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Research Article

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Neurological Stimulation of Certain Brain Functions and Related Models of Neuroendocrine Simulations Using both Neurology Knowledge and Viscoplastic Energy Model of GH-Method: Math-Physical Medicine (No. 1031, Viscoelastic Medicine Theory #429)

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Abstract

The author's paper number 094 published in 2019 addressed certain brain stimulation and simulation models of the endocrine system using data collected over a 5-year period, from 2015 to 2019. The author has since revisited the same subject with his expanded understanding of brain functions, incorporating additional data collected over a span of 10 years, from 2015 to 2024. Additionally, he utilized an energy model associated with the space-domain viscoplastic medicine theory (SD-VMT) to provide quantitative findings regarding relationships among certain specific endocrine biomarkers that are controlled and regulated by the brain.

The brain plays a pivotal role in regulating energy balance, glucose metabolism, and insulin sensitivity through the coordination of various neurological pathways, including neuronal circuits in hypothalamus, the autonomic nervous system, neuroendocrine regulation, brain-gut interaction, and behavioral regulation. Furthermore, the brain also plays a central role in regulating blood pressure and blood lipid metabolism through the coordination of various neural pathways and signaling molecules, such as the autonomic nervous system, baroreflex mechanism, neuroendocrine regulation, and neuroimmune interactions.

In short, the brain processes its received information regarding food and water consumed and bowel movement the previous day and sleep conditions at night to determine the next morning's body weight, which directly affects the fasting plasma glucose (FPG) level in the early morning. Throughout the day, the brain continuously receives further inputs, such as the amount of carbohydrates and sugar intake, physical activity level, ambient temperature, stress and more (20+ other factors), to make its decisions and provide "marching orders" to the liver for glucose production and the pancreatic beta cells for insulin production. This process alters the level of postprandial plasma glucose (PPG). Additionally, the brain also plays a role in regulating blood pressure and cholesterol levels.

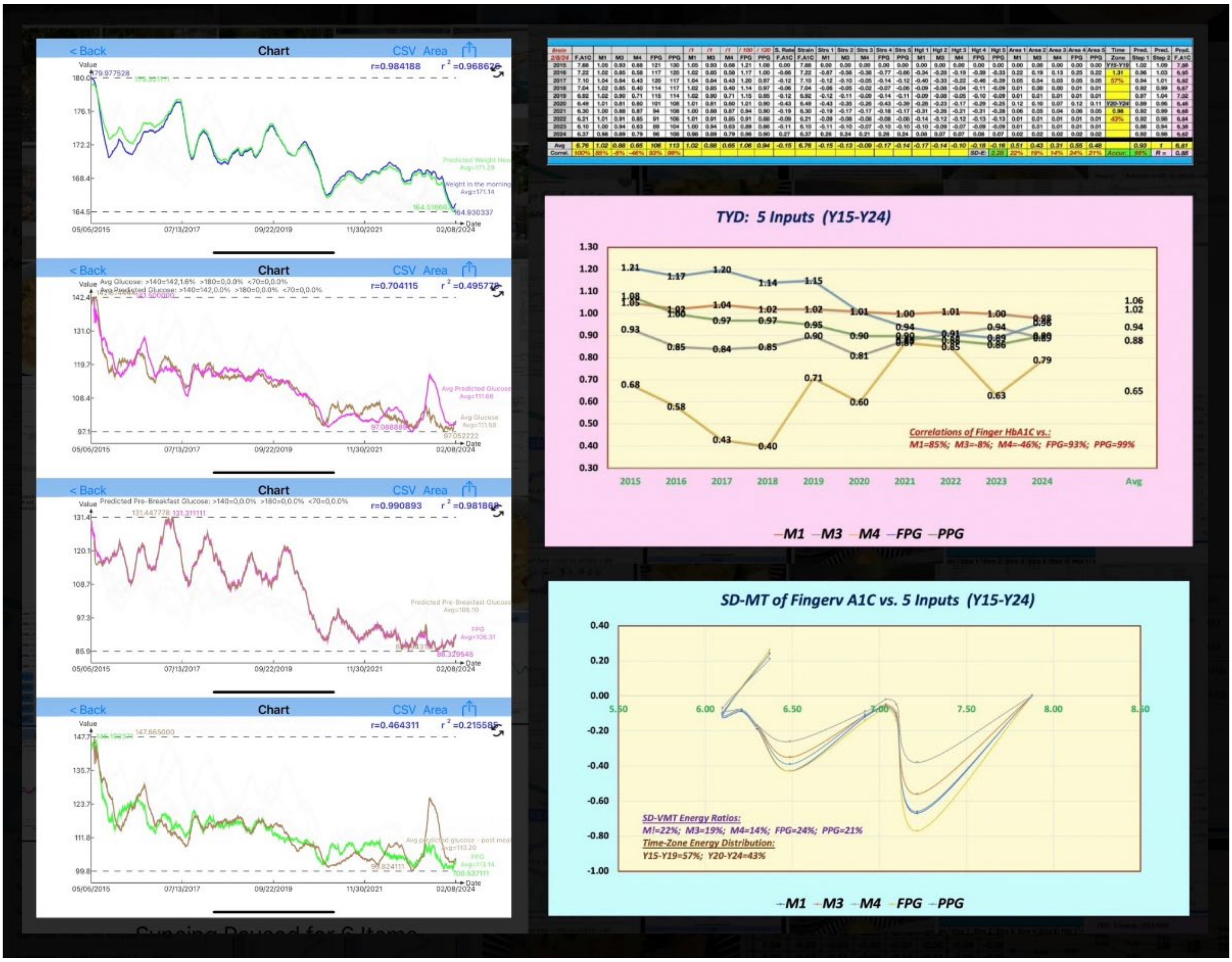
An excerpt of the abstract of his paper No.094 and additional detailed biomedical information regarding the brain's neurological functions related to the endocrine system are included in the Introduction Section of this article.

Over the past 10 years, the author developed numerous accurate and practical simulation models and achieved predicted results for certain endocrine biomarkers, such as body weight, FPG, and PPG. These predicted results have very high prediction accuracies (most of them above 99%) and high correlations between measured and predicted biomarker values (above 70%, except for PPG at 46%).

In summary, *the SD-VMT energy ratios of finger glucose based HbA1C versus 5 influential factors are:*
Body weight (M1): 22%,
Blood pressures (M3): 19%,
Blood Lipids (M4): 14%.

FPG: 24%
PPG: 21%
Time-zone energy distributions are:
Y15-Y19: 57%
Y20-Y24: 43%

Key Message
Brain is the most important organ which controls all functions of human body. A good understanding of brain functions and their relationship with other organs are useful for our health maintenance and improvements.



1. Introduction

The author's paper number 094 published in 2019 addressed certain brain stimulation and simulation models of the endocrine system using data collected over a 5-year period, from 2015 to 2019. The author has since revisited the same subject with his expanded understanding of brain functions, incorporating additional data collected over a span of 10 years, from 2015 to 2024. Additionally, he utilized an energy model associated with the space-domain viscoplastic medicine theory (SD-VMT) to provide quantitative findings regarding relationships among certain specific endocrine biomarkers that are controlled and regulated by the brain.

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1.1Biomedical and Engineering or Technical information

The following sections contain excerpts and concise information on 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.

2. Neurological Explanation of Relationship between Brain and Body Weight and Glucoses, Including Both FPG and PPG

The relationship between the brain and body weight and glucose regulation, including fasting plasma glucose (FPG) and postprandial plasma glucose (PPG), involves a complex interplay of neuroendocrine, autonomic, and behavioral mechanisms. The brain plays a pivotal role in regulating energy balance, glucose metabolism, and insulin sensitivity through the coordination of various neurological pathways. Here are some key neurological explanations for the relationship between the brain and these metabolic factors:

2.1 Hypothalamus

The hypothalamus is a key brain region that integrates peripheral signals related to energy balance, glucose metabolism, and insulin action. Neuronal circuits within the hypothalamus sense circulating levels of hormones (e.g., leptin, insulin, ghrelin) and nutrients (e.g., glucose, fatty acids) and in response, modulate feeding behavior, energy expenditure, and glucose homeostasis. Dysregulation of these circuits can lead to changes in body weight and glucose dysregulation.

2.2 Autonomic Nervous System

The autonomic nervous system, particularly the sympathetic and parasympathetic branches, exerts direct control over glucose metabolism and insulin sensitivity. The brain, including the hypothalamus and brainstem, plays a crucial role in modulating autonomic outflow to regulate hepatic glucose production, peripheral insulin sensitivity, and glucose uptake in tissues. Dysregulation of autonomic control can contribute to abnormal glucose levels, both fasting and postprandial.

2.3 Neuroendocrine Regulation

The brain influences glucose metabolism through neuroendocrine pathways. For example, the hypothalamus signals the pituitary gland to release hormones that regulate glucose homeostasis, such as growth hormone and adrenocorticotropic hormone. Additionally, the brain's control of the adrenal gland and the release of cortisol can impact glucose metabolism and contribute to dysregulation of FPG and PPG.

2.4 Brain-Gut Interaction

The brain communicates with the gut and influences glucose regulation through the gut-brain axis. Enteroendocrine cells in the gastrointestinal tract release hormones like incretins in response to nutrient intake, which signal to the brain to regulate glucose metabolism and insulin secretion. Dysfunction in this communication can lead to aberrant postprandial glucose responses.

2.5 Behavioral Regulation

Higher brain regions, including those involved in reward processing and decision-making, influence eating behavior and physical activity, which in turn impact body weight and glucose regulation. Dysfunction in these brain circuits can lead to overeating, sedentary behavior, and weight gain, contributing to dysregulation of glucose metabolism and insulin sensitivity.

Overall, the relationship between the brain and metabolic factors such as body weight, FPG, and PPG involves a sophisticated network of neuroendocrine, autonomic, and behavioral pathways. Disruption in these neuroregulatory processes can lead to alterations in glucose metabolism, insulin sensitivity, and body weight regulation, with potential implications for metabolic health and the development of conditions such as obesity and type 2 diabetes. Understanding the neurological aspects of these relationships is crucial for developing targeted interventions to manage metabolic disorders and promote overall metabolic health.

3. Neurological Explanation of Relationship between Brain and Blood Pressure, Blood Lipids

The relationship between the brain and blood pressure/blood lipids involves a complex interplay of neurological, biochemical, and physiological mechanisms. The brain plays a central role in regulating blood pressure and lipid metabolism through the coordination of various neural pathways and signaling molecules. Here are some key neurological explanations for the relationship between the brain and these cardiovascular factors:

3.1 Autonomic Nervous System

The autonomic nervous system, which consists of the sympathetic and parasympathetic branches, exerts direct control over blood pressure regulation. The brain, particularly the medulla oblongata in the brainstem, plays a crucial role in integrating sensory input and modulating autonomic outflow to regulate heart rate, peripheral vascular resistance, and blood pressure. Additionally, the brainstem is involved in coordinating cardiovascular responses to changes in blood pressure and blood volume.

3.2 Baroreflex Mechanism

The brain, particularly the medullary cardiovascular centers, is responsible for the baroreflex, a vital mechanism that helps maintain blood pressure within a narrow range. Baroreceptors located in the carotid sinus and aortic arch relay information to the brainstem, where autonomic adjustments are made to regulate blood pressure. These adjustments involve changes in heart rate, vascular tone, and sympathetic/parasympathetic activity.

3.3 Central Regulation of Lipid Metabolism

The hypothalamus, a region of the brain involved in regulating homeostasis and metabolism, plays a critical role in the central control of lipid metabolism. Neuronal circuits within the hypothalamus sense circulating levels of hormones and nutrients, and in response, modulate feeding behavior, energy expenditure, and lipid storage. Dysfunction in these pathways can contribute to dyslipidemia and metabolic disturbances.

3.4 Neuroendocrine Regulation

The brain influences blood lipid levels through neuroendocrine pathways. For example, the hypothalamus signals the pituitary gland to release hormones that regulate lipid metabolism, such as growth hormone and adrenocorticotropic hormone. Additionally, the brain's control of the adrenal gland and the release of cortisol can impact lipid metabolism and contribute to dyslipidemia.

3.5 Neuroimmune Interactions

Emerging evidence suggests a bidirectional interaction between the brain, the immune system, and metabolic pathways. Neuroinflammation and immune activation in the brain can influence peripheral lipid metabolism and contribute to dyslipidemia. Conversely, dyslipidemia and metabolic factors can impact neuroinflammatory pathways and contribute to neurodegenerative diseases.

Overall, the relationship between the brain and cardiovascular factors such as blood pressure and blood lipids involves intricate neurological pathways and regulatory mechanisms. Disruption in these neuroregulatory processes can lead to alterations in blood pressure and lipid metabolism, with potential implications for cardiovascular health and neurological function. Additionally, understanding the neurological aspects of these relationships is critical for developing targeted interventions to manage cardiovascular and metabolic disorders.

4. 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 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.

5. 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.

6. 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.***

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).***

7. Results

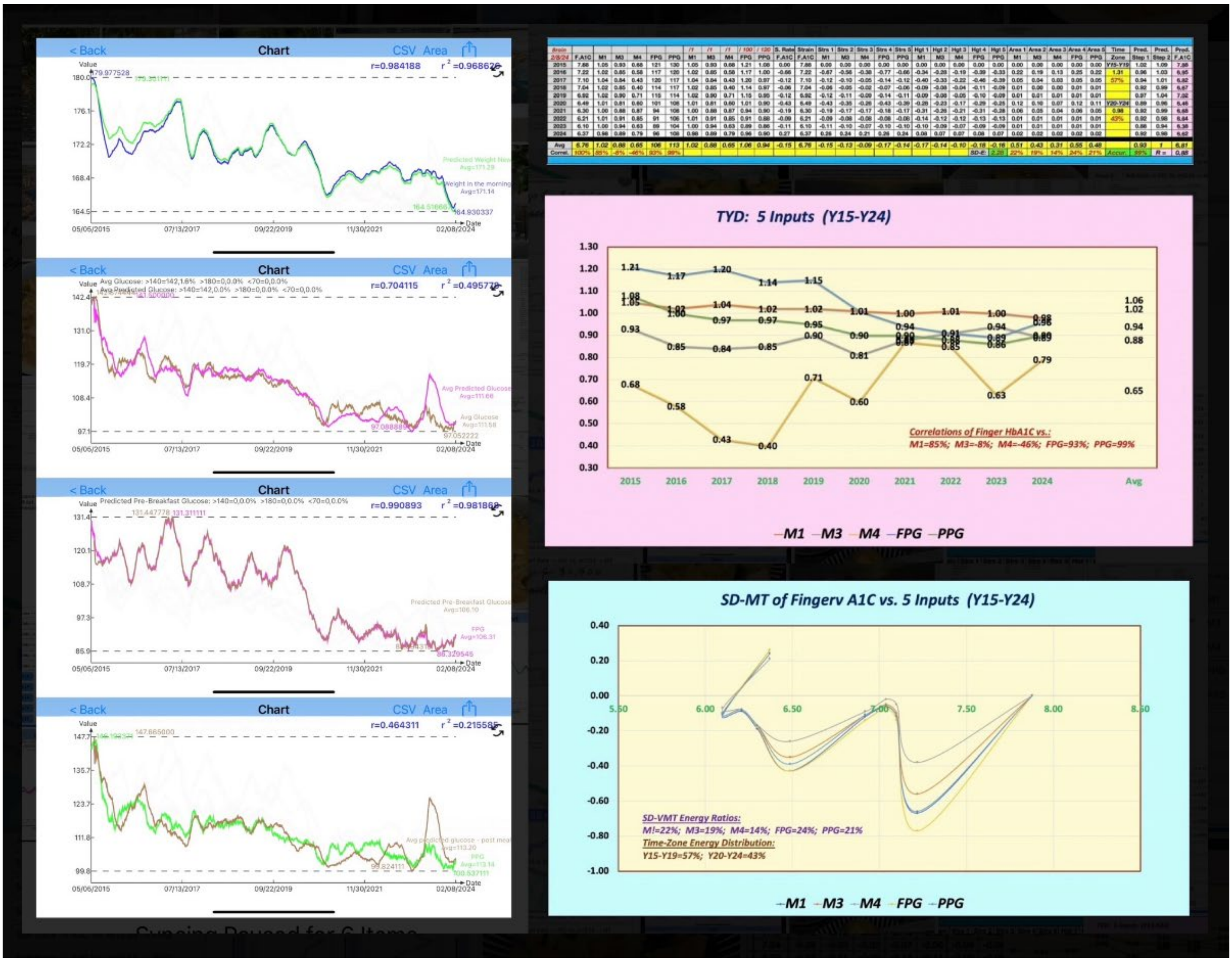

Figure 1. shows Data table, TD and SD results.

8. Conclusions

In summary, the SD-VMT energy ratios of finger glucose based HbA1C versus 5 influential factors are:

Body weight (M1): 22%,
Blood pressures (M3): 19%,
Blood Lipids (M4): 14%.
FPG: 24%
PPG: 21%

Time-zone energy distributions are:

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Y20-Y24: 43%

Key Message

Brain is the most important organ which controls all functions of human body. A good understanding of brain functions and their relationship with other organs are useful for our health maintenance and improvements.

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.

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