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Heat Therapy and Human Health: Benefits of Sauna Bathing

Iga Kobryń⁷, ORCID <https://orcid.org/0009-0000-8777-5076>

E-mail iga.kobryn@gumed.edu.pl

⁷Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Igor Nowiński², ORCID <https://orcid.org/0009-0002-3480-2557>

E-mail igornowinski80@gmail.com

²University Clinical Centre in Gdańsk, Medical University of Gdańsk, ul. Dębinki 7, 80-952 Gdańsk, Poland

Dawid Ocicki³, ORCID <https://orcid.org/0009-0009-8638-7907>

E-mail dawid.ocicki@gumed.edu.pl

³University Clinical Centre in Gdańsk, Medical University of Gdańsk, ul. Dębinki 7, 80-952 Gdańsk, Poland

Michał Bojarski⁴, ORCID <https://orcid.org/0009-0001-5236-1655>

[E-mail michal.bojarski@gumed.edu.pl](mailto:michal.bojarski@gumed.edu.pl)

⁴University Clinical Centre in Gdańsk, Medical University of Gdańsk, ul. Dębinki 7, 80-952 Gdańsk, Poland

Michał Kwiatkowski⁵, ORCID <https://orcid.org/0009-0001-8305-1633>

[E-mail michal.kwiatkowski@gumed.edu.pl](mailto:michal.kwiatkowski@gumed.edu.pl)

⁵Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Michał Musielak⁶, ORCID <https://orcid.org/0009-0002-0070-1694>

[E-mail mich.musielak@onet.pl](mailto:mich.musielak@onet.pl)

⁶Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Pola Kobryń¹, ORCID <https://orcid.org/0009-0001-6477-7092>

[E-mail pola.kobryn@gumed.edu.pl](mailto:pola.kobryn@gumed.edu.pl)

¹Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Aleksandra Zybert⁸, ORCID <https://orcid.org/0009-0004-5247-9161>

[E-mail azybert@gumed.edu.pl](mailto:azybert@gumed.edu.pl)

⁸Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Aleksandra Borowska⁹, ORCID <https://orcid.org/0009-0001-4757-4859>

E-mail aleksandra.borowska@gumed.edu.pl

⁹Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Jakub Grabowski¹⁰, ORCID <https://orcid.org/0009-0002-8024-7160>

E-mail jak0grabowski@gmail.com

¹⁰Medical University of Gdańsk, Marii Skłodowskiej-Curie 3a, 80-210 Gdańsk, Poland

Corresponding author

Iga Kobryń E-mail iga.kobryn@gumed.edu.pl

Abstract

Background. Sauna bathing has gained increasing attention as a potential non-pharmacological intervention for improving health and preventing chronic diseases.

Aim. The aim of this review was to evaluate the effects of regular sauna bathing on cardiovascular, metabolic, musculoskeletal, mental, and immune health.

Material and methods. A narrative review of the literature was conducted using PubMed and Google Scholar. Relevant studies were identified using keywords such as “sauna benefits,” “heat therapy,” “cardiovascular,” “mental health,” and “infrared sauna.” Observational and interventional studies involving human participants were included. The findings were synthesized and organized into thematic categories.

Results. Regular sauna bathing was associated with improved cardiovascular outcomes, including reduced blood pressure, enhanced vascular function, and lower risk of cardiovascular disease and mortality. Additional benefits were observed in metabolic health, muscle recovery, and mental well-being. Evidence also suggests potential improvements in immune function and reduced risk of respiratory diseases. Furthermore, combining sauna bathing with physical exercise may enhance physiological adaptations.

Conclusions. Sauna bathing appears to be a safe and effective complementary intervention for promoting health, particularly in the context of cardiovascular disease prevention. However, further high-quality studies are required to confirm these findings and to establish optimal usage protocols.

Key words: sauna bathing, heat therapy, cardiovascular health, mental health, recovery, immune system, sport

1. Introduction

Sauna bathing, particularly in its traditional Finnish form, has long been an integral part of cultural and recreational practices in many regions of the world. In recent years, increasing scientific attention has been directed toward its potential role as a non-pharmacological intervention supporting human health. This interest reflects the growing global burden of chronic diseases, including cardiovascular and metabolic disorders, and the need for accessible lifestyle-based preventive strategies.

Exposure to high temperatures during sauna bathing induces a range of acute physiological responses. These include increases in heart rate, peripheral vasodilation, enhanced skin blood flow, and activation of thermoregulatory mechanisms such as sweating. Notably, several of these responses resemble those observed during moderate-intensity physical activity, suggesting that passive heat exposure may elicit beneficial cardiovascular adaptations [1,2]. Repeated exposure to heat stress has been associated with improvements in endothelial function, arterial compliance, and modulation of inflammatory pathways, which may contribute to long-term health benefits [3,4].

An expanding body of epidemiological and clinical research indicates that regular sauna bathing may be associated with reduced risk of cardiovascular disease and all-cause mortality

[5]. In addition to cardiovascular outcomes, potential benefits have been reported in relation to metabolic health, including lipid metabolism and insulin sensitivity, as well as musculoskeletal recovery and chronic pain management. Furthermore, emerging evidence suggests that sauna use may have a positive impact on mental well-being and stress reduction, and may influence immune function [6,7].

Despite these promising findings, the available evidence remains heterogeneous, with variability in study design, population characteristics, and sauna exposure protocols. A significant proportion of the data originates from specific populations, particularly Finnish cohorts, which may limit generalizability. Moreover, potential risks, including dehydration, hypotension, and adverse events in individuals with underlying health conditions, require careful consideration.

The aim of this review is to provide a comprehensive overview of the current evidence on the effects of regular sauna bathing on cardiovascular, metabolic, musculoskeletal, mental, and immune health, with particular emphasis on underlying physiological mechanisms and safety considerations.

2. Research materials and methods

This study was conducted as a narrative review of the literature addressing the health effects of sauna bathing and passive heat exposure. A structured search was performed using two electronic databases: PubMed and Google Scholar.

The search strategy was based on combinations of keywords such as “sauna benefits,” “heat therapy,” “immune system,” “cardiovascular system,” “mental health,” “musculoskeletal system,” and “infrared sauna.” These terms were used individually and in combination to identify studies relevant to the topic.

Studies were included if they investigated the effects of sauna bathing or passive heat exposure on human health outcomes. Both observational and interventional studies were considered, including randomized controlled trials, cohort studies, systematic reviews, and meta-analyses. Only articles published in English were included. Particular emphasis was placed on more recent publications, while also incorporating earlier studies of fundamental importance to the topic.

Studies conducted exclusively on animal models, case reports, or those lacking clearly defined health-related outcomes were excluded. In addition, studies examining heat exposure under conditions not comparable to sauna use were not considered.

The selection of studies was guided by their relevance to the predefined thematic areas of this review: cardiovascular health, metabolic effects, musculoskeletal recovery, mental health, and immune function. Reference lists of selected articles were also screened to identify additional relevant sources.

Due to the heterogeneity of the included studies in terms of design, population, and intervention protocols, a quantitative meta-analysis was not performed. Instead, the findings were synthesized qualitatively and organized into thematic categories.

3. Research results

3.1. Cardiovascular health

3.1.1. Blood pressure

A substantial body of evidence indicates that sauna bathing exerts both acute and long-term effects on blood pressure regulation. Acute exposure to high temperatures during sauna sessions leads to peripheral vasodilation and increased skin blood flow, resulting in a transient reduction in systolic and diastolic blood pressure [1]. These effects are primarily mediated by decreased peripheral vascular resistance and enhanced endothelial function.

Several studies have demonstrated that repeated sauna exposure may contribute to sustained improvements in blood pressure control. Passive heat therapy has been associated with improved arterial compliance and reduced vascular stiffness, which are key determinants of cardiovascular health [8]. Additionally, heat exposure may promote nitric oxide availability, further supporting vasodilation and vascular function.

Recent evidence also suggests that sauna bathing can be safely implemented in individuals with controlled hypertension, although caution is advised in patients with unstable cardiovascular conditions [9]. Overall, the available data support the role of sauna bathing as a complementary strategy for blood pressure management.

3.1.2. Risk of cardiovascular disease

Long-term observational studies have consistently reported an association between frequent sauna bathing and reduced risk of cardiovascular disease. One of the most prominent cohort studies demonstrated that individuals who used the sauna more frequently had a significantly lower risk of fatal cardiovascular events and all-cause mortality compared to those with less frequent use [5].

The protective effects of sauna bathing are likely multifactorial. Regular heat exposure has been linked to improvements in endothelial function, reduction of oxidative stress, and favorable effects on autonomic nervous system balance. These adaptations may collectively contribute to reduced cardiovascular risk [10].

Emerging evidence also suggests that sauna bathing may play a role in the prevention of ischemic heart disease and other cardiovascular conditions. Although the majority of studies are observational, the consistency of findings across different populations supports a potential causal relationship [11].

3.1.3. Heart failure and vascular function

Sauna bathing has also been investigated in the context of heart failure and vascular dysfunction. Systematic reviews and meta-analyses suggest that controlled heat therapy may improve cardiac output, reduce symptoms, and enhance quality of life in patients with chronic heart failure [12].

Furthermore, passive heat exposure has been shown to improve endothelial function and peripheral circulation, which are critical factors in the management of cardiovascular diseases [13]. These effects may be particularly relevant in populations with limited ability to engage in regular physical activity.

Recent studies have also explored the potential role of sauna bathing in peripheral arterial disease, highlighting improvements in vascular function and walking capacity [14]. While further research is needed, current evidence supports the therapeutic potential of sauna use in selected cardiovascular conditions.

3.2. Metabolic effects

3.2.1. Diabetes and glucose metabolism

There is growing interest in the effects of sauna bathing on metabolic health, particularly in relation to glucose metabolism and insulin sensitivity. Heat exposure has been shown to induce the expression of heat shock proteins, which may improve cellular stress responses and enhance insulin signaling pathways [4].

Some studies suggest that regular sauna use may contribute to improved glycemic control, particularly in individuals with impaired glucose tolerance. Passive heat therapy may mimic certain metabolic effects of physical exercise, including increased glucose uptake and improved insulin sensitivity [15].

Although the available evidence remains limited, these findings indicate that sauna bathing may have a supportive role in the prevention and management of metabolic disorders such as type 2 diabetes.

3.2.2. Obesity and lipid profile

The impact of sauna bathing on body weight and lipid metabolism has also been investigated. While sauna use alone is unlikely to result in significant weight loss, it may contribute to metabolic improvements when combined with other lifestyle interventions.

Systematic reviews have reported beneficial effects of heat therapy on lipid profiles, including reductions in total cholesterol and low-density lipoprotein (LDL) levels [16]. These changes may be associated with improved cardiovascular risk profiles.

Additionally, sauna exposure may increase energy expenditure and promote metabolic adaptations, although these effects are generally modest [17]. Overall, sauna bathing should be considered as an adjunct rather than a primary intervention for obesity management.

3.3. Musculoskeletal and recovery

3.3.1. Muscle recovery

Sauna bathing is commonly used as a recovery modality following physical exercise. Heat exposure may enhance muscle relaxation, increase blood flow to skeletal muscles, and facilitate the removal of metabolic byproducts.

Systematic reviews have indicated that post-exercise heat exposure may support recovery processes and contribute to improved performance adaptations over time [18]. Increased circulation may enhance nutrient delivery and tissue repair.

These findings suggest that sauna bathing can be a useful component of post-exercise recovery strategies, particularly in physically active individuals.

3.3.2. Delayed-onset muscle soreness (DOMS)

Delayed-onset muscle soreness (DOMS) is a common consequence of unaccustomed or intense exercise. Heat therapy has been proposed as a method to alleviate muscle soreness and improve functional recovery.

A recent meta-analysis comparing various physical therapy modalities found that heat-based interventions may reduce the severity of DOMS, although the magnitude of the effect varies depending on the protocol used [19]. Sauna bathing, as a form of passive heat exposure, may therefore contribute to symptom relief.

However, further high-quality studies are needed to establish optimal protocols and confirm the effectiveness of sauna use in this context.

3.3.3. Chronic pain and rheumatic diseases

Sauna therapy has also been explored as a supportive intervention in chronic pain conditions and rheumatic diseases. Heat exposure may reduce muscle tension, improve joint mobility, and decrease pain perception.

Evidence suggests that sauna use may provide symptomatic relief in patients with rheumatic disorders, although the mechanisms are not fully understood [20]. Additionally, heat therapy has been included among non-pharmacological approaches to pain management, particularly in chronic conditions [21].

While sauna bathing should not replace conventional treatment, it may serve as a complementary therapeutic option.

3.4. Mental health

3.4.1. Stress reduction

Sauna bathing is widely reported to promote relaxation and reduce stress levels. Exposure to heat may influence the autonomic nervous system, leading to decreased sympathetic activity and increased parasympathetic tone.

Recent studies have highlighted the potential role of sauna use in stress management, with reported improvements in mood and subjective well-being [22]. These effects may be related to both physiological responses and the overall relaxing environment associated with sauna use.

3.4.2. Depression and well-being

There is emerging evidence suggesting that regular sauna bathing may have beneficial effects on depressive symptoms and overall mental well-being. Heat exposure may influence neuroendocrine pathways, including the release of endorphins and other neurotransmitters involved in mood regulation.

Some authors have proposed that sauna use may contribute to improved quality of life and emotional health, particularly when incorporated into regular lifestyle practices [7]. However, more robust clinical trials are needed to confirm these observations.

3.4.3. Psychosis and psychiatric outcomes

Prospective cohort studies have investigated the relationship between sauna bathing frequency and psychiatric outcomes. Findings suggest that frequent sauna use may be associated with a reduced risk of psychotic disorders [23].

Additionally, recent research has explored the interaction between sauna use and cardiorespiratory fitness in relation to mental health outcomes, indicating potential synergistic effects [24]. While these findings are promising, further studies are required to better understand the underlying mechanisms.

3.5. Immune system

3.5.1. Inflammation and immune modulation

Sauna bathing may influence immune function through its effects on inflammation and oxidative stress. Regular heat exposure has been associated with reductions in inflammatory markers, including C-reactive protein (CRP) [25].

Furthermore, passive heat therapy may enhance immune system regulation by improving cellular stress responses and reducing chronic low-grade inflammation [26]. These effects may contribute to the overall health benefits associated with sauna use.

3.5.2. Resistance to infections

Some evidence suggests that frequent sauna bathing may be associated with a reduced risk of respiratory infections. Long-term observational studies have reported lower incidence of respiratory diseases among individuals who regularly use the sauna [27].

These findings may be related to improved immune function, as well as enhanced respiratory circulation and mucosal defense mechanisms. However, further research is needed to establish causality.

3.6. Sauna combined with physical activity

3.6.1. Sauna and exercise

The combination of sauna bathing and physical exercise has gained increasing attention in recent years. Studies suggest that adding sauna sessions to regular exercise programs may enhance cardiovascular adaptations beyond those achieved by exercise alone [28].

Potential mechanisms include increased plasma volume, improved thermoregulation, and enhanced vascular function. These adaptations may contribute to improved endurance and overall physical performance.

3.6.2. Performance and adaptation

Post-exercise heat exposure has been shown to influence training adaptations, particularly in endurance athletes. Systematic reviews indicate that passive heat acclimation may improve performance outcomes, including time to exhaustion and aerobic capacity [29].

These findings suggest that sauna bathing may be a valuable adjunct to training programs, although optimal protocols remain to be established.

4. Discussion

The findings of this review indicate that regular sauna bathing may exert a wide range of beneficial effects on human health, particularly in the context of cardiovascular function. Among the analyzed domains, the strongest and most consistent evidence relates to cardiovascular outcomes, including reductions in blood pressure, improvements in vascular function, and decreased risk of cardiovascular disease and mortality. These findings are supported by both observational studies and clinical research, suggesting that sauna bathing may represent a valuable adjunct to established preventive strategies.

The physiological mechanisms underlying these effects are likely multifactorial. Heat exposure induces cardiovascular responses that resemble those observed during moderate-intensity physical activity, including increased heart rate and vasodilation. Repeated exposure may lead to long-term adaptations such as improved endothelial function, enhanced arterial compliance, and modulation of autonomic balance. In addition, reductions in systemic inflammation and oxidative stress may contribute to the observed protective effects.

Beyond cardiovascular health, emerging evidence suggests that sauna bathing may also influence metabolic, musculoskeletal, and mental health outcomes. Although the available data in these areas are less extensive, several studies indicate potential improvements in glucose metabolism, lipid profiles, and recovery following physical exertion. The role of sauna use in

mental health, particularly in stress reduction and overall well-being, is also gaining attention, although further high-quality research is required.

The potential impact of sauna bathing on immune function represents another area of interest. Some studies suggest that regular heat exposure may reduce low-grade inflammation and improve resistance to certain infections. However, the mechanisms remain incompletely understood and require further investigation.

An important aspect highlighted in this review is the potential synergy between sauna bathing and physical exercise. Evidence suggests that combining these interventions may enhance cardiovascular and performance-related adaptations, which may be particularly relevant for physically active individuals and athletes.

Despite these promising findings, several limitations should be acknowledged. A substantial proportion of the available evidence is derived from observational studies, which limits the ability to establish causality. Furthermore, many studies have been conducted in specific populations, particularly in Finland, where sauna bathing is deeply embedded in lifestyle, potentially limiting generalizability to other populations. There is also considerable variability in sauna protocols, including temperature, duration, and frequency of use.

Safety considerations must also be taken into account. Although sauna bathing is generally considered safe for healthy individuals, it may pose risks in certain populations. Potential adverse effects include dehydration, hypotension, and, in rare cases, cardiovascular events, particularly in individuals with unstable medical conditions. Therefore, appropriate caution and individualized recommendations are warranted.

Future research should focus on well-designed randomized controlled trials to better establish causal relationships and to determine optimal sauna protocols. Studies involving diverse populations are also needed to improve the generalizability of findings.

5. Conclusions

In conclusion, current evidence suggests that regular sauna bathing may provide a range of health benefits, particularly in relation to cardiovascular function. The most robust findings

indicate improvements in blood pressure regulation, vascular health, and a reduced risk of cardiovascular disease and mortality.

Additional benefits have been observed in metabolic health, musculoskeletal recovery, mental well-being, and immune function, although these areas require further investigation. Sauna bathing may also enhance the effects of physical exercise, representing a promising complementary approach within lifestyle-based interventions.

Despite these positive findings, the current evidence base is limited by the predominance of observational studies and variability in study protocols. Further high-quality research is needed to establish standardized recommendations and to better understand the mechanisms underlying the observed effects.

Overall, sauna bathing appears to be a safe and potentially effective non-pharmacological strategy for supporting general health when used appropriately and with consideration of individual health status.

Disclosure

Author's contribution:

Iga Kobryń - conceptualization, methodology, formal analysis, writing - review and editing, supervision

Pola Kobryń - resources, writing - rough preparation

Dawid Ocicki - investigation, resources, formal analysis

Michał Bojarski - investigation, formal analysis, project administration

Michał Kwiatkowski - formal analysis, resources

Michał Musielak - formal analysis, resources

Igor Nowiński - investigation, data curation

Aleksandra Zybert - resources, data curation

Aleksandra Borowska - data curation, writing - review and editing

Jakub Grabowski - data curation, writing - rough preparation

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