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Exposure sequence and recovery in a quantitative European job-exposure matrix (heat JEM): a comment

We read with interest the study by de Crom and colleagues developing a quantitative European job-exposure matrix (heat JEM) for occupational heat stress. By integrating job-, region-, year-, clothing-, metabolic- and acclimatization-related factors, the heat JEM represents an important advance toward harmonized assessment of occupational heat exposure (1). Its development also raises a complementary question: should the temporal sequence of heat exposure and recovery between consecutive work shifts be considered when characterizing occupational heat risk?

This question may be particularly relevant to renal outcomes.

Renal responses to heat have been documented across at least two distinct timescales that remain insufficiently connected in the available evidence. In California agricultural workers, heat strain was associated with acute kidney injury across a single work shift (2). At a longer timescale, longitudinal studies among Nicaraguan and Salvadoran sugarcane workers documented changes in renal injury biomarkers and kidney function across a harvest season (3, 4). Repeated assessments among Guatemalan sugarcane workers similarly showed a high cumulative incidence of acute kidney injury during the harvest (5). Although these studies differ in population, crop, and observation window, together they document renal responses across markedly different temporal scales of recurrent occupational heat exposure. What remains unknown is how recovery between consecutive workdays links these within-shift and across-season observations.

This temporal gap also has a direct implication for individual risk stratification. Two workers assigned an equivalent heat exposure during a given shift may not enter that shift in an equivalent physiological state. One may have experienced adequate recovery since the preceding exposure, whereas another may carry residual thermal, cardiovascular or renal strain from previous workdays. Annual or shift-level estimates of heat exposure, although essential for exposure assessment, may not fully represent this difference.

Importantly, none of the cited studies was designed to test a cumulative dose–response relationship across consecutive workdays, and we do not claim one is established here. What they do establish is an unresolved temporal dimension of occupational heat assessment, which prospective studies could address directly. Heat intensity could be characterized together with exposure sequence and inter-shift recovery, operationalized through measures such as overnight ambient and body temperature, sleep duration and quality (eg, actigraphy) (6), pre- and post-shift hydration status, and pre-shift renal biomarkers relative to the previous day's exposure. Repeated measurements across consecutive workdays would allow investigators to test whether these temporal variables improve prediction of adverse responses beyond conventional single-shift exposure metrics, and whether a threshold recovery duration modifies subsequent responses to comparable heat loads. This possibility is consistent with laboratory evidence that whole-body heat loss can be impaired on the day following prolonged heat exposure in older men, though not in younger men under the same experimental conditions (7).

If confirmed, this distinction could have practical implications for occupational heat prevention: preventive strategies may need to consider not only how much heat a worker encounters, but also how high-heat shifts are distributed across the working week. Work–rest recommendations, scheduling practices and surveillance of workers exposed on consecutive days could then incorporate recovery as an explicit component of heat-risk management.

The heat JEM developed by de Crom and colleagues provides an important framework for harmonizing occupational heat-exposure assessment. Complementing exposure intensity and duration with measures of exposure sequence and inter-shift recovery could help identify workers at elevated risk of heat-related renal strain across consecutive workdays.

We thank the authors for their valuable contribution and hope that these comments may stimulate further research in this important area of occupational epidemiology.

Conflict of interest statement

The author declares no conflicts of interest.

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