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The GH-Method

Viscoelastic Medicine Theory (VMT #333): Multi-Tiered VMT Energy Method Uses Multiple Tiers of Input Causes to Predict Risk of Cardiovascular Diseases or Strokes Based on GH-Method: Math-Physical Medicine (No. 933)

Gerald C. Hsu*

eclaireMD Foundation, USA

Abstract

Since January of 2021, the author has used the space-domain viscoplastic energy model (SD-VMT) for his medical research work. He has written 333 VMT papers so far. This article is dedicated on researching multiple diseases or symptoms utilizing multiple influential causes with a multi-tiered research approach. His research process are: (1) body weight (BW) versus food quantity (food size), daily walking steps (exercise), and sleep quality score (sleep); (2) PPG (representation of T2D) versus pancreatic beta cells health state (via FPG), carbs & sugar intake grams (carbs), and post-meal walking steps (steps); (3) Combination of artery ruptures (about 75% occurrences) due to hypertension and artery blockage (about 35% occurrences) due to dyslipidemia versus blood pressure (BP), cholesterols (lipids), and food quality (contents of food nutrition). In the author's opinion, the specific roles of diabetes versus hypertension and dyslipidemia in the development of cardiovascular disease (CVD) and strokes can be thought of as the culprits versus the accomplices of a crime. Conducting three VMT analyses, the author has obtained predicted outputs for BW, T2D, and arterial health. These predicted outputs are then further been utilized for his VMT analysis to assess the risk of developing cardiovascular diseases (CVD). Additionally, he also compares his CVD risks based on his measured input data of BW, T2D and arterial health against his CVD risk values based on VMT-predicted inputs. Finally, he compares these two VMT-based CVD risks with his calculated CVD risk using the metabolism index (MI) model through both prediction accuracy and correlation. This study analyzes interactions between multiple influfactors and multiple disease symptoms using a two-tiered SD-VMT models with data collected from 1/1/2015 to 9/23/2023. In summary, this analysis leads to three important observations: 1. The VMT analysis shows a high similarity between the predicted inputs and measured inputs. The total energy ratios for BW, T2D, and Artery health are approximately 36-37%, 35-36%, and 28%, respectively. The ratio of damage on blood vessel structure due to glucose compared to artery blockage or rupture situations is around 1.25 to 1.26. 2. The distribution of energy across time zones is approximately 69-70% for Y15-Y19 and 30-31% for Y29-Y23 (a 70/30 split). 3. These two VMT-based CVD risks have the same average value as the MI-based CVD risk (with a prediction accuracy of 100%). However, the waveform correlations are 78% for VMT-predicted versus MI-based (higher R), and 59% for VMT-measured versus MI-based (lower R). Overall, this multi-tiered VMT model provides a comprehensive understanding and demonstrates a continuous roadmap of relationship from lifestyle details, through metabolic disorders to mortality diseases.

Keywords: Viscoelastic; Viscoplastic; Cardiovascular diseases; Body weight; Diabetes; Exercise

Abbreviations: MI: metabolism index; CVD: cardiovascular diseases; BW: body weight; CKD: chronic kidney diseases; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose

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

1. INTRODUCTION

Since January of 2021, the author has used the space-domain viscoplastic energy model (SD-VMT) for his medical research work. He has written 333 VMT papers so far.

This article is dedicated on researching multiple diseases or symptoms utilizing multiple influential causes with a multi-tiered research approach. His research processes are:

(1) body weight (BW) versus food quantity (food size), daily walking steps (exercise), and sleep quality score (sleep);

(2) PPG (representation of T2D) versus pancreatic beta cells health state (via FPG), carbs & sugar intake grams (carbs), and post-meal walking steps (steps);

(3) Combination of artery ruptures (about 75% occurrences) due to hypertension and artery blockage (about 35% occurrences) due to dyslipidemia versus blood pressure (BP), cholesterols (lipids), and food quality (contents of food nutrition).

In the author's opinion, the specific roles of diabetes versus hypertension and dyslipidemia in the development of cardiovascular disease (CVD) and strokes can be thought of as the culprits versus the accomplices of a crime.

Conducting three VMT analyses, the author has obtained predicted outputs for BW, T2D, and arterial health. These predicted outputs are then further been utilized for his VMT analysis to assess the risk of developing cardiovascular diseases (CVD). Additionally, he also compares his CVD risks based on his measured input data of BW, T2D and arterial health against his CVD risk values based on VMT-predicted inputs.

Finally, he compares these two VMT-based CVD risks with his calculated CVD risk using the metabolism index (MI) model through both prediction accuracy and correlation. This study analyzes interactions between multiple influfactors and multiple disease symptoms using a two-tiered SD-VMT models with data collected from 1/1/2015 to 9/23/2023.

1.1 Biomedical information

The following sections contain excerpts and concise information drawn from multiple medical articles, which have been 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.

Notes from the author of this paper:

Upon reviewing the upcoming excerpts from other published articles, it becomes evident that these findings are predominantly conveyed using qualitative statements. On occasion, these statements include a limited number of numerical values, typically sourced from statistical data within epidemiological studies. However, a recurring deficiency among them is the lack of robust quantitative findings to underpin their qualitative conclusions. Consequently, the author of this paper has deliberately opted to leverage his familiar methodologies from mathematics, physics, and engineering fields in his medical research pursuits. This strategic choice is intended to yield substantial conclusions supported by sound proofs via quantitative data, effectively bridging the current gap in the realm of biomedical research.

Pathophysiological explanations and statistics data regarding body weight or obesity versus food portion, exercise level, and sleep quality and hours:

Pathophysiological explanations for the relationship between body weight or obesity and food portion, exercise level, and sleep quality and hours can vary. Here are some general explanations:

1. Food portion

Consuming larger portions of food can lead to increased calorie intake. When individuals consistently consume more calories than they burn, the excess energy is stored as fat, leading to weight gain over time. Additionally, larger portion sizes may contribute to a higher caloric density and a reduced feeling of fullness, potentially leading to overeating.

2. Exercise level

Regular physical activity is essential for maintaining a healthy weight. Exercise helps burn calories and increase metabolism, contributing to weight loss or weight maintenance. Lack of exercise or a sedentary lifestyle can lead to weight gain. Additionally, physical activity can help build muscle mass, which can increase metabolic rate and promote weight loss.

3. Sleep quality and hours

Poor sleep quality and inadequate sleep duration can disrupt hormonal regulation, leading to weight gain or obesity. Sleep deprivation can affect the regulation of appetite hormones, such as ghrelin and leptin, leading to increased hunger and reduced satiety. It can also impair insulin sensitivity and glucose metabolism, potentially contributing to the development of insulin resistance and weight gain.

Statistics data regarding these relationships can be obtained from various sources, including research studies, surveys, and population health data. These data provide insights into the prevalence of obesity, the impact of food portion sizes, exercise levels, and sleep quality and hours on weight status, and associations between these factors. Such statistics help identify trends, patterns, and potential risk factors related to body weight and obesity.

Pathophysiological explanations and statistics data regarding PPG or T2D status versus pancreatic beta cells health state via FPG, carbohydrates and sugar intake grams and post-meal walking steps:

Pathophysiological explanations for the relationship between pre-diabetes or type 2 diabetes (T2D) status and pancreatic beta cell health, fasting plasma glucose (FPG) levels, carbohydrate and sugar intake, and post-meal walking steps exercise level can be described as follows:

1. Pancreatic beta cell health

Pancreatic beta cells are responsible for producing and releasing insulin, a hormone that helps regulate blood sugar levels. In individuals with pre-diabetes or T2D, the pancreatic beta cells may become dysfunctional or damaged over time. This can result from various factors, including chronic hyperglycemia, oxidative stress, inflammation, and genetic predisposition. Dysfunction of beta cells can lead to impaired insulin secretion and reduced ability to regulate blood sugar levels properly.

2. Fasting plasma glucose (FPG) levels

FPG levels are used as a diagnostic criterion for pre-diabetes and T2D. Elevated FPG levels indicate impaired glucose regulation and may suggest reduced insulin sensitivity or impaired pancreatic beta cell function.

3. Carbohydrate and sugar intake

In individuals with pre-diabetes or T2D, excessive intake of carbohydrates, especially refined carbohydrates and added sugars, can lead to sharp spikes in blood sugar levels. Chronic high blood sugar levels can put stress on the pancreatic beta cells, leading to their dysfunction or damage over time.

4. Post-meal walking steps exercise level

Engaging in physical activity, such as walking after meals, has been shown to have positive effects on blood sugar control. Regular exercise, including post-meal walking steps, can improve insulin sensitivity, help maintain healthy body weight, and promote glucose uptake by muscles, reducing the burden on pancreatic beta cells.

Statistics data regarding these relationships can be obtained from various studies and sources. For example, studies exploring the association between sugar intake, carbohydrate intake, exercise level, and T2D risk can provide insights into the impact of these factors on pancreatic beta cell health and glucose regulation. Additionally, population health data may provide statistics on the prevalence of pre-diabetes and T2D in different populations and their relationship with lifestyle factors like carbohydrate intake, sugar consumption, and exercise levels.

Pathophysiological explanations and statistics data regarding artery damage risks from blockage and rupture versus blood pressure, blood lipids and cholesterols, and food nutrition contents:

Pathophysiological explanations for the risk of artery blockage and rupture, and their relationship with blood pressure, blood lipids and cholesterol levels, and food nutrition contents can be as follows:

1. Artery blockage and rupture

Artery blockage occurs when fatty deposits, known as plaques, build up on the inner lining of the arteries, leading to narrowing and reduced blood flow. When these plaques rupture or break open, they can trigger the formation of blood clots, which can further obstruct blood flow or travel to other parts of the body, causing potentially severe complications like heart attack or stroke.

2. Blood pressure

High blood pressure (hypertension) can damage the inner lining of the blood vessels, making it easier for plaques to form and causing increased strain on the arterial walls. Additionally, hypertension can lead to the thickening of the blood vessel walls, making them more prone to rupture.

3. Blood lipids and cholesterol levels

Elevated levels of low-density lipoprotein (LDL) cholesterol, often called "bad" cholesterol, contribute to the development of artery blockage. LDL cholesterol can accumulate within the arterial walls, triggering inflammation and the formation of plaques. Similarly, high triglyceride levels and low levels of high-density lipoprotein (HDL) cholesterol, known as "good" cholesterol, can also increase the risk of plaque formation and artery blockage.

4. Food nutrition contents

The composition of the diet can greatly influence blood pressure, blood lipids, and cholesterol levels. A diet high in saturated and trans fats, dietary cholesterol, and excessive sodium intake can contribute to elevated LDL cholesterol levels and hypertension. Conversely, consuming a diet rich in fiber, omega-3 fatty acids, unsaturated fats, and antioxidants from fruits, vegetables, whole grains, and lean proteins can help maintain healthy blood pressure and lipid profiles.

Statistics data regarding these relationships can be obtained from various sources, including epidemiological studies, clinical trials, and health surveys. These data provide insights into the prevalence of high blood pressure, abnormal lipid profiles, and artery-related diseases like coronary artery disease or stroke. Additionally, studies examining dietary patterns and nutrient intakes can offer information on the associations between food nutrition contents, blood pressure, blood lipids, and the risk of artery blockage and rupture.

Pathophysiological explanations and statistics data regarding cardiovascular diseases and strokes versus body wright or obesity, glucose levels or type 2 diabetes, and artery healthy state of blockage and rupture risks:

Pathophysiological explanations for the relationship between cardiovascular diseases, strokes, and body weight or obesity, glucose levels or type 2 diabetes, and the healthy state of arteries in terms of blockage and rupture risks can be described as follows:

1. Body weight or obesity

Excess body weight and obesity can contribute to the development of cardiovascular diseases and strokes. Obesity is associated with various risk factors, including elevated blood pressure, dyslipidemia (abnormal levels of blood lipids), insulin resistance, and chronic inflammation. These factors can damage the blood vessels, increase the likelihood of plaque formation, and accelerate the progression of atherosclerosis, which is the buildup of plaque within the arteries.

Statistics data show a significant association between obesity and cardiovascular diseases. According to the World Health Organization, obesity increases the risk of developing heart disease by 50% compared to individuals with a healthy weight.

2. Glucose levels or type 2 diabetes

High glucose levels or the presence of type 2 diabetes can increase the risk of cardiovascular diseases and strokes. Elevated blood glucose levels, often seen in diabetes, can promote endothelial dysfunction (impaired blood vessel function), oxidative stress, inflammation, and damage to the arterial walls.

Data from studies indicate that individuals with diabetes have two to four times higher risks of cardiovascular diseases compared to those without diabetes. The American Heart Association reports that two out of three people with diabetes die from cardiovascular disease or stroke.

3. Artery health and blockage/rupture risks

Arteries play a crucial role in cardiovascular health and can be affected by the aforementioned factors. The buildup of plaque in the arterial walls (atherosclerosis) can lead to a decrease in arterial flexibility and narrowing of the blood vessels, increasing the risk of blockages. Plaques can also become unstable and rupture, leading to the formation of blood clots that may cause a stroke.

Statistics data show that atherosclerosis is a significant contributor to cardiovascular diseases and strokes. The American Heart Association reports that atherosclerosis is present in the majority of heart attacks, strokes, and peripheral artery diseases.

Understanding these pathophysiological explanations and statistics data highlights the importance of maintaining a healthy body weight, managing glucose levels, and promoting arterial health to reduce the risk of cardiovascular diseases and strokes. These factors can be addressed through lifestyle modifications, including a balanced diet, regular physical activity, and appropriate management of chronic conditions like diabetes.

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 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 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 to develop 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 takes 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 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 over 40,000 hours and read 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 an example, the combination of hyperglycemia and hypertension would cause micro-blood vessel's leakage in kidney systems which is one of the major cause 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. deform; 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 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 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 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, 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 5 data tables.

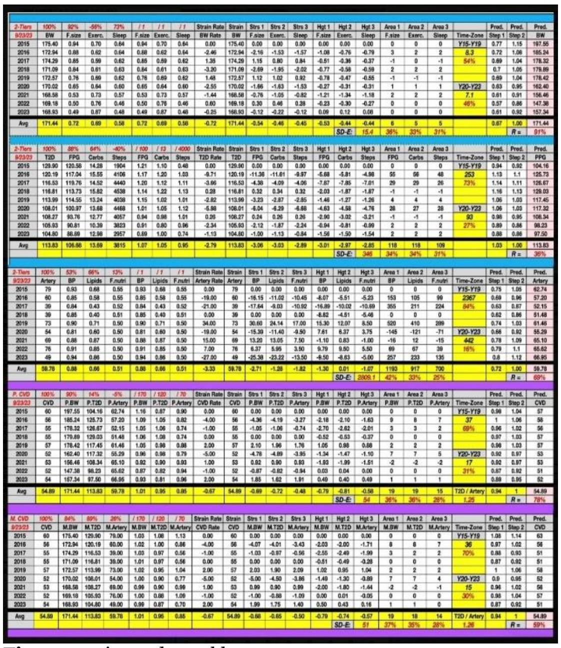

Figure 1: 5 input data tables.

Figure 2 shows 3 output diagrams.

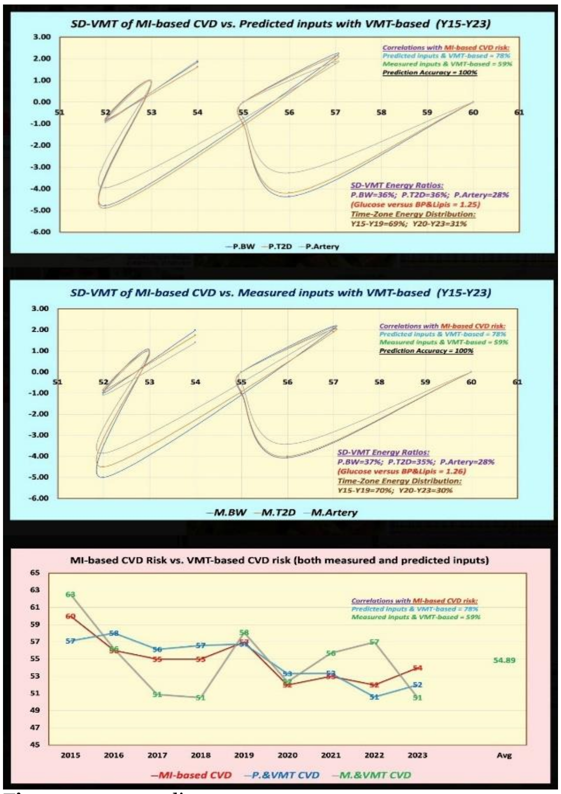

Figure 2: 3 output diagrams.

4. CONCLUSION

In summary, this analysis leads to three important observations:

1. The VMT analysis shows a high similarity between the predicted inputs and measured inputs. The total energy ratios for BW, T2D, and Artery health are approximately 36-37%, 35-36%, and 28%, respectively. The ratio of damage on blood vessel structure due to glucose compared to artery blockage or rupture situations is around 1.25 to 1.26.

2. The distribution of energy across time zones is approximately 69-70% for Y15-Y19 and 30-31% for Y29-Y23 (a 70/30 split).

3. These two VMT-based CVD risks have the same average value as the MI-based CVD risk (with a prediction accuracy of 100%). However, the waveform correlations are 78% for VMT-predicted versus MI-based (higher R), and 59% for VMT-measured versus MI-based (lower R).

Overall, this multi-tiered VMT model provides a comprehensive understanding and demonstrates a continuous roadmap of relationship from lifestyle details, through metabolic disorders to mortality diseases.

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.eclairemd.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.

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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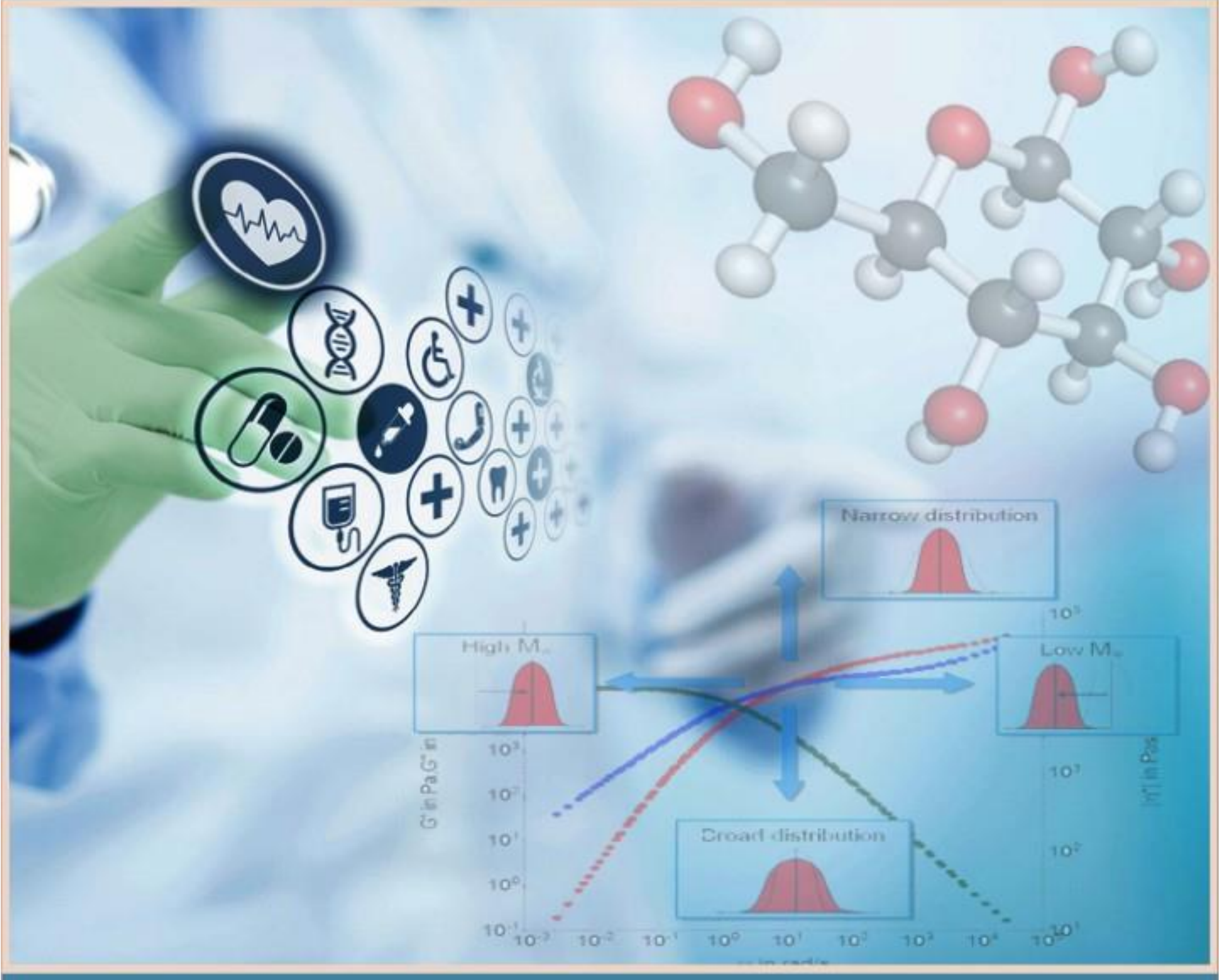
Gerald C. Hsu



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2022