The GH-Method

Viscoelastic Medicine theory (VMT #426): Preliminary study of visceral fat versus body weight, exercise, sleep, food quantity, glucose using Viscoplastic Energy Model of GH-Method: Math-Physical Medicine (No. 1028)

Gerald C. Hsu*

eclaireMD Foundation, USA

Abstract

This study represents an initial exploration of the correlation between visceral fat (commonly referred to as belly fat) and five potential influential factors or consequences. The term "preliminary" is used because the author relied exclusively on his data gathered over 175 days, spanning from August 11, 2023, to February 1, 2024.

The author successfully decreased his body weight from 220 lbs. (BMI 32.0) in 2010 to 165 lbs. (BMI 24.4) in 2024. However, his visceral fat rate remains at 16%, which exceeds the ideal 13% and constitutes 90% of his total body fat of 18% (within the healthy range). Reducing visceral fat is particularly challenging as it is situated deep within the abdominal cavity, surrounded by internal organs.

To measure his visceral fat, the author has utilized a weight scale with Bioelectrical Impedance Analysis (BIA) capability every morning since August 11, 2023. Compared to laboratory CT or MRI imaging methods, BIA is simpler, non-invasive, and poses no risk of radiation exposure. Typically, he would rely on several years of his amassed data for his biomedical research work. However, he was motivated to initially comprehend how his visceral fat ratio might be influenced by or have an impact on five chosen metabolic and lifestyle factors. He acknowledges the strong correlation between body weight and visceral fat ratio. His previous research has established the links between sleep (as an input) and body weight, as well as hyperglycemia (insulin resistance as an output) and the combination of body weight, body fat, and visceral fat. He also recognizes that excessive eating and insufficient exercise contribute to increases in body weight, body fat, and visceral fat. In addition, he also acknowledges that hydration affects the visceral fat ratio but has excluded water intake as a factor since he consumes 3,000 cc of water daily without variation.

In summary, this study incorporated two monthly datasets: one utilizing daily data and the other utilizing 90-day moving averages data. The first comparison involves the traditional correlation coefficients between belly fat and five input variables.

Daily data: M1 (body weight) = 88%; M5 (exercise) = 86%; M7 (sleep) = 28%; M9a (food portion) = 3%; M2 (glucose) = -29%.

90-days moving averaged data: M1 (body weight) = 96%; M5 (exercise) = 68%; M7 (sleep) = 93%; M9a (food portion) = 85%; M2 (glucose) = 43%.

The Viscoplastic energy percentages through SD-VMT analysis are as follows:

Daily data: M1 (body weight) = 28%; M5 (exercise) = 23%; M7 (sleep) = 13%; M9a (food portion) = 13%; M2 (glucose) = 24%.

90-days moving averaged data: M1 (body weight) = 28%; M5 (exercise) = 14%; M7 (sleep) = 23%; M9a (food portion) = 13%; M2 (glucose) = 23%.

These two stress-strain (input-output) diagrams exhibit different looks of curve patterns, with the daily curve area (total energy 0.41) being 2.6 times larger than the 90-day moving average curve area (total energy 0.16).

It is important to note that the preliminary findings mentioned above may be subject to change after conducting further analysis based on a much larger database.

Key message:

From this analysis, it is evident that body weight and glucose are closely linked to visceral fat. In the case of daily data, exercise accounts for 23% of the total stress-strain energy, and sleep contributes 13%. Conversely, in the 90-day case, exercise contributes 14%, while sleep plays a

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*Corresponding author: Gerald C. Hsu, eclaireMD Foundation, USA

larger role at 23%. Additionally, in both scenarios, food portion has a smaller impact on visceral fat, accounting for only 13%. However, it is worth noting that the food portion plays the most significant role in his body weight.

Keywords: Viscoelastic; Viscoplastic; Diabetes; Glucose; Biomarkers; Insulin; Hyperglycemia

Abbreviations: CGM: continuous glucose monitoring; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose; SD: space-domain; VMT: viscoelastic medicine theory; FFT: Fast Fourier Transform

1. INTRODUCTION

This study represents an initial exploration of the correlation between visceral fat (commonly referred to as belly fat) and five potential influential factors or consequences. The term "preliminary" is used because the author relied exclusively on his data gathered over 175 days, spanning from August 11, 2023, to February 1, 2024.

The author successfully decreased his body weight from 220 lbs. (BMI 32.0) in 2010 to 165 lbs. (BMI 24.4) in 2024. However, his visceral fat rate remains at 16%, which exceeds the ideal 13% and constitutes 90% of his total body fat of 18% (within the healthy range). Reducing visceral fat is particularly challenging as it is situated deep within the abdominal cavity, surrounded by internal organs.

To measure his visceral fat, the author has utilized a weight scale with Bioelectrical Impedance Analysis (BIA) capability every morning since August 11, 2023. Compared to laboratory CT or MRI imaging methods, BIA is simpler, non-invasive, and poses no risk of radiation exposure. Typically, he would rely on several years of his amassed data for his biomedical research work. However, he was motivated to initially comprehend how his visceral fat ratio might be influenced by or have an impact on five chosen metabolic and lifestyle factors. He acknowledges the strong correlation between body weight and visceral fat ratio. His previous research has established the links between sleep (as an input) and body weight, as well as hyperglycemia (insulin resistance as an output) and the combination of body weight, body fat, and visceral fat. He also recognizes that excessive eating and insufficient exercise contribute to increases in body weight, body fat, and visceral fat. In addition, he also acknowledges that hydration affects the visceral fat ratio but has excluded water intake as a factor since he consumes 3,000 cc of water daily without variation.

1.1 Biomedical and Engineering or Technical information:

The following sections contain excerpts and concise information meticulously reviewed by the author of this paper. The author has adopted this approach as an alternative to including a conventional reference list at the end of this document, with the intention of optimizing his valuable research time. It is essential to clarify that these sections do not constitute part of the author's original contribution but have been included to aid the author in his future reviews and offer valuable insights to other readers with an interest in these subjects.

Visceral fat measurement via either electrical impedance method or image method, which method is easier or more accurate?

Visceral fat measurement is an important indicator of overall health and is associated with various health risks, including insulin resistance, cardiovascular disease, and metabolic syndrome. There are several methods available for measuring visceral fat, including electrical impedance (bioelectrical impedance analysis, or BIA) and imaging methods such as computed tomography (CT) or magnetic resonance imaging (MRI). Each method has its advantages and limitations in terms of accuracy and practicality.

Electrical Impedance Method (BIA):
BIA measures body composition by analyzing the impedance of electrical currents as they pass through the body. This method is non-invasive, relatively quick, and widely available, making it convenient for clinical and research settings. While BIA can estimate visceral fat levels, its accuracy can be affected by factors such as hydration status, body positioning, and the quality of the equipment used. Additionally, BIA

measurements may not always provide the same level of precision as imaging methods.

Imaging Method (CT or MRI):
CT and MRI are imaging techniques that can directly visualize and quantify visceral fat deposits within the abdominal cavity. These methods are considered gold standards for visceral fat measurement due to their high level of accuracy and precision. They provide detailed and reliable data on visceral fat distribution and volume, allowing for precise risk assessment and monitoring of changes over time. However, imaging methods are more expensive, require specialized equipment, and may carry some degree of radiation exposure in the case of CT scans.

In terms of accuracy, imaging methods such as CT and MRI are generally considered to be more precise for measuring visceral fat compared to BIA. They offer a direct and detailed assessment of visceral fat distribution and volume, providing valuable clinical information for risk assessment and research purposes. However, the choice of measurement method depends on various factors, including the specific research or clinical objectives, cost, availability of equipment, and patient considerations. For population-based studies or routine clinical assessment, BIA may provide a practical and cost-effective alternative, despite its potential limitations in accuracy compared to imaging methods.

Pathophysiological explanations of visceral fat rate versus body weight, glucose, food portion, exercise, sleep conditions, hydration:

Visceral fat, also known as intra-abdominal fat, is stored within the abdominal cavity and surrounds a number of important internal organs such as the liver, pancreas, and intestines. It is different from subcutaneous fat, which is found beneath the skin. Excess visceral fat is associated with a higher risk of several health conditions, including type 2 diabetes, heart disease, and certain cancers.

The pathophysiological relationships between visceral fat and various factors such as body weight, glucose levels, food portion size, exercise intensity, sleep conditions, and hydration state are complex and multifaceted.

Body Weight:
Body weight is a general measure that includes muscle, bone, water, and fat mass. While body weight can give a general idea of health status, it doesn't distinguish between muscle and fat mass, or between subcutaneous and visceral fat. However, a higher body weight, especially due to excess fat mass, is often associated with increased visceral fat. This is because, with weight gain, fat tends to accumulate not only subcutaneously but also viscerally.

Glucose:
Visceral fat plays a significant role in glucose metabolism and insulin sensitivity. It releases fatty acids and pro-inflammatory cytokines, which can lead to insulin resistance, a condition where the body's cells do not respond properly to insulin. Insulin resistance is a key feature of type 2 diabetes. Therefore, higher levels of visceral fat are closely linked with disturbances in glucose metabolism, leading to elevated blood glucose levels.

Food Portion:
Larger food portions can contribute to an overall excess caloric intake, leading to weight gain and potentially an increase in visceral fat if the excess calories are stored as fat. The type of nutrients consumed also plays a role; diets high in refined carbs and sugars may particularly promote the accumulation of visceral fat due to their impact on insulin resistance and fat deposition.

Exercise:
Exercise, particularly aerobic and resistance training, can help reduce visceral fat by burning calories, improving metabolism, and enhancing insulin sensitivity. (Note by the author: At age 77, the author hired a professional trainer and started his daily resistance training and exercise on 12/1/2923). Regular physical activity encourages the use of visceral fat for energy, thus reducing its levels.

Sleep Conditions:
Poor sleep or sleep deprivation is linked to hormonal imbalances that can increase appetite and cravings for high-calorie foods, leading to a higher risk of obesity and visceral fat accumulation. Moreover, insufficient sleep can disrupt the balance of hunger hormones, such as increasing ghrelin (the hunger hormone) and decreasing leptin (the satiety hormone), which can lead to increased food intake and weight gain.

Hydration:
While hydration itself might not directly affect visceral fat levels, adequate water intake is essential for overall metabolic health and can support weight management efforts. Proper hydration can aid in appetite control and enhance metabolic rate, indirectly supporting the management of visceral fat.

The interactions between these factors and visceral fat accumulation highlight the importance of a holistic approach to health, focusing on balanced nutrition, regular physical activity, adequate sleep, and overall lifestyle management to control visceral fat levels and reduce the risk of associated health conditions.

1.2 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 (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 the 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 diabetes history:

The author has had a severe T2D patient since 1995. He weighed 220 lb. (100 kg) at that time. By 2010, he still weighed 198 lb. with an 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 lbs. (100 kg) to 176 lbs. (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 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 lbs. (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 own 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 checked 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 lengths 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.

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 glucose 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).

Currently, 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, the 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 processes of energy influx and energy dissipation 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 have continuously improved during the past 13-year time window.

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 (dε/dt)

where strain is expressed as Greek epsilon or ε.

In this article, in order 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 the 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).

2. RESULTS

Figure 1 shows Input information, TD and SD results.

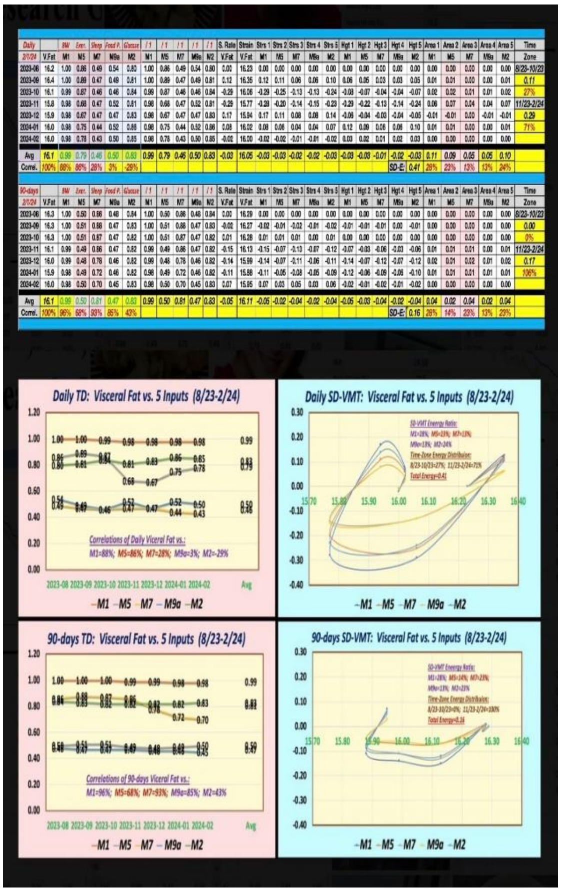

Figure 1: Input Information, TD and SD results

3. CONCLUSION

In summary, this study incorporated two monthly datasets: one utilizing daily data and the other utilizing 90-day moving averages data. The first comparison involves the traditional correlation coefficients between belly fat and five input variables.

Daily data:

M1 (body weight) = 88%
M5 (exercise) = 86%
M7 (sleep) = 28%
M9a (food portion) = 3%
M2 (glucose) = -29%

90-days moving averaged data:

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These two stress-strain (input-output) diagrams exhibit different looks of curve patterns, with the daily curve area (total energy 0.41) being 2.6 times larger than the 90-day moving average curve area (total energy 0.16).

It is important to note that the preliminary findings mentioned above may be subject to change after conducting further analysis based on a much larger database.

Key message:

From this analysis, it is evident that body weight and glucose are closely linked to visceral fat. In the case of daily data, exercise accounts for 23% of the total stress-strain energy, and sleep contributes 13%. Conversely, in the 90-day case, exercise contributes 14%, while sleep plays a larger role at 23%. Additionally, in both scenarios, food portion has a smaller impact on visceral fat, accounting for only 13%. However, it is worth noting that the food portion plays the most significant role in his body weight.

4. REFERENCES

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

For reading more of the author's published VGT or FD analysis results on medical applications, please locate them through platforms for scientific research publications, such as ResearchGate, Google Scholar, etc.

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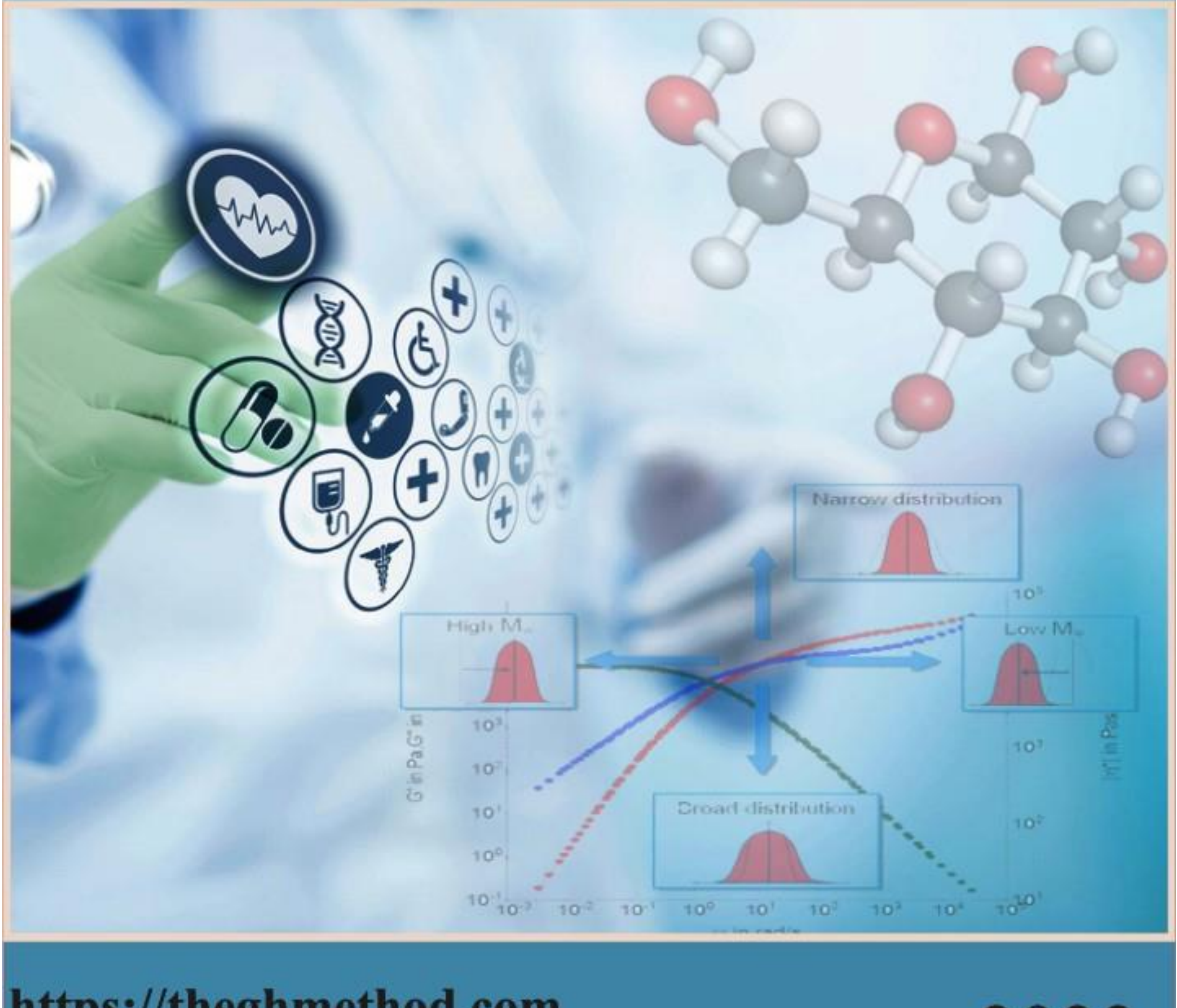
Gerald C. Hsu



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