International Journal of Research in Medical and Clinical Science (IJRMCS)
ISSN: 2997-6189 | Volume 3, Issue 1, 2025
www.journalserapublications.com

Review article

A Systematic Review (Before 15 October 2024) on the Effects of Ketogenic Diet on Blood Lipid Levels

Jun Kai Soh, Nicholas Jia Le Yip, Charmaine Zi Xuan Lim, Natalie Lileen Chew, Riko Keting Sng, Estelle Yun Chi Sim, Maurice Han Tong Ling*

School of Health and Nursing, Management Development Institute of Singapore, Singapore
Department of Life Sciences, University of Roehampton, United Kingdom

Abstract

The ketogenic diet (KD) is a high-fat, moderate-protein, and low-carbohydrate dietary regimen; resulting in ketosis–a metabolic state where fats become the primary energy source. This diet was originally used to as a dietary treatment for epileptic seizures but recently been explored to manage type 2 diabetes, and obesity. Due to KD's high-fat content, it may increase blood lipid levels but studies had been inconclusive. Furthermore, there is no systematic review in PubMed examining the effects of KD on blood lipids to-date. Hence, we present a systematic review on the effects of KD on blood lipids using articles indexed in PubMed prior to 15 October 2024. Fifteen students were included from 128 articles. Of which 12 of the 15 studies indicated that KD increases total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), while 3 studies suggested lipid profile improvements in obese individuals. This suggests that KD is likely to impact blood lipid profiles negatively for non-obese individuals but may improve blood lipid profiles for obese individuals.

Introduction

The ketogenic diet (KD) [1] is a diet consisting of high fat intake (60-75% of calories), moderate protein intake (20-30% of calories) and very low carbohydrate intake (5% of calories); which has been known to be beneficial in aiding weight loss, enhancing mental clarity and boosting energy levels. KD induces a state of ketosis where the body utilizes fats as the main energy source in place of carbohydrates; and has been found to reduce risk or managing certain chronic diseases such as type 2 diabetes, hypertension, cancer and hyperlipidaemia [2]. Ketogenesis occurs when the liver produces ketone bodies from fatty acids and ketogenic amino acids, and is inhibited by insulin. There are three main ketone bodies produced in the human body: 3-hydroxybutyrate (3-OHB), acetoacetate and acetone. Majority of the ketone bodies that circulate during ketogenesis comprises of 3-OHB. The ketone bodies are used as the main energy source in the heart and brain during KD [3]. KD has been used as a dietary treatment for epileptic seizures for about 100 years [4]. With the advancement of modern medicine, this method of treatment has fallen out of favour, except among those with drug-resistant epilepsy [5]. The efficacy of KD for treating epilepsy is high in patients ranging from infants to adults [6]. However, the efficacy is higher for certain syndromes compared to others, KD was found to have higher reduction rate in patients with Dravet syndrome compared to infantile spasms [7]. Besides epilepsy, KD has many potential benefits [8]; such as, reduction disease biomarkers, increased mental clarity, weight loss and others.

The incidence of obesity is rising worldwide every year, turning it into an epidemic [9]. The rise of obesity in turn will cause a rise in cardiovascular diseases, dyslipidaemia, diabetes and hypertension in the long run, as obesity is a major risk factor for such non-communicable diseases [10]. Thus, came the rise of weight loss diets such as KD. The KD has been recommended by medical professionals to patients that require weight loss diets to combat obesity, which has been effective in the short to medium time frame [11].

***Corresponding Author:** Maurice Han Tong Ling, School of Health and Nursing, Management Development Institute of Singapore, Singapore.*

The state of ketosis reduces lipogenesis and increase lipolysis [12, 13]. Other drivers of fat loss includes; reduction of appetite due to the higher satiety effects of high protein consumption [14], better regulation of appetite controlling hormones [15], direct action from ketone bodies to suppress appetite [16].

The effects of KD on type 2 diabetes is due to the fact that fat has no major impact on blood glucose levels and subsequent insulin secretion as compared to carbohydrate consumption [17], with a study found that 46% of patients achieved diabetes remission as a result of weight loss intervention [18]. However, the study does not address those who are not overweight. This led to a rise in research for the potential benefits of KD as a treatment for type 2 diabetes. As such, dietary alterations such as KD should be recommended as a potential treatment or disease management protocol [19].

Despite so, there may be negative effects of KD on blood lipid levels – Dreon et al. [20] showed an increase in low density lipoprotein (LDL) to high density lipoprotein ratio (HDL). Other studies showed that this increase in LDL was due to increase in larger sized LDL particles with a decrease in small dense LDL particles which are more atherogenic [21, 22]. However, there is no existing systematic reviews on the effects of KD on blood lipids. Therefore, this systematic review examines the effects of KD on blood lipids.

Methods

A PubMed search was conducted on 15 October 2024, for existing studies on KD and effects on lipidaemia and cholesterol published before 15 October 2024. The search terms were ("ketogen*" OR "keto diet*") and (hyperlipidaemia OR "high lipid*" OR "high cholesterol") with the following search URL https://pubmed.ncbi.nlm.nih.gov/?term=(ketogen*+OR+"keto+diet*")+AND+(hyperlipidaemia+OR+"high+lipid*"+OR+"high+cholesterol")&filter=dates.1000/1/1-2024/10/15. The exclusion criteria are as follows: (A) articles with no full text access, (B) articles on non-human subjects, (C) articles with non-primary studies, (D) articles not about ketogenic diet or low carbohydrate diet, (E) articles not about hyperlipidaemia or high cholesterol. The articles that passed the exclusion criteria were then used in this review.

Results and Discussion

A total of 128 articles were found with the search term on PubMed; including 2 systematic reviews, which are focused on seizures [23] and epilepsy [24]. After screening through the exclusion criteria (Figure 1), only 15 articles were included in this review. Of which, 12 studies [25–36] show that KD increased blood lipid levels while 3 studies [37–39] show that KD decreased blood lipid levels.

Ketogenic Diet Increases Blood Lipid Levels

Twelve of the 15 studies [25–36] showed increases in blood lipid levels. Cervenka et al. [28] investigated the effects of Modified Atkins Diet (MAD) – a variation of KD – on lipid profiles in adults with epilepsy. They demonstrated increases in total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG) from a baseline before starting KD even though there was also a decrease in high-density lipoprotein cholesterol (HDL-C) in the first few months of KD up to a year. As majority of the studies presented utilised KD as a form of short-term intervention during the study, the thematic classification of the papers was decided based on lipid profiles presented within a 12-month period of starting KD. This is supported by Budoff et al. [25] who followed participants that underwent KD for 4.7 ± 2.8 years and found highly elevated levels of TC, LDL-C compared to a control cohort that had no dietary intervention. The KD subjects had a mean TC of 369 ± 95 mg/dL and LDL-C of 272 ± 91 mg/dL compared to the control cohort of 205 ± 40 mg/dL for TC and 123 ±38 mg/dL for LDL-C. This study exhibited an 80% difference in mean TC and a 121% difference in LDL-C between the KD subjects and control subjects.

Kwiterovich et al. [31] examined the effects of KD on plasma levels of lipoproteins and lipids in 141 children by measuring TC, LDL-C, very low-density lipoprotein cholesterol (VLDL-C), HDL-C and TG. Results at 6 months showed significant increases in TC (mean increase: 58 mg/dL), LDL-C (50 mg/dL), VLDL-C (8 mg/dL), TG (58 mg/dL) while HDL-C decreased by 7 mg/dL. At the 12 and 24 months, the changes persisted but there was a reduction in compared to the 6-month mark. Similarly, Nizamuddin et al. [33] also investigated the effects of KD in children. At baseline before starting KD, 25% of children has TC levels above 200 mg/dL, while 1% had levels above 300 mg/dL. After initiating KD, the proportions rose with 60% of children exceeding 200 mg/dL 20% exceeding 300 mg/dL. TG levels also increased with 51% of children exceeding 130 mg/dL and 26% exceeding 200 mg/dL compared to the 18% and 5% respectively at baseline before KD. LDL-C also showed a rise with 52% of children exceeding 130 mg/dL compared to 19% at baseline. Conversely HDL-C decrease with 24% of children falling below 35 mg/dL compared to 7% at baseline. After adjusting for variables like age, they found that formula-based diets were associated with lower risks of cholesterol levels above 200 mg/dL. Interventions to the KD, such as changing ratio of fats to other macronutrients or addition of medium chain triglycerides, were implemented to children that

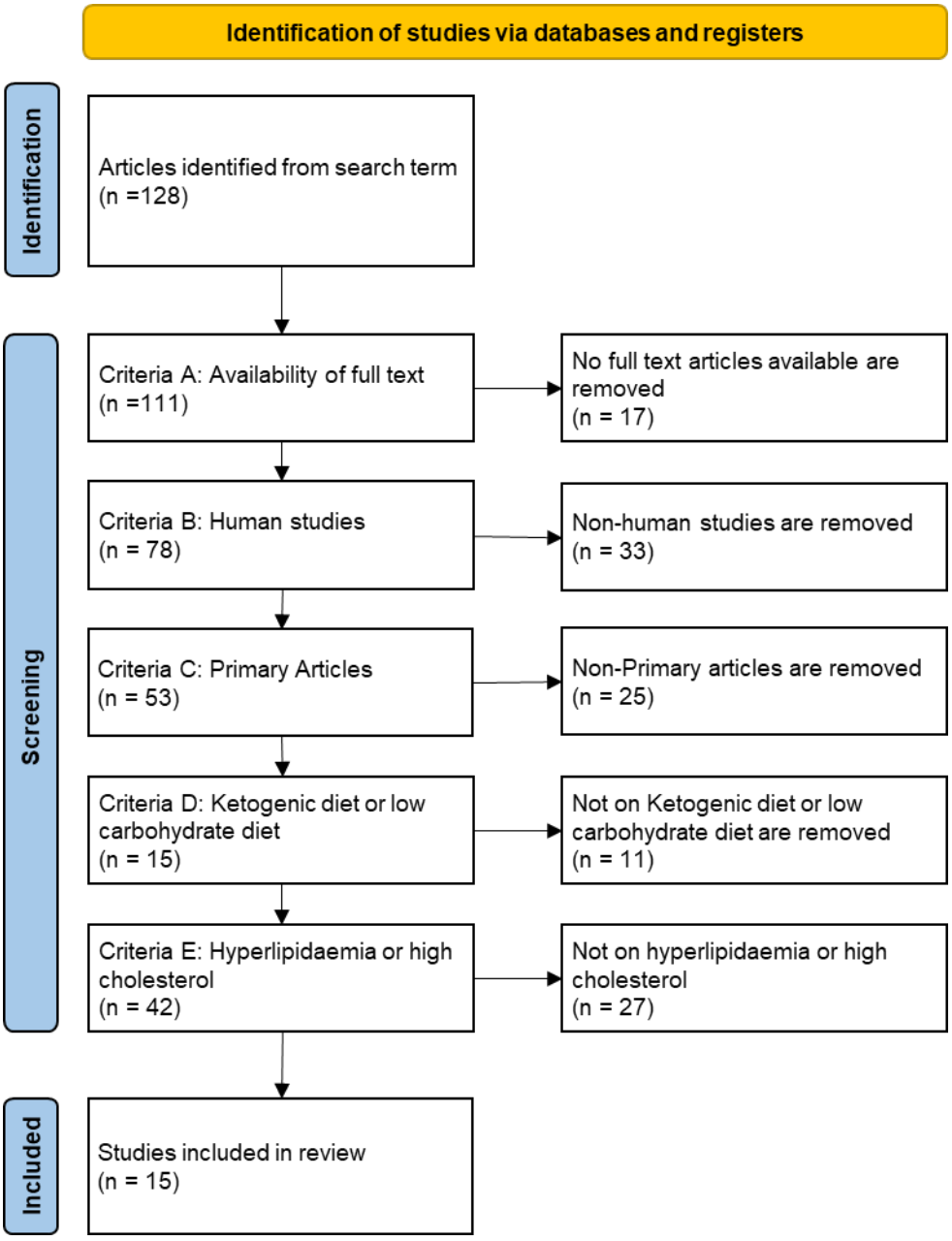

Figure 1. *PRISMA flowchart.*

developed high cholesterol. These interventions resulted in a 20% reduction in cholesterol levels in 60% of the bases [33].

Two articles presented are case series presentation. Firstly, Goldberg et al. [29] presented a series of case reports, all independent of each other, that examined the effects of KD on blood lipid levels. The cases saw an increase in LDL-C, with one patient having an increase of over 300%, from 120 mg/dL at baseline to around 400 mg/dL while on KD. There was variability in the TG response, with some showing a reduction while others showing significant increases. This highlighted the different outcomes of starting KD with different risk factors of metabolic diseases, with some already pre-existing and others a genetic predisposition from familial history. Secondly, Schmidt et al. [36] also examined the effect of KD on blood lipid levels in seventeen cases. The mean baseline LDL-C before KD was 129 mg/dL (SD ± 26.6 mg/dL). The patients did a low-carbohydrate, high-fat diet for an average 12.3 months before measuring the blood LDL-C again. Upon second measurement, the mean LDL-C was 316 mg/dL (SD ± 160.2 mg/dL) with a range of 210 – 810 mg/dL among the patients. The authors drew the conclusion that undergoing KD for an average of 12.3 months resulted in an average increase in LDL-C by an average of 187 mg/dL, which represents a 245% increase from baseline before KD.

Five articles are individual case reports. Firstly, Anekwe et al. [26] presented the case of a 57-year-old woman with Class I obesity who adopted a KD for weight loss. After initiating KD, there was significant increase in TC (from 206 mg/dL to 353 mg/dL), LDL-C (from 134 mg/dL to 248 mg/dL) and a slight increase in TG (from 55 mg/dL to 68 mg/dL). HDL-C saw an increase as well from 63 mg/dL to 72 mg/dL. The patient then discontinued KD as per her doctor's recommendations and the lipid levels returned to baseline after one year post KD. The subject also had elevated liver enzymes during her blood tests on the KD, which returned to baseline one year after discontinuation. Secondly, Buse et al. [27] presented a case report of a 51-year-old male with history of hypertriglyceridemia on treatment with gemfibrozil, developing acute pancreatitis after initiating KD for weight loss. Baseline TG was approximately 200 mg/dL while on gemfibrozil. After starting KD, TG levels rose to 1200 mg/dL, while maintaining gemfibrozil dosage. In his case, he developed acute pancreatitis by mechanism of increase free fatty acids from the elevated triglycerides. The free fatty acids potentially causing tissue damage and inflammation which led to the pancreatitis, highlighting the risk of starting KD with a pre-existing metabolic disorder. Thirdly, a 5-year-old girl with Glut1D and seizures was provided with a KD as dietary treatment for seizure prevention [30]. This girl developed severe hypertriglyceridemia with significant elevations in TG and TC. TG levels elevated from a baseline of 106 mg/dL to 577 mg/dL after 3 months on the KD. TC levels also elevated from a baseline of 135 mg/dL to 231 mg/dL within the same period of 3 months. Fourthly, Naveh et al. [32] presented a case of a 38-year-old man with acute hyperlipidaemia. He was an active smoker with normal body mass index (BMI) of 21.6 kg/m^2. Before starting KD, his baseline LDL-C during a 15-year period was ranging between 100 mg/dL and 140 mg/dL. After initiating KD, his LDL-C rose almost five times his usual range, up to 496 mg/dL. He was then recommended pharmacotherapy via ezetimibe and a change of dietary patterns to include lower saturated fat consumption. LDL-C levels decreased to 173 mg/dL after a few weeks on the treatment. Lastly, Norwitz et al. [34] showcased a 26-year-old man with ulcerative colitis adopting a KD experiencing significant elevations in his lipid profile. LDL-C rose from 95 mg/dL pre-KD to 521 mg/dL after one year on KD. TC also saw a significant rise from 160 mg/dL after one year to 649 mg/dL after one year on KD.

Ketogenic Diet Decreases Blood Lipid Levels

Three of the 15 studies [37–39] show that KD decreased blood lipid levels. Firstly, Yancy et al. [39] conducted a randomised controlled trial over 24 weeks with 120 overweight participants with elevated lipid levels (TC, LDL-C or TG) but no serious medical condition, to compare effects of KD to a low fat and low cholesterol, calorie reduced diet. The study found that the KD group had greater changes in lipid levels. There was a decrease in TG (157.8 mg/dL to 83.6 mg/dL), and an increase in HDL-C levels (55.4 mg/dL to 60.9 mg/dL), in the KD group. For LDL-C, there was no change on average (157.2 mg/dL to 158.8 mg/dL). Secondly, Paoli et al. [38] examined the effects of ketogenic Mediterranean diet with phytoextracts on weight, body composition and cardiovascular risk over six weeks with a measurement before and at the end. Participants were of BMI ≥ 25 kg/m^2. Results showed significant decrease to TC (204.2 mg/dL to 181.1 mg/dL), LDL-C (149.7 mg/dL to 135.8 mg/dL), and TG (118.6 mg/dL to 93.8 mg/dL). There was a significant increase in HDL-C levels (46.2 mg/dL to 52.1 mg/dL). By the end of six weeks, there was an average decrease in body weight, BMI, waist and hip measurements, as well as an improvement in body composition. Lastly, Dashti et al. [37] studied the effects of long-term KD in obese subjects with pre-elevated TC levels by following 66 healthy obese individuals with BMI > 30 kg/m^2 for 56 weeks, taking measurements every eight weeks. Out of the 66 participants, they were grouped into two groups, group I had pre-existing high cholesterol level above 6 mmol/L, and group II with normal cholesterol level less than 6 mmol/L. There were 35 subjects in group I and 31 subjects in group II. By week 56, only 49 subjects completed the full study, 26 from group I and 23 from group II. Over the 56 weeks there was a significant reduction in TG, it decreased from 4.25 mmol/L to 1 mmol/L, and from 2 mmol/L to 1 mmol/L on average in group I and II respectively. LDL-C also decreased significantly from an average of 5.4 mmol/L to 3.5 mmol/L in group I, and 3.6 mmol/L to 2.5 mmol/L in group II. TC significantly decreased for group I, going from an average of 7 mmol/L to 5 mmol/L, which falls within the study's normal range for TC of 3.4 to 6 mmol/L. TC decreased for group II as well, going from 5 mmol/L to 4.6 mmol/L. HDL-C saw a significant increase for both groups, going from 1.05 mmol/L to 1.6 mmol/L and 1.23 mmol/L to 1.62 mmol/L for group I and II respectively. Both groups saw significant reduction in body weight and BMI.

Of the three studies found to show a decrease in lipid levels, Dashti et al. [37] conducted the longest study of 56 weeks, with the shortest being 6 weeks by Paoli et al [38]. All three studies had subjects who were obese – BMI ≥ 25 kg/m^2 – with varying degrees of lipidaemia. This suggests a reduction of lipid levels in obese individuals undertaking the KD.

Conclusion

The KD presents an alternative dietary therapy to individuals looking to lose weight as well as a form of treatment for individuals with epilepsy. The individuals can have high adherence to the diet as they only need to keep carbohydrate intake under control. The presence of excess fat intake leads to the rise of serum lipid levels, specifically LDL-C, TC and TG. The exposure to elevated lipid levels can have negative impacts on health and CVD risk. However, KD has proven beneficial in lowering blood lipids in obese individuals, although longer term studies are required to understand the effects after individuals are within the normal weight range.

Supplementary Materials

Supplementary materials for this review can be downloaded from https://bit.ly/KD_Lipids_SR.

Conflict of interest

No conflict of interest to declare.

References

1. McGaugh E, Barthel B (2022) A Review of Ketogenic Diet and Lifestyle. *Missouri Medicine* 119(1):84–88.
2. Wajeed M, Pavan A, Mahammed Z. KS, Kalyan R. U (2024) Ketogenic Diet. *StatPearls*. Available at https://www.ncbi.nlm.nih.gov/books/NBK499830/
3. Luong TV, Abild CB, Bangshaab M, Gormsen LC, Søndergaard E (2022) Ketogenic Diet and Cardiac Substrate Metabolism. *Nutrients* 14(7). https://doi.org/10.3390/nu14071322
4. Zarnowska IM (2020) Therapeutic Use of the Ketogenic Diet in Refractory Epilepsy: What We Know and What Still Needs to Be Learned. *Nutrients* 12(9):2616. https://doi.org/10.3390/nu12092616
5. Janmohamed M, Brodie MJ, Kwan P (2020) Pharmacoresistance-Epidemiology,mechanisms,and impact on epilepsy treatment. *Neuropharmacology* 168:107790. https://doi.org/10.1016/j.neuropharm.2019.107790
6. Green SF, Nguyen P, Kaalund-Hansen K, Rajakulendran S, Murphy E (2020) Effectiveness, retention, and safety of modified ketogenic diet in adults with epilepsy at a tertiary-care centre in the UK. *Journal of Neurology* 267(4):1171–1178. https://doi.org/10.1007/s00415-019-09658-6
7. Tian X, Chen J, Zhang J, Yang X, Ji T, Zhang Y, Wu Y, Fang F, Wu X, Zhang Y (2019) The Efficacy of Ketogenic Diet in 60 Chinese Patients With Dravet Syndrome. *Frontiers in Neurology* 10:625. https://doi.org/10.3389/fneur.2019.00625
8. Dowis K, Banga S (2021) The Potential Health Benefits of the Ketogenic Diet: A Narrative Review. *Nutrients* 13(5):1654. https://doi.org/10.3390/nu13051654
9. Olshansky SJ, Passaro DJ, Hershow RC, Layden J, Carnes BA, Brody J, Hayflick L, Butler RN, Allison DB, Ludwig DS (2005) A potential decline in life expectancy in the United States in the 21st century. *The New England Journal of Medicine* 352(11):1138–1145. https://doi.org/10.1056/NEJMsr043743
10. Koh-Banerjee P, Wang Y, Hu FB, Spiegelman D, Willett WC, Rimm EB (2004) Changes in body weight and body fat distribution as risk factors for clinical diabetes in US men. *American Journal of Epidemiology* 159(12):1150–1159. https://doi.org/10.1093/aje/kwh167
11. Bueno NB, de Melo ISV, de Oliveira SL, da Rocha Ataide T (2013) Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. *The British Journal of Nutrition* 110(7):1178–1187. https://doi.org/10.1017/S0007114513000548
12. Veldhorst MAB, Westerterp-Plantenga MS, Westerterp KR (2009) Gluconeogenesis and energy expenditure after a high-protein, carbohydrate-free diet. *The American Journal of Clinical Nutrition* 90(3):519–526. https://doi.org/10.3945/ajcn.2009.27834
13. Cahill GF (2006) Fuel metabolism in starvation. *Annual Review of Nutrition* 26:1–22. https://doi.org/10.1146/annurev.nutr.26.061505.111258
14. Westerterp-Plantenga MS, Nieuwenhuizen A, Tomé D, Soenen S, Westerterp KR (2009) Dietary protein, weight loss, and weight maintenance. *Annual Review of Nutrition* 29:21–41. https://doi.org/10.1146/annurev-nutr-080508-141056
15. Sumithran P, Prendergast LA, Delbridge E, Purcell K, Shulkes A, Kriketos A, Proietto J (2013) Ketosis and appetite-mediating nutrients and hormones after weight loss. *European Journal of Clinical Nutrition* 67(7):759–764. https://doi.org/10.1038/ejcn.2013.90
16. Johnstone AM, Horgan GW, Murison SD, Bremner DM, Lobley GE (2008) Effects of a high-protein ketogenic diet on hunger, appetite, and weight loss in obese men feeding ad libitum. *The American Journal of Clinical Nutrition* 87(1):44–55. https://doi.org/10.1093/ajcn/87.1.44

17. Nuttall FQ, Gannon MC (1991) Plasma glucose and insulin response to macronutrients in nondiabetic and NIDDM subjects. *Diabetes Care* 14(9):824–838. https://doi.org/10.2337/diacare.14.9.824

18. Lean ME, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, Peters C, Zhyzhneuskaya S, Al-Mrabeh A, Hollingsworth KG, Rodrigues AM, Rehackova L, Adamson AJ, Sniehotta FF, Mathers JC, Ross HM, McIlvenna Y, Stefanetti R, Trenell M, Welsh P, Kean S, Ford I, McConnachie A, Sattar N, Taylor R (2018) Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. *Lancet (London, England)* 391(10120):541–551. https://doi.org/10.1016/S0140-6736(17)33102-1

19. Kalra S, Singla R, Rosha R, Dhawan M (2018) Ketogenic diet: situational analysis of current nutrition guidelines. *JPMA The Journal of the Pakistan Medical Association* 68(12):1836–1839.

20. Dreon DM, Fernstrom HA, Campos H, Blanche P, Williams PT, Krauss RM (1998) Change in dietary saturated fat intake is correlated with change in mass of large low-density-lipoprotein particles in men. *The American Journal of Clinical Nutrition* 67(5):828–836. https://doi.org/10.1093/ajcn/67.5.828

21. Krauss RM, Blanche PJ, Rawlings RS, Fernstrom HS, Williams PT (2006) Separate effects of reduced carbohydrate intake and weight loss on atherogenic dyslipidemia. *The American Journal of Clinical Nutrition* 83(5):1025–1031; quiz 1205. https://doi.org/10.1093/ajcn/83.5.1025

22. Abbasi J (2018) Interest in the Ketogenic Diet Grows for Weight Loss and Type 2 Diabetes. *JAMA* 319(3):215–217. https://doi.org/10.1001/jama.2017.20639

23. [Mahmoud SH, Ho-Huang E, Buhler J (2020) Systematic review of ketogenic diet use in adult patients with status epilepticus. *Epilepsia Open* 5(1):10–21. https://doi.org/10.1002/epi4.12370

24. Cai Q-Y, Zhou Z-J, Luo R, Gan J, Li S-P, Mu D-Z, Wan C-M (2017) Safety and tolerability of the ketogenic diet used for the treatment of refractory childhood epilepsy: a systematic review of published prospective studies. *World journal of pediatrics: WJP* 13(6):528–536. https://doi.org/10.1007/s12519-017-0053-2

25. Budoff M, Manubolu VS, Kinninger A, Norwitz NG, Feldman D, Wood TR, Fialkow J, Cury R, Feldman T, Nasir K (2024) Carbohydrate Restriction-Induced Elevations in LDL-Cholesterol and Atherosclerosis: The KETO Trial. *JACC Advances* 3(8):101109. https://doi.org/10.1016/j.jacadv.2024.101109

26. Anekwe CV, Chandrasekaran P, Stanford FC (2020) Ketogenic Diet-induced Elevated Cholesterol, Elevated Liver Enzymes and Potential Non-alcoholic Fatty Liver Disease. *Cureus* 12(1):e6605. https://doi.org/10.7759/cureus.6605

27. Buse GJ, Riley KD, Dress CM, Neumaster TD (2004) Patient with gemfibrozil-controlled hypertriglyceridemia that developed acute pancreatitis after starting ketogenic diet. *Current Surgery* 61(2):224–226. https://doi.org/10.1016/S0149-7944(03)00159-4

28. Cervenka MC, Patton K, Eloyan A, Henry B, Kossoff EH (2016) The impact of the modified Atkins diet on lipid profiles in adults with epilepsy. *Nutritional Neuroscience* 19(3):131–137. https://doi.org/10.1179/1476830514Y.0000000162

29. Goldberg IJ, Ibrahim N, Bredefeld C, Foo S, Lim V, Gutman D, Huggins L-A, Hegele RA (2021) Ketogenic diets, not for everyone. *Journal of Clinical Lipidology* 15(1):61–67. https://doi.org/10.1016/j.jacl.2020.10.005

30. Klepper J, Leiendecker B, Heussinger N, Lausch E, Bosch F (2016) Severe Hypertriglyceridemia in Glut1D on Ketogenic Diet. *Neuropediatrics* 47(2):132–136. https://doi.org/10.1055/s-0036-1572413

31. Kwiterovich PO, Vining EPG, Pyzik P, Skolasky R, Freeman JM (2003) Effect of a high-fat ketogenic diet on plasma levels of lipids, lipoproteins, and apolipoproteins in children. *JAMA* 290(7):912–920. https://doi.org/10.1001/jama.290.7.912

32. Naveh N, Avidan Y, Zafrir B (2023) Extreme Hypercholesterolemia Following a Ketogenic Diet: Exaggerated Response to an Increasingly Popular Diet. *Cureus* 15(8):e43683. https://doi.org/10.7759/cureus.43683

33. Nizamuddin J, Turner Z, Rubenstein JE, Pyzik PL, Kossoff EH (2008) Management and risk factors for dyslipidemia with the ketogenic diet. *Journal of Child Neurology* 23(7):758–761. https://doi.org/10.1177/0883073808318061

34. Norwitz NG, Soto-Mota A, Feldman D, Parpos S, Budoff M (2022) Case Report: Hypercholesterolemia "Lean Mass Hyper-Responder" Phenotype Presents in the Context of a Low Saturated Fat Carbohydrate-Restricted Diet. *Frontiers in Endocrinology* 13:830325.

https://doi.org/10.3389/fendo.2022.830325

35. Salas Noain J, Minupuri A, Kulkarni A, Zheng S (2020) Significant Impact of the Ketogenic Diet on Low-Density Lipoprotein Cholesterol Levels. *Cureus* 12(7):e9418. https://doi.org/10.7759/cureus.9418

36. Schmidt T, Harmon DM, Kludtke E, Mickow A, Simha V, Kopecky S (2023) Dramatic elevation of LDL cholesterol from ketogenic-dieting: A Case Series. *American Journal of Preventive Cardiology* 14:100495. https://doi.org/10.1016/j.ajpc.2023.100495

37. Dashti HM, Al-Zaid NS, Mathew TC, Al-Mousawi M, Talib H, Asfar SK, Behbahani AI (2006) Long term effects of ketogenic diet in obese subjects with high cholesterol level. *Molecular and Cellular Biochemistry* 286(1–2):1–9. https://doi.org/10.1007/s11010-005-9001-x

38. Paoli A, Cenci L, Grimaldi KA (2011) Effect of ketogenic Mediterranean diet with phytoextracts and low carbohydrates/high-protein meals on weight, cardiovascular risk factors, body composition and diet compliance in Italian council employees. *Nutrition Journal* 10:112. https://doi.org/10.1186/1475-2891-10-112

39. Yancy WS, Olsen MK, Guyton JR, Bakst RP, Westman EC (2004) A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia: a randomized, controlled trial. *Annals of Internal Medicine* 140(10):769–777. https://doi.org/10.7326/0003-4819-140-10-200405180-00006

Cite this article: Jun Kai Soh, Nicholas Jia Le Yip, Charmaine Zi Xuan Lim, *et al.* *A Systematic Review (Before 15 October 2024) on the Effects of Ketogenic Diet on Blood Lipid Levels. International Journal of Research in Medical and Clinical Sciences. 2025; 3(1): 108-114.*