

T. Kunz-Plapp, J. Hackenbruch, J.W. Schipper

Responses to interactive comments of Anonymous Referee #2
C2218–C2224

on the discussion paper:

**“Factors of subjective heat stress of urban citizens in contexts of everyday life”
by T. Kunz-Plapp et al.**

Corresponding author: tina.kunz-plapp@kit.edu

Dear Reviewer,

Thank you very much for your time and your helpful questions and comments. We appreciate them very much. In the following lines, we respond to all of them and outline how we address them in a restructured and revised manuscript.

1. Introduction (section 1) Heat Stress (HS) economic impacts - Heat stress and productivity at work: (Burke, Hsiang, und Miguel 2015): new empirical foundation for modelling economic loss in response to climate change.

A.: Thank you for the additional reference by Burke et al., 2015. This article was published after we submitted our manuscript.

We include it in the introduction in the revised manuscript.

“Due to the urban heat island effect” (Oke, 1973) – strange reference here, put it at the end of the phrase.

A.: We reword the phrase so that the reference fits nicely to the other references at the end of the phrase.

“Reducing impacts of heat stress thus is among the top issues of urban climate change adaptation strategies in Europe (EEA, 2012; Revi et al., 2014)”. – Thus, reducing: : : Highly dependent to world regions, specially when it comes to different reduction alternatives (see e.g. (Fernandez Milan und Creutzig 2015)).

A.:

“Thus, reducing ...”: We reword the phrase.

We agree that reduction of heat wave impacts is dependent on world regions. Therefore, we had already included “in Europe” in the manuscript.

In the revised manuscript, we make the regional reference in the introduction clearer. We include the additional reference (Fernandez Milan and Creutzig 2015) in section 2 of the revised paper (see below).

2. Unclear structure of the review part (section 2).

Section 2.1 starts with a review on mortality, then it describes biometeorological studies and their methodology, and then in section 2.2. “the social science perspective”, it covers both morbidity and the so-called “subjective HS” and HS in general (including both impacts and adaptive behaviours). It is a bit unclear what is what.

Suggestion: Rename the whole section as “Literature review” and divide it into clearer fields of research, or if difficult, extrinsic and intrinsic factors affecting HS. Otherwise, according to what is reported (e.g. one on mortality, one on HS, one on subjective HS).

A.: Section 2 summarizes factors for heat stress or heat-related health impacts (mortality, morbidity) that have been found in different research strands and that were relevant for

developing the study concept because they are potentially determining factors for subjective heat stress.

For the distinction of intrinsic and extrinsic factors please see our response below.

We rename the section “Factors for heat stress” in the revised manuscript.

Mix of past/present when reviewing literature on HS - Why in past sentence when listing factors if location/ date is not given? I'd suggest “has been related to...”.

A.: We check the revised version of the manuscript carefully for the correct use of tenses.

Characteristics of vulnerability to heat, including socioeconomic vulnerability, have been reviewed before. Typically, literature distinguish between extrinsic and intrinsic factors (see e.g. (Fernandez Milan und Creutzig 2015)). I suggest making this distinction in the section.

A.: Thank you for this additional reference and the distinction of extrinsic and intrinsic factors.

We adopt it in the section 2.1 in the revised manuscript.

A recent review, (Gronlund 2014), focuses specifically on racial and SES vulnerability and lists other reviews that address this topic as well. The authors of this paper are missing some key papers in their review of heat-associated mortality, e.g., (Uejio u. a. 2011; Madrigano u. a. 2013; Smargiassi u. a. 2009; Zanobetti u. a. 2013; Fernandez Milan und Creutzig 2015), Additionally, the authors imply that their research focuses on HS, but their HS-factors literature review focuses only on mortality. They should also include in their review part susceptibility to heat-associated morbidity.

A.: Thank you for the additional references. As mentioned above, in section 2 we focus on factors for heat stress or heat-related health impacts that have been discussed in different research strands and that were relevant for developing the study concept. This was definitely the case for epidemiologic studies on health impacts from heat. Therefore, they had to be included. As our aim was not an exhaustive review on epidemiologic literature, we may have missed references.

In the revised manuscript, we include the additional references in section 2.1 where appropriate. We include as well examples for heat-associated morbidity.

Better (and earlier) definition of “subjective heat stress”, as comparison to “individual heat stress”/ heat vulnerability? Why selecting that term? (Found only in line 26, and with no reference ““heat stress” here refers to the subjective and individual experiencing of heat as stress and is measured with the statements expressed by individual study participants.””).

A.: We agree that an earlier definition of subjective heat stress would be helpful.

We address the definition and origin of the term “subjective heat stress” in the introduction as follows:

So far, only a few social science studies have investigated individual, subjective experiencing of heat as stress by introducing the term subjective heat stress (Großmann et al., 2012; Pfaffenbach and Siuda, 2010). “Subjective heat stress” hereby refers to the individual and self-reported assessments of respondents to what extent they experience hot summer temperature as stress.”

Unclear the distinction between heat morbidity, heat stress and subjective heat stress in the review paragraph (p 4624, line 25 – p.4625 line 17).

A.: The different research strands in the review paragraph from different disciplines approach heat and its impact on humans with different concepts, methods and operationalizations, respectively: heat morbidity, (physiological) heat stress and subjective heat stress.

In the revised manuscript, we make the distinctions between mortality/morbidity, (physiological) heat stress and subjective heat stress clearer.

What is chronological age? “Studies on the vulnerability of elderly citizens to heat in the UK (Abrahamson et al., 2009; Wolf et al., 2010), the US (Sampson et al., 2013; Sheridan, 2007), and Australia (Hansen et al., 2011) suggested that elderly persons did not perceived themselves as vulnerable to heat just because of their chronological age.”

A.: “Chronological age” is a term used in the study by Abrahamson et al. 2009. It refers to the distinction of chronological age in years and the subjective age experienced by a person.

To avoid confusion, we reword it to “chronological age in years” in the revised manuscript.

3 Methods

3.1 Fine methods, but a bit unclear the overall methodology (in terms of questions/ answers and what do they mean for the research question). Maybe a Figure/ Table on this? (e.g. table with “types of question”).

A.: We agree that a table with all relevant variables would be helpful for clarity and for shortening the text.

(see also comments by Reviewer 1 and our response)

For the revised manuscript, we prepare a new table 1 with all variables and scores.

Make clearer to the reader how “subjective HS” is measured from the beginning.

A.: We add the definition and measurement of subjective heat stress in the introduction and in section 3 (see above).

Concept of the study: shorter (this is not the interesting part for the reader, supposedly).

A.: We will shorten the text in the revised manuscript (see above).

Why not just a graph with peak T during the study period and showing the HW days?

A.: We insert a figure with temperature data (daily max, min and average) in the 4 weeks before the survey.

“(: :) subjective heat stress in everyday life experience was operationalized as subjective heat stress in general, at home, and at work as dependent variables and put in the context of subjective heat stress during twelve further typical daily activities”- ok but explain directly how you measure it.

A.: This is included in the revised manuscript in the new table 1 and in the text of the revised manuscript as follows:

“For all of them, subjective heat stress was measured using the question “During a hot weather period, to what extent do you experience heat as stress (... in general / at home / at work)?”

“(..) To identify the main determinant of heat stress, a wide range of factors associated with heat stress reported in previous research was considered. They included health (subjective health status, health symptoms, and impairments from the heat), negative coping attitude (agreement to the statement that one is helplessly subjected to the heat), coping behaviour, elements of the urban built environment, and a number of social demographic characteristics”. Are these the dependent variables? Or how you measure subjective HS?

A.: The dependent variables in the study concept are subjective heat stress in general, at home, and at work. They are also included in the new table 1. How we measure the subjective heat stress is explained in our previous answer.

3.2 OK Why not summary table with main socioec. variables? Refer to Table 1 in the text.

A.: Please see our responses comments above. We prepare a new Table 1.

4. Results

Brief intro to help the reader. Make it shorter, and more precise, by using the info in Tables.

A.: We add a brief introduction and we shorten the text in the revised manuscript.

English “In the context of the increased likelihood of longer, more frequent and more intense heat waves in Europe, which has been recently concluded by the IPCC again (IPCC, 2013), prevention of the health consequences of heat stress of urban citizens is an emerging environmental challenge (WHO and WMO, 2012).” – reformulate.

A.: We shorten the first paragraph of the introduction in the revised manuscript and this sentence, too.

“: : dramatically show the magnitude of the impacts of such extreme events on human health”. “2.2 Factors of HS in (from) a social science perspective” “(: : :) heat stress” here refers to the subjective and individual experiencing of heat as stress and is measured with the statements expressed by individual study participants”. Write clearer: this is your contribution you are trying to highlight

A.: We do so.

“The outlined results from previous surveys on subjective heat stress suggest that lots of socio-demographic, health, and behavioural factors and many factors related to the built environment help to explain the observed differences. As these results have been obtained in bivariate analyses and comparisons, the previous studies, however, limit conclusions across the factors’ effects on subjective heat stress and conclusions on major or minor determinants for subjective heat stress. Additionally, it is not yet clear what proportion of observed variability in subjective heat stress they actually explain. Furthermore, as for some of the mentioned studies the data collection took place without preceding pronounced hotweather periods, the actual weather conditions and the fact that respondents had to rely on their memories of heat experience might have influenced the responses (Abrahamson et al., 2009)”.

Make use of abbreviations: e.g. Heat stress: HS.

A.: We use the abbreviation SHS for “subjective heat stress” in the revised manuscript.

References

Burke, Marshall, Solomon M. Hsiang, und Edward Miguel. 2015. "Global Non-Linear Effect of Temperature on Economic Production". Nature advance online publication (Oktober). doi:10.1038/nature15725.

Fernandez Milan, Blanca, und Felix Creutzig. 2015. "Reducing urban heat wave risk in the 21st century". Current Opinion in Environmental Sustainability, Open Issue, 14 (Juni): 221–31.

doi:10.1016/j.cosust.2015.08.002. Gronlund, Carina J. 2014. "Racial and Socioeconomic

Disparities in Heat-Related Health Effects and Their Mechanisms: A Review". *Current Epidemiology Reports* 1 (3): 165–73. doi:10.1007/s40471-014-0014-4.

Madrigano, Jaime, Murray A. Mittleman, Andrea Baccarelli, Robert Goldberg, Steven Melly, Stephanie von Klot, und Joel Schwartz. 2013. "Temperature, Myocardial Infarction, and Mortality: Effect Modification by Individual and Area-Level Characteristics". *Epidemiology (Cambridge, Mass.)* 24 (3): 439–46. doi:10.1097/EDE.0b013e3182878397.

Smargiassi, A., M. S. Goldberg, C. Plante, M. Fournier, Y. Baudouin, und T. Kosatsky. 2009. "Variation of Daily Warm Season Mortality as a Function of Micro-Urban Heat Islands". *Journal of Epidemiology and Community Health* 63 (8): 659–64. doi:10.1136/jech.2008.078147.

Uejio, Christopher K., Olga V. Wilhelmi, Jay S. Golden, David M. Mills, Sam P. Gulino, und Jason P. Samenow. 2011. "Intra-urban societal vulnerability to extreme heat: The role of heat exposure and the built environment, socioeconomics, and neighborhood stability". *Health & Place, Geographies of Care*, 17 (2): 498–507. doi:10.1016/j.healthplace.2010.12.005.

Zanobetti, Antonella, Marie S. O'Neill, Carina J. Gronlund, und Joel D. Schwartz. 2013. "Susceptibility to Mortality in Weather Extremes: Effect Modification by Personal and Small-Area Characteristics". *Epidemiology* 24 (6): 809–19. doi:10.1097/01.ede.0000434432.06765.91.

A.: We add the references in the revised manuscript.

#####

Specific

1. Is the amount and quality of supplementary material (if any) appropriate?

Yes

2. Does the paper address relevant scientific and/or technical questions within the scope of NHESS? Yes

3. Does the paper present new data and/or novel concepts, ideas, tools, methods or results?

Yes

4. Are these up to international standards? Yes

5. Are the scientific methods and assumptions valid and outlined clearly? In theory yes, but could be clear to the reader with a re-writing exercise.

A.: We revise the manuscript, in particular sections 1, 2 and 3.

6. Are the results sufficient to support the interpretations and the conclusions? Yes. Also authors address the limitations openly in the discussion part.

7. Does the author reach substantial conclusions? Yes, however these should be written in a more focused way, avoiding repeating the results part. Suggestion: think what has to be said to a policymaker, and why is YOUR study relevant, compared to others.

A.: Thank you very much for your advice. We shorten the conclusions and try to avoid repetition as far as possible.

8. Is the description of the data used, the methods used, the experiments and calculations made, and the results obtained sufficiently complete and accurate to allow their reproduction by fellow scientists (traceability of results)? Yes, however, it is unclear how the survey a) was structured b) designed, and c) looked like (number of questions?)

A.: We have already included information on the type of questions in the manuscript. In the revised manuscript, we include information on the number of questions (->28) and the type of sampling (random sample). The structure of the questionnaire corresponds to the information given in the new table 1.

9. Does the title clearly and unambiguously reflect the contents of the paper? Yes, but Iod suggest a shorter and more concise title e.g. "Urban subjective heat stress throughout the day"

A.: In our opinion, the title reflects the content of the paper precisely. We therefore prefer to keep the original title.

10. Does the abstract provide a concise, complete and unambiguous summary of the work done and the results obtained? Yes.

11. Are the title and the abstract pertinent, and easy to understand to a wide and diversified audience? See answer 9. I would include a brief clarification of what subjective HS is, to capture attention of readers (that's what's new, isn't it?)

A.: Thank you for suggesting this. We include it in the abstract.

12. Are mathematical formulae, symbols, abbreviations and units correctly defined and used? If the formulae, symbols or abbreviations are numerous, are there tables or appendixes listing them?

13. Is the size, quality and readability of each figure adequate to the type and quantity of data presented? I would add a figure with "agglomerated data" (e.g. coping measures: yes /no/ would have liked to, instead of all the measures). Don't understand why some coloured, some not. Figure 4 has no title (although it does have captionation).

A.: In response to reviewer 1 and reviewer 2 we insert a new table 1 in the revised manuscript that lists all variables and scores and their measurements (see also above). In the revised manuscript we use a color code in figure 3 and 4 that is still readable when printed in black and white.

14. Does the author give proper credit to previous and/or related work, and does he/she indicate clearly his/her own contribution? Yes, but the distinction between subjective HS and heat vulnerability (although clear after reading the whole article) should be explicitly addressed before.

A.: In our revised version with the earlier definition of subjective heat stress (see responses above), this distinction will be clearer.

15. Are the number and quality of the references appropriate? Yes, some additional given already. Only a bit unclear the distinction between fields reviewed.

A.: Please see responses above referring to section 2.

16. Are the references accessible by fellow scientists?

17. Is the overall presentation well structured, clear and easy to understand by a wide and general audience?

18. Is the length of the paper adequate, too long or too short? I suggest to make it shorter, specially sections indicated above.

19. Is there any part of the paper (title, abstract, main text, formulae, symbols, figures and their captions, tables, list of references, appendixes) that needs to be clarified, reduced, added, combined, or eliminated? See detailed comments.

A.: Please see our responses above.

20. Is the technical language precise and understandable by fellow scientists? yes

21. Is the English language of good quality, fluent, simple and easy to read and understand by a wide and diversified audience? Refine some parts. Shorter phrases.

A.: We consider this in the revised manuscript.

Thank you very much again for your time and your comments.

Tina Kunz-Plapp, Janus W. Schipper, Julia Hackenbruch