Supplementary Materials

Heat Stress Exposure and Physiological Responses among Sugarcane Workers in Thailand

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Table S1. Log-transformed pre-shift and post-shift results of participant physiological parameters - blood pressure, heart rate, and body temperature (n = 295).

Parameter	Mean ± S.D. (Range)			*p*-value [†]
	Pre-Shift	**Post-Shift**	**Difference (Post-Pre)**	
Systolic blood pressure (mm Hg)	2.087 ± 0.053 (1.920, 2.240)	2.072 ± 0.051 (1.910, 2.240)	−0.015 ± 0.042 (−0.170, 0.240)	<0.001
Diastolic blood pressure (mm Hg)	1.889 ± 0.056 (1.680, 2.050)	1.874 ± 0.055 (1.670, 2.050)	−0.015 ± 0.039 (−0.180, 0.180)	<0.001
Heart rate (bpm)	1.836 ± 0.069 (1.640, 2.020)	1.921 ± 0.058 (1.710, 2.080)	0.085 ± 0.053 (−0.060, 0.260)	<0.001
Body temperature (°C) [a]	1.559 ± 0.006 (1.540, 1.570)	1.569 ± 0.004 (1.560, 1.580)	0.010 ± 0.006 (−0.010, 0.030)	<0.001
Rest period duration (minutes) [b]	1.187 ± 0.144 (0.900, 1.590)	1.178 ± 0.163 (1.000, 1.750)	−0.009 ± 0.200 (−0.570, 0.580)	0.46

[a] Calculated from both left and right tympanic temperature readings; [b] Rest period duration before taking physiological parameter measurements; [†] Two-sided p-value from the dependent *t*-test.

Table S2. The full model details that adjusted for pre-shift results and other available confounding variables: β (95% CI) of blood pressure.

Explanatory Variable	n	Systolic Blood Pressure β (95% CI)	Diastolic Blood Pressure β (95% CI)
WBGT$_{eff}$-FS-TWA (°C)	295	−0.33 (−0.76, 0.11)	−0.21 (−0.48, 0.05)
Gender			
Female	130	−3.97 (−6.74, −1.20)	−2.14 (−3.84, −0.44)
Male	165		
Age (years)			
≥ 50	87	−4.38 (−8.07, −0.69)	−0.82 (−3.06, 1.42)
40–49	84	−3.03 (−6.59, 0.54)	−0.28 (−2.46, 1.91)
30–39	66	−2.31 (−5.89, 1.27)	−1.22 (−3.44, 1.01)
<30	58		
Education			
≥High school	31	−1.27 (−5.25, 2.71)	−0.62 (−3.07, 1.82)
Middle school	65	−1.76 (−4.86, 1.35)	−0.89 (−2.80, 1.02)
≤primary school	199		

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Table S2. *Cont.*

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Explanatory Variable	n	Systolic Blood Pressure β (95% CI)	Diastolic Blood Pressure β (95% CI)
Work experience (years)			
>10	59	1.02 (−2.19, 4.23)	−0.20 (−2.17, 1.77)
5.01–10	81	−0.45 (−3.27, 2.38)	−1.17 (−2.91, 0.57)
≤5	155		
BMI			
Obese I	80	3.18 (0.23, 6.13)	2.04 (0.22, 3.87)
Overweight	39	2.33 (−1.24, 5.91)	0.78 (−1.42, 2.98)
Underweight	35	1.68 (−2.05, 5.43)	1.74 (−0.57, 4.05)
Normal weight	141		
Medical conditions			
Yes	54	0.80 (−2.34, 3.95)	0.46 (−1.48, 2.39)
No	241		
Alcohol drinking			
Yes	152	−1.39 (−3.94, 1.16)	−1.72 (−3.30, −0.15)
No	143		
Smoking			
Yes	141	2.23 (−0.54, 4.99)	0.33 (−1.38, 2.05)
No	154		
Caffeine intake			
Yes	283	3.29 (−2.71, 9.28)	3.80 (0.11, 7.49)
No	12		
Last night sleep duration (hours)	295	0.56 (−0.36, 1.47)	0.22 (−0.35, 0.78)
Total duration breaks (hours)	295	0.64 (−0.79, 2.08)	0.20 (−0.69, 1.09)
Total fluid intake at work (litres)	295	0.13 (−0.55, 0.80)	0.15 (−0.26, 0.56)
Main responsibility on measurement day			
Harvesting with a low-physical-level task	9	6.20 (−0.78, 13.17)	2.21 (−2.28, 6.30)
Harvesting only/harvesting with a high-physical-level task	286		
Harvesting methods			
Mixed harvesting in one day [a]	73	1.75 (−1.25, 4.75)	0.74 (−1.11, 2.58)
Unburnt	103	1.76 (−1.29, 4.81)	0.21 (−1.66, 2.09)
Burnt	119		
Pre-shift result	295	0.62 (0.54, 0.70)	0.75 (0.68, 0.83)

WBGT$_{eff}$-FS-TWA = full work shift time-weighted average effective Wet Bulb Globe Temperature; β = Beta coefficient.
[a] Unburnt and burnt harvesting in one day.

Table S3. The full model details that adjusted for pre-shift results and other available confounding variables: β (95% CI) of heart rate and body temperature.

Explanatory Variable	n	Heart Rate β (95% CI)	Body Temperature β (95% CI)
WBGT$_{eff}$-FS-TWA (°C)	295	0.61 (0.24, 0.98)	0.02 (0.002, 0.03)
Gender			
Female	130	−0.33 (−2.65, 1.99)	−0.03 (−0.12, 0.05)
Male	165		
Age (years)			
≥50	87	2.38 (−0.62, 5.37)	−0.02 (−0.14, 0.09)
40–49	84	−0.67 (−3.63, 2.29)	−0.02 (−0.13, 0.09)
30–39	66	1.29 (−1.69, 4.27)	−0.04 (−0.15, 0.07)
<30	58		
Education			
≥High school	31	0.69 (−2.69, 4.02)	−0.01 (−0.13, 0.12)
Middle school	65	2.19 (−0.43, 4.80)	0.002 (−0.10, 0.10)
≤primary school	199		
Work experience (years)			
>10	59	−0.74 (−3.43, 1.94)	0.02 (−0.08, 0.12)
5.01–10	81	−1.04 (−3.40, 1.32)	−0.01 (−0.10, 0.08)
≤5	155		
BMI			
Obese I	80	1.85 (−0.62, 4.31)	−0.01 (−0.10, 0.08)
Overweight	39	−0.47 (−3.47, 2.53)	−0.01 (−0.12, 0.10)
Underweight	35	−2.50 (−5.66, 0.67)	0.04 (−0.08, 0.16)
Normal weight	141		

Table S3. *Cont.*

Explanatory Variable	n	Heart Rate β (95% CI)	Body Temperature β (95% CI)
Medical conditions			
Yes	54	−0.18 (−2.82, 2.45)	−0.04 (−0.14, 0.06)
No	241		
Alcohol drinking			
Yes	152	1.35 (−0.76, 3.46)	−0.02 (−0.10, 0.06)
No	143		
Smoking			
Yes	141	0.76 (−1.55, 3.07)	−0.04 (−0.13, 0.05)
No	154		
Caffeine intake			
Yes	283	−3.30 (−8.29, 1.69)	−0.10 (−0.29, 0.09)
No	12		
Last night sleep duration (hours)	295	0.28 (−0.49, 1.05)	0.02 (−0.01, 0.05)
Total duration breaks (hours)	295	−0.59 (−1.80, 0.62)	−0.01 (−0.05, 0.04)
Total fluid intake at work (litres)	295	0.65 (0.08, 1.21)	−0.02 (−0.04, 0.01)
Main responsibility on measurement day			
Harvesting with a low-physical-level task	9	−5.81 (−11.68, 0.06)	0.12 (−0.09, 0.34)
Harvesting only/harvesting with a high-physical-level task	286		
Harvesting methods			
Mixed harvesting in one day [a]	73	−4.17 (−6.68, −1.65)	−0.04 (−0.13, 0.05)
Unburnt	103	−0.02 (−2.59, −2.55)	0.02 (−0.08, 0.11)
Burnt	119		
Pre-shift result	295	0.68 (0.59, 0.77)	0.16 (0.08, 0.24)

$WBGT_{eff}$-FS-TWA = full work shift time-weighted average effective Wet Bulb Globe Temperature; β = Beta coefficient.
[a] Unburnt and burnt harvesting in one day.

Table S4. Summary results from additional models exploring the effect of specific groups of confounders (Models 1–5) and a mediator (Model 6) in a step-by-step process: β (95% CI) of post-shift physiological parameters.

Explanatory Variable	Model	Model Descriptions	β (95% CI)			
			Post-Shift Systolic Blood Pressure	Post-Shift Diastolic Blood Pressure	Post-Shift Heat Rate	Post-Shift Body Temperature
$WBGT_{eff}$-FS-TWA	0	adjusted for pre-shift results only	−0.46 (−0.88, −0.05)	−0.21 (−0.46, 0.04)	0.58 (0.24, 0.92)	0.01 (0.001, 0.03)
	1	adjusted for pre-shift results and socio-demographic variables	−0.32 (−0.74, 0.10)	−0.20 (−0.45, 0.06)	0.57 (0.22, 0.93)	0.01 (0.001, 0.03)
	2	adjusted for pre-shift results, socio-demographic variables, and health metrics variables	−0.30 (−0.72, 0.13)	−0.18 (−0.44, 0.08)	0.63 (0.27, 0.99)	0.01 (0.001, 0.03)
	3	adjusted for pre-shift results, socio-demographic variables, health metrics variables, and health behaviour variables	−0.31 (−0.74, 0.12)	−0.20 (−0.46, 0.06)	0.64 (0.27, 1.01)	0.01 (0.001, 0.03)
	4	adjusted for pre-shift results, socio-demographic variables, health metrics variables, health behaviour variables, and mitigating variables	−0.34 (−0.78, 0.09)	−0.22 (−0.48, 0.05)	0.62 (0.25, 0.99)	0.02 (0.002, 0.03)
	5	adjusted for pre-shift results, socio-demographic variables, health metrics variables, health behaviour variables, mitigating variables, and the working task	−0.33 (−0.76, 0.11)	−0.21 (−0.48, 0.05)	0.61 (0.24, 0.98)	0.02 (0.002, 0.03)
	6	adjusted for pre-shift results, socio-demographic variables, health metrics variables, health behaviour variables, mitigating variables, the working task, and the mediating variable	−0.33 (−0.78, 0.13)	−0.21 (−0.49, 0.07)	0.62 (0.23, 1.01)	0.02 (0.001, 0.03)

$WBGT_{eff}$-FS-TWA = full work shift time-weighted average effective Wet Bulb Globe Temperature.