

CARBOHYDRATE RESTRICTION & INTERMITTENT FASTING FOR AEROMEDICAL PRACTITIONERS



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DISCLOSURE INFORMATION

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I have no financial relationships to disclose.

This presentation reflects the personal views of the author and not those of the RNZAF

INTRODUCTION

- Aeromedical practitioners are generally advised that a high carbohydrate diet (HCD) is necessary for optimal performance and health.
- However, a growing body of evidence regarding metabolic and cardiovascular risk factors, suggests a low carbohydrate diet (LCD) or periods of Intermittent fasting (IF) may be more beneficial.
- What is the evidence?
- Could a LCD or IF provide more effective outcomes for the health and performance of Aeromedical practitioners?

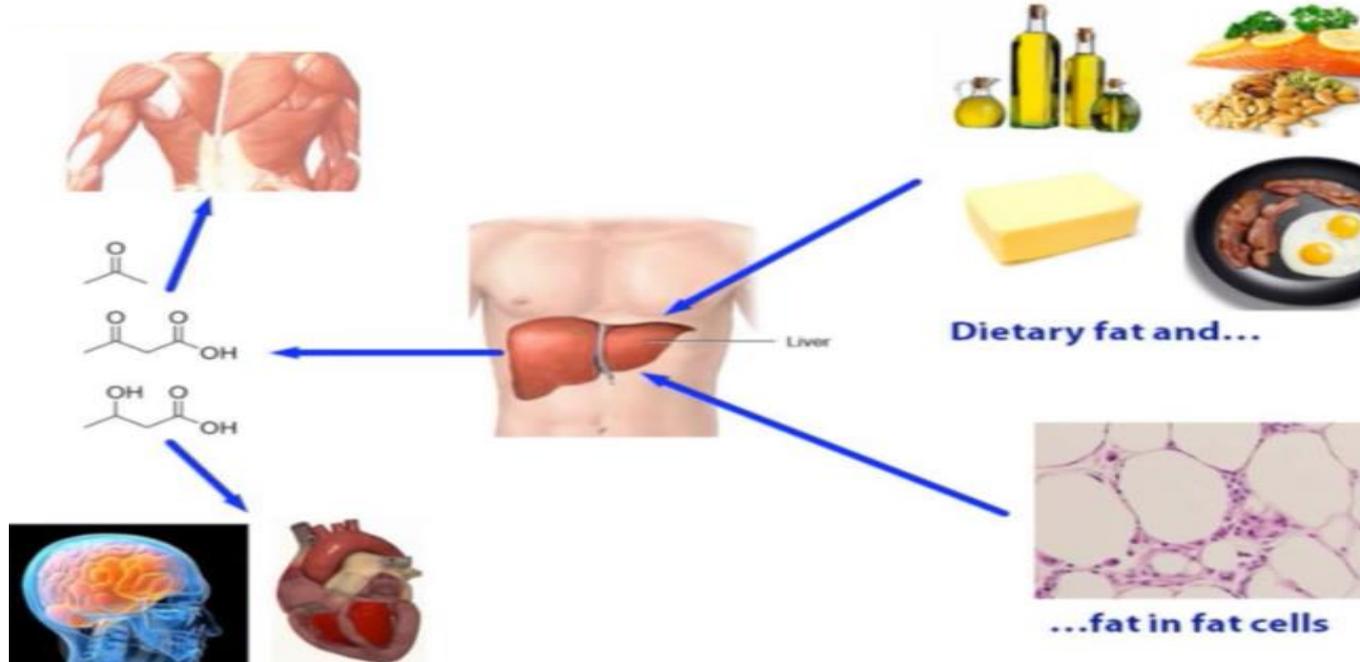
WHAT IS A LOW CARBOHYDRATE DIET?

Macronutrient Composition	HCD	LCD	LCKD
Carbohydrate (% of daily calories)	> 50%	< 25%	< 10%
Fat (% of daily calories)	< 30%	> 55%	> 70%
Protein (% of daily calories)	~ 20%	~ 20%	~ 20%

WHAT IS INTERMITTENT FASTING?

Method	Description
Alternate-day fasting	Alternating fasting days (no energy-containing foods or beverages consumed) with eating days (foods and beverages consumed ad libitum).
Modified fasting regimens	Fasting or reduced calorie consumption for a specific number of days per week: 5/2 Diet, Eat STOP Eat.
Time-restricted feeding	Restricting meals and fasting to set time intervals: 1vs 3 meals per day, 16 hours fasting, 8 hours eating (Lean gains), 20 hours fasting, 4 hours eating (Warrior diet).
Religious Fasting	A fast from dawn to sunset during the holy months of Ramadan. The most common dietary practice is to consume 1 large meal after sunset and 1 lighter meal before dawn. (Generally 12-18 hours duration)

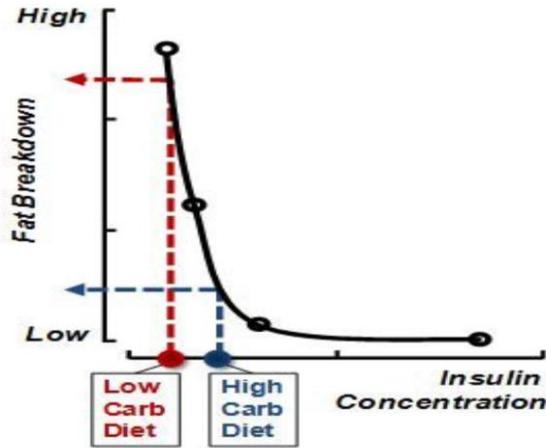
KETOSIS



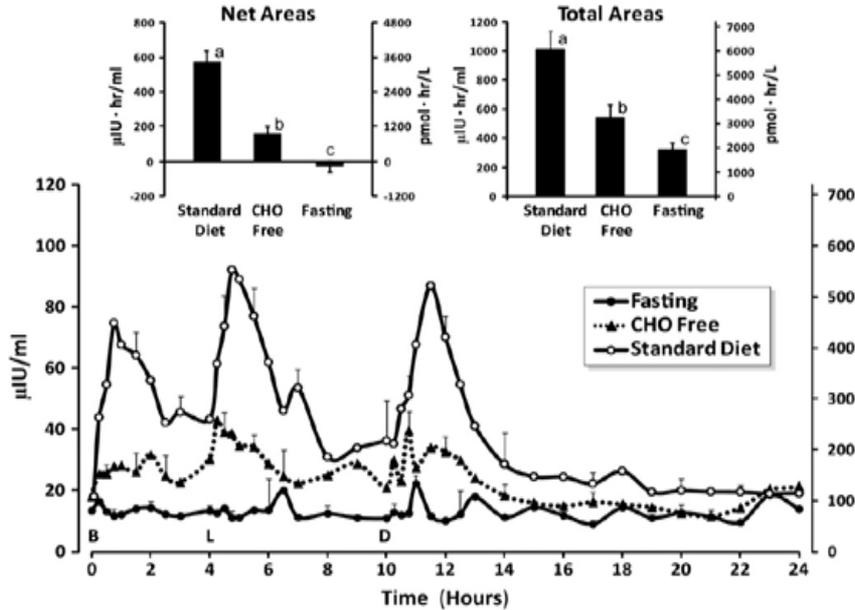
(Attia 2014)

FUEL AVAILABILITY: IF & LCD VS HCD

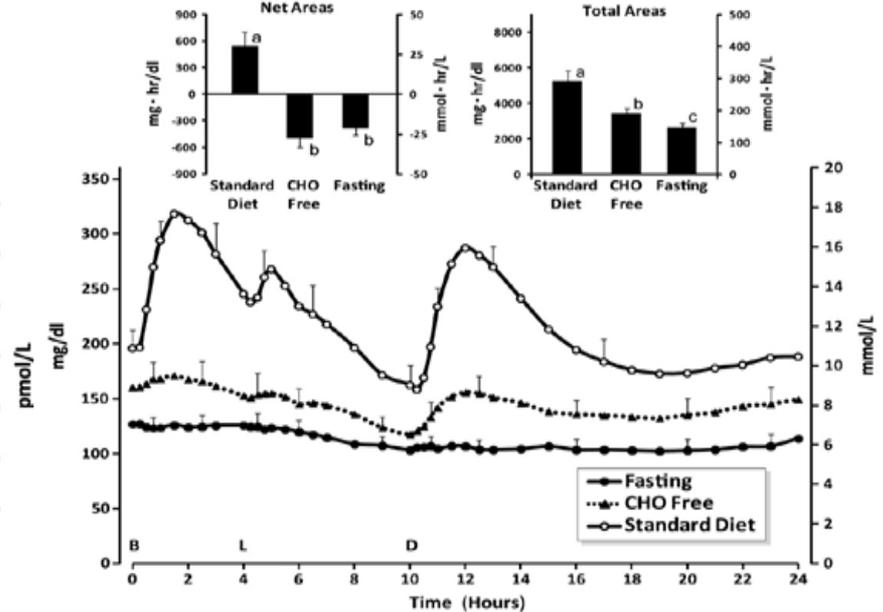
- Insulin is the primary regulator of lipolysis (Jensen et al., 1989)



Insulin Response



Glucose Response



Final 24 hour Insulin and glucose response during 72 hours of either a HCD, LCD or Fasting in type 2 diabetics with medication withheld (Nuttal., et al., 2015)

EVIDENCE: CARDIOVASCULAR AND METABOLIC RISK FACTORS (LCD / LCKD vs HCD)

- **Improved insulin sensitivity** (Gower & Goss 2015, Maekawa et al 2014, Saslow et al., 2014, Hussain et al., 2012,
- **Reduction in body mass & Improved blood lipid profiles** (Gower& Goss 2015, Bazzano et al., 2014, Maekawa et al 2014, Jenkins et al., 2014, Hussain et al., 2012, Volek et al., 2009,
- **Reduced inflammatory response** (Forsythe et al., 2010, Volek et al., 2008, Volek et al., 2005)
- **Reduced de-novo lipogenesis** (Volk et al., 2014, Forsythe et al., 2010, Volek et al., 2009, Sharman et al., 2005)

IF vs HCD

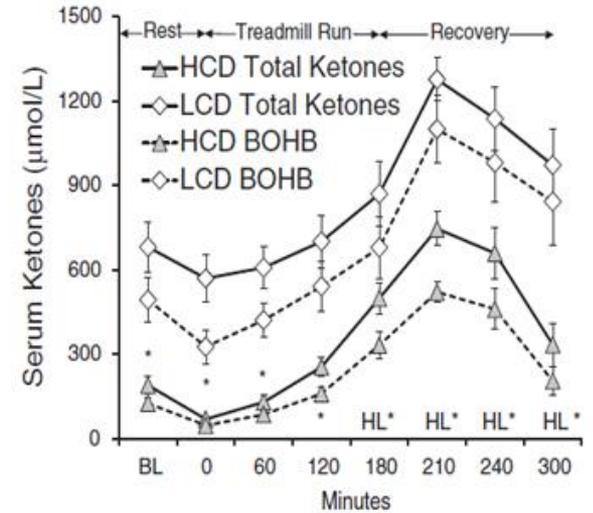
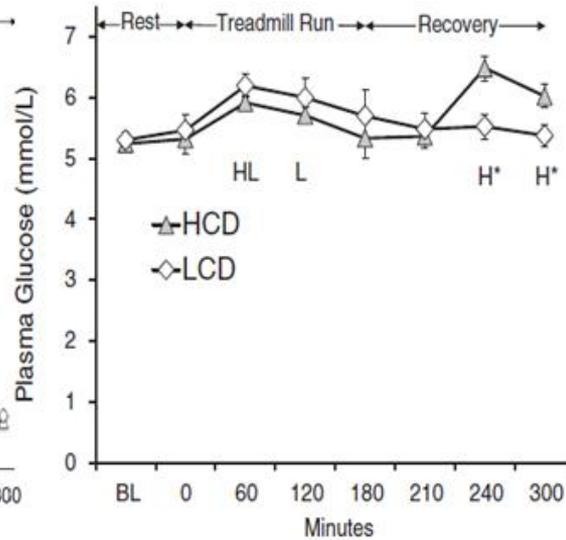
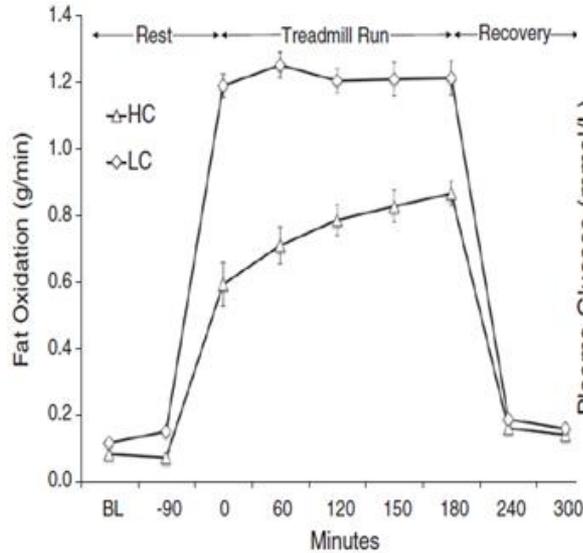
- **Reduction in body mass & Improved blood lipid profiles** (Varady et al., 2009, Halberg et al., 2005).
- **Improved insulin sensitivity** (Heilbronn et al., 2005, Halberg et al., 2005).
- Recently, Marinac et al., 2016 reported HbA1c is inversely related to night time fasting duration (0.2 mmol reduction for every 2 h increase in fasting duration).
- In addition, women who fasted < 13.1 hours per night had a 50% higher hazard for experiencing a breast cancer event

Study	Description of Meta-Analysis	Outcome <i>(Statistically significant changes for LCD vs HCD)</i>
Naude et al., 2014 (3209 subjects)	Analysis of 19 randomised controlled trials, >3 months duration which directly compared LCD and LCKD to HC diets	No differences in body mass or metabolic risk factors
Bueno et al., 2013 (1577 subjects)	Analysis of 13 randomised controlled trials, >12 months duration which directly compared LCKD to HC diets	Reductions in body mass, diastolic blood pressure, and triglycerides. Increases in LDL and HDL cholesterol.
Hu et al., 2012 (2788 subjects)	Analysis of 23 randomised controlled trials, >6 months duration which directly compared LCD (<45% of energy from Carbohydrate) HC diets	Reductions in triglycerides, total cholesterol, LDL cholesterol. Increases in HDL cholesterol. No differences in body mass
Nordman et al., 2006 (447 subjects)	Analysis of 5 randomised controlled trials, >3 months duration which directly compared LCKD to HC diets	Reductions in body mass, and triglycerides. Increases in total, LDL and HDL cholesterol
Santos et al., 2012 (1141 subjects)	Analysis of 17 randomised controlled trials, >3 months duration. Analysis compared responses from the LCD (<45% of energy from Carbohydrate) group of the selected studies.	Reductions in body mass, blood pressure, triglycerides, plasma glucose, insulin, HbA1c, CRP Increases in HDL cholesterol
Schwingshackl & Hoffman 2013 (1753 subjects)	Analysis of 14 randomised controlled trials, >12 months duration which directly compared LCKD to HC diets in pre diabetic and diabetic subjects	Reductions in, diastolic blood pressure, triglycerides and fasting glucose. Increases in HDL cholesterol

Study	Description of Meta-Analysis	Outcome <i>(Statistically significant changes for IF vs HCD)</i>
Sadeghirad et al., 2012 (1234 Subjects)	Analysis of 35 studies comparing outcomes before and after 1 month of Ramadan fasting	Reduction in Body mass.
Kul et al., 2013 (806 Subjects)	Analysis of 20 studies comparing outcomes before and after 1 month of Ramadan fasting	Reduction in Body mass. LDL cholesterol and plasma glucose
Headland et al., 2016 (981 subjects)	Analysis of 8 studies > 6 months duration comparing Modified fasting to continuous energy restriction with a HCD	No differences in body mass or metabolic risk factors

EVIDENCE: PHYSICAL PERFORMANCE

- Research investigating the influence of adaptation to LCD or intermittent fasting on exercise performance is limited.
- Erlenbush et al., 2005 conducted a meta analysis of 20 controlled studies investigating the effect of LCD or HCD on endurance performance. Performance was generally better with the HCD.
- However, only 4 studies from this analysis were > 4 weeks duration. Evidence from 3 of these studies favoured LCKD(Phinney et al., 83, Hovrath et al., 2000 and Venkatraman et al., 2001).



Physiological differences between HCD or LCD ultra distance runners exercising at 65% VO₂ max for 3 hours (Volek et al., 2015)

- Exercising in the fasted state does not impair endurance performance and can improve fat utilization during exercise and reduce hypoglycaemia (Van Proeyen et al., 2011)
- Exercising in the fasted state for 2 hours can cause a significant rise in blood ketones of 0.5–1.0 mmol (Ferry et al., 1986).
- Only 1 study has investigated strength and power (Paoli et al 2012). Performance with LCKD was uncompromised in comparison to a HCD for elite gymnasts.

EVIDENCE: COGNITIVE PERFORMANCE

- Only 4 studies, ≥ 4 weeks duration have compared changes in cognitive performance following adaptation to either LCD or HCD.
- Makris et al., 2013 & Brinkworth et al., 2009 - no significant differences in performance.
- Haylyburton et al., 2007 - significantly greater improvements in speed of processing with HCD,
No differences in working memory.
- Wing et al., 1995 - significantly impaired performance during the 1st week only with LCKD.

- Numerous studies have shown that short term or extended periods of fasting (12 hours to several days) does not impair cognition (Chamari et al., 2016, Lieberman et al., 2008, Green et al., 1995)

POTENTIAL BENEFITS

- Access to the body's most abundant source of fuel and protection from hypoglycaemia
- Maintenance of cognition with a reduced requirement for food and snacks during intensive and prolonged work shifts.
- Improved metabolic health which is of particular importance for shift workers

POTENTIAL ISSUES

- Increased risk of dehydration if insufficient electrolytes, in particular sodium, are not consumed.
- Some individuals may feel fatigued and show a reduction in physical and cognitive performance during the initial stages of a LCKD diet.

FUTURE RESEARCH

- Future research needs to investigate performance
 - Combined IF and LCD
 - Cognitive performance
 - Exogenous Ketones
 - Sleep and fatigue mitigation

CONCLUSION

- There is now substantial evidence that adaptation to a low carbohydrate diet or periods of intermittent fasting can provide beneficial outcomes in metabolic health.
- While the evidence is limited, cognitive performance and most indices of physical performance appear to be uncompromised once the individual is adapted to a LCD or following periods of IF.

CONTACT DETAILS

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RECOMMENDED REVIEW ARTICLES

- Feinman, et al., (2015). Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. *Nutrition*, 31(1), 1-13.
- Patterson, R. E., Laughlin, G. A., LaCroix, A. Z., Hartman, S. J., Natarajan, L., Senger, C. M., ... & Gallo, L. C. (2015). Intermittent fasting and human metabolic health. *Journal of the Academy of Nutrition and Dietetics*, 115(8), 1203-1212
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- Paoli, A et al., (2013). Beyond weight loss: a review of the therapeutic uses of very-low-carbohydrate (ketogenic) diets. *European journal of clinical nutrition*, 67(8), 789-796.
- Siri-Tarino, et al., (2010) Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. *The American journal of clinical nutrition*, ajcn-27725.