



Infrared thermography as a tool to monitor workload adaptation in Brazilian Army militaries soccer players by position

Danielli Mello¹, José Mauro Maia Junior^{1,2,6}, Wandembergue Pereira Sampaio^{1,2}, Guilherme Rosa³, Antônio Moreira⁴, Eduardo Borba Neves², Rodrigo Vale^{5,6}.

1. Physical Education College of Brazilian Army (EsEFEx, EB, Brazil)

2. Brazilian Army Sports Commission (CDE, EB, Brazil)

3. Federal Rural University of Rio de Janeiro (UFRRJ, RJ, Brazil)

4. Brazilian Air Force (FAB, RJ, Brazil)

5. Exercise and Sports Science Program, Rio de Janeiro State University (PPGCEE, UERJ, Brazil)

6. Laboratory of Exercise and Sport of Rio de Janeiro State University (LABEES, UERJ, Brazil)

Introduction

Sports training process involves exercise repetition to develop specialized motor skills, structural and functional changes to maximize performance. This improvement depends on the proper distribution of training loads and recovery, and infrared thermography can be used to measure it.

Objective

Analyze the effect of mesocycle training preparation (MTP) on skin temperature (Tsk) of Brazilian Army militaries soccer team by position.

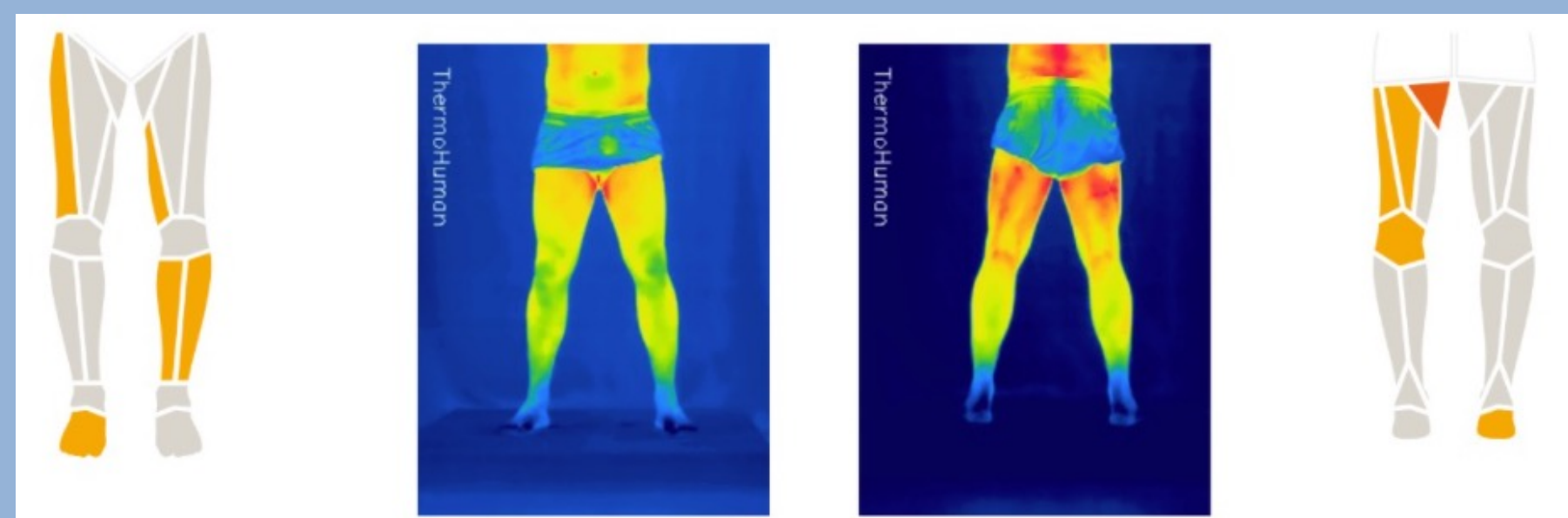
Methods

Sample: 28 soccer male athletes (midfielder, center forward, striker, defender, goalkeeper, fullback), 20-38 years old, volunteers of the Brazilian Army Military Soccer Team.

Data collection: Occurred in an acclimatized room at EsEFEx's biosciences lab, attending Delphi study recommendations for Tsk evaluation pre and post MTP.



It was used E75 FLIR® infrared camera and the images were processed by ThermoHuman® software. The selected regions of interest (ROIs) were the anterior and posterior regions of lower limbs.



MTP consisted in low-middle intensity physical exercise intending the development of endurance, strength, speed, and flexibility.

Statistical analysis: Data was analyzed by SPSS® using descriptive statistics, paired t-Student test and ANOVA's test were used with adjusted Bonferroni post-hoc. The effect size (d) was calculated. Significant level was $p < 0.05$.

Results

The ambient temperature range from 21.5 to 23.2°C and relative ambient humidity from 64 to 68%.

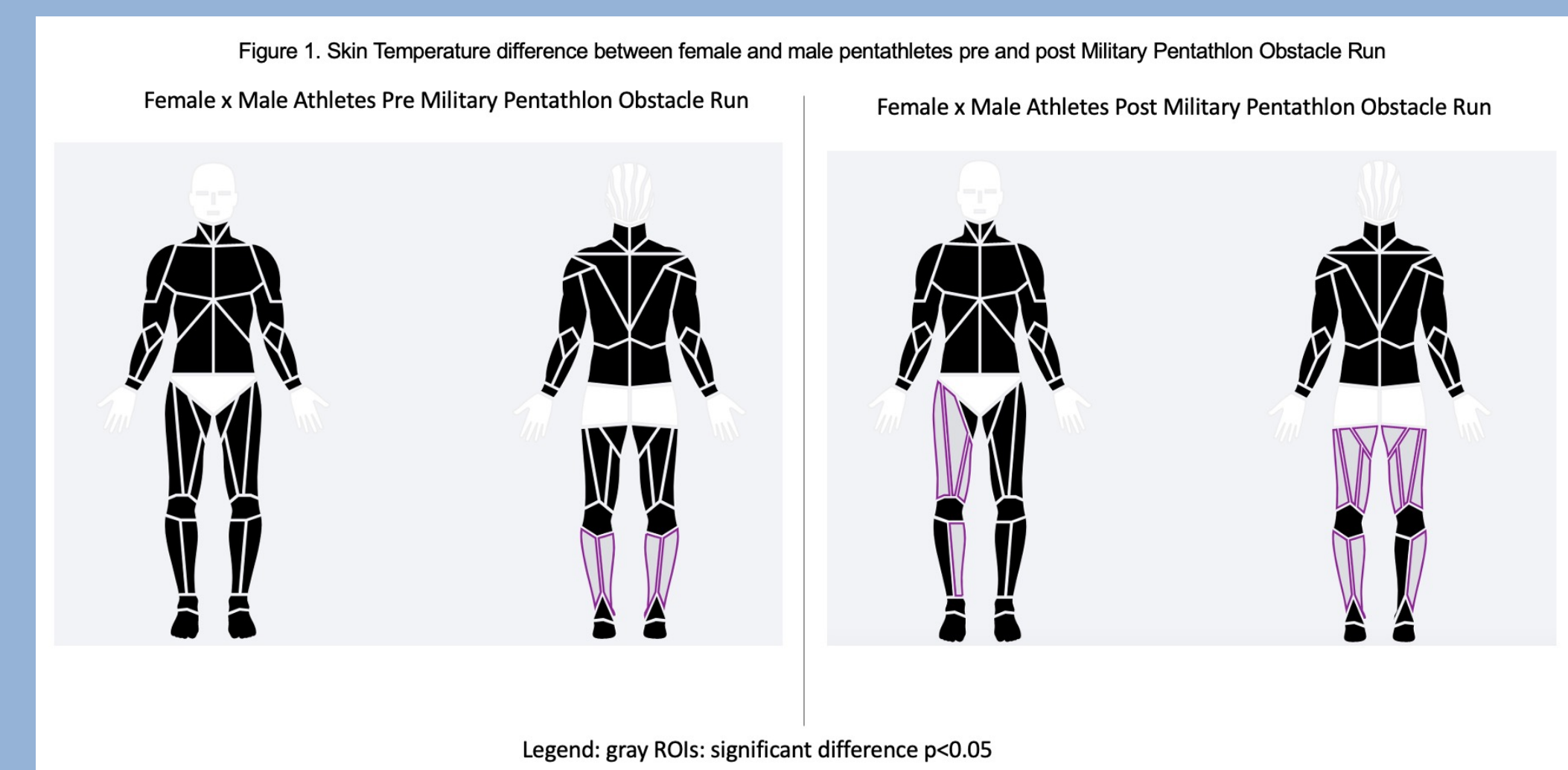
Table 1 presents a significant reduction in Tsk post MTP.

Table 1. Mean Skin Temperature (°C) pre and post Military Pentathlon Obstacle Run

Anterior View					Posterior View				
ROIs	Pre	Post	Δ%	p-value	ROIs	Pre	Post	Δ%	p-value
Front Thigh_R	32.72±0.75	31.90±0.86	0.82	0.008	Front Back_R	32.82±0.96	31.97±1.27	0.85	0.041
Front Thigh_L	32.75±0.75	31.76±0.95	0.99	0.003	Front Back_L	32.82±0.92	32.06±1.32	0.82	0.050
Central Thigh_R	33.07±0.97	32.12±1.04	0.95	0.009	Central Thigh_R	33.03±0.82	32.19±1.11	0.84	0.022
Central Thigh_L	33.04±0.85	32.06±1.08	0.97	0.008	Central Thigh_L	32.93±0.81	32.24±1.11	0.69	0.052
Adductor_R	33.56±0.92	32.22±1.57	1.34	0.006	Adductor_R	32.85±1.06	32.08±1.35	0.77	0.082
Adductor_L	33.53±0.86	32.20±1.50	1.33	0.004	Adductor_L	32.95±1.07	32.05±1.38	0.90	0.049
Inner Thigh_R	33.10±0.74	32.23±0.94	0.87	0.007	Inner Thigh_R	33.21±0.73	32.60±0.96	0.61	0.053
Inner Thigh_L	33.12±0.82	32.30±1.05	0.82	0.020	Inner Thigh_L	33.08±0.75	32.46±0.98	0.62	0.053
Knee_R	32.11±0.49	31.47±0.77	0.64	0.008	Popliteus_R	33.32±0.72	32.70±0.98	0.62	0.053
Knee_L	32.13±0.59	31.34±0.90	0.79	0.006	Popliteus_L	33.35±0.73	32.76±1.03	0.59	0.070
Outer Leg_R	32.61±0.54	31.90±0.82	0.71	0.007	Outer Leg_R	32.72±0.89	31.98±1.00	0.74	0.035
Outer Leg_L	32.62±0.56	32.02±0.76	0.60	0.016	Outer Leg_L	32.71±0.87	32.03±0.95	0.68	0.042
Inner Leg_R	32.52±0.65	31.96±0.89	0.66	0.024	Inner Leg_R	32.78±0.90	32.13±1.04	0.66	0.066
Inner Leg_L	32.46±0.54	31.98±0.80	0.49	0.053	Inner Leg_L	32.67±0.76	32.04±0.99	0.63	0.052
Ankle_R	31.10±0.53	31.63±0.64	-0.53	0.017	Achilles_R	30.99±0.74	30.86±1.35	0.13	0.733
Ankle_L	31.25±0.52	31.81±0.64	-0.56	0.011	Achilles_L	30.87±0.70	30.96±1.32	-0.09	0.820
Anterior Foot_R	29.96±0.86	30.25±1.30	-1.19	0.005	Back Foot_R	28.42±0.81	29.14±1.15	-0.72	0.050
Anterior Foot_L	28.84±0.84	30.30±1.38	-1.47	0.001	Back Foot_L	28.66±0.81	29.47±1.06	-0.81	0.022

Legend: skin temperature values in °C; R = right; L = left; sd = standard deviation; * = significant value ($p < 0.05$); n=16; age=26.33±3.28.

Figure 1 present the ROIs of the Tsk by soccer position pre MTP, where there was a significant difference between the positions center forward, defender and goalkeeper.



Discussion and Conclusion

The reduction in Tsk post MTP could be related to a progressive adaptation of the imposed training load. And the difference only in the ROIs front and inner thigh, and knee in center forward and defender is associated to shot muscles, physical practice, and competitions; and the lack of training routine and soccer club by the goalkeepers before MTP.

Practical Implications for CISM

The authors recommend the insertion of infrared thermography on daily training for monitoring internal training load, metabolic stress, preventing injuries and optimize performance in Military Soccer Team.

References

- MELLO, D. B. (2018). Estresse Térmico—os efeitos do calor sobre o desempenho físico. *Revista de Educação Física/Journal of Physical Education*, 87(4), 542-546. <https://doi.org/10.37310/refv87i4.810>.
- PRIEGO-QUESADA, J. I. et al. (2019). A preliminary investigation about the observation of regional skin temperatures following cumulative training loads in triathletes during training camp. *Journal of Thermal Biology*, 84, 431-438.
- MOREIRA, DANILO GOMES, JOSEPH T. COSTELLO, CIRO J. BRITO, JAKUB G. ADAMCZYK, KURT AMMER, AARON JE BACH, CARLOS MA COSTA et al. (2017). "Thermographic imaging in sports and exercise medicine: A Delphi study and consensus statement on the measurement of human skin temperature." *Journal of Thermal Biology* 69, 155-162.

