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Forest recreation and well-being - a survey of sanatorium patients' opinions

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Abstract Numerous studies provide evidence of the positive effects of forest recreation on well-being. However, there is a lack of research conducted among sanatorium patients. Some sanatoria organize various exercises for patients, supervised by instructors in the forests surrounding the health resort. This study examined the opinions of patients in these sanatoria regarding the impact of such forest exercises on their well-being. An additional objective was to gain knowledge about the type of exercises held in the forest, as well as their frequency and duration. A total of 293 patients participated in the individual questionnaire interview. Ninety-five percent of respondents declared that forest exercises took place several times a week, while 5% indicated a frequency of 1-2 times a week. Seventy-five percent of patients spent 1 to 2 hours during individual forest exercises, 23% spent more than 2 hours, and 2% less than 1 hour. The most frequently organized forms of forest activities for sanatorium patients were walking (40%) and Nordic walking (31%), followed by exercising in the outdoor gym (17%) and gymnastics (12%). Almost all patients reported improved well-being after forest exercises. Additionally, 92% of patients also visited the forest during their leisure time. The results may pave the way for the potential development of forest bathing as an effective method to enhance the well-being of sanatorium patients, thereby positively influencing the process of improving their health. Considering health promotion, sanatorium management is encouraged to implement various forms of forest recreation, including forest bathing, into sanatorium treatment programs. It is essential to ensure that the form of forest recreation and the duration of sessions (1-2 hours) are tailored to the capabilities of sanatorium patients.

Keywords: forest bathing, forest therapy, public health, shinrin-yoku, spas, wellness.

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Introduction

Many studies provide evidence for the positive effects of forest recreation, including forest bathing, on health (Hansen et al. 2017, Bielinis et al. 2020, Doimo et al. 2020). Various forms of forest activity have been shown to reduce stress levels (Morita et al. 2007, Chun et al. 2016, Rajoo et al. 2020, Markwell & Gladwin, 2020) and contribute to an improved sense of well-being (Farrow et al. 2019, Antonelli et al. 2021, Janeczko et al. 2021). Research by Kobayashi et al. (2019) has demonstrated that walking in the forest is only marginally more effective in reducing salivary cortisol levels compared to merely being in the forest – observing the woodland scenery. The differences were found to be statistically insignificant. Meanwhile, walking in the city had little to no impact on cortisol levels. This provides evidence that the forest environment has a decisive impact on stress reduction, confirming findings from various studies (Grilli & Sacchelli 2020).

From the perspective of the modern people with limited time, it is crucial to note that the positive impact of the forest on health persists for up to a month after the last visit (Li et al. 2008, Li 2010). This is significant, as the forest environment, beyond its direct influence on physiological and psychological health, contributes to building the body's resilience (Li et al. 2007, Tsao et al. 2018, Lyu et al. 2019). This prolonged positive effect of a visit to the forest may also be due to the fact that monoterpenes saturating the forest air penetrate the respiratory system and accumulate in the body (Sumitomo et al. 2015). Research demonstrates that even a short walk in the forest (ranging from several minutes to 2 hours) yields noticeable improvements in physiological parameters and mental well-being (Song et al. 2015, Yu et al. 2017, Wen et al. 2023). The World Health Organization (WHO, 2025) recognizes the health benefits of spending time in natural environments, including green spaces, in its report "Nature-Based Solutions and Health." These benefits include reduced stress, improved mood, physical activity, improved cognitive function, and a reduced risk of chronic disease. This positive effect of the forest environment on health should be leveraged in sanatorium treatment (Dudek & Piegdoń 2021). In Poland, there are 46 health resorts with 196 spa sanatoria, predominantly privately owned (Szafkowski et al. 2017).

Society in Poland, as in the rest of Europe, is aging. The vast majority of research to date on the health effects of forest bathing and forest recreation focuses on young adults (Park et al. 2009, Ochiai et al. 2015, Janeczko et al. 2023). Therefore, we believe that research on the effects of forest bathing and forest recreation on older people should be intensified. The main patients of sanatoriums are elderly people. Hence, the results of our research will fill the gap in the literature on the subject.

Despite the growing popularity of forest bathing and forest recreation, there is limited empirical evidence on how sanatorium patients experience such interventions: experience instructor-led physical activities conducted in forest environments. This study aims to fill that gap by exploring patients' opinions on the impact of such exercises on their well-being. Additionally, the study examines the nature, frequency, and duration of these activities, as well as whether patients independently engage in forest recreation outside of organized sessions.

Materials and Methods

The town of Rymanów Zdrój is surrounded by forests, predominantly composed of silver fir (*Abies alba* Mill.) and European beech (*Fagus sylvatica* L.), with an average age ranging from 54 to 104 years (Table 1). Sycamore (*Acer pseudoplatanus* L.) and ash tree (*Fraxinus excelsior* L.) also constitute a large proportion of these forests. The undergrowth is not very dense and typically covers about 20% of the area.

The climate exhibits continental characteristics. The average annual air temperature is +7.7°C. January is the coldest month with an average temperature of -3.7°C, while July is the warmest (+18.1°C). Annual precipitation is quite high at 926 mm, with an average humidity of 70-86% (pl.climate-data.org).

The therapeutic profile of the health resort is shaped by climatic conditions and mineral waters. The air is characterized by a significant content of iodine, ozone, salt, and relatively high humidity. Diseases of the upper and lower respiratory tract, cardiovascular diseases, orthopedic-traumatic and

rheumatologic diseases, as well as kidney and urinary tract diseases are treated at this location (Kozłowska-Szczęsna et al. 2002). Additionally, the air in the Rymanów Zdrój health resort, due to its direct proximity to large forest complexes, is saturated with terpenes and terpenoids. However, their detailed qualitative and quantitative characterization requires further research.

An individual questionnaire-based interview was conducted with the first 293 patients encountered at the sanatoria located in Rymanów Zdroj, in southeastern Poland (intercept sampling method). Interviews were conducted with sanatorium patients encountered on forest paths in the woods surrounding the health resort, as well as those walking around the spa sanatoria (Figure 1). The sanatorium patients participated in activities conducted in the forest compartments described in Table 1. However, the patients themselves were unaware of which specific compartment their forest sessions took place in. The information about the compartments where the sessions occurred was provided by the activity organizer. It is not possible to link any individual respondent, who filled out the questionnaire anonymously, to a specific forest compartment where they participated in the exercises. As a result, the findings refer collectively to all forest stands (Table 1) where the forest-based activities for patients were conducted (these are forests located in the immediate vicinity of the sanatoriums).

The surveys were conducted during several sunny days in the months of May to August 2023. Respondents self-administered the pilot questionnaire. To achieve the aim of this work, 5 closed-ended thematic questions were used:
- During your stay at the sanatorium, are there any activities/exercises for patients conducted in the forest, such as walking, Nordic walking, gymnastics, outdoor gym, or others?
- How long do the activities/exercises for patients conducted in the forest last at a time?
What activities/exercises are conducted for patients in the forest?
- How do you feel after the forest activities/exercises?
- During your stay at the sanatorium, do you visit nearby forests in your free time?

The relationship between respondents' characteristics (such as age, gender, etc.) and their responses was examined using the Chi-square test. All statistical analyses were performed using the Statistica v13.3 software (StatSoft Inc., Tulsa, OK, USA), and differences were considered statistically significant at the alpha level of 0.05.

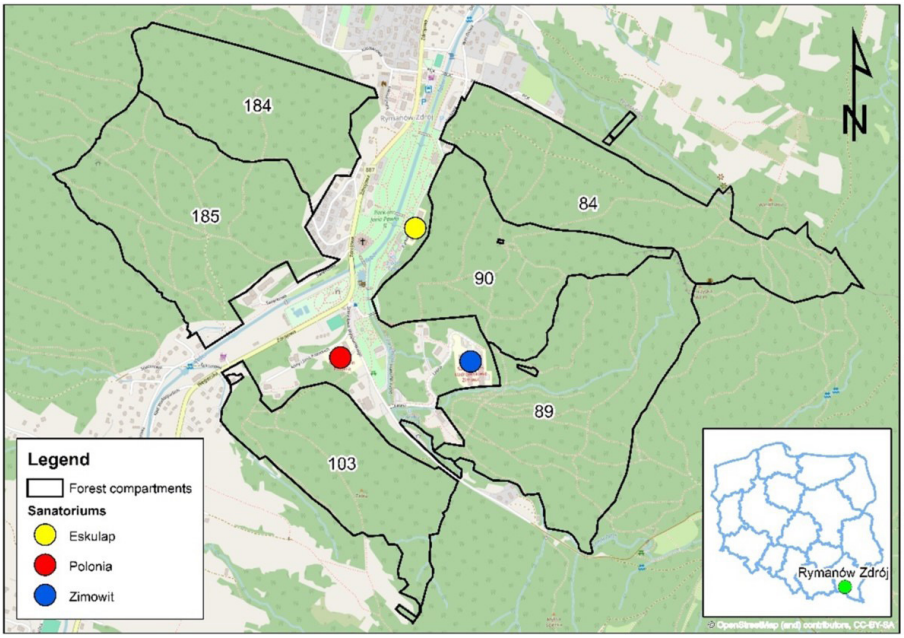

Figure 1 Location of sanatoria against the forests surrounding the Rymanów Zdrój health resort.

Table 1 Characteristics of forest stands surrounding Rymanów Zdrój health resort based on forest data bank (https://www.bdl.lasy.gov.pl/portal/mapy#; accessed: 12.01.2024).

Forest compartment	TSL	SD	SC [%]	Admixture species	Age [years]	UU [%]	H [m]
84a	mfe	Um	90A; 10P	B,Ac,Pt,Pi,Q,F,Fr,C	99	20	30
84b	mfe	Prz	50F; 30A; 10Ac; 10B	Q	104	20	26
84c	mfe	Um	100A	Fr,P,F,Pi	74	20	25
84d	mfe	Um	100A	F,Q,P,L	59	20	21
89b	mfe	Um	90A; 10F	Ac,B	64	10	23
89c	mfe	Um	70F; 30A	B,Ac,Pt	64	10	22
89f	mfe	Um	90A; 10F	B	44	20	14
90a	mfe	Um	90A;10F	Ac,Pi	69	10	22
90b	mfe	Um	100F	A,B,Ac,Pt	64	30	24
103a	mhe	Prz	80A; 20Ac	Fr,C	84	20	23
103b	mfe	Um	100A	C,F	59	10	19
103c	mfe	Prz	40Ac; 30F; 20A; 10L	Fr,Q,T,P,C,Pi	64	30	26
103f	mfe	Um	100A	Ac	54	0	20
103h	mfe	Um	50Ac; 30F; 10C; 10T	Fr	64	30	24
184a	mfe	Um	60A; 40F	Q,P,L,Ac,Pi,C,B	54	10	21
184b	mfse	Prz	50A; 40F; 10Q	Fr,C,B,P	84	10	26
184c	mfse	Prz	80A; 20F	Q,P,B,	104	40	24
185b	mfse	Um	80A; 20F	Q,Pt,Fr,Ac,P,C,B	84	20	24

Note: TSL - forest habitat types, mfe – mountain fresh eutrophic, mfse – mountain fresh semi-eutrophic, mhe - mountain humid eutrophic; SD - stand density, Um – between the crowns of the trees are narrow, free spaces, Prz - between the crowns of trees there are breaks where individual trees can easily fit; SC- tree species composition; P – *Pinus sylvestris*, Q - *Quercus robur*, F - *Fagus sylvatica*, L - *Larix decidua*, C - *Carpinus betulus*, A - *Abies alba*, B - *Betula pendula*, Pi- *Picea excelsa*, Ac- *Acer pseudoplatanus*, Fr- *Fraxinus excelsior*, T- *Tilia cordata*, Pt- *Populus tremula*; Age - age of trees stands according to the dominant species; UU - undergrowth and underbrush; H – height of trees stands according to the dominant species.

Table 2 Demographic characteristics of participants (N = 293).

Characteristics	Rymanów N (%)
Sex	
Female	176 (60.1)
Male	117 (39.9)
Age	
< 35	0 (0.0)
36-45	12 (4.1)
46-60	99 (33.8)
> 60	182 (62.1)
Place of residence	
Village	83 (28.3)
City < 50,000 inhabitants	67 (22.9)
City 50,001-100,000	94 (32.1)
City > 100,000	49 (16.7)

Results

A total of 295 individuals participated in the study, but 2 respondents provided answers inconsistent with the form structure, i.e., they were unable to limit themselves to only one response in closed-ended questions. Therefore, ultimately, 293 questionnaires were subjected to analysis. Women predominated on the paths; hence their surveys accounted for 60% of the total responses (Table 2). The gender structure of health resort patients in this study was consistent with nationwide data on the gender structure of patients. The study excluded minors, who constitute approximately 2% of health resort patients according to nationwide report data, as well as individuals aged 18–35, who account for about 1% of such patients. The

surveyed respondents were at least 36 years old, with the majority being above 60 years of age (62%). Nearly 72% of respondents resided in urban areas, while 28% lived in rural areas.

All respondents confirmed that forest exercises were conducted for patients during their stay at the sanatorium, with 95% declaring that such exercises took place several times a week, and 5% indicating a frequency of 1-2 times per week (Figure 2). These activities were organized in the forests in the immediate vicinity of the sanatoriums, where fir, beech, maple sycamore and ash dominated (Table 1). There were no statistical differences based on age (Table 3) and place of residence. However, women tended to spend fewer days per week on such exercises compared to men.

As shown in Figure 3, 75% of patients spent 1 to 2 hours during individual forest exercises, 23% spent more than 2 hours, and 2% spent less than 1 hour. There were no significant differences based on age and gender, while noticeable dissimilarities were observed depending on the place of residence (Table 3). Residents of rural areas decidedly spent more time during individual forest exercises than residents of cities of various sizes. Residents of cities with populations ranging from 50,000 to 100,000 were least likely to spend more than 2 hours exercising. In summary, the duration of forest exercise varied significantly by place of residence, with rural residents spending more time in the forest than urban dwellers, regardless of age or gender.

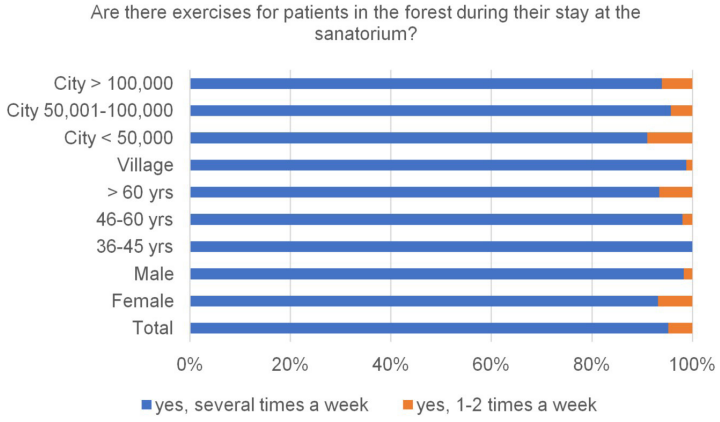

Figure 2 Frequency of exercises organized in the forest for sanatorium patients.

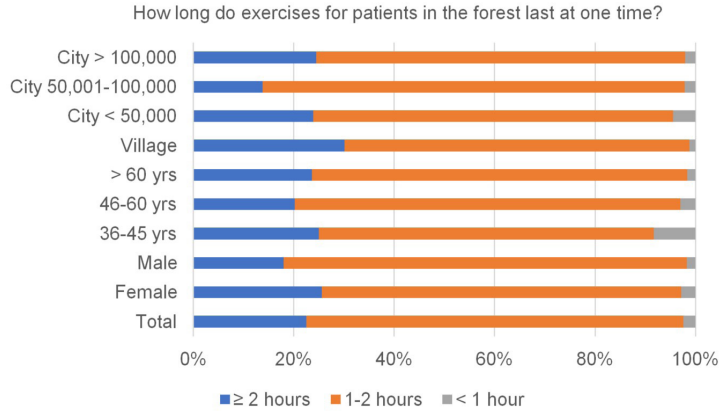

Figure 3 Duration of exercises organized in the forest for sanatorium patients.

Table 3 Chi2 test results, N = 293.

Questions	Sex	Age	Place of residence
Are there exercises for patients in the forest during their stay at the sanatorium?	4.0315* df = 1	3.5753 df = 2	6.9725 df = 3
How long do exercises for patients in the forest last at one time?	2.9047 df = 2	2.9422 df = 4	9.4287* df = 3
What exercises are conducted for sanatorium patients in the forest?	14.4994** df = 3	11.7142 df = 6	37.9333** df = 9
How do you feel after exercising in the forest?	0.7451 df = 1	6.2533 df = 2	9.4287* df = 3
During your stay at the sanatorium, do you visit nearby forests in your free time?	30.1915** df = 3	15.8259* df = 6	34.1657** df = 9
Was the stay in the sanatorium paid for privately or is it refunded?	1.0208 df = 1	46.6651** df = 2	24.6539** df = 3

*Significant at 0.05 level, **Significant at 0.01 level

As shown in Figure 4, walking and Nordic walking accounted for 71% of all reported forest activities. Significantly fewer respondents indicated more strenuous forms of exercises such as exercising in the outdoor gym (17%) and gymnastics (12%). Statistically significant differences could be observed here (Table 3), with women more frequently engaging in walking, while men more inclined to exercise in the outdoor gym or practice gymnastics. Differences by place of residence were also apparent. Residents of large and major cities were more likely to walk, including Nordic walking, while rural residents were more likely to exercise at an outdoor gym (Figure 4). In summary, walking and Nordic walking were the most common forest activities, with notable gender and residence-based differences in preferences for specific forms of exercise.

As shown in Figure 5, 98% of patient's participants of exercises organized in the forest during their stay at the sanatorium felt better after such activities, with no significant differences recorded based on age and gender. However, there were noticeable differences related to the place of residence (Table 3). All individuals from cities with populations exceeding 50,000 felt an improvement in their well-being after engaging in forest recreation. However, among residents of cities with populations up to 50,000, two respondents felt worse after exercises conducted in the forest. For the purposes of the Chi^2 test, the answers: "I feel no difference" and "I feel worse" were combined. Despite merging these groups of answers, the result of the Chi-squared test should be regarded as less reliable in this case due to their low representation in the overall response structure. In summary, nearly all patients reported improved well-being after forest-based activities, with minor variation by place of residence and no significant differences by age or gender.

Nearly 47% of the respondents visited nearby forests in their free time several times a week during their stay at the health resort, 38% did so 1-2 times a week, and 7% visited less than once a week. Meanwhile, 7% of patients would like to visit the forests, but their health did not allow them to do so. Only 1% responded that they did not visit the forests because they preferred to spend their leisure time in other ways during their stay at the health resort (Figure 6). Statistically significant differences in the responses were demonstrated at a significance level of 0.01 for the gender and place of residence of respondents, and at a level of 0.05 for their age (Table 3). A higher proportion of the surveyed men visit forests more frequently, despite their lower overall participation in the study. Residents of villages and smaller towns (up to 50,000 inhabitants) visited the forests significantly more often during their stay at the health resort than residents of larger cities. A higher percentage of middle-aged (46-60 years) and older (>60 years) individuals were more likely to visit forests in their free time during a sanatorium stay than younger people (36-45 years), with a significantly higher participation rate among older individuals – 62% (Figure 6). In summary, most patients visited nearby forests in their free time during their sanatorium stay, with visitation frequency significantly influenced by gender, age, and place of residence.

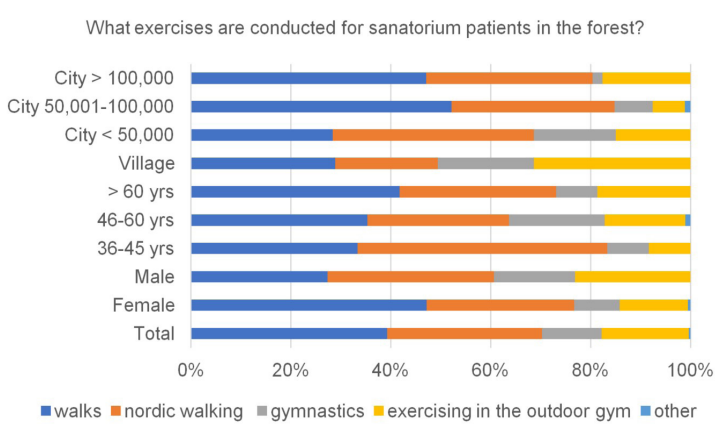

Figure 4 Types of exercises organized in the forest for sanatorium patients.

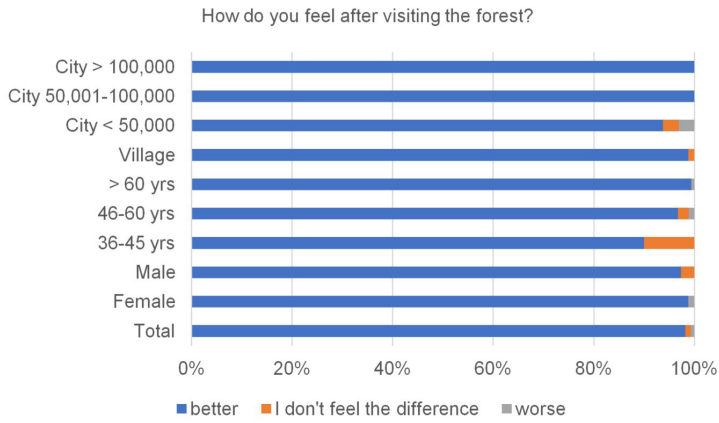

Figure 5 Subjective assessment of the impact of forest recreation on the well-being of sanatorium patients.

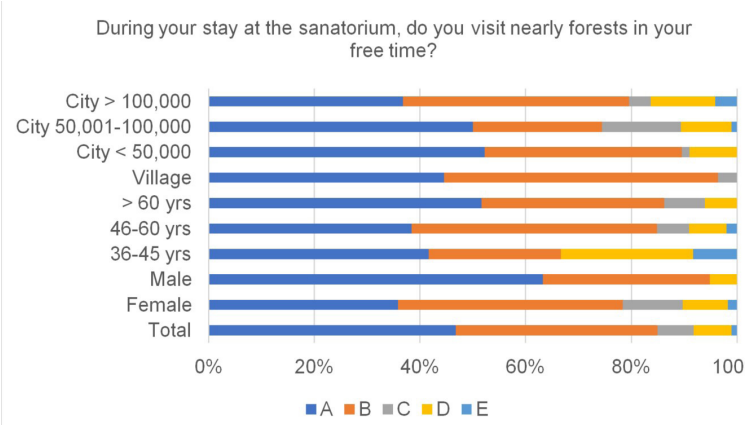

Figure 6 Frequency of visits to forests by sanatorium patients in their free time; A - yes, several times a week; B - yes, 1-2 times a week; C - yes, less than once a week; D - I would like to, but my health does not allow it; E - I do not visit forests, I prefer to spend my free time in other ways.

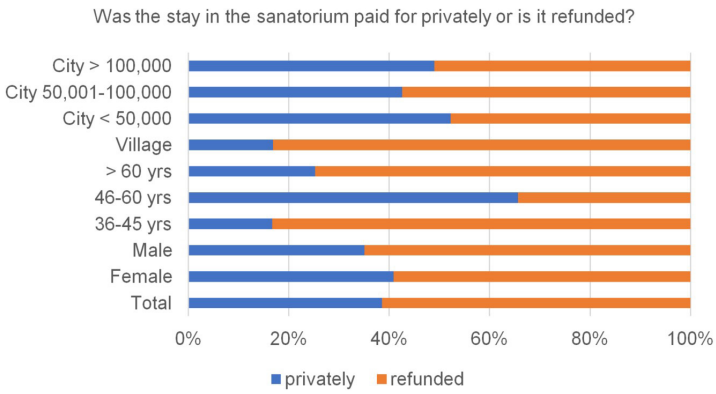

Figure 7 Who pays for the stay in the sanatorium?

Discussion

Forest recreation, including forest bathing, has been confirmed by numerous studies to exert positive effects on both physiological and mental health (Karjalainen et al. 2010, Mao et al. 2017, Lee et al. 2017, Lackey et al. 2021). Yu et al. (2017) reported that a 2-hour forest bathing session improved heart rate, blood pressure, and well-being in individuals of middle and older age. Song et al. (2015), on the other hand, claimed that just a 17-minute walk in the forest brought visible physiological and psychological benefits. Our findings are consistent with the above studies, 23% of surveyed sanatorium patients exercised during organized forest activities for at least 2 hours in one session (usually several sessions per week), and another 75% for 1-2 hours, and precisely 98% of patients declared an improvement in their well-being after forest exercises.

Kobayashi et al. (2019) have demonstrated that it is the forest environment, not physical activity, that has a decisive impact on improving well-being. Guan et al. (2017) proved that a given type of forest may have a different impact on men and women. Approximately 20% of the analyzed research works dedicated to the influence of forests on human health have lack of descriptions of the type of forest habitats (Bach et al. 2020a).

In the study, the recreation in forests dominated by the following species: *Abies alba*, *Fagus sylvatica*, *Acer pseudoplatanus* and *Fraxinus excelsior*, had a positive impact on the well-being of sanatorium patients. This is consistent with the reports of Probst et al. (2024), who found that species-diverse deciduous forests are perceived as more friendly and conducive to psychological regeneration than homogeneous coniferous forests. Zhu et al. (2021) also concluded that mixed and deciduous forests are characterized by higher phytoncide concentrations, higher oxygen content, and a more favorable microclimate, which translates into better health effects for visitors. Most likely, terpenes, whose concentration and chemical composition vary in different types of forests (Meneguzzo et al. 2019, Bach et al. 2020b, Dudek et al. 2022), are responsible for the positive impact of the forest environment on health (Cho et al. 2017, Tsai et al. 2021). In the air of beech forests, the predominant phytoncide is farnesol; limonene, which is absent in pine forests, is also present (Dudek et al. 2022).

Tsunetsugu et al. (2005) demonstrated that inhaling air containing limonene led to a decrease in blood pressure after just 20 seconds, and inhaling limonene was perceived as comfortable and soothing. Fir and spruce, in turn, emit chemical compounds (e.g. α-cadinol, spathulenol) that have antiviral, anticancer and immunomodulatory

properties (Zorić et al. 2022). Miyazaki et al. (1999) showed that the scent of *Cryptomeria japonica* lowers systolic blood pressure as early as 40-60 seconds after the start of inhalation. In cypress forests, one of the main phytoncides is α-pinene (Tsunetsugu et al. 2010). Similarly, this compound predominates in the air of pine forests (Dudek et al. 2022), the most common type of forests in Poland. Antonelli et al. (2020) have argued that inhaling forest VOCs like limonene and pinene has a beneficial effect on respiratory pathways and reduces mental fatigue. An earlier survey of sanatorium patients' opinions on the impact of forest recreation on health showed that 99% of respondents were convinced that staying in the forest, without specifying a particular type of forest, could positively influence their health. They expressed a desire to stay in sanatoriums located in the vicinity of forests (Dudek & Piegdoń 2021).

Research results indicate that the forest environment, regardless of the forest type, promotes lower cortisol levels, lower heart rate, lower blood pressure, higher activity of the parasympathetic nervous system, and lower activity of the sympathetic nervous system compared to the urban environment (Park et al. 2010). McEwan et al. (2021), considering the positive impact of forest bathing on well-being, recommended it as a viable social prescription for improving overall well-being. Forest bathing is recommended for virtually all groups; however, the session duration should be shortened for individuals exhibiting fear or discomfort in the forest and for the elderly (Clarke et al. 2021).

Sanatorium patients declared that in addition to participating in organized forest exercises during their stay, they also visited the forest in their free time: 47% several times a week, 38% 1-2 times a week, and 7% less than once a week. The present results are similar to those presented by Dudek and Piegdoń (2021), where 88% of patients of sanatoriums located in south-eastern Poland declared that they frequently visited nearby forests during their stay at the sanatorium and an additional 5% did so sporadically. In summary, our findings are consistent with previous studies showing that diverse deciduous and mixed forests positively influence well-being, with sanatorium patients frequently engaging in voluntary forest recreation during their stay.

Healthcare reimbursement and insurance coverage were used by 61% of patients to cover the treatment expensive, with statistically significant differences in terms of age and place of residence (but no differences in relation to gender) (Figure 7, Table 3). Residents of rural areas were significantly more likely to have a reimbursed service than urban residents. Individuals aged 36-45 and over 60 were far more likely to have their treatment reimbursed than individuals aged 46-60 years, among whom as many as 65% privately purchased the services. The structure of the surveyed visitors was also consistent with national statistics: of the 737,000 visitors in 2016, 34% privately paid for the services (Szafkowski et al. 2017). The situation appeared to be similar in the entire region. In Slovakia a part (27-34% of local and 44-52% of foreign) of sanatorium patients paid privately for the services; foreigners were 20% of all visitors (Derco et al. 2020). Foreign patients were 7% of all patients in Poland and 20% in Slovakia (Szafkowski et al. 2017). Despite the small proportion of foreign patients, they contribute nearly 20% of the revenue for private sanatoriums and approximately 5% for state-owned companies managing sanatoriums (Szromek et al. 2016). In summary, the majority of patients had reimbursed services, with patterns significantly influenced by age and place of residence, and our findings are consistent with national and regional data on the structure of sanatorium funding.

Limitations

Respondents were intercepted in person on forest paths surrounding the health resort or in areas adjacent to the spa buildings. This intercept sampling approach, while practical, introduces a risk of selection bias, for instance, patients who were more mobile or physically active were more likely to be surveyed. Therefore, the findings may not be generalizable to all sanatorium patients.

The results are from only one region, so they cannot be generalized to all spas or forest types. Furthermore, there is no baseline or comparison group -since this is a single-group, cross-sectional survey, we can only analyze associations, not causation. Moreover, the studies were conducted on sunny and warm days, so the patients' responses may be subject to a positive error due to favorable conditions. Therefore, future studies should be repeated in other seasons and weather conditions and other limitations of this study should also be taken into account.

Conclusions

In summary, participation in 1-2 hours of instructor-led exercise several times a week in forests dominated by *Abies alba*, *Fagus sylvatica*, *Acer pseudoplatanus* and *Fraxinus excelsior* - was associated with improved self-reported well-being among sanatorium patients. These findings suggest that regular, organized physical activity in forest environments may serve as a supportive element in health resort therapy programs. While the results align with broader literature on the benefits of nature-based interventions, it is important to note the limitations of this study, including the use of self-reported outcomes, the convenience sampling method, and seasonal timing of data collection. Given the positive perceptions expressed by participants, it is reasonable to recommend that sanatorium administrators consider incorporating a variety of forest-based recreational activities such as walking, Nordic walking, outdoor gym sessions, gymnastics, and forest bathing into their therapeutic offerings. Implementing such initiatives can contribute to a healthier lifestyle among patients even after completing their treatment at the sanatorium. Tailoring the type and duration of activities to patients' physical capabilities could further enhance engagement and benefits. While the potential for long-term health impact is promising, further research is needed to establish causal relationships and explore effects across different patient populations and seasons.

Authors' contributions

T.D. – conceptualization, methodology, formal analysis, statistical analysis, data curation, writing original draft preparation, writing review and editing; A.P. – formal analysis, survey interviews, data curation, visualization.

Conflict of interest

The authors declare the absence of potential conflicts of interest.

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