



DOSSIER · THERAPY

Sauna

The database records a large number of works on sauna, a considerable part of which in humans. The controlled study situation is narrow, but highly cited observational studies shape the picture. The most interesting finding: most statements on **cardiovascular effects** come from observational studies, not from randomised controls.

539

STUDIES IN
TOTAL

235

IN HUMANS

34

OF WHICH
CONTROLLED

1

IN ANIMALS

1

IN THE LAB

Figures from the IHR study database · Last updated 2026-10-04

How to Read This Dossier

ESTABLISHED

measured in humans, with a comparison group

PLAUSIBLE

supported by mechanism, animal studies or observation

HYPOTHESIS

a likely connection that still needs to be tested

Sauna at a Glance

ORIGIN:

Sauna is a thermal procedure in which the body is exposed to controlled dry or moist heat (70–100 °C) to trigger physiological adaptation reactions such as vasodilation, sweating and increased heart rate. Originally from Finland, it is traditionally operated with wood or electric heating; variants such as the infrared sauna use radiant heat at lower temperatures (40–60 °C). The application takes place in cycles of 10–20 minutes, followed by cooling phases and optional rest, with the aim of passive hyperthermia.

EVIDENCE BASE:

539 evaluated papers · 34 controlled human studies · 201 observational studies · 19 review papers · 1 animal study · 0 cell-culture studies

STRONGEST EVIDENCE:

- **Heart and circulation:** In patients with chronic heart failure (CHF), daily infrared-sauna sessions (15 min, 60 °C, 2 weeks) produced significant improvements in heart-rate variability, a reduction in ventricular extrasystoles and a lowering of BNP levels as a preclinical indication of possible cardiac relief. A multicentre study also supplied indications of changes in the cardiothoracic ratio, ejection fraction and left-ventricular diameter.
- **Oxidative stress** In patients with coronary risk factors, repeated infrared sauna (15 min, 60 °C, 2 weeks) led to a significant reduction in the oxidative-stress marker 8-epi-prostaglandin F2α in urine and lowered systolic blood pressure. This supplies an indication of a possible preventive effect against atherosclerosis, yet it is not established as a clinical effect.
- **Safety and tolerability:** In a multicentre study with 188 CHF patients, no serious adverse events occurred under Waon therapy (daily infrared sauna, 2 weeks). NYHA class improved significantly, and cardiovascular parameters such as ejection fraction and cardiothoracic ratio showed positive changes.
- **Metabolism:** The combination of exercise and sauna (15 min, 60 °C) over eight weeks produced greater improvement in cardiorespiratory fitness and a greater fall in systolic blood pressure in participants with cardiovascular risk factors compared with exercise alone. The effect of sauna alone on these parameters remains to be clarified.
- **Inflammatory processes:** Review papers point to potential benefits of heat therapy (e.g. sauna) in type-2 diabetes, including observed reductions in fasting blood glucose, HbA1c and body weight. The underlying mechanisms such as increased heat-shock-protein expression and improved nitric-oxide bioavailability were examined in preclinical studies; their relevance for humans remains to be clarified.

LIMITATIONS:

- The controlled studies on cardiovascular effects are often small (n < 40), with limited blinding and short duration. Causality is frequently unclear, and confounders such as lifestyle or socioeconomic status are rarely fully adjusted for.
- Long-term data on risks such as dehydration, orthostatic dysregulation or effects in vulnerable groups (e.g. severe aortic stenosis) remain to be established. Standardisation of sauna protocols (temperature, duration, frequency) varies widely between studies.
- Acute effects on endothelial function (e.g. flow-mediated dilatation) are not significant, and data on long-term adaptations in risk populations remain to be established. Mechanistic studies on heat-shock proteins or oxidative stress are often preclinical or small; their transferability to humans has not been examined.

CLASSIFICATION:

Sauna is a thermal procedure with observed short-term cardiovascular effects, particularly in chronic heart failure, whose long-term benefit and safety require further controlled studies.

1. What Sauna Is and How It Is Applied

Sauna denotes a **thermal procedure** in which the body is exposed for a limited time in a dry or moist heat environment (usually 70–100 °C). Originally from Finland, the classic sauna is operated by heating stones with wood or electric heat sources. Variants such as the **infrared sauna** use radiant heat at lower temperatures (40–60 °C). Application typically occurs in cycles of 10–20 minutes, followed by cooling phases and optional rest. The aim is **passive hyperthermia** that triggers physiological adaptation reactions, including vasodilation, sweating and increased heart rate.

For research, **standardisation of exposure** is decisive: duration, temperature, humidity and repetition frequency vary widely between studies. While Finnish saunas often operate at high temperature and low humidity, infrared saunas use longer exposure times at lower heat. The **thermal dose** – a product of temperature, duration and body surface area – is rarely defined uniformly. In addition, information on individual factors such as hydration status, acclimatisation or accompanying measures (e.g. fluid replacement) that can influence the results is often missing.

2. What the Studies Show in Detail

The key human studies and the most important reviews — by application area, with population, duration, preparation, measured variable and result as reported in the original papers. Numbers appear only where the work states them.

Distribution of **controlled human studies** by application area — the numbers are not additive, as one paper may be assigned to several areas:

APPLICATION AREA	CONTROLLED STUDIES
Heart and circulation	15
Safety and tolerability	10

APPLICATION AREA	CONTROLLED STUDIES
Uptake and availability	6
Metabolism	4
Musculoskeletal system	4
Inflammatory processes	4
Skin	4
Fatigue and stress	4

Heart and Circulation

In a randomised controlled study with 30 patients (59 ± 3 years) with chronic heart failure (CHF) of NYHA class II or III and at least 200 ventricular extrasystoles (VES) per 24 hours, the effect of repeated sauna applications was examined. The intervention group ($n=20$) received a daily 15-minute infrared dry sauna at 60°C for two weeks, followed by 30 minutes of bed rest with a blanket, on five days per week. The control group ($n=10$) rested for 45 minutes in an air-conditioned room at 24°C . The total number of VES per 24 hours decreased significantly in the sauna group compared with the control group. In addition, heart-rate variability (SDNN) improved from 112 ± 11 ms to 142 ± 10 ms ($p < 0.05$) and the concentration of brain natriuretic peptide (BNP) fell from 419 ± 110 pg/ml to 229 ± 54 pg/ml ($p < 0.05$)¹. The small sample size and lack of blinding should be noted as limitations.

A prospective multicentre study with 188 CHF patients (NYHA class not specified) compared the effect of Waon therapy ($n=112$) with a control group ($n=76$). Waon therapy consisted of daily 15-minute infrared dry-sauna sessions at 60°C , followed by 30 minutes of bed rest with a blanket, over two weeks. Both groups continued their conventional therapy. After two weeks, the Waon group showed a significant improvement in the cardiothoracic ratio ($57.2 \pm 8.0\%$ to $55.2 \pm 8.0\%$, $p < 0.0001$), left-ventricular diastolic diameter (60.6 ± 7.6 mm to 59.1 ± 8.4 mm, $p < 0.0001$), left-atrial diameter (45.4 ± 9.3 mm to 44.1 ± 9.4 mm, $p < 0.05$) and ejection fraction ($31.6 \pm 10.4\%$ to $34.6 \pm 10.6\%$, $p < 0.0001$). No significant changes in these parameters were observed in the control group³. The study was not blinded, and the NYHA classes of the participants were not reported in detail.

A study with 93 participants (52.0 ± 8.8 years, 53.8 % men) with cardiovascular risk factors examined the acute effects of a single 30-minute sauna session (73°C , 10–20 % humidity) on heart rate variability (HRV). The HRV parameters changed significantly ($p < 0.001$) during the sauna and returned nearly to baseline values after 30 minutes of recovery. Resting heart rate fell from 77/min before the sauna to 68/min after recovery. The vagal component of HRV decreased during the sauna, while the cool-down phase after the sauna reduced low-frequency power ($p < 0.001$) and increased high-frequency power ($p < 0.001$), indicating favourable modulation of the autonomic nervous system⁵. The study examined only acute effects and not long-term adaptations.

No significant effects were observed on left ventricular end-diastolic diameter, left atrial diameter or blood pressure. The strength of evidence ranged from moderate to insufficient, and most studies were small ($n < 40$)⁹. **Hypothesis:** The results provide an indication that regular sauna use may improve cardiovascular parameters in CHF patients; however, larger, blinded studies with longer follow-up are required to confirm clinical relevance.

A randomised crossover study with 21 healthy older adults (66 ± 6 years) examined the acute effects of one or two 10-minute Finnish sauna sessions ($80.2 \pm 3.2^\circ\text{C}$, $23 \pm 2\%$ humidity) on flow-mediated dilatation (FMD) of the brachial artery and reactive hyperaemia. No significant changes in FMD were observed after a single sauna session ($4.69 \pm 2.46\%$ to $5.41 \pm 2.64\%$, $p = 0.20$) or two sauna sessions ($4.16 \pm 1.79\%$ to $4.55 \pm 2.14\%$, $p = 0.58$). Reactive hyperaemia also remained unchanged⁷. The study was small and examined only acute effects, so long-term adaptations cannot be assessed. What is missing are studies on the long-term effects of sauna on endothelial function in at-risk populations.

Oxidative Stress

In a randomised controlled study with 28 patients with at least one coronary risk factor, the effect of sauna on the oxidative stress marker 8-epi-prostaglandin $\text{F}_{2\alpha}$ (PGF $_{2\alpha}$) was examined. The sauna group ($n=14$) received a daily 15-minute infrared dry sauna at 60°C for two weeks, followed by 30 minutes of bed rest with a blanket. The control group ($n=14$) received no sauna. After two weeks, systolic blood pressure was significantly lower in the sauna group (110 ± 15 mmHg vs. 122 ± 13 mmHg, $p < 0.05$) and urinary 8-epi-PGF $_{2\alpha}$ concentration fell from 380 ± 101 pg/mg creatinine to 230 ± 67 pg/mg creatinine ($p < 0.0001$)². The study showed that repeated sauna use reduces the oxidative stress marker. Whether this produces clinically relevant effects such as slowing of atherosclerosis remains to be determined. Limitations include the small sample and lack of blinding.

HYPOTHESIS The reduction of the oxidative stress marker by sauna could be a plausible mechanism contributing to cardiovascular benefits. However, studies confirming this effect in larger populations and over longer periods and examining clinical endpoints such as cardiovascular events are still outstanding.

Safety and Tolerability

A prospective multicentre study with 188 CHF patients examined the safety and clinical efficacy of Waon therapy. The control group ($n=76$) continued their usual therapy. No serious adverse events occurred in either group. NYHA class improved significantly in both groups. In the Waon group, the cardiothoracic ratio ($57.2 \pm 8.0\%$ to $55.2 \pm 8.0\%$, $p < 0.0001$) and ejection fraction ($31.6 \pm 10.4\%$ to $34.6 \pm 10.6\%$, $p < 0.0001$) improved³. The study showed improvements in these cardiac measurements in CHF patients undergoing Waon therapy. Limitations include the lack of blinding and the fact that compliance was not systematically recorded.

Only 13 studies were randomised controlled, and many of the controlled studies were small ($n < 40$). Most controlled studies reported positive health effects; however, only one small study ($n=10$) reported a reversible disturbance of spermatogenesis in men. **Hypothesis:** Sauna use appears to be safe for most healthy adults; however, data on long-term effects and specific risk groups, particularly patients with unstable angina pectoris or severe aortic stenosis, are still outstanding.

A randomised study with 24 healthy women examined the pharmacokinetics of a contraceptive patch under various conditions, including daily sauna use. Participants wore the patch for seven days under normal conditions or under conditions such as sauna, whirlpool or physical activity. Mean concentrations of ethinylestradiol (EE) and norelgestromin (NGMN) remained within the therapeutic range during the seven days, and only one patch detached spontaneously (1.1 % of 87 patches). The study therefore provides an indication regarding the concentrations of these two active substances under the conditions examined; clinical endpoints were not investigated. Whether sauna is safe in patients with cardiovascular disease on drug therapy remains to be examined.

Metabolism

Waon therapy, a specific form of heat therapy, led to significant improvements in NYHA class, 6-minute walk distance (6MWD) and cardiothoracic ratio in one study, but not to a significant change in BNP. No serious adverse events were observed. Whether comparable effects also apply to classical sauna use remains to be determined.

A randomised controlled study with 47 participants (49 ± 9 years) with low physical activity levels and at least one cardiovascular risk factor compared the effects of regular exercise alone (EXE) with exercise combined with 15-minute sauna after training (EXS) over eight weeks. The EXS group showed greater improvement in cardiorespiratory fitness ($+2.7$ ml/kg/min, 95 % CI: $+0.2$ to $+5.3$ ml/kg/min) and a greater reduction in systolic blood pressure (-8.0 mmHg, 95 % CI: -14.6 to -1.4 mmHg) compared with the EXE group. Total cholesterol levels also fell in the EXS group ⁴. The study provides an indication that sauna in combination with exercise may offer additional metabolic benefits; however, long-term data on the sustainability of these effects are lacking.

Cognition and Psyche

The intervention group ($n=17$) received sauna sessions twice weekly for eight weeks, while the control group ($n=20$) received only counselling and education. Pain intensity, measured with the numerical pain rating scale (NPRS), decreased significantly in the sauna group by 1.27 points (95 % CI: 0.48 – 2.07 , $p = 0.002$). Sleep disturbances, depression (measured with the Beck Depression Inventory) and the Headache Disability Index (HDI) showed no significant changes ⁶. The study suggests that regular sauna use can reduce pain intensity in CTH; however, data on long-term effects and larger samples are lacking.

Skin

A randomised crossover study with 19 healthy men (26.8 ± 4.6 years) compared the cardiovascular responses to whole-body heat pack therapy (HPTT) with Waon therapy (infrared sauna). HPTT consisted of 15-minute application of heat packs to the back, lower abdomen and popliteal fossae, followed by 30 minutes of bed rest. Both therapies significantly increased radial artery flow velocity and brachial artery diameter, but without significant differences between the methods ¹⁰. The study shows that passive heat applications can produce similar cardiovascular effects to sauna; however, data on long-term adaptations or clinical endpoints are lacking.

Oncology

A longitudinal study with ten normozoospermic men examined the effects of twice-weekly sauna sessions (80 – 90 °C, 15 minutes) over three months on spermatogenesis. After three months of sauna exposure, a significant deterioration in sperm count ($p < 0.001$) and motility ($p < 0.001$) was observed, while hormone levels did not change significantly. Three months after cessation of sauna exposure, the parameters partially normalised but remained below baseline values. The study suggests that repeated sauna exposure can reversibly impair spermatogenesis ¹⁵. **Hypothesis:** Men wishing to have children should possibly refrain from frequent sauna use until further data on reversibility are available. What is missing are studies on the effects of sauna on other reproductive or oncological parameters.

Inflammation

A review article discussed the potential benefits of various forms of heat therapy (e.g. sauna, hot baths) in type 2 diabetes. The authors referred to studies showing a reduction in fasting blood glucose, HbA1c, body weight and obesity through heat therapy. Possible mechanisms mentioned were increased expression of heat shock protein 70 and improved nitric oxide bioavailability. The authors suggested that heat therapy (including sauna: 80 – 100 °C, 15 minutes, three times per week over three months) could be a safe method to support diabetes therapy. **Hypothesis:** The data from the review article indicate anti-inflammatory effects of various heat therapies; however, randomised controlled studies confirming this hypothesis specifically for sauna are still outstanding.

Musculoskeletal System

A review article discussed the potential role of passive heating (e.g. sauna) on muscle contractile function. Acute increases in muscle temperature through passive heating can, in preclinical settings, improve voluntary rate of force development and electrically evoked contraction properties (e.g. time to peak torque, half-relaxation time). Mechanisms mentioned were increased calcium kinetics, calcium sensitivity and increased intramuscular fluid content. **Hypothesis:** Passive heating could improve muscle strength in older adults or rehabilitation patients; however, clinical studies in humans systematically examining these preclinical effects are lacking.

Further Investigations

A randomised controlled study with 23 healthy older adults (68.7 ± 5.9 years) examined the effect of sauna yoga (50 °C) on flexibility, strength and balance. The intervention group ($n=11$) performed sauna yoga for eight weeks, while the control group ($n=12$) performed similar exercises without heat. The sauna-yoga group showed a significant improvement in flexibility in the Chair-Sit-and-Reach test ($+83$ % vs. $+3$ % in the control group, $p = 0.028$) and a trend towards improvement in leg strength ($+16$ % vs. $+3$ %, $p = 0.061$) and balance with eyes closed ($+187$ % vs. $+58$ %, $p = 0.056$) ⁸. The study suggests that sauna yoga can improve physical fitness in older adults; however, data on long-term effects or clinical populations are lacking.

A review summarised the biological effects and medical applications of far-infrared radiation (FIR, 3–12 µm). FIR is used in saunas and special lamps and can trigger cellular and tissue-specific effects. The authors referred to preclinical studies (animal and cell models) that provide indications of possible therapeutic effects in various diseases. However, systematic clinical studies on efficacy and safety in humans are still outstanding.

Overall Picture

The controlled studies available show that sauna applications – particularly in the form of infrared dry sauna at 60 °C – produced effects on heart rate variability, blood pressure and oxidative stress markers (laboratory values) as well as the cardiothoracic ratio in patients with chronic heart failure, cardiovascular risk factors and metabolic diseases. In addition, data suggest that sauna can reduce pain intensity in chronic tension headaches and improve physical fitness in older adults. However, most studies are small, unblinded and often examine only acute or short-term effects. **Hypothesis:** The cumulative effects of regular sauna applications could go beyond the observed acute adaptations, yet long-term studies that systematically investigate this are lacking.

The safety of sauna applications appears to be given for most healthy adults and stable cardiovascular patients; however, there are indications of reversible impairments of spermatogenesis in men and potential risks in unstable cardiovascular diseases. The data on specific risk groups (e.g. patients with severe aortic stenoses or on certain medications) are insufficient. What is missing are large-scale, blinded studies with clearly defined clinical endpoints and longer follow-up periods.

Methodology of the Study Situation

[‘The controlled studies on sauna applications comprise randomised or prospective cohort studies with small samples (mostly $n < 50$). Typical intervention durations range between two and eight weeks, with sauna applications usually carried out daily or several times a week for 15–30 minutes at temperatures between 50 °C and 80 °C. Frequently measured endpoints include cardiovascular parameters (e.g. blood pressure, heart rate variability, ejection fraction), metabolic markers (e.g. BNP, oxidative stress), physical fitness (e.g. 6-minute walk distance, flexibility) and subjective parameters (e.g. pain intensity, quality of life). Systematically missing are blinded studies, long-term data (> 6 months), studies on specific risk groups (e.g. patients with severe cardiovascular diseases) and comparative studies on different sauna forms (e.g. Finnish sauna vs. infrared sauna).’]

Observational Studies Shape the Picture – But What Do They Really Say?

The most frequently cited works on sauna are

OBSERVATIONAL STUDIES

that report **associations** between regular sauna bathing and health outcomes. The two most influential studies show an association with **lower cardiovascular mortality** and **improved endothelial function**. These findings are often interpreted as **proof of effect**, but they are **not evidence of causality**. Observational studies cannot rule out confounding factors such as physical activity, diet or access to medical care. In addition, a **dose-response relationship** is lacking: whether more frequent or longer sauna sessions enhance the effects remains unclear.

The

CONTROLLED STUDIES

are methodologically more robust, but limited in number and scope. Most examine **acute effects** (e.g. on blood pressure or vascular function) or **short-term interventions** (e.g. 4–12 weeks). Long-term data are almost completely absent. Another problem is **publication bias**: negative or neutral results on sauna are published less frequently, which can distort the overall picture. The **reviews** emphasise the **cardiovascular benefits**, yet themselves point to the **still growing body of studies** and the **need for randomised long-term studies**.

3. How Robust the Research Is

Research on sauna is distributed across **basic research** and **human studies**, with the latter predominantly observational and only a small proportion comprising controlled studies. The controlled studies available focus on **cardiovascular effects**, followed by safety aspects, metabolism and inflammatory markers. The most frequently cited controlled works originate from Japan (“Waon therapy”) and Finland, with a focus on **chronic heart failure** and **vascular function**. Observational studies dominate the evidence on **mortality and long-term effects**, while mechanistic reviews frequently address **heat shock proteins** and **endothelial function**.

The **methodological robustness** of the studies is heterogeneous. Controlled works are often small and short-term, with limited blinding (practically impossible with thermal procedures). Observational studies show **associations**, but cannot prove causality – confounders such as lifestyle or socioeconomic status are rarely fully adjusted. **Reproducibility** suffers from missing standards: sauna protocols vary, and transferability between Finnish sauna, infrared sauna or “Waon therapy” is unclear. In addition, long-term data on **risks** such as dehydration or orthostatic dysregulation are lacking, particularly in vulnerable groups.

4. What Is Frequently Claimed — And What the Data Support

STATEMENT	STUDY SITUATION
Sauna lowers blood pressure permanently	Controlled studies show acute blood pressure reductions after sauna sessions, but no robust data on long-term effects . Observational studies indicate associ
Sauna improves athletic performance	Individual studies report short-term adaptations (e.g. improved thermoregulation), but no controlled work shows long-term performance improvements . The r
Infrared sauna is more effective than Finnish sauna	There are no direct comparative studies between the methods. Mechanistic work suggests that infrared penetrates deeper into the tissue, but clinical differen
Sauna detoxifies the body	Sweating leads to the excretion of electrolytes and trace metals , but no study shows relevant detoxification of harmful substances. The assumption is not scie

5. The Most Robust Works

Ordered by strength of evidence, not by prominence. The complete evaluation comprises considerably more works; the most robust ones are presented here.

Controlled Studies in Humans

- ¹ Effects of repeated sauna treatment on ventricular arrhythmias in patients with chronic heart failure (2004)
- ² Repeated sauna therapy reduces urinary 8-epi-prostaglandin F(2alpha) (2004)
- ³ Beneficial effects of Waon therapy on patients with chronic heart failure: results of a prospective multicenter study (2008)
- Clinical Effects of Regular Dry Sauna Bathing: A Systematic Review (2018)
- Waon Therapy for Managing Chronic Heart Failure – Results From a Multicenter Prospective Randomized WAON-CHF Study (2016)
- Pharmacokinetics of norelgestromin and ethinyl estradiol delivered by a contraceptive patch (Ortho Evra/Evra) under conditions of heat, humidity, and (2001)
- ⁴ Effects of regular sauna bathing in conjunction with exercise on cardiovascular function: a multi-arm, randomized controlled trial (2022)
- ⁵ Recovery from sauna bathing favorably modulates cardiac autonomic nervous system (2019)
- ⁶ Efficacy of regular sauna bathing for chronic tension-type headache: a randomized controlled study (2015)
- A crossover control study of three methods of heat acclimation on the magnitude and kinetics of adaptation (2022)
- ⁷ Acute effect of Finnish sauna bathing on brachial artery flow-mediated dilation and reactive hyperemia in healthy middle-aged and older adults (2019)
- Sauna as a therapeutic option for cardiovascular disease (2004)
- Safety, acceptance, and physiologic effects of sauna bathing in people with chronic heart failure: a pilot report (2009)
- ⁸ Sauna Yoga Superiorly Improves Flexibility, Strength, and Balance: A Two-Armed Randomized Controlled Trial in Healthy Older Adults (2019)
- Pharmacokinetics and adhesion of the Agile transdermal contraceptive patch (AG200-15) during daily exposure to external conditions of heat, humidity a (2013)
- ⁹ Effects of sauna bath on heart failure: A systematic review and meta-analysis (2018)
- Effects of a Finnish sauna on the pharmacokinetics and haemodynamic actions of propranolol and captopril in healthy volunteers (1995)
- ¹⁰ Cardiovascular reactions for whole-body thermal therapy with a hot pack and Waon therapy (2020)
- ¹¹ Preliminary clinical experience with waon therapy in Korea: safety and effect (2010)
- Effects of heat exposure in a Finnish sauna on the pharmacokinetics and metabolism of midazolam (1996)
- ¹² No effects of a 4-week post-exercise sauna bathing on targeted gut microbiota and intestinal barrier function, and hsCRP in healthy men: a pilot rando (2022)
- ¹³ Hematological Adaptations to Post-Exercise Sauna Bathing With No Fluid Intake: A Randomized Cross-Over Study (2022)
- ¹⁴ Infrared sauna as exercise-mimetic? Physiological responses to infrared sauna vs exercise in healthy women: A randomized controlled crossover trial (2022)
- A Detoxification Intervention for Gulf War Illness: A Pilot Randomized Controlled Trial (2019)

6. Summary

The controlled studies available show primarily short-term cardiovascular effects of sauna applications, particularly in patients with chronic heart failure. Regular infrared or Finnish sauna led in these works to improvements in heart rate variability, reduction of ventricular extrasystoles, lowering of BNP levels and positive changes in structural heart parameters such as ejection fraction and cardiothoracic ratio. In addition, they provide indications of a reduction in oxidative stress and a lowering of systolic blood pressure in risk populations. The safety of the application is well documented in stable CHF patients, with no serious adverse events in the studied collectives. Combined with exercise, sauna appears to offer additional metabolic benefits, such as improved cardiorespiratory fitness and more favourable cholesterol levels.

HYPOTHESIS The observed effects could be due to mechanisms such as improved endothelial function, increased expression of heat shock proteins and modulation of the autonomic nervous system. A reduction in oxidative stress, which is reflected in reduced markers such as 8-Epi-PGF2 α , also appears plausible. Should these hypotheses be confirmed in larger studies, sauna could be established as a supportive measure in cardiovascular diseases, metabolic syndrome or chronic inflammatory conditions. However, individual findings indicate reversible impairments of spermatogenesis, which should be taken into account in men wishing to have children. In addition, it remains unclear whether the effects are limited to acute adaptations or persist in the long term.

To clarify the clinical relevance of sauna, larger, blinded long-term studies with standardised protocols (temperature, duration, frequency) and clearly defined endpoints are necessary. Particularly urgent are investigations into long-term effects on endothelial function, mortality and cardiovascular events in risk populations. In addition, data on safety in unstable cardiovascular diseases (e.g. unstable angina pectoris) or under drug therapy are lacking. Mechanistic studies should further elucidate the role of heat shock proteins, oxidative stress and autonomic adaptations. Finally, a systematic recording of risks such as dehydration or orthostatic dysregulation in vulnerable groups (e.g. older patients) would be desirable in order to define contraindications more precisely.

7. What Remains Open

- **Long-term effects:** Are there demonstrable benefits or risks with decades of regular use?
- **Dose-response relationship:** How do temperature, duration and frequency relate to physiological effects?
- **Vulnerable groups:** What risks exist for patients with cardiovascular diseases or older people?

Frequently Asked Questions

Can sauna be used in chronic heart failure?

The **controlled studies** on "Woon therapy" (Japanese variant with milder heat) were investigated for **improvement of heart function** and **symptom relief** in chronic heart failure; the results are inconsistent. However, the data come from small, short-term studies with specific protocols. **Safety data** are lacking for other sauna forms or longer applications. Patients should be **medically monitored**, as heat exposure can promote **orthostatic dysregulation** or **fluid loss**.

How does sauna affect inflammatory markers?

Individual controlled studies report **reductions in proinflammatory markers** (e.g. 8-epi-prostaglandin F2 α) after repeated sauna use. However, the study situation is **still developing and heterogeneous**: other studies show **no significant effects**. In addition, long-term data are lacking, and the **clinical relevance** of the marker changes is unclear.

Is sauna safe for pregnant women?

There are **no controlled studies** on the safety of sauna during pregnancy. Observational data suggest **possible risks** such as **hyperthermia** or **orthostatic problems**, especially in the first trimester. Professional societies advise **caution against sauna sessions** until reliable data are available.

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Research, put in context. Every statement leads to the original paper; the decision in the individual case rests with the treating professional.
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