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Research Article

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Postprandial Plasma Glucose Segmentation Analysis of Influences from Diet and Exercise between the Pre-COVID-19 and COVID-19 Periods (No. 321)

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Abstract

In this paper, the author describes the special segmentation analysis of impact on his post-prandial plasma glucose (PPG) via diet and exercise during the pre-COVID-19, from 5/5/2018 - 1/18/2019, and COVID-19, from 1/19/2020 - 8/28/2020, periods. He segmented his carbs/sugar intake amount and post-meal walking step into two ranges, low range and high range, for two periods, respectively. Initially, he calculates their associated PPG values for each range of input data, then he compares these two segmented outcomes against the total results from the combined periods.

I*n this particular research of segmentation analysis, he selected the following two time periods.*

Pre-COVID-19:
From 5/5/2018 to 1/18/2020

COVID-19:
From 1/19/2020 to 8/28/2020

Here are the two ranges established for diet and exercise.

Carbs/sugar amount in grams:
Low range: 0 - 15 grams
High range: 15 - 80 grams

Post-meal walking in steps:
Low range: 0 - 4,000 steps
High range: 4,000 - 10,000 steps

The three outstanding findings are as follows:

1. As expected, the high range of carbs/sugar amount provides higher PPG values and low range of post-meal walking steps offers higher PPG values.
2. The low and high ranges for the categories of carbs/sugar amount and walking steps during the COVID-19 period has the overall lower PPG values compared to the pre-COVID-19 period. This certainly signifies the "best performance period" statement.
3. The combination of the total PPG for all ranges is 115 mg/dL for pre-COVID-19 period and 110 mg/dL for COVID-19 period. With almost the same amount of walking steps for both periods, the finger PPG difference is 5.2 mg/dL, which comes from two major sources. First, the carbs/sugar difference of (14.3 grams - 12.2 grams =) 2.1 grams which generates (2.1 * 1.8 =) 3.78 mg/dL. Second, his pancreatic beta cell's self-recovering rate of 2.2% per year gives (2.2 * 8/12 *110 =) 1.61 mg/dL. By combining these two figures, the amount is (3.78 + 1.61 =) 5.4 mg/dL. This PPG reduction of 5.4 mg/dL is quite close to the finger PPG difference of 5.2 mg/dL between these two periods.

In this investigation, the majority of his glucose values are quite "normal", i.e. below 120 mg/dL, except for the high-carbs situation during pre-COVID-19 (124 mg/dL). His diabetes condition has already been "well-controlled" prior to 5/5/2018, which is the beginning date of pre-COVID-19 period. Nevertheless, the detailed segmentation analyses not only confirmed many of his previous research findings, but also revealed some new discoveries, for example, the above calculations of the total finger PPG difference from two sources: carb/sugar and beta cell's self-repair.

From the results of COVID-19 period, it is obvious that his diabetes control has reached to its best performance point for his past 25-years history of diabetes. The relationship between inputs of diet and exercise and outputs of finger PPG are not fundamentally different from his previous research findings; however, the deviations, between the low range and high range of diet and exercise during COVID-19 of having a quiet life, are smaller than the pre- COVID-19 period with a hectic travel schedule. This result demonstrates again how important lifestyle management is for diabetes control.

This article proves that the special segmentation modeling technique and its associated analysis, based on merit alone, can definitely be beneficial for other type 2 diabetes patients.

Introduction

In this paper, the author describes the special segmentation analysis of impact on his post-prandial plasma glucose (PPG) via diet and exercise during the pre-COVID-19, from 5/5/2018 - 1/18/2019, and

COVID-19, from 1/19/2020 - 8/28/2020, periods. He segmented his carbs/sugar intake amount and post-meal walking step into two ranges, low range and high range, for two periods, respectively. Initially, he calculates their associated PPG values for each range of input data, then he compares these two segmented outcomes against the total results from the combined periods.

Method

Background

To learn more about the GH-Method: math-physical medicine (MPM) methodology, readers can review the article in Reference 1 to understand his MPM analysis method, along with the outlined history of his personalized diabetes research and application tools development in Reference 2.

Diabetes Research

The author estimated and proved that PPG contributes approximately 75% to 80% towards HbA1C formation. Therefore, he tried to unravel the mystery of PPG first. Through his diabetes research, he has identified at least 19 influential factors associated with PPG formation. Among those influential factors, diet (carbs/sugar intake amount) would provide ~39% and exercise (post-meal walking) would contribute ~41%. Combining these two primary influential factors, it gives ~80% of the PPG formation. Among the rest of the 17 secondary factors, a high weather temperature contributes ~5%, whereas stress and illness only make noticeable contributions when they occur.

Previously, he has taken high doses of three prescribed diabetes medications for 18 years starting in 1997; however, in 2013, he started to reduce the number of prescriptions and dosages of his daily medications. By 12/8/2015, he finally ceased taking any diabetes medications; therefore, there are no medication involvement in this study.

Since July 2019, he also launched a special investigation on the degree of damage to his pancreatic beta cells. During this one yearlong of research work, he noticed that his FPG and PPG values have been decreasing in the past 6 to 8 years at a rate between 2.2% to 3.2% annually. In other words, his pancreatic beta cells have been self-regenerating or self-repairing about 13% to 26% for over these 6 to 8 years (Reference 4).

Glucose Data

Since 1/1/2012, he has collected his four vital medical conditions of biomarker values, including weight, glucose, blood pressure, and lipids, along with six lifestyle details, including food, water intake, sleep, stress, exercise, daily life routines, plus some key environmental factors, such as weather temperature, pollution, water quality, poison, radiation, and more. Those data are stored in a cloud server and managed via a customized APP software on his iPhone. To date, he has collected, processed, and stored nearly 2 million data regarding his health conditions.

In this particular research of segmentation analysis, he selected the following two time periods.

Pre-COVID-19:
From 5/5/2018 to 1/18/2020

COVID-19:
From 1/19/2020 to 8/28/2020

Here are the two ranges established for diet and exercise.

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High range: 15 - 80 grams

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Low range: 0 - 4,000 steps
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Results

At the start of COVID-19, the author began his quarantined life on 1/19/2020. This unique, quiet, and special lifestyle has a significant impact on his overall health conditions, including diabetes control. As a matter of fact, his diabetes control situation for these past 8 months has reached to a "historical best performance period" in his past 25 years of diabetes history.

In Figure 1, it shows his summarized data regarding these segmentation analysis results of pre- COVID-19 period and COVID-19 period.

Low carbs (0-15 g); High carbs (15-80 g)	5/5/18-1/18/20	1/19/20-8/28/20	pre-virus minus virus
PPG (mg/dL) Segmentation	pre-virus	virus	Difference = 5 mg/dL
Low carbs meals #	1247	456	
High carbs meals #	605	219	
Low carbs meals %	67%	68%	
High carbs meals %	33%	32%	
PPG (mg/dL) Segmentation	pre-virus	virus	pre-virus minus virus
Low carbs PPG (mg/dL)	110	108	2
High carbs PPG (mg/dL)	124	113	10
Low steps (0-4k); High steps (4k-10k)	5/5/18-1/18/20	1/19/20-8/28/20	pre-virus minus virus
PPG (mg/dL) Segmentation	pre-virus	virus	Difference = 6 mg/dL
Low steps meals #	623	202	
High steps meals #	1281	515	
Low steps meals %	33%	28%	
High steps meals %	67%	72%	
PPG (mg/dL) Segmentation	pre-virus	virus	pre-virus minus virus
Low steps PPG (mg/dL)	118	111	7
High steps PPG (mg/dL)	114	109	5
PPG (mg/dL) Segmentation	pre-virus	virus	pre-virus minus virus
Carbs & Sugar grams	14.3	12.2	2.1
Post-meal walking steps	4236	4278	-42
Finger PPG mg/dL	115	110	5

Figure 1: Summarized data table

In Figure 2, it depicts 5 PPG bars of low-carbs, high-carbs, low-walking steps, high walking steps, and total Finger PPG values including all ranges.

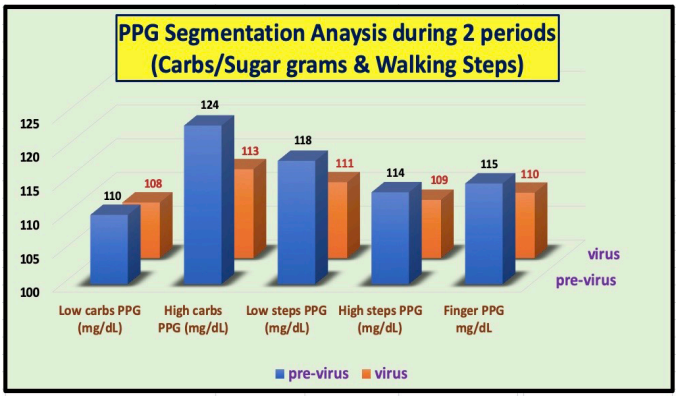

Figure 2: Low range and High range of carbs/sugar intake amount and post-meal walking steps during two periods

In Figure 3, it reflects carbs/sugar amount in grams, post-meal walking in steps, and Finger PPG in mg/dL during pre- COVID-19 period from 5/5/2018 to 1/18/2020.

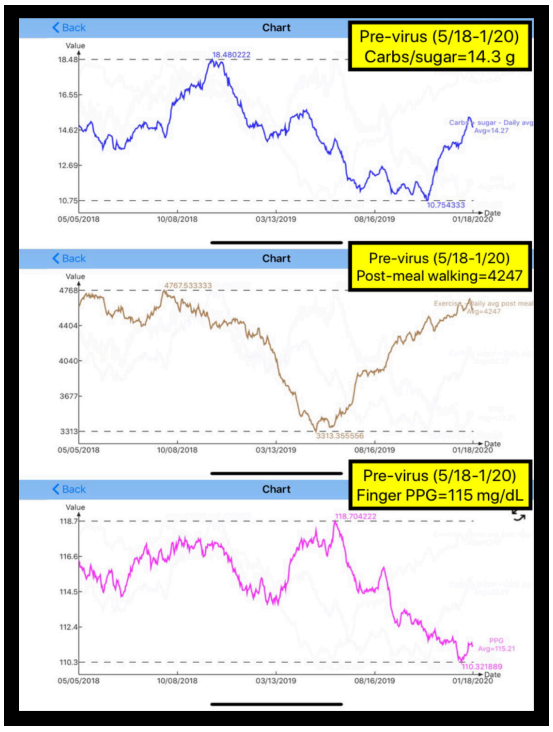

Figure 3: Pre-virus period (5/5/2018 - 1/18/2020)

In Figure 4, it indicates carbs/sugar amount in grams, post-meal walking in steps, and Finger PPG in mg/dL during COVID-19 period from 1/19/2020 to 8/28/2020.

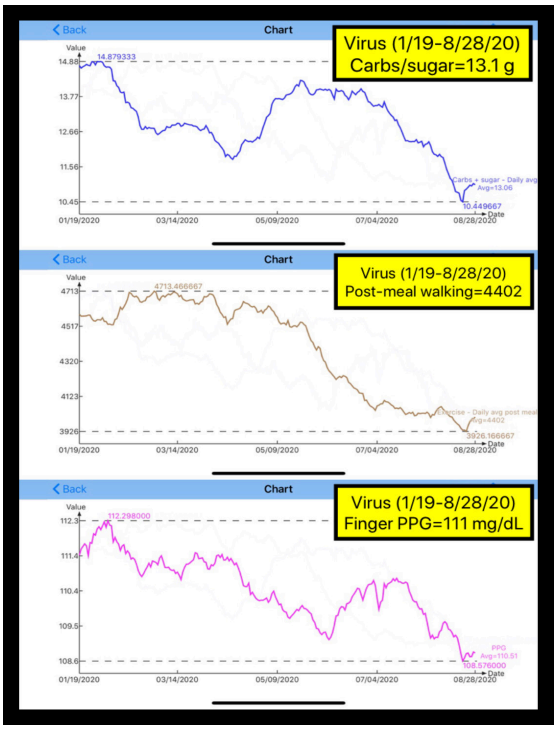

Figure 4: Virus period (1/19/2020 - 8/28/2020)

In Figure 3, it illustrates the fluctuation of carbs, walking, and PPG during this 21 month for the pre- COVID-19 period which includes his hectic schedules of traveling through 50+ international cities, attending 60+ medical conferences, and giving ~120 oral presentations. This busy traveling lifestyle interrupted his daily life routines and increased his difficulty of maintaining his stringent rules regarding diet and exercise. On the contrary, the declination of his Finger PPG from 112 mg/dL to 108 mg/dL (average PPG of 110 mg/dL) for the past 8 months during COVID-19 is shown in Figure 4. It should be pointed out that the Finger PPG values are the combined PPG of low range and high range for both diet and exercise (Figures 3 and 4).

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(1) As expected, the high range of carbs/sugar amount provides higher PPG values and low range of post-meal walking steps offers higher PPG values.
(2) The low and high ranges for the categories of carbs/sugar amount and walking steps during the COVID-19 period has the overall lower PPG values compared to the pre-COVID-19 period. This certainly signifies the "best performance period" statement.
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Conclusions

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This article proves that the special segmentation modeling technique and its associated analysis, based on merit alone, can definitely be beneficial for other type 2 diabetes patients.

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