Progress in Cardiovascular Diseases 60 (2018) 635–641

Contents lists available at ScienceDirect

Progress in Cardiovascular Diseases

journal homepage: www.onlinepcd.com

Special Article

Combined Effect of Sauna Bathing and Cardiorespiratory Fitness on the Risk of Sudden Cardiac Deaths in Caucasian Men: A Long-term Prospective Cohort Study

Jari A. Laukkanen [a,b,c,*], Tanjaniina Laukkanen [a], Hassan Khan [d], Maira Babar [e], Setor K. Kunutsor [f,g]

[a] Institute of Public Health and Clinical Nutrition, University of Eastern Finland, Kuopio, Finland
[b] Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland
[c] Central Finland Health Care District, Jyväskylä, Finland
[d] Emory University School of Medicine, Atlanta, GA, USA
[e] Southmead Hospital, North Bristol NHS Trust, BS10 5NB, UK
[f] Translational Health Sciences, Bristol Medical School, University of Bristol, Southmead Hospital, Learning & Research Building (Level 1), Bristol, UK
[g] National Institute for Health Research Bristol Biomedical Research Centre, University Hospitals Bristol NHS Foundation Trust and University of Bristol, Bristol, UK

ARTICLE INFO

Keywords:
Cardiorespiratory fitness
Sauna
Sudden cardiac death

ABSTRACT

Both cardiorespiratory fitness (CRF) and frequency of sauna bathing (FSB) are each strongly and independently associated with sudden cardiac death (SCD) risk. However, the combined effect of CRF and FSB on SCD risk has not been previously investigated. We evaluated the joint impact of CRF and FSB on the risk of SCD in the Kuopio Ischemic Heart Disease prospective cohort study of 2291 men aged 42–61 years at recruitment. Objectively measured CRF and self-reported sauna bathing habits were assessed at baseline. CRF was categorized as low and high (median cutoffs) and FSB as low and high (defined as ≤2 and 3–7 sessions/week respectively). Multivariable adjusted hazard ratios (HRs) with confidence intervals (CIs) were calculated for SCD. During a median follow-up of 26.1 years, 226 SCDs occurred. Comparing high vs low CRF, the HR (95% CIs) for SCD in analysis adjusted for several established risk factors was 0.48 (0.34–0.67). Comparing high vs low FSB, the corresponding HR was 0.67 (0.46–0.98). Compared to men with low CRF & low FSB, the multivariate-adjusted HRs of SCD for the following groups: high CRF & high FSB; high CRF & low FSB; and low CRF & high FSB were 0.31 (0.16–0.63), 0.49 (0.34–0.70), and 0.71 (0.45–1.10) respectively. In a general male Caucasian population, the combined effect of high aerobic fitness (as measured by CRF) and frequent sauna baths is associated with a substantially lowered risk of future SCD compared with high CRF or frequent sauna bathing alone.

Contents

Abbreviations and acronyms: BMI, body mass index; CHD, coronary heart disease; CRF, cardiorespiratory fitness; CRP, C-reactive protein; CV, Cardiovascular; CVD, cardiovascular disease; ECG, electrocardiogram; FSB, frequency of sauna bathing; KIHD, Kuopio Ischaemic Heart Disease; PA, Physical activity; SCD, sudden cardiac death; SES, socio-economic status; VO_{2max}, maximal oxygen uptake.

Statement of Conflict of Interest: see page 640.

* Address reprint requests to Jari A. Laukkanen, MD, PhD, Institute of Public Health and Clinical Nutrition, University of Eastern Finland, P.O. Box 1627, FIN-70211 Kuopio, Finland.
E-mail address: jariantero.laukkanen@uef.fi (J.A. Laukkanen).

https://doi.org/10.1016/j.pcad.2018.03.005
0033-0620/

Sudden cardiac death (SCD) is a global public health problem which accounts for 15–20% of all deaths, [1] and coronary heart disease (CHD) is known to be the most common pathology underlying SCD.[2] Though SCD and CHD share common atherosclerotic risk factors[3] and these factors explain a large proportion of the risk of SCD[4]; its pathogenesis is still not fully established as many cases are idiopathic[5] and it also appears other additional factors may be involved. These atherosclerotic risk factors are often absent in a large proportion of SCD victims,[6] which makes the identification of individuals at increased SCD risk and its prevention a difficult undertaking.

Cardiorespiratory fitness (CRF), as measured by maximal oxygen uptake (VO_{2max}), is an indicator of cardiovascular (CV) and pulmonary function, an index of the level of physical activity (PA), and is considered to be the gold standard for assessing aerobic capacity.[7] CRF has been shown to be consistently and independently associated with a reduced risk of major adverse cardiovascular outcomes including SCD, among general population settings.[8–11] Evidence also suggests that CRF might improve SCD risk prediction beyond that of traditional risk factors.[9] Sauna bathing, a traditional Finnish activity which is commonly used for the purposes of pleasure, relaxation, and wellness, and becoming a popular activity in many other countries,[12,13] has been observed to be linked to several health benefits. These include improvement in the pain and symptoms associated with musculoskeletal diseases [14]; treatment of chronic headache [15]; improvement in CV function[16,17] and reduced risk of respiratory diseases,[18,19] hypertension,[20] and neurocognitive disease.[21] Recent long-term observational epidemiological evidence has shown that having frequent sauna baths is independently associated with a reduced risk of SCD.[22]

Although CRF and sauna bathing are each associated with a reduced risk of SCD in the general population, the combined effect of these risk markers on the risk of SCD is not known. We hypothesized that a combination of high CRF and frequent sauna bathing may further reduce the risk of SCD in the general population. In this context, using a population-based prospective cohort of 2291 Caucasian men, we evaluated the combined association of CRF and frequency of sauna bathing (FSB) with the risk of SCD. To enable direct comparisons, we initially assessed the separate associations of CRF and FSB with the risk of SCD.

Methods

Study design and population

Participants in this study were part of the Kuopio Ischemic Heart Disease (KIHD) risk factor study, which is an ongoing population-based prospective cohort study comprising a representative sample of middle-aged men aged 42–61 years recruited from the town of Kuopio or its surrounding rural communities in eastern Finland. A detailed report of recruitment methods for the KIHD study has been described in previous papers.[21,23] A representative sample of 3433 randomly selected potentially eligible men were invited for screening examinations carried out between March 1984 and December 1989. Of this number, 3235 were found to be eligible and 2682 (78%) provided consent to participate in the study. In the current analyses, 2291 men had complete information on CRF and FSB, relevant covariates and SCD outcomes. The study protocol was approved by the Research Ethics Committee of the University of Eastern Finland and written informed consent was obtained from all participants. The investigation was concordant with the principles outlined in the Declaration of Helsinki and its future amendments.

Measurement of risk markers

Participants were instructed to fast overnight, abstain from alcohol consumption for at least 3 days, and to keep away from smoking for at least 12 h prior to blood specimen collections. The cholesterol contents of serum lipoprotein fractions and triglycerides were measured enzymatically (Boehringer Mannheim, Germany). Serum C-reactive protein (CRP) was measured with an immunometric assay (Immulite High Sensitivity C-Reactive Protein Assay; DPC, Los Angeles, CA, USA). The assessment of age, smoking, alcohol consumption, level of physical activity, socio-economic status (SES), prevalent diseases, medication history, and family history of diseases employed the use of self-administered health and lifestyle questionnaires.[24] History of type 2 diabetes was defined as having a clinical diagnosis of diabetes and regular treatment with diet or medications, fasting plasma glucose ≥7.0 mmol/l, or according to self-reports. History of CHD was based on a previous myocardial infarction, angina pectoris, the use of nitroglycerin for chest pain once a week or more frequently or chest pain. The validated KIHD 12-month leisure-time physical activity history questionnaire was used to assess the energy expenditure of PA.[25,26] Adulthood SES was assessed as a combined index of income, education, occupation, occupational prestige, material standard of living, and housing conditions, all of which were assessed with self-reported questionnaires.[27,28] Alcohol consumption was assessed using the Nordic Alcohol Consumption Inventory. Resting blood pressure was measured between 08:00 and 10:00 h with a random-zero sphygmomanometer using a standardized protocol.

Assessment of CRF and FSB

CRF, as measured by VO_{2max}, was assessed using respiratory gas exchange analyzers (Medical Graphics, MCG, St. Paul, Minnesota) during cycle ergometer exercise testing as described in detail elsewhere.[21] Briefly, a maximal symptom-limited exercise tolerance test was performed between 08:00 and 10:00 h using an electrically braked cycle ergometer. The standardized testing protocol comprised of a 3-minute warm-up at 50 W followed by a step-by-step increase in workload by 20 W/min with direct analyses of respiratory gases. An experienced physician assisted by a nurse supervised the exercise tests and ensured safety. Assessment of FSB was based on a traditional Finnish sauna which has air with a relative humidity of 10 to 20%. The recommended temperature for a sauna bath is from 80 °C to 100 °C at the level of the bather's head, but it is lower at the floor-level which ensures efficient ventilation and makes sure the conditions are comfortable for sauna bathers.[29] The weekly frequency and duration of sauna sessions and temperature in the sauna room were assessed by a self-administered questionnaire.[20,21] An experienced nurse checked the questionnaires at the time of baseline examination.