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Experimental assessment of thermal sensation and thermal comfort of sedentary subjects: a scoping review protocol

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Abstract

Thermal comfort affects satisfaction in the workplace, which impacts work efficiency and productivity. Since office workers spend most of their working hours performing sedentary tasks, a scoping review is proposed to contextualize how thermal sensation and thermal comfort are experimentally assessed in the scientific literature. This work presents the scoping review protocol for the scoping review. It follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for systematic review protocols (PRISMA-P). The scoping review will be elaborated based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR). The scoping review will consider peer-reviewed articles written in English, published or in-press. Grey literature and conference papers will be excluded. Only studies performing the experimental assessment of thermal sensation and thermal comfort of human subjects engaged in sedentary activities within homogeneous environments will be considered suitable for the scoping review. Studies will be retrieved from the Journal Storage (JSTOR), PubMed, Scopus, and Web of Science databases. The search strategy will consist of the use of the expression ("thermal comfort" OR "therm* sensation" OR "thermosensation") AND ("sedentary" or "office work*" or "office task*"). After removing duplicates, the remaining studies will have their title, abstract, and keywords screened. Studies meeting the eligibility criteria will be selected for full-text screening. Data items will be summarized using summary tables, and their reporting will consider the PRISMA-ScR checklist. The scoping review aims to summarize the existing scientific evidence and identify research needs to experimentally assess the thermal sensation and the thermal comfort of subjects performing sedentary tasks.

1. INTRODUCTION

Humans are highly sensitive to thermal conditions, which affect their physiological state, mood, and behavior (Parsons, 2003). Thermal discomfort is a significant cause of dissatisfaction in the workplace and a predictor of low productivity (Huizenga et al., 2006). Concomitantly, the replacement of manual labor with sedentary work is regarded as a major emerging risk due to the increase of digital work (EU-OSHA, 2018), since about 75% of the working hours of office workers are now spent in sedentary activities (Thorp et al., 2012; Toomingas et al., 2012).

Considering these aspects, the proposed scoping review aims to address how thermal stress (TS) and thermal comfort (TC) of sedentary individuals in indoor conditions have been assessed in the scientific literature. The scoping review will contextualize the scientific evidence on the experimental assessment of TS and TC while sedentary work is performed in

homogenous and steady-state indoor environments. The scoping review will be guided by the following research questions: (i) What are the bibliometric aspects of the identified publications (number of studies and their country of publication)? (ii) What are the considered experimental design elements (duration of the experiment, characteristics of participants, parameters measured and subjective assessment of TS and TC)? and (iii) How can studies be classified according to the assessment of TS and TC?

The scoping review will follow an extension of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009), the PRISMA extension for scoping reviews (PRISMA-ScR) (Tricco et al., 2018). The scoping review protocol is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for systematic review protocols (PRISMA-P) (Moher et al., 2015). PRISMA-P is used since, to date, there are no specific guidelines for the development of scoping review protocols.

The relevance of the formulation of a review protocol to conduct a scoping review is based on the following aspects: (i) it supports the careful planning of a review; (ii) it ensures the reproducibility of the review and supports the previous documentation of methods before the beginning of the review, (iii) it prevents arbitrary decision-making concerning inclusion criteria and extraction of data, and (iv) it reduces duplication of efforts, among other advantages. The present scoping review protocol is not registered in the International prospective register of systematic reviews (PROSPERO), which currently does not accept the registration of scoping reviews, literature reviews, or mapping reviews (NIRH, 2019).

2. MATERIALS AND METHODS

The PRISMA-P checklist is the document guiding the elaboration of the scoping review protocol. It contains 17 numbered items, and its items are categorized into three main sections: administrative information, introduction, and methods (Moher et al., 2015; Shamseer et al., 2015). The compliance with the PRISMA-P checklist is presented in Annex I. Sections 2.1 to 2.90 present the description of methods of the scoping review, as stated in items 6 to 17 of the PRISMA-P checklist.

2.1. Eligibility criteria

The scoping review will consider published or in press peer-reviewed articles, written in English. The eligibility criteria consider the exclusion of grey literature and conference papers. The assessment of grey literature is not considered since the lack of peer review can lead to great variability in the quality of studies, requiring the development of specific quality appraisal techniques and methods (Adams et al., 2017). Other criteria are presented in Sections 2.1.1 and 2.1.2.

2.1.1. Type of studies

The scoping review will consider studies involving the experimental assessment of TS and TC in humans. Only experiments conducted with healthy adults of both genders will be considered suitable. Therefore, studies assessing specific groups, such as the elderly, children, or athletes, will be excluded from the scoping review.

Studies considering outdoor and heterogeneous conditions will be excluded from the scoping review. Heterogeneous environments present the following variations: transient environments, cycles and drifts, and non-uniformities (such as radiant asymmetry and thermal stratification) (Mishra et al., 2016).

2.1.2. Other inclusion criteria

Since the scoping review will only consider studies carried out experimentally in homogeneous environments, theoretical studies will be excluded. Considering that the environmental conditions are critical for the research questions, only studies reporting the physical quantities of the thermal environment will be considered suitable for the scoping review. Also, the following criteria for inclusion of studies may be considered:

- Sedentary activities, i.e., those up to a limit of 1.5 met (SBRN, 2012).
- Studies evaluating thermal sensation votes or TC subjectively.

- Studies that include physiological indicators of comfort (such as average skin temperature, ocular dryness, local or extraneous temperature, evaluation of the differences between the trunk and the extremities, among others).

2.2. Information sources

The identification of studies for the scoping review considered searches in the following databases: Journal Storage (JSTOR), PubMed (which includes Medline), Scopus (which includes ScienceDirect), and Web of Science. These databases are currently the most relevant in the engineering field of knowledge and will support the identification of pertinent information for the scoping review.

2.3. Search strategy

The search strategy will be based on two groups of keywords. These groups will be linked through the Boolean operators 'AND' and 'OR' as follows: ("thermal comfort" OR "therm* sensation" OR "thermosensation") AND ("sedentary" or "office work*" or "office task*"). The expression "office work*" is used to account for office work or workers. The expressions "office work*" or "office task*" are included to support the identification of studies that do not specifically refer to sedentary work.

The inclusion of the expression office worker or office task is based on ISO 8996:2004 (ISO, 2004). Considering the 'Method A' for the evaluation of the metabolic rate at level 2 (observation), office work or office tasks (use of computers, writing, and reading, mostly) account for a total metabolic rate of 70 Wm^{-2} (or approximately 1.2 met), which includes these activities in sedentary work. This metabolic rate corresponds to the addition of the baseline metabolic rate to the metabolic rate for sitting body postures (0 Wm^{-2}) to the metabolic rate for the body motion related to work speed (work with hands at a medium workload, equivalent to a mean of 70 Wm^{-2}).

The search strategy for each of the considered information sources is presented in Annex II. The terms "indoor" or "climatic chamber" were not considered to allow a broader scope of results, as these conditions might not be mentioned in some studies.

In addition to searching the selected databases, a snowballing approach will be considered to identify other relevant studies. The approach considers the identification of peer-reviewed articles in the reference lists of all the selected studies. This process can be referred to as "backward snowballing" (Wohlin, 2014). The studies identified through the snowballing approach are also subject to the eligibility criteria defined in Section 2.1.

2.4. Study records

Once the search is complete, the results from each information source will be retrieved for further assessment. The identified studies will be compiled in a spreadsheet, as presented in Annex III. The obtained records will be exported to EndNote X8 (Clarivate Analytics) to identify repeated records.

After removing duplicates, two independent reviewers will examine the title, abstract, and keywords of the remaining studies. After this step, the full text of studies meeting the eligibility criteria will be retrieved and assessed. If the inclusion of a study is unclear, the full text will be assessed by two independent reviewers.

2.5. Data items

Tables will be prepared to summarize the data items identified in the selected studies. Data items to be assessed are divided into two groups: general and a specific synthesis. In these groups, the outcomes of each study will be summarized for comparison and discussion. When reported data are insufficient or unclear, the corresponding author of the studies will be contacted through any available contact information for further clarification.

In the first group, bibliometric aspects and the experimental design are assessed. In the bibliometric assessment, the number of studies per year and their publication place (based on the first author's affiliation) will be assessed. In the assessment of the experimental design, the presence of written consent, the total duration of the experiment, the sample size, and the characteristics of the sample will be assessed. This section also presents the objective

parameters measured by each study and the scales considered in TS and TC subjective assessment.

The specific synthesis will categorize the selected studies according to the different parameters considered in the assessment of TS and TC. These categories are defined as follows: (i) assessment of thermal comfort parameters, (ii) effects of other parameters, (iii) effects of fatigue, boredom, performance or similar aspects, (iv) TS or TC of a group, and (v) other aspects.

2.6. Outcomes and prioritization

The expected outcomes of the scoping review are the identification of (i) bibliometric aspects of the selected studies, (ii) methods of assessment of each study and the trends, (iii) parameters measured, and (iv) strategies to conduct the subjective assessment of TS and TC. It is also an objective of the scoping review to identify the potential knowledge gaps in the scientific literature and their implications for occupational health and safety management.

2.7. Risk of bias in individual studies

The risk of bias in individual studies will not be assessed since the scoping review aims to contextualize experiments in the conditions delimited in Section 2.1. The risk of bias in the selected studies may exist due to the aspects related to the design of the experiments (characteristics of the thermal environment, clothing insulation level) and the characteristics of the participants (gender, body composition, age), which will be subject to discussion in the scoping review.

2.8. Data synthesis

A spreadsheet to support the data treatment process will be elaborated to synthesize the selected studies' data. The spreadsheet will support the characterization of bibliometric aspects (publication year and location), the experimental design, participant characteristics, parameters measured, scales to conduct the subjective assessment of TS and TC, and results.

A meta-analysis of the environmental parameters of the thermal environment and the results will be performed if the results of the selected studies support such an assessment. If the selected studies do not support a meta-analysis, a narrative synthesis will be conducted. The narrative synthesis will be performed based on the retrieved data to present the experimental design of the selected studies, their methods, the characteristics of the thermal environment, the aspects considered for assessing TS and TC, and key findings. The PRISMA-ScR checklist will delimitate the reporting of the scoping review (Tricco et al., 2018).

2.9. Meta-biases and confidence in cumulative evidence

The risk of meta-biases will be assessed if the results of the selected studies support a meta-analysis. Confidence in cumulative evidence will not be assessed since the proposed scoping review does not examine alternative management strategies or interventions (Guyatt et al., 2011).

4. CONCLUSIONS

This review protocol defines the methodological aspects to conduct a scoping review. The proposed scoping review aims to summarize the scientific evidence on how the TS and TC of subjects engaged in sedentary activities are assessed experimentally. Another objective of the proposed scoping review is to identify further research needs.

AUTHORS' CONTRIBUTIONS

Study design and development: DC, JCG, JSB. Article search and recording: DC. Title and abstract screening: DC, JCG. Full-text screening: DC, JCG. Data extraction: DC, JCG. Data synthesis: DC, JCG. Draft of the protocol: DC. Support in draft development: DC, JCG, JSB. All authors approved the final version of the scoping review protocol.

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ANNEX I

Table 1. PRISMA-P (Preferred Reporting Items for Systematic Review and Meta-Analysis for systematic review protocols) checklist. Source: adapted from Shamseer et al. (2015).

Section and topic	Item number	Checklist item	Compliance	Notes
ADMINISTRATIVE INFORMATION				
Title:				
Identification	1a	Identify the report as a protocol of a systematic review	Yes	The report is identified as a protocol of a scoping review.
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	Not applicable	The protocol is not an update.
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	Not applicable	Scoping reviews are not accepted in PROSPERO or similar databases.
Authors:				
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	Yes	–
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	Yes	–
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	Not applicable	The protocol does not represent an amendment of a previously completed or published protocol.
Support:				
Sources	5a	Indicate sources of financial or other support for the review	Yes	–
Sponsor	5b	Provide name for the review funder and/or sponsor	Yes	–
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	Not applicable	–
INTRODUCTION				
Rationale	6	Describe the rationale for the review in the context of what is already known	Yes	–
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	Yes	–
METHODS				
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	Yes	–
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage	Yes	–

Section and topic	Item number	Checklist item	Compliance	Notes
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	Yes	–
Study records:				
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	Yes	–
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility, and inclusion in meta-analysis)	Yes	–
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	Yes	–
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	Yes	–
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	Yes	–
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	Not applicable	The risk of bias in individual studies will not be assessed.
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesized	Yes	–
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	Yes	–
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	No	No additional analyses are proposed.
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	Yes	–
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	Yes	–
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	No	Confidence in cumulative evidence will not be assessed.

ANNEX II

The search strategy for each database is determined as follows:

Journal Storage – JSTOR

(("thermal comfort" OR "therm* sensation" OR "thermosensation") AND ("sedentary" or "office work*" or "office task*"))

PubMed

(("thermal comfort" OR "therm* sensation" OR "thermosensation") AND ("sedentary" or "office work*" or "office task*"))

Scopus

ALL (("thermal comfort" OR "therm* sensation" OR "thermosensation") AND ("sedentary" or "office work*" or "office task*"))

Web of Science

TOPIC: ((("thermal comfort" OR "therm* sensation") OR "thermosensation") AND (sedentary or "office work*" or "office task*"))

ANNEX III

Table 2. Spreadsheet to compile the identified studies.

Summary of the selected articles	Summary of the collected articles	Summary of the rejected articles	Summary of total rejected items						Database	Search terms							
										Number of selected articles	Number of collected articles	Number of included articles after criteria insertion					
			Date	Document type	Source type	Language	Off-topic	Other				Date	Document type	Source type	Language	Other	On topic
									Scopus								
									Web of Science								
									PubMed								