

## Sauna

### Benefits and risks of sauna bathing.

Hannuksela ML, Ellahham S.

Am J Med. 2001 Feb 1;110(2):118-26.

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Although sauna bathing causes various acute, transient cardiovascular and hormonal changes, it is well tolerated by most healthy adults and children. Sauna bathing does not influence fertility and is safe during the uncomplicated pregnancies of healthy women. Some studies have suggested that long-term sauna bathing may help lower blood pressure in patients with hypertension and improve the left ventricular ejection fraction in patients with chronic congestive heart failure, but additional data are needed to confirm these findings. The transient improvements in pulmonary function that occur in the sauna may provide some relief to patients with asthma and chronic bronchitis. Sauna bathing may also alleviate pain and improve joint mobility in patients with rheumatic disease. Although sauna bathing does not cause drying of the skin-and may even benefit patients with psoriasis-sweating may increase itching in patients with atopic dermatitis.

Contraindications to sauna bathing include unstable angina pectoris, recent myocardial infarction, and severe aortic stenosis. Sauna bathing is safe, however, for most people with coronary heart disease with stable angina pectoris or old myocardial infarction. Very few acute myocardial infarctions and sudden deaths occur in saunas, but alcohol consumption during sauna bathing increases the risk of hypotension, arrhythmia, and sudden death, and should be avoided.

### Health effects and risks of sauna bathing.

Int J Circumpolar Health. 2006 Jun;65(3):195-205.

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To study physiological, therapeutic and adverse effects of sauna bathing with special reference to chronic diseases, medication and special situations (pregnancy, children).

A literature review.

Experiments of sauna bathing were accepted if they were conducted in a heated room with sufficient heat (80 to 90 degrees C), comfortable air humidity and adequate ventilation. The sauna exposure for five to 20 minutes was usually repeated one to three times. The experiments were either acute (one day), or conducted over a longer period (several months).

The research data retrieved were most often based on uncontrolled research designs with subjects accustomed to bathing since childhood. Sauna was well tolerated and posed no health risks to healthy people from childhood to old age. Baths did not appear to be particularly risky to patients with hypertension, coronary heart disease and congestive heart failure, when they were medicated and in a stable condition. Excepting toxemia cases, no adverse effects of bathing during pregnancy were found, and baths were not teratogenic. In musculoskeletal disorders, baths may relieve pain. Medication in general was of no concern during a bath, apart from antihypertensive medication, which may predispose to orthostatic hypotension after bathing.

Further research is needed with sound experimental design, and with subjects not accustomed to sauna, before sauna bathing can routinely be used as a non-pharmacological treatment regimen in certain medical disorders to relieve symptoms and improve wellness.

### Arsenic, cadmium, lead, and mercury in sweat: a systematic review.

J Environ Public Health. 2012;2012:184745. doi: 10.1155/2012/184745. Epub 2012 Feb 22.

Sears ME, Kerr KJ, Bray RI.

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Arsenic, cadmium, lead, and mercury exposures are ubiquitous. These toxic elements have no physiological benefits, engendering interest in minimizing body burden. The physiological process of sweating has long been regarded as "cleansing" and of low risk. Reports of toxicant levels in sweat were sought in Medline, Embase, Toxline, Biosis, and

AMED as well as reference lists and grey literature, from inception to March 22, 2011. Of 122 records identified, 24 were included in evidence synthesis. Populations, and sweat collection methods and concentrations varied widely. In individuals with higher exposure or body burden, sweat generally exceeded plasma or urine concentrations, and dermal could match or surpass urinary daily excretion. Arsenic dermal excretion was several fold higher in arsenic-exposed individuals than in unexposed controls. Cadmium was more concentrated in sweat than in blood plasma. Sweat lead was associated with high-molecular-weight molecules, and in an interventional study, levels were higher with endurance compared with intensive exercise. Mercury levels normalized with repeated saunas in a case report. Sweating deserves consideration for toxic element detoxification. Research including appropriately sized trials is needed to establish safe, effective therapeutic protocols.

### **Chemical sensitivity after intoxication at work with solvents: response to sauna therapy.**

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J Altern Complement Med. 1998 Spring;4(1):77-86.

St. Joseph's Health Centre, Toronto, Ontario, Canada.

**OBJECTIVES:** The purpose of this case study is twofold. One, to illustrate a simple method of detoxification using heat chamber depuration (sauna). Second, to raise awareness in the practice of medicine of the importance of taking an environmentally oriented history. **SUBJECT:** A patient with a chronic, debilitating multisystem disorder of 20-years' duration related to a chemical sensitivity resulting from low-level exposure to toxic chemicals (solvents) at work. **INTERVENTIONS:** Detoxification treatment consisted of heat chamber depuration (sauna) together with a specific protocol of oral and intravenous therapy. Appropriate advice was offered related to choosing a safe and suitable workplace. **OUTCOME MEASURES:** Observation of the dynamic interaction and elimination of chlorinated and aromatic hydrocarbons (solvents) from the patient's bloodstream and related clinical improvement during the course of treatment. **RESULTS:** The patient was able to discontinue, without ill effect, all medications previously prescribed to treat her symptoms. Heat chamber depuration (sauna) detoxification treatment brought substantial release of symptoms and returned the individual to gainful employment. **CONCLUSION:** The connection between symptoms of chronic degenerative diseases and environmental and/or nutritional factors is missed in many cases due to lack of obtaining an environmentally oriented medical history. Taking such a history and dealing with the cause of illness using avoidance and/or appropriate therapy is preventive and cost-effective for both the patient and society.

### **Effects of a sauna on the pharmacokinetics and pharmacodynamics of midazolam and ephedrine in healthy young women.**

Vanakoski J, Stromberg C, Seppala T.

Eur J Clin Pharmacol. 1993;45(4):377-81.

Laboratory of Pharmacology and Toxicology, National Public Health Institute, Helsinki, Finland.

The effect of a sauna on the pharmacokinetics and pharmacodynamics of single doses of ephedrine 50 mg and midazolam 15 mg have been studied in 6 young healthy women in a placebo-controlled, double-blind study. The sauna (3 x 10 min; temperature 80-100 degrees C; relative humidity 30-50%) modified the pharmacokinetics of both drugs: it retarded the absorption of midazolam estimated as  $K_a$  values, and it reduced the mean plasma midazolam concentrations at 2 h; ephedrine, was absorbed more rapidly and the maximum plasma concentration occurred earlier than in the control sessions. Changes in the pharmacodynamics due to the sauna were consistent with the pharmacokinetic findings: midazolam decreased flicker recognition and induced exophoria significantly less during the early sauna period than in the control session, whereas ephedrine made the volunteers subjectively more alert at that time. Later, at 2.5 and 3.5 h (1 h 20 min and 2 h 20 min after cessation of the sauna), and despite the equalisation of the plasma levels, midazolam caused significantly more exophoria after the sauna than in the control situation. This indicates an influence of a sauna on drug pharmacodynamics in the post-sauna adaptive phase. The results suggest that exposure to a sauna may alter both drug pharmacokinetics and pharmacodynamics.

### **[The sauna in the treatment of children with atopic dermatitis]**

Pashkov VK, Ogorodova LM, Gontarskaia VM, Pashkova EN.

Vopr Kurortol Fizioter Lech Fiz Kult. 2000 Jul-Aug;(4):37-9.

Complex sauna therapy for children with atopic dermatitis gives positive clinical results and improves the condition of their autonomic nervous system. Marked clinical response but unsatisfied autonomic nervous system regulation necessitate long-term sauna treatment to cure this disease.

### **Unreported sauna use in anorexia nervosa: evidence from the world-wide-web.**

Vahasoini A, Vazquez R, Birmingham CL, Gutierrez E.

Eat Weight Disord. 2004 Mar;9(1):50-5.

Departamento de Psicologia Clinica y Psicobiologia, Universidad de Santiago de Compostela, Spain.

Weight loss methods employed in anorexia nervosa (AN) are vomiting, laxatives, diuretics, enemas, suppositories, ipecac, weight loss medications and inadequate insulin in diabetics. Some methods result in weight loss from fluid depletion and not a reduction in body fat. Sauna use causes rapid fluid loss, but has not been reported in the medical literature as a weight loss strategy used in AN. We found reports of sauna use in AN on the world-wide-web are rare. We hypothesize that the warming caused by the use of sauna, may result in physical improvement in AN and thereby reduce its acceptability as a weight loss strategy.

### **Effect of sauna bathing and beer ingestion on plasma concentrations of purine bases.**

Yamamoto T, Moriwaki Y, Ka T, Takahashi S, Tsutsumi Z, Cheng J, Inokuchi T, Yamamoto A, Hada T.

Division of Endocrinology and Metabolism, Department of Internal Medicine, Hyogo College of Medicine, Hyogo, Japan.

Metabolism. 2004 Jun;53(6):772-6.

To determine whether sauna bathing alone or in combination with beer ingestion increases the plasma concentration of uric acid, 5 healthy subjects were tested. Urine and plasma measurements were performed before and after each took a sauna bath, ingested beer, and ingested beer just after taking a sauna bath, with a 2-week interval between each activity. Sauna bathing alone increased the plasma concentrations of uric acid and oxypurines (hypoxanthine and xanthine), and decreased the urinary and fractional excretion of uric acid, while beer ingestion alone increased the plasma concentrations and urinary excretion of uric acid and oxypurines. A combination of both increased the plasma concentration of uric acid and oxypurines, and decreased the urinary and fractional excretion of uric acid, with an increase in the urinary excretion of oxypurines. The increase in plasma concentration of uric acid with the combination protocol was not synergistic as compared to the sum of the increases by each alone. Body weight, urine volume, and the urinary excretion of sodium and chloride via dehydration were decreased following sauna bathing alone. These results suggest that sauna bathing had a relationship with enhanced purine degradation and a decrease in the urinary excretion of uric acid, leading to an increase in the plasma concentration of uric acid. Further, we concluded that extracellular volume loss may affect the common renal transport pathway of uric acid and xanthine. Therefore, it is recommended that patients with gout refrain from drinking alcoholic beverages, including beer, after taking a sauna bath, since the increase in plasma concentration of uric acid following the combination of sauna bathing and beer ingestion was additive.

### **Repeated sauna therapy reduces urinary 8-epi-prostaglandin F(2alpha).**

Masuda A, Miyata M, Kihara T, Minagoe S, Tei C.

Jpn Heart J. 2004 Mar;45(2):297-303.

Department of Cardiology, Respiratory and Metabolic Medicine, Kagoshima University, Kagoshima, Japan.

We have reported that repeated sauna therapy improves impaired vascular endothelial function in a patient with coronary risk factors. We hypothesized that sauna therapy decreases urinary 8-epi-prostaglandin F(2alpha) (PGF(2alpha)) levels as a marker of oxidative stress and conducted a randomized, controlled study. Twenty-eight patients with at least one coronary risk factor were divided into a sauna group (n = 14) and non-sauna group (n = 14). Sauna therapy was performed with a 60 degrees C far infrared-ray dry sauna for 15 minutes and then bed rest with a blanket for 30 minutes once a day for two weeks. Systolic blood pressure and increased urinary 8-epi-PGF(2alpha) levels in the sauna group were significantly lower than those in the non-sauna group at two weeks after admission (110 +/- 15 mmHg vs 122 +/- 13 mmHg, P < 0.05, 230 +/- 67 pg/mg x creatinine vs 380 +/- 101 pg/mg x creatinine, P < 0.0001, respectively). These results suggest that repeated sauna therapy may protect against oxidative stress, which leads to the prevention of atherosclerosis.

### **Analysis of body water compartments after a short sauna bath using bioelectric impedance analysis.**

Perrone F, Garofano P, Iacopino L, Servidio MF, Mohamed EI, Maiolo C, Hereba AT,

Acta Diabetol. 2003 Oct;40 Suppl 1:S207-9.

Divisions of Human Nutrition and Clinical Pathology, Faculty of Medicine and Surgery, University of Tor Vergata, Rome, Italy.

Studies have suggested that long-term sauna bathing may lower blood pressure in persons with hypertension by causing a direct loss of extracellular water and plasma minerals. The objective of the present study was to evaluate the effect of short-term sauna bathing on body water compartments as estimated by bioelectric impedance analysis (BIA). We recruited 15 men [mean age (+/-SD) of 23.93+/-5.12 years and mean body mass index (BMI) of 23.25+/-2.84 kg/m(2)] and 10 women matched for age and BMI. Total body resistance, reactance, and impedance were measured for all participants using BIA, at baseline, after a short sauna bath, and after a rest period. Total, extracellular, and intracellular water compartments were calculated using BIA formulae. There were no significant differences for any of the body water compartments when comparing the measurements taken before and after the sauna bath and after the rest period. However, it remains to be determined whether or not BIA is sensitive to rapid changes in water volume.

### **Clinical implications of thermal therapy in lifestyle-related diseases.**

Biro S, Masuda A, Kihara T, Tei C.

Exp Biol Med (Maywood). 2003 Nov;228(10):1245-9. Department of Cardiovascular, Respiratory and

Metabolic Medicine, Graduate School of Medicine, Kagoshima University, Kagoshima 890-8520, Japan.

Systemic thermal therapy, such as taking a warm-water bath and sauna, induces systemic vasodilation. It was found that repeated sauna therapy (60 degrees C for 15 min) improved hemodynamic parameters, clinical symptoms, cardiac function, and vascular endothelial function in patients with congestive heart failure. Vascular endothelial function is impaired in subjects with lifestyle-related diseases, such as hypertension, hyperlipidemia, diabetes mellitus, obesity, and smoking. Sauna therapy also improved endothelial dysfunction in these subjects, suggesting a preventive role for atherosclerosis. In animal experiments, sauna therapy increases mRNA and protein levels of endothelial nitric oxide synthase (eNOS) in aortas. In normal-weight patients with appetite loss, repeated sauna therapy increased plasma ghrelin concentrations and daily caloric intake and improved feeding behavior. In obese patients, the body weight and body fat significantly decreased after 2 weeks of sauna therapy without increase of plasma ghrelin concentrations. On the basis of these data, sauna therapy may be a promising therapy for patients with lifestyle-related diseases.

### **Sauna-induced rapid weight loss decreases explosive power in women but not in men.**

Gutierrez A, Mesa JL, Ruiz JR, Chiroso LJ, Castillo MJ.

Int J Sports Med. 2003 Oct;24(7):518-22.

Department of Physiology, School of Medicine, University of Granada, Granada, Spain.

This study aimed at investigating to what extent sauna-induced dehydration is effective to rapidly decrease body weight and whether this practice alters strength and/or explosive power (jump capacity) in healthy athletes. We also investigated whether the observed changes could be rapidly reversed through rehydration. Six male (aged 21.6 +/- 1.8 y) and six female (aged 24.5 +/- 3.7 y) athletes who were not familiar with weight cutting procedures were tested on three occasions: 1) before sauna, 2) after three consecutive sauna sessions (3 x 20 min at 70 degrees C, with 5 min rest interval), and 3) after one hour rehydration period (2.5 ml/kg body weight every 15 min). For rehydration, a carbohydrate beverage (6.3 % glucose, 9.5 mmol/l Na (+), 10 degrees C) was used. Evaluation consisted of body composition, strength (row-strength, handgrip-strength) and jump capacity (squat jump, counter-movement jump and elastic capacity). Sauna-induced dehydration, significantly decreased body weight in men (- 1.8 +/- 0.5 %) and women (-1.4 +/- 0.6 %). This reduction could not be rapidly reversed through rehydration. This weight cutting scheme did not affect strength or jump capacity in men. In women, a statistically significant decrease in squat jump was manifested after rehydration compared to pre-sauna values 23.7 +/- 2.2 vs. 25.2 +/- 1.4 cm, p < 0.05). The squat jump decrease in women was linearly and directly related to the percent reduction of body weight.

### **Human monocyte stimulation by experimental whole body hyperthermia.**

Zellner M, Hergovics N, Roth E, Jilma B, Spittler A, Oehler R.

Wien Klin Wochenschr. 2002 Feb 15;114(3):102-7.

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The thermal effect of fever, an evolutionarily conserved acute-phase response, has been associated with better survival and a shorter duration of disease in cases of infection. The molecular consequence of this beneficial fever response is poorly understood. To determine the influence of hyperthermia on human monocytes, which are important for the recognition and elimination of pathogens, twelve healthy volunteers were immersed in a 39.5 degrees C hot water bath to increase their body temperature. The expression of the endotoxin receptor CD14 and the complement receptor CD11b increased after the hot water bath ( $P < 0.05$ ), whereas the expression of the selectin CD62L, which mediates the initial attachment of leukocytes at the endothelium during inflammation, was downregulated after hyperthermia ( $P < 0.05$ ). Comparable changes in monocyte receptor expression were observed after in vitro hyperthermia. Furthermore, 3 hours after in vivo hyperthermia, the response of monocytes to endotoxin was enhanced in an ex vivo lipopolysaccharide stimulation assay, as expressed by a greater TNF-alpha release ( $P < 0.05$ ). We conclude that the thermal effect of fever directly activates monocytes, which increases their ability to respond to bacterial challenge.

### **Repeated sauna treatment improves vascular endothelial and cardiac function in patients with chronic heart failure.**

Kihara T, Biro S, Imamura M, Yoshifuku S, Takasaki K, Ikeda Y, Otsuji Y, Minagoe S, Toyama Y, Tei C.

J Am Coll Cardiol. 2002 Mar 6;39(5):754-9.

First Department of Internal Medicine, Faculty of Medicine, Kagoshima University, Kagoshima, Japan.

**OBJECTIVES:** The purpose of this study was to determine the mechanism by which 60 degrees C sauna treatment improves cardiac function in patients with chronic heart failure (CHF). **BACKGROUND:** We have previously reported that repeated 60 degrees C sauna treatment improves hemodynamic data and clinical symptoms in patients with CHF. We hypothesized that the sauna restores endothelial function and then improves cardiac function. **METHODS:** Twenty patients (62 plus minus 15 years) in New York Heart Association (NYHA) functional class II or III CHF were treated in a dry sauna at 60 degrees C for 15 min and then kept on bed rest with a blanket for 30 min, daily for two weeks. Ten patients with CHF, matched for age, gender and NYHA functional class, were placed on a bed in a temperature-controlled (24 degrees C) room for 45 min as the nontreated group. Using high-resolution ultrasound, we measured the diameter of the brachial artery at rest and during reactive hyperemia (percent flow-mediated dilation, %FMD: endothelium-dependent dilation), as well as after sublingual administration of nitroglycerin (%NTG: endothelium-independent dilation). Cardiac function was evaluated by measuring the concentrations of plasma brain natriuretic peptide (BNP). **RESULTS:** Clinical symptoms were improved in 17 of 20 patients after two weeks of sauna therapy. The %FMD after two-week sauna treatment significantly increased from the baseline value, whereas the %NTG-induced dilation did not. Concentrations of BNP after the two-week sauna treatment decreased significantly. In addition, there was a significant correlation between the change in %FMD and the percent improvement in BNP concentrations in the sauna-treated group. In contrast, none of the variables changed at the two-week interval in the nontreated group. **CONCLUSIONS:** Repeated sauna treatment improves vascular endothelial function, resulting in an improvement in cardiac function and clinical symptoms.

### **Repeated thermal therapy improves impaired vascular endothelial function in patients with coronary risk factors.**

Imamura M, Biro S, Kihara T, Yoshifuku S, Takasaki K, Otsuji Y, Minagoe S, Toyama Y, Tei C.

J Am Coll Cardiol. 2001 Oct;38(4):1083-8.

First Department of Internal Medicine, Faculty of Medicine, Kagoshima University, Sakuragaoka, Kagoshima, Japan.

**OBJECTIVES:** We sought to determine whether sauna therapy, a thermal vasodilation therapy, improves endothelial function in patients with coronary risk factors such as hypercholesterolemia, hypertension, diabetes mellitus and smoking. **BACKGROUND:** Exposure to heat is widely used as a traditional therapy in many different cultures. We have recently found that repeated sauna therapy improves endothelial and cardiac function in patients with chronic heart failure. **METHODS:** Twenty-five men with at least one coronary risk factor (risk group: 38 +/- 7 years) and 10 healthy men without coronary risk factors (control group: 35 +/- 8 years) were enrolled. Patients in the risk group were treated with a 60 degrees C far infrared-ray dry sauna bath for 15 min and then kept in a bed covered with blankets for 30 min once a day for two weeks. To assess endothelial function, brachial artery diameter was measured at rest, during reactive hyperemia (flow-mediated endothelium-dependent dilation [%FMD]), again at rest and after sublingual nitroglycerin administration (endothelium-independent vasodilation [%NTG]) using high-resolution ultrasound. **RESULTS:** The %FMD was significantly impaired in the risk group compared with the control group (4.0 +/- 1.7% vs. 8.2 +/- 2.7%,  $p <$

0.0001), while %NTG was similar (18.7 +/- 4.2% vs. 20.4 +/- 5.1%). Two weeks of sauna therapy significantly improved %FMD in the risk group (4.0 +/- 1.7% to 5.8 +/- 1.3%,  $p < 0.001$ ). In contrast, %NTG did not change after two weeks of sauna therapy (18.7 +/- 4.2% to 18.1 +/- 4.1%). **CONCLUSIONS:** Repeated sauna treatment improves impaired vascular endothelial function in the setting of coronary risk factors, suggesting a therapeutic role for sauna treatment in patients with risk factors for atherosclerosis.

### **Thermal therapy for congestive heart failure: estimation by TEI index.**

Tei C.

J Cardiol. 2001;37 Suppl 1:155-9.

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Systolic dysfunction commonly coexists with diastolic dysfunction in patients with congestive heart failure due to myocardial disease. Also, right ventricular dysfunction is frequently associated with left ventricular dysfunction. The Doppler total ejection isovolume (TEI) index, a combined measurement of systolic and diastolic myocardial performance, is more reflective of overall cardiac function than systolic or diastolic function alone in both ventricles, and provides a conceptually new measure of global cardiac function. Single sauna bathing improves acute hemodynamics and repeated sauna therapy improves cardiac function and clinical symptoms in patients with heart failure. More recently, improvement of vascular endothelial function were observed by repeated sauna therapy in patients with heart failure. The TEI index, combining systolic and diastolic myocardial function, is a promising tool for the quantitative assessment of global cardiac function before and after thermal therapy.

### **The Finnish sauna bath and its use in patients with cardiovascular disease.**

Keast ML, Adamo KB.

J Cardiopulm Rehabil. 2000 Jul-Aug;20(4):225-30.

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The Finnish tradition of sauna bathing is meant to be an experience in relaxation, and the length of time spent in the sauna and the preferred temperature vary considerably among individuals. The pleasures of sauna bathing can be considered safe and without undue risk of cardiac complications even for CVD patients, providing bathing is conducted sensibly for an appropriate period of time, and extremes in temperature are avoided.

### **Sauna-induced myocardial ischemia in patients with coronary artery disease.**

Giannetti N, Juneau M, Arsenault A, Behr MA, Gregoire J, Tessier M, Larivee L.

Am J Med. 1999 Sep;107(3):228-33.

Department of Medicine, Montreal Heart Institute, University of Montreal, Quebec, Canada.

**PURPOSE:** Sauna bathing is a popular recreational activity that is generally considered to be safe. However, there have been case reports of adverse cardiac events. We sought to determine whether sauna use caused myocardial ischemia in patients with coronary artery disease. **METHODS:** Sixteen patients with proven coronary artery disease were submitted to three conditions (rest, exercise, and sauna bathing) with continuous electrocardiographic (ECG) monitoring and regular blood pressure measurements. During each condition, patients were injected with Tc-99 sestamibi followed by nuclear scintigraphic imaging. Perfusion defect scores were calculated in 15 patients. **RESULTS:** Sauna bathing was well tolerated. There was a mean (+/- SD) increase in heart rate of 32% +/- 20% in the sauna (resting mean heart rate = 60 +/- 9 beats per minute vs sauna mean heart rate = 79 +/- 11 beats per minute,  $P < 0.001$ ) and a 13% +/- 6% drop in systolic blood pressure (resting mean systolic blood pressure = 142 +/- 14 mm Hg vs sauna mean systolic blood pressure = 123 +/- 15 mm Hg,  $P < 0.001$ ). There were no arrhythmias or ECG changes in the sauna. Compared with rest, there was significant ischemia during sauna bathing (average perfusion defect score at rest = -0.44 vs average sauna score = -0.93,  $P < 0.001$ ). The perfusion defect score in the sauna was worse than the resting score in 14 of the 15 patients. Sauna-associated perfusion defect scores were highly correlated with exercise-induced scores ( $R^2 = 0.65$ ,  $P < 0.001$ ). **CONCLUSION:** In patients with stable coronary artery disease, sauna use is clinically well tolerated but is associated with scintigraphically demonstrated myocardial ischemia.

### **Acute hemodynamic improvement by thermal vasodilation in congestive heart failure.**

Tei C, Horikiri Y, Park JC, Jeong JW, Chang KS, Toyama Y, Tanaka N.

Circulation. 1995 May 15;91(10):2582-90.

Department of Rehabilitation and Physical Medicine, Kagoshima University, Japan.

**BACKGROUND:** A warm-water bath (WWB) or sauna bath (SB) has generally been considered inappropriate for patients with severe congestive heart failure (CHF). However, a comprehensive investigation of the hemodynamic effects of thermal vasodilation in CHF has not been previously undertaken. **METHODS AND RESULTS:** To investigate the acute hemodynamic effects of thermal vasodilation in CHF, we studied 34 patients with chronic CHF (mean age, 58 +/- 14 years). Clinical stages were New York Heart Association functional class II in 2, III in 19, and IV in 13 patients. Mean ejection fraction was 25 +/- 9%. After a Swan-Ganz catheter was inserted via the right jugular vein, the patient had a WWB for 10 minutes at 41 degrees C or an SB for 15 minutes at 60 degrees C. Blood pressure, ECG, echo-Doppler, expiration gas, and intracardiac pressures were recorded before, during, and 30 minutes after each bath. Oxygen consumption increased mildly, pulmonary arterial blood temperature increased by 1.2 degrees C, and heart rate increased by 20 to 25 beats per minute on average at the end of WWB or SB. Systolic blood pressure showed no significant change. Diastolic blood pressure decreased significantly during SB ( $P < .01$ ). Cardiac and stroke indexes increased and systemic vascular resistances decreased significantly during and after WWB and SB ( $P < .01$ ). Mean pulmonary artery, mean pulmonary capillary wedge, and mean right atrial pressures increased significantly during WWB ( $P < .05$ ) but decreased significantly during SB ( $P < .05$ ). These pressures decreased significantly from the control level after each bath ( $P < .01$ ). Mitral regurgitation associated with CHF decreased during and 30 minutes after each bath. Cardiac dimensions decreased and left ventricular ejection fraction increased significantly after WWB and SB. In an additional study, plasma norepinephrine increased significantly during SB in healthy control subjects and in patients with CHF and returned to control levels by 30 minutes after SB. **CONCLUSIONS:** Hemodynamics improve after WWB or SB in patients with chronic CHF. This is attributable to the reduction in cardiac preload and afterload. Thus, thermal vasodilation can be applied with little risk if appropriately performed and may provide a new nonpharmacological therapy for CHF.

### **[An evaluation of the effect of the sauna on the clinical, laboratory and psychological indices in rheumatoid arthritis]**

Matveikov GP, Marushchak VV.

Ter Arkh. 1993;65(12):48-51.

The direct effect of sauna procedures was assessed in 196 patients with rheumatoid arthritis (RA) in minimal or moderate activity stage. Three temperature and humidity regimens were tested. The optimal conditions occurred at 80 +/- 5 degrees C and relative air humidity 10-20%. Sauna produced a positive effect on locomotor system, psychoemotional status, alleviated pain. Clinico-biochemical and immunological indices of the peripheral blood underwent insignificant transient shifts.

### **[Excretion of nitrogen compounds in sweat during a sauna]**

Czarnowski D, Gorski J. Zakladu Fizjologii AM, Bialymstoku.

Pol Tyg Lek. 1991 Feb 18-Mar 4;46(8-10):186-7

The aim of the study was to determine a loss of nitrogen compounds with sweat in sauna and to estimate their plasma concentration. Sweat was collected during 30 min stay in sauna. Blood was taken before and immediately after the sauna. Concentrations of ammonia, urea, creatinine and uric acid were determined in the both fluids. It has been found, that the concentration of ammonia in sweat exceeds, that in plasma by 77 times. Ammonia plasma concentration following sauna increased by about 60%. Sweat urea concentration exceeded that in plasma by 3.5 times. Plasma urea concentration was significantly reduced after sauna. Sweat creatinine concentration was about two times higher than that in plasma. No uric acid was detected in sweat. Sweating did not affect plasma creatinine and uric acid concentrations. Results indicate that considerable amount of nitrogen is lost with sweat during sauna.