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THE IMPACT OF SAUNA USE ON CARDIOVASCULAR RISK – A LITERATURE REVIEW

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ABSTRACT

Introduction and objective: Cardiovascular diseases remain leading cause of morbidity and mortality worldwide. One of non-pharmacological method that can support primary and secondary prevention is the use of saunas, especially Finnish dry saunas. The aim of this study is to present the current state of knowledge on the impact of sauna use on cardiovascular risk factors.
Methods: A literature review based on data from the Pubmed database published between 2000 and 2025.
Conclusions: Sauna use has a beneficial effect on most modifiable cardiovascular risk factors. In the long term, it improves endothelial function and reduces arterial stiffness, lowers blood pressure, optimizes lipid profile and sleep quality, reduces stress level and excessive activity of the sympathetic nervous system. However, it has no effects on body weight and its individual components in the long run. In terms of its effect on glycemia, it increases insulin sensitivity, but in insulin-treated diabetics it can cause hypoglycemia. Future studies should be well designed with specific frequency and parameters of sauna use, and include more women, older people, diabetics as well as other patients to determine the impact on cardiovascular risk.

KEYWORDS

Sauna Bathing, Cardiovascular Risk, Finnish Sauna, Dry Sauna, Cardiovascular Health, Cardiovascular Disease

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1. Introduction

Cardiovascular disease remains the leading cause of morbidity and mortality worldwide despite advances in diagnosis and treatment (Thomas et al., 2018). In recent years, there has been growing interest in non pharmacological methods that can support primary and secondary prevention. One of these is the use of saunas, especially dry and steam saunas. Clinical experience and epidemiological observations show that long-term use of saunas can have a beneficial effect on the cardiovascular system by improving hemodynamics and endothelial function (Kihara et al., 2002; Laukkanen T, Kunutsor, Zaccardi et al., 2018). What is more, heat therapy has an impact on modifiable risk factors, including hypertension, lipid profile, glycemia, inflammation, sleep quality and stress (Behzadi et al., 2020; Gryka et al., 2014; Laukkanen T et al., 2019; Zaccardi et al., 2017).

Evidence from recent years suggests that saunas act as controlled heat stress, eliciting a physiological response corresponding to moderate-intensity exercise (Laukkanen T et al.,2015; Laukkanen JA, Laukkanen T, Kunutsor SK, 2018). Increased cardiac output, dilation of skin blood vessels, improved coronary blood flow and stimulation of the autonomic nervous system can lead to lower blood pressure, reduced arterial stiffness and improved neurocirculatory regulation (Laukkanen T, Kunutsor, Zaccardi et al., 2018).

Observational studies involving thousands of adults have demonstrated an association between sauna frequency and a lower risk of cardiovascular death, stroke and all-cause mortality (Laukkanen T et al., 2015; Laukkanen T, Kunutsor, Khan et al., 2018). In addition, studies indicate short-term and long-term benefits for blood pressure, endothelial function and inflammatory markers (Brunt et al., 2016, Lee E et al., 2022).

Despite the growing number of studies, the mechanisms underlying the observed effects are not fully understood. The effect of sauna on cardiovascular risk depends on the individual characteristics of the patient, the type of sauna, the temperature, the duration of the session and the regularity of use. However, the available evidence suggests that the use of heat therapy in a responsible manner and tailored to the patient's health status may complement cardiovascular prevention (Kjertakov et al., 2024; Laukkanen JA, Laukkanen T, Kunutsor, 2018).

The aim of this narrative review is to present the current state of knowledge on the impact of sauna use on cardiovascular risk, taking into account population data, clinical studies, possible protective mechanisms and safety aspects.

2. Methodology

The literature review was conducted based on data from the Pubmed database and the following keywords: sauna bathing, cardiovascular risk, Finnish sauna, dry sauna, cardiovascular health, cardiovascular disease. The inclusion criteria were prospective cohort studies, clinical trials, narrative and systematic reviews published between 2000 and 2025. The review is based on an analysis of the impact of sauna use (mainly dry sauna) on cardiovascular risk. Articles not available in English were excluded. The results were analyzed and summarized to provide a comprehensive overview of the current state of knowledge.

3. Definition and purposes of saunas

A sauna is a form of whole-body thermotherapy that has been used since ancient times for hygienic, health, spiritual and social purposes (Hussain and Cohen; 2018). Today, it is relatively inexpensive and widely available for both public and private use. Current forms of sauna use vary in design, heating source and humidity level. The most popular is the Finnish (dry) sauna which involves staying in a designated room for 5-20 minutes at temperatures of 80°C – 100°C with dry air (relative humidity of 10% to 20%) with periods of higher humidity when water is poured over the stones (Hannuksela and Ellahham, 2001; Hussain and Cohen, 2018;). Each sauna session should be followed by cooling down so that the body quickly lowers its temperature and stops sweating (Pilch et al., 2013).

4. The effect of sauna use on individual cardiovascular risk factors

4.1. Blood vessels

One of the most important elements of the circulatory system are blood vessels and their good condition is essential for the proper functioning of the body. Sauna use has a beneficial effect on blood vessels by improving endothelial function and reducing arterial stiffness (Laukkanen JA, Laukkanen T, Kunutsor, 2018). Repeated dry sauna sessions (at 60°C for 15 minutes a day for 2 weeks) increase FMD (flow-mediated dilation) of the brachial artery from 4.0% to 5.8% in people with risk factors for atherosclerosis and chronic heart failure (Kihara et al., 2002). In patients with chronic heart failure, improvement in FMD correlated with a decrease in BNP (**Brain Natriuretic Peptide)** concentration and improvement in coronary perfusion (Kihara et al., 2002). Heat therapy increased eNOS (endothelial nitric oxide synthase) expression and NO (nitric oxide) production (Kihara et al., 2002; Sastriques-Dunlop et al., 2025).

4.2. Immune system and inflammatory markers

Both acute and chronic inflammation can cause endothelial dysfunction and accelerate atherosclerosis which significantly increases cardiovascular risk. Laukkanen JA and Laukkanen T (Laukkanen JA and Laukkanen T, 2018) noted that more frequent sauna use is associated with lower levels of CRP (C-reactive protein). The study involved 2084 men aged 42 to 60 with no coexisting inflammatory conditions (Laukkanen JA and Laukkanen T, 2018). The lowest CRP values (CRP = 1.65 mmol/L) were recorded in subjects who used the sauna 4-7 times a week (Laukkanen JA and Laukkanen T, 2018).

In contrast, a study by Behzadi et al. (Behzadi et al., 2020) showed an increase in IL-6 and a slight increase in IL1-RA, but no changes in CRP. Chronically elevated IL-6 levels are affiliated with an increased risk of diseases (including cardiovascular diseases) but if the increases in circulating Il-6 are acute and transient they are considered beneficial in the long term for cardiometabolic health (Behzadi et al., 2020).

In the research conducted by Pilch et al. (Pilch et al., 2013), which compared the effect of sauna on blood parametres in trained and untrained individuals, it was noted that the number of white blood cells, lymphocytes, neutrophils and basophils increases after a sauna session but mainly in athletes. It was also found that after using the sauna the number of monocytes was significantly higher in athletes than in non-athletes which may suggest faster mobilization of the immune system in athletes (Pilch et al., 2013).

Pilch et al. in the subsequent study (Pilch et al., 2023) demonstrated HSP70 induction in both groups – trained and untrained men, with a tendency to a stronger response to heat stress in non-athletes. A single sauna session and multiple sessions in both groups caused an increase in IL-6 and IL-10 (Pilch et al., 2023). The immune response in trained and untrained individuals is similar to its activation during physical activity (Pilch et al., 2023).

4.3. Blood pressure

Hypertension is one of the most important modifiable cardiovascular risk factors. Using the sauna lowers blood pressure both during and immediately after the session as well as in the long term, which reduces the risk of hypertension. Studies show that a single Finnish sauna session (duration – 30 minutes, temperature - 73°C) decreases systolic and diastolic blood pressure, simulating moderate physical activity (Laukkanen, Kunutsor, Zaccardi et al., 2018). Heat therapy increases heart rate, stroke volume, cardiac output and reduces blood pressure and vascular resistance (Laukkanen, Kunutsor, Zaccardi et al., 2018). The results of another study conducted on a population of Finnish men indicate a strong inverse relationship between the frequency of sauna use and the risk of newly diagnosed hypertension (Zaccardi et al., 2017). Regular sauna use 4-7 times a week reduced the risk of hypertension by 46% compared to sauna use once a week (Zaccardi et al., 2017).

4.4. Lipid profile

High levels of non-HDL cholesterol, triglycerides and low levels of HDL cholesterol increase the risk of cardiovascular events. Sauna accelerates lipolysis and lipid metabolism through hyperthermia and an increase in cardiac output (Gryka et al., 2014; Pilch et al., 2010; Yamasaki et al., 2025). Regular sauna use improves the lipid profile. In physically active men a decrease in total and LDL cholesterol was observed within 3 weeks after the intervention with a reduction in triglycerides immediately after the sessions (Gryka et al., 2014). In women, on the other hand, a decrease in total and LDL cholesterol and an increase in HDL were observed, especially during longer sessions (Pilch et al., 2010). Systematic reviews have shown that regular sauna use causes a decrease in total cholesterol and LDL, an increase in HDL cholesterol, with younger and physically active individuals achieving better results (Hussain and Cohen, 2018; Yamasaki et al., 2025).

4.5. Glycemia

Chronic hyperglycemia damages the endothelium through oxidative stress, protein glycation and inflammation, leading to arterial stiffness and the accumulation of atherosclerotic proteins. Sauna use improves insulin sensitivity by inducing heat shock proteins and eNOS, which is comparable to the effects of aerobic training (McCarty et al., 2009). This is particularly beneficial for people who are unable to achieve effective aerobic exercise due to illness or disability. However, insulin – treated diabetics are at risk of hypoglycemia because heat therapy accelerates absorption of subcutaneously injected insulin (Gradel et al., 2018; Pitt JP et al., 2020). Therefore, special caution is required when using the sauna in this group of patients.

4.6. Body weight

Overweight and obesity significantly increase cardiovascular risk leading to

atherosclerosis, hypertension, heart failure and ischemic heart disease. Regular sauna bathing causes weight loss immediately after the session, mainly through water loss, without affecting adipose tissue (Podstawski et al., 2014; Podstawski et al., 2019). Heat therapy does not reduce fat tissue and has no long-term effect on body composition (Toro et al., 2021).

4.7. Autonomic nervous system

The balance between the parasympathetic and sympathetic nervous system is crucial in terms of cardiovascular risk. The response to stress (including thermal stress) is stimulation of the sympathetic nervous system which causes an increase in blood pressure, tachycardia and constriction of resistance vessels. Sauna use has a beneficial effect on the autonomic nervous system, increasing parasympathetic activity after a session (Laukkanen T et al., 2019). During the session there is a short-term acceleration of the heart rate but the cooling phase improves heart rate variability and the parasympathetic nervous system gains the upper hand – the heart slows down (Laukkanen T et al., 2019). Other studies in patients with chronic heart failure have shown that repeated sauna sessions reduce excessive sympathetic activity and decrease the number of extra ventricular contractions (Kihara T et al., 2004). In both studies, the authors emphasize that further research on larger groups and healthy individuals is necessary.

4.8. Sleep quality

Poor sleep quality significantly increases cardiovascular risk because it leads to inflammation, oxidative stress and increased sympathetic nervous system activity (Guo et al., 2025; Saputro et al., 2025). Furthermore, abnormal sleep increases the probability of hypertension, dyslipidemia, obesity and cardiovascular events (Onyegbule et al., 2025).

In the survey of 482 sauna users, the majority (83,5%) reported improved sleep quality for 1-2 nights after a session (Hussain et al., 2019). Although there are few studies evaluating sauna bathing's impact on sleep, the research reveals the high correlation between the speed of core body temperature reduction, peripheral vasodilation and the onset of sleep (Hussain et al., 2019). There are hypotheses that this is related to body cooling intensified by sauna-induced peripheral vasodilation and fatigue caused by augmented cardiovascular activity (Hussain et al., 2019).

In another study, sauna bathers were more satisfied with their sleep pattern than non-sauna bathers, and the differences in sauna frequency were not statistically significant (Enström et al., 2022).

4.9. Stress

Chronic stress considerably increases cardiovascular risk by activating the sympathetic nervous system and increasing cortisol and adrenaline secretion leading to hypertension, accelerated heart rate and chronic inflammation (Ajibewa et al., 2024; Pimple et al., 2017). Using a sauna aid to relax by reducing everyday anxiety and fears (Laukkanen T, Laukkanen JA, Kunutsor, 2018). However, there is a little research on sauna in the fields of neuroscience and psychology. In terms on neural oscillation, there is an increase in alpha and theta power after sauna (Chang et al., 2023). Higher alpha activity may be related to relaxation and higher theta power reflects increased awareness, attention as well as cognitive and emotional enhancement (Chang et al., 2023).

If it comes to cortisol, the study conducted on athletes and non-athletes by Pilch (Pilch et al., 2023) showed that after a sauna session cortisol levels increased in both groups but more so in non-training men suggesting that athletes are more adapted to heat stress. The long-term effect of sauna on cortisol levels has not been studied.

Oxidative stress depends on a thermal stressor. Physical exercise at elevated ambient temperature cause lower changes in the oxidative stress indicators compared to sauna bathing (Pilch et al., 2014). Thus, both passive and active overheating disturbed pro-oxidant – antioxidant balance (Gryka et al., 2020, Pilch et al., 2014). On the other hand, sauna bathing induces a mechanism leading to an increase in NO availability and a drop in the concentration of nitrosative stress markers, which improves the pro-oxidative – antioxidative balance in both training and non-training people (Gryka et al., 2020). It is implied to be useful in a biological renewal of sportsmen as well as people with moderate physical activity.

Sauna use induces significant changes in stress markers like heat shock proteins and interleukins. The results of another study conducted that heat exposure simulates the effects of physical exercise in modulating stress genes which strengthen stress resistance in a similar way to training (Żychowska et al., 2017). There was a significant increase in expression of HSP1A, HSPB1, IL-6, IL-10, CRP genes in non-training group while in the group of athletes the changes in genes expression were smaller. It suggests a conclusion that trained people have a higher thermotolerance and the pro-inflammatory response to heat stress was smaller than in non-athletes group (Pilch et al., 2014; Żychowska et al., 2017). On this basis, the use of sauna may constitute to improve tolerance to exercise for people with lower physical activity (Żychowska et al., 2017).

5. Safety of sauna use and contraindications

The standard session duration is 5-20 minutes followed by immersion in cold water (pool or shower) and a recovery period at room temperature (Crinnion, 2011). During a sauna visit this process is repeated 2-3 times (Crinnion, 2011).

Hannuksela and Ellahham (Hannuksela and Ellahham, 2001) state that saunas are well tolerated by most healthy adults and children causing only temporary cardiovascular and hormonal changes with no effect on fertility or safety in uncomplicated pregnancies. Long-term sauna use can lower blood pressure in hypertensive patients and improve left ventricular ejection fraction in patients with chronic heart failure, it alleviates the symptoms of asthma, rheumatic pain and psoriasis (Hannuksela and Ellahham, 2001).

Absolute contraindications for sauna use include unstable coronary artery disease, recent heart attack, severe aortic stenosis, severe heart failure (NYHA III-IV), uncontrolled hypertension >180/110 mmHg, life-threatening arrhythmias and acute infections (Hannuksela and Ellahham, 2001). It is not recommended to consume alcohol before or during sauna use as this may lead to hypotension, fainting and increase the risk of arrhythmias, acute heart attacks and sudden death (Hannuksela and Ellahham, 2001; Nguyen et al., 2004).

It is recommended that people with fever and skin diseases (urticaria, abrasions, oozing wounds) avoid using the sauna (Crinnion, 2011). The safety of sauna use during pregnancy is a matter of debate as there are concerns that elevated temperatures may increase the risk of miscarriage, especially in early pregnancy, particularly in women who have not previously used saunas (Crinnion, 2011). However, several epidemiological studies conducted in Finland have not confirmed this hypothesis which may be due to Finnish women' adaptation to sauna use before pregnancy (Crinnion, 2011; Hannuksela and Ellahham, 2001).

6. Limitations

This review is a narrative review limited by its scope, subjective selection of studies and lack of methodological transparency. The number of high-quality randomized clinical trials is low. Furthermore, individual factors such as age, gender, comorbidities, life style and fitness level may influence outcomes and were not consistently controlled for in all available researches. Due to these limitations targeted clinical trials are needed to obtain recommendations that take into account the regular use of saunas in reducing cardiovascular risk in healthy individuals and specific patient groups.

7. Conclusions

In summary, sauna use has beneficial effects on most modifiable cardiovascular risk factors. In the long term, it improves endothelial function and reduces arterial stiffness, lowers blood pressure, improves lipid profile and sleep quality, reduces stress levels and excessive activity of the sympathetic nervous system. However, it has no effect on body weight and its individual components. In terms of its effect on glycemia, it increases insulin sensitivity but in insulin-treated diabetics it can cause hypoglycemia.

While the reviewed studies provide encouraging results, there are several limitations in the existing literature. The authors of most studies point to the need for well designed randomized clinical trials with specific frequency and parameters of sauna use (number of sessions in a given time and interval, temperature) and biomarkers to be assessed (e.g. BNP, cortisol, CRP, IL-6, IL-10 etc.). Priority should be given to molecular studies (e.g. HSP, eNOS) and the inclusion of more women, older people, diabetics and patients from other groups for whom the sauna could potentially have beneficial results and help to reduce the cardiovascular risk.

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REFERENCES

1. Ajibewa, T. A., Kershaw, K. N., Carr, J. J., Terry, J. G., Gabriel, K. P., Carnethon, M. R., Wong, M., & Allen, N. B. (2024). Chronic stress and cardiovascular events: Findings from the CARDIA Study. *American Journal of Preventive Medicine, 67*(1), 24–31. https://doi.org/10.1016/j.amepre.2023.12.015
2. Behzadi, P., Gravel, H., Neagoe, P. E., Barry, H., Sirois, M. G., & Gagnon, D. (2020). Impact of Finnish sauna bathing on circulating markers of inflammation in healthy middle-aged and older adults: A crossover study. *Complementary Therapies in Medicine, 52*, Article 102486. https://doi.org/10.1016/j.ctim.2020.102486
3. Brunt, V. E., Howard, M. J., Francisco, M. A., Ely, B. R., & Minson, C. T. (2016). Passive heat therapy improves endothelial function, arterial stiffness and blood pressure in sedentary humans. *The Journal of Physiology, 594*(18), 5329–5342. https://doi.org/10.1113/JP272453
4. Chang, M., Ibaraki, T., Naruse, Y., & Imamura, Y. (2023). A study on neural changes induced by sauna bathing: Neural basis of the "totonou" state. *PLOS ONE, 18*(11), Article e0294137. https://doi.org/10.1371/journal.pone.0294137
5. Crinnion, W. J. (2011). Sauna as a valuable clinical tool for cardiovascular, autoimmune, toxicant-induced and other chronic health problems. *Alternative Medicine Review, 16*(3), 215–225.
6. Engström, Å., Hägglund, H., Lee, E., Wennberg, M., Söderberg, S., & Andersson, M. (2024). Sauna bathing in northern Sweden: Results from the MONICA study 2022. *International Journal of Circumpolar Health, 83*(1), Article 2419698. https://doi.org/10.1080/22423982.2024.2419698
7. Gradel, A. K. J., Porsgaard, T., Lykkesfeldt, J., Seested, T., Gram-Nielsen, S., Kristensen, N. R., & Refsgaard, H. H. F. (2018). Factors affecting the absorption of subcutaneously administered insulin: Effect on variability. *Journal of Diabetes Research, 2018*, Article 1205121. https://doi.org/10.1155/2018/1205121
8. Gryka, D., Pilch, W. B., Czerwińska-Ledwig, O. M., Piotrowska, A. M., Klocek, E., & Bukova, A. (2020). The influence of Finnish sauna treatments on the concentrations of nitric oxide, 3-nitrotyrosine and selected markers of oxidative status in training and non-training men. *International Journal of Occupational Medicine and Environmental Health, 33*(2), 173–185. https://doi.org/10.13075/ijomeh.1896.01514
9. Gryka, D., Pilch, W., Szarek, M., Szygula, Z., & Tota, Ł. (2014). The effect of sauna bathing on lipid profile in young, physically active, male subjects. *International Journal of Occupational Medicine and Environmental Health, 27*(4), 608–618. https://doi.org/10.2478/s13382-014-0281-9
10. Guo, X., Mi, S., Zhao, L., & Chen, T. (2025). Sleep patterns and cardiovascular disease risk: Investigating the mediating role of inflammatory markers in a large NHANES adult population. *Mediators of Inflammation, 2025*, Article 3250786. https://doi.org/10.1155/mi/3250786
11. Hannuksela, M. L., & Ellahham, S. (2001). Benefits and risks of sauna bathing. *The American Journal of Medicine, 110*(2), 118–126. https://doi.org/10.1016/S0002-9343(00)00671-9
12. Hussain, J., & Cohen, M. (2018). Clinical effects of regular dry sauna bathing: A systematic review. *Evidence-Based Complementary and Alternative Medicine, 2018*, Article 1857413. https://doi.org/10.1155/2018/1857413
13. Hussain, J. N., Greaves, R. F., & Cohen, M. M. (2019). A hot topic for health: Results of the Global Sauna Survey. *Complementary Therapies in Medicine, 44*, 223–234. https://doi.org/10.1016/j.ctim.2019.03.012
14. Kihara, T., Biro, S., Imamura, M., Yoshifuku, S., Takasaki, K., Ikeda, Y., Otuji, Y., Minagoe, S., Toyama, Y., & Tei, C. (2002). Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure. *Journal of the American College of Cardiology, 39*(5), 754–759. https://doi.org/10.1016/S0735-1097(01)01824-1
15. Kihara, T., Biro, S., Ikeda, Y., Fukudome, T., Shinsato, T., Masuda, A., Miyata, M., Hamasaki, S., Otsuji, Y., Minagoe, S., Akiba, S., & Tei, C. (2004). Effects of repeated sauna treatment on ventricular arrhythmias in patients with chronic heart failure. *Circulation Journal, 68*(12), 1146–1151. https://doi.org/10.1253/circj.68.1146
16. Kjertakov, M., & Petersen, A. (2025). Hot water immersion as a means to prevent cardiovascular disease and associated mortality. *Current Cardiology Reviews, 21*(1), Article e1573403X319557. https://doi.org/10.2174/011573403X319557240822094347
17. Laukkanen, J. A., & Kunutsor, S. K. (2024). The multifaceted benefits of passive heat therapies for extending the healthspan: A comprehensive review with a focus on Finnish sauna. *Temperature, 11*(1), 27–51. https://doi.org/10.1080/23328940.2023.2300623
18. Laukkanen, J. A., & Laukkanen, T. (2018). Sauna bathing and systemic inflammation. *European Journal of Epidemiology, 33*(3), 351–353. https://doi.org/10.1007/s10654-017-0335-y
19. Laukkanen, J. A., Laukkanen, T., & Kunutsor, S. K. (2018). Cardiovascular and other health benefits of sauna bathing: A review of the evidence. *Mayo Clinic Proceedings, 93*(8), 1111–1121. https://doi.org/10.1016/j.mayocp.2018.04.008
20. Laukkanen, T., Khan, H., Zaccardi, F., & Laukkanen, J. A. (2015). Association between sauna bathing and fatal cardiovascular and all-cause mortality events. *JAMA Internal Medicine, 175*(4), 542–553. https://pubmed.ncbi.nlm.nih.gov/25705824/

21. Laukkanen, T., Kunutsor, S. K., Khan, H., Willeit, P., Zaccardi, F., & Laukkanen, J. A. (2018). Sauna bathing is associated with reduced cardiovascular mortality and improves risk prediction in men and women: A prospective cohort study. *BMC Medicine, 16*(1), Article 219. https://doi.org/10.1186/s12916-018-1198-0
22. Laukkanen, T., Kunutsor, S. K., Zaccardi, F., Lee, E., Willeit, P., Khan, H., & Laukkanen, J. A. (2018). Acute effects of sauna bathing on cardiovascular function. *Journal of Human Hypertension, 32*(2), 129–138. https://doi.org/10.1038/s41371-017-0008-z
23. Laukkanen, T., Laukkanen, J. A., & Kunutsor, S. K. (2018). Sauna bathing and risk of psychotic disorders: A prospective cohort study. *Medical Principles and Practice, 27*(6), 562–569. https://doi.org/10.1159/000493392
24. Laukkanen, T., Lipponen, J., Kunutsor, S. K., Zaccardi, F., Araújo, C. G. S., Mäkikallio, T. H., Khan, H., Willeit, P., Lee, E., Poikonen, S., Tarvainen, M., & Laukkanen, J. A. (2019). Recovery from sauna bathing favorably modulates cardiac autonomic nervous system. *Complementary Therapies in Medicine, 45*, 190–197. https://doi.org/10.1016/j.ctim.2019.06.011
25. Lee, E., Kolunsarka, I., Kostensalo, J., Ahtiainen, J. P., Haapala, E. A., Willeit, P., Kunutsor, S. K., & Laukkanen, J. A. (2022). Effects of regular sauna bathing in conjunction with exercise on cardiovascular function: A multi-arm, randomized controlled trial. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 323*(3), R289–R299. https://doi.org/10.1152/ajpregu.00076.2022
26. McCarty, M. F., Barroso-Aranda, J., & Contreras, F. (2009). Regular thermal therapy may promote insulin sensitivity while boosting expression of endothelial nitric oxide synthase—Effects comparable to those of exercise training. *Medical Hypotheses, 73*(1), 103–105. https://doi.org/10.1016/j.mehy.2008.12.020
27. Nguyen, Y., Naseer, N., & Frishman, W. H. (2004). Sauna as a therapeutic option for cardiovascular disease. *Cardiology in Review, 12*(6), 321–324. https://doi.org/10.1097/01.crd.0000124844.56479.05
28. Onyegbule, C. J., Muoghalu, C. G., Ofoegbu, C. C., & Ezeorah, F. (2025). The impact of poor sleep quality on cardiovascular risk factors and quality of life. *Cureus, 17*(1), Article e77397. https://doi.org/10.7759/cureus.77397
29. Pilch, W., Pokora, I., Szyguła, Z., Pałka, T., Pilch, P., Cisoń, T., Malik, L., & Wiecha, S. (2013). Effect of a single Finnish sauna session on white blood cell profile and cortisol levels in athletes and non-athletes. *Journal of Human Kinetics, 39*, 127–135. https://doi.org/10.2478/hukin-2013-0075
30. Pilch, W., Szarek, M., Czerwińska-Ledwig, O., Piotrowska, A., Żychowska, M., Klocek, E. S., Andraščíková, Š., & Pałka, T. (2023). The effects of a single and a series of Finnish sauna sessions on the immune response and HSP-70 levels in trained and untrained men. *International Journal of Hyperthermia, 40*(1), Article 2179672. https://doi.org/10.1080/02656736.2023.2179672
31. Pilch, W., Szyguła, Z., Klimek, A. T., Pałka, T., Cisoń, T., Pilch, P., & Torii, M. (2010). Changes in the lipid profile of blood serum in women taking sauna baths of various duration. *International Journal of Occupational Medicine and Environmental Health, 23*(2), 167–174. https://doi.org/10.2478/v10001-010-0020-9
32. Pilch, W., Szygula, Z., Tyka, A. K., Palka, T., Tyka, A., Cison, T., Pilch, P., & Teleglow, A. (2014). Disturbances in pro-oxidant-antioxidant balance after passive body overheating and after exercise in elevated ambient temperatures in athletes and untrained men. *PLOS ONE, 9*(1), Article e85320. https://doi.org/10.1371/journal.pone.0085320
33. Pimple, P., Lima, B. B., Hammadah, M., Wilmot, K., Ramadan, R., Levantsevych, O., Sullivan, S., Kim, J. H., Kaseer, B., Shah, A. J., Ward, L., Raggi, P., Bremner, J. D., Hanfelt, J., Lewis, T., Quyyumi, A. A., & Vaccarino, V. (2019). Psychological distress and subsequent cardiovascular events in individuals with coronary artery disease. *Journal of the American Heart Association, 8*(9), Article e011866. https://doi.org/10.1161/JAHA.118.011866
34. Pitt, J. P., McCarthy, O. M., Hoeg-Jensen, T., Wellman, B. M., & Bracken, R. M. (2020). Factors influencing insulin absorption around exercise in type 1 diabetes. *Frontiers in Endocrinology, 11*, Article 573275. https://doi.org/10.3389/fendo.2020.573275
35. Podstawski, R., Borysławski, K., Clark, C. C. T., Choszcz, D., Finn, K. J., & Gronek, P. (2019). Correlations between repeated use of dry sauna for 4 × 10 minutes, physiological parameters, anthropometric features, and body composition in young sedentary and overweight men: Health implications. *BioMed Research International, 2019*, Article 7535140. https://doi.org/10.1155/2019/7535140
36. Podstawski, R., Boraczyński, T., Boraczyński, M., Choszcz, D., Mańkowski, S., & Markowski, P. (2014). Sauna-induced body mass loss in young sedentary women and men. *The Scientific World Journal, 2014*, Article 307421. https://doi.org/10.1155/2014/307421
37. Saputro, R. E., Chou, C. C., Lin, Y. Y., Tarumi, T., & Liao, Y. H. (2025). Exercise-mediated modulation of autonomic nervous system and inflammatory response in sleep-deprived individuals: A narrative review of implications for cardiovascular health. *Autonomic Neuroscience, 259*, Article 103256. https://doi.org/10.1016/j.autneu.2025.103256
38. Sastriques-Dunlop, S., Elizondo-Benedetto, S., & Zayed, M. A. (2025). Sauna use as a novel management approach for cardiovascular health and peripheral arterial disease. *Frontiers in Cardiovascular Medicine, 12*, Article 1537194. https://doi.org/10.3389/fcvm.2025.1537194
39. Thomas, H., Diamond, J., Vieco, A., et al. (2018). Global atlas of cardiovascular disease 2000–2016: The path to prevention and control. *Global Heart, 13*(3), 143–163. https://doi.org/10.1016/j.gheart.2018.09.511

40. Toro, V., Siquier-Coll, J., Bartolomé, I., Pérez-Quintero, M., Raimundo, A., Muñoz, D., & Maynar-Mariño, M. (2021). Effects of twelve sessions of high-temperature sauna baths on body composition in healthy young men. *International Journal of Environmental Research and Public Health, 18*(9), Article 4458. https://doi.org/10.3390/ijerph18094458
41. Yamasaki, S., Tokunou, T., Kashiwado, Y., Makishi, M., & Horiuchi, T. (2025). Hot spring and sauna use for improving blood lipid profiles: A systematic review and expert consensus on efficacy and recommendations. *Complementary Therapies in Medicine, 94*, Article 103241. https://doi.org/10.1016/j.ctim.2025.103241
42. Zaccardi, F., Laukkanen, T., Willeit, P., Kunutsor, S. K., Kauhanen, J., & Laukkanen, J. A. (2017). Sauna bathing and incident hypertension: A prospective cohort study. *American Journal of Hypertension, 30*(11), 1120–1125. https://doi.org/10.1093/ajh/hpx102
43. Zychowska, M., Półrola, P., Chruściński, G., Zielińska, J., & Góral-Półrola, J. (2017). Effects of sauna bathing on stress-related genes expression in athletes and non-athletes. *Annals of Agricultural and Environmental Medicine, 24*(1), 104–107. https://doi.org/10.5604/12321966.1233977