Author’s response to reviews

Title: Sauna bathing is associated with reduced cardiovascular mortality and improves risk prediction in men and women. A prospective cohort study

Authors:

Tanjaniina Laukkanen (tanjaniina.laukkanen@uef.fi)

Setor Kuntsor (skk31@cantab.net)

Hassan Khan (hassan.khan@emory.edu)

Francesco Zaccardi (frazac@fastwebnet.it)

Peter Willeit (peter.willeit@i-med.ac.at)

Jari Laukkanen (jari.a.laukkanen@jyu.fi)

Version: 2 Date: 10 Oct 2018

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Editorial comments:

- "In your 'Ethics approval and consent to participate' declaration, please add the ethics approval/reference number(s)"

Please provide this/these.

RE: Done

Editorial comments:

Please note that author Tanjaniina Laukkanen has not confirmed authorship for this manuscript. Please note that, should we decide to accept this paper, we will not be able to until all authors have confirmed authorship. If you could please remind this author to respond to the email we sent in this regard, we'd appreciate it.

RE: Done
Reviewer reports:

Reviewer #1: Hirofumi Tanaka

The authors made addressed all of my concerns.

Reviewer #2: Joel Trinity

The authors have addressed all concerns from the initial review and the manuscript has been improved based on the revisions.

I have only a few minor comments:

1) Page 8 lines 226-227: Consider rewording this sentence to improve clarity.

RE: We have now reworded the sentence as suggested.

2) Page 10 lines 294-297: The explanation that long-term sauna use may be beneficial by reducing high blood pressure does not appear to be supported by the findings of the current study. All groups, independent of sauna frequency and duration, had similar rates of hypertension (41-43%) and similar systolic and diastolic blood pressures.

RE: It is true that there are no significant differences in the prevalence of hypertension and the levels of blood pressure between the sauna frequency groups at baseline. However, in our previous prospective study (Am J Hypertens 2017, 30(11):1120-1125) which was based on participants without a history of hypertension at baseline, we showed that the incidence of hypertension during the follow-up was the lowest among those with the highest frequency of sauna use. This study findings support our current study and its discussion about possible mechanisms of the relationship between sauna bathing and fatal CVD events.

3) Page 11 lines 313-314: Technically the statement that "increasing the frequency of sauna sessions per week is associated with a decrease in risk of fatal CVD" is not correct as this implies a longitudinal study design where sauna frequency was altered and risk of CVD was assessed. Should be stated that a history of more frequent sauna use is associated with a decrease in risk of fatal CVD. The authors provide no evidence that changing sauna use in a given individual is beneficial.

RE: Thank you for the important comment. We have now corrected the sentence as requested.
Reviewer #5: Oliver Gibson

Thank you for the response to my initial comments on your manuscript.

The amendments to the paper based on my own, and the well-considered input of the other reviewers has facilitated another interesting analysis from your group.

I am largely satisfied by your responses and appreciate that this is your paper and therefore you are free to amend as you see fit, however I believe that your offer to include further discussion relating to the following review comment of mine is one that is still pertinent (original review comment below).

“Results – It is interesting that more frequent Sauna use is related to higher BMI, alcohol intake and energy intake. Is it the case that access to Sauna, and/or use is limited to only a specific cohort? i.e. wealthy? Does this impact upon their ability to seek medical care or other influences on health more potent than Sauna?”

RE: Thank you for the comment about this important issue.

Our baseline cross-sectional analysis showed that BMI, alcohol consumption and energy intake varied between sauna frequency groups – participants who had 4-7 sauna baths per week had higher BMI, they used more alcohol and had higher energy intake compared to those who had only one sauna bath session per week. Our analysis showed that the beneficial effect of sauna on CVD mortality was independent of BMI. Higher BMI is directly related to higher energy intake, including the use of alcohol. We have adjusted our results using a comprehensive panel of important covariates, and the associations remained significant.

Table 1 “Socioeconomic status (SES) and living conditions characteristics” provide some further explanations; SES is the highest in the group who use sauna 2-3/week. Academics use sauna less often compared to others, but they are not in the highest income group in Finland. Those who use sauna most, usually have a family house, they have longer working hours and have the highest income, and they may have better access to own sauna. However, they may not have more time use the sauna bath due to longer working hours.

Sauna habits are highly culture-related and we have around 3 million saunas for 5 million people in Finland; people has access to sauna use regardless of income levels. In Finnish culture, sauna ownership does not directly correlate with financial status (even the less wealthy people do own saunas at home); in contrast to other countries where sauna bathing habits are more related to spas, fitness and a healthy/wealthy lifestyle.
This issue might be culture-related, as we have strong and free public sector health-care for everyone, so the health or the use of health-care services is not so much related to socioeconomic status.

We have provided further discussion on page 13: “In Finland, sauna is easily accessible to the majority of the population independently of socioeconomic and educational backgrounds. Sauna bathing is an activity that has been a tradition in Finland for thousands of years and sauna ownership does not correlate with financial status in Finland. It is therefore highly unlikely that these factors may explain the observed findings on sauna and fatal CVD events in this population. Indeed, SES did not differ when comparing 1 vs. 4-7 times/week frequency groups; SES level was the highest among those using sauna 2-3 times/week. Based on our cross-sectional baseline data, the most frequent sauna use was directly related to the level of physical activity (kcal/day), BMI, energy intake and alcohol consumption.”

Given that a growing body of evidence is forming relating to the benefits of passive heating (incl Sauna) as a therapeutic intervention, there is now a clear need to determine whether the efficacy of such an intervention extends to all cohorts. I believe within this analysis you have the data to begin to answer this challenging but important question, so please consider adding further data (if available and of sufficient quality) and further discussion on this point. It would add greater impact if this could be framed both in Scandinavia, and elsewhere in the developed world where the use of Sauna may be less.

RE: Thank you for the important question. It would be very interesting to add further data on sauna from Scandinavia and other countries. Unfortunately, the KIHD is currently the only population-based cohort in which sauna habits have been collected with long-term follow-up for cardiovascular outcomes. We are pursuing efforts in new study populations to evaluate the benefits of passive heating such as sauna bathing as a new therapeutic intervention.