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CASE STUDY

The Role of Fruit/Snack Intake between Meals and Their Impact on Postprandial Plasma Glucose Using GH-Method: Math-Physical Medicine

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Introduction:

In this paper, Gerald has analyzed the role of fruit intake between meals and its impact on type-2 diabetes (T2D) patient's postprandial plasma glucose (PPG) utilizing GH-Method: math-physical medicine approach.

Methods:

Gerald has been a T2D patient for 25 years. He has collected his blood sugar values via a continuous glucose monitoring device (the "Sensor") that was applied to his arm during the period of 5/5/2018 - 9/28/2019. As shown in Figure 1, during these 481 days, he has collected a total of 35,748 glucose data (total 100%) with an averaged 74.32 collections per day. This big glucose data included 481 fasting plasma glucose (FPG) waveforms with 5,291 data (15% of total), 1,443 PPG waveforms with 18,759 data (52% of total), and 11,698 pre-periods glucose data (both pre-meals and pre-bed for 33% of total) [1].

From: 5/5/2018		
To: 9/28/2019		
Glucose Type	Sensor	Finger
Days	481	481
FPG / Day	11	1
PPG / Day	39	3
Pre- / Day	24	0
Data / Day	74	4
Total Data	35,748	1,924
FPG Data	5,291	481
PPG Data	18,759	1,443
Pre- Data	11,698	-
FPG Waveforms	481	0
PPG Waveforms	1443	0

Figure 1: Sensor data size and window.

Based on the signal processing of wave theory, optical physics, and 8 million stored food nutritional data in the information bank, he developed an artificial intelligence (AI) based APP software. The APP is available on mobile phones and PCs for T2D patients to keep their food and meal records and also predicts their PPG values before their first bite of food.

Due to the severity of his diabetes conditions, Gerald has decided to consume fruits between two normal meals, i.e. around 10am and 3pm. In order to reduce the peak of his PPG, he continuously takes the necessary vitamins to maintain balanced nutritional requirements [2]. In addition, he usually eats a specific portion size of fruits each time, which are about half the size of his fist, usually tomatoes and berries to avoid overly sweet fruits. Furthermore, he hardly touches any processed snacks which contain lots of sugar, salt, and fat as their main ingredients that are detrimental to the human body.

Gerald meal contents are comprised of mainly fresh vegetables which provide approximately 50% of the same size of high carbohydrates foods. He also eats protein-rich foods such as fish, cheese, and eggs. These kinds of meals are largely lighter carbohydrate based which take around 30 minutes to be converted into glucose in the bloodstream. On the other hand, most of the fruits have high sugar content with some carbohydrates [3]. It normally takes about 10 to 15 minutes for the sugar to be converted into glucose. His diabetes condition is very severe that by eating overly sweet fruit would push his post-meal glucose above 200 mg/dL quickly. Once his glucose goes above 200 mg/dL, even with one full hour of walking exercise would only bring his glucose level down to approximately 150-160 mg/dL [4,5].

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Results:

During this period of 481 days, he had consumed a total of 100% of 1,593 foods which include 96% of 1,530 normal meals and 4% of 63 fruits/snacks (mostly fruits between meals and extremely rare processed snacks or raw vegetables). As shown in Figure 2, the three derived major conclusions are as follows:

(A) Total (meals plus fruits):

Amount: 14.6 grams / meal

Average glucose: 116.3 mg/dL

(B) Pure meal (without fruits):

Amount: 14.1-14.3 grams / meal

Average glucose: 115.7 mg/dL

(C) Fruits/Snacks (mainly fruits):

Amount: 27 grams / meal

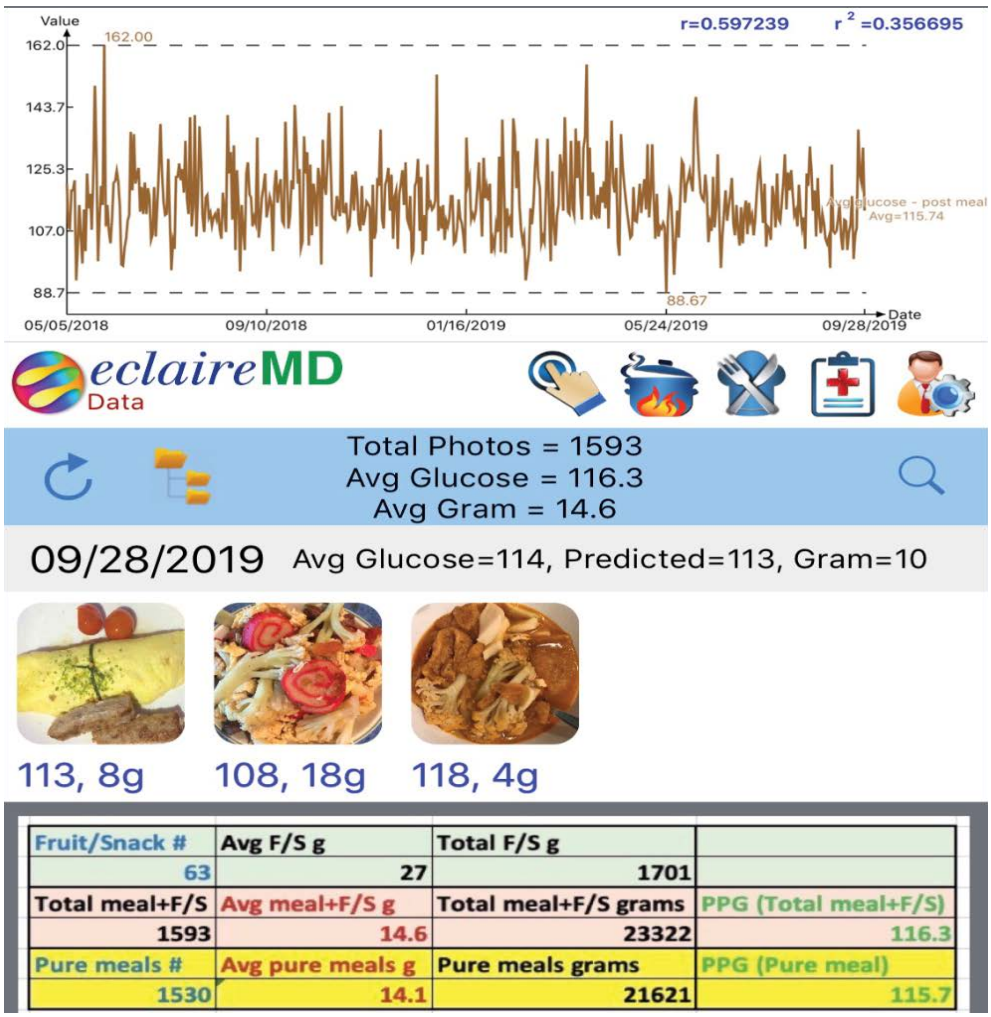
(twice the meal's averaged carbs/sugar grams)

Incremental glucose: 0.6 mg/dL (only 0.5% increase due to 4% of its total volume)

It should be noted that, this averaged 14.6 grams of carbs/sugar would increase his glucose by about 29 mg/dL at a conversion rate of 2 mg/dL per gram of carbs/sugar. On the other hand, during these 481 days, his averaged Exercise is 4,153 steps per meal which would decrease his PPG by about 31 mg/dL at a conversion rate of 7.5 mg/dL per thousand steps of walking. Therefore, his "net reduction" of glucose is about 2 mg/dL per meal (31-29=2). Giving his relative health state of his pancreatic beta cells (see reference paper no.120), his initial condition of glucose (without any stimulators), should be around the level of 121 mg/dL or somewhat lower. Therefore, after a controlled diet and diligent exercise, his resulting average PPG would be around 119 mg/dL (121-2=119) or lower which is very comparable with the actual measured 116 mg/dL as shown in Figure 3.

Conclusion:

Most of the metabolic disorder complications are caused from high glucoses (the major crime offender), particularly PPG (around 75-80% of HbA1C formation). Hypertension and hyperlipidemia are accomplices of those complications. High glucoses are directly controlled by both carbs/sugar



Fruit/Snack #	Avg F/S g	Total F/S g	
63	27	1701	
Total meal+F/S	Avg meal+F/S g	Total meal+F/S grams	PPG (Total meal+F/S)
1593	14.6	23322	116.3
Pure meals #	Avg pure meals g	Pure meals grams	PPG (Pure meal)
1530	14.1	21621	115.7

Figure 2: Intake amount and glucoses by fruits/snacks and normal meals.

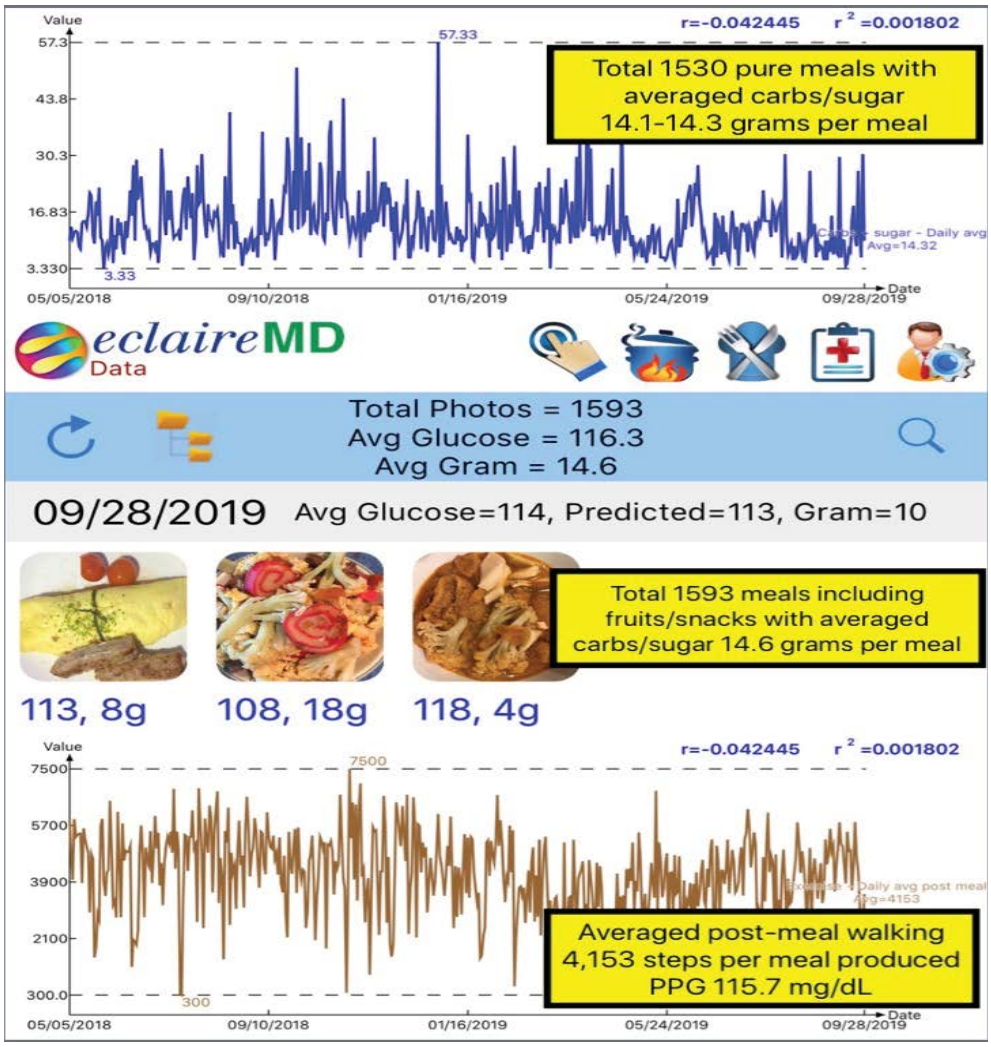


Figure 3: Carbs/sugar intake and post-meal walking to Postprandial Plasma Glucose (PPG).

intake and post-meal exercise intensity, with a combined 80% contribution of PPG. A quantitative and scientific approach to understand and control these two lifestyle factors is the key to control T2D patient's glucose.

This case study and fruit intake example further illustrates the power of GH-Method: math-physical medicine methodology on diabetes control.

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