

## The Role of Fasting Glucose Monitoring in Diabetes Self-Management

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### Abstract

Those who monitor fasting glucose daily have a better chance of staying on a healthy path and improving diabetes self-management.

### Abbreviations

CGM – Continuous Glucose Monitoring  
SMBG- Self-monitoring of blood glucose  
PPG -- PostPrandial Glucose  
FG – Fasting Glucose  
RE – Resistance Exercise  
AE – Aerobic Exercise  
TIR- time in range  
MG – daily mean glucose

### Introduction

People using a continuous glucose monitoring (CGM) system can view their own glucose levels at any time by touching a button. Those without a CGM have to do a pinprick each time when they want to see the glucose level. Thus, it becomes necessary to pick and choose the glucose checking. There is an ongoing discussion about the cost benefits and ultimate utility of self-monitored blood glucose (SMBG) in type 2 diabetes [1-3]. This commentary talks about the role of monitoring fasting glucose daily in diabetes self-management on the basis of literature findings and my own CGM data [4,5].

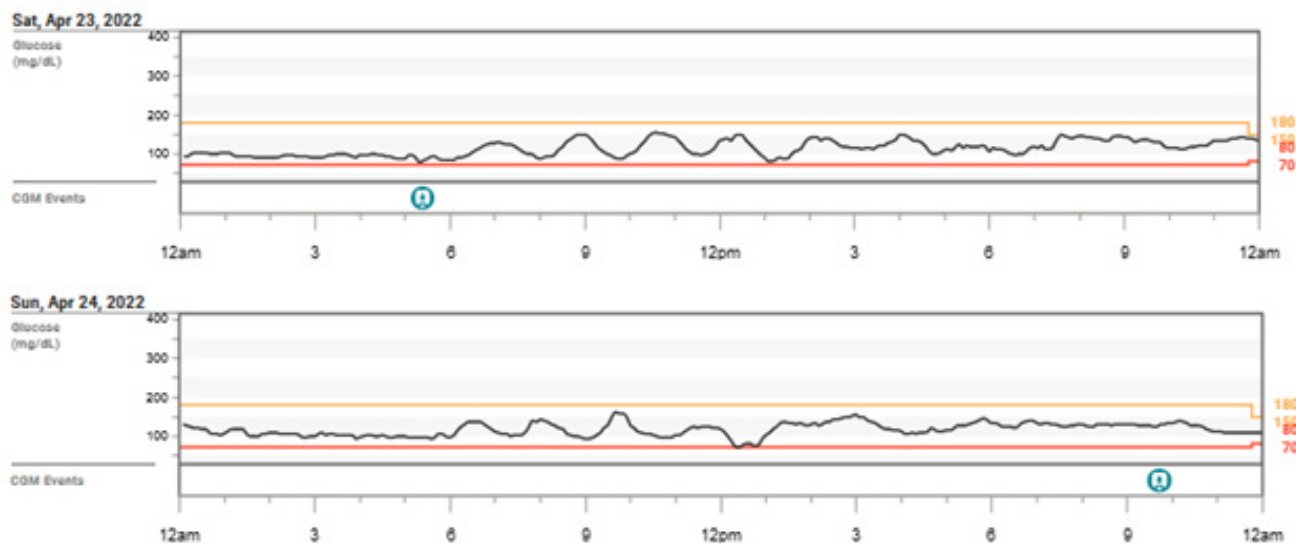
### Fasting Glucose

Fasting glucose (FG) is very sensitive to many variables [4,5]. FG is closely related to the fat content of the liver and pancreas: liver fat increases insulin resistance in the liver and FG goes up [6]. Fat in the pancreas decreases insulin secretion and FG goes up. Diabetes patients with obesity may have fatty liver. Decreasing calorie intake or carb intake lowers fat content in the liver and pancreas.

Lim et al. normalized FG by cutting down calorie intake to 600 calories per day: fat in the liver and pancreas decreased leading to lower insulin resistance in the liver, and improved insulin secretion in the pancreas, both resulting in normal FG [6].

FG is also affected by the postprandial glucose (PPG) values which also means that optimal meal composition and meal timing can improve FG [7-18]. Optimal meal composition means appropriate carb serving plus extra fiber, non-starchy vegetables, nuts, lean protein, and healthy fat [7]. A very low-carb diet is another option to keep post-meal glucose levels modest [8]. As far as meal timing goes, diabetes patients have been told to eat a small balanced meal every 1-2 hours to prevent hyper- or hypoglycemia [19]. But lately, a better option is being supported by data. Several studies showed early eating, the second meal effect from a morning snack and an early, light supper can be diabetes-friendly [9-18]. A late, big supper increases fat in the liver and pancreas and FG goes up [16-18]. A modified meal plan to deal with the poor glucose tolerance in the morning and evening includes a morning snack, breakfast, lunch, an afternoon snack, and early, light supper [20-23].

If liver glycogen is depleted from a fasted state exercise, glucose tolerance improves and FG comes down during liver glycogen repletion [24]. A 30-60-minute morning walk followed by a morning snack every other day has been my primary exercise last 3 plus years and fasting glucose has been in the target range and A1C has been in the 5.8 -6.1 range under different med regimens (Figure 1) [23]. (In 2011 my A1C was 8.8%, when my medications were metformin 1000 mg twice a day and glargine 36 units a day).



**Figure 1:** Glucose profiles when healthy lifestyle habits are practiced

Medications are metformin 500 mg twice a day, semaglutide 1 mg injection once a week and empagliflozin 10 mg once a day

- A. Exercises are a morning walk and post-meal exercises when high CGM alert comes on (150 mg/dL); TIR, MG, and FG are 100%, 114 mg/dL and 93 mg/dL, respectively.
- B. Exercises are post-meal exercises only when high CGM alert comes on (150 mg/dL); TIR, MG, and FG are 100%, 116 mg/dL and 95 mg/dL, respectively.

A timely post-meal exercise of moderate energy expenditure (intensity and duration) is known to blunt post-meal glucose surges and that would help FG [25-32]. Glucose peaks in the blood any time between 40 and 120 minutes depending on the glycemic load [33-35]. For a typical breakfast, the exercise may be started 30 to 45-minute after the start of the meal [25-27]. For lunch or dinner, one may start the post-meal exercise 45-60 minutes after the start of the meal [34,35]. A moderate resistance exercise depletes muscle glycogen and glucose levels improve during muscle glycogen repletion [34]. A short duration interval exercise is also effective in controlling glucose [36-38]. A combined exercise is better than either resistance exercise (RE) or aerobic exercise (AE) [6,39-41]. Also, an evening exercise is better than a morning exercise [42].

What to avoid with post-meal exercise are the following? A delayed exercise, two hours or more after the start of the meal can cause glucose elevation or glucose dysregulation [43-45]. High-intensity exercise gives hyper- or hypoglycemia [46-49]. A long duration (2 hours) of post-meal exercise does not improve FG [24]. Duration of post-meal exercise beyond 35 minutes' triggers hypoglycemia in all subjects in Nelson et al. study [25]. Late timing (two hours or more after the start of the meal), high intensity (>60% VO<sub>2</sub>max), and long duration (>30 minutes) are to be avoided with post-meal exercise.

Insulin lowers FG via decreasing counter-regulation and lowering

free fatty acid levels [7]. Established type 2 diabetes patients who do not make enough endogenous insulin may need exogenous insulin to keep FG normal. If the insulin dose is high FG may be low and the insulin dose should be lowered. If FG is high increasing the insulin dose may help. Metformin lowers glucose levels including FG via different mechanisms in the liver [50].

If FG is normal that is a good sign that diabetes management is sound and insulin dose is appropriate [4,5]. If FG is high, it must be corrected as soon as possible.

### Correcting FG

1. If your BMI is above the normal range, it is important to cut down on calories [6] or carbohydrate servings [7].
2. Optimize meal timing [9-18]. The updated meal plan involves a morning snack, breakfast, lunch, afternoon snack, and an early, light supper or early, regular supper plus an appropriate post-supper exercise. A 10-minute resistance exercise plus a 10-minute brisk walk 45 to 60-minute after the start of supper would be effective.
3. Optimize meal composition. Adjust carb serving so that PPG is near your goal. Even though ADA recommends PPG below 180 mg/dL, I find a PPG below 160 mg/dL is better for a lower daily mean glucose (MG) [7]. The next step is to balance the carbohydrate with other fillers. The MyPlate approach is simple [7]. Half of the plate contains non-starchy vegetables and healthy fat (for example, avocado), and nuts. A serving of lean protein is in the third quarter of the Plate. The remaining quarter has the healthy (> 3-gram fiber and > 3-gram protein) carb serving; barley, farro, or quinoa is better than rice. (Rice is useful for those who have a gluten sensitivity). Whole grain wheat flour or almond flour is better than rice flour. Whole grain bread is better than white bread. Fruits are better than fruit juice. Pasta made with legumes is better than that from wheat flour.

4. A 30 to 60-minute morning walk followed by a morning snack every other day is a powerful insulin sensitizer via liver glycogen depletion and it directly improves FG during glycogen repletion [21-23,24]. See Figure 1 A.
5. Do a 10-minute resistance exercise plus a 10- minute walk 30 to 45-minute after the start of breakfast or 45 to 60-minute after the start of lunch or supper to moderate PPGs [25-32]. In Figure 1 most of the post-meal exercises are moderate intensity yard work.

My experience has been that when all these healthy habits are strictly practiced FG can be normalized in a few days. Although your doctor prescribes your medication, if you are on insulin you need to adjust your insulin dose up or down depending on your FG.

### Summary

Monitoring FG every day can be valuable for diabetes self-management. If FG is in the target range, it reassures that the diabetes management is sound. Those who are on insulin can adjust the insulin dose up or down as needed based on the FG value. Checking FG daily will keep you on a healthy track.

If FG is higher than the target range, it alerts you to correct FG using healthy eating and safe physical activities. Those with CGM can aim for better time-in-range (TIR) and MG. If all PPGs are below 160 mg/dL the person can expect a MG below 126 mg/dL and an A1C below 6.0%. Newly diagnosed diabetes patients and those with pre-diabetes may achieve remission or prevent diabetes with this approach.

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### Duality of Interest

No potential conflicts of interest to this article were reported.

### Author Contributions

The corresponding author, E.C., is the guarantor of this work and, as such, had full access to all the data and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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