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Is there scientific evidence that sauna bathing enhances the health effects of physical activity? - Review.

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Abstract

Introduction

Sauna bathing and sport are well-known methods of improving a person's overall health. These activities not only have a positive impact on mental wellbeing, but also have a real effect on improving certain physical parameters such as, for example, blood pressure.

Aim of the review

A summary of the information gathered to date on the health effects of sauna bathing and undertaking physical activity.

Results

The results of the studies cited in this article are consistent: sauna enhances the positive effects of physical activity on cardiovascular function among people with at least one major cardiovascular risk factor and who are not professional athletes.

Conclusions

Although sauna seems to increase the health effects of physical activity one should be aware of the contraindications to its use. Additionally, it is worth conducting more large scale randomized trials to verify this information.

Keywords “sauna”, “sauna bathing”, “physical activity”, “sauna and exercise”, “Finnish sauna”

Finnish sauna bathing - what is it?

Taking a sauna bath has been known in Finland for about two thousand years. This form of activity was once used to wash, maintain health and aid the healing process of many disease entities. Sauna users noted the positive effects of sauna bathing on their well-being although they did not know the exact mechanism of this relationship. As time passed, taking sauna baths became increasingly popular not only in Finland but also in other parts of the world. People began to use this type of activity mainly for relaxation. The sauna was a place of tranquility which was seen as a sacred venue and therefore requiring proper behavior. To this day it is accepted that it forms a part of sauna savoir-vivre to maintain silence in order to ensure comfortable bathing conditions for other users. (1, 2) Sauna bathing involves exposure to relatively dry air at a high temperature. The temperature and humidity of the air during sauna bathing can be regulated but it is recommended that the temperature fluctuates between 80 and 100 degrees Celsius, while the humidity oscillates between the values of 10 and 20 %. (3, 4) A typical Finnish sauna bath takes place in sessions, consisting of the following elements: staying in the sauna room, cooling the body in the shower or pool, relaxing in quiet conditions with simultaneous oral replacement of fluids. The number of sessions during a single day as well as the length of stay in high-temperature conditions varies depending on individual preferences. (3, 5) The frequency of sauna bathing over the course of a week also differs but these days the typical Finn uses a sauna at least once a week, with an average sauna bathing frequency of 2 to 3 times a week. (3, 6, 7, 8)

Physical activity

Regularly engaging in physical activity is a well-documented way to improve overall well-being and a factor that protects us from developing many chronic diseases. (9) Regular physical activity reduces both all - cause and cardiovascular disease mortality. It also has a beneficial effect on the course of diseases such as hypertension, type 2 diabetes and malignant

tumours. In addition, it has a soothing effect on mental and cognitive health as well as sleep. According to the World Health Organization's 2020 recommendations, adults aged 18-64 should perform at least 150-300 minutes of moderate-intensity aerobic physical activity or at least 75-150 minutes of high-intensity aerobic physical activity or an equivalent combination of moderate- and high-intensity activity throughout the week to achieve significant health benefits. Adults should also do moderate- or higher-intensity muscle-strengthening exercises that engage all major muscle groups 2 or more days a week, as these provide additional health benefits. (10)

Health benefits of sauna bathing and physical activity - scientific work to date

To date, there have been many studies confirming the positive effects of exercise training on physical health. (11, 12) Aerobic exercise performed systematically has been proven to improve not only cardiorespiratory fitness (13), but also body composition (12). In addition, there is evidence that performing resistance exercise before aerobic training increases the body's energy expenditure which contributes to greater fat loss. (14-16) However, it is worth mentioning that heat therapy, which is becoming increasingly popular worldwide, is also an important factor in human health. Indeed, there are reference works confirming an inverse relationship between sauna bathing and the risk of sudden cardiac death (SCD), fatal coronary heart disease (CHD), fatal cardiovascular disease (CVD), and all-cause mortality. (7) Regular sauna use appears to have similar health effects to regular physical activity, such as lowering blood pressure and improving left ventricular heart function. (4, 17)**.** In addition, sauna bathing has been reported to raise vital capacity, minute ventilation and forced expiratory volume of the lungs. (18, 19)

It is worth taking into account, there is scientific evidence that aerobic exercise and sauna bathing looked at separately as activities provide similar health benefits (particularly in terms of cardiovascular function). (20, 21, 22) However, the effects of exercise and sauna bathing taken in a single session are far less well understood. To date most scientific papers have investigated the effects of conjunctive use of heat therapy and physical activity among athletes. (23, 24) Nevertheless, studies focusing on the non-athlete patient population are lacking. Therefore, we used reference works combining sauna bathing, physical activity and non-athlete populations when writing our review article. We searched for source papers on the Pubmed platform using the following keywords: sauna bathing, sauna, physical activity, sauna and exercise, finnish sauna.

Sauna bathing in conjunction with exercise - acute effects

In 2020, an article was published in the European Journal of Preventive Cardiology discussing the results of a study conducted in a group of 77 participants with a minimum of one cardiovascular risk factor and no previously diagnosed cardiovascular disease. All participants underwent the same intervention: aerobic physical activity in the form of stationary cycling for 15 minutes immediately followed by a 15-minute sauna bath. During the study values of several parameters were assessed, including: systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), the left ventricular ejection time (LVET), the diastolic time, pulse pressure, pulse wave velocity (PWV) as a measure of arterial stiffness, the augmentation index (AIx) and heart rate at three different time points: PRE (before the intervention), POST (immediately after the intervention) and POST30 (after 30 minutes of post-intervention recovery). Significant decreases in the values of the following parameters were observed between the PRE-POST time points: PWV, AIx, MAP, LVET and diastolic time. However, at the POST30 time point, the same effects persisted only for: MAP, LVET and diastolic time. (22) Undoubtedly, a drawback of this study is the lack of a control group - it does not allow us to assess whether the observed changes in the values of the measured parameters are the result of the undertaken physical activity , the sauna bath or the effect of a combination of these two interventions. However, a year later, in 2021, the same group of researchers conducted another crossover study on a group of 72 participants (25), which was far better documented than the previous one. (22) The aim was to compare the haemodynamic changes in the human body in two situations: after a single sauna bath and a single sauna bath preceded by aerobic exercise. The participants in this study were united by the fact that each was burdened with at least one cardiovascular factor. Each participant was exposed to two interventions on different days. The first intervention consisted of a 30-minute sauna session and the second intervention consisted of a 15-minute aerobic workout on a stationary bike with a subsequent 15-minute sauna session. The main parameter assessed during this study was blood pressure, divided into systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP). Pressure values were measured at the same 3 time points: PRE (before the intervention), POST (immediately after the intervention) and POST30 (after 30 minutes of post-intervention recovery). The results of this study showed that sauna bathing induces greater PRE - POST changes in parameters such as DBP and MAP compared to sauna bathing combined with physical activity. However, sauna combined with exercise gives better effect of decreasing SBP, DBP and MAP PRE-POST30. (25)

Regular sauna bathing in conjunction with exercise - long - term effects

Another year later, in 2022, the American Journal of Physiology published an interesting multi-arm randomized controlled trial which at the time was the first article of its kind to discuss the long-term effects of undertaking regular physical activity in combination with sauna bathing among the non-athletic general population. The study ultimately included 47 subjects (with a significant female preponderance) who met two main inclusion criteria. The first was having a sedentary lifestyle (defined as having a desk-bound job and engaging in less than 30 minutes of total physical activity per week). The second criterion was the burden of at least one common cardiovascular risk factor, such as: elevated cholesterol levels, family history of coronary heart disease (CHD), hypertension, obesity and smoking. The exclusion criteria in this study were as follows: 1) sauna bathing more than once a week within the past 6 months, 2) commuting to work via activities such as running or cycling, 3) previous coronary heart disease and/or diabetes and 4) any diagnosed and/or symptomatic cardiovascular disease (CVD), musculoskeletal injury or any other physical or mental condition within 6 months before the commencement of the study. Participants were also excluded if they had resting systolic blood pressure (SBP) below 100 mmHg or above 159mmHg, BMI over 40 kg/m2 or if they were on any CVD medication. (26) Study participants were randomly assigned (1:1:1) to three groups: guideline-based regular exercise and 15-min post exercise sauna (EXS), guideline-based regular exercise (EXE), or control (CON) for 8 weeks. Participants in the study groups exercised three times a week. Each training session lasted 60 minutes and consisted of the following: a 10-minute full-body warm-up, 20 minutes of resistance exercise and 30 minutes of aerobic exercise. Resistance training was a combination of body weight exercises and basic resistance exercises. Aerobic exercise was performed using Monark bicycle ergometers. An individual's maximum heart rate (27) was calculated and then used to determine the intensity of aerobic exercise, starting at 65% of maximum heart rate, increasing by 5% every two weeks. After the exercise session, participants in the EXS group took a 15-minute sauna bath. The air temperature in the sauna room started at 65 degrees Celsius and was increased by 5 degrees every two weeks. The average humidity in the sauna room varied between 10 and 20 %. (26) The primary parameters measured during the study were blood pressure (BP) and cardiorespiratory fitness (CRF). CRF is an indicator describing the body's ability to transport oxygen from the air we breathe to the mitochondria of muscle cells in order to perform physical work. It can therefore be said to be a parameter that assesses an individual's functional capacity and describes

several consecutive processes: ventilation, oxygen diffusion in the lungs, systolic and diastolic function of both the left and right ventricles of the heart, the ability of blood vessels to transport oxygen to target cells and the ability of target cells to take up and use oxygen. CRF is therefore an indicator that reflects the integrated function of many systems in the human body and is therefore considered a good marker of overall health. CRF can be measured directly, expressed as maximal oxygen consumption (V_{O_2}max), or estimated from the peak work rate achieved on a treadmill or cycle ergometer or from non-exercise algorithms. Regardless of the method of measurement, CRF is an important predictor of a person's health. (28) The results of the study (26) conducted were as follows: the EXS group showed greater decreases in systolic blood pressure values after the 8-week intervention compared to the EXE group. In addition, it is worth noting that no significant decrease in blood pressure values were observed between the EXE group and the control. The study also showed a greater increase in V_{O_2}max in both the EXE and EXS groups compared to controls. Nontheless, it is noteworthy that the increase in cardiorespiratory fitness was greater in the EXS, rather than in the EXE group, i.e. among participants not only regularly exercising, but also routinely subjected to high temperatures. (26)

Results

If we wanted to compare the results of the studies cited in this article, it could be argued that they are consistent with each other. The results of two of them (26, 25) show that the combination of physical activity and sauna bathing during the same session shows a stronger long-term blood pressure lowering effect (mainly SBP) compared to sauna bathing (25) or exercise (26) taken as separate interventions. Therefore, it is plausible that regular participation in sessions combining exercise and subsequent heat therapy may contribute to a long-term reduction in blood pressure values, which could be used as a non-pharmacological way of combating hypertension, which is one of the major factors that increase cardiovascular risk (29).

Controversies

It is important to bear in mind that sauna use exposes the human body to a great deal of stress, which may not benefit all patients and may even be a health risk for some. Absolute contraindications for sauna use are considered to include severe aortic stenosis, unstable

angina pectoris and recent myocardial infarction. (30) In addition, heat therapy can be risky for people under the influence of alcohol and patients regularly taking beta-blockers and nitrates. (31) Elderly people should also be careful when using the sauna, as exposure to high temperatures leads to significant vasodilation, a decrease in peripheral resistance and a drop in blood pressure values, which, if the body is suddenly upright after a sauna session, can lead to orthostatic hypotonia and fainting, to which elderly people are at greater risk in the population. (32) In addition, after analysing the methodology of the studies cited in this article it is worth noting that there is no study that includes, in addition to the control group, as many as 3 research groups: a group of people who only exercise, a group of people who only use the sauna and a group of people who combine exercise with sauning. It seems to us that carrying out such a study would allow a more reliable assessment of whether indeed combining physical activity with sauning during a single session has greater health effects than undertaking these activities as single interventions.

Conclusions

In conclusion, there is scientific evidence that sauna use enhances the health-promoting effects induced by physical activity. This is particularly noticeable with regard to the parameter blood pressure values. The beneficial effect of combining physical activity and heat therapy during a single intervention is most evident in the long term. For this reason, regular exercise with subsequent sauna bathing seems to be a good way of non-pharmocologically combating a disease such as hypertension. However, it should be borne in mind that there are certain contraindications to sauna use and one would need to consult one's doctor before making such an intervention.

Authors' contribution

All authors contributed to the article. Conceptualization – Jagoda Elias; methodology – Wiktor Biesiada, Sara Szydłowska; check - Marlena Zubiak, Dominika Kaźmierczak; formal analysis – Krzysztof Błaszków; resources – Sara Szydłowska; data curation - Wiktor Biesiada; writing - rough preparation – Dominika Kaźmierczak; writing - review and editing - Jagoda Elias, Marlena Zubiak; visualization –Krzysztof Błaszków; supervision – Wiktor Biesiada; project administration – Jagoda Elias. All authors have read and agreed with the published version of the manuscript.

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