

The GH-Method

Comparison of the Author's PPG Waveforms Using Continuous Glucose Monitoring Sensor Data Over 3.7 Years from 5/5/2018 to 1/16/2022 and their Associated Energy Levels Against Three Publicly Reported Standard Postprandial Plasma Cases (Normal, Pre-Diabetes, and Severe Diabetes) with their Calculated Relative Energies Based on GH-Method: Math-Physical Medicine (No. 584)

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Abstract

The author utilized a flash glucose monitoring (FGM) technique with 14-days of continuous glucose monitoring (CGM) sensor device to collect his glucose data (sensor glucoses) 96 times per day from 5/5/2018 to 1/16/2022. Next, he selects his collected postprandial plasma glucose (PPG) data over 3.7 years along with the data from Y2021 to compare against the published three standard PPG curves for normal people, pre-diabetes patients, and severe diabetes patients (Reference 2). He then calculates the PPG associated "relative energy" level utilizing the squared value of the average PPG as his estimated energy associated with PPG. In basic physics, the energy associated with a wave is proportional to the square of this wave's amplitude. The relative energies are generated by glucose itself which are carried by red blood cells circulating in the blood vessels throughout the body. Human organs and glucoses have their biochemical reasonings and needed operations, but their biophysical behaviors also present certain phenomena following the established physics theories, laws, and principles which can definitely be interpreted or solved using various mathematical equations, formulas, or engineering tools. In summary, the author's PPG

(average of 126 mg/dL) from the past 3.7 years and Y2021 (average of 116 mg/dL) are higher than the standard normal case (average PPG of 109 mg/dL), but lower than the standard pre-diabetes case (average PPG of 135 mg/dL). In other words, his recent diabetes situations are between the standard normal case (HbA1C <5.6%) and the standard pre-diabetes case (HbA1C 5.7% - 6.4%). This observed conclusion is also confirmed through his average lab-tested HbA1C levels of 6.56% over the past 3.7 years and 6.30% during Y2021. For the PPG associated energy, the author's energy level is between the range of 113% to 134% in comparison with the energy level for the standard normal case of 100% and the energy level for the standard pre-diabetes case of 152%. From the comparisons using HbA1C and PPG associated energy, his type 2 diabetes (T2D) condition has been downgraded from severe diabetes in Y2010 (PPG over 380 mg/dL and HbA1C at 10%) to the lower end for the standard pre-diabetes case in Y2021. Actually, his most recent lab-tested HbA1C was at 5.8% on 10/22/2021. It should be noted that he ceased to take any diabetes medications since 12/8/2015 and is dependent solely on a lifestyle management program.

Keywords: Continuous glucose monitoring; Postprandial plasma glucose; Glucose; Diabetes

Abbreviations: T2D: type 2 diabetes; FPG: fasting plasma glucose; PPG: postprandial plasma glucose; CGM: continuous glucose monitoring; MPM: math-physical medicine

1. INTRODUCTION

The author utilized a flash glucose monitoring (FGM) technique with 14-days of continuous glucose monitoring (CGM) sensor device to collect his glucose data (sensor glucoses) 96 times per day from 5/5/2018 to 1/16/2022. Next, he selects his collected postprandial plasma glucose (PPG) data over 3.7 years along with the data from Y2021 to compare against the published three standard PPG curves for normal people, pre-diabetes patients, and severe diabetes patients (Reference 2). He then calculates the PPG associated "relative energy" level utilizing the squared value of the average PPG as his estimated energy associated with PPG. In basic physics, the energy associated with a wave is proportional to the square of this wave's amplitude. The relative energies are generated by glucose itself which are carried by red blood cells circulating in the blood vessels throughout the body.

Human organs and glucoses have their biochemical reasonings and needed operations, but their biophysical behaviors also present certain phenomena following the established physics theories, laws, and principles which can definitely be interpreted or solved using various mathematical equations, formulas, or engineering tools.

2. METHODS

2.1 MPM background

To learn more about his developed GH-Method: math-physical medicine (MPM) methodology, readers can read the following three papers selected from the published 400+ medical papers.

The first paper, No. 386, describes his MPM methodology in a general conceptual format. The second paper, No. 387, outlines the history of his personalized diabetes research, various application tools, and the differences between biochemical medicine (BCM) approach versus the MPM approach. The third paper, No. 397, depicts a general flow diagram containing ~10 key MPM research methods and different tools.

All of the listed papers in the References section are from his written and published medical research papers.

2.2 The author's case of diabetes

The author has been a severe T2D patient since 1996. He weighed 220 lb. (100 kg, BMI 32.5) at that time. By 2010, he still weighed 198 lb. (BMI 29.2) with an average daily glucose of 250 mg/dL (HbA1C of 10%). During that year, his triglycerides reached to 1161 and albumin-creatinine ratio (ACR) at 116. He also suffered from five cardiac episodes within a decade. In 2010, three independent physicians warned him regarding his needs of kidney dialysis treatment and his future high risk of dying from his severe diabetic complications. Other than cerebrovascular disease (stroke), he has suffered most of known diabetic complications, including both macro-vascular and micro-vascular complications.

In 2010, he decided to launch his self-study on endocrinology, diabetes, and food nutrition in order to save his own life. During 2015 and 2016, he developed four prediction models related to diabetes conditions: weight, postprandial plasma glucose (PPG), fasting plasma glucose (FPG), and A1C. As a result, from using his developed mathematical metabolism index (MI) model in 2014 and the four prediction tools, by end of 2016, his weight was reduced from 220 lbs. (100 kg, BMI 32.5) to 176 lbs. (89 kg, BMI 26.0), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger glucose reading from 250 mg/dL to 120 mg/dL, and lab-tested A1C from 10% to ~6.5%. One of his major accomplishments is that he no longer takes any diabetes medications since 12/8/2015.

In 2017, he has achieved excellent results on all fronts, especially glucose control. However, during the pre-COVID period of 2018 and 2019, he traveled to approximately 50+ international cities to attend 65+ medical conferences and made ~120 oral presentations. This hectic schedule inflicted damage to his diabetes control, through dinnning out frequently, post-meal exercise disruption, jet lag, and along with the overall metabolism impact due to his irregular life patterns through a busy travel schedule; therefore, his glucose control and overall metabolism state were somewhat affected

during this two-year heavier traveling period.

During 2020-2021 with a COVID-19 quarantined lifestyle, not only has he published ~500 medical papers in 100+ journals, but he has also reached his best health conditions for the past 28 years. By Y2021, his weight was further reduced to 165 lbs. (BMI 24.4) along with a 5.8% A1C value on 10/22/2021, without having any medication interventions or insulin injections. These good results are due to his non-traveling, low-stress, and regular daily life routines. Of course, his knowledge of chronic diseases, practical lifestyle management experiences, and developed various high-tech tools contribute to his excellent health status since 1/19/2020, the beginning date of his COVID-19 quarantined life.

On 5/5/2018, he applied a continuous glucose monitoring (CGM) sensor device on his upper arm and checks his glucose measurements every 5 minutes for a total of ~288 times each day. He has maintained the same measurement pattern to present day. In his research work, he uses his CGM sensor glucose at time-interval of 15 minutes (96 data per day). By the way, the difference of average sensor glucoses between 5-minute intervals and 15-minute intervals is only 0.4% (average glucose of 114.81 mg/dL for 5-minutes and average glucose of 114.35 mg/dL for 15-minutes with a correlation of 93% between these two sensor glucose curves) during the period from 2/19/20 to 8/13/21.

Therefore, over the past 12 years, he could study and analyze the collected ~3 million data regarding his health status, medical conditions, and lifestyle details. He applies his knowledge, models, and tools from mathematics, physics, engineering, and computer science to conduct his medical research work. His medical research work is based on the aims of achieving both "high precision" with "quantitative proof" in the medical findings.

The following timetable provides a rough sketch of the emphasis of his medical research during each stage:

2000-2013: Self-study diabetes and food nutrition, developing a data collection and analysis software.

2014: Develop a mathematical model of metabolism, using engineering modeling and advanced mathematics.

2015: Weight & FPG prediction models, using neuroscience.

2016: PPG & HbA1C prediction models, using optical physics, artificial intelligence (AI), and neuroscience.

2017: Complications due to macro-vascular research, such as Cardiovascular disease (CVD), coronary heart diseases (CHD) and stroke, using pattern analysis and segmentation analysis.

2018: Complications due to micro-vascular research such as kidney (CKD), bladder, foot, and eye issues (DR).

2019: CGM big data analysis, using wave theory, energy theory, frequency domain analysis, quantum mechanics, and AI.

2020: Cancer, dementia, longevity, geriatrics, DR, hypothyroidism, diabetic foot, diabetic fungal infection, and linkage between metabolism and immunity, learning about certain infectious diseases, such as COVID-19.

2021: Applications of linear elastic glucose theory (LEGT) and perturbation theory from quantum mechanics on medical research subjects, such as chronic diseases and their complications, cancer, and dementia.

Again, to date, he has collected more than two million data regarding his medical conditions and lifestyle details. In addition, he has written 572 medical papers and published 500+ paper in 100+ various medical journals. Moreover, he has also given ~120 presentations at ~65 international medical conferences. He has continuously dedicated his time and efforts on his medical research work and shared his findings and learnings with other patients worldwide.

The following brief introductions are excerpt from Wikipedia:

"Time–frequency analysis:

In signal processing, time–frequency analysis comprises those techniques that study a signal in both the time and frequency

domains simultaneously, using various time–frequency representations. Rather than viewing a 1-dimensional signal (a function, real or complex-valued, whose domain is the real line) and some transform (another function whose domain is the real line, obtained from the original via some transform), time–frequency analysis studies a two-dimensional signal – a function whose domain is the two-dimensional real plane, obtained from the signal via a time–frequency transform.

The mathematical motivation for this study is that functions and their transform representation are tightly connected, and they can be understood better by studying them jointly, as a two-dimensional object, rather than separately.

The practical motivation for time–frequency analysis is that classical Fourier analysis assumes that signals are infinite in time or periodic, while many signals in practice are of short duration, and change substantially over their duration. For example, traditional musical instruments do not produce infinite duration sinusoids, but instead begin with an attack, then gradually decay. This is poorly represented by traditional methods, which motivates time–frequency analysis.”

3. RESULTS

Figure 1 shows the data table containing both input data of PPG and output data of calculated energy associated with PPG. It includes three standard cases and the author's two cases of both past 3.7 years and Y2021.

1/17/22	Glycemic Edge			Author's 3.7 yrs		Author-Y2021	
	Normal	Pre-Diabetes	Diabetes				
0-min	80	95	175	123	116		
15-min	87	111	224	125	117		
30-min	93	127	273	130	120		
45-min	100	143	321	134	122		
60-min	107	158	370	134	121		
75-min	113	174	375	131	119		
90-min	120	190	380	128	116		
105-min	120	172	385	125	114		
120-min	120	153	373	123	111		
135-min	120	135	362	122	110		
150-min	120	117	350	122	112		
165-min	120	98	340	123	114		
180-min	120	80	330	123	115		
Average	109	135	327	126	116		
	Normal	Pre-Diabetes	Diabetes	Author-3.7 yrs	Author-Y2021		
Sq. of Avg. PPG	11,931	18,173	107,251	15,966	13,426		
Sq. of Avg. PPG %	100%	152%	899%	134%	113%		

Figure 1: Data table of input data of PPG and output data of energy.

Figure 2 depicts the PPG waveforms of three standard cases of normal, pre-diabetes, and severe diabetes (Reference 2). For consistency

reason, the author has only chosen the first three hours data for comparison.

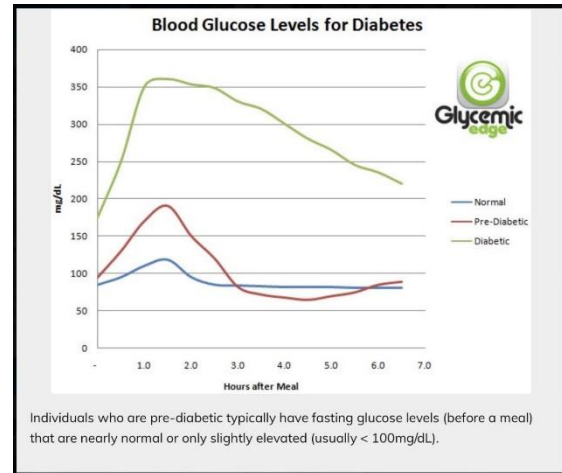


Figure 2: Three standard cases of normal, pre-diabetes, and severe diabetes.

Figure 3 shows those three standard PPG waveforms (upper diagram) and the author's two PPG waveforms in comparison with both standard normal and standard pre-diabetes cases (lower diagram).

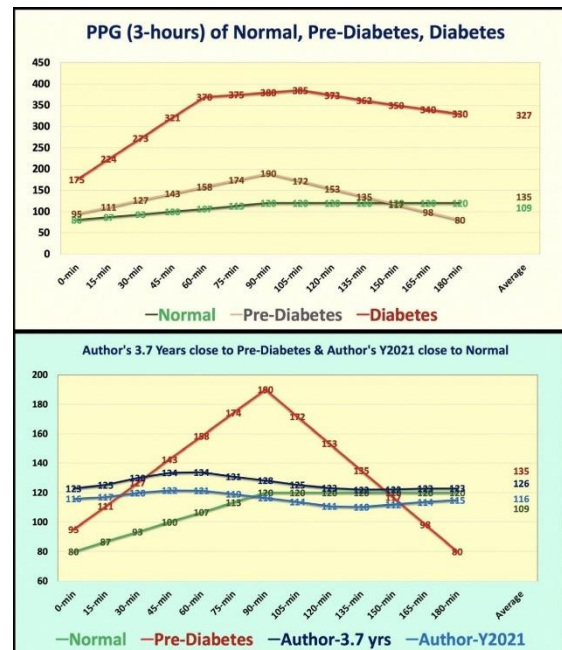


Figure 3: Three standard PPG waveforms (upper diagram) and the author's two PPG waveforms in comparison with both standard normal and standard pre-diabetes cases (lower diagram).

4. CONCLUSION

In summary, the author's PPG (average of 126 mg/dL) from the past 3.7 years and Y2021 (average of 116 mg/dL) are higher than the standard normal case (average PPG of 109 mg/dL), but lower than the standard pre-diabetes case (average PPG of 135

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It should be noted that he ceased to take any diabetes medications since 12/8/2015 and is

dependent solely on a lifestyle management program.

5. REFERENCES

For editing purposes, majority of the references in this paper, which are self-references, have been removed for this article. Only references from other authors' published sources remain. The bibliography of the author's original self-references can be viewed at www.eclaircmd.com.

Readers may use this article as long as the work is properly cited, and their use is educational and not for profit, and the author's original work is not altered.

(1) Guido Freckmann, Sven Hagenlocher, Cornelia Haug, Journal of diabetes science and technology, "Continuous Glucose Profiles in Healthy Subjects under everyday life conditions and after different meals".

(2) Glycemic Edge:
<https://www.glycemicedge.com>.