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User-friendly tool for heat-related risk assessment of the working environment in health facilities

Checklist

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USER-FRIENDLY TOOL FOR HEAT-RELATED RISK ASSESSMENT OF THE WORKING ENVIRONMENT IN HEALTH FACILITIES

Checklist (version 1.0, February 2025)

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Procedure for assessment of heat risks

This risk assessment checklist provides a **practical and systematic procedure to identify and assess risks caused by working in high temperatures in healthcare settings**, with the goal to prevent or reduce heat-related health risks, improve workers' health and well-being, and ultimately the quality of care.

↘ **Disclaimer.** The checklist is developed within the framework of the HIGH Horizons project that studies how heat exposure affects pregnant and postpartum women, newborns, young children, and health workers. This checklist is a stand-alone document, based on the HIGH Horizons tool for heat-related risk assessment of the working environment in health facilities, as described in: Toftum J, HIGH Horizons Study Group. HIGH Horizons - User-friendly tool for heat-related risk assessment of the working environment in health facilities – REPORT. Zenodo; 2025. 10.5281/zenodo.14942940.

↘ **Context.** To a large degree, the suggested procedure relies on international standard ISO 8025 "Ergonomics of the thermal environment – management of working conditions in hot environments" (2024). This document describes the methods and practices for organizing the management of hot working environments and the supervision of the exposed persons. In addition, emphasis is placed on evaluating building-related features that may influence the heat exposure of the employees, and which may be modified to alleviate the heat stress. The procedure is not intended to perform a detailed, analytical evaluation of the risks involved in working in heat that may include measurement of both physical and physiological parameters.

↘ **Scope**. The scope is health facilities in hot climate regions.

↘ **Required knowledge**. Using the checklist requires knowledge of some of the terms and definitions that are relevant for assessing occupational heat stress, although expert knowledge should not be required.

↘ **Procedure**. Complete the respondent details and answer the questions in sections A to C. Most items are explained in Appendix, to clarify why it was included in the evaluation and often followed by a suggestion of potential remediation.

- Section A: Most items in section A can be easily scored. It includes 8 scored items for which different thresholds are suggested. If the scores of items 1 to 8 are summed and the total is in the range from 14 to 20, heat risk severity may be high and there is a need to critically evaluate the thermal exposure at the workplace. However, even at lower totals, each individual score at or above 1, depending on the item, needs to be evaluated carefully to identify or rule out risk factors.
- Sections B & C: The items in "B. The working situation and "C. Building features" are less feasible to score to quantify the severity of heat exposure. Instead, these sections may raise awareness of an issue that should be considered to evaluate and/or reduce heat exposure.

↘ **Assessment**. After completing the checklist, the heat-related risks for the working conditions at your health facility can be assessed. Potential remediations are given in the appendices. If you have questions or comments, you can contact jtof@dtu.dk.

Respondent details

Inspector:

(This can be left open if the respondent prefers to complete this checklist anonymously. The other respondent details are relevant and should be completed.)

Facility name:

Work activity:

(Please describe your role in the facility)

Description of the working areas and activities:

(Please describe where in the facility you work most of the time)

A. Factors related with heat exposure and heat stress

Appendix A elaborates on the effects and suggests potential remedial measures for the factors evaluated in Section A.

Air temperature

Air temperature	Score	Criterion
Air temperature does not cause problems	**0**	Low (18°C to 25°C)
Air temperature might cause problems	**1**	Moderate (25°C to 32°C)
Air temperature definitely causes problems	**2** **3**	High (32°C to 40°C) or Very high (higher than 40°C)

Air humidity

Air humidity	Score	Criterion
Neither too dry nor too humid	**0**	Normal (dry) skin
Rather too humid	**1**	Moist skin
Very humid (e.g. wet industrial process)	**2**	Skin completely wet

Thermal radiation

Thermal radiation	Score	Criterion
No additional thermal radiation	**0**	No radiation discernible
Medium exposure to radiating hot surfaces or to the sun	**1**	Warm on the face after 2-3 min
High exposure to radiating hot surfaces or to the sun	**2** **3**	Unbearable on the face after 2-3 min Immediate burning sensation

Air movement

Air movement	Score	Criterion
Air movement adjustable to individual preferences	**0**	Possibility to increase air movement, e.g. desk fan or open windows
Limited possibility to adjust air movement to individual preferences	**1**	Air movement can be adjusted in some zones or outdoor air temperature exceeds indoor air temperature
No possibility to increase air movement	**2**	No fan available or windows cannot be opened

Clothing

Clothing insulation	Score	Criterion
Adequate	**0**	Light, e.g. underwear, shirt, trousers, shoes (I_{cl} = 0.7 clo, ISO 7730-2006)
Partly inadequate (e.g. slightly too highly insulating)	**1**	Moderate, e.g. underwear with short sleeves and legs, shirt, trousers, jacket, socks, shoes (I_{cl} = 1 clo, ISO 7730-2006)
Inadequate (e.g. too heavy or too thick)	**2**	High, e.g. underwear with long sleeves and legs, shirt, trousers, sweater, jacket, socks, shoes (I_{cl}=1.3 clo, ISO 7730-2006)

Personal protective equipment (body, hands, head)

	Score	Criterion
Not applicable	**0**	Light, flexible
Interferes to some extent (impaired protection against heat)	**1**	Long, heavier, may interfere with the work
Considerable interference	**2**	Clumsy, heavy, special for radiation or liquids

Physical workload

	Score	Criterion
Light	**0**	**Error! Reference source not found.** shows criteria to evaluate the workload.
Moderate	**1**	
High	**2**	
Very high	**3**	

Opinions of the workers

Condition	Score	Criterion
Comfortable	**0**	No thermal constraint, best comfort
Slightly warm	**1**	No thermal constraint, increased thermal dissatisfaction
Warm	**2**	No thermal constraint, high thermal dissatisfaction
Hot	**3**	Light sweating, thirst, very high thermal dissatisfaction
Very hot	**4**	Heavy sweating and thirst, slowing of the work rhythm, beyond comfort
Extremely hot	**5**	Excessive sweating, very painful work

Additional factors related to heat

Factor
Duration of the heat exposure more than short periods during the workday (more than 20-30 min per hour)
Variation of the thermal exposure (e.g. moving between hot and more moderate environments)
Other factors that need to be considered but are not included int the above sections

B. The working situation

Appendix B elaborates on the effects of the factors evaluated in section B.

Work-rest schedule

Is the work organized or will it be possible to organize the work in appropriate work-recovery schedules?	**Yes**
	No

Recovery after high heat exposure

Is it possible for workers to recover (cool down) after periods of high or very high activity in heat?	**Yes**
	No

Recovery after high heat exposure

If yes in 2.2.2, is it possible for workers to cool down in designated areas with a lower temperature or higher air movement?	**Yes**
	No

Adaptive measures - clothing

Can workers adjust their clothing as preferred if the insulation provided is moderate, high or very high?	**Yes**
	No

Adaptive measures - workload

Can workers moderate their physical workload, if it is high or very high?	**Yes**
	No

Adaptive measures - windows

Can workers operate windows to increase air movement or reduce the indoor temperature?	**Yes**
	No

Acclimatization

Are workers acclimatized to working in heat?	**Yes**
	No

Hydration

Do workers have easy access to drinking water?	**Yes**
	No

Health and safety training

Are supervisors trained in recognizing signs of heat illness?	**Yes**
	No

Health and safety awareness

Do workers have basic knowledge about working in heat, e.g. the importance of staying hydrated or how they can compensate heat exposure?	**Yes**
	No

Previous heat illness

Has any screening for heat intolerance been performed, e.g. for previous heat illness?	**Yes**
	No

C. Building features

Appendix C elaborates on the effects of the building features evaluated in section C and what potentially can be done to reduce indoor heat.

Window orientation

What is the main orientation of windows in the surveyed room?	**North**
	South
	East
	West
	Northeast
	Northwest
	Southeast
	Southwest

Window-to-floor-area ratio

What is the approximate window-to-floor-area ratio?	**0-5%**
	5-10%
	10-15%
	15-20%
	>20%

Operable windows

Are windows operable and is it possible for workers to open windows?	**Yes**
	No

One-sided or crossflow natural ventilation

Can windows be opened on only one side of the room/building or on two opposite sides	**Only on one side**
	On two opposite sides

Night cooling

Can windows be opened at night (at least partly) to cool down the building when the outdoor temperature is lower than during the day?	**Yes**
	No

Solar shading

What type of solar shading is available?	**None**
	Curtains
	Blinds
	Fixed overhang

Shading objects

Are there trees or other objects near the building that provide shading?	**Yes**
	No

Ratio of room area to number of occupants

Approximately what is the ratio of the area of the room to the number of occupants?	**>10 m^2 per person**
	5-10 m^2 per person
	1-5 m^2 per person

Heat sources

Are there strong heat sources in the room?	**Yes**
	No

Fans

Are desk, standing or ceiling fans available?	**Yes**
	No

Ventilation grilles

Does the room have ventilation grilles in the façade?	**Yes**
	No

Mechanical ventilation

Does the building have a mechanical ventilation system?	**Yes**
	No

Air conditioning

Does the building have comfort cooling, e.g. a ventilation system with cooling or a split-type air conditioner on the wall?	**Yes**
	No

Thermal accumulation

Is the building made of light (wood) or heavy materials (concrete, brick)?	**Yes**
	No

Appendix A. Elaboration on factors related with heat exposure and heat stress and their potential remediation

Air temperature

A high air temperature reduces the potential for convective heat loss from the body. if air temperature is higher than skin temperature, e.g. 40°C, in principle, the body gains heat from the environment through convective heat exchange.

Potential remediation if 1: at high or very high workload – see item 7. Physical workload. If 2 or 3: Reduce temperature through ventilation or air-conditioning.

Air humidity

A high air humidity reduces the potential for evaporative heat loss from the body. At high physical activity when a high rate of evaporation is needed to cool the body, even a moderately high air humidity may inhibit evaporative heat loss. Air humidity should therefore be considered in combination with the air temperature and physical activity. Integrated indices such as the Heat Stress Index or the Wet Bulb Globe Temperature (WBGT) may be used to evaluate the combined influence on heat stress of air temperature, humidity, clothing, and activity (Belding & Hatch 1955; NIOSH 1986).

Potential remediation if 2: Reduce humidity through ventilation or air-conditioning or exhaust vapours directly from internal sources.

Thermal radiation

Strong thermal radiation caused by the sun or hot surfaces reduces the potential for radiant heat loss from the body. It may also gradually during the day warm up the indoor environment (radiant temperature), adding to the heat stress.

Potential remediation if 2 or 3: Shield the radiant heat at the source through insulation and reflective barriers. If solar radiation through windows, apply solar shading, preferably external.

Air movement

When the air temperature is lower than the body surface temperature, increased air movement will increase the convective and evaporative heat loss from the body.

Potential remediation if 2: Increase air movement if air temperature score is 1 or 2. If the air temperature is slightly higher than skin temperature (around 35-36oC), increased air movement can be still beneficial for the evaporative heat loss, although the body may gain convective heat. If the air temperature is higher than 40oC, increased air movement will no longer increase heat loss.

Clothing

High clothing insulation reduces the overall heat loss from the body. Clothing may also protect the worker from environmental exposures, e.g. thermal radiation. If the work situation allows, modifying clothing composition is a behavioural action that the worker may use to adjust to the environmental conditions.

Potential remediation if 1 or 2: Evaluate if the clothing composition or number of layers can be reduced or differently designed garments can be used, e.g. to some that allow higher air circulation or auxiliary cooling in the clothing.

Personal protective equipment (body, hands, head)

Personal protective equipment may impede body movement and inhibit evaporation of sweat.

If 1 or 2: PPE may inhibit evaporation of sweat. Consider if the work can be organized with only short duration of PPE use or if personal cooling devices can be used (vests or other devices with ice or phase-change materials near the body).

Physical workload

High physical workload increases the generation of heat in the body and needs to be compensated for by the heat lost to the surroundings. In the case of intermittent work, a time-weighted average shall be calculated (ISO 7243-2017). If there is doubt as to which metabolic rate to be adopted for the evaluation of heat stress, the value to be used is that corresponding to the higher metabolic rate. A time-motion study can be conducted to characterize the working situation and the corresponding workload at a specific time (ISO 8025-2024).

Potential remediation at 2 or 3: If possible, reduce the physical exertion by modifying processes or prolong rest time.

Opinions of the workers

The scoring is aligned with the 9-pt thermal sensation scale often used to assess thermal sensation where high heat exposure is expected.

Appendix B. Elaboration on factors related with the working situation and their potential remediation

Work-rest schedule

Appropriate work-recovery schedule will depend on the thermal conditions and the physical activity. Heat-TLV (2024) suggests work-recovery cycles based on the WBGT and the physical load of the work (Table 4). Note: Evaluation of the WBGT is done under stage 3 Analysis and therefore the necessary input to table 4 may not be available in the suggested procedure for screening and observation. Work-recovery schedules in table 4 indicate the ratio of duration of heat exposure to duration of recovery (periods without heat exposure).

Recovery after high heat exposure

Potential remediation: Provide cooled booths, rest areas with air-conditioning or increased air movement. Increase frequency and duration of rest periods, if possible.

Adaptive measures - acclimatisation

If employees are not acclimatized to heat, apply a work schedule to allow for acclimatization. ISO 8025 (2024) suggests that acclimatization can be achieved by daily exposures for several hours to heat during five consecutive days of exposure according to the scheme:

- For persons familiar to a task: 50% of normal hours the first day, 60% on the second day, 80% on the third day and 100% from the fourth day.
- For persons newly affected by the task: 20% on the first day and then, if possible, increase by 20% each successive day.
- During the acclimatization period, the workers should be monitored by someone trained to recognize early signs of heat illness.

Hydration

If there is no easy access to drinking water, offer drinking water to compensate for water lost through sweating. Depending on the EC of the working situation, allow workers to frequently drink in small quantities (150 to 200 ml) every 15-20 min (ISO 8025 -2024).

Health and safety training

ISO 8025 (2024) recommends supervisor training depending on the EC level. At high levels from 3 to 6, supervisor should be able to recognize signs of heat-related illness and focus on the need to drink regularly.

Health and safety awareness

If no, set up buddy arrangement to remind each other to drink.

Appendix C. Elaboration on features related with the building

Window orientation

If the building is located on the southern hemisphere and the main orientation of the windows is north, northeast, or northwest, or the building is located on the northern hemisphere and the main orientation of the windows is south, southeast, or southwest, solar irradiation may contribute to raise the indoor heat exposure.

Solar shading can mitigate the issue, but depending on the type of solar shading, irradiation may still affect significantly the indoor heat exposure and temperature. The best shading efficiency is achieved when the shading device is located on the outside of the window.

Window-to-floor-area ratio

Windows are needed for daylight access but also allow radiant heat to enter the building. If the window-to-floor-area ratio is larger than 10%, solar shading should be used to reduce the solar load, in particular if the main orientation of the windows may be affected by direct solar irradiation during a large part of the day (see item above).

Operable windows

Operable windows are needed to enable ventilative cooling when the outdoor temperature permits. However, even though windows can be operated, access may be blocked or there may be social restrictions (colleagues, security concerns, outdoor air quality, noise) that prevent opening.

One-sided or crossflow natural ventilation

If windows can be opened only on one side of the building, ventilation is restricted to come from one side, which is far less efficient than when cross-flow ventilation can be achieved with open windows in two opposite (or perpendicular) facades.

Night cooling

Depending on the geographical location and the season, night cooling by ventilation with cool outdoor air may provide cooling also during the day, especially in buildings with high thermal mass (concrete, brick) where the temperature increase will be slower than in light buildings (e.g. wooden). However, safety issues may prevent windows from being opened at night. Depending on the geographical location, mosquitoes may present another issue.

Solar shading

The efficiency of solar shading to reduce solar irradiation depends on its type. Curtains are least efficient, while fixed overhang may eliminate entirely direct solar irradiation depending on their depth. In general, solar shading installed on the outside of the building envelope is more efficient than on the inside.

Shading objects

A building located far away from trees, neighbouring buildings or other objects that may provide shading can be highly exposed to solar irradiation.

Ratio of room area to number of occupants

People emit heat, so a high occupant density should be avoided, at least during periods with high solar load or high heat load from equipment.

Heat sources

Strong heat sources contribute to the heat exposure by emission of radiant and/or convective heat.

Potential remediation: If the equipment produces mostly radiant heat, shield the radiant heat at the source through insulation and reflective barriers. With convective heat, exhaust warm air from the equipment to the outside.

Fans

Desk or standing fans increase air movement and thus convective cooling if the air temperature does not exceed the skin temperature by too much (see comment to item 2.1.4 "Air movement").

Ventilation grilles

Like windows, ventilation grilles may introduce outdoor air to a room and provide ventilative cooling, although considerably less than windows, which typically offer a larger opening area. Increased ventilation with unfiltered outdoor air requires an appropriate outdoor air quality.

Mechanical ventilation

If the outdoor temperature is lower than the indoor temperature, a mechanical ventilation system may be a robust way to lower the indoor temperature.

Air conditioning

Air conditioning can provide comfortable indoor temperatures but requires energy and maintenance and has high installation cost. Sustainable use of air conditioning may require use of photovoltaics or other green energy production.

Thermal accumulation

Heavy building materials can accumulate more heat than light ones. Heavy materials exposed to the room can therefore absorb more heat with only moderate temperature change. If cooled at night, heavy materials can contribute to keeping a low temperature indoors for longer than light materials.

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