The New American Journal of Medicine

Research Article

Using Candlestick Charting and GH-Method: Math-Physical Medicine to Investigate the Differences of Glucose Measurement Results Based on Both Finger-Piercing Method and Continuous Monitoring Device

Hsu GC*

Department of Medicine, eclaire MD Foundation, USA

Received: 17 May 2023

Accepted: 30 July 2023

Published: 15 Aug 2023

***Corresponding author:**
Gerald C Hsu, Department of Medicine, 7 Oak Haven Way Woodside, CA 94062, Eclaire MD Foundation, USA, Tel: +1-510-331-5000, Email: g.hsu@eclairemd.com

1. Abstract

The author developed his GH-Method: Math-Physical Medicine (MPM) by applying mathematics, physics, engineering modelling, and computer science such as big data analytics and artificial intelligence to derive the mathematical metabolism model and three prediction tools for weight, FPG, and PPG with >30 input elements. This research paper describes glucose measurement results based on the finger-piercing method and continuous glucose monitor device using candlestick charting and segmentation analysis.

2. Keywords: Type 2 diabetes; Fasting plasma glucose; Postprandial plasma glucose; Finger-piercing; Continuous glucose monitor device; Candlestick charting; Segmentation analysis; Artificial intelligence; Math-physical medicine

3. Introduction

This paper describes glucose measurement results during the same period of 376 days from 5/5/2018 to 5/15/2019 based on both finger-piercing (Finger) and sensor monitoring (Sensor) data using candlestick charting and glucose segmentation analysis. The dataset is provided by the author, who uses his own type 2 diabetes metabolic conditions control, as a case study via the "math-physical medicine" approach of a non-traditional methodology in medical research.

Math-Physical Medicine (MPM) starts with the observation of the human body's physical phenomena (not biological or chemical characteristics), collecting elements of the disease related data (preferring big data), utilizing applicable engineering modelling techniques, developing appropriate mathematical equations (not just statistical analysis), and finally predicting the direction of the development and control mechanism of the disease.

4. Method

The author was diagnosed with type 2 diabetes in 1995. He has measured his Finger glucoses four times a day (1 FPG and 3 PPG) since 2012. He has uploaded his 10,760 Finger glucose data of 2,690 days on a cloud server. On 5/5/2018, he applied a Sensor on his upper arm to collect 73 glucose data each day (every hour during sleep and every 15 minutes during daytime). During the recent period of 376 days from 5/5/2018 - 5/15/2019, he has collected 1,504 glucose data via Finger and 27,448 glucose data via Sensor in parallel.

He borrowed one specific statistical analysis tool, the Candlestick Chart, from the stock market and further modified and customized it for his specific glucose analysis. A "candlestick" model contains the following five daily glucose data also known as the OHLC model:

Opening: wake up ~7:00 glucose

Highest: daily maximum glucose

Lowest: daily minimum glucose

Closing: pre-bedtime ~23:30 glucose

Average: daily average glucose

However, his Finger Candlestick model's wake up and pre-bedtime glucoses are identical since he did not measure his finger glucose prior to bedtime (Figure 1). These two Candlestick models provide four to five data per day on the chart instead of the traditional graphic chart of having only one tested data.

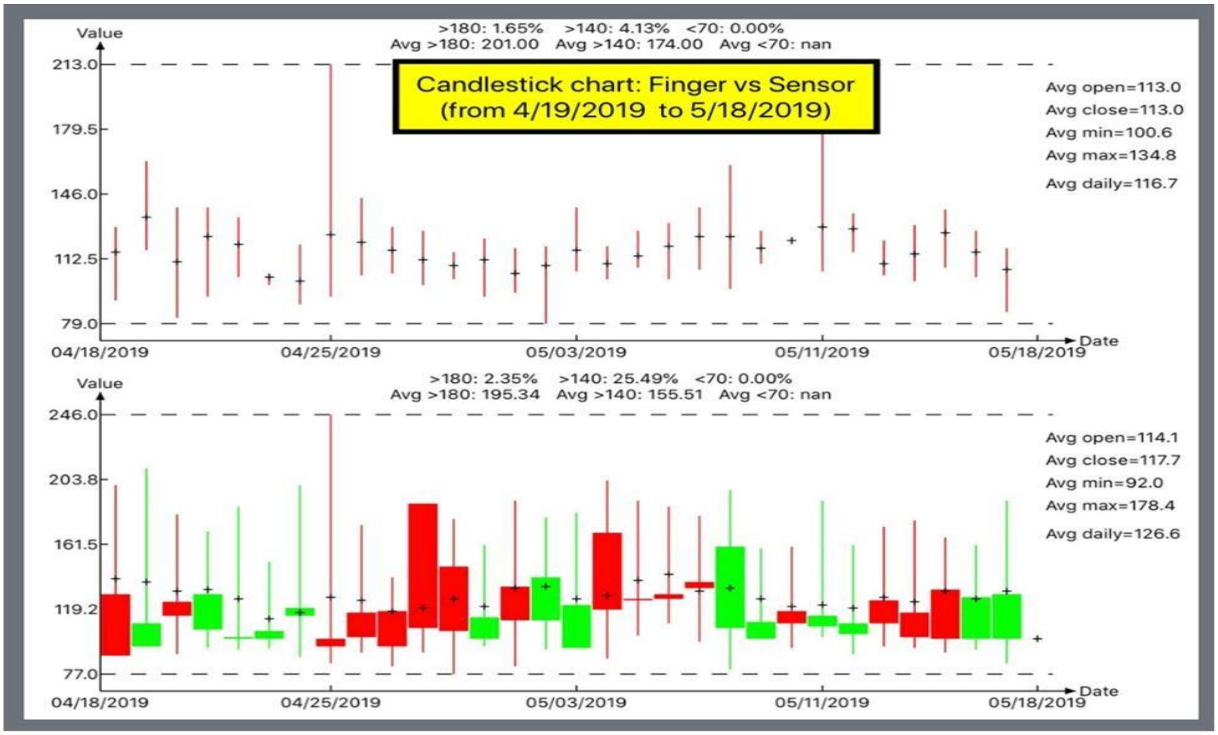

Figure 1: Sample drawing of two candlesticks

Based on these two sets of 376 candlesticks for each one, various glucose patterns and their moving trends can be observed and analysed through further mathematical and statistical operations. Finally, by using his acquired medical domain knowledge, he then interpret these mathematical results into biomedical phenomena in order to discover some hidden medical facts and their potential dangers to his health (Table 1).

Table 1: HOLC data and Glucose Segmentation Analysis results

Method	Finger(F)	Sensor(s)	F/S
Time per Day	4	73	
Open (Morning)	112	117	96%
Close (pre-Bed)	112	121	935
Highest	135	187	72%
Lowest	99	90	110%
Averaged Glucose	116	129	90%
(5/5/2018 - 5/15/2019)			
Glucose > 180 avg	204	199	103%
Glucose > 180 %	1.10%	4.40%	
Glucose > 140 avg	161	160	101%
Glucose > 140 %	6.80%	31.00%	
Glucose > 70 avg	69	65	106%
Glucose > 70 %	0.30%	0.20%	
FPG	112	112	100%
PPG	116.00%	134.00%	87%

5. Results

Here are some of his research findings:

1. His average Finger glucose (116 mg/dL) is ~10% lower than the average Sensor glucose (129 mg/dL). This is due to the Finger testing being performed around 2 hours after first bite of meal and actually the real peak of PPG usually happens around 1 hour after meal (~45 to 75 minutes).

2. The H-value (averaged daily highest glucoses) of sensor is 187 mg/dL while Finger's H-value is only 135 mg/dL (missed by almost 30%). Furthermore, via a glucose segmentation pattern analysis for glucoses >140 mg/dL, there are 31% of high glucoses captured by Sensor while only 7% for Finger. The excessive energy carried by high glucoses are the major cause of diabetes complications such as CVD, stroke, renal and eye issues.

3. The FPG differences between two methods are negligible, while PPG is a different situation (PPG contributes ~80% of HbA1C). Sensor's PPG (134 mg/dL) is 13% higher than

Finger's PPG (116 mg/dL).

4. Due to the large size of Sensor data, it even shows 65% correlation between 90-days moving average data of FPG and PPG. This high correlation could not be identified in Finger data (Figure 2).

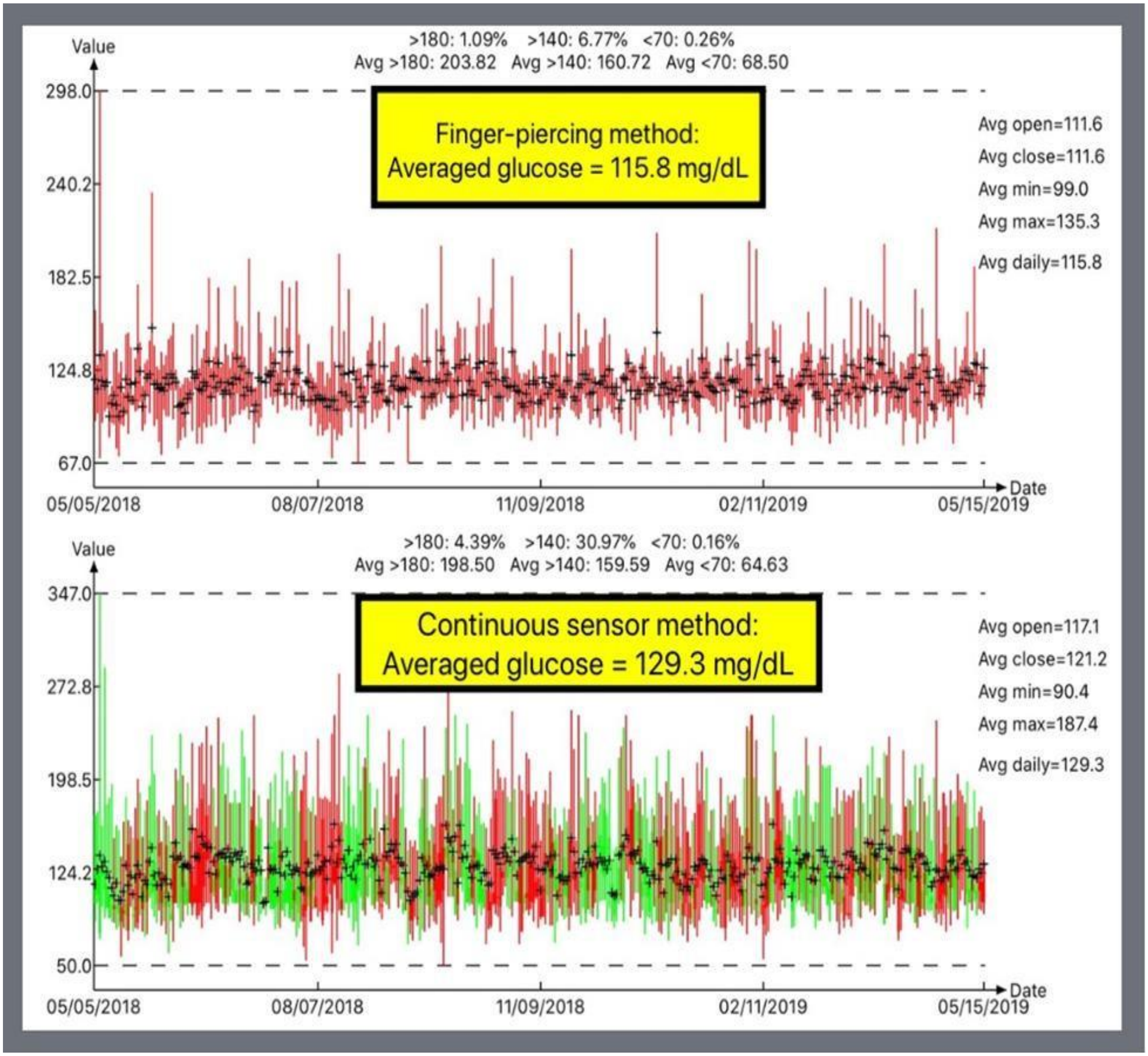

Figure 2: Candlestick Chart for both Finger and Sensor

6. Conclusion

This paper has further demonstrated the power of the GH-Method: math-physical medicine (Figure 3). It utilizes observation of the physical phenomena of glucose, derivation of mathematical equations, application of computer technology, and finally combined with biomedical domain-knowhow for further medical interpretations in order to discover and predict more hidden biomedical facts regarding the human body.

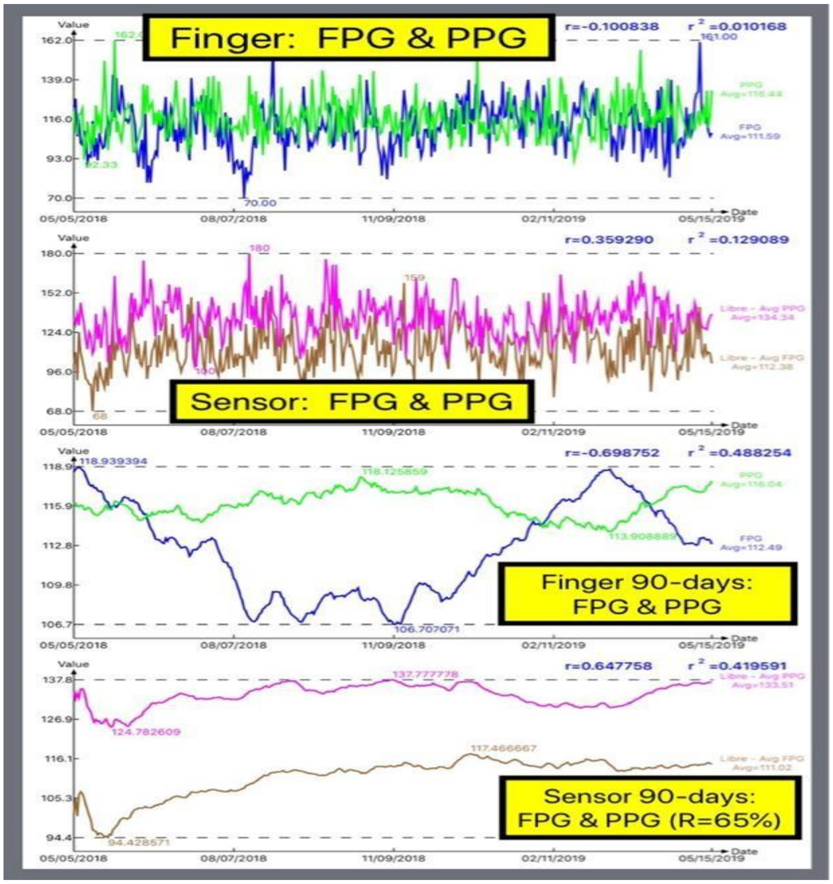

Figure 3: Time-series results of FPG & PPG with Finger and Sensor

References:

1. Gerald CH. Using Math-Physical Medicine to Control T2D via Metabolism Monitoring and Glucose Predictions. Journal of Endocrinology and Diabetes. 2018; 1: 1-6.

2. Gerald CH. Using Signal Processing Techniques to Predict PPG for T2D. International Journal of Diabetes & Metabolic Disorders. 2018; 3: 1-3.

3. Gerald CH. Using Math-Physical Medicine and Artificial Intelligence Technology to Manage Lifestyle and Control Metabolic Conditions of T2D. International Journal of Diabetes & Its Complications. 2018; 2: 1-7.

4. Gerald CH. Using Math-Physical Medicine to Study the Risk Probability of having a Heart Attack or Stroke Based on Three Approaches, Medical Conditions, Lifestyle Management Details, and Metabolic Index. EC Cardiology. 2018; 5: 1-9.