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Three Cases Using Lifestyle Medicine to Control Diabetes Conditions *via* GH-Method: Math-Physical Medicine (No. 347)

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Abstract

The author applies the diabetes research methodology and prior findings to examine the glucose control situations of 3 type 2 diabetes (T2D) patients from lifestyle viewpoints in 2020. The key methods involve the glucose data and their associated waveforms to check for curve shapes, changing patterns, and behavior interpretations. Glucose are the direct outcomes of lifestyle details, such as diet, exercise, and medication. Instead of delving into carbs/sugar intake amounts and the intensity and duration of walking exercise, he can quickly assess a patient's overall health by examining the lifestyle details hidden behind the glucose data and curves. It should be noted that the 3 T2D patients are not taking any diabetes medications; therefore, this case study excludes the medication's chemical effect.

The method described above is called "lifestyle medicine" in addition to the traditional internal medical practice of relying on medications.

Among the 3 patients, Case A has the worst diabetes conditions with a 25-year history. His stringent carbs/sugar intake amount control (12.3 g) and diligent post-meal walking exercise (4,300 steps) has brought down his sharp rising postprandial plasma glucose (PPG) peak very rapidly to a healthy state. Combined with his regular schedule and good quality of sleep along with his 9 lbs. weight reduction have directly contributed to his low average fasting plasma glucose (FPG) at 100 mg/dL in 2020. His average PPG is at 123 mg/dL; therefore, his average daily glucose is 116 mg/dL (< 120 mg/dL).

Case B has a moderate level of diabetes conditions with a 22-year history. Her diet is similar to Case A, except that she enjoys eating meat which affects her hypertension and hyperlipidemia conditions. The intensity and duration of her exercise are half of the amount of Case A (~2,000 steps and 30 min). However, her irregular sleep pattern of waking up around 4 am and then going back to sleep around 6 am not only raised her FPG to 103 mg/dL (in comparison with 100 mg/dL of Case A), but also pushed her post-breakfast PPG around 8:00 am to the highest peak in her daily glucose waveform. Nevertheless, Case B has the lowest daily average glucose at 111 mg/dL in the 3 cases.

Case C has the least of the diabetes conditions due to his 4-year history of T2D. However, he is an extremely obese patient with a body mass index (BMI) of 44 on 1/1/2020 and a BMI of 39 on 10/17/2020. He has a 34 lbs. weight loss and BMI 5 reduction in 2020, which assisted his glucose

control tremendously. His inactivity after eating breakfast has continuously pushed his glucose waveform to the peak of his daily glucose around 13:00 when he starts his post-lunch exercise. Case C has average daily glucose of 114 mg/dL which is located in the middle of the 3 cases.
Overall, the 3 T2D patients' sensor glucose is within the normal range of 120 mg/dL. However, many important facts of their lifestyle details can still be revealed by examination of the glucose data and waveforms. These are examples of "lifestyle medicine".
This article demonstrates that lifestyle details, including diet, exercise, and sleep directly change the numerical values of glucose data and influence the physical shapes of the glucose waveforms. Through these 3 clinical cases, the author's role is like a physician, except that he uses lifestyle details to perform his interpretation, diagnosis, problem solving, and treatment instead of prescribing drugs to control the symptoms. He does not use medications himself because he believes that lifestyle is 80% of the root cause for T2D. Medication only suppresses the external symptoms of the chronic diseases; consequently, it does not cure it internally within the body. He firmly believes that the body is a wonderful machine which can repair itself in many ways; however, it would not be able to cure everything. Of course, a stringent lifestyle management program requires vast knowledge, useful tools, strong willpower, and persistence that unfortunately many patients are lacking. It is the most effective way of controlling diabetes and, to some degree, even self-repairing certain parts of the body, for example the author's pancreatic beta cells.
He has named his approach as "lifestyle medicine" which should be included in the scope of internal medicine. That is why he spent the past decade and ~30,000 h to self-study and research chronic diseases and their complications. To date, he has written 347 articles or research notes over the past 10.25 years. Through presentations at medical conferences and publications in medical journals, he hopes to promote his math-physical medicine methodology, knowledge of lifestyle and metabolism, and discoveries from case studies to inspire other healthcare professionals and patients to join him in saving people's lives.

Keywords: lifestyle medicine, diabetes, glucose, weight loss, diet, exercise

Abbreviations: T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose; BMI: body mass index; MPM: math-physical medicine; HbA1C: hemoglobin A1C

Introduction

The author applies the diabetes research methodology and prior findings to examine the glucose control situations of 3 type 2 diabetes (T2D) patients from lifestyle viewpoints in 2020. The key methods involve the glucose data and their associated waveforms to check for curve shapes, changing patterns, and behavior interpretations. Glucose are the direct outcomes of lifestyle details, such as diet, exercise, and medication. Instead of delving into carbs/sugar intake amounts and the intensity and duration of walking exercise, he can quickly assess a patient's overall health by examining the lifestyle details hidden behind the glucose data and curves. It should be noted that the 3 T2D patients are not taking any diabetes medications; therefore, this case study excludes the medication's chemical effect.

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Methods

Background

To learn more about the author's developed GH-method: math-physical medicine (MPM) methodology, readers can refer to his article to understand this MPM analysis method [1].

Highlights of his related research

In his published medical papers, he has outlined the following key research findings:

- Fasting plasma glucose (FPG) and bodyweight have a high correlation (> 77% based on 7 years of data) between them. FPG has 5 influential components with weight contributing > 85% of FPG formation [2].
- Postprandial plasma glucose (PPG) has 19 influential components. Both carbs/sugar intake amount and post-meal walking exercise contributes ~40% of PPG formation, individually [3].
- He has identified that FPG could serve as a good indicator for pancreatic beta cells' health status in a diabetes patient [4].
- He proved that his pancreatic beta cells have been self-repairing at an annual rate of 2.7% [5].
- Sensor glucose are ~14%–18% higher than finger glucose.

Three T2D patients' information

Case A is the author himself. He is a 73-year-old male with a 25-year history of T2D. His average glucose was 280 mg/dL and hemoglobin A1C (HbA1C) 10% in 2010. He started his stringent lifestyle management program in 2014 and stopped taking his diabetes medication on 12/8/2015.

Case B is a 72-year-old female with a 22-year history of T2D. Her average glucose was 183 mg/dL and HbA1C 8% in 2010. She has followed the author's lifestyle management program since 2019 and stopped taking her diabetes medication on 1/1/2019.

Case C is a 47-year-old male with a 4-year history of T2D. His average glucose was 150 mg/dL and HbA1C 6.9% in 2017. He did not follow the author's lifestyle management program. His body mass index (BMI) was 44 in early 2020 and since 4/1/2020, he started a weight reduction program and has lost 34 lbs. He has never taken any diabetes medication.

Data in this case study

All 3 patients are using a continuous glucose monitoring (CGM) device to collect their glucose at 15 min time interval (sensor glucose). Therefore, each patient would collect 96 glucose data each day which are stored on a cloud server to be processed *via* iPhone. For data consistency concern, all the patients' glucose is sensor glucose data. The starting date for Cases A and B is 1/1/2020 and for Case C is 4/1/2020. The ending date of glucose data for this study is 10/17/2020.

Results

The figure (Figure 1) shows the collected raw data of weight, daily average glucose, FPG, PPG, and their calculated weigh change, PPG rising and dropping speed, which is mg/dL per 10 min.

The first key observation is that the weight reductions are 9 lbs. (5%), 7 lbs. (4%), and 34 lbs. (12%), for the 3 cases, respectively. Weight reduction directly helps their FPG reduction and indirectly helps their PPG reduction during this research period. The second key observation is that the daily average glucose is 116 mg/dL, 111 mg/dL, 114 mg/dL, for the 3 cases, respectively. This indicates that they have glucose within the normal range (< 120 mg/dL) from a diabetes standpoint. The third key observation is that their PPG rising speed/dropping speed (mg/dL per each 10 min) are 2.0/1.1, 0.6/0.6, and 0.3/0.3, for the 3 cases, respectively. Case A's highest PPG rising speed of 2.0 means his T2D conditions is the worst; his highest dropping speed of 1.1 means he has been diligently doing his post-meal walking exercise. This can be confirmed in figure 5, reflecting his average carbs/sugar intake amount of 12.44 g and his post-meal walking of 4,296 steps (1.8 miles or 2.9 km).

Lifestyle Medicine Cases	4/1-10/17/2020	1/1-10/17/2021	4/1-10/17/2022
T2D history	25 years	22 years	4 years
Data of Weight & Glucose	Case A	Case B	Case C
Weight (Average)	171	155	295
Weight (Reduction)	9	7	34
Weight reduction %	5%	4%	12%
Daily Glucose (Sensor)	116	111	114
FPG (Sensor)	100	103	99
PPG (Sensor)	123	117	108
Sensor PPG (Start, 0-min)	122	118	107
Sensor PPG (Max, 45/45/60 min)	131	121	109
Sensor PPG (Min, 150/180/150min)	119	113	107
PPG rising speed (every 10 min)	2.0	0.6	0.3
PPG dropping speed (every 10 min)	1.1	0.6	0.3
T2D conditions comparison	Worst	Medium	Lightest

Figure 1: Background data table and calculations of weight change and PPG speeds.

After examining the numerical data, he will then focus on checking the PPG waveforms (curves) which can disclose more hidden truth for each patient's lifestyle details.

The figure (Figure 2) depicts the synthesized or the assembly of glucose data together, FPG curve within 7 h, from 00:00 through 07:00 with 15 min time intervals, of the 3 cases, respectively.

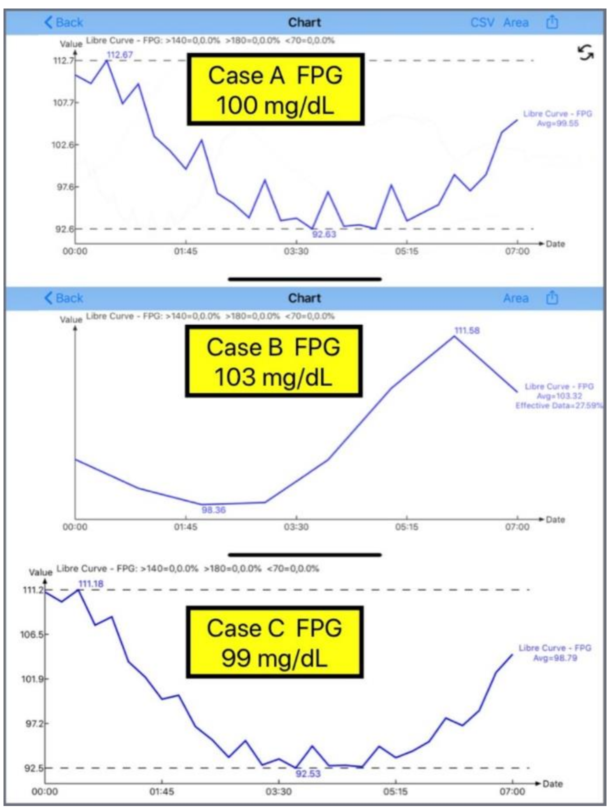

Figure 2: Synthesized FPG waveforms of 3 cases (7 h).

Case A's FPG waveform is almost identical to Case C's FPG waveform. Not only are their curve shape similar to a "salad bowl" with the highest value, 113 mg/dL for Case A and 111 mg/dL for Case C, on the rim of the bowl at 00:00; and with the lowest value of 93 mg/dL for both, at the bottom of the bowl around 03:00. However, Case B is a different story. Her peak FPG of 112 mg/dL occurs around 06:00 instead of 00:00. The author discovered that she usually wakes up around 04:00 with her FPG 102 mg/dL, and then go back to sleep again around 06:00, where her FPG raised to 112 mg/dL. During this 2 h period, her FPG increased by approximately 10 mg/dL. The author's previous neuroscience research based on his 2.5 years of data also disclosed that between his wake-up moment and the first bite of breakfast, his FPG would increase by around 10 mg/dL [6, 7]. Therefore, Case B's unique FPG waveform is a result of a disturbance in her sleep pattern.

The figure (Figure 3) illustrates the synthesized PPG curve within 3 h or 180 min, with 15 min time intervals, of 3 cases, respectively. 3 PPG waveforms are similar in pattern with peak PPG values occurring around 45–60 min after the first bite of meals, except their peak PPG values are 131 mg/dL, 121 mg/dL, and 109 mg/dL, respectively. Their average PPG values are 123 mg/dL, 117 mg/dL, and 108 mg/dL, respectively. These differences in peak PPG and average PPG also reflect the severity of T2D in each patient: Case A being the worst, Case B in the middle, and Case C as the best. The 3 PPG waves are trending down at around 150–180 min. Actually, at the 120 min time instant, all 3 PPG values are extremely low, at least lower than the PPG at 0 min at the moment of the first bite. This observed phenomenon proves that the long-standing advice from healthcare professionals to diabetes patients of measuring their finger-piercing PPG at 2 h post-meal is inaccurate and useless. To match the author's statement in data observation from the table in figure 1, the PPG waveforms indicate the same findings. The "cliff" shape with a sharp rise to the higher peak value and then a sharp drop in Case A have confirmed the severity of his diabetes (sensitivity of carbs/sugar) and the effectiveness of his stringent post-meal exercise. However, the "not-so-sharp lump" shapes of the PPG waveforms in Cases B and C reveal that they have room for improvement in their post-meal exercise.

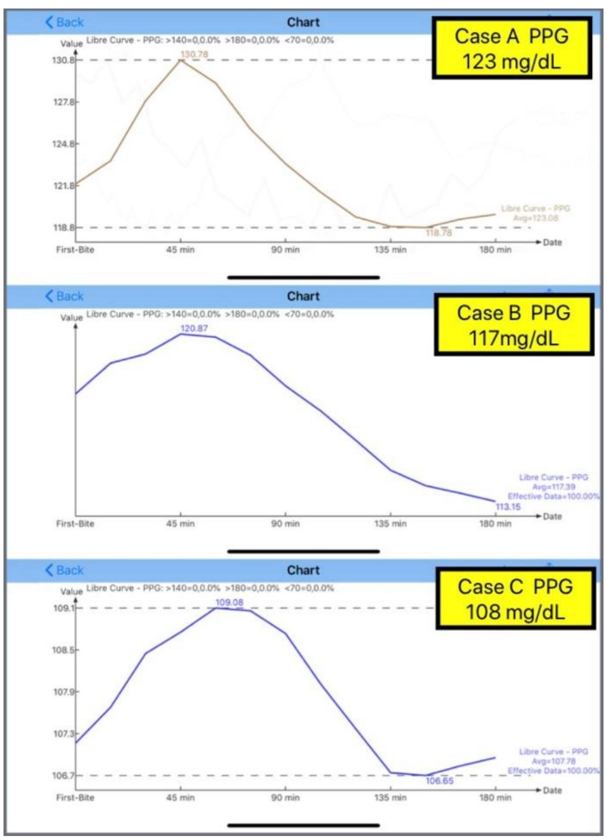

Figure 3: Synthesized PPG waveforms of 3 cases (7 h).

The synthesized daily glucose curve within 24 h with 15 min time interval, of the 3 cases, respectively, is shown in the figure (Figure 4). At first glance, the 3 waveforms have similar shapes, except for Case B's peak occurring daily around post-breakfast time, whereas Cases A and C occur around post-lunch time. As mentioned earlier, Case B's sleep pattern disturbance in the early morning from 04:00–06:00, combined with her carbs/sugar intake during breakfast at 07:00 pushes her glucose trend to the highest point, around 08:00.

For Case A, his heaviest meal is lunch, followed by breakfast, and then dinner as the lightest for weight control; therefore, his daily peak glucose occurs around 13:00, 1 h after lunch. Due to smaller portions for breakfast and dinner, his 2 PPG peaks for breakfast and dinner are not as severe as the post-lunch peak.

The 3 meal portion sizes for Case B are similar, and her post-meal walking is about 2,000 steps (0.8 miles or 1.3 km). Therefore, her waveforms for lunch and dinner are quite similar.

When observing the curve for Case C, the author can tell that he eats his breakfast around 08:00; therefore, his breakfast peak occurs at 09:00 and does not walk or exercise at all after his meal. That is why his glucose wave continues to trend upward (despite a small dip between 09:00 and 10:00) to reach the lunch peak at 13:00. The sharp decline after 13:00 is resulting from his physical activities, probably some sort of exercise, until the wave reaches the valley between 15:00–18:00. His weight reduction program limits him to a light dinner, usually just a small salad. That is why there is no sharp rise after 18:00. In addition, he exercises again to bring his wave to a downward trend until sleep time.

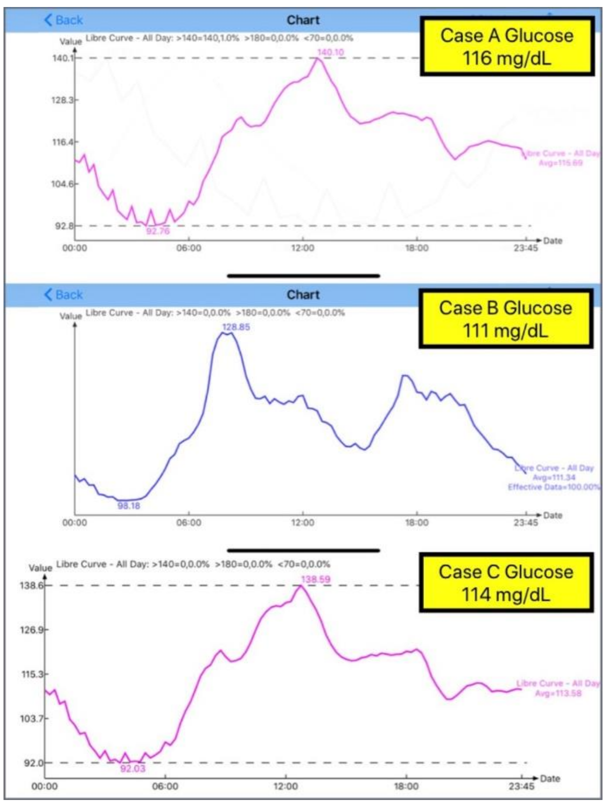

Figure 4: Synthesized daily glucose waveforms of 3 cases (24 h).

Despite of their individual daily peak glucose values of 140 mg/dL (lunch), 129 mg/dL (breakfast), 139 mg/dL (lunch), respectively, the 3 patients average daily glucose values are 116 mg/dL, 111 mg/dL, 114 mg/dL, respectively. Therefore, their T2D severity ranking is Case A being the worst, Case C in the middle, and Case B is the best. It is important that the 3 T2D patients have done well on controlling their glucose without any medication intervention. However, by examining their lifestyles with a magnifying glass, the author can still identify room of improvement for each individual.

From the above explanations, many lifestyle details can be seen and identified in the glucose data and waveforms. The body does not lie. Energy enters the body through food, and one must consume energy *via* exercise and activities; otherwise, the excessive unburned energy stored in the body will lead to obesity, diabetes, and other chronic diseases.

In the figure (Figure 5), it displays Case A's PPG waveforms, carbs/sugar intake amount, along with post-meal walking steps for breakfast, lunch, and dinner. Unfortunately, Cases B and C do not keep their detailed records of diet and exercise like Case A. As mentioned earlier, similar observations and interpretations can be applied to this diagram, for example, the author stated medium breakfast, heavy lunch, and light dinner from carbs/sugar intake amount of 8.7 g, 18.9 g, and 13.8 g, respectively. His post-meal walking steps are 4,401, 3,844, and 4,895, respectively. The least amount of walking steps for post-lunch exercise is due to the hot weather temperature around noon time from the months of May through September. These 5 months of scorching temperature, consisting of 50% of the total period, have directly lowered his willingness to walk outside in the heat.

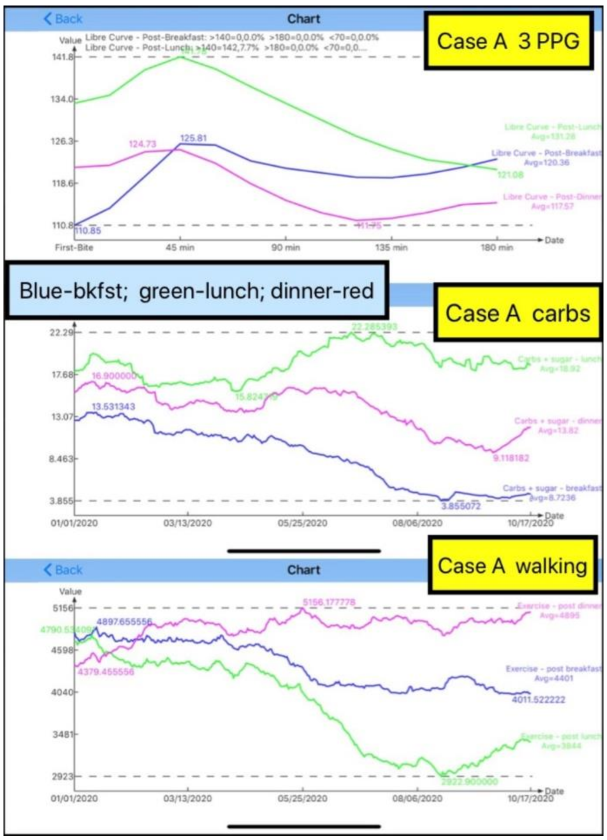

Figure 5: Case A's 3 meals PPG waveforms and carbs/sugar intake and post-meal walking steps.

Summary

Among the 3 patients, Case A has the worst diabetes conditions with a 25-year history. His stringent carbs/sugar intake amount control (12.3 g) and diligent post-meal walking exercise (4,300 steps) have brought down his sharp rising PPG peak very rapidly to a healthy state. Combined with his regular schedule and good quality of sleep along with his 9 lbs. weight reduction have directly contributed to his low average FPG at 100 mg/dL in 2020. His average PPG is at 123 mg/dL; therefore, his average daily glucose is 116 mg/dL (< 120 mg/dL).

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Conclusion

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References

1. Hsu GC. Biomedical research methodology based on GH-Method: Math-Physical Medicine (No. 310). J App Mat Sci & Engg Res. 2020;4(3):116-124.

2. Hsu GC. Application of linear equations to predict sensor and finger based postprandial plasma glucoses and daily glucoses for pre-virus, virus, and total periods using GH-Method: Math-Physical Medicine. eclaireMD Foundation. 2020:345.

3. Hsu GC. A simplified yet accurate linear equation of PPG prediction model for type 2 diabetes patients (GH-Method: Math-Physical Medicine). J Manag Weight D. 2020;2020(1):09-11.

4. Hsu GC. Application of linear equation-based PPG prediction model for four T2D clinic cases using GH-Method: Math-Physical Medicine. eclaireMD Foundation. 2019:99.

5. Hsu GC. Self-recovery of pancreatic beta cell's insulin secretion based on 10+ years annualized data of food, exercise, weight, and glucose using GHMethod: Math-Physical Medicine (No. 339). Internal Med Res Open J. 2020;5(4):1-7.

6. Hsu GC. A neural communication model between brain and internal organs, specifically stomach, liver, and pancreatic beta cells based on PPG waveforms of 131 liquid egg meals and 124 solid egg meals). eclaireMD Foundation. 2020:340.

7. Hsu GC. A neurocommunication model between the brain and liver regarding glucose production and secretion in early morning using GH-Method: Math-Physical Medicine. Acta Scientific Nutritional Health. 2020;4(11):41-45.