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Research Article

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A Clinical Case Study for Weight, Glucose, and Glucose Fluctuations Using 138 Days of Sixteen-Hour Intermittent Fasting Data Based on GH-Method: Math-Physical Medicine (No. 452)

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Abstract

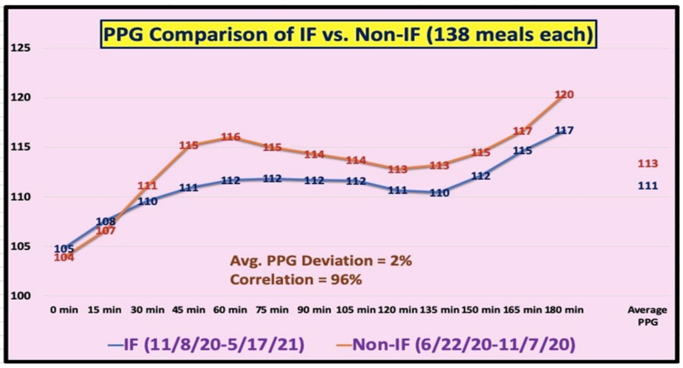
*The author uses a continuous glucose monitoring sensor (CGMS) device to collect 96 sensor glucose values per day since 5/5/2018. He selects two distinctive time periods with 138 meals each. The first period, from 11/8/2020 to 5/17/2021, consists of 138 tea only meals (0.02 grams of carbohydrates each), where it combined with 16-hours of fasting, from 20:00 previous day through 12:00 next day. He names it "**the intermittent fasting (IF) period**". The second period, from 6/22/2020 to 11/7/2020, comprises of 138 light breakfasts which contains egg, coffee, and an occasional half-toast (average at 4.5 grams of sugar and carbohydrates amount each, also known as "low-carbs" meals). He names it "**the Non-IF period**".*

This particular investigation has three objectives. First, the author compares the postprandial plasma glucose (PPG) results between two distinct periods to study the IF impact on glucose, particularly PPG. Second, he also isolates and compares his body weight during the corresponding days to study the IF impact on weight. Third, he assesses his daily glucose fluctuation (GF) situations, including both daily GF and PPG GF from these two periods.

The human organs and glucoses have their biochemical functions and needed interactions, but they also present certain external biophysical phenomena which follow the basic theories and principles of physics which can definitely be interpreted or solved using various mathematical equations or tools.

In summary, there are four key conclusions drawn from this investigation:

1. The overall observations include ***the differences of both weight and glucose between two periods are insignificant.*** The IF period weight is 4 pound less and a lower breakfast PPG of 2 mg/dL than the non-IF period.
2. ***The GF of both daily glucose and breakfast PPG in the IF period*** are actually slightly higher than the non-IF period. The daily GF value in the IF period is 6 mg/dL higher than the non-IF period which indicates the breakfast PPG wave only occupies 1/8 of the entire daily glucose wave. However, the breakfast PPG GF value in the IF period is 4 mg/dL higher compared to the non-IF period puzzles the author. This finding does not match with his intuitive feeling. Usually, a fasting PPG wave should be calmer than a non-IF PPG wave; therefore, it should produce a lower GF value in the PPG wave.
3. The synthesized breakfast PPG waveform in the IF period is highly similar to its counterpart PPG waveform in the non-IF period (96% correlation). However, the IF period has a lower average PPG value (by 2 mg/dL) and a decreased peak PPG value (by 4 mg/dL) than the non-IF period.
4. ***The key conclusions drawn from this particular study is that the IF does not seem to have a significant impact on both body weight and glucose. Furthermore, the GF on its own merit does not receive any benefit from IF.***



Introduction

The author uses a continuous glucose monitoring sensor (CGMS) device to collect 96 sensor glucose values per day since 5/5/2018. He selects two distinctive time periods with 138 meals each. The first period, from 11/8/2020 to 5/17/2021, consists of 138 tea only meals (0.02 grams of carbohydrates each), where it combined with 16-hours of fasting, from 20:00 previous day through 12:00 next day. He names it "the intermittent fasting (IF) period". The second period, from 6/22/2020 to 11/7/2020, comprises of 138 light breakfasts which contains egg, coffee, and an occasional half-toast (average at 4.5 grams of sugar and carbohydrates amount each, also known as "low-carbs" meals). He names it "the Non-IF period".

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Methods and Results

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 (Reference 1) describes his MPM methodology in a general conceptual format. The second paper, No. 387 (Reference 2) 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 (Reference 3) depicts a general flow diagram containing ~10 key MPM research methods and different tools.

The Author'S Case of Diabetes

The author has been a severe type 2 diabetes 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.

In 2010, he decided to self-study endocrinology, diabetes, and food nutrition. During 2015 and 2016, he developed four prediction models related to diabetes conditions, i.e., weight, PPG, fasting plasma glucose (FPG), and HbA1C (A1C). As a result, from using his developed mathematical metabolism index (MI) model and those 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), waistline from 44 inches (112 cm) to 33 inches (84 cm), averaged finger glucose from 250 mg/dL to 120 mg/dL, and HbA1C 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 had 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 dinning 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 was affected during this two-year period.

By year end of 2020, his weight was further reduced to 165 lbs. (BMI 24.4) and his HbA1C was at 6.2% without any medication's intervention or insulin injection. Actually, during 2020 with the special COVID-19 quarantined lifestyle, not only has he published approximately 400 medical papers in journals, but he has also achieved his best health conditions for the past 26 years. 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 his developed various high-tech tools contribute to his excellent health status since 1/19/2020.

On 5/5/2018, he applied a 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 this study, he uses his CGM sensor glucose at time-interval of 15 minutes (96 data per day).

Therefore, during the past 11 years, he could study and analyze his collected 2 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 his medical findings.

Intermittent Fasting

The following section covers the health effects of IF with an excerpt from References 35 and 36:

"Intermittent fasting (IF) refers to fasts lasting from 12 to 48 hours that are repeated every 1 to 7 days, whereas periodic fasting (PF) lasts between 2 and 7 days and is repeated at least once per month.

Furthermore, there are two types of PF. The first is water-only and the second is a fast-mimicking diet (FMD), which refers to consuming only a plant-based, calorie-restricted diet that consists of low proteins, low sugars, and high unsaturated fats.

According to an article published in Nature Aging, IF and PF/FMD trigger pathways that activate alternative metabolic modes that focus on"conserving energy and on protecting the organism while enduring extended periods of food deprivation to optimize survival and reproduction once food becomes available." Intriguingly, the refeeding period plays an equally important part in regeneration, as well as rejuvenation of organs, cells, and organelles.

"In humans, the alternation of fasting and refeeding periods is accompanied by positive effects on risk factors for aging, diabetes, autoimmunity, cardiovascular disease, neurodegeneration and cancer," the authors wrote. "But not all fasting interven-

tions are equal, and some are associated with smaller beneficial effects as well as side effects, including, in some cases, reduced longevity.

Health Effects of Intermittent Fasting

The Nature Aging authors cited studies that showed IF resulted in weight loss, as well as positive effects on metabolic markers and decreased insulin resistance. IF was correlated with decreased levels of low-density lipoprotein (LDL); the metabolic regulator triiodothyronine; and soluble intracellular adhesion molecule-1 (sICAM-1), an age-associated inflammatory marker.

Other studies demonstrated that IF led to a reduction in weight gain, better sleep, decreased deterioration in cardiac performance caused by age and diet, decreased oxidative stress, and better blood pressure levels. Along the same lines, in a review published in Clinical Diabetes and Endocrinology, the authors found evidence that IF helps improve diabetes and decreases body weight; lowers fasting glucose, fasting insulin, levels of leptin, insulin resistance; and increases adiponectin levels. Because IF is effective at attenuating the harms of type 2 diabetes, it makes sense that it could be a useful dietary intervention. ***Although the authors recommend this therapy, they urge caution."***

Unfortunately, the findings from this particular single case with limited patient data do not completely conform with the conclusions in References 35 and 36. The resulted analysis data in this article shows some insignificant and lower impacts from IF on his body weight or glucoses.

Graphic Results

Figure 1 shows the data and graphs associated with the ***IF period.*** During this period, the carbohydrates intake amount is only 0.02-gram, post-breakfast walking is 3,881 steps, his finger-pierced PPG is 106 mg/dL (see right diagram). In the left diagram, his weight trends upward from 166 lbs. to 169 lbs. with an average weight of 168 lbs., his average daily glucose is 115 mg/dL, and his PPG is 119 mg/dL. As a result, all of his weight, daily glucose, and breakfast PPG curves have similar shapes with high correlation coefficients. The GF from the k-line diagram reflects 26 mg/dL (by Max. 126 - Min. 100).

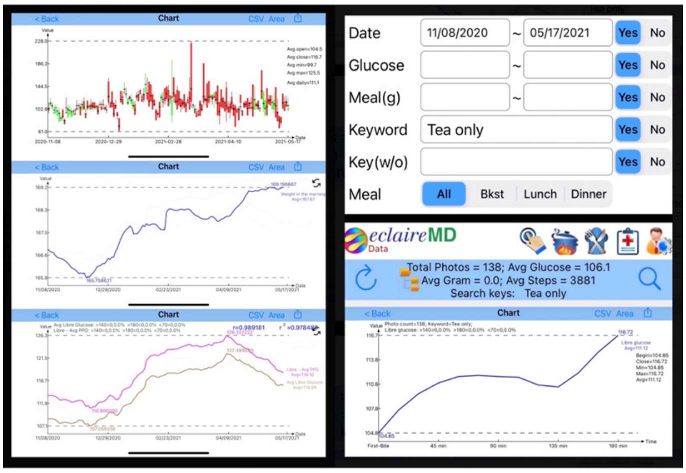

Figure 1: 138 meals data and various graphic diagrams of the IF period (11/8/2020 - 5/17/2021)

Figure 2 depicts the data and graphs associated with the ***non-IF period.*** During this period, the average carbs intake amount is 4.5 grams, average post-breakfast walking is 4,093 steps, and his finger-pierced PPG is 107 mg/dL (see right diagram). The ***non-IF period's finger PPG is only 1 mg/dL higher than the IF period due to its low-carbs breakfasts.*** In the left diagram, his weight decreases from 173 lbs. to 167 lbs. with an average weight of 170 lbs., his average daily glucose is 113 mg/dL, and his PPG is 120 mg/dL. As a result, all of his weight, daily glucose, and breakfast PPG curves also have similar shapes with high correlation coefficients. The GF from the k-line diagram illustrates 28 mg/dL (by Max. 129 - Min. 102).

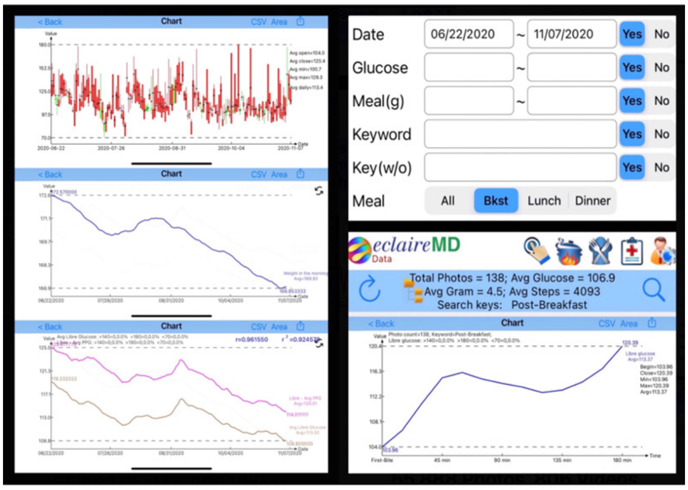

Figure 2: 138 breakfasts data and various graphic diagrams of the Non-IF period (6/22/2020 - 11/7/2020)

Figure 3 reveals the comparison between IF and non-IF periods of synthesized breakfast PPG waveforms, body weight, and breakfast PPG.

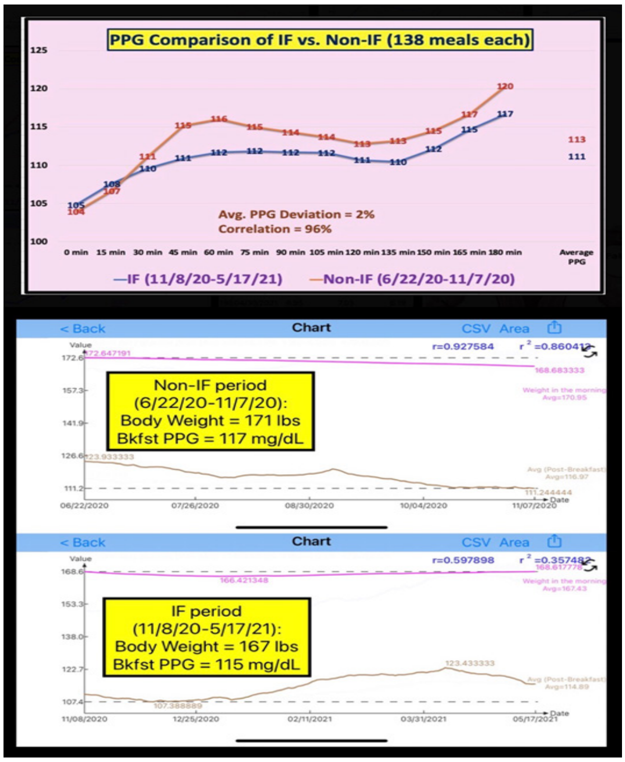

Figure 3: 3-hours PPG waveform comparison between IF and Non-IF periods (138 meals each) and insignificant influence on both body Weight and daily PPG

Figure 4 compares the IF and non-IF periods of synthesized breakfast PPG waveforms, daily glucose GF, and breakfast PPG GF.

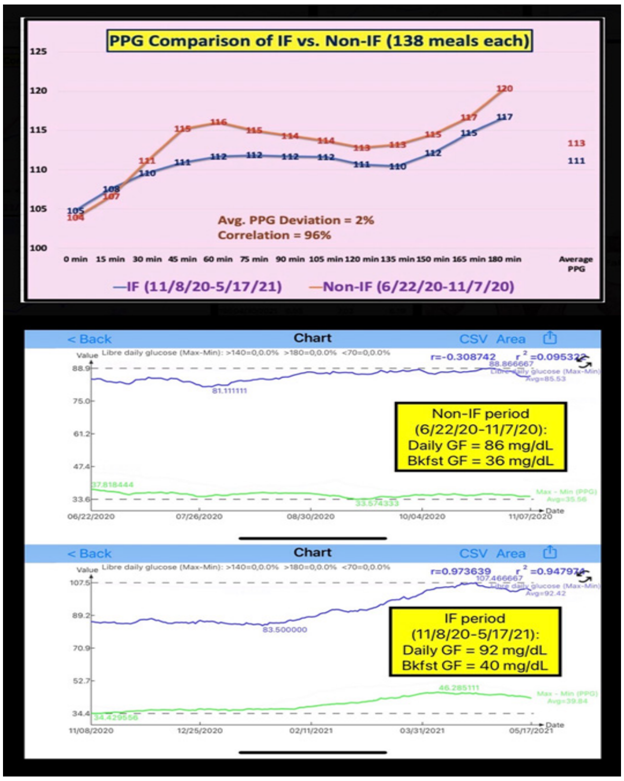

Figure 4: 3-hours PPG waveform comparison between IF and Non-IF periods (138 meals each) and insignificant influence on GF (daily glucose and breakfast PPG)

The following table summarizes the insignificant (i.e., minor) differences of various variables between these two periods in the format of IF data and non-IF data:

Carbs/sugar: (0.02, 4.5)
Post-meal walking: (3881, 4093)
Finger breakfast PPG: (106, 107)
Weight: (168, 170)
Breakfast PPG (115, 117)
Daily Glucose: (115, 113)
Daily PPG: (119, 120)
K-Line GF: (26, 28)
IF slightly lower than non-IF

Daily GF: (92, 86)
Breakfast PPG GF: (40, 36)
IF slightly higher than non-IF

Figure 5 demonstrates the correlation between body weight and meal quantity for one-year period and three-year period. Both periods have high correlation coefficients of 56% and 57% between weight and meal quantity. ***Therefore, the key element of weight reduction is the consumed food quantity.*** For the last 5 years, his breakfast has been the "lightest" meal with a "low-carbs diet" for all three meals. This explains why his weight reduction due to IF efforts is insignificant. ***Once again, the conclusion is that the total quantity of consumed food and meal controls body weight.***

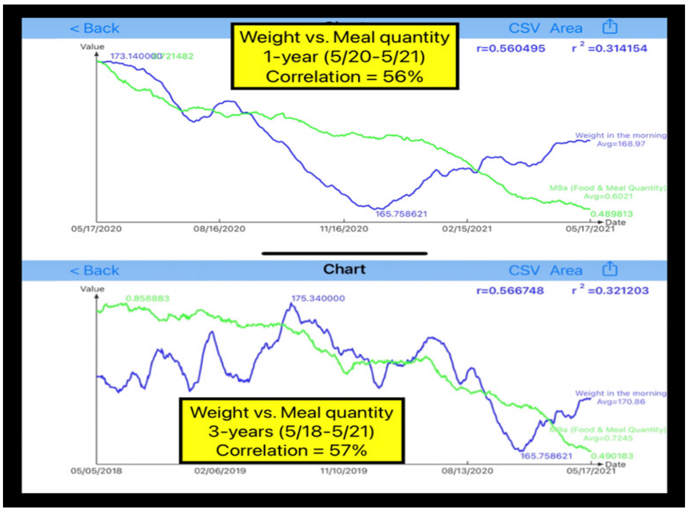

Figure 5: High Correlations of Weight vs. Meal Quantity for both one-year and three-year periods

Conclusions

The human organs and glucoses have their biochemical functions and needed interactions, but they also present certain external biophysical phenomena which follow the basic theories and principles of physics which can definitely be interpreted or solved using various mathematical equations or tools.

In summary, there are four key conclusions drawn from this investigation:

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