



The effect of a low carbohydrate high fat diet on lipid and lipoprotein metabolism: insight from a RCT

D. McCullough^{1,2}, T. Harrison², L.M. Boddy³, K.J. Enright³, F. Amirabdollahian⁴, M. Mazidi⁵, K.E. Lane³, C.E. Stewart³ and I.G. Davies³

¹Carnegie School of Sport, Leeds Beckett University, Leeds, UK,

²Department of Clinical Sciences and Nutrition, University of Chester, Chester, UK,

³Research Institute of Sport and Exercise Science, Liverpool John Moores University, Liverpool, UK,

⁴School of Public Health Studies, University of Wolverhampton, Wolverhampton, UK and

⁵Medical Research Council Population Health Research Unit, University of Oxford, Oxford, UK

Metabolic diseases are the leading global causes of death⁽¹⁾. Low carbohydrate, high fat (LCHF) diets improve markers of metabolic health and can mitigate disease risk⁽²⁾ however, the mechanisms are poorly understood. We aimed to explore the effects of an *ad libitum* LCHF vs. high carbohydrate low fat (HCLF) diet on the plasma lipidome in 16 relatively healthy adults.

Participants were randomly assigned to a HCLF diet ($n = 8$, $\geq 50\%$ of energy from carbohydrates) or a LCHF diet ($n = 8$, consume < 50 g/day of carbohydrates). Plasma samples were collected at 0, 4 and 8 weeks, and analysed for biomarkers of lipids and lipoprotein metabolism using high-throughput NMR spectroscopy platform. Data (mean \pm SD) were subjected to 2 x 3-way mixed ANOVA. All the p-values are corrected for multiple testing via The Benjamini and Hochberg method.

Dietary conditions did not differ in plasma triglyceride concentrations; however, triglycerides within HDL were significantly ($P < 0.05$) lower at week 4 (0.10 ± 0.03 mmol/L) compared with baseline (0.125 ± 0.05 mmol/L) and week 8 (0.119 ± 0.03 mmol/L) following the LCHF diet only. In contrast, the total phospholipids within LDL increased from baseline to week 8 with both the LCHF (0.72 ± 0.14 to 0.76 ± 0.12 mmol/L, $P = 0.012$) and HCLF (0.62 ± 0.16 to 0.68 ± 0.17 mmol/L, $P = 0.031$) diets leading to a significant interaction between diets ($P < 0.001$). Both diets resulted in increased total esterified cholesterol but only the HCLF diet increased within LDL at week 4 (1.48 ± 0.34 mmol/L, ($P = 0.018$) and week 8 (1.45 ± 0.41 mmol/L, ($P = 0.008$) compared with baseline (1.30 ± 0.37 mmol/L). Both dietary conditions impacted free cholesterol similarly although only the HCLF diet increased the free cholesterol within LDL from baseline to week 8 (0.48 ± 0.14 to 0.54 ± 0.15 mmol/L, $P = 0.013$) whereas no significant change was observed with the LCHF diet. Only the HCLF diet resulted in significant increases in total lipids within LDL from baseline to week 8 (2.53 ± 0.67 to 3.12 ± 0.50 mmol/L, $P = 0.010$) whereas no significant change was observed with the LCHF diet with no differences between diets. Similarly, no difference between groups was observed on lipoprotein particle concentration. However, LDL particle concentration significantly increased from baseline to week 8 (1071.47 ± 517.78 to 1302.54 ± 306.07 nmol/L, $P = 0.027$) following the HCLF diet whereas no change was observed with the LCHF diet.

A HCLF diet can increase LDL lipids, cholesterol and particle concentrations that might lead to increased cardiometabolic risk⁽³⁾. Conversely, a LCHF diet could decrease risks associated with lower HDL triglycerides⁽⁴⁾. However, longer term dietary studies with larger sample sizes in other ethnicities are warranted.

References

1. World Health Organization (2020) *The Top 10 Causes of Death* [Available at: <https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death>].
2. Mansoor N, Vinknes KJ, Veierod MB, et al. (2016) *Br J Nutr* **115**(3), 466–79.
3. Duran EK, Aday AW, Cook NR, et al. (2020) *J Am Coll Cardiol* **75**(17), 2122–35.
4. Girona J, Amigo N, Ibarretxe D, et al. (2019) *Int J Mol Sci* **20**(13), 3151.