2021

Effect of a Ketogenic Diet on Glycemic Control in Type 2 Diabetics

Steven Moore
University of North Dakota

Effect of a Ketogenic Diet on Glycemic Control in Type 2 Diabetics

Steve Moore M.S., PA-S with Professor Julie Skiba, PA-C & Professor Daryl Sieg, PA-C
Department of Physician Assistant Studies, University of North Dakota School of Medicine & Health Sciences
Grand Forks, ND 58202-9037

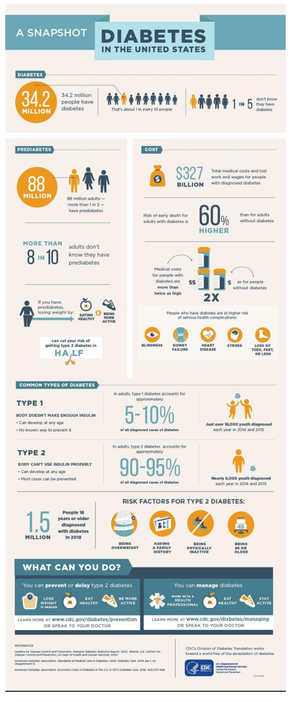
Abstract

With the increasing rate of patients diagnosed with type 2 diabetes mellitus (T2DM) and the serious complications associated with this disease, there continues to be controversy surrounding the most effective way to manage glycemic control in this population. The intention of this meta-analysis is to determine the effect of a ketogenic diet as a first-line treatment option on glycemic control in type 2 diabetic patients. Effectiveness was determined by comparing the ketogenic diet to other popular diets recommended to diabetics by practitioners following guidelines set forth by the American Diabetes Association. Several high-quality studies were selected utilizing PubMed, Dynamed plus, Cochrane Library, CINAHL, and Clinical Key databases with keyword and MeSH terms to narrow search results. These studies provide data of the diet's effects on HbA1c along with other parameters such as body weight, lipids, blood glucose levels of which can increase the risk of complications and associated diseases in T2DM patients. According to several studies, initiation of a ketogenic diet does not improve health parameters more than the current recommended diets for T2DM patients. With multiple diet plans providing health benefits in type 2 diabetics, the main component of success was adherence. The research does show promise, but the treatment plan will need to be individualized based on the patient's readiness and willingness to implement lifestyle changes.

https://alleideen.com/ketogene-diat-vor-und-nachteile/

Introduction

With these drastic numbers it is time to investigate the most effective way for this population to successfully manage their disease. With the high medical costs and reduced productivity due to T2DM, this disease is a serious health and economic problem. Diet is one-way T2DM patients manage their blood sugar. A ketogenic diet consists of reducing carbohydrate intake with the replacement of fat. The ketogenic diet is a strict nutritional regimen consisting of low carbohydrates, high fat, and sufficient protein that pushes one into a state of ketosis where the body's fat storage provides most of the fuel for the body as the glucose reserve is depleted (Blanco et al., 2019).



https://www.cdc.gov/diabetes/library/socialmedia/infographics/diabetes.html

Statement of the Problem

With the increased in patients with T2DM, medical providers encounter this disease daily. Treatment options need to be backed by evidence-based medicine to prove their effectiveness along with the ability of the treatment to be successfully implemented. A ketogenic diet should be a first-line treatment option in terms of effectiveness on glycemic control in patients living with T2DM. This research will help guide providers and patients with a nutritional option as their treatment plan for managing blood sugar in a T2DM patient.

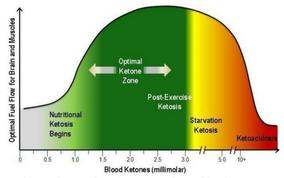
Research Question

Does a ketogenic diet influence the improvement of glycemic control in patients who are living with T2DM?

Literature Review

Safety of using ketogenic diet management as first-line treatment of T2DM

- The safety with the use of a ketogenic diet in diabetic participants has been of concern since there is limited long-term data according to Blanco et al. (2019).
- Goday et al. (2016) found that electrolytes remained stable on the ketogenic diet.
- Gomez-Arbelaez et al. (2017) agreed and added that lactic acid did not show significant variations. When compared to patients with ketoacidosis the blood pH was significantly lower than the ketogenic diet group (pH of 7.16 ± 0.12 ($p < 0.001$) vs. pH of 7.37 ± 0.02 ($p < 0.001$)).
- Goday et al. concluded it a safe medical nutritional therapy option for T2DM participants.



https://bicycles.stackexchange.com/questions/31471/how-to-decrease-belly-fat-while-cycling

Advantages of using ketogenic diet management as first-line treatment of T2DM

- The most common parameters researching a ketogenic diet focused on lipids and glycemic control.
- The results of the study by Ajala et al. (2013) revealed that the low-carbohydrate was able to reduce HbA1c by a range of 0.12% to 0.5% , along with increasing HDL cholesterol an average of 10% ($p < 0.00001$).
- Kodama et al. (2009) found that there was a 13.4% ($p < 0.001$, CI = 95%) decrease in triglycerides with the ketogenic diet.
- Yamada et al. (2014) study produced similar results as the studies above.
- According to Ajala et al., an argument can be made that a low carbohydrate diet would be beneficial for patients with T2DM due to the added benefit of possibly increasing HDL cholesterol and decreased triglycerides and HbA1c.

Disadvantages of using ketogenic diet management as first-line treatment of T2DM

- The results of the review by Feinman et al. (2015) provide some disadvantages with the most noticeable being patient adherence.
- Due to the effectiveness on glycemic control, there is a danger of hypoglycemia for those patients on glucose lowering medication (Feinman et al., 2015) .
- More research is needed to determine whether there is an optimal intake of dietary carbohydrate for patients with T2DM (Huntriss et al. 2018), with the definition of a ketogenic diet not well defined.
- Kirk et al. (2008) went on to say that until further research is done showing the safety and long-term adherence, the ketogenic diet as a first-line treatment for T2DM will remain a debatable topic.

Effectiveness of using ketogenic diet management as first-line treatment of T2DM

- Fasting plasma glucose improved significantly in the ketogenic group in the research by Ahmed et al. (2020), with a mean reduction of 43.5±76.3 mg/mL ($p < 0.05$) compared to 8.5±8.0 mg/mL ($p=0.29$) in the usual diabetic care group.
- Results from the study performed by Hussein et al. (2007) suggested that the total cholesterol, LDL cholesterol and triglycerides had a significant decrease in the ketogenic group ($p < 0.0001$), with a significant increase in the level of HDL cholesterol ($p < 0.0001$).
- These results above were also confirmed in a similar study by Talib et al. (2012).

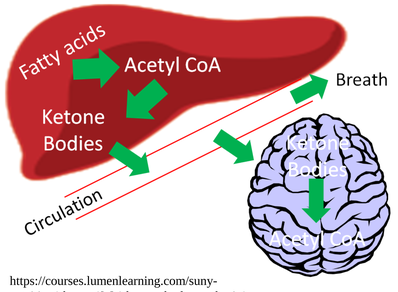
Discussion

- Almost all the studies reviewed found that using a ketogenic diet decreased HbA1c except in one meta-analysis by Huntriss et al. (2018) where there was an increase of 0.2%.
- The other studies included in the meta-analysis by Huntriss et al. (2018) and the meta-analysis performed by Kirk et al. (2008) had a decrease in HbA1c between 0.2% and 2.2%.
- All T2DM patients can benefit from a ketogenic diet since it provides additional improvement in health parameters including weight, HDL cholesterol, triglycerides and glycemic control.
- Some of the studies showed no significant difference on glycemic control with the ketogenic diet when compared to other types of diets. (Ajala et al (2013), Kodoma et al (2009), Jung and Choi (2017), and Tay et al. (2015).
- Difficulty with adherence was a problem with many of the studies. Patients may not be willing to make such a change especially with other less lifestyle altering treatment options available. Effectiveness hinges on the patient's desire and ability to follow to the diet.
- There will need to be shared decision making as to what treatment option will produce the greatest results. This might mean a combination of therapies to provide the highest possibility of patient success.
- Even with the data of the short-term success that the ketogenic diet produces, there is very little long-term data. This will remain a controversial topic, according to Kirk et al. (2008), until further research is provided.
- Many of the studies differed on specific guidelines of the amount of carbohydrates the participants were consuming. The terms ketogenic and low-carbohydrate diet were frequently used interchangeably. The studies by Huntriss et al. (2018) and Feinman et al. (2015) did agree on guidelines of carbohydrate consumption provided in the table below.

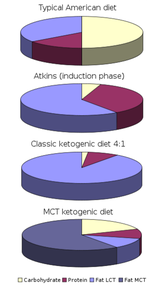
Definitions for Different Forms of Low-Carbohydrate diets

Very Low-Carbohydrate Ketogenic Diet	**Carbohydrate, 20-50 g/d or <10% of the 2000 kcal/d diet, whether or not ketosis occurs. Derived from levels of carbohydrate required to induce ketosis in most people.**
Low-Carbohydrate Diet	**<130 g/d or <26% total energy of the 2000 kcal/d diet.**
Moderate-Carbohydrate Diet	**26%-45% of total energy of the 2000 kcal/d diet.**
High-Carbohydrate Diet	**>45% of total energy of the 2000 kcal/d diet.**

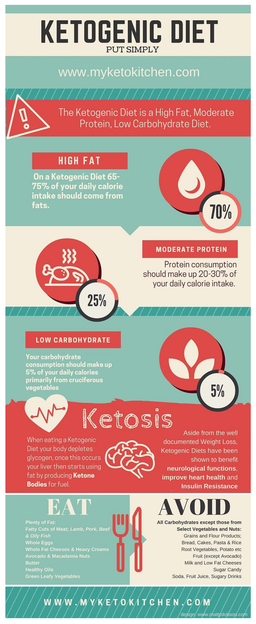
Table by Steve Moore, data from Feinman, R., Pogozelski, W., Astrup, A., Bernstein, R., Fine, E., Westman, E., … Worm, N. (2015, January 1). Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. Nutrition, 31(1), 1–13.



https://courses.lumenlearning.com/suny-nutrition/chapter/6-34-ketone-body-synthesis/



https://en.wikipedia.org/wiki/File:Ketogenic_diets_pie.svg



https://www.flickr.com/photos/143206160@N07/28218431492

Applicability to Clinical Practice

The ketogenic diet seems to be a safe option to include in the treatment plan for T2DM patients with an acceptable insulin function. The most significant health parameters affected by a ketogenic diet included raising HDL cholesterol, lowering triglycerides and bodyweight, with the most crucial parameter being the reduction in HbA1c. With this substantial impact on HbA1c, diabetic patients will need to monitor blood glucose closely and adjust antidiabetic medications accordingly. The beneficial changes were the most significant early in the intervention in obese patients with a high blood glucose level. Diet adherence was the most important factor regardless of the diet chosen. The adherence rate of a low-carbohydrate diet was equivalent, or better to other diets and comparable to pharmacologic treatment plans. There will need to be a conversation with a shared decision on treatment options that might include combination therapies to produce the greatest results. With the limited long-term data, and the unresolved optimal mix of macronutrients for therapy, utilizing a low-carbohydrate diet as a first-line intervention for T2DM patients will remain a controversial topic.

References

- Ahmed, S., Bellamkonda, S., Zilbermint, M., Wang, J., & Kalyani, R. (2020). Effects of the low carbohydrate, high fat diet on glycemic control and body weight in patients with type 2 diabetes: Experience from a community-based cohort. British Medical Journal Open Diabetes Research & Care, 8(1), e000980. https://doi.org/10.1136/bmjdrc-2019-000980
- Ajala, O., English, P., & Pinkney, J. (2013). Systematic review and meta-analysis of different dietary approaches to the management of type 2 diabetes. The American Journal of Clinical Nutrition, 97(3), 505–516. https://doi.org/10.3945/ajcn.112.042457
- American Diabetes Association. (2020). Statistics about diabetes. Retrieved from https://www.diabetes.org/
- Blanco, J., Khatri, A., Kifayat, A., Cho, R., & Aronow, W. (2019). Starvation ketoacidosis due to the ketogenic diet and prolonged fasting - a possibly dangerous diet trend. American Journal of Case Reports, 20, 1728–1731. https://doi.org/10.12659/AJCR.917226
- Feinman, R., Pogozelski, W., Astrup, A., Bernstein, R., Fine, E., Westman, E., … Worm, N. (2015). Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. Nutrition, 31(1), 1–13.
- Goday, A., Bellido, D., Sajoux, I., Crujeiras, A., Burguera, B., García-Luna, P., … Casanueva, F. (2016). Short-term safety, tolerability, and efficacy of a very low-calorie-ketogenic diet interventional weight loss program versus hypocaloric diet in patients with type 2 diabetes mellitus. Nutrition and Diabetes, 6(9), e230. https://doi.org/10.1038/nutd.2016.36
- Gomez-Arbelaez, D., Crujeiras, A., Castro, A., Goday, A., Mas-Lorenzo, A., Bellon, A., … Casanueva, F. (2017). Acid-base safety during the course of a very low-calorie-ketogenic diet. Endocrine, 58(1), 81–90. https://doi.org/10.1007/s12020-017-1405-3
- Huntriss, R., Campbell, M., & Bedwell, C. (2018). The interpretation and effect of a low-carbohydrate diet in the management of type 2 diabetes: A systematic review and meta-analysis of randomized controlled trials. European Journal of Clinical Nutrition, 72(2), 311–325. https://doi.org/10.1038/s41430-017-0019-4
- Hussein, D., Thazhumpal, M., Mousa, K., Mahdi, A., Husain, T., Sami, A., … Naji, A. (2007). Beneficial effects of ketogenic diet in obese diabetic subjects. Molecular and Cellular Biochemistry, 302(1–2), 249–256. https://doi.org/10.1007/s11010-007-9448-z
- Jung, C., & Choi, K. (2017). Impact of high-carbohydrate diet on metabolic parameters in patients with type 2 diabetes. Nutrients, 9(4), 322. https://doi.org/10.3390/nu9040322
- Kirk, J., Graves, D., Craven, T., Lipkin, E., Austin, M., & Margolis, K. (2008). Restricted-carbohydrate diets in patients with type 2 diabetes: A meta-analysis. Journal of the American Dietetic Association, 108(1), 91–100. https://doi.org/10.1016/j.jada.2007.10.003
- Kodama, S., Saito, K., Tanaka, S., Maki, M., Yachi, Y., Sato, M., … Sone, H. (2009). Influence of fat and carbohydrate proportions on the metabolic profile in patients with type 2 diabetes: A meta-analysis. Diabetes Care, 32(5), 959–965. https://doi.org/10.2337/dc08-1716
- Talib, H., Thazhumpal, M., Ali, D., Sami, A., Naji, A., & Hussein, D. (2012). Effect of low-calorie-ketogenic low-carbohydrate ketogenic diet in type 2 diabetes. Nutrition, 28(10), 1016–1021. https://doi.org/10.1016/j.nut.2012.01.016
- Tay, J., Luscombe-Marsh, N., Thompson, C., Noakes, M., Buckley, J., Wittert, G., … Brinkworth, G. (2015). Comparison of low- and high-carbohydrate diets for type 2 diabetes management: A randomized trial. The American Journal of Clinical Nutrition, 102(4), 780–790. https://doi.org/10.3945/ajcn.115.112581
- Yamada, Y., Uchida, J., Izumi, H., Tsukamoto, Y., Inoue, G., Watanabe, Y., … Yamada, S. (2014). A non-calorie-restricted low-carbohydrate diet is effective as an alternative therapy for patients with type 2 diabetes. Internal Medicine, 53(1), 13–19. https://doi.org/10.2169/internalmedicine.53.0861

Acknowledgements

First, I would like to thank my wife, Janelle and children, Olivia and Brooks. Your constant love and support made this journey even better. Next, I would like to thank my parents Dave and Loretta for teaching the importance of hard work and valuing education to pursue my passion. Lastly, I would like to thank Dr. McHugo, Professor Sieg, and Professor Skiba, for assisting me with selecting my topic, reviewing multiple drafts of the project, and sharing your passion for the profession.