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Abstract

The Effect of a 2-Week Ketogenic Diet, versus a Carbohydrate-Based Diet, on Cognitive Performance, Mood and Subjective Sleepiness during 36 Hours of Extended Wakefulness in Military Personnel †

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Abstract: Sleep deprivation compromises the cognitive performance of military personnel, jeopardising operational safety. Sleep deprivation-related performance deficits coincide with decreased glucose metabolism in associated brain regions, suggesting the potential utility of a ketogenic diet (KD) to provide an alternative fuel source during sleep deprivation. A randomised, cross-over trial was conducted with military personnel. Participants ingested an iso-energetic KD (CHO, ~25 g·day^{-1}) or a carbohydrate (CHO)-based diet (CHO, ~285 g·day^{-1}) for 14 days, immediately followed by 36 h of wakefulness and separated by a 12-day washout period. Cognitive performance (5-minute Psychomotor Vigilance Task; PVT), mood, subjective sleepiness, capillary blood glucose and D-β-hydroxybutyrate (D-βHB) were measured every 2 h. Linear mixed models tested the interaction and main effects of diet, period (six 6-hourly bins), and test time (1–3) within periods. D-βHB was higher in the KD than the CHO diet (+0.75 to +1.45 mM; $p < 0.001$), whilst glucose was lower (−0.26 to −1.16 mM; $p < 0.01$). The KD improved performance for all PVT variables (lapses, mean reciprocal reaction time (RT), slowest 10% RT and fastest 10% RT) ($p < 0.05$), mood ($p = 0.001$) and sleepiness ($p < 0.001$) compared with the CHO diet. Sleep deprivation-related deficits independent of diet were found for lapses, mean reciprocal RT, slowest 10% RT, mood and subjective sleepiness (all $p < 0.01$). Circadian effects were also observed independent of diet; fastest 10% RT was slower in periods 4 and 5 (0130–1330) compared with periods 1, 2 and 3 (0730–0130), but was faster in period 6 (1330–1930) compared with period 4 (all $p < 0.01$); and mood declined and sleepiness increased from period 1 (0730–1330) to period 4 (0130–0730) ($p < 0.001$), but stabilised across periods 4, 5 and 6 (0130–1830). The KD appeared to improve cognitive performance, mood and sleepiness during 36 h of extended wakefulness compared with the CHO-based diet. This suggests the KD could be considered for military operations when sleep deprivation is anticipated.

Keywords: sleep deprivation; psychomotor vigilance task; keto-adaptation; randomised cross-over trial

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