

Ketogenic Diet and Cancer

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The ketogenic diet focuses on eating high-fat foods, moderate amounts of protein, and very few carbohydrates. This diet encourages the body to enter a special metabolic state called ketosis. In ketosis, the body shifts from using glucose (sugar) for energy to using ketones, which come from fat.

The ketogenic diet has been studied in cancer. The ketogenic diet may help deprive cancer cells of their main energy source, glucose, due to its high-fat and low-carbohydrate design. Healthy cells can use both glucose and ketones for energy, but cancer cells heavily rely on glucose, using about 10 times more of it than healthy cells. This unique characteristic of cancer cells is used in PET scans (positron emission tomography) to detect areas with increased metabolic activity in the body. Since cancer cells take up more radioactive glucose in these scans, it's easier to pinpoint cancerous areas. [<https://cancer.ca/en/treatments/tests-and-procedures/positron-emission-tomography-pet-scan>]. [Lane, J., Brown, N. I., Williams, S., Plaisance, E. P. & Fontaine, K. R. Ketogenic Diet for Cancer: Critical Assessment and Research Recommendations. *Nutrients* 13, 3562 (2021).] By limiting glucose intake, the ketogenic diet makes it harder for cancer cells to thrive. This reduction in glucose levels also lowers insulin and Insulin-Growth-Factor levels, which can otherwise promote tumor growth. [Weber, D. D. et al. Ketogenic diet in the treatment of cancer – Where do we stand? *Molecular Metabolism* 33, 102–121 (2020).]

Additionally, by replacing glucose with ketone bodies as the primary energy source, tumors with faulty or low levels of mitochondria, the cell's energy production site, may struggle to efficiently use ketones, causing metabolic energy stress. Tumors with functional mitochondria may still be affected by the diet,

but the presence of key enzymes (SCOT, BDH1, and ACAT1) involved in ketone utilization can influence the therapeutic effect. More research is needed to clarify the exact role of ketone bodies in the ketogenic diet's impact on tumors. [Weber, D. D. et al. Ketogenic diet in the treatment of cancer – Where do we stand? *Molecular Metabolism* 33, 102–121 (2020).]

Moreover, the ketogenic diet may help reduce inflammation in the body, which is believed to contribute to cancer development and progression. By reducing inflammation, the body may become better equipped to fight cancer cells and hinder their growth. [Pinto A, Bonucci A, Maggi E, Corsi M, Businaro R. Anti-Oxidant and Anti-Inflammatory Activity of Ketogenic Diet: New Perspectives for Neuroprotection in Alzheimer's Disease. *Antioxidants (Basel)*. 2018 Apr 28;7(5):63.]

While further research is required to fully understand the ketogenic diet's role in cancer, early studies have shown promising results. Some studies have even suggested that the ketogenic diet could enhance the effectiveness of specific cancer treatments, such as chemotherapy and radiation therapy. [Dal Bello S, Valdemarin F, Martinuzzi D, Filippi F, Gigli GL, Valente M. Ketogenic Diet in the Treatment of Gliomas and Glioblastomas. *Nutrients*. 2022 Sep 17;14(18):3851]

Here are some studies on the use of the ketogenic diet in clinical settings.

- 1. Ketogenic Metabolic Therapy for Glioma.** This study is of a retrospective case series involving patients with glioma who underwent ketogenic metabolic therapy (KMT), primarily through dietary adherence and intermittent fasting.

A retrospective chart review was conducted that included charts of patients seen by a single surgeon between January 2015 and

October 2020 and who maintained nutritional ketosis for at least four months during their treatment. Sixteen patients were identified with various types of gliomas, including World Health Organization (WHO) grade IV gliomas (glioblastoma and gliosarcoma), WHO grade III gliomas (oligodendroglioma and astrocytoma), and one WHO grade II oligodendroglioma. The patients had their IDH1 mutation status and MGMT methylation status assessed. On average, patients maintained ketogenic metabolic therapy for 20.6 months. Response assessment during the KMT period showed complete responses in eight patients and partial responses in eight additional patients. The mean (Std deviation) progression-free survival while patients adhered to ketogenic metabolic therapy was 20.0 (14.4) months.

This case study suggests that ketogenic metabolic therapy may provide a survival advantage to patients with glioma and that KMT has the potential to complement standard care for glioma. Further exploration of this treatment modality in prospective studies to better understand its potential benefits is necessary.

2. **Effects of Ketogenic metabolic therapy on patients with breast cancer: A randomized controlled clinical trial.**

This study aimed to assess the impact of a ketogenic diet (KD) on patients with locally advanced and metastatic breast cancer patients who were receiving chemotherapy.

A total of 80 patients undergoing chemotherapy were randomly assigned to either the KD group or the control group for a duration of 12 weeks. Fasting blood samples were collected at the beginning, midway point, and after 12 weeks of treatment to assess various biomarkers. Imaging studies were performed at the start

and after 12 weeks of treatment. Patients with locally advanced disease underwent surgery after completing chemotherapy, and their disease stage was reassessed. Patients with metastatic disease were evaluated for response rate.

Patients in the KD group had lower serum insulin levels compared to the control group and the KD resulted in a reduction in tumor size compared to the control group. TNF- α levels significantly decreased after 12 weeks while IL-10 levels increased in the KD group compared to the control group. In patients with locally advanced disease, the stage of cancer decreased significantly in the KD group after 12 weeks; however, no significant differences in response rates were observed in patients with metastatic disease.

This study suggests that a ketogenic diet may have a positive impact on breast cancer patients undergoing chemotherapy, particularly in terms of reducing tumor size and modulating certain biomarkers. However, more research is required to confirm these findings and explore the broader potential benefits of the KD in cancer management.

3. **Ketogenic diets consumed during radio-chemotherapy have beneficial effects on quality of life and metabolic health in patients with rectal cancer.**

The study investigated the impact of a ketogenic diet as complementary nutritional treatments for rectal cancer patients receiving radio-chemotherapy.

A total of 18 patients following a Ketogenic diet (KD) were compared to 23 patients who continued with their standard diet (SD). The study collected data using the EORTC-QLQ30 questionnaire, which measures the quality of life, as well as various metabolic and hormonal blood parameters. Data

were collected before radiotherapy, in the middle of treatment, and at the end of radiotherapy as part of the KETOCOMP study.

The majority (89%) of patients on the KD reported feeling subjectively good or very good. However, about half of them found daily routine implementation of the KD to be challenging. However, the SD group experienced significant declines in physical and role functioning, while the KD group showed improvements in role, emotional, and social functioning. Urinary frequency, buttock pain, and fatigue increased significantly in the SD group but to a lesser extent in the KD group. Several biomarkers of metabolic health, including gamma-glutamyl-transpeptidase, triglyceride-glucose index, HDL cholesterol/triglyceride ratio, and free T3, improved in the KD group but not in the SD group.

Despite some patients finding it challenging to implement, KDs are feasible as complementary therapies alongside radio-chemotherapy and are associated with subjective well-being. The study suggests that KDs may have beneficial effects on the quality of life and metabolic health of rectal cancer patients undergoing treatment. Further research and clinical investigations may help confirm these findings and explore the potential benefits of KDs in cancer care.

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Practitioners trained by the Metabolic Terrain Institute of Health take a scientific approach to working with patients who wish to implement the ketogenic diet as a treatment option. It is essential to consult with a MATC Certified™ Practitioner to properly test, assess and address each patient before and during implementing a ketogenic diet intervention, or at the very least consult with a practitioner or health care provider familiar with your specific state of metabolic health.

References

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3. Klement RJ, Meyer D, Kanzler S, Sweeney RA. Ketogenic diets consumed during radio-chemotherapy have beneficial effects on quality of life and metabolic health in patients with rectal cancer. *Eur J Nutr*. 2022 Feb;61(1):69-84. doi: 10.1007/s00394-021-02615-y. Epub 2021 Jun 27. PMID: 34175978.