

DUDZIK, Tomasz, DUDZIK, Łucja, KOZIEL, Aleksandra and DOMAŃSKI, Igor. The Impact of Sauna on Health. *Journal of Education, Health and Sport*. 2024;69:49430. eISSN 2391-8306.
<https://dx.doi.org/10.12775/JEHS.2024.69.49430>
<https://apcz.umk.pl/JEHS/article/view/49430>

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences). Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu). © The Authors 2024; This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non commercial license Share alike. (<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited. The authors declare that there is no conflict of interests regarding the publication of this paper. Received: 15.03.2024. Revised: 10.05.2024. Accepted: 14.05.2024. Published: 16.05.2024.

The Impact of sauna on health - review

¹Tomasz Dudzik tomek4732@gmail.com <https://orcid.org/0009-0003-1937-1004>

¹Łucja Dudzik lucja.dudzik126@gmail.com <https://orcid.org/0009-0009-0990-7964>

¹Aleksandra Kozieł olakozie@gmail.com <https://orcid.org/0009-0004-3807-4678>

¹Igor Domański igor.daniel.domanski@gmail.com <https://orcid.org/0000-0003-2293-8553>

¹ Medical University of Wrocław

Abstract

Introduction and Objective

Sauna bathing, a practice with deep cultural roots, particularly in Finnish society, has garnered global interest for its potential health benefits. This review aims to consolidate current knowledge on the physiological and health-related effects of regular sauna use, exploring the breadth of benefits and identifying potential risks and safety considerations.

Review Methods

This study synthesizes findings from a broad range of scientific papers, focusing on the impact of traditional sauna use. Publications were selected based on their relevance to health outcomes associated with sauna bathing, including cardiovascular health, mental well-being, and overall mortality. Studies not directly assessing the impact of traditional sauna practices or lacking in

methodological rigor were excluded. The literature search encompassed databases such as PubMed and Scopus, with an emphasis on systematic reviews and longitudinal studies to ensure the inclusion of high-quality evidence.

Results

In this section of the study, we focus on the impact of sauna bathing on cardiovascular health, synthesizing evidence from multiple studies to understand the relationship between regular sauna use and various cardiovascular outcomes. The physiological responses induced by sauna exposure, including elevated heart rate, increased blood flow, and sweating, mimic moderate physical exercise, which has known benefits for cardiovascular health.

Keywords: sauna, sauna bathing, Cardiovascular, Mental health, Risks of Sauna, Benefits of sauna

Impact of Sauna on Cardiovascular Health

Regular sauna bathing has been associated with a range of positive cardiovascular outcomes. These include reduced risks of hypertension, coronary artery disease, and sudden cardiac death. The mechanisms proposed to underlie these benefits encompass improved endothelial function, reduced arterial stiffness, and beneficial changes in systemic blood pressure.

A study by Laukkanen et al. (2015) found that the risk of sudden cardiac death (SCD) for those bathing two to three times a week was 22% lower and 63% lower for those bathing four to seven times a week, compared to those bathing once a week. Similar patterns were observed for coronary heart disease (CHD), cardiovascular disease (CVD), and all-cause mortality, with significant trends. Sauna sessions lasting longer than 19 minutes significantly reduced the risk of SCD by 52%, compared to sessions under 11 minutes, with trends also showing significant reductions in fatal CHDs and CVDs, but not in all-cause mortality.(1) Study performed by the same researcher three years later has demonstrated that in middle-aged to elderly men and women, both the frequency and length of time spent in sauna sessions show a robust, negative

correlation with the incidence of fatal cardiovascular disease (CVD) events. This suggests that engaging in sauna bathing more frequently and for longer periods can significantly reduce the risk of death from CVD. Moreover, incorporating the frequency of sauna use into assessments can enhance the accuracy of long-term forecasts regarding the likelihood of CVD-related mortality. This implies that regular and extended sauna sessions could be a potent preventive measure against fatal outcomes associated with cardiovascular conditions, offering an effective strategy for improving heart health and potentially extending lifespan. (2) Tei et al. proposed study in which they found out that during and 30 minutes following each sauna session, there was a notable reduction in mitral regurgitation linked to congestive heart failure (CHF). After undergoing whole-body warming (WWB) and sauna bathing (SB), there was a significant shrinkage in cardiac dimensions and a notable improvement in the left ventricular ejection fraction. Further research showed a marked increase in plasma norepinephrine levels during SB in both healthy participants and those suffering from CHF, which normalized to baseline levels within 30 minutes post-SB.(3) Study conducted by Kihara et al. showed in following a two-week period of sauna therapy, there was a significant enhancement in the percentage of flow-mediated dilation (%FMD) from its initial value, while nitroglycerin (%NTG)-induced dilation remained unchanged. Additionally, levels of brain natriuretic peptide (BNP) saw a substantial reduction after the two weeks of sauna treatment. Moreover, a significant association was observed between the improvement in %FMD and the percentage decrease in BNP levels among those who underwent sauna therapy. On the other hand, there were no changes in any of the measured parameters over the same two-week period in the group that did not receive sauna treatment.(4) Another study showed that after undergoing heat therapy for eight weeks, there was a notable enhancement in endothelial function, as evidenced by an increase in flow-mediated dilation from $5.6 \pm 0.3\%$ to $10.9 \pm 1.0\%$ ($P < 0.01$), and an improvement in superficial femoral artery compliance, which went from 0.06 ± 0.01 to 0.09 ± 0.01 mm²/mmHg ($P = 0.03$). Additionally, there was a beneficial decrease in aortic pulse wave velocity from 7.1 ± 0.3 m/s to 6.1 ± 0.3 m/s ($P = 0.03$), a reduction in carotid artery intima-media thickness from 0.43 ± 0.01 mm to 0.37 ± 0.01 mm ($P < 0.001$), and a drop in mean arterial blood pressure from 83 ± 1 mmHg to 78 ± 2 mmHg ($P = 0.02$). No significant changes were noted in the control group, nor were there improvements in carotid artery compliance, superficial femoral intima-media thickness, or endothelium-independent dilation. The results indicate that heat therapy can significantly enhance endothelium-dependent dilation, reduce arterial stiffness and intima-media thickness, and lower blood pressure, thereby contributing to better cardiovascular health.

(5) One of the discussed physiological mechanisms is the rise in bone marrow blood flow induced by heat stress, similar to what is observed during exercise, might also prompt the release of stem cells, including endothelial progenitor cells, with potential benefits for tissue repair and overall health. However, it is important to note that direct experimental evidence to support this theory is currently lacking. While the exact origin of these cells has not been explored in prior research, it has been documented that regular sauna bathing can lead to an elevation in the levels of CD34-positive cells within the bloodstream.(6)

In conclusion, the accumulation of evidence suggests that regular sauna bathing has a positive impact on cardiovascular health through various mechanisms, including reduced hypertension risk, improved endothelial function, decreased incidence of coronary artery disease

Mental Health and Neurocognitive Effects

Exposure to sauna heat can reduce stress levels and alleviate symptoms of depression and anxiety, enhancing mental well-being (7) Study that examined the effects of thermal therapy on depression revealed significant benefits. Four weeks after beginning the therapy, participants reported notable improvements in physical discomfort, hunger levels, and feelings of relaxation, with statistical significance. Although improvements were also observed in psychological complaints, these were less pronounced, with a statistical significance of $p = .054$, compared to individuals who received non-thermal treatments. This indicates that while thermal therapy offers considerable physical benefits, its impact on psychological aspects may require further investigation. Additionally, there was a notable increase in plasma ghrelin levels and daily calorie consumption in the group treated with thermal therapy, in contrast to the group that did not receive such treatment. These outcomes indicate that repeated sessions of thermal therapy could be beneficial for patients with mild depression experiencing loss of appetite and general discomfort.(8)

Evidence suggests that the benefits of sauna use extend beyond alleviating depression and appetite loss. The arena of neurodegenerative diseases, a field that is rigorously researched, also encompasses investigations into the therapeutic effects of sauna bathing. Regular sauna use is associated with a lower risk of Alzheimer's disease and dementia, suggesting potential protective effects on cognitive function (7). Study showed returning to normal body

temperature after a sauna session resulted in improved relaxation of the brain's neural networks and more efficient cognitive processing in specific tasks. The recovery did not impact auditory processing more than visual processing. Changes in the brain's response to stimuli, after sauna use, did not significantly alter cognitive abilities in either auditory or visual tasks.(9) In the studied group of men, engaging in sauna baths with moderate to high regularity was found to be linked with a reduced incidence of both dementia and Alzheimer's disease. This correlation suggests that the practice of sauna bathing at these frequencies could potentially play a role in decreasing the likelihood of developing these cognitive disorders.(10) Sauna bathing may boost the production of heat shock proteins, crucial for preventing protein misfolding and aggregation, a hallmark of neurodegenerative diseases. It can also reduce inflammation and oxidative stress, both implicated in the development of such conditions. By mitigating these factors, regular sauna use may offer neuroprotective benefits, potentially delaying the progression of neurodegenerative diseases. Further research is needed to understand fully and harness sauna bathing's potential for neuroprotection. (11)

Furthermore, sauna use offers subtle yet significant advantages for mental health. The study noted that sauna usage among university undergraduates was not widely embraced, primarily due to a lack of knowledge regarding its health advantages. However, those who did partake in sauna sessions reported substantial improvements in both their physical and emotional health. Consequently, integrating sauna sessions into the lifestyle of university students could markedly enhance their mental well-being. Thus, there's a strong case for increasing awareness and promoting the benefits of sauna bathing within this demographic. (12) Another study provides a comprehensive overview of sauna bathing habits among participants from Finland, Australia, and the United States, revealing that the primary motivation for using saunas is to achieve a state of relaxation. These individuals have noted significant health improvements, with a strong emphasis on enhanced mental well-being and better sleep patterns. Despite the extensive use of saunas among these populations, the report indicates that the occurrence of adverse effects is relatively rare. This suggests that sauna bathing is not only a popular method for unwinding and de-stressing but also offers tangible benefits for physical and mental health with minimal risks involved. (13) From a psychoanalytic perspective, sauna bathing is considered a positive mental health resource, reducing aggressive behavior and allowing bathers to relax. This relaxation can facilitate social interactions by creating a peaceful and friendly environment .(14)

Other health beneficial effects

Sauna use also has the potential to positively impact other health aspects not previously discussed. Research has explored a variety of conditions where sauna therapy may offer therapeutic benefits or even prevent certain diseases.

Temporary enhancements in lung function observed during sauna sessions may offer temporary symptom relief for individuals suffering from asthma and chronic bronchitis. The warm and humid environment of the sauna can help in loosening phlegm, easing breathing difficulties, and potentially reducing the frequency of asthma attacks or bronchitis flare-ups. Additionally, the heat from sauna bathing is known to soothe aches and pains, which could be particularly beneficial for those dealing with rheumatic conditions. The warmth not only helps in reducing stiffness but also improves the range of motion in joints, making it a potentially effective complementary therapy for enhancing the quality of life of individuals with rheumatic diseases by easing their discomfort and improving their mobility. (15) A research investigation examined the impact of undergoing sauna therapy regularly over a six-week period on the autonomic nervous system, maximum airflow through the nose (PNIF), and overall lung capacity in Thai individuals suffering from allergic rhinitis. The results highlighted notable enhancements in the activity of the sympathetic nervous system, PNIF, and the volume of air that can be forcibly exhaled, indicating positive effects of sauna use on these parameters. (16) A separate research effort revealed that engaging in sauna sessions on a frequent basis could be linked to a decreased likelihood of contracting pneumonia. This discovery points to the possibility that the benefits of sauna use extend well into the realm of overall respiratory wellness, offering more than just fleeting relief from particular health issues. It suggests that the therapeutic effects of sauna bathing may have far-reaching implications for enhancing lung health and preventing respiratory infections, underscoring the importance of further exploring sauna therapy as a preventative measure against such conditions. (17) The positive impact of sauna use on respiratory health could also stem from its immediate influence on lung tissues and air passages, leading to enhanced breathing capacity, better lung performance, and a decrease in lung congestion. (18) Sauna sessions followed by cooling down significantly boost the overall white blood cell count in trained men, markedly increasing neutrophil, basophil, and lymphocyte levels in their blood. Athletes experience a greater rise in white blood cells and monocytes from sauna use compared to untrained individuals. This suggests that changes in the white blood cell profile indicate athletes have a quicker mobilization of first-line immune

defense cells after sauna bathing than untrained people. (19) Sauna sessions, particularly those of the Finnish tradition, have been shown to beneficially affect blood lipid profiles, including the regulation of total cholesterol, LDL cholesterol (low-density lipoprotein), HDL cholesterol (high-density lipoprotein), and triglyceride levels.(20)

Risks and Safety Considerations

While sauna bathing is safe for most people, it carries risks for those with cardiovascular conditions or those who are pregnant. It is essential to stay hydrated and limit time spent in high heat to prevent adverse effects(21). The risk of dehydration, overheating, and hypotension can be mitigated through proper hydration and avoiding alcohol consumption before sauna use (7). While sauna use generally doesn't lead to skin dryness and might even help those with psoriasis, it can exacerbate itching for individuals with atopic dermatitis due to increased sweating. Those advised against using saunas include individuals with unstable angina, those who have recently experienced a heart attack, or have severe aortic valve narrowing. Nonetheless, saunas are considered safe for individuals with stable heart conditions, including those who have recovered from a previous heart attack. Instances of heart attacks or sudden deaths in saunas are rare, yet drinking alcohol while sauna bathing can heighten the risks of low blood pressure, heart rhythm problems, and sudden death, thus should be avoided.(15)The study of the potential hazards associated with taking a sauna immediately after intensive physical activity indicated that a brief session in the sauna following exercise poses a manageable risk for men in good health. This research underscores the importance of understanding the implications of combining strenuous workouts with sauna use, highlighting that, with moderation, this sequence of activities can be safely enjoyed by those without underlying health issues.(22) Incidents of sudden fatalities associated with sauna use have been documented, with investigations revealing that alcohol intake played a significant role in many of these cases, contributing to the occurrence of such accidents. (23) Also there have been instances of fatalities linked to individuals plunging into cold water head-first immediately following a sauna session.(24)

Discussion

The evidence compiled in the literature points towards significant health benefits associated with regular sauna use, particularly concerning cardiovascular health, neurocognitive function,

and general well-being. These findings suggest that sauna bathing could serve as a valuable complement to traditional health promotion strategies, given its potential to mitigate risks associated with cardiovascular diseases, improve mental health outcomes, and enhance overall quality of life.

Cardiovascular benefits of sauna use have been well-documented, with studies indicating that regular sauna sessions can lead to reductions in hypertension, coronary artery disease, and sudden cardiac death risks. The physiological mechanisms proposed to explain these benefits include improved endothelial function (25), reduced arterial stiffness (26), and favorable changes in systemic blood pressure(27) These effects resemble those achieved through moderate physical exercise, suggesting that sauna bathing could be particularly beneficial for individuals unable to engage in traditional forms of exercise due to physical limitations or other barriers. Moreover, sauna use has been shown to exert positive effects on mental health and neurocognitive function. The reduction in stress levels, symptoms of depression, and anxiety, as well as the potential protective effects against neurodegenerative diseases like Alzheimer's and dementia, highlight the broad spectrum of sauna bathing benefits.

These findings are supported by evidence suggesting that sauna use can increase the production of heat shock proteins, reduce inflammation, and alleviate oxidative stress(28), thereby offering neuroprotective benefits that could delay the progression of neurodegenerative diseases. Evidence from observations suggests that lowering inflammation could be a key factor that connects regular sauna use with a lower chance of developing both short-term and long-term health issues. (29)

Frequent sauna bathing has been identified as a factor contributing to enhanced health-related quality of life. This finding comes from a detailed analysis within a broader longitudinal cohort study, which specifically examined 524 octogenarians. The study sought to understand the impact of regular sauna use on the overall well-being and quality of life among individuals in this age group, revealing positive correlations that highlight the potential benefits of incorporating sauna sessions into regular health routines for older adults.(30)

Despite the numerous health benefits, it is crucial to consider the potential risks and safety considerations associated with sauna use. Individuals with certain cardiovascular conditions or

those who are pregnant may face heightened risks, underscoring the importance of consulting healthcare professionals before incorporating sauna bathing into routine health practices. Additionally, the emphasis on staying hydrated and avoiding alcohol before sauna sessions can help mitigate risks of dehydration, overheating, and hypotension.

Conclusions

The accumulated body of research highlights the significant benefits of sauna use on cardiovascular and neurocognitive health, among other areas. These benefits are tempered by the need for caution in individuals with specific health conditions. Future research should continue to explore the mechanisms underlying the health benefits of sauna use, the long-term effects of regular sauna bathing, and strategies to maximize benefits while minimizing risks. In conclusion, the integration of sauna bathing into health promotion strategies could be highly beneficial, particularly for cardiovascular and mental health. Future research should aim to further elucidate the mechanisms underlying these health benefits, explore the long-term effects of regular sauna use, and identify strategies to maximize benefits while minimizing risks. As evidence continues to accumulate, sauna bathing emerges as a promising, non-invasive method for enhancing health and well-being, warranting its consideration as a complementary health practice alongside conventional medical advice.

References

1. Laukkanen T, Khan H, Zaccardi F, Laukkanen JA. Association Between Sauna Bathing and Fatal Cardiovascular and All-Cause Mortality Events. *JAMA Intern Med.* 2015 Apr 1;175(4):542.
2. Laukkanen T, Kunutsor SK, Khan H, Willeit P, Zaccardi F, Laukkanen JA. Sauna bathing is associated with reduced cardiovascular mortality and improves risk prediction in men and women: a prospective cohort study. *BMC Med.* 2018 Dec 29;16(1):219.
3. Tei C, Horikiri Y, Park JC, Jeong JW, Chang KS, Toyama Y, et al. Acute Hemodynamic Improvement by Thermal Vasodilation in Congestive Heart Failure. *Circulation.* 1995 May 15;91(10):2582–90.
4. Kihara T, Biro S, Imamura M, Yoshifuku S, Takasaki K, Ikeda Y, et al. Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure. *J Am Coll Cardiol.* 2002 Mar;39(5):754–9.

5. Brunt VE, Howard MJ, Francisco MA, Ely BR, Minson CT. Passive heat therapy improves endothelial function, arterial stiffness and blood pressure in sedentary humans. *J Physiol*. 2016 Sep 15;594(18):5329–42.
6. Ohori T, Nozawa T, Ihori H, Shida T, Sobajima M, Matsuki A, et al. Effect of Repeated Sauna Treatment on Exercise Tolerance and Endothelial Function in Patients With Chronic Heart Failure. *Am J Cardiol*. 2012 Jan;109(1):100–4.
7. Reeder M, Anderson T, Alumbaugh B, Murray S. Sauna Bathing as an Alternative Adjunct Therapy in the Prevention and Treatment of Chronic Health Conditions Including Cardiovascular Disease, Neurodegenerative Disease, Metabolic Disease, and Mental Health Disorders. *Med Res Arch*. 2023;11(6).
8. Masuda A, Nakazato M, Kihara T, Minagoe S, Tei C. Repeated Thermal Therapy Diminishes Appetite Loss and Subjective Complaints in Mildly Depressed Patients. *Psychosom Med*. 2005 Jul;67(4):643–7.
9. Cernych M, Satas A, Brazaitis M. Post-sauna recovery enhances brain neural network relaxation and improves cognitive economy in oddball tasks. *International Journal of Hyperthermia*. 2018 Dec 31;35(1):375–82.
10. Laukkanen T, Kunutsor S, Kauhanen J, Laukkanen JA. Sauna bathing is inversely associated with dementia and Alzheimer’s disease in middle-aged Finnish men. *Age Ageing*. 2017 Mar 1;46(2):245–9.
11. Hunt AP, Minett GM, Gibson OR, Kerr GK, Stewart IB. Could Heat Therapy Be an Effective Treatment for Alzheimer’s and Parkinson’s Diseases? A Narrative Review. *Front Physiol*. 2020 Jan 10;10.
12. Robert Podstawski, Antti Honkanen, Ewelina Kolanowska, Anja Touchino. Recreational-health use of saunas by 19-20-year old Polish university students. *Asian J Sci Res*. 2013 Apr;3(9):910–23.
13. Hussain JN, Greaves RF, Cohen MM. A hot topic for health: Results of the Global Sauna Survey. *Complement Ther Med*. 2019 Jun;44:223–34.
14. Sorri P. The sauna and sauna bathing habits--a psychoanalytic point of view. *Ann Clin Res*. 1988;20(4):236–9.
15. Hannuksela ML, Ellahham S. Benefits and risks of sauna bathing. *Am J Med*. 2001 Feb;110(2):118–26.

16. Kunbootsri N. The effect of six-weeks of sauna on treatment autonomic nervous system, peak nasal inspiratory flow and lung functions of allergic rhinitis Thai patients. *Asian Pac J Allergy Immunol.* 2013 Apr 1;31(2).
17. Kunutsor SK, Laukkanen T, Laukkanen JA. Frequent sauna bathing may reduce the risk of pneumonia in middle-aged Caucasian men: The KIHHD prospective cohort study. *Respir Med.* 2017 Nov;132:161–3.
18. Laitinen LA, Lindqvist A, Heino M. Lungs and ventilation in sauna. *Ann Clin Res.* 1988;20(4):244–8.
19. Pilch W, Pokora I, Szyguła Z, Pałka T, Pilch P, Cisoń T, et al. Effect of a Single Finnish Sauna Session on White Blood Cell Profile and Cortisol Levels in Athletes and Non-Athletes. *J Hum Kinet.* 2013 Dec 1;39(1):127–35.
20. Pilch W, Szyguła Z, Klimek A, Pałka T, Cisoń T, Pilch P, et al. Changes in the lipid profile of blood serum in women taking sauna baths of various duration. *Int J Occup Med Environ Health.* 2010 Jan 1;23(2).
21. Kukkonen-Harjula K, Kauppinen K. Health effects and risks of sauna bathing. *Int J Circumpolar Health.* 2006 Jul 18;65(3):195–205.
22. Paolone AM, Lanigan WT, Lewis RR, Goldstein MJ. Effects of a postexercise sauna bath on ECG pattern and other physiologic variables. *Aviat Space Environ Med.* 1980 Mar;51(3):224–9.
23. Ylikahri R, Heikkonen E, Soukas A. The sauna and alcohol. *Ann Clin Res.* 1988;20(4):287–91.
24. Vuori I. Healthy and unhealthy sauna bathing. *Ann Clin Res.* 1988;20(4):217–9.
25. Ohori T, Nozawa T, Ihori H, Shida T, Sobajima M, Matsuki A, et al. Effect of Repeated Sauna Treatment on Exercise Tolerance and Endothelial Function in Patients With Chronic Heart Failure. *Am J Cardiol.* 2012 Jan;109(1):100–4.
26. Ganio MS, Brothers RM, Shibata S, Hastings JL, Crandall CG. Effect of passive heat stress on arterial stiffness. *Exp Physiol.* 2011 Sep 1;96(9):919–26.
27. Zaccardi F, Laukkanen T, Willeit P, Kunutsor SK, Kauhanen J, Laukkanen JA. Sauna Bathing and Incident Hypertension: A Prospective Cohort Study. *Am J Hypertens.* 2017 Nov 1;30(11):1120–5.
28. Sutkowy P, Woźniak A, Boraczyński T, Mila-Kierzenkowska C, Boraczyński M. The effect of a single Finnish sauna bath after aerobic exercise on the oxidative status in healthy men. *Scand J Clin Lab Invest.* 2014 Mar 5;74(2):89–94.

29. Kunutsor SK, Laukkanen T, Laukkanen JA. Longitudinal associations of sauna bathing with inflammation and oxidative stress: the KIID prospective cohort study. *Ann Med*. 2018 Jul 4;50(5):437–42.
30. Strandberg TE, Strandberg A, Pitkälä K, Benetos A. Sauna bathing, health, and quality of life among octogenarian men: the Helsinki Businessmen Study. *Aging Clin Exp Res*. 2018 Sep 29;30(9):1053–7.

Conceptualization, Tomasz Dudzik, and Łucja Dudzik; methodology, Igor Domański; software, Igor Domański; check, Aleksandra Koziel, Łucja Dudzik and Igor Domański; formal analysis, Tomasz Dudzik; investigation, Tomasz Dudzik; resources, Aleksandra Koziel; data curation, Aleksandra Koziel; writing - rough preparation, Tomasz Dudzik; writing - review and editing, Łucja Dudzik; visualization, Łucja Dudzik; supervision, Igor Domański; project administration, Aleksandra Koziel; receiving funding, None

All authors have read and agreed with the published version of the manuscript.

Please refer to the CRediT taxonomy for an explanation of the terms. For more background on CRediT, see here.

Funding Statement

There was no funding for this article.

Institutional Review Board Statement

Not applicable

Informed Consent Statement

Not applicable

Conflict of Interest Statement

There are no conflicts of interest.