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Continuous Monitorization of Physiologic Mediators of Allostasis Indicate Overuse Injury Risk in Marine Officer Candidates

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Allostasis is the dynamic shift of physiologic mediator activity of biological responses to stress such as increased heart rate (HR), energy expenditure (EE) and altered sleep architecture (SA) that increase overuse injury risk. Overuse injuries are common in multi-stressor military training courses. Yet, mediator activity between recruits who later sustain overuse injuries (MSKI) and those who do not (noMSKI) remain unknown. **PURPOSE** Compare mediator activity via wearables between MSKI and noMSKI recruits during Marine Corps Officer Candidates School (OCS). **METHODS** 149 recruits received a wrist-worn device to record distance (mi), steps, EE (kcal; kcal/kg), SA (deep, light, REM, total sleep; h) and HR (bpm). Devices included age (y), height (cm), mass (kg), and sex for metrics and continued wear excluding device charge and data export every 15 ± 3 d. Inclusion criteria required ≥ 80% 24 h wear time (WT) ≥ 50% maximum WT. EE was captured as kilocalories burned during activity. Overuse injury data were sourced from OCS physical therapists. Data post-injury date were omitted. Data were shown as median [Q1, Q3]. Device metrics were compared between MSKI and noMSKI via Mann-Whitney U-test ($\alpha = 0.05$). **RESULTS** 69 recruits (23 women, 24 [22, 27] y, 172 [166, 178.5] cm, 73.7 [67.6, 84.9] kg) were included minus dropouts (n = 52), those with unmet WT (n = 26), or lost devices (n = 2). Daily device metrics were as follows: absolute EE: 1261 [751.2, 1910] kcal, relative EE: 17.04 [10.07, 25.79] kcal/kg, day HR: 86 [74, 100] bpm, sleep HR: 56 [49, 63] bpm, deep sleep: 1.03 [0.53, 1.87] h, light sleep: 2.77 [1.98, 3.63] h, REM sleep: 0.43 [0, 1.28] h, total sleep: 5.02 [3.72, 6.08] h, steps: 20529 [16344, 24354], and distance: 11.09 [8.50, 13.47] mi. 21 recruits (30.4%, 8 women) sustained an overuse injury (strains: 47.6%, 5 women). MSKI had significantly more daily absolute EE (1624 [925, 2479] vs 1224.5 [749.5, 1786] kcal, $p < 0.001$), relative EE (22.32 [13.58, 33.33] vs 16.42 [9.90, 23.89] kcal/kg, $p < 0.001$), higher day HR (90 [78, 104] vs 86 [73, 99] bpm, $p < 0.001$) and sleep HR (59 [48, 62] vs 55 [48, 62] bpm, $p < 0.001$), more deep sleep (1.22 [0.62, 2.04] vs 0.93 [0.48, 1.75] h, $p < 0.001$), light sleep (2.99 [2.03, 3.80] vs 2.75 [2, 3.58] h, $p < 0.001$), less REM sleep (0.28 [0, 1.10] vs 0.52 [0, 1.33] h, $p = 0.001$) and more total sleep (5.22 [3.91, 6.15] vs 4.88 [3.65 5.93] h, $p = 0.012$) than noMSKI. Daily steps (21102 [16999, 24710] vs 20696 [16610, 24446], $p = 0.265$) and distance (11.35 [8.72, 13.53] vs 11.25 [8.75, 13.59] mi, $p = 0.985$) were similar between groups. **CONCLUSION** Greater cardiometabolic activity and altered sleep architecture from more deep and light sleep and less REM sleep were found in MSKI recruits under similar physical activity to suggest overuse injury risk signs. **SIGNIFICANCE/NOVELTY** Wearable devices are crucial for military practitioners to detect shifts in mediator activity for overuse injury prevention.

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