Reviewer’s report

Title: Sustainable solutions to mitigate occupational heat strain – an umbrella review of physiological effects and global health perspectives.

Version: 0 Date: 16 Jun 2020

Reviewer: Iain Parsons

Reviewer's report:

Morris et al have produced a systematic review of systematic reviews, which has been supplemented by original research, of sustainable solutions to mitigate occupational heat strain.

The study eligibility was somewhat broad in my opinion: RCTs, T>28C or hypohydration, quantitative findings of physical performance, cognitive performance, TC, HR and Tcore.

Solutions were also evaluated by strength of evidence, effectiveness, cost, feasibility in indoor and outdoor large environments and environmental impact.

The heterogeneity of studies precluded formal meta-analysis but ES were studied.

Review interventions included:

Cold water immersion, cold fluid/slurry ingestion, cooling vests, environmental conditions, cooling packs, skin wetting and heat acclimation, ice towels, fanning, neck cooling collars, air cooled garments and liquid cooling garments, external menthol application, internal menthol use and hand cooling. Mixed method cooling, compression garments, intravenous cooling, cold air inhalation, protein and carbohydrate ingestion, protective clothing, hybrid cooling, aerobic fitness and sodium supplementation.

In addition to these reviews:
Shading, improved clothing design, utilize clothing with ventilator incorporated into the clothing, electrolyte consumption, taking intermittent rest brakes and slowing pace/reducing work intensity.

The authors describe their principle finding as the most effective being:
Environmental condition, cooling garments, state of physiological adaptation (heat acc), personal cooling interventions,

Reviewer comments:

This review is well written. This review of SRs appears to have been competently performed and the methods appear reasonable if not ambitious to try and review such a heterogeneity of studies. The study also appears novel. The authors should be commended in being able to produce a hierarchy of effectiveness of interventions for occupational thermal strain. I particularly appreciated the 'environmental' impact of these solutions and how this buttressed with your introduction highlighting the future challenges of climate change (ie non-environmental solutions
will make the problem worse) and how this will increase occupational heat stress in the future. I can see that on a given day firefighters would be more likely to work on a hot day, similarly outdoor construction workers, agricultural workers etc. Do the authors feel any jobs which previously would have been largely protected from thermal stress will be less safe in the future as a consequence of climate change?

I wonder if the large differences in interventions and their applicability to all hot, dehydrating workplaces, somewhat dilutes the message? The authors do mention this as a limitation.

I think this paper would perhaps have been better if the authors attempted to limit its scope by perhaps limiting it to novel cooling solutions. There have been multiple reviews into the heat acclimation/acclimatization and physical performance and the effect this has on occupational load (firefighters/military). Alternatively one could limit the occupational field- again effectiveness is very much role specific. What could be useful to the army might be less useful to construction workers due to PPE, availability of working at own pace, availability of aircon rest areas or shade. The authors do mention these limitations in the text but they so seem to reduce the impact of the article. That a formal meta-analysis couldn't be performed, due to the heterogeneity also limits the impact.

The author's mention that aircon can interfere with heat acc (mentioned line 549) and how the interventions impact with one another seems to be quite important to me but relatively glossed over. Does fanning improve sweat evaporation particularly in a heat acclimated state? Does a construction worker loose their heat acclimatization physiological changes if they sleep in an aircon room and spend several hours in aircon rest facilities?

What is, in my opinion, of particular interest to the reader is how cooling solutions interfere with the physiological state and nutrition, salt and hydration. This would be an alternate (and much easier!) way of improving the manuscript (as opposed to limiting the scope as described above) in my opinion. The authors could and focus more on how one solution could impact physiological manifestations and nutritional requirements in the discussion. This seems very important to the feasibility of any given measure as presently measures are reviewed in isolation when. I am aware that little evidence may be available for these but the authors opinions, based on their findings, would still be valuable.

The authors are right to state that there is a large gap in the literature between men and women and this is commendable.

Minor points:

Introduction
Please define primary and secondary sector economies
88.Aggravating dehydration?

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