was used the Mini-Z questionnaire and the Oldenburg Burnout Inventory (OLBI). The Mini-Z questionnaire addresses job satisfaction and indicates potential burnout predictors [46]. OLBI assesses the level of burnout using formulated items to measure exhaustion and disengagement [47]. Outcomes from this study were collected two times – before and after the intervention. Although in analysing data from the Mini-Z questionnaire there was a slight statistically significant decrease in post-test scores in the intervention group compared to the control group. However, after adjusting the p-values as well as in the OLBI questionnaire outcomes revealed no statistically significant differences in burnout scores between the

pre-test and post-test scores within the intervention group, nor between the post-test scores of the intervention and control groups. While these findings appear to contradict previous research suggesting that participation in shinrin-yoku alleviates symptoms of depression, anxiety, and stress – factors closely linked to burnout – this study also gathered subjective comments from participants about reduction in stress levels and improvement in overall mental well-being following the intervention. Despite the fact that the data obtained from this randomized controlled trial did not reveal a significant change in burnout symptoms following participation in a single shinrin-yoku walk, we have to remember that burnout symptoms develop cumulatively over time, so it is reasonable to suggest that alleviation may similarly require sustained intervention. Regular participation in shinrin-yoku may contribute to the reduction of burnout severity by improvements in reduction of stress and anxiety. These observations raise important considerations, they point out that what is often perceived as burnout might be something more complex within mental health. The results of this study do not mean that there is no possible role for forest bathing in providing relief from burnout symptoms, but these findings need further longitudinal research to evaluate the effects of repeated shinrin-yoku sessions on burnout symptoms.

Conclusions

Forest bathing is a low-cost, accessible, and deeply restorative way to recalibrate in an increasingly stressful world. Whether you are seeking peace of mind, a boost to your immune system, or just a quiet moment with the trees, shinrin-yoku offers an evidence-based path to wellness – one step, one breath, one leaf at a time. In conclusion, there are numerous studies exploring the impact forest bathing has on people, their well-being and physical health. The growing body of literature on forest bathing is compelling – the clinical evidence from randomized controlled trials, case reports, and even pilot studies indicate positive outcomes across diverse populations. The most extensively studied outcomes are related to psychological and physiological factors such as feeling less anxious or depressed while experiencing lower blood pressure, reduced heart rate and improved oxygen levels. Several studies indicated that even short-term participation in forest bathing can be beneficial for health. Furthermore, some studies indicated the need to conduct large-scale studies to explore its long-term effects. Overall, studies showed that forest bathing can be used as a complementary therapeutic approach to different groups of patients, as well as to the general populace looking to improve their everyday life.

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Conflict of interest

The authors declare that there is no conflict of interest.

Authors' contribution

Study design – A. Ożga, A. Przybyłowska
Data collection – P. Kolano, S. Bryksy, J. Krzeszowiak
Manuscript preparation – A. Ożga, A. Podolska
Literature research – B. Chojnacka, B. Boba, J. Wątor
Final approval of the version to be published – A. Ożga

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