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Original Research

# Study the Role of Glycemic Index Values of Some Foods in the Type 2 Diabetes Mellitus Control

**Sara. M. Elgazwi*, Saja .S. Algazawany, Ebtehaj .A. Mohamed**

*Department of Chemistry, Faculty of Sciences, University of Derna*

*Deran, Libya*

***Corresponding Author**: Sara M. Elgazwi. E.mail: s.elgazwi@uod.edu.ly*

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**ABSTRACT:**

The glycemic index (GI) classifies carbohydrates based on how they affect blood sugar levels. Foods with a high GI cause rapid spikes in blood glucose, while those with a medium or low GI lead to more gradual increases. This study explored how foods with different GI levels influence blood sugar control, metabolic health, and overall well-being in both healthy individuals and those

with diabetes. In healthy individuals, consuming high-GI foods resulted in temporary spikes in blood glucose followed by sharp drops, which may trigger increased hunger and fluctuations in energy levels—rising from (204 ± 19.88)mg/dl to (320 ± 19.89)mg/dl after consuming high-GI foods. In contrast, medium and low-GI foods helped maintain more stable blood sugar levels, improving satiety and potentially lowering the risk of metabolic disorders. For people with diabetes, high and medium-GI foods like bananas and white bread can worsen post-meal blood sugar spikes, making it harder to manage glucose levels and increasing the risk of long-term complications, such as cardiovascular disease. Low-GI foods, such as whole grain bread, when consumed in controlled amounts, proved to be a safer option. They supported more gradual changes in blood glucose—from (200 ± 12.74) to (220 ± 10.0)—and enhanced insulin sensitivity. The study underscores the importance of tailored dietary strategies, recommending a focus on medium and low-GI foods to maintain stable blood sugar levels. It highlights the value of considering individual health needs, dietary habits, and glycemic targets in planning effective nutrition for both healthy and diabetic populations.

**KEYWORDS:** Type 2 Diabetes, Glycemic Index, Carbohydrates Metabolism, Food Control.

## INTRODUCTION

In recent years, there has been a notable rise in the global incidence of type 2 diabetes mellitus (T2DM). By 2026, developing nations are projected to represent over 75% of all diabetes cases worldwide. Epidemiological studies indicate that the prevalence of diabetes in Libya is around 5.5%. However, the International Diabetes Federation (IDF) has more recently estimated that approximately 300,000 Libyans between the ages of 20 and 79 are living with diabetes—a figure expected to grow to 700,000 by the year 2030(Irwansyah et al., 2021)..

Diabetes is often referred to as a self-managed condition, as much of the care is carried out by the patient. Self-management involves the individual applying their knowledge and skills to maintain healthy lifestyle practices. Key elements of diabetes self-care include following a nutritious diet, engaging in regular physical activity, monitoring blood glucose levels, adhering to prescribed medications, and performing proper foot care. Research supports the role of healthy dietary habits in preventing chronic diseases. In particular, diets high in dietary fiber have been shown to help reduce the risk of such conditions (Jiménez et al., 2020)

Dietary carbohydrates are found in a wide range of plant-based foods, which are among the most plentiful food sources available. The variations in the types and quantities of carbohydrates in these foods warrant focused attention from researchers, as understanding their effects on satiety, blood sugar regulation, body weight, and blood lipid levels is crucial for maintaining good health (Chandel, 2021). Numerous studies have highlighted that improving diabetes management is not only crucial for better treatment outcomes but also that lowering the glycemic response to food can significantly reduce the risk of developing diabetes and cardiovascular diseases (Xie et al., 2004).

In studies on the glycemic index of foods, many researchers have also examined glycemic load, describing it as a newer metric that considers both the quality and quantity of carbohydrates in foods. Derived from the

glycemic index and total carbohydrate content, glycemic load provides practical insights for diet planning by predicting the blood glucose response to specific foods or meals. It captures the interplay between carbohydrate quality, represented by the glycemic index, and the total carbohydrate content of consumed foods.

Despite its potential utility in dietary recommendations, glycemic load is still infrequently applied in practice (Hatami Marbini et al., 2021).

### *Risk of Diabetes and Glycemic Index Values*

Consuming high-GI foods leads to a rapid increase in blood glucose levels. In response, the body secretes a significant amount of insulin to regulate this spike.

Persistent overproduction of insulin can eventually result in insulin resistance, where cells become less responsive to insulin's effects. Prolonged intake of high-GI foods is linked to elevated insulin levels, insulin resistance, reduced high-density lipoprotein (HDL) levels, and hypertriglyceridemia.

There is a strong correlation between the consumption of high-GI foods and an increased risk of developing type 2 diabetes (T2DM). This may be due to the higher postprandial blood glucose levels and greater insulin demand triggered by high-GI foods compared to low-GI alternatives (Jenkins & Willett, 2024).

Chronic increases in insulin demand may contribute directly to the development of insulin resistance, a condition widely recognized as a precursor to type 2 diabetes (T2DM). Conversely, low-GI diets have been associated with improved metabolic control and a reduced risk of T2DM. This is due to their slow digestion and absorption, which result in a gradual rise in blood glucose and insulin levels. By minimizing fluctuations in blood glucose, low-GI diets may enhance insulin sensitivity and mitigate the risk of insulin resistance. In contrast, the rapid rise in blood glucose following the consumption of high-GI foods triggers substantial insulin secretion to restore balance, which, when repeated over time, can lead to decreased sensitivity of cells to insulin (Gerontiti et al., 2024).

Prolonged consumption of high-GI foods is strongly associated with elevated insulin levels, insulin resistance, lower high-density lipoprotein (HDL) concentrations, and hypertriglyceridemia. There is a significant positive correlation between the intake of high-GI foods and an increased risk of type 2 diabetes (T2DM).

High-GI foods may contribute to this risk by causing higher postprandial blood glucose levels and greater insulin demands compared to low-GI foods. Persistent high insulin demand can potentially lead to insulin resistance, which is widely recognized as a precursor to T2DM. In contrast, low-GI diets have been shown to improve metabolic control and reduce the risk of T2DM due to their slower digestion and absorption, resulting in a more gradual increase in blood glucose and insulin levels (Cura & Carruthers, 2012).

Low-GI diets may enhance insulin sensitivity by stabilizing blood glucose levels and reducing insulin secretion throughout the day. Substituting a high-GI diet with a low-GI one could help minimize frequent and rapid spikes in blood glucose, thereby improving the body’s response to insulin.

Research on postprandial glucose responses to carbohydrate-containing foods has shown that low-GI foods result in lower insulin and glucose levels compared to high-GI foods, suggesting improved insulin sensitivity in both

healthy individuals and obese insulin-resistant subjects. Furthermore, studies have indicated that low-GI diets lead to a more significant reduction in fasting plasma glucose levels than high-GI diets. Additionally, glycosylated serum proteins (fructosamine) levels decreased by 7% ($p < 0.05$) in individuals following low-GI diets. The joint Food and Agriculture Organization (FAO) and World Health Organization (WHO) Expert

Consultation Committee has recommended low-GI diets for managing individuals at risk of diabetes and its complications. However, the full extent of the health benefits associated with low-GI foods remains to be explored (Hatami Marbini et al., 2021).

The potential protective effects of low-GI diets against chronic diseases like diabetes and coronary heart disease have been investigated through epidemiological observational studies. Additionally, short- to medium-term intervention studies focusing on risk factors have primarily targeted individuals with type 2 diabetes (Gerontiti et al., 2024).

## MATERIALS AND METHODS

### *Study Design*

30 volunteers were involved in this study, twenty patients with type 2 diabetes mellitus, aged 30–75 (mean 55 years) ten of them treated with metformin 850 mg and had a mean glycosylated hemoglobin ( HbA1crange = 7–15%) first group ( MET1); the second group patients with type 2 diabetes mellitus, aged 30–75 (mean 55 years) ten of them treated with metformin 850 mg and had a mean glycosylated hemoglobin (HbA1crange = 5-7%) (MET2). The third group is ten of healthy non-diabetic aged 40-60 (mean 55 years) (N.D)were studied.

### *Food Study Design*

Apple fruit, apple juice, honey, banana, white bread and whole grain bread were examined on three group.

The GI values of each food were obtained from publicly available online sources, such as the NHS Foundation Trust, which contains values tested after publication.

Additional sources for some of the fruits' data included MyPlate.gov (USDA) accessed on 2 August 2024, Gestational Diabetic.com accessed on 3 August 2024.

Each volunteer in this study ate the every time one type of theses food four hours after last meal.

### *Study Duration*

10- 12 weeks (Non-Consecutive)

### *Sample Preparation*

Blood glucose was measured by home glucose meter (Viva check Ino), at 0, 30, 60 ,90 and 120 minutes blood glucose was measured.

### *Statistical Analysis*

Standard computer program SPSS for Windows, release 13.0 (SPSS Inc., USA) was used for data entry and analysis.

## RESULTS AND DISCUSSION

Thirty subjects of ages 30-75 years (female and male) were studied. A group study received only metformin and has high HbA1c (7-15%) ( MET 1) shown significant correlation between different type of food have been given in this study and the control of blood glucose , table 1. and figure 1. explain the extremely change in blood glucose level in different time points.

**Table 1 :**mean plasma glucose (± SD) mg/dl in MET1.

| Time (Minute) | 0 | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|
| Apple J | 206 ± 17.0 | 257 ± 12.0 | 339 ± 9.09 | 328 ± 22.0 | 290 ± 22.9 |
| Apple F | 204 ± 19.0 | 250 ± 12.8 | 257 ± 9.52 | 243 ± 11.5 | 226 ± 11.8 |
| Honey | 200 ± 24.0 | 240 ± 12.9 | 269 ± 10.4 | 289 ± 22.9 | 240 ± 19.9 |
| Banana | 206 ± 21.24 | 260 ± 17.30 | 328 ± 8.64 | 345 ± 16.9 | 298 ± 18.0 |
| W.bread | 204 ± 19.88 | 276 ± 18.0 | 360 ± 8.30 | 359 ± 19.8 | 320 ± 19.89 |
| WH.bread | 200 ± 12.74 | 240 ± 9.0 | 257 ± 7.90 | 235 ± 9.7 | 220 ±10.0 |

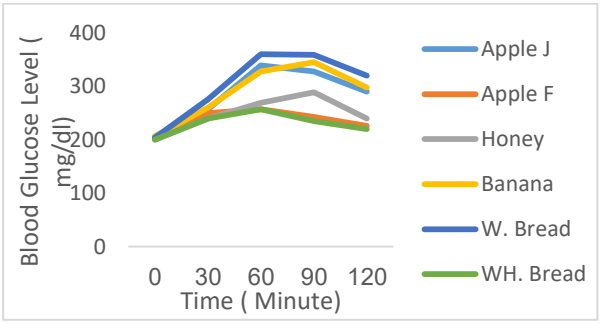


**Figure1 .**blood glucose level MET 1

In addition the second group that received metformin 850 but with HbA1c level between (5-7%)( MET2) shown different response to food during the time with blood glucose. figure 2. and table 2.reveal less increase in blood glucose with food has high glycemic index.

**Table2.**mean plasma glucose (± SD) mg/dl in MET2.

| Time (Minute) | 0 | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|
| Apple J | 200 ± 12.0 | 257 ± 16.9 | 320 ± 17.90 | 260 ± 21.0 | 180 ±22.87 |
| Apple F | 190 ± 11.0 | 250 ± 12.90 | 244 ± 12.0 | 200 ± 12.43 | 140 ± 17.9 |
| Honey | 190 ± 23.9 | 240 ± 24.0 | 257 ± 9.78 | 220 ± 20.8 | 158 ± 22.0 |
| Banana | 188 ± 18.0 | 260 ± 18.0 | 290 ± 17.9 | 267 ±7.8 | 190 ± 19.8 |
| W.bread | 200 ± 20.0 | 260 ± 19.0 | 290 ± 7.0 | 260 ±24.9 | 256 ± 23.0 |
| WH.bread | 200 ± 11.0 | 240 ± 11.98 | 250 ± 7.9 | 190 ± 10.8 | 134 ±10.8 |

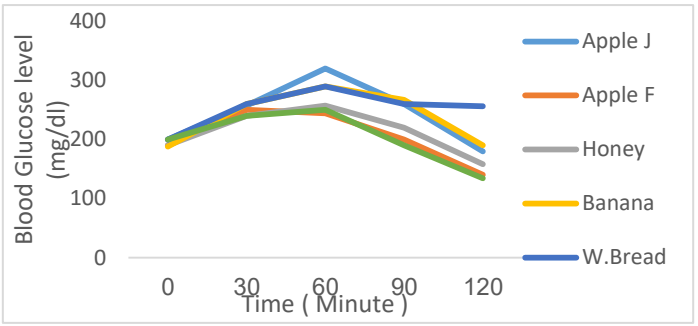


**Figure 2.** Blood glucose level MET2

In contrast, the third group none diabetic (N.D) the blood glucose was monitored for 2 hrs at 0,30,60,90 and 120 minutes, there were no a big statistically significant differences in the low and high GI between the different food groups figure.3 and table 3.

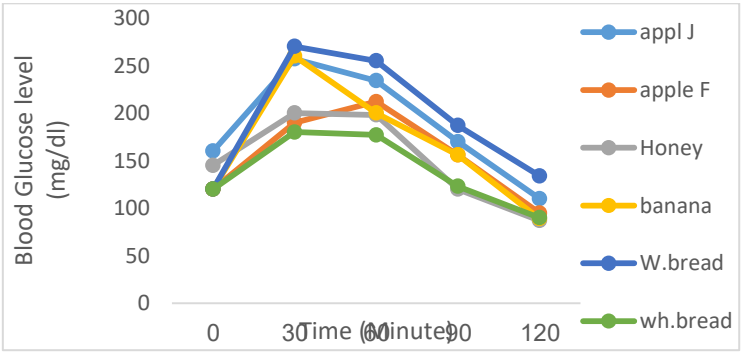


**Figure 3.** Blood glucose level N.D

**Table 3.** mean plasma glucose (± SD) mg/dl in N.D.

| Time (Minute) | 0 | 30 | 60 | 90 | 120 |
|---|---|---|---|---|---|
| Apple J | 160 ± 16.0 | 257 ± 16.80 | 234 ± 19.0 | 170 ± 11.9 | 110 ± 17.90 |
| Apple F | 120 ± 11.9 | 190 ± 11.0 | 212 ± 12.90 | 156 ± 11.90 | 95 ± 12.0 |
| Honey | 145 ± 21.0 | 200 ± 23.0 | 198 ± 23.09 | 120 ± 22.9 | 87 ± 19.0 |
| Banana | 120 ± 11.90 | 260 ± 11.0 | 200 ± 12.90 | 156 ± 12.0 | 89 ± 19.0 |
| W.bread | 120 ± 20.98 | 270 ± 24.0 | 255 ± 23.9 | 187 ± 24.0 | 134 ± 22.9 |
| WH.bread | 120 ± 12.0 | 180 ± 7.8 | 177 ± 8.7 | 123 ± 9.8 | 90 ± 7.0 |

This study evaluated the effect of food with high and low glycemic index values on controlling blood glucose level . In general, there are inter- and intra-individual differences, In our study, the measurement of blood glucose levels of the reference

Food glycemic index values high and medium such as White bread (90) banana (62) and honey (58) , following by measurement of blood glucose with food have low glycemic index f whole grain bread ( 51) apple juice (41)apple fruit( 36).(Haini et al., 2022)

In this study group (MET1) group 2 ( MET2) and group 3( N.D) shown verities increase in blood glucose level with food has high and medium glycemic index in different the time of study ( 2 hours) , results from group 1 conducted that the effect of apple fruit and apple juice is different , fiber plays a significant role influencing the glycemic index of food .

Food rich in fiber tend to have lower glycemic index and reduce blood sugar spike which prevent sudden sugar in blood and regular the insulin sensitive which play vital role in manage blood glucose (Jenkins et al., 2021)

Whole apples have a low GI because of their fiber content, which slows down the absorption of sugar into the bloodstream. Eating a whole apple provides a steady release of glucose, minimizing blood sugar spikes while Apple juice has a higher GI compared to whole apples because the fiber is removed during processing. Without fiber, the natural sugars in the juice are absorbed more quickly, leading to faster blood sugar spikes(Gerontiti et al., 2024).

The digestion of food is differ from type to another type also the content of food from fiber protein and lipid effect how this food raise blood glucose White bread is made from refined flour, which is quickly digested, leading to a rapid rise in blood sugar levels (Cicardo, Le, & Traynor, 2025).

Whole grain bread contains more fiber, protein, and complex carbohydrates, which slow digestion and result in a slower rise in blood sugar, that explain how in this study white bread shown increase in blood glucose continue to 2 hrs with group 1 and group 2 shown less extremely increase , life style for example type of food , non-smoking exercise and good sleep decrease with group 2 (Jenkins et al., 2021).

Honey glycemic index value is 58 ( medium GI) shown effect on blood glucose for diabetes patients ( MET1) and (MET20 , honey should be consumed in moderation as it can cause blood glucose spike , albeit slower than high-GI glucose like white bread.

In comparison for healthy group 9N.D) honey provides a steady energy source , but excessive intake can contribute to insulin resistance or weight gain over time (Hjort et al., 2024).

## CONCLUSION

We concluded from our study that Diabetics Prioritize low-GI foods are able to maintain stable blood sugar. Limit medium- and high-GI foods, pairing them wisely when consumed. On the other hand healthy Individuals Include a mix of GI foods but lean toward low-GI options for long-term health and prevention of metabolic disorders.

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## الملخص

يصنّف بناء على أنسبة السكر في الدم للكربوهيدرات مؤشر تأثيرها على مستويات السكر في الدم الأطعمة ذات المؤشر الجلايسيمي المرتفع ارتفاعات سريعة في نسبة السكر في الدم، بينما تُؤدي الأطعمة ذات المؤشر الجلايسيمي المتوسط أو المنخفض إلى زيادات تدريجية. اثبتت هذه الدراسة كيف تؤثر الأطعمة ذات مستويات المؤشر الجلايسيمي المختلفة على التحكم في نسبة السكر في الدم، والصحة الأيضية، لدى كل من الأفراد الأصحاء والمصابين بداء السكري. في الأفراد الأصحاء، أدى تناول الأطعمة ذات المؤشر الجلايسيمي المرتفع إلى ارتفاعات مؤقتة في نسبة السكر في الدم تليها انخفاضات حادة، مما قد يؤدي إلى زيادة الجوع وتقلبات في مستويات الطاقة - حيث ارتفعت من (204 ± 19.88) إلى (320 ± 19.89) بعد تناول الأطعمة ذات المؤشر الجلايسيمي المرتفع. في المقابل، والمنخفض في الحفاظ على مستويات سكر الدم أكثر استقرارًا، مما يُحسّن الشعور بالشبع ويُحتمل أن يُقلل من خطر الاضطرابات الأيضية. بالنسبة لمرضى السكري، يمكن أن تُفاقم الأطعمة ذات المؤشر الجلايسيمي المرتفع والمتوسط مثل الموز والخبز الأبيض ارتفاع نسبة السكر في الدم بعد الوجبات، مما يُصعّب التحكم في مستويات الجلوكوز ويزيد من خطر حدوث مضاعفات طويلة المدى، مثل أمراض القلب والأوعية الدموية. أثبتت الأطعمة منخفضة المؤشر الجلايسيمي، مثل خبز الحبوب الكاملة، عند تناولها بكميات محددة، أنها خيار أكثر أمانًا. فقد دعمت تغيرات تدريجية في مستوى سكر الدم - من (200 ± 12.74) إلى (220 ± 10.0) ملجم/ديسيلتر ، مما يؤدي الى تقليل حساسية الأنسولين. تؤكد الدراسة على أهمية اتباع استراتيجيات غذائية مُصممة خصيصًا، وتوصي بالتركيز على الأطعمة متوسطة ومنخفضة المؤشر الجلايسيمي للحفاظ على استقرار مستويات السكر في الدم. كما تُبرز أهمية مراعاة الاحتياجات الصحية الفردية، والعادات الغذائية، وأهداف نسبة السكر في الدم عند تخطيط تغذية فعالة لكل من الأشخاص الأصحاء والمصابين بالسكري .


**الكلمات المفتاحية**: مرض السكر النوع الثاني، المؤشر الجلايسيمي، ايض الكربوهيدرات، التحكم في الغذاء.