

The GH-Method

Viscoelastic Medicine theory (VMT #287): Pathophysiological Explanations of Intermittent Fasting (IF) and Non-Intermittent Fasting (non-IF) versus Body Weight (BW), Postprandial Plasma Glucose (PPG) and Fasting Plasma Glucose (FPG) During a Period of 12 Quarters from Q4Y20 to W3Y23, and a Quantitative SD-VMT Energy Analysis of GH-Method: Math-Physical Medicine (No. 887)

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Abstract

The author began practicing intermittent fasting (IF) on 11/1/2020, following a fasting period of 16 hours each day with only water or tea consumed. From 11/1/2020 to 7/15/2023, he practiced IF for 693 meals and non-IF for 2,125 meals, totaling 2,818 meals over 2.57 years. Throughout this period, he collected personal daily data on body weight (BW), postprandial plasma glucose (PPG), and fasting plasma glucose (FPG). Recently, the author expanded his research focus to include traditional pathology and physiology perspectives on various metabolic syndromes and lifestyles in addition to his usual math-physical medicine research approach. Drawing on 2.57 years of his collected personal data from 693 IF meals and 2,125 non-IF meals, the author analyzes the impact of three key metabolic conditions - BW, PPG, and FPG - on his calculated overall Metabolism Index (MI) values. He initially explores qualitative explanations of these biomarkers through the lens of pathology and physiology in traditional biomedicine training. After reading certain selected medical papers, he received a strong impression that there are direct connections between IF and the reduction of both

body weight and glucose levels. However, after using his math-physical quantitative research method to analyze these collected personal data, the author discovered some interesting findings, particularly regarding the non-existence of expected impact of IF on his body weight reduction. In summary, the three key findings are as follows: 1. Using averaged values from TD data, the reduction percentages between non-IF and IF are as follows: BW=0%, FPG=1%, finger PPG=2%, sensor PPG=6%, and the peak sensor PPG difference at 60-minutes is 11 mg/dL. 2. Results from the SD-VMT energy model demonstrate that almost identical energy distribution rates existed among BW, FPG, and PPG (about 1/3 for each influential factor). An interesting finding is that the energy in IF for FPG is almost equivalent to the energy in non-IF for PPG. 3. Time-zone analysis in SD reveals that a higher energy distribution during Y20-Y21 existed in comparison with Y22-Y23 for both IF and non-IF cases. The most noteworthy finding from this research is the clear evidence supporting the beneficial effects of IF practice on glucose reduction. However, there is no quantitative evidence supporting the beneficial effects of IF practice on body weight reduction.

Keywords: Viscoelastic; Viscoplastic; Intermittent fasting; Body weight; Glucose; Diabetes

Abbreviations: IF: intermittent fasting; non-IF: non-intermittent fasting; BW: body weight; BMI: body mass index; IR: insulin resistance; MI: metabolism index; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose

1. INTRODUCTION

The author began practicing intermittent fasting (IF) on 11/1/2020, following a fasting period of 16 hours each day with only water or tea consumed. From 11/1/2020 to 7/15/2023, he practiced IF for 693 meals and non-IF for 2,125 meals, totaling 2,818 meals over 2.57 years. Throughout this period, he collected personal daily data on body weight (BW), postprandial plasma glucose (PPG), and fasting plasma glucose (FPG).

Recently, the author expanded his research focus to include traditional pathology and physiology perspectives on various metabolic syndromes and lifestyles in addition to his usual math-physical medicine research approach.

Drawing on 2.57 years of his collected personal data from 693 IF meals and 2,125 non-IF meals, the author analyzes the impact of three key metabolic conditions - BW, PPG, and FPG - on his calculated overall Metabolism Index (MI) values.

He initially explores qualitative explanations of these biomarkers through the lens of pathology and physiology in traditional biomedicine training. After reading certain selected medical papers, he received a strong impression that there are direct connections between IF and the reduction of both body weight and glucose levels. However, after using his math-physical quantitative research method to analyze these collected personal data, the author discovered some interesting findings, particularly regarding the non-existence of expected impact of IF on his body weight reduction.

1.1 Pathophysiological interpretation

IF and reduction of body weight:

Intermittent fasting is an eating pattern that involves fasting for a specific period of time followed by a period of eating within a designated window. There are several pathophysiological explanations for how intermittent fasting may contribute to body weight reduction:

1. Caloric restriction: Intermittent fasting often involves reducing calorie intake by

limiting the eating window. This leads to a reduced overall caloric intake, which can create an energy deficit and contribute to body weight loss.

2. Increased fat oxidation: During fasting periods, the body depletes its glycogen stores and starts relying more on stored fat for energy. This increased fat oxidation can lead to a reduction in body fat and subsequent body weight loss.

3. Improved insulin sensitivity: Intermittent fasting has been shown to improve insulin sensitivity. This means that cells are better able to respond to insulin and effectively utilize glucose. Improved insulin sensitivity can help regulate blood sugar levels and prevent excessive insulin release, which is associated with fat storage.

4. Enhanced hormonal balance: Intermittent fasting has been found to influence the secretion of various hormones involved in metabolism. For example, it can increase levels of human growth hormone (HGH), which promotes fat burning and muscle preservation. It may also impact levels of adiponectin, a hormone that plays a role in regulating glucose and fatty acid metabolism.

5. Reduced inflammation: Chronic inflammation is associated with obesity and metabolic disorders. Intermittent fasting has been found to reduce inflammation markers in the body, which may contribute to body weight loss and improved metabolic health.

It is important to note that individual responses to intermittent fasting may vary. Other factors such as overall diet quality, physical activity, and individual metabolic differences also play a role in body weight reduction. Therefore, consulting with a healthcare professional or registered dietitian is recommended before starting any fasting regimen.

IF and reduction of PPG:

Intermittent fasting has been shown to have various pathophysiological effects that can contribute to the reduction of postprandial plasma glucose levels:

1. Improved insulin sensitivity: Intermittent fasting has been found to enhance insulin

sensitivity. This means that cells become more responsive to insulin, allowing for better uptake and utilization of glucose. Improved insulin sensitivity leads to more efficient regulation of blood sugar levels and reduces the likelihood of postprandial hyperglycemia.

2. Enhanced glucose transport: Intermittent fasting increases the expression and activity of glucose transporters, such as GLUT4, in skeletal muscle and adipose tissue. This facilitates the transport of glucose from the bloodstream into muscle and fat cells, reducing blood glucose levels after a meal.

3. Increased glycogen storage capacity: Intermittent fasting has been shown to enhance the storage capacity for glycogen, the body's primary energy reserve in the liver and skeletal muscles. This increased glycogen storage helps regulate blood sugar levels by rapidly absorbing and storing glucose from the bloodstream after a meal.

4. Regulation of hormonal balance: Intermittent fasting can modulate hormone release, leading to better glucose control. For example, it may decrease the release of glucagon, a hormone that opposes the actions of insulin and increases blood glucose levels. It can also regulate the release of incretins, such as glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP), which enhance insulin secretion and inhibit glucagon release.

5. Reduced liver gluconeogenesis: Intermittent fasting can suppress the production of glucose by the liver, a process known as gluconeogenesis. By limiting the availability of dietary glucose during fasting periods, the body relies more on stored glycogen and fat as energy sources, leading to a decrease in liver glucose production and postprandial hyperglycemia.

These physiological mechanisms collectively contribute to the reduction of postprandial plasma glucose levels during intermittent fasting. However, it's important to note that individual responses may vary.

IF and reduction of FPG in the early morning:

Intermittent fasting has been shown to have various pathophysiological effects that can

contribute to the reduction of fasting plasma glucose in the early morning:

1. Enhanced insulin sensitivity: Intermittent fasting improves insulin sensitivity, which means this enhances the uptake and utilization of glucose, leading to a reduction in fasting plasma glucose levels.

2. Reduced liver gluconeogenesis: Intermittent fasting can suppress the production of glucose by the liver, particularly during fasting periods. By limiting the availability of dietary glucose, the body relies more on stored glycogen and fat as energy sources, resulting in a decrease in liver glucose production overnight. This helps to lower fasting plasma glucose levels in the morning.

3. Increased glycogen storage: Intermittent fasting has been found to increase glycogen storage capacity in the liver and muscles. This increased storage capacity allows for better regulation of blood sugar levels, as glycogen stores are readily available to maintain stable glucose levels during periods of fasting.

4. Hormonal regulation: Intermittent fasting affects the release of various hormones that influence glucose metabolism. For example, it can decrease the release of glucagon, a hormone that promotes the production and release of glucose by the liver. It can also modulate the release of growth hormone and cortisol, which can impact glucose regulation.

5. Body fat utilization: During fasting periods, the body relies more on stored fats for energy. This increased fat utilization leads to a decrease in the demand for glucose, allowing for better glucose regulation and lower fasting plasma glucose levels in the morning.

These physiological mechanisms collectively contribute to the reduction of fasting plasma glucose levels in the early morning during intermittent fasting. However, it is important to note that individual responses may vary.

IF and overall metabolism:

Intermittent fasting has several pathophysiological effects that can impact overall metabolism:

1. Improved insulin sensitivity: Intermittent fasting enhances insulin sensitivity, meaning cells become more responsive to insulin's actions. This improved sensitivity allows for better regulation of blood sugar levels and more efficient uptake and utilization of glucose by cells throughout the body. Enhanced insulin sensitivity also facilitates the storage of glucose as glycogen in the liver and muscles.

2. Enhanced fat utilization: During periods of fasting, the body relies on stored fats as an energy source. Intermittent fasting promotes the breakdown of stored body fat through the activation of lipolysis, the process of breaking down triglycerides into fatty acids. These fatty acids are then utilized by cells for energy, contributing to weight loss and improved metabolic flexibility.

3. Increased ketone production: Intermittent fasting can trigger the production of ketone bodies, such as beta-hydroxybutyrate, as an alternative fuel source. Ketone bodies are produced by the liver from fatty acids and can be used by various tissues, including the brain, as an energy source. This shift to ketone metabolism promotes metabolic flexibility and may have neuroprotective effects.

4. Autophagy activation: Intermittent fasting stimulates autophagy, a cellular process that involves the removal of damaged or dysfunctional components. Autophagy plays a vital role in maintaining cellular health and homeostasis, as well as mitigating the risk of age-related diseases. By clearing out cellular waste, intermittent fasting promotes efficient cellular metabolism and overall metabolic health.

5. Hormonal regulation: Intermittent fasting affects the release and balance of various hormones that influence metabolism. For example, it can increase the release of growth hormone, which helps maintain lean muscle mass and promotes fat utilization. It may also regulate ghrelin, a hormone that stimulates hunger, leading to better appetite control and overall metabolic balance.

6. Improved mitochondrial function: Mitochondria are the cellular organelles responsible for energy production. Intermittent fasting has been shown to improve mitochondrial function and

biogenesis, enhancing the capacity for energy production. This improved mitochondrial function leads to more efficient metabolism of nutrients and increased energy levels.

These pathophysiological mechanisms collectively contribute to improved overall metabolism during intermittent fasting. However, individual responses may vary, and it is recommended to consult with a healthcare professional, especially for individuals with underlying health conditions, before initiating intermittent fasting or making significant changes to their diet and lifestyle.

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 his published 760+ 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 the 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.

2.2 The author's diabetes history

The author was a severe T2D patient since 1995. He weighed 220 lb. (100 kg) at that time. By 2010, he still weighed 198 lb. with average daily glucose of 250 mg/dL (HbA1C at 10%). During that year, his triglycerides reached 1161 (high risk for CVD and stroke) and his albumin-creatinine ratio (ACR) at 116 (high risk for chronic kidney disease). He also suffered from five cardiac episodes within a decade. In 2010, three independent physicians warned him regarding the need for kidney dialysis treatment and the future high risk of dying from his severe diabetic complications.

In 2010, he decided to self-study endocrinology with an emphasis on diabetes and food nutrition. He spent the entire year of 2014 developing a metabolism index (MI)

mathematical model. During 2015 and 2016, he developed four mathematical prediction models related to diabetes conditions: weight, PPG, fasting plasma glucose (FPG), and HbA1C (A1C). Through using his developed mathematical metabolism index (MI) model and the other four glucose prediction tools, by the end of 2016, his weight was reduced from 220 lb. (100 kg) to 176 lb. (89 kg), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger-piercing glucose from 250 mg/dL to 120 mg/dL, and A1C from 10% to ~6.5%. One of his major accomplishments is that he has no longer taken any diabetes-related medications since 12/8/2015.

In 2017, he achieved excellent results on all fronts, especially his glucose control. However, during the pre-COVID period, including both 2018 and 2019, he traveled to ~50 international cities to attend 65+ medical conferences and made ~120 oral presentations. This hectic schedule inflicted damage to his diabetes control caused by stress, dining out frequently, post-meal exercise disruption, and jet lag, along with the overall negative metabolic impact from the irregular life patterns; therefore, his glucose control was somewhat affected during the two-year traveling period of 2018-2019.

He started his COVID-19 self-quarantined life on 1/19/2020. By 10/16/2022, his weight was further reduced to ~164 lb. (BMI 24.22) and his A1C was at 6.0% without any medication intervention or insulin injection. In fact, with the special COVID-19 quarantine lifestyle since early 2020, not only has he written and published ~500 new research articles in various medical and engineering journals, but he has also achieved his best health conditions for the past 27 years. These achievements have resulted from his non-traveling, low-stress, and regular daily life routines. Of course, his in-depth knowledge of chronic diseases, sufficient practical lifestyle management experiences, and his developed high-tech tools have also contributed to his excellent health improvements.

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. Furthermore, he extracted the 5-minute intervals from every 15-minute interval for a

total of 96 glucose data each day stored in his computer software.

Through the author's medical research work of over 40,000 hours and reading over 4,000 published medical papers online in the past 13 years, he discovered and became convinced that good life habits of not smoking, moderate or no alcohol intake, avoiding illicit drugs; along with eating the right food with well-balanced nutrition, persistent exercise, having a sufficient and good quality of sleep, reducing all kinds of unnecessary stress, maintaining a regular daily life routine contribute to the risk reduction of having many diseases, including CVD, stroke, kidney problems, micro blood vessels issues, peripheral nervous system problems, and even cancers and dementia. In addition, a long-term healthy lifestyle can even "repair" some damaged internal organs, with different required time-length depending on the particular organ's cell lifespan. For example, he has "self-repaired" about 35% of his damaged pancreatic beta cells during the past 10 years.

2.3 Energy theory

The human body and organs have around 37 trillion live cells which are composed of different organic cells that require energy infusion from glucose carried by red blood cells, and energy consumption from labor-work or exercise. When the residual energy (resulting from the plastic glucose scenario) is stored inside our bodies, it will cause different degrees of damage or influence to many of our internal organs.

According to physics, energies associated with the glucose waves are proportional to the square of the glucose amplitude. The residual energies from elevated glucoses are circulating inside the body via blood vessels which then impact all of the internal organs to cause different degrees of damage or influence, e.g. diabetic complications. Elevated glucose (hyperglycemia) causes damage to the structural integrity of blood vessels. When it combines with both hypertension (rupture of arteries) and hyperlipidemia (blockage of arteries), CVD or Stroke happens. Similarly, many other deadly diseases could result from these excessive energies which would finally shorten our lifespan. For example, the combination of hyperglycemia and

hypertension would cause micro-blood vessel leakage in kidney systems which is one of the major causes of CKD.

The author then applied Fast Fourier Transform (FFT) operations to convert the input wave from a time domain into a frequency domain. The y-axis amplitude values in the frequency domain indicate the proportional energy levels associated with each different frequency component of input occurrence. Both output symptom value (i.e. strain amplitude in the time domain) and output symptom fluctuation rate (i.e. the strain rate and strain frequency) are influencing the energy level (i.e. the Y-amplitude in the frequency domain).

Many people live a sedentary lifestyle and lack sufficient exercise to burn off the energy influx which causes them to become overweight or obese. Being overweight and having obesity leads to a variety of chronic diseases, particularly diabetes. In addition, many types of processed food add unnecessary ingredients and harmful chemicals that are toxic to the bodies, which lead to the development of many other deadly diseases, such as cancers. For example, ~85% of worldwide diabetes patients are overweight, and ~75% of patients with cardiac illnesses or surgeries have diabetes conditions.

In engineering analysis, when the load is applied to the structure, it bends or twists, i.e. deforms; however, when the load is removed, it will either be restored to its original shape (i.e. elastic case) or remain in a deformed shape (i.e. plastic case). In a biomedical system, the glucose level will increase after eating carbohydrates or sugar from food; therefore, carbohydrates and sugar function as the energy supply. After having labor work or exercise, the glucose level will decrease. As a result, the exercise burns off the energy, which is similar to load removal in the engineering case. In the biomedical case, both energy influx and dissipation processes take some time, which is not as simple and quick as the structural load removal in the engineering case. Therefore, the age difference and 3 input behaviors are “dynamic” in nature, i.e. time-dependent. This time-dependent nature leads to a “viscoelastic or viscoplastic” situation. For the author’s case, it is “viscoplastic” since most of his biomarkers are continuously

improved during the past 13-year time window.

2.4 Time-dependent output strain and stress of (viscous input*output rate)

Hooke’s law of linear elasticity is expressed as:

Strain (ϵ : epsilon)
= Stress (σ : sigma) / Young’s modulus (E)

For biomedical glucose application, his developed linear elastic glucose theory (LEGT) is expressed as:

PPG (strain)
= carbs/sugar (stress) * GH.p-Modulus (a positive number) + post-meal walking k-steps * GH.w-Modulus (a negative number)

Where GH.p-Modulus is the reciprocal of Young’s modulus E.

However, in viscoelasticity or viscoplasticity theory, the stress is expressed as:

Stress
= viscosity factor (η : eta) * strain rate ($d\epsilon/dt$)

Where strain is expressed as Greek epsilon or ϵ .

In this article, to construct an “ellipse-like” diagram in a stress-strain space domain (e.g. “hysteresis loop”) covering both the positive side and negative side of space, he has modified the definition of strain as follows:

Strain
= (body weight at a certain specific time instant)

He also calculates his strain rate using the following formula:

Strain rate
= (body weight at next time instant) - (body weight at present time instant)

The risk probability % of developing into CVD, CKD, and Cancer is calculated based on his developed metabolism index model (MI) in 2014. His MI value is calculated using inputs of 4 chronic conditions, i.e. weight, glucose, blood pressure, and lipids; and 6 lifestyle details, i.e. diet, drinking water, exercise, sleep, stress, and daily routines.

These 10 metabolism categories further contain ~500 elements with millions of input data collected and processed since 2010. For individual deadly disease risk probability %, his mathematical model contains certain specific weighting factors for simulating certain risk percentages associated with different deadly diseases, such as metabolic disorder-induced CVD, stroke, kidney failure, cancers, dementia; artery damage in heart and brain, micro-vessel damage in kidney, and immunity-related infectious diseases, such as COVID death.

Some of explored deadly diseases and longevity characteristics using the viscoplastic medicine theory (VMT) include stress relaxation, creep, hysteresis loop, and material stiffness, damping effect based on time-dependent stress and strain which are different from his previous research findings using linear elastic glucose theory (LEGT) and nonlinear plastic glucose theory (NPGT).

Note: For a more detailed description, please refer to the “consolidated method” section which is given at the beginning of the special issue.

3. RESULTS

Figure 1 shows data tables.

Figure 2 shows TD and SD-VMT analysis results.

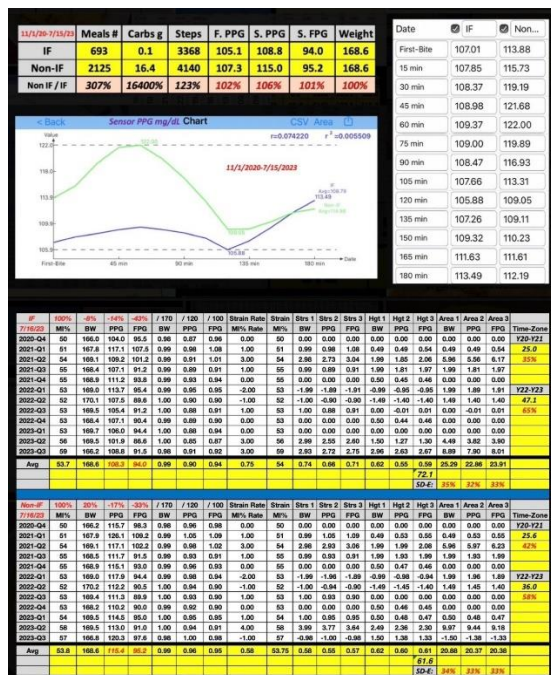


Figure 1: Data tables.

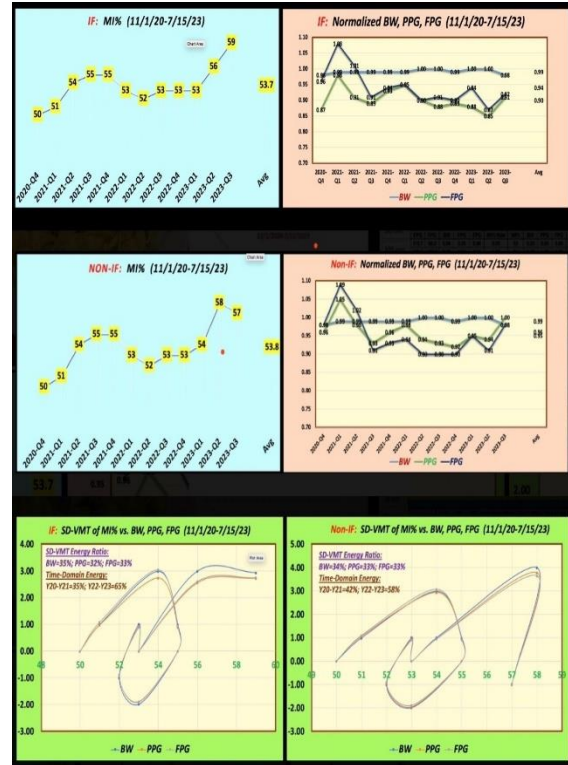


Figure 2: TD and SD-VMT analysis results.

4. CONCLUSION

In summary, the three key findings are as follows:

1. Using averaged values from TD data, the reduction percentages between non-IF and IF are as follows: BW=0%, FPG=1%, finger PPG=2%, sensor PPG=6%, and the peak sensor PPG difference at 60-minutes is 11 mg/dL.

2. Results from the SD-VMT energy model demonstrate that almost identical energy distribution rates existed among BW, FPG, and PPG (about 1/3 for each influential factor). An interesting finding is that the energy in IF for FPG is almost equivalent to the energy in non-IF for PPG.

3. Time-zone analysis in SD reveals that a higher energy distribution during Y20-Y21 existed in comparison with Y22-Y23 for both IF and non-IF cases.

The most noteworthy finding from this research is the clear evidence supporting the beneficial effects of IF practice on glucose reduction. However, there is no quantitative evidence supporting the beneficial effects of IF practice on body weight reduction.

5. REFERENCES

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

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

For reading more of the author's published VGT or FD analysis results on medical applications, please locate them through three published special editions from the following three specific journals:

(1) Special Issue. The GH-Method. (<https://www.theghmethod.com>).

(2) Journal of Applied Material Science & Engineering Research (contact: Catherine).

(3) Advances in Bioengineering and Biomedical Science Research (contact: Sony Hazi).

Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

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