

Research article

Clinical Applications and Biological Effects of Sauna Bathing – a Narrative Review

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Abstract: Background: Regular sauna exposure has been shown to positively influence clinical symptoms in various pathologies. The purpose of this review is to present the evidence accumulated so far in order to evaluate the efficiency, effects, benefits and risks of sauna therapy in the field of various pathologies that require medical rehabilitation. **Methods:** A literature search was conducted on Publons and PubMed databases from January 2000 onwards. The studies selected for this review included research in humans undergoing repeated sauna sessions with at least one reported health outcome. **Results:** Constant application of sauna therapy has visible effects on improving cardiac activity, endothelial function, myocardial perfusion, ventricular arrhythmia. Sauna treatment is a safe procedure for patients with cardiovascular, respiratory, musculo-skeletal pathologies, with no notable side-effects. **Conclusions:** Sauna therapy has proved its effectiveness in medical rehabilitation treatment starting from the musculoskeletal system and skin to the nervous system. In addition, it brings a significant improvement in the quality of life of patients.

Keywords: sauna bathing, dry sauna, regular sauna exposure, clinical applications sauna, biological effects sauna, quality of life,

1. Introduction

In Scandinavian regions, sauna bathing has been known and used for hundreds of years as a standard health-promotion treatment [1]. Being a Finnish tradition, the sauna was and is used mainly for general relaxation and detoxification of the body. Beyond these purposes, sauna has also been associated with many other health benefits. Studies have demonstrated an extremely beneficial effect in people with cardiovascular pathologies, such as congestive heart failure or hypertension, but it has also demonstrated its beneficial effects in patients with myocardial infarction [2,3]. In addition, the sauna is also recognized as a physiotherapeutic method and is also beneficial in different pathologies of the respiratory system [4]. Additionally, recent studies have shown that periodic sauna treatment has positive effects on chronic pain but successfully treats both arthritis and joint pain [5].

Regular sauna exposure has been shown to positively influence clinical symptoms, hemodynamic markers, and cardiac function in patients with known hyperlipidemia, hypertension, obesity, diabetes, and smokers. The beneficial effect of sauna on endothelial dys-

function represents the preventive role in treating atherosclerosis. In normal-weight patients with decreased/loss of appetite, sauna therapy improved this behavior, and in obese patients, body fat mass decreased significantly, whilst sauna can be considered as a promising therapy for this categories of patients [6].

The thermal effects represent the basis of the whole process both through the hyperemia effect and through the hot-cold alternation. Being known as a hydro-thermo-therapy procedure, the sauna offers a wide range of beneficial effects on important systems: cardiovascular, neurological, musculoskeletal and also on the skin. The sauna is approached as a medical rehabilitation procedure, to improve and/or complete a healthy lifestyle [4-6].

The purpose of this review is to present the evidence accumulated so far in order to evaluate the efficiency, effects, benefits and risks of sauna therapy in the field of various pathologies that require medical rehabilitation (in several age categories). By following in detail the studies, we can better understand the mechanisms of action, see the benefits and recommend sauna bathing therapy to all patients whose pathologies fold on the benefits brought by this treatment.

2. Materials and Methods

A literature search was conducted on Publons and PubMed databases, using keywords and combination of keywords: finnish sauna / sauna bath / heat / body temperature / repeated thermal therapy / heart failure / hypertension / Alzheimer / stroke / chronic pain / chronic fatigue / inflammation and oxidative stress / psychotic disorders / venous thromboembolism.

Studies of humans undergoing repeated sauna bathing that reported on health measures were included in the review. Studies were included for initial review if they were published in English from January 2000 onwards and involved research in humans undergoing repeated sauna sessions with at least one reported health outcome. Studies involving high-humidity wet/steam "sauna" or immersion hydrotherapy were excluded.

After searching the Publons and PubMed databases for keywords, we analyzed a total of 903 studies and after reading the title, 786 studies were excluded, including duplicates. Most of the studies excluded were based on: the analysis of dermatological pathologies transmissible in the sauna; various infections; effects on hemophilia, metabolic effects on body weight. Other issues related to the exclusion concerned studies regarding the sauna as an environmental pollutant.

After a first exclusion, a number of 117 studies were submitted to the analysis criteria. Most of the excluded studies promoted the beneficial effects obtained only after a single sauna session, and other studies focused primarily on the application of other thermotherapy procedures in which the sauna was only occasionally mentioned; other studies were excluded because they were conducted in children and animals.

Following this selection, only 36 studies met the analysis requirements.

3. Results

Most studies conducted used the infrared sauna and measured different outcomes in patients with various cardiovascular pathologies. Results show that daily usage of infrared sauna can have a visible effect on improving cardiac activity, endothelial function, myocardial perfusion, ventricular arrhythmia and, implicitly, the quality of life of patients with preexistent cardiovascular diseases [7-9]. Following repeated sauna treatments, positive changes were recorded in terms of cardiovascular parameters. At the same time, the scores for the quality of life assessment improved [10].

Moreover, endothelial function recorded a decrease in blood pressure and vascular resistance at a systemic level, and the concentration of natriuretic peptides (BNP) also decreased, this being an indicator of great importance regarding the future of patients with cardiac pathology. Thus, the decrease in BNP was associated with a significant improvement in blood flow, that was directly correlated with improvement in peripheral circulation and clinical symptomatology [7]. As for myocardial perfusion dysfunctions, these values have been reevaluated; it also increased the body's resistance to effort, increased

exercise time (treadmill exercises). Scores related to the calculation of the stress level registered a significant decrease [8]. Ventricular tachycardia and the value of premature ventricular contractions decreased significantly, while increases in BNP levels and increases in cardiac output have been reported [9-13].

Regarding the safety of application, several studies have evaluated whether sauna therapy could have unwanted adverse effects in patients with cardiovascular disease. It was concluded that sauna treatments were well tolerated by the patients included in the studies and led to the modification of increased clinical parameters in a positive manner. Given this data, it can be assumed that sauna treatment is a safe procedure for patients with cardiovascular pathologies. More importantly, the number of hospitalizations (related to the case groups) was significantly reduced, as reported by different authors [14-16].

If some studies analyzed the benefits and effects of sauna treatment on cardiovascular diseases, other studies analyzed the possibility of a relationship between the duration and frequency of the sauna and death due to cardiovascular pathology. Results show there were fewer cases of cardiac death in the case groups than in the non-exposed groups with sauna, as hospitalization or rehospitalization rate registered a noticeable decrease [17]. Additionally, it was shown that with weekly supplementation of the sauna sessions, the risk of cardiovascular mortality was reduced, and that the frequency and the duration of the sessions are inversely proportional to deaths due to cardiovascular etiology [18].

From the scientific databases, following the same pathological line, two studies could be identified that calculate the risk of developing a circulatory pathology. Following the presentation of the results, through the adjustments made (to BMI, lifestyle, age, sex, alcohol, AHC), sauna treatment carried out regularly was the cause that led to a low risk of diseases of systemic circulatory system, like hypertension (251 cases were recorded) and pulmonary thromboembolism (146 events were recorded). It remains necessary to carry out additional studies grouped by different age groups to conclude the effects of treatment with sauna on the cardiovascular system [19,20].

Four studies looked at the possibility of an association between the risk of developing certain neurological pathologies and the frequency of sauna sessions, while two studies looked at validating the effects of the sauna in improving the general condition and reducing chronic headache. The results showed a significant improvement of the applied parameters as well as the reduction of pain in the case groups. In terms of pain duration, sleep deprivation and onset of depression, no significant changes were recorded and there were no statistically significant changes between the two groups [21]. At the same time, the sauna also had beneficial effects on appetite (the effects were recorded by increasing caloric intake and plasma ghrelin concentration) [22].

Five studies analyzed the impact of sauna treatment on respiratory dysfunction [23-27]. The effects of the sauna were followed both in patients diagnosed with allergic rhinitis, but also explored the possibility of a link between the frequency of sauna treatment sessions and the risk of respiratory diseases such as asthma, pneumonia, or COPD. In association, a study looked at whether sauna has beneficial effects both on quality of life in general and on PAH in COPD patients in particular. Another study compared how the inhalation of different types of sauna air (dry, hot air) applied to patients diagnosed with the common cold influences the health status of patients compared to dry air at room temperature. Sauna therapy has air with properties of cleaning the nasal cavity and properties of increasing air flow, thus achieving the inhibition of neural vascular responses. The effects of sauna treatments on allergic rhinitis in the analyzed patients were recorded by measuring the peak nasal inspiratory flow (PNIF) - in the case group, these values registered a significant increase as a result of decreased congestion in the nasal cavities, an aspect associated inversely proportionally with an increase in nasal cavity volume. In addition, pulmonary function was monitored, registering a significant increase in the case group, its initial values being below the normal value. This fact indicated the existence of an obstructive respiratory problem [23]. During physical exercise, after sauna treatment,

pulmonary hypertension was positively influenced. Similar effects were reflected both on the clinical symptomatology and on the results of the addressed scores. Ventilation registered an improvement which led to the prevention of a possible desaturation during the effort; at the same time pressure in the pulmonary artery function during exercise decreased significantly, and exercise tolerance increased. [24] Implicitly, also in the case of respiratory diseases, the way in which the risk of the occurrence of the disease can be detected could be related to the number of sauna sessions performed by the patient. After a series of adjustments, the risk of respiratory pathology is much more lower in patients who followed a greater number of sessions than in patients with a lower number of sessions [25,26.] Comparing the effectiveness of applying hot dry air with the effectiveness of dry air at normal temperature in patients with a common cold, there were no significant differences [27].

Additionally, five of the selected studies focus on how sauna therapy can influence recovery in rheumatismal pathologies, as the benefits of sauna in chronic fatigue, fibromyalgia pain and other types of pain were explored [28-32]. The approach to sauna therapy in chronic pain concluded that sauna treatment led to a significant improvement in all analyzed parameters, from the number of pain behaviors to the visual analogue scale. In both groups, there was an improvement in the relationship between heat therapy and treatment. Implicitly, the quality of life was also improved, a significant number of patients being socio-professionally reintegrated. Both depressed and anxious patients experienced significant changes as a result of sauna treatment. Effects on fatigue were mostly quantifiable only at the end of treatment. On the other hand, energy levels did not show any significant changes [28,29].

At the same time, pain associated with fibromyalgia also registered a significant decrease even after the application of the first sauna session, so that at the end of the treatment, changes were registered at the level of all the parameters under study. Pain points associated with fibromyalgia markedly decreased in intensity [30,31].

In the case of patients with ankylosing spondylitis and rheumatoid arthritis, stiffness, fatigue and pain decreased markedly after sauna treatment. Study patients felt comfortable both during and after treatment, but no relevant changes were recorded in disease activity scores [32].

Along with a wide range of diseases addressed, sauna therapy was evaluated as an activator for the skin, which is the organ directly involved and influenced. One of the studies identified relevant effects of the sauna on the pH of the skin and on the epidermal barrier. The present study demonstrated the fact that the sauna has an important role: that of a protective barrier on the skin. In the case of the group with prolonged exposure, a decrease in the content of skin sebum was observed on the surface of the skin of the forehead of the patients [33].

On the other hand, three studies looked at how physical exercises conducted in the sauna influence the state of health in different categories of patients: patients with chronic cardiac conditions or elderly patients. In the case group, a significant improvement of the Barthel index could be observed, a fact that attests to an important increase in both the performance and the independence of the patients. The combination of sauna therapy can be addressed in the treatment of patients with chronic heart disease, itself with beneficial effects on the cardiovascular system, with physical training and with effects on activities of daily living [34]. Repeated high cardiorespiratory fitness and sauna therapy have a more pronounced impact, providing both long-term protection and a reduced risk of mortality, compared to single therapy [35]. Also, yoga exercises performed in the sauna have a positive impact on muscle strength and flexibility [36].

4. Discussion

The aim of this review was to identify the benefits, effects and precautions of sauna as a therapy method in the medical rehabilitation of patients with different pathologies. With

a varied range of effects, sauna treatment can be considered among the treatments of choice in physical medicine and rehabilitation.

The risks analyzed were those of stroke, cardiovascular mortality, psychosis, dementia, COPD, asthma, all whom were inversely associated with the frequency of sauna sessions, thus it was demonstrated that patients who benefited from a greater number of sessions of sauna registered a lower risk of developing various pathologies than patients who followed a smaller number of sessions. The benefits associated with the sauna treatment were numerous: there were significant changes, increases and decreases in the parameters analyzed in groups of study exposed compared to groups non-exposed, there was an improvement in the patients' quality of life through an increase in exercise tolerance and, implicitly, in the body's resistance.

At the same time, there was a lower rate of hospitalizations (admissions and readmissions) as well as an early social reintegration of patients. Visible improvements were also registered on cardiac function, by changing the value of myocardial perfusion, by reducing arrhythmia, reduced values in the case of headache pain, restoring appetite, improving markers from allergic rhinitis and COPD, reducing chronic pain from ankylosing spondylitis, from polyarthritis rheumatoid and fibromyalgia, visible benefits in skin structure and physiology, strength, flexibility and balance. Analyzing both the positive results obtained and reproduced in the specialized literature as well as the fact that some of the studies showed their benefits even after relatively short periods of time (two weeks - two months), it can be stated with certainty that the sauna treatment has visible effects in improving patients' lives in relation to the pathology.

In addition to the beneficial effects demonstrated in the treatment of various pathologies, the sauna brought a significant improvement on the quality of life of patients in general - by decreasing the number of readmissions / hospitalizations and the possibility of their early social reintegration. Along with all these benefits, the protective role of sauna treatment against the onset and development of certain conditions has also been observed, with an inversely proportional association between the number of sauna sessions and potential risk. Having a direct action on the entire organism, through steam or hot air, action that causes both local and systemic vasodilatation, the sauna is associated with both risks, precautions and contraindications.

Taken from the specialized literature, the contraindications are made up of patients with cardiovascular pathologies such as: recent myocardial infarction, unstable angina pectoris, patients with SAS (severe aortic stenosis) [37]. At the same time, it is strictly forbidden to drink alcohol before starting sauna treatments, because alcohol increases the risk of hypotension, injury and even sudden death [38].

Sauna risks and precautions are numerically reduced. One of the ways to avoid these risks is represented by a rigorous hydration and the quantification of the time spent in the sauna - a long time spent in the sauna can generate injuries through contact or scalding, through burns, can lead to eye irritation, difficult breathing, and dehydration can lead to hypotension, hypovolemic shock, headache, kidney failure, seizures, and even coma [39]. At the same time, the sauna should be recommended with caution to children under the age of 7, as the high temperature in the sauna induces mechanisms to deregulate body thermoregulation [40,41].

5. Conclusions

Even if most people often define the sauna as just a "wellness" procedure, this review comes as a confirmation of the effects of the sauna in various pathologies, systemic effects that positively influence the entire human body.

Sauna therapy has proved its effectiveness in medical rehabilitation treatment starting from the musculoskeletal system and skin to the nervous system. In addition, sauna therapy brings a significant improvement in the quality of life of patients by decreasing the number of readmissions / hospitalizations and the possibility of their early social reintegration.

Along with all these benefits, the protective role of sauna treatment against the onset and development of certain conditions has also been observed, with an inversely proportional association between the number of sauna sessions and potential risk.

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