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Does sauna bathing prevent chronic obstructive pulmonary disease or alzheimer's disease? May adults with cardiovascular disease use a sauna? A systematic review

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Abstract

Recently, there has been a surge of interest in sauna bathing and its role in health aspects. However, there are few studies focusing on the association between regular sauntering and the risk of dementia and chronic obstructive pulmonary disease (COPD). Considerably better understood are the effects on the cardiovascular system. This study delves into contemporary scientific research on Finnish saunas, exploring their potential correlation with Alzheimer's disease prevention, their impact on vascular health in adults with cardiovascular disorders, and their association with reducing the risk of chronic obstructive pulmonary disease. Scientific studies published in PubMed, Scopus and Google Scholar databases were analyzed, including terms related to Finnish sauna, dementia, COPD and cardiovascular disease. The methodological quality and results of each study were evaluated. Sauna bathing in addition to being a relaxing lifestyle habit, remains a potential additional strategy which can be used in improving cardiovascular function in adults with well-controlled cardiovascular disorders. A limited amount of research has been identified on the correlation between sauna bathing and reduced risk of Alzheimer's disease and COPD. The accumulating evidence suggests that frequent sauna bathing may reduce the risk or severity of several vascular and nonvascular conditions including COPD and also moderate to high frequency of sauna bathing was associated with lowered risks of dementia and Alzheimer's disease. Further research is required, especially large-scale cohort studies with repeated measurement on sauna to establish the potential mechanisms linking sauna bathing and either memory diseases or COPD and better understand the relationship between sauntering and cardiovascular health. Upcoming studies may become very promising for the development of sauna bathing as a new non-pharmacological treatment or prevention of various diseases and improvement in the quality of life.

KEYWORDS: Sauna; Alzheimer's disease; Dementia; Chronic obstructive pulmonary disease; Cardiovascular diseases

Introduction and purpose:

In recent years, there has been a growing interest in the practice of sauna baths and saunas as a place for relaxation and wellness. Sauna culture has developed in parallel in many places around the world. It can take many different forms, but archaeological and ethnographic evidence suggests that it is at least several thousand years old [1]. All types of saunas are based on the same principle-affecting the human body through high temperatures followed by cooling. The most popular types of sauna are: Finnish sauna (dry air type with temperature 75-100°C, relative humidity 5-15%); Roman bath (consisting of tepidarium with temperature of air 45-50°C, laconium - 60-70°C and frigidarium, which consists of a pool with water temperature 35°C and second pool with water temperature 12°C); Russian Banya (wet/steam sauna with maximum air temperature of 50°C and relative humidity of 90%); Infrared sauna.

In this work, we focused on current scientific reports on Finnish saunas, which include: the correlation between sauna bathing and Alzheimer's disease, sauna bathing and vascular health of adults with cardiovascular disorders and the correlation between sauna bathing and the reduction of chronic obstructive pulmonary disease risk.

Materials and methods:

We used databases such as PubMed, Scopus and Google Scholar. Our principal focus was on randomized controlled trials published after 2022 and articles published after 2016. Search terms included: sauna, health effects of sauna, history of sauna, advantages of sauna use, sauna and Alzheimer's disease, vascular health, coronary artery disease, dementia, alzheimer's disease, apoe, alzheimer's epidemiology, alzheimer's pathophysiology, alzheimer's mutations, beta amyloid, tau protein, synonuclein alfa, PSEN 1 mutation, PSEN 2 mutation, APO E E4 mutation, alzheimer's risk factors, chronic obstructive pulmonary disease, COPD, COPD sauna, COPD risk factors, COPD low socioeconomic status, coronary heart disease, cardiovascular disease, sauna and dementia, blood pressure and sauna, hypertension and sauna, medical aspects of sauna bathing.

Description of the state of knowledge:

Sauna bathing as Alzheimer's disease prevention.

Dementia is a syndrome caused by an organic brain disease, most often chronic and progressive. It is an acquired disorder and does not include intellectual disability. The prevalence of dementia increases rapidly with age. The estimated increases in the number of dementia cases are concerning. The total number of people living with dementia in Europe will increase to 11,379,701 by 2025 and to 18,846,286 by 2050, which means it will nearly double by 2050 [2]. The main cause of dementia is Alzheimer's disease [3]. Alzheimer's disease is a primary degenerative brain disease of unknown etiology. The etiopathogenesis of the disease is related to the deposition of proteins (amyloid β , tau protein, synuclein α) [4,5,6]. The results of some studies suggest that histopathological markers of AD (A β plaques and NFTs) may not be a cause but a consequence of AD, as there are other mechanisms preceding the developments, such as oxidative stress, vascular pathology and metabolic brain disorders [7]. The risk of developing AD increases with age. Carrying mutations of either the β APP or presenilins: 1 and 2 (PSEN 1, PSEN 2) genes, as well as polymorphisms of the apolipoprotein E (APO E)-isoform ϵ 4 gene also predisposes to the disease [8,9,10]. Lower education, loneliness and lack of social contacts also promote the disease. Likely protective factors are higher education, APO ϵ 2 isoform, use of NSAIDs, diet, and active lifestyle [11,12,13].

There is one large prospective cohort study (n= 2315) that analyzed the correlation between the frequency of sauna bathing of Finnish men with the incidence of dementia and Alzheimer's disease. A strong inverse association was found between sauna bathing frequency and risk of dementia and Alzheimer's disease, which was independent of known risk factors. The hazard ratio for dementia was 0.78 (95% confidence interval: 0.57–1.06) for 2–3 sauna bathing sessions per week and 0.34 (95% CI: 0.16–0.71) for 4–7 sauna bathing sessions per week. The corresponding HRs for Alzheimer's disease were 0.80 (95% CI: 0.53–1.20) and 0.35 (95% CI: 0.14–0.90) [14]. Another prospective cohort study (n= 13994) that analyzed the same hypothesis also suggests that frequent sauna bathing may provide protection against dementia [15].

However, the etiology of this association is unknown and no firm conclusions can be drawn. An in vivo study in mice suggests that sauna-like conditions or menthol treatment can lower

tau protein phosphorylation through mild hyperthermia [16]. There are also other factors that are associated with sauna bathing and may have a beneficial effect on cognitive function due to metabolic, physiological and cellular changes as a result of passive heating of the body. The elevation of body temperature induces heat shock proteins which play significant role in protein aggregate degradation (i.e. b-amyloid plaques and neurofibrillary tangles), stress sensing in distant organs such as the brain, improve mitochondrial function and proteostasis in variety of tissues and general cell health. In addition, heat therapy prevents obesity and insulin resistance and restores target blood glucose and insulin levels-all risk factors associated with Alzheimer's disease [17].

The evidence suggests that vascular pathology and hypertension are pathogenic contributors to age-related dementia, including Alzheimer's disease, inextricably linked to disease onset and progression [18,19]. In recent prospective study it was provided that frequent sauna bathing may have cardiovascular benefits [20]. Improvement of endothelium-dependent dilatation, arterial stiffness, blood pressure and intima media thickness were observed as an effect of heat therapy [21,22].

Inflammatory processes are involved in the pathogenesis of Alzheimer's disease, including both complement components and inflammatory cells and substances produced by them, such as cytokines and chemokines [23]. Two studies found that there is a significant inverse association between the frequency of sauna bathing and the level of inflammatory serum markers [24,25]. Therefore, a decrease in inflammatory processes should not be excluded as a potentially protective factor against neurodegenerative diseases resulting from frequent sauna use.

Individuals with AD and other types of dementia are often diagnosed with sleep disorders, which cause changes in A β peptide and t-tau protein levels, and may even complicate the removal of neurotoxic A β peptide. Many studies proposed an association between sleep disorders and a higher risk of dementia [26]. Improvements in sleep quality often occur in people 1-2 days after a sauna bath. It may be a consequence of the relationship between the speed of core body temperature reduction, peripheral vasodilation and normal sleep onset. However, there are not many studies explaining the mechanism of this incidence [27].

Although most studies focus on the beneficial aspects of sauna bathing, it is important not to underestimate the negative consequences of overheating (such as harmful effects on brain) and using excessively high temperatures in the sauna. Increased blood-brain barrier permeability and decreased cerebral blood flow may result from severe heat stress. Elderly people and other groups with thermoregulatory disorders are particularly at risk [15].

Sauna bathing as chronic obstructive pulmonary disease prevention.

The European Respiratory Society (ERS) define chronic obstructive respiratory disease (COPD) as „a preventable and treatable disease state characterised by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily caused by cigarette smoking. Although COPD affects the lungs, it also produces significant systemic consequences.” [28]. Other important risk factors include exposure to dust, vapours, and fumes in the workplace and to air pollution inside poorly ventilated spaces following the burning of biomass. In some patients, the cause is insufficient maximal lung function achieved at a young age or genetically determined α 1-antitrypsin deficiency [29]. The pathogenesis of lung damage is a result of chronic inflammation of the airways, lung parenchyma and pulmonary vessels, an imbalance between protease and antiprotease activity, and oxidative stress [30].

Prospectively, frequent sauna bathing (3-7 sessions/week) has been associated with potentially reduced incidence of COPD in middle-aged and older Finnish men [31]. The authors of this study postulate that the reduction in COPD risk is possibly due to the anti-inflammatory and antioxidant effects of sauna bathing. In addition, sauna baths may have a direct effect on the lungs by increasing ventilation, tidal volume, vital capacity and forced expiratory volume (FEV), and reducing pulmonary congestion.

Evidence suggests that low socioeconomic status is an independent risk factor for worsening respiratory health and influences risk of COPD [32,33]. In the previously mentioned prospective study, it was shown that frequent sauna bathing was associated with a reduced risk of COPD [31]. A different study estimated the relationship between low socioeconomic status, sauna bathing frequency and risk of COPD. Though the risk of COPD was increased in men with low socioeconomic status and low sauna bathing frequency, this risk was offset in men with low socioeconomic status and high sauna bathing frequency [34]. One considers poverty as a substitute measure for many of the indicators that subsequently enhance the risk of COPD, such as poor nutritional condition, overcrowding, exposure to pollution, including high work exposure and high smoking rates (in low- and middle-income countries), weak access to health care and early respiratory infections [29]. Frequent sauna exposure may reduce the risk of COPD via its anti-inflammatory and antioxidant effect or affect the lung tissues directly as it was mentioned previously. Furthermore frequent sauna bathing may enhance the beneficial

impact of protective risk factors such as physical fitness and physical training and/or offset the negative impact of other risk factors.

Frequent sauna bathing may be a beneficial lifestyle strategy in the prevention of COPD, nonetheless, further research is essential to validate these observational findings and explore the precise mechanisms underlying these associations.

Sauna baths in adults with cardiovascular disorders.

An important aspect of the topic we discuss is also the impact of sauna on the cardiovascular system. In this review, we will try to answer ongoing questions and uncertainties regarding the heart, cardiovascular system and the potential connection between their diseases and regular Finnish sauna practise.

First of all, it is important to analyze how the sauna affects the cardiovascular system. During the sauna bathing process, many changes occur in our body's homeostasis. Studies have observed an increase in hormones such as plasma renin, cortisol, growth hormone. The sympathetic nervous system is also stimulated (which is associated with an increase in the production of norepinephrine). It has been noted that these changes are similar to those that take place in our body when performing maximal physical exercise. However, the hormonal changes are short-lived and normalize within a few hours after leaving the sauna. Sauna bathing causes an increase in body temperature, which consequently increases the heart rate [35]. Subsequently, cardiac output increases by an average of 70% [36]. Frequent sauntering promotes training and habituation of the body to this process. Then we have a situation where the increase in HR is correlated exclusively with the activation of the sympathetic nervous system [35]. A topic causing contention among researchers is the effect of sauna on cardiac output. There is a lack of up-to-date and reliable research, as the most recent study was carried out on a group of patients using saunas once, rather than regularly. The sauna affects the systolic blood pressure in various ways - this depends on the method of measurement, the type and duration of the sauna process as well as on the human body's adaptation [35].

Should people with cardiovascular disease be strictly contraindicated to use the sauna? Of course, it all depends on the type of disease, its stability and the patient's condition. Conditions that constitute absolute contraindications to the sauna, which are not scientifically disputable, include: unstable angina, decompensated heart failure, uncontrolled hypertension and severe

aortic stenosis. With reference to the review of current knowledge and literature, we will discuss clinical conditions with relative contraindications to sauna bathing.

Table 1. Relative and absolute contraindications in adults with cardiovascular diseases. Be aware that such individuals require consultation and comprehensive evaluation by a doctor for the possibility of using a sauna, and the conditions listed in the table are for reference only.

Contraindications to sauna:	Permissible use of sauna:
Unstable angina	Low risk patients - stable angina
Decompensated heart failure	Controlled hypertension
Uncontrolled hypertension	Compensated heart failure
Severe aortic stenosis	
Patients just after intense exercise	
Use of short-acting nitrates	
Alcohol use during or just before session	
Acute pain in the chest	

ISCHAEMIC HEART DISEASE

Sauna bathing causes changes in the haemodynamics of the body. However, studies conducted with continuous ECG monitoring of patients, with ischaemic heart disease while taking such baths, have shown that the subjects tolerate the phenomena occurring during the sauna process well. Moreover, people with ischaemic heart disease show high sauna tolerance [35,36].

A study was carried out in Finland, confirming the thesis that myocardial infarction and cardiac surgery are not contraindications to sauna use. The study investigated 117 patients after myocardial infarction who started sauna bathing (87 per cent of respondents) after leaving the hospital. The results were surprising - in a 10-year follow-up, only 1 of them experienced symptoms during sauna bathing - mild angina. Furthermore, it was proven that physical exertion corresponding to a heart rate such as that during a sauna session resulted in abnormalities in test results, such as changes in the ECG or arrhythmias, more frequently. It is worth mentioning that no sudden death, reinfarction or significant cardiac disorders were reported among the

patients who regularly used saunas. In addition, studies have also been conducted in Germany and Norway, which have shown a high tolerance of saunas in patients with coronary heart disease. [35,36]. Another important aspect that should be noted is the fact that, after several studies, there have been no adverse reactions from the combination of sauna bathing and the use of drugs affecting the cardiovascular system. As the sauna causes almost maximum vasodilation, patients with coronary heart disease taking long-acting nitrates and calcium antagonists tolerate the sauna very well [36]. People taking beta blockers should use the sauna with caution as it may trigger a hypotensive reaction caused by thermal stress. In summary, patients after acute myocardial infarction can use the sauna without harmful cardiovascular complications [37].

CONGESTIVE HEART FAILURE

Studies have shown that sauna bathing not only does not harm people with congestive heart failure, but can also be used in the future as a non-pharmacological treatment [38]. In this study, researchers proved that oxygen consumption during a sauna session slightly increases without changing systolic blood pressure, while diastolic blood pressure decreases significantly. Unfortunately, the study did not include pharmacological treatment. However, more recent studies have not reported any negative effects of sauna use in patients taking beta-blockers and other antihypertensive drugs [35].

HYPERTENSION

When bathing in a Finnish sauna, the average arterial pressure decreases moderately with heat [36]. According to current knowledge, the stereotype that people with hypertension should not use saunas has been disproved. It has been proven that sauna bathing has a positive effect on such patients; regular sauna use reduce blood pressure permanently [35].

Analysis of the statistical data showed that the majority of deaths caused by cardiac incidents during sauna bathing were due to alcohol consumption during or immediately before the sauna bath. It should therefore be reiterated that drinking alcohol is contraindicated in saunas [35].

In the case of people with cardiovascular disease, special attention should be paid to the correct use of sauna bathing and appropriate cooling after - sudden, too rapid cooling of the body can contribute to serious consequences in the disrupted haemodynamism of a heart with a chronic

disease and may even lead to death [35]. Patients should also follow the recommendation that they should wait 6-8 weeks after a heart attack, that the temperature in the sauna should ideally be 60-80 °C and that the duration of the exposure should be 5-10 minutes (this time may be extended depending on the body's training and habituation).

WAON THERAPY

Due to the many benefits of sauna use, research has begun to be conducted into the use of such baths in the treatment of various conditions. A highly promising treatment is Waon therapy. This is a modified form of the traditional Finnish sauna. The dry sauna temperature in Waon therapy is maintained at approximately 60°C, a single session lasts 15 minutes, during which an increase in core temperature of 1-1.2 °C is sought. After the bath, rest is recommended for a further 30 minutes along with adequate hydration.

Potential benefits of Waon therapy have been reported in patients with chronic heart disease, peripheral arterial disease and those suffering from lifestyle-related illnesses [39,40]. The long-term effects of Waon therapy on the cardiovascular system were reported by researchers in Japan and the conclusions were surprising. Repeated Waon therapy in patients with chronic heart disease was shown to have a significant effect on symptoms, increased EF and decreased heart size - this was confirmed by ECG and X-ray [40]. Moreover, a study on a group of patients with chronic heart failure who regularly received waon therapy, compared to a group of patients with CHF who did not receive this therapy, showed that waon therapy significantly reduced the rate of death or hospitalisation [40]. Thanks to a number of studies, we know that Waon therapy improves haemodynamics, the functioning of the peripheral circulation and has a positive effect on arrhythmias and clinical symptoms in patients with CHF [41]. Currently, this therapy is not included in any guidelines and needs more clinical research. However, it is very promising and perhaps in the future more benefits and uses of saunas in heart disease will be discovered as a non-pharmacological treatment.

Conclusions:

In conclusion, prospective cohort studies conducted in Finland indicate the existence of an inverse association between the frequency of sauna bathing and the risk of dementia and Alzheimer's disease, which in the future may be used to prevent or delay the onset of memory

and neurodegenerative diseases. It has also been shown that regular sauna sessions can affect the hemodynamics of the body, so it can be used to reduce the risk of vascular and nonvascular conditions including COPD and may constitute an important life-style strategy for COPD prevention. Studies conducted on patients with ischemic heart disease have shown that patients tolerate the sauna very well and this disease is not an absolute contraindication to using it. Moreover, the sauna process leads to maximum vasodilation, which is probably the reason why sauna baths are well tolerated by coronary patients taking long-acting nitrates and calcium antagonists. Regular sauna use has been proven to reduce blood pressure permanently, what may be used to reduce hypertension. To sum up, the Finnish sauna, used in a suitable way to adjust to the requirements of the body, did not cause harmful complications in people after heart attacks and with compensated cardiovascular diseases. The benefits observed in people who regularly use the Finnish sauna have already begun to be of interest to scientists, and as a result, Waon therapy has been developed, which is based on a modified sauna bath that brings benefits to patients, which has been confirmed by clinical studies. The ability and knowledge of how to properly perform sauna baths and how to properly cool the body after a session are extremely important. In conclusion, further research is essential in order to confirm these observational findings and may be very promising for the development of new non-pharmacological treatments and improvements in the quality of life. In the meantime, healthy practices such as sauntering are encouraged as part of taking care of overall health.

Author's contribution

Conceptualization: Maciej Sobczyk, Małgorzata Słaboń and Małgorzata Pasztelan; methodology: Maciej Sobczyk, Jarosław Pulikowski, Karolina Garbacz; software: Joanna Baran; check: Aleksandra Marczak, Aleksandra Muca and Maria Maciąg; formal analysis: Maciej Sobczyk, Julia Krawczuk vel Walczuk; investigation, Maciej Sobczyk, Małgorzata Słaboń; resources: Karolina Garbacz, Małgorzata Pasztelan and Maria Maciąg; data curation: Maciej Sobczyk, Jarosław Pulikowski; writing - rough preparation: Maciej Sobczyk, Małgorzata Słaboń, Małgorzata Pasztelan, Julia Krawczuk vel Walczuk; writing - review and editing: Maciej Sobczyk, Aleksandra Muca, Aleksandra Marczak, Joanna Baran; visualization: Maciej Sobczyk; supervision: Julia Krawczuk vel Walczuk, Maria Maciąg; project administration: Maciej Sobczyk; All authors have read and agreed with the published version of the manuscript.

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