



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

Lydia Henderson, Margo van den Berg and David M. Shaw



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 [†]

Lydia Henderson ^{1,*}, Margo van den Berg ² and David M. Shaw ^{1,3}¹ School of Sport, Exercise and Nutrition, Massey University, Auckland 0632, New Zealand; david.shaw2@nzdf.mil.nz² Sleep-Wake Research Centre, School of Health Sciences, Massey University, Wellington 6021, New Zealand; m.j.vandenberg@massey.ac.nz³ Aviation Medicine Unit, Royal New Zealand Air Force Base Auckland, Whenuapai, Auckland 0618, New Zealand

* Correspondence: l.r.henderson@outlook.com

[†] Presented at the Nutrition Society of New Zealand Annual Conference, Online, 2–3 December 2021.

Citation: Henderson, L.; van den Berg, M.; Shaw, D.M. 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. *Med. Sci. Forum* **2022**, *9*, 22. <https://doi.org/10.3390/msf2022009022>

Academic Editors: Rachel Brown, Sally Mackay, Helen Eyles and Shabnam Jalili-Moghaddam

Published: 29 April 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

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

Author Contributions: D.M.S. and M.v.d.B. conceptualised the study; L.H., D.M.S. and M.v.d.B. implemented the study's procedures and collected data; D.M.S. and L.H. analysed the data; L.H. wrote the initial draft manuscript; L.H., D.M.S. and M.v.d.B. co-wrote and approved the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: The study was funded by Massey University School of Sport Exercise and Nutrition Post-Graduate Research Supporting Funding and the Aviation Medicine Unit, Royal New Zealand Air Force.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the New Zealand Defence Force Ethics Committee and Massey University Ethics Committee (SOA 20/47). The study was retrospectively registered with the Australian New Zealand Clinical Trials Registry (ACTRN12621000105842).

Informed Consent Statement: Informed written consent was obtained from all participants involved in the study.

Data Availability Statement: Data is currently publicly unavailable.

Conflicts of Interest: The authors declare no conflict of interest.