

An Experimental Study on Self-Repair and Recovery of Pancreatic Beta Cells via Carbs/Sugar Intake Increase and Associated Postprandial Plasma Glucose Variation using Linear Elastic Glucose Theory and GH-Method: Math-Physical Medicine (No. 396)

Gerald C Hsu

EclaireMD Foundation, USA

***Corresponding author**

Gerald C Hsu, EclaireMD Foundation, USA

Submitted: 19 July 2021; **Accepted:** 28 July 2021; **Published:** 02 Aug 2021

Citation: Gerald C Hsu (2021) An Experimental Study on Self-Repair and Recovery of Pancreatic Beta Cells via Carbs/Sugar Intake Increase and Associated Postprandial Plasma Glucose Variation using Linear Elastic Glucose Theory and GH-Method: Math-Physical Medicine (No. 396). *J App Mat Sci & Engg Res*, 5(2), 1-5.

Abstract

The author investigates the pancreatic beta cells self-recovery by utilizing fasting plasma glucose (FPG), carbohydrates & sugar intake amount, post-meal walking steps, and his developed equation of linear elastic glucose theory (LEGT) to predict his postprandial plasma glucose (PPG) values. He then adjusts the proper GH.p-modulus values to make the predicted PPG values completely match with his measured PPG values. Finally, he compares and examines the different GH.p-modulus values to verify different pancreatic beta cells self-recovery status in different time periods. In this study, he uses his collected biomedical data and lifestyle details of two equal length 3-month time periods. The first period starts from 8/1/2020 to 10/31/2020 and the second period begins from 11/1/2020 to 1/31/2021.

His diabetes control has achieved significant accomplishments during the COVID-19 quarantine year of 2020. Therefore, after 11/1/2020, he decided to increase his carbs/sugar intake amount to see how high his hyperglycemia level would be. In another words, he wanted to determine if his pancreatic beta cells' level of tolerance increased in terms of the strength and quality from insulin secretion.

This experiment further confirms the importance of the pancreatic beta cells in regard to their insulin capability and quality in improving diabetes conditions and the possibility of the self-repair and recovery.

In summary, the lower value of GH.p-modulus (i.e., carbs/sugar multiplier) means the PPG contribution by carbs/sugar is less due to the existing stronger beta cells of insulin secretion. On the contrary, the higher value of GH.p-modulus means the PPG formation is more sensitive to carbs/sugar intake amount and less dependent on insulin.

In this research note, the author has proven the possibility of "self-repair and recovery" to the pancreatic beta cells regarding both quality and quantity of insulin secretion. He has written more than 10 papers on this subject. In this experimental project, he has singled out the "higher-carbs" period to further validate his pre-

vious findings. Hopefully, this series of medical research papers regarding the self-repair and recovery of pancreatic beta cells can shed some light to type 2 diabetes patients worldwide. At least, in his personal opinion, diabetes is no longer a "non-curable" disease.

Input Measured Data:	Aug20-Oct20	Nov20-Jan21	Aug20-Jan21
PPG	113.19	108.42	110.80
FPG	97	93	95
Carbs gram	11.2	15.5	13.4
Walking k-steps	4.079	4.837	4.458
Detailed Calculated Data:	Aug20-Oct20	Nov20-Jan21	Aug20-Jan21
Carbs to PPG (* GH.p=3.0435)	34	47	41
Walking to PPG (* -5.0)	-20	-24	-22
Net change (carbs+walking)	14	23	18
Predicted PPG	107.89	113.74	110.80
Difference on PPG	5	-5	0
PPG Difference % due to Pancreas	5%	-5%	0%
Final Results:	Aug20-Oct20	Nov20-Jan21	Aug20-Jan21
GH.p value (Pancreatic beta cells)	3.5	2.7	3.0
Predicted PPG	113.19	108.42	110.80

Introduction

The author investigates the pancreatic beta cells self-recovery by utilizing fasting plasma glucose (FPG), carbohydrates & sugar intake amount, post-meal walking steps, and his developed equation of linear elastic glucose theory (LEGT) to predict his postprandial plasma glucose (PPG) values. He then adjusts the proper GH.p-modulus values to make the predicted PPG values complete-

ly match with his measured PPG values. Finally, he compares and examines the different GH.p-modulus values to verify different pancreatic beta cells self-recovery status in different time periods. In this study, he uses his collected biomedical data and lifestyle details of two equal length 3-month time periods. The first period starts from 8/1/2020 to 10/31/2020 and the second period begins from 11/1/2020 to 1/31/2021.

His diabetes control has achieved significant accomplishments during the COVID-19 quarantine year of 2020. Therefore, after 11/1/2020, he decided to increase his carbs/sugar intake amount to see how high his hyperglycemia level would be. In another words, he wanted to determine if his pancreatic beta cells' level of tolerance increased in terms of the strength and quality from insulin secretion.

Methods

MPM Background

To learn more about the author's GH-Method: math-physical medicine (MPM) methodology, readers can refer to his articles to understand the developed MPM methodology in References 1 and 2.

This Particular Study

During 2020, he noticed that his PPG values are acceptable even when he consumed starchy foods, such as pancakes, toasts, noodles, and brown rice. This type of diet would have pushed his PPG level up to the 180-200 mg/dL range prior to 2020.

Recently, as he was organizing the graphic diagrams of his collected data from 1/1/2020, he noticed some *strange* trends and patterns of his carbs/sugar intake amounts and their associated PPG levels after November 1, 2020.

During the recent 3-month period from 11/1/2020 to 1/31/2021, his carbs/sugar intake amount has been increased from 11 grams per meal on 11/1/2020 to 21 grams per meal on 1/31/2021. However, his average PPG of finger and sensor have decreased from 107 mg/dL and 119 mg/dL for the previous 3-month period of 8/1/2020 to 10/31/2020 down to 104 mg/dL and 113 mg/dL for the recent 3-month period from 11/1/2020 to 1/31/2021. His carbs/sugar intake amount increased by 4-10 grams during the last period while his average finger and sensor PPG values over the two periods decreased by 3 mg/dL and 6 mg/dL, respectively. Therefore, he checked the second important influential factor, exercise. His post-meal walking steps was 4,079 steps for the previous period and 4,837 steps for recent period. This insignificant exercise difference of 758 walking steps would decrease PPG level by ~4 mg/dL only. On the other hand, his increased average carbs/sugar would increase PPG level by ~12-30 mg/dL. In combination, the net gain of PPG from the previous period to the recent period should be plus 10-25 mg/dL; however, the actual measured PPG is minus 3-6 mg/dL.

As a result, this did not make any sense to him. He then decided to utilize his developed *linear elastic glucose equation* (References 10, 11, 12, and 13) listed below to find the reason.

Predicted PPG = PPG baseline + food influence - exercise influence = (FPG * GH.f-modulus) + (carbs/sugar grams * GH.p-modulus) - (post-meal walking k-steps * 5)

Where GH.f (0.89-0.97) is a multiplier on FPG value and GH.p is a multiplier on carbs/sugar amount.

Actually, the lower value of GH.p-modulus (i.e., carbs/sugar multiplier) means the PPG contribution by carbs/sugar is less due to the stronger contribution by insulin. On the contrary, the higher GH.p-modulus means PPG is more sensitive to carbs/sugar amount and less dependent on insulin.

Results

Figure 1 shows the PPG data and curves for the two periods, from August 2020 through October 2020 and November 2020 through January 2021, along with the combined longer period from August 2020 through January 2021. The focus will be on the two periods only with the longer combined period provided as reference.

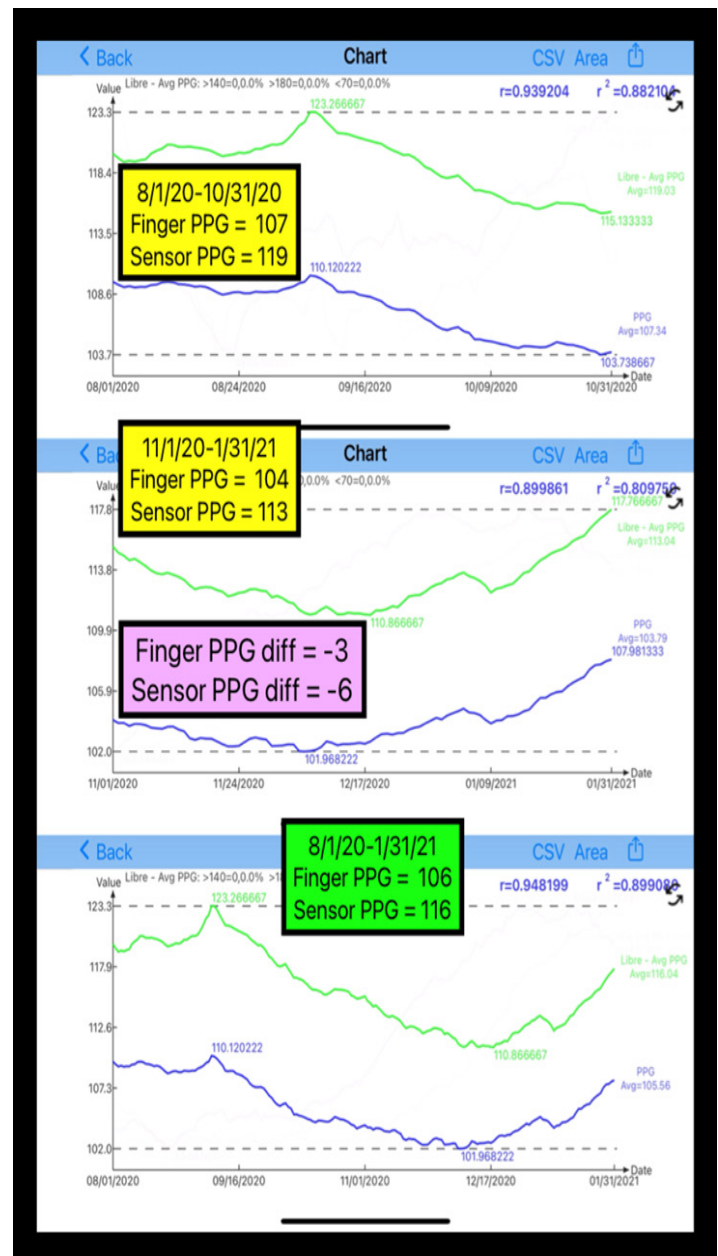


Figure 1: Finger PPG and Sensor PPG for three periods

The following data table lists in the format of Finger PPG and Sensor PPG:

August 2020 – October 2020:
107, 119
November 2020 – January 2021: 104, 113

The recent period has a lower PPG value than the previous period. The PPG differences are -3 mg/dL for Finger and -6 mg/dL for Sensor.

Figure 2 depicts the carbs/sugar intake amounts and curves for the two periods, from August 2020 through October 2020 and November 2020 through January 2021, along with the combined longer period from August 2020 through January 2021.

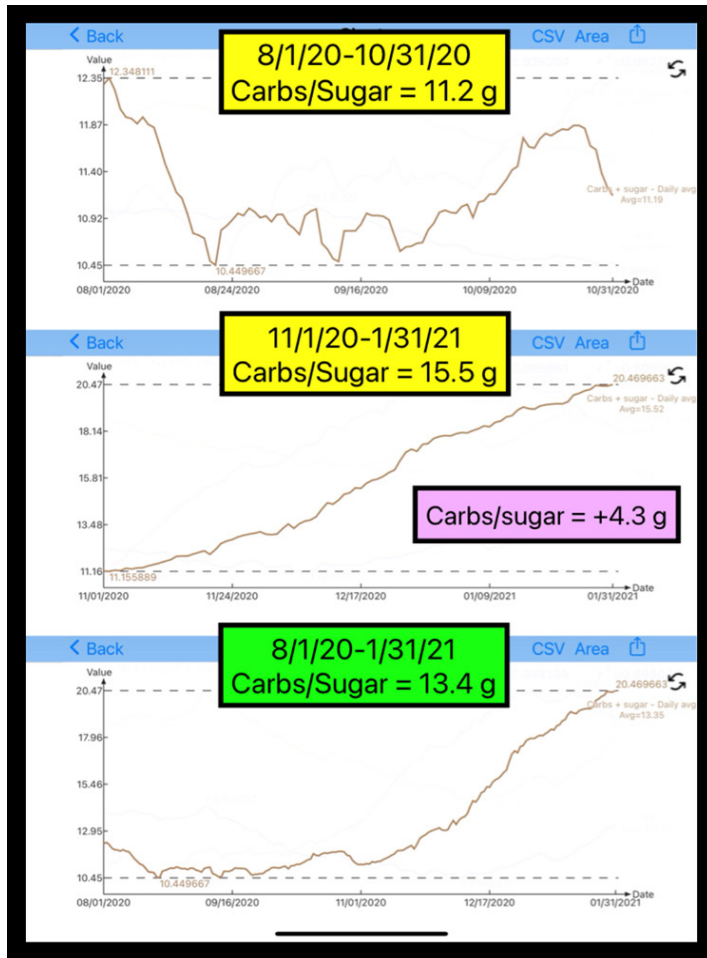


Figure 2: carbs/Sugar intake grams for three periods

The following data table lists in the format of carbs/sugar intake amount per meal:

August 2020 – October 2020:
11.2 grams
November 2020 – January 2021:
15.5 grams

The recent period has a higher carbs/sugar amount than the previous period. The Carbs/Sugar intake difference is +4.3 grams per meal.

Figure 3 reflects the post-meal walking steps and curves for the two periods, from August 2020 through October 2020 and November 2020 through January 2021.

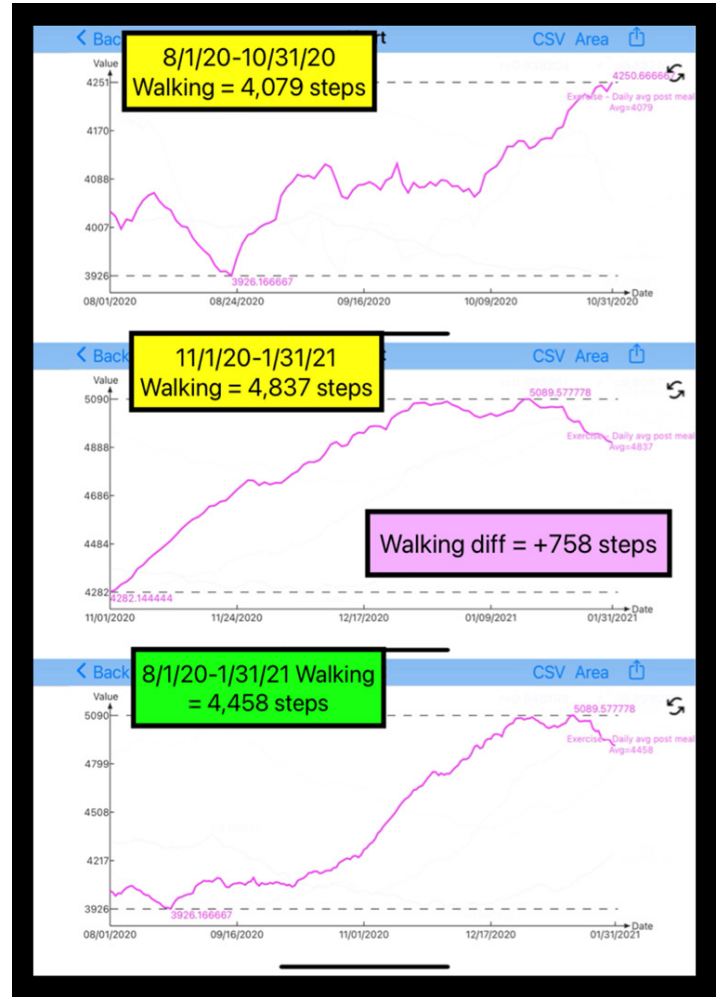


Figure 3: Post-meal walking steps for three periods

The following data table lists in the format of post-meal walking k-steps:

August 2020 – October 2020:
4.079 k-steps
November 2020 – January 2021: 4.837 k-steps

The recent period has a slightly higher walking k-steps than the previous period. The post-meal walking k-steps difference is +0.758 k-steps per meal.

Figure 4 illustrates the FPG data and curves for the two periods, from August 2020 through October 2020 and November 2020 through January 2021. The focus will be on the two periods only

with the longer combined period provided as reference.

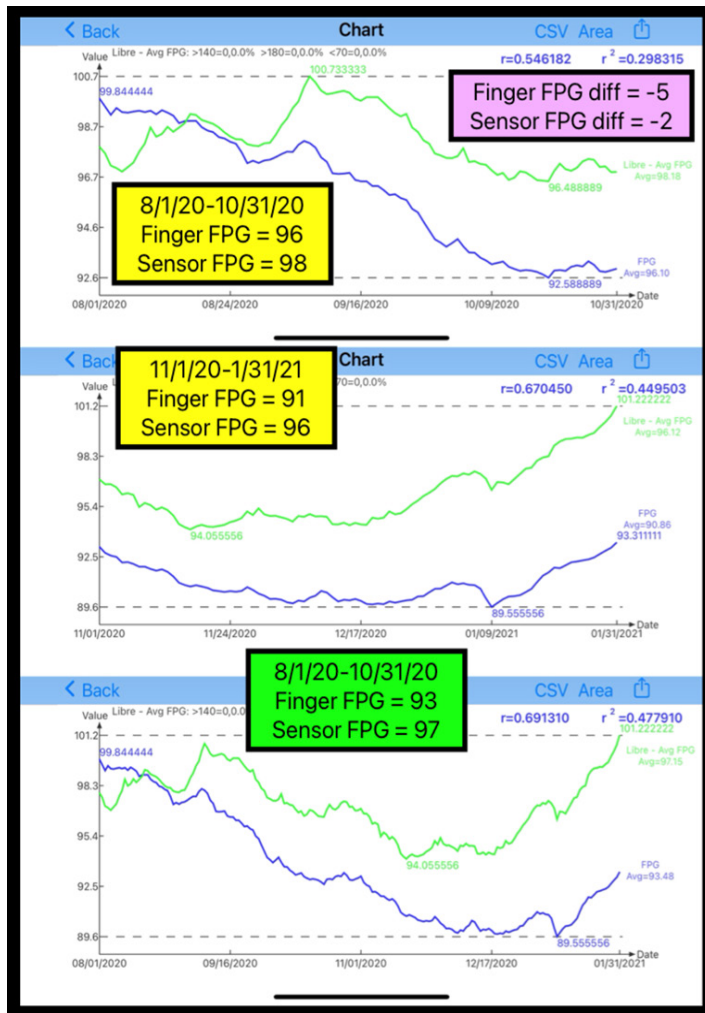


Figure 4: Finger FPG and Sensor FPG for three periods

The following data table lists in the format of Finger FPG, Sensor FPG:

August 2020 – October 2020:
96, 98
November 2020 – January 2021:
91, 96

Similar to the PPG trend, the recent period has lower FPG values compared to the previous period. The FPG differences are -5 mg/dL for Finger and -2 mg/dL for Sensor. When he improves his diabetes control, both of his FPG and PPG levels will benefit from his efforts at the same time. The FPG values is needed to determine the baseline of his predicted PPG value. FPG can also be served as an indicator of overall health of pancreas.

Figure 5 is the most important and conclusive presentation in the analysis results. The data table has three parts, where the top lists all of his collected input data, the middle section presents all of his calculation steps utilizing the developed equation of linear elastic

glucose theory (LEGT) below:

Input Measured Data:	Aug20-Oct20	Nov20-Jan21	Aug20-Jan21
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Predicted PPG	113.19	108.42	110.80

Figure 5: Data table of inputs, calculations and results of GH.p-modulus values for three periods

$$\text{Predicted PPG} = \text{PPG baseline} + \text{food influence} - \text{exercise influence}$$

$$= (\text{FPG} * \text{GH.f-modulus}) + (\text{carbs/sugar grams} * \text{GH.p-modulus}) - (\text{post-meal walking k-steps} * 5)$$

Where GH.f (0.89-0.97) is a multiplier on FPG value and GH.p is a multiplier on carbs/sugar amount.

The bottom part displays his analysis results of GH.p-modulus values for two different time periods which are 3.5 for previous period of August 2020 to October 2020 and 2.7 for the recent period of November 2020 to January 2021. The two GH.p-modulus will make his calculated PPG predictions identical with the two measured average PPG values. The lower GH.p-modulus of 2.7 for the recent period from November 2020 to January 2021 indicates that his pancreas conditions are better during this recent period.

Based on this analysis, his pancreatic beta cells' self-repair and recovery has contributed approximately 5% to his PPG formation.

This observation and calculated results have resolved the mystery of why his PPG value became lower with a higher carbs/sugar intake amount with a near constant exercise amount.

Conclusions

This experiment further confirms the importance of the pancreatic beta cells in regard to their insulin capability and quality in improving diabetes conditions and the possibility of the self-repair and recovery.

In summary, the lower value of GH.p-modulus (i.e., carbs/sugar multiplier) means the PPG contribution by carbs/sugar is less due to the existing stronger beta cells of insulin secretion. On the contrary, the higher value of GH.p-modulus means the PPG formation is more sensitive to carbs/sugar intake amount and less dependent on insulin.

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