

Benefits of sauna on lung capacity, neurocognitive diseases, and heart health

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Abstract

Sauna refers to passive heat therapy that involves exposure of the body to a high-temperature environment for an appropriately short period, contingent on the therapy's purpose. Ideally, the therapy aims to raise the internal body temperature by a few degrees, and its effect happens in two phases. The first phase occurs during the first ten minutes, encouraging the body to perspire while maintaining a temperature of around 98.6 degrees. The extra heat is dispersed by increased blood circulation, blood pushing on the skin's surface, and sweating. The body enters the second phase after 10-30 minutes in the sauna. During this period, the body cannot disperse the sauna heat, thereby increasing the body temperature. In return, the heart rate and sweating increase.

There are four different types of saunas. These include traditional saunas, usually heated with wood-burning stoves, rocks, or an electric coil. Far-infrared saunas are usually heated by metallic or ceramic elements that produce a small spectrum of light, referred to as far-infrared. Infrared lamp saunas are heated using heat lamps that produce radiant heat. The last type is steam saunas, traditionally heated, but water increases the humidity and air temperatures. During sauna therapy, the heart rate of an individual increase from the standard range up to 120 or 150 beats per minute. Unlike physical activity, sauna therapy does not involve any active function of the skeletal muscles. Even though skeletal muscles are inactive during a sauna session, blood volume is partially redirected to the internal organs' exterior body parts due to decreased venous return.

Sauna therapy assists in liberating toxins piled in our tissues, facilitating lymph and blood circulation and strengthening one's immune system. Sauna bathing has mainly been used for purposes of relaxation and pleasure. Today, the activity is increasingly becoming popular as a form of treatment therapy. Several pieces of evidence claim that sauna bathing has numerous health benefits, including hemodynamic regulation processes, reduced risk of vascular diseases, cardiovascular disease, neurocognitive diseases, mortality, pulmonary diseases, stabilized arterial blood pressure, and enhancement of conditions such as flu, headache, and arthritis. However, response to stress from heat can increase muscle blood flow. This report will precisely explore the benefits of sauna bathing on lung capacity and heart health for people with cardiovascular, lung-related or respiratory-related, and neurocognitive diseases.

Keywords: Sauna; Lung capacity; Cognition; Stroke; Heart Health; Pain

1. Introduction

What if there were a way to improve cardiovascular and respiratory function, brain activity in neurocognitive conditions, and musculoskeletal pain conditions without doing any physical movement? Well, there may be such a way. Finnish sauna has been around for centuries, and history tells us that the benefits are numerous. But what does the science say so far? The documented research suggests that you can improve heart health and cognition, reduce musculoskeletal

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symptoms resulting from brain injuries and reduce chronic pain. How all this can be achieved will be described in this article.

2. Benefits of Sauna Bathing in Cardiovascular Diseases

Evidence suggests that repeated exposure to sauna therapy increases the fraction of the left ventricular ejection and decreases the brain's natriuretic and norepinephrine plasma levels. Further, repeated exposure to sauna therapy has been found to reduce diastolic blood pressure. Immersion in warm water, another type of passive heat therapy, has been linked with specific health benefits such as improvement in microvascular and endothelial functions as well as a reduction in stiffness of arteries and reduced blood pressure. In people who live a sedentary lifestyle, passive heat therapy has been found to enhance cutaneous microvascular function (Brunt et al., 2016a). This usually occurs through the enhancement of nitric-oxide-dependent dilation. Exposure to sauna therapy causes a rise in core temperatures. It changes circulatory hemodynamics, such as the vascular shear stress and cardiac output, which mirror the effects of physical activity. As such, sauna therapy may be used as an alternative means of health improvement (Brunt et al., 2016b).

Laukkanen et al. (2018) highlights that in an infrared sauna exposure trial conducted for two weeks and once per day in patients with cardiovascular risk factors, there was a significant improvement in the flow-mediated endothelium-dependent dilation. Shui et al. (2015) explain that exposure to far-infrared therapy (FIR) rays provide protective effects on CVD. Further, the research states that exposure to sauna therapy for several weeks can enhance the brachial artery flow-mediated endothelium-dependent dilation. The enhanced dilation is associated with increased tolerance to cardiopulmonary exercise. In most cases, patients with conditions such as hypertension, diabetes mellitus, obesity, hypercholesterolemia, and patients who smoke experience endothelial dysfunction. As such, sauna therapy provides a therapeutic role for patients and those with coronary risk factors as it improves the vascular functions of the endothelium (Shui et al., 2015).

Nonetheless, evidence to support the therapeutic effects of Finnish sauna bathing on cardiac function attributed to reduced risk of CVDs is still lacking. Exposure to sauna improves vascular compliance, evident in patients with CVD risk factors, indicating the protective character of the sauna's heat therapy on arterial stiffening. Increased ambient temperature due to passive heat therapy also reduces blood pressure. Even though sauna therapy can be well endured, evidence demonstrates that the sessions could trigger myocardial ischemia in patients with existing coronary artery disease.

Evidence shows that the endothelial nitric oxide synthase (eNOS) highly influences endothelial function, which catalyzes nitric oxide (NO) in the endothelium and the amino acid L-arginine into L-citrulline. As an essential vasodilator substance, NO inhibits atherosclerosis progression by inhibiting some arterial disorders (*i.e., platelet aggregation and smooth muscle cell proliferation*) and dilating blood vessels. As such, sauna bathing improves cardiovascular functions by improving various critical aspects of the body, these include the cardiorespiratory system, modulation of the autonomic nervous system, endothelium-dependent dilation, the variation in the circulating lipid profiles, as well as reduction of arterial stiffness, oxidative stress, and the systemic blood pressure.

Highlighted experiments evidence of the beneficial effects of systemic blood pressure and arterial stiffness by Laukkanen et al. (2018) and Lee et al. (2018). The research involved 100 individuals between 32 and 75 years; after a thirty-minute sauna bathing session, it was identified that at least a single cardiovascular risk factor had been reduced in diastolic and systolic blood pressures. Further, favorable variations in arterial compliance or stiffness (*i.e., the pulse wave velocity*) in the patients were recorded. The patients' mean carotid-femoral velocity pulse wave was recorded as 9.82 ± 4 m/s before the heat therapy session, which was reduced to 8.61 ± 6 m/s instantly after the heat therapy session. Further, the mean systolic blood pressure reduced from 137 ± 16 to 130 ± 14 mm Hg after exposure to sauna therapy. On the other hand, the diastolic blood pressure reduced from 82 ± 10 to 75 ± 9 mm Hg after exposure to sauna therapy.

Zaccardi et al. (2017) conducted a prospective cohort study involving 1621 male participants aged 42-60 to evaluate the association between sauna bathing and hypertension. The research's findings demonstrated that the men who undertook four to seven sauna sessions in a week had approximately 47 percent reduced probability of developing hypertension if the routine is maintained for at least 24 years. From Tsai & Hamblin's (2017) article, it has been demonstrated through experimenting with hamsters with cardiomyopathy, and it was established that vascular endothelial dysfunction in the hamsters improved after IR sauna therapy. The hamsters were treated through subjection to a 15-minutes daily IR sauna session. After four weeks, their arterial endothelial nitric oxide mRNA synthase and production of nitric oxide significantly increased compared with other normal controls. This is essential knowledge as vascular endothelial dysfunction is induced by chronic heart failure (Tsai & Hamblin, 2017).

In a study by Iiyama et al. (2008), it is highlighted that after 15 minutes of LTSB exposure at 60°C, patients with chronic heart failure improved their cardiac functioning. Further, repeated sauna therapy sessions improved the left ventricular ejection fraction, increasing their six-minute walk distance in correlation with the improvement in flow-mediated dilation. Also, there was a heightened quantity of circulating CD34 (+) cells, declined norepinephrine plasma levels, and brain natriuretic peptide. This experiment demonstrates that sauna therapy improved exercising tolerance due to improved endothelial function. Additionally, the patient's total and low-density lipoprotein cholesterol concentration levels were reduced after the LTSB session. On the other hand, the high-density lipoprotein cholesterol levels increased. These positive changes are beneficial for ischemic heart disease prevention.

To evaluate the sauna's long-term benefits, Laukkanen et al. (2018) conducted a cohort study that involved healthy Finnish men aged 42-60. From their study, out of the 2315 participants, men who undertook four to seven sauna sessions in a week, and maintained a higher frequency as well as the duration of sauna bathing for 20.7 years, demonstrated reduced risks of fatal coronary heart disease and cardiovascular disease as well as sudden cardiac death.

It is essential to understand that even a single session of sauna heat therapy induces variations in the cardiovascular system's autonomic control in patients with untreated high blood pressure. This is evidenced by declined parasympathetic and increased sympathetic drive (Gayda et al., 2012)

3. Sauna Benefits on Neurocognitive Diseases

Neurocognitive disease's etiology is multifactorial, I.e., inflammation, oxidative stress, and impaired cardiovascular, which are postulated to be critical contributors to high systemic blood pressure with heightened levels of major cardiovascular risk factors as well as the disease's pathogenesis. Several upcoming pieces of evidence affirm that sauna heat therapy's protective properties on neurocognitive disease. For instance, Laukkanen et al. (2018) conducted a cohort study that involved healthy Finnish men aged 42-60. From their study, out of the 2315 participants, men who undertook four to seven sauna sessions in a week had 65 percent and 66 percent reduced risks of getting Alzheimer's and dementia conditions, respectively, compared to their counterparts who undertook a single session per week.

In addition, through transcranial near-infrared laser (808 nm), cerebral blood flow is promoted, and nitric oxide levels are increased (Uozumi Y et al., 2010). The article further suggests that the IR laser promotes cerebral circulation and reduces apoptotic cell levels in the hippocampus. This is usually achieved through nitric oxide release and neuroprotective pathways activation from laser IR exposure. However, it is yet to be established or understood whether exposure to sauna influences the neurocognitive protective effects through pathways mediations that contribute to these disorders or whether it is just a relaxing recreational activity that prevents or delays the progress of these mental health conditions.

Several hypotheses attempt to explain the neuronal process degeneration in Parkinson's disease. These include; cytoplasmic inclusions, surviving neurons' unusual alpha-synuclein-positive axonal swellings, and reduced dopaminergic neuron levels in the substantia nigra (Tsai & Hamblin, 2017). In an attempt to establish a further understanding of the degeneration process, Trimmer PA et al. (2009) conducted research to assess the decreased axonal transport induced in Parkinson's disease. Neurons exchanging their mitochondria with infected mitochondria acquired from different cells are called cybrids. The mitochondrial movement velocity in human trans mitochondrial cybrid neuronal cells (*extracted from patients with Parkinson's disease*) was measured during an 810 nm laser treatment session. The speed of mitochondrial movement in Parkinson's syndrome cybrid neurites increased after a two-hour IR radiation exposure. The research, therefore, suggested that IR laser exposure treatment inhibits neurodegenerative symptoms in Parkinson's syndrome patients.

Again in another study, Trimmer PA et al. (2009) used variant doses of 808 nm to treat Alzheimer's amyloid- β protein precursor transgenic in mice thrice a week. From the transcranial laser therapy, the mice's amyloid-beta peptide neuropathology in amyloid-beta protein precursor transgenic is attenuated. In addition, the experiment showed that the brain's amyloid- β plaques, plasma amyloid- β peptide, cerebrospinal fluid amyloid- β peptide, and the amyloid- β peptide quantities significantly decreased as a result of IR laser exposure treatment; in proportion to dosage administered. Further, ATP generation induced through IR laser inhibited amyloid plaque formation and enhanced neuronal preservation (Tsai & Hamblin, 2017). This research suggested that IR radiation could induce the promotion of cell visibility as well as its growth factors. These changes elicit specific therapeutic effects on degenerative brain illnesses and disorders such as stroke, Parkinson's syndrome, and Alzheimer's. The IR induced ATP synthesis and anti-apoptosis. Anti-inflammatory effects and growth factor production. Also, the session positively influenced the disease's treatment (Hamblin, 2016).

Additionally, Wang Y et al. (2017) researched the effects of 980nm and 810nm IR radiation stimulation on ATP synthesis/production. The study argues that the proliferation and adipose-derived stem cell differentiation were controlled by the 980nm Infrared Radiation which is identified as influencing the temperature-gated calcium ion channels. On the other hand, 810 nm Infrared Radiation stimulated ATP synthesis through CCO photons absorption.

Iiyama et al. (2008) conducted a comparative study before and after the experiment. In the experiment, the researchers examined the clinical effects and hemodynamics of a single session Low-Temperature Sauna Bath (LTSB) exposure in patients with cerebral palsy who also have a history of cardiac dysfunctions. LTSB involves bathing at sixty degrees Celsius for fifteen minutes. The experiment involved sixteen patients aged between 19-53 years and challenged with severe intellectual and motor disabilities. A noninvasive technique was utilized to investigate the peripheral and systemic circulatory variation before and after exposure to Low-Temperature Sauna Bath.

Further, blood-flow-velocity assessment measured the resistive indexes and the pulsatile of the patient's lower limbs and peripheral arteries. After the LTSB session, the patient's blood pressure slightly decreased, heart rates increased, and deep body temperatures rose significantly by one degree Celsius (Iiyama et al., 2008). In general, the patient's cardiac output rose by 14%, while their total peripheral resistance declined by 11%. In addition, the patients experienced a significant improvement in parameters that indicated the peripheral circulatory status. This included; blood flow velocity, skin blood flow, resistive index, and pulsatile index. Further, chronic myalgia and numbness of the extremities declined, and the patients never experienced any adverse side effects. The experiment concluded that the cerebral palsy patients' peripheral circulation improved after their LTSB session (Iiyama et al., 2008).

4. Benefits of Sauna on Lung-related and Respiratory Illnesses

Several studies have argued that saunas help airway obstruction and lung capacity in COPD patients (Kunutsor et al., 2017). In a recent study, Kunutsor et al. evaluated and confirmed whether repeated heat therapy assists COPD patients. To effectively compare the effects of heat therapy, the research entailed a 140-degree sauna session for fifteen minutes, then an additional 30 minutes, during which the patient sat in warm blankets. This was repeated daily for five days a week and accumulated to 20 sessions. In addition, the patients were also subjected to a conventional therapy session that also included medications. Another cohort was only subjected to conventional therapy. After four weeks (20 sessions), the cohort subjected to heat therapy showed a significant change in forced expiratory volume and vital capacity than the other cohort. Although this research demonstrates that repeated heat therapy improves airway obstruction for patients with COPD, more research must be done to establish a concrete understanding and back up this argument. Nevertheless, several articles have documented that the sauna's heat therapy ability to reduce oxidative stress explains its ability to reduce the risk of respiratory illnesses. Further, the sauna's bath-associated heat could directly benefit lung functioning and tissues by decreasing pulmonary congestion and increasing forced expiratory volume, vital capacity, tidal volume, and ventilation (Kunutsor et al., 2017).

Laukkanen et al. (2018) explored the association of sauna therapy with pulmonary function. The study involved twelve male patients with obstructive pulmonary illness. The results demonstrated that sauna therapy affected a transient improvement in lung function and improved breathing among patients infected with chronic bronchitis, pneumonia, or asthma. Janyacharoen et al. (2009) highlight that patients with chronic bronchitis or asthma reported that sauna heat therapy improved their breathing. Additionally, in another controlled experiment, 12 patients with obstructive pulmonary disease were subjected to sauna sessions as a phase of their rehabilitation program. After the program, the patients demonstrated improved lung functioning, while the cohort under the same program but without sauna therapy revealed no such changes (Janyacharoen et al., 2009).

Pneumonia is an inflammatory illness of the lung tissue, usually resulting from viruses or bacteria. It is the primary cause of death among chronic obstructive pulmonary disease (COPD) patients and asthma (Kunutsor et al., 2017). To assess the relationship between the frequency of sauna therapy and the risk of pneumonia, Kunutsor et al. (2017) conducted a research experiment that featured participants who were part of the Kuopio Ischemic Heart Disease (KIHD) risk factor study. The sample involved 2210 Finnish Caucasian men aged between 42 and 61 years. The participants were assessed using Cox proportional hazard models concerning the frequency of sauna bathing sessions in a week (i.e., ≤ 1 , 2-3 & ≥ 4). From this assessment, increased sauna bathing frequency was noted to be independently linked with a declined risk of pneumonia infection. These results were consistent with a graded-dose reaction pattern and were persistent even after adjustment for various pneumonia's major risk factors. Inflammatory processes are identified to be involved in pneumonia's pathogenesis. Oxidative stress is a known pathogenic mechanism that underlies the development of inflammatory lung diseases like pneumonia. Therefore, exposure to sauna heat therapy influences pneumonia's pathogenesis through oxidative stress reduction. Sauna's direct effects on lung tissues and the airways include lung functioning, ventilation improvement, and pulmonary congestion reduction (Kunutsor & Laukkanen,

2021). As such, Kunutsor et al. (2017) assessment suggests that frequent sauna baths p/wk are linked with a declined risk of pneumonia infection among middle-aged men. Nevertheless, further rigorous research is required to confirm these findings and establish additional potential protective effects of sauna therapy on pneumonia infection (Kunutsor et al., 2017). As such, today, immense research studies are being conducted by various researchers to affirm the discussed findings on the therapy's health benefits and to cement these discussed findings for more intense use in treatment centers (Kunutsor & Laukkanen, 2021).

Nonetheless, it is important to note that even though sauna sessions offer health and therapeutic benefits, they also pose certain risks, such as significant blood pressure variations, dehydration, and sweating, which could heighten itching among patients with atopic dermatitis. Even though very few sudden deaths or acute myocardial infarctions occur in saunas, the therapy poses an uncertain reaction to patients with old myocardial infarction or coronary heart disease with stable angina pectoris. Therefore, if one has a lung or heart-related condition, it is critical to consult a healthcare provider before engaging in sauna therapy. It is also critical to note that alcohol consumption during sauna sessions heightens the risk of arrhythmia, hypotension, and sudden death; as such, it must be avoided (Kukkonen-Harjula, & Kauppinen, 2006).

5. Conclusion

It is, therefore, evident that accumulating findings from several researchers' experiments have echoed that sauna bathing is a habit recommended for patients with certain lung-related respiratory system illnesses, as well as heart and brain dysfunctions since it alleviates suffering as well as prevents the risk of both chronic and acute lung conditions. In addition, it also provides other remarkable health benefits. Nonetheless, sauna heat therapy should be sensibly administered for a specific period and frequency to realize the optimum benefits and avoid the adverse reactions mentioned in the paper. In conclusion, sauna therapy is simple yet very effective in improving a patient's health with insignificant adverse effects. As such, with the increasingly piling evidence from numerous researchers and journals, it is easy to agree with heart specialist Rita Redberg who says, "Time spent in the sauna is time well spent."

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest.

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