

# The GH-Method

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## Segmentation and Pattern Analyses for Three Meals of Postprandial Plasma Glucose Using GH-Method: Math-Physical Medicine (No. 325)

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### Abstract

This article describes the results of segmentation and pattern analyses of postprandial plasma glucose (PPG) levels associated with breakfast, lunch, and dinner. There are three consistent glucose ranges used for each meal, which include low (70-120 mg/dL), medium (120-140 mg/dL), and high (140-300 mg/dL). The final analysis results reflect a part of the total lifestyle profile for food and meals of the author during a period of 2+ years from 5/5/2018 to 9/6/2020 (855 days with 2,565 meals and 33,345 glucose data). The glucose pattern analysis depicts a clear pattern of his general lifestyle regarding his food and meals via his PPG segmented data. The results reflect a heavy lunch, medium breakfast, and light dinner. This research work used a segmentation analysis of his 33,345 PPG data to conduct a pattern identification analysis from the PPG of his three meal profiles and the associated lifestyle patterns of his food and meals for the past 855 days. Since 12/8/2015, the author ceased taking any diabetes medications. In other words, his diabetes control

is 100% dependent on his lifestyle management program with no chemical intervention from any medications. During this period, his average finger-piercing and test strips measured PPG is 113.15 mg/dL (within the normal range), and his average CGM sensor collected PPG is 127.35 mg/dL (within the pre-diabetes range). His sensor PPG is 12.5% higher than his finger PPG on average. Nevertheless, disregarding the debate of accuracy from using different measurement devices, his PPG control via stringent lifestyle management without medication is effective. His estimated mathematically derived HbA1C values should be between 5.56% to 6.05%, which is a satisfactory HbA1C level for a 73-year-old male with a 25-year history of severe diabetes with an average glucose of 280 mg/dL and A1C of 11% in 2010. This particular segmented pattern analyses of his PPG data and glucose profiles are results of the style and amount of his three daily meals. This method can offer a useful tool for analyzing other types of biomarkers in a deeper investigation with a wider entry point of research.

**Keywords:** Postprandial plasma glucose; Lifestyle management; Glucose; Diabetes

**Abbreviations:** FPG: fasting plasma glucose; PPG: postprandial plasma glucose; CGM: continuous glucose monitoring; MPM: math-physical medicine

## 1. INTRODUCTION

This article describes the results of segmentation and pattern analyses of postprandial plasma glucose (PPG) levels associated with breakfast, lunch, and dinner. There are three consistent glucose ranges used for each meal, which include low (70-120 mg/dL), medium (120-140 mg/dL), and high (140-300 mg/dL). The final analysis results reflect a part of the total lifestyle profile for food and meals of the author during a period of 2+ years from 5/5/2018 to 9/6/2020 (855 days with 2,565 meals and 33,345 glucose data).

## 2. METHODS

### 2.1 Data collection

The author started measuring his glucose on 1/1/2012 by using traditional finger-piercing and test strip (Finger glucose) 4 times each day, once in the early morning (FPG) when he wakes up from sleeping, and three times at two-hours after each meal (PPG). In this particular analysis, he will not use his finger glucose data for his segmentation and pattern analyses.

In addition, since 5/5/2018, he applied a continuous glucose monitoring (CGM) device on his upper arm and collect ~96 glucose values each day at a time interval of each 15 minutes. With this CGM-based sensor collected glucose (Sensor glucose), he selected a 3-hour (180 minutes) timespan after the first bite of a meal as his standard Sensor PPG timeframe.

### 2.2 Background

To learn more about the GH-Method: math-physical medicine (MPM) research methodology, readers can review his specific article, Biomedical research methodology based on GH-Method: math-physical medicine (No. 310), to understand his MPM analysis method.

### 2.3 Segmentation and pattern analyses

He has established three consistent glucose segments or ranges as follows:

Low range (normal): 70 - 120 mg/dL

Medium range (pre-diabetes): 120 - 140 mg/dL

High range (diabetes): 140 - 300 mg/dL

He will then segregate his collected CGM sensor glucose of 33,345 data associated with 2,565 meals into three types of meals distributed as breakfast, lunch, and dinner with three ranges of low, medium, and high for each type of 855 meals.

Finally, he will study the distinguished pattern associated with each type of meal to examine its relationship with his lifestyle.

## 3. RESULTS

Figure 1 shows the data table and bar chart of distribution percentages of three ranges for each meal. It is obvious that 42% of breakfasts are within the medium range (pre-diabetes), 42% of lunches are within the high range (diabetes), and 41% of dinners are within the low range (normal). In other words, his dinner result falls in the normal range, lunch in the diabetes range, and dinner in the pre-diabetes range. This observation depicts a picture of his meals in his general lifestyle, which includes a heavy lunch, medium breakfast, and light dinner.

The third observation is that the medium-range bar (120-140 mg/dL) occupies 49% of his total PPG data within his average daily PPG bars. His 30% in the high range (140-300 mg/dL) would be somewhat balanced out by his 21% of the low range (70-120 mg/dL). Therefore, this observation describes the overall PPG status placing his diabetes condition into the pre-diabetes range.

The data table and bar chart of his average PPG values for the three ranges of each meal is shown in Figure 2. It is obvious from the average PPG of all ranges that the lunch meals reflect the highest average PPG among all of the three types. Lunch has the highest average PPG of 138 mg/dL, breakfast's average PPG is 133 mg/dL, and dinner has the lowest average PPG of 127 mg/dL. Another observation is that the total average PPG of 132 mg/dL falls within the definition of pre-diabetes range.

The above descriptions demonstrate a clear picture of his meal profile regarding his general lifestyle. His lunch is the heaviest meal due to his concern about meeting balanced nutritional requirements plus his needs for daily energy supply, whereas breakfast falls in the medium level of his meals. Dinner is the lightest meal due to his concern about weight measurement next early morning via the current day's dinner portion control.

Of course, exercise is another primary influential factor in PPG formation. All of his three average post-meal walking exercise is around 4,000 steps with an average daily walking exercise of 16,600 steps. Therefore, this exercise factor can be excluded from this particular analysis.

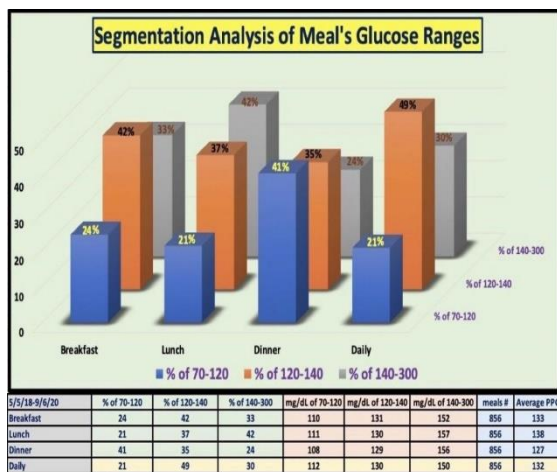


Figure 1: PPG contribution percentages of three meals (5/5/2018 - 9/6/2020).

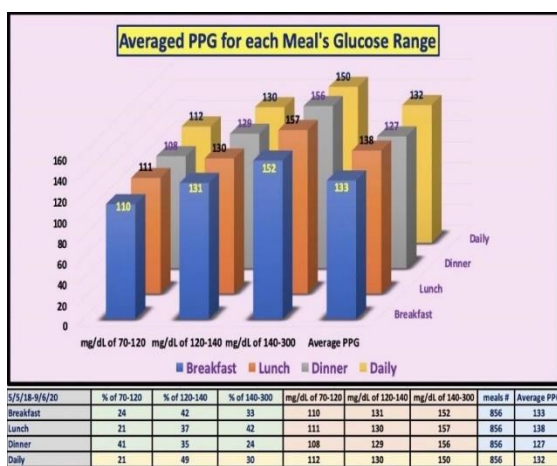


Figure 2: Average PPG values of each range for three meals (5/5/2018 - 9/6/2020).

#### 4. CONCLUSION

This research work used a segmentation analysis of his 33,345 PPG data to conduct a

pattern identification analysis from the PPG of his three meal profiles and the associated lifestyle patterns of his food and meals for the past 855 days. Since 12/8/2015, the author ceased taking any diabetes medications. In other words, his diabetes control is 100% dependent on his lifestyle management program with no chemical intervention from any medications. During this period, his average finger-piercing and test strips measured PPG is 113.15 mg/dL (within the normal range), and his average CGM sensor collected PPG is 127.35 mg/dL (within the pre-diabetes range). His sensor PPG is 12.5% higher than his finger PPG on average. Nevertheless, disregarding the debate of accuracy from using different measurement devices, his PPG control via stringent lifestyle management without medication is effective. His estimated mathematically derived HbA1C values should be between 5.56% to 6.05%, which is a satisfactory HbA1C level for a 73-year-old male with a 25-year history of severe diabetes with an average glucose of 280 mg/dL and A1C of 11% in 2010.

This particular segmented pattern analyses of his PPG data and glucose profiles are results of the style and amount of his three daily meals. This method can offer a useful tool for analyzing other types of biomarkers in a deeper investigation with a wider entry point of research.

#### 5. REFERENCES

- 1) Hsu, Gerald C., eclaireMD Foundation, USA, No. 310 "Biomedical research methodology based on GH-Method: math-physical medicine".
- 2) Hsu, Gerald C., eclaireMD Foundation, USA, No. 297: "Self-recovery of pancreatic beta cell's insulin secretion based on annualized fasting plasma glucose, baseline postprandial plasma glucose, and baseline daily glucose data using GH-Method: math-physical medicine".
- 3) Hsu, Gerald C., eclaireMD Foundation, USA, No. 288: "Diabetes control and metabolism maintenance during COVID-19 period in comparison to three other periods

using GH-Method: math-physical medicine”.

4) Hsu, Gerald C., eclaireMD Foundation, USA, No. 261: “Comparison study of PPG characteristics from candlestick model using GH-Method: Math-Physical Medicine”.

5) Hsu, Gerald C., eclaireMD Foundation, USA, No. 321:

“Postprandial plasma glucose segmentation analysis of influences from diet and exercise between the pre-COVID-19 and COVID-19 periods”.

6) Hsu, Gerald C., eclaireMD Foundation, USA, No. 312: “Segmentation analysis of the impact on glucose via diet, exercise, and weather temperature during COVID-19 quarantine period”.