



Glycation, Aging, and Low Carbohydrate Diets

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Abstract

The term "AGEs" is an acronym derived from "Advanced Glycation End Products (AGEs)." The medical community has been focusing on AGEs in recent years. So, what exactly is "glycation"? Glycation refers to the reaction in which monosaccharides such as glucose or fructose directly bind to proteins or other substances. AGEs produced in the body cause diabetic complications. AGEs have garnered attention because they are now considered a primary cause of various diabetic complications. The processes involved are diverse, but the most straightforward example is when AGEs accumulate in the inner walls of blood vessels, leading to atherosclerosis. Depending on which part of the blood vessels is affected by atherosclerosis, the resulting diabetic complications vary, but it is no exaggeration to call them all vascular diseases. AGEs in the vessel walls are like an unpayable debt, often referred to as the "memory of high blood sugar."

Keywords

Low-Carbohydrate Diet, Advanced Glycation End Products, Glycation, Longevity

Abbreviations

LCD: Low-Carbohydrate Diet; AGEs: Advanced Glycation End Products

Introduction

The risk of complications caused by AGEs is determined by "blood sugar level × duration." The higher the blood sugar and the longer the duration of elevated blood sugar, the greater the production and accumulation of AGEs. Consequently, patients who have had diabetes for many years are more prone to glycation, and their AGEs accumulation is inevitably higher compared to non-diabetic individuals. As a result, they are more susceptible to the three major

microvascular complications: diabetic retinopathy, diabetic neuropathy, and diabetic nephropathy [1,2], as well as macrovascular complications like myocardial infarction [2,3] and stroke. Thus, poorly controlled diabetes has been described as a disease that accelerates vascular aging.

Whether dietary AGEs from external sources affect atherosclerosis remains a subject of global debate. The authors believe that AGEs produced in the body are a

primary cause of atherosclerosis, but dietary AGEs from external sources have little to no impact on it. A significant historical piece of evidence supporting this view is that since humans began using fire, dietary AGEs have drastically increased, yet human lifespans have lengthened. Incidentally, the oldest archaeological site clearly indicating the use of fire is the Gesher Benot Ya'aqov site in Israel, dating back more than 750,000 years, where burnt seeds (olives, barley, grapes), wood, and flint were discovered [4].

Does Good Blood Sugar Control Prevent Complications?

According to the Japan Diabetes Society (JDS), diabetes with an HbA1c below 7%, considered "well-controlled blood sugar," should not lead to complications [5]. However, if the HbA1c reflects poor quality—due to "postprandial hyperglycemia" (high blood sugar after meals) or "increased blood sugar variability"—complications may still occur. In reality, in Japan, diabetic complications result in the Fig-1.

- ✓ Over 16,000 new cases of dialysis annually
- ✓ Over 3,000 amputations annually
- ✓ Over 3,000 cases of blindness annually

Fig-1: Complications in Diabetes in Japan

This serves as evidence that the "diabetic diet (high-carb diet)" recommended by the JDS fails to prevent complications. Postprandial hyperglycemia increases AGEs accumulation. Thus, regrettably, the conventional diabetic diet can be called a "complication-manufacturing diet."

Diabetic Individuals with Super-LCD Have Less AGEs

With a super low-carb diet, AGEs accumulation is minimized, making it possible to prevent complications. Diabetic individuals adhering to a super low-carb diet have less AGEs accumulation than healthy individuals eating a standard carbohydrate-rich diet. I was born on January 8, 1950. In June 2002, at the age of 52, I was diagnosed with diabetes. I immediately started a "super low-carb diet" and have continued it for 23 years, now at the age of 75, in the category of the late elderly. As a result:

1. All my teeth remain intact, with no cavities or periodontal disease.
2. My eyesight allows me to read the fine print of a dictionary without glasses and drive a car.
3. No hearing loss.
4. No nighttime urination.
5. No reduction in height.
6. Diagnosed with diabetes at 52, but no oral medications needed.
7. HbA1c maintained between 5.6–5.8%, with no diabetic complications.
8. Blood pressure remains normal at 120–135/70–85, with no need for antihypertensive drugs.
9. Over 40 years of playing tennis, with no joint pain.

Clearly, practicing a low-carb diet has prevented aging. It seems that aging, an extension of glycation, has been minimized compared to those on a standard diet. At 75, the probability of achieving all nine of these outcomes (1–9) is roughly 1 in 10 million!—making me nearly superhuman. It's precisely because I developed diabetes and started a low-carb diet that I've achieved this "superhuman health."

LCD Development in Japan

The low-carbohydrate diet (LCD) was initiated in 1999 at Kyoto Takao Hospital as a dietary therapy for diabetes and metabolic syndrome. As the name suggests, it restricts carbohydrate intake. The low-carb hospital meal menu at Takao Hospital averages: Protein 32%, Fat 56%, and Carbohydrates 12% (Table-1).

Table-1: Comparison of Nutrient Profiles from Food at Takao Hospital Versus the 2019 NHNS

	Protein	Fat	Carbs
Takao Hospital	32%	56%	12%
2019 NHNS	15%	29%	56%

From 2001 to April 2025, the cumulative number of outpatient type 2 diabetes (T2D) patients exceeds 4,400, and the cumulative number of hospitalized T2D patients exceeds 1,800. Among outpatients who strictly adhered to the LCD, significant improvements in HbA1c were observed. However, in patients who couldn't effectively follow the diet, HbA1c improvement

was mild or absent. Among inpatients, over 95% achieved significant HbA1c improvement.

The American Diabetes Association (ADA), in its April 2019 "Consensus Recommendation," explicitly stated that the low-carb diet is "one of the most researched dietary therapies" and strongly recommended it, backed by clear evidence [6]. This stance has been upheld in the guidelines for 2020, 2021, 2022, 2023, and 2024. The LCD is expected to have remarkable effects not only on diabetes but also on the prevention and improvement of all lifestyle-related diseases.

Comparison with US and Japan

The guidelines in 2020–2024 showed a similar stance. LCD can be expected to be extremely effective in preventing and improving not only diabetes, but all lifestyle-related diseases.

During hospitalization, due to meal cost constraints, the diet is set at 1,800 kcal/day, slightly low. After discharge, patients are allowed to consume the "estimated energy requirement" recommended by the Ministry of Health, Labour and Welfare.

According to the ADA, among the three major nutrients, only carbohydrates directly raise blood sugar levels, while protein and fat do not. The LCD restricts carbohydrates to prevent blood sugar spikes.

According to the 2019 National Health and Nutrition Survey (2019 NHNS), the average energy intake for Japanese adults (over 20) is about 1,900 kcal, with a nutrient ratio of Protein 15.0%, Fat 29.0%, and Carbohydrates 56.0% (Table-1).

Nutrient Ratio

The Ministry of Health, Labour and Welfare recommends that 13–20% of daily energy come from protein, 20–30% from fat, and 50–65% from carbohydrates as the ideal nutritional balance for Japanese people. The JDS currently recommends 40–60% of total energy from carbohydrates, up to 20% from protein, and 25% or less from fat. Previously, it was 60% carbohydrates, 20% protein, and 20% fat,

showing a slight shift toward a low-carb approach. However, neither the Ministry's nor the JDS's figures are supported by evidence regarding effectiveness and safety.

Conclusion

An LCD is an effective defense against endogenous glycation and aging.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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