The GH-Method

Viscoplastic Medicine theory (VMT #199): Application of Food Technology to Control Type 2 Diabetes Using Collected Data Between Y2015 and Y2023 While Applying Optical Physics, Wave Theory, Energy Theory, Artificial Intelligence, Big Data Analytics, and the Space-Domain Energy Model of Viscoplastic Medicine Theory Based on GH-Method: Math-Physical Medicine (No. 794)

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Abstract

Between 5/8/2015 and 1/23/2023, the author has collected 8,871 meal pictures which contain 4,258 billion digits of data (20*24*8871). With his limited knowledge of botany (plant biology), the author at least understands that the molecular structures inside plant or food determine the type and strength of ingredients of plant & food. The ingredients inside would appear to the outside world through different colors. Using his knowledge of optical physics, he can further analyze each color's optical wave by its 3 key elements, i.e. frequency, amplitude, and wavelength. At this stage, he can then link the food optical wave pattern with his collected big data from his meal pictures to conduct necessary numerical analysis. That is how the author has successfully figured out the carbohydrates and sugar amount in his consumed meals, through his collected 8,871 meal pictures. Moving further ahead, the post-meal glucose (PPG) level depends on both carbs/sugar amount (carbs) and post-meal walking exercise level (steps). He has learned that his fasting glucose in the early morning (FPG) can serve as the baseline of the estimated PPG value. He then applies the linear elastic glucose theory (LEGT) from strength of materials in mechanical engineering to calculate his predicted PPG at below: Predicted PPG = FPG * GH.f + carbs/sugar * GH.p - steps * GH.p, where GH.f, GH.p and GH.w are 3 independent modular to convert food ingredients and exercise level into PPG value. He then applies the space-domain viscoplastic medicine theory (VMT) to calculate relative contribution percentages from both carbs/sugar and walking steps on the measured PPG. Finally, he conducts an analysis of TBR # (<70 mg/dL), TAR # (>180 mg/dL), and TIR # (glucose <180 & > 70). These three numbers (#) are defined as: TxR # = TxR averaged glucose * TxR % of occurrence, where TxR is "Time x Range" and x = below (B), above (A), or in (I). In summary, there are 5 conclusions: (1) The optical physics knowledge-based artificial intelligence tool (AI) has reached to a 99.4% prediction accuracy in comparison with the food nutrition knowledge-based natural intelligence tool (NI). (2) Using LEGT method, his predicted PPG versus finger-pierced PPG has reached an 87% correlation coefficient and a 99.6% prediction accuracy. (3) Using Space - VMT, the degrees of influence or contribution are 59% from carbs and 41% from steps. (4) Using time-zone energy analysis, the pre-COVID period of earlier 4+ years (Y15-Y19) contributes 58% while the COVID period of recent 3+ years (Y20-Y23) contributes 42%. (5) Using TxR analysis, his probability of being health is 90% (TIR #), his probability of developing into various deadly complications such as CVD, CKD, and even Cancers is 7%, and his probability of sudden death from insulin shock is 2%. This article has demonstrated the usefulness and high degree of accuracy of carbs/sugar amount determination and PPG prediction using the optical physics AI tool, LEGT, and VMT on this important biomarker of glucose. It also proves that an ultimate mortality study is feasible starting from food quality research via optical physics AI technology, big data analytics, physics theories and engineering models.

Keywords: Viscoelastic; Viscoplastic; Postprandial plasma glucose; Fasting plasma glucose; Diabetes

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Abbreviations: PPG: postprandial plasma glucose; FPG: fasting plasma glucose; AI: artificial intelligence; TD: time-domain; SD: space-domain; FD: frequency-domain; CGM: continuous glucose monitoring

1. INTRODUCTION

Since 5/8/2015, the author has collected thousands photos of his consumed food and meals using an iPhone. As of 1/23/2023, he has already collected 8,871 food pictures. Using iPhone 13 as an example, each photo has 20 million pixels and each pixel contains 24 alpha-numerical digits. Therefore, he has collected and stored 4,258 billion digits of data (20*24*8871) in a remote cloud server for his research usage. Analysis based on this huge amount of data is certainly qualified as "big data analytics".

The author does not have strong academic training in botany, biology, and chemistry; instead, mathematics, physics, and engineering are his strong suits. With his limited knowledge of botany (plant biology), he at least understands that the molecular structures inside plant food determine the type and strength of plant ingredients. The ingredients inside would appear to the outside world through different colors. That is why the author has tried to understand the food ingredients through food colors. Using his physics knowledge, he can further analyze each color's optical wave by three key elements, frequency, amplitude, and wavelength. At this stage, he can then link the food optical wave pattern with his collected big data from food photos to conduct necessary numerical analysis. Each unique wave in the time domain (the x-axis is time and the y-axis is the wave's amplitude) can be transformed into the frequency domain (the x-axis is the frequency and the y-axis is the wave's associated energy) through Fourier transform operation.

The above descriptions link food pictures, big data, and food optical waves to determine food ingredient amounts, such as carbohydrates and sugar amounts (grams) from his individual meal photo.

Moving further ahead, the postprandial plasma glucose (PPG) level depends on both carbs/sugar amount (carbs) and post-meal walking exercise steps (steps). Based on his previous research, the fasting plasma glucose (FPG) in the early morning can serve as the baseline of the estimated PPG. He then applies the linear elastic glucose theory (LEGT) from strength of materials in mechanical engineering to calculate the predicted PPG as described by the following equation:

Predicted PPG
= FPG * GH.f + carbs/sugar * GH.p - steps * GH.p

Where GH.f, GH.p and GH.w are 3 independent modular to convert food ingredients and exercise level into PPG. All of these 3 moduli depend upon the patient's conditions, history, and certain external influential factors.

After obtaining the predicted PPG using the optical physics AI technology, he can calculate his prediction accuracy of PPG using this optical physics AI tool.

He then applies the space-domain viscoplastic medicine theory (VMT) to calculate relative contribution percentages from both carbs/sugar and walking steps on the measured PPG.

Finally, he conducts an analysis of time below range TBR # (<70 mg/dL), time above range TAR # (>180 mg/dL), and time in range TIR # (glucose <180 & > 70). These three numbers (#) are defined as:

TxR # = TxR averaged glucose * TxR % of occurrence

Where TxR is "Time x Range" and x = below (B), above (A), or in (I).

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 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 accuracy of optical physics AI tool and predicted PPG.

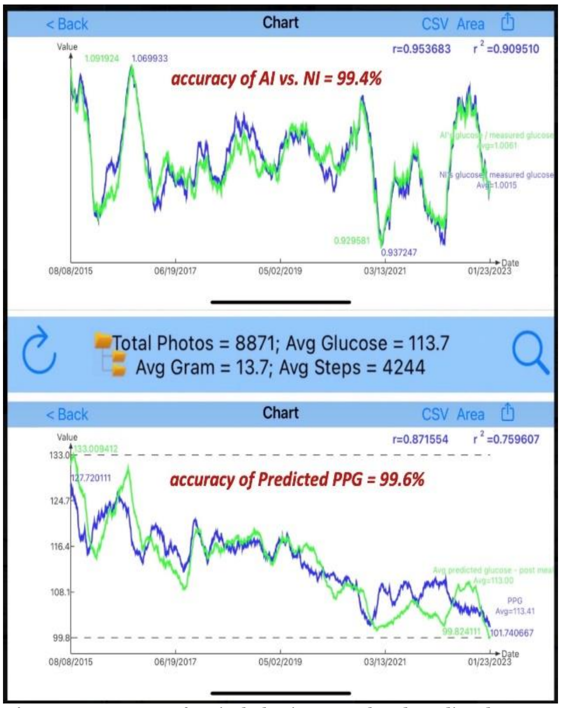

Figure 1: Accuracy of optical physics AI tool and predicted PPG.

Figure 2 shows SD-VMT energy distribution and TxR analysis results.

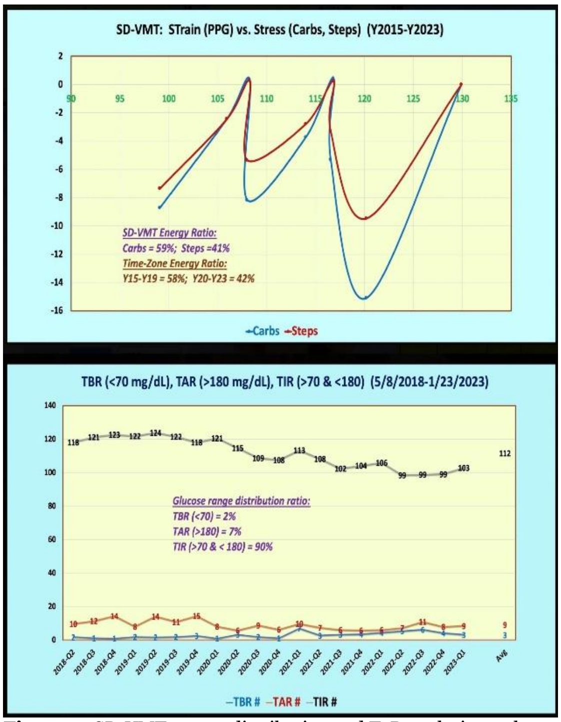

Figure 2: SD-VMT energy distribution and TxR analysis results.

4. CONCLUSION

In summary, there are 5 conclusions:

(1) Using 8,871 meal photos and their associated 4,258 billion digits data, the optical physics knowledge-based AI tool (AI) has reached to a 99.4% prediction accuracy in comparison with the food nutrition knowledge-based natural intelligence tool (NI).

(2) Using the LEGT method, his predicted PPG versus finger-pierced PPG has reached an 87% correlation coefficient and a 99.6% prediction accuracy.

(3) Using Space-domain viscoplastic medicine theory, the energy distribution ratio (i.e. degree of influence or degree of contribution) is 59% from carbs and 41% from steps. According to some medical research study findings, there are 8 physiopathological pathways identified for influencing glucose or diabetes condition. Among them, all 8 pathways (62%) are related to diet and only 5 pathways are related to exercise (38%).

(4) Using time-zine energy analysis, the pre-COVID period of 4+ years (Y15-Y19) contributes 58% while the COVID period of 3+ years (Y20-Y23) contributes 42%.

(5) Using TxR analysis, his probability of staying healthy is 90% (TIR #), his probability of developing into various deadly complications such as CVD, CKD, and even Cancers is 7%, and his probability of sudden death due to insulin shock is 2%.

This article has demonstrated the usefulness and high degree of accuracy of carbs/sugar amount determination and PPG prediction using the optical physics AI tool, LEGT, and viscoplastic medicine theory on this important biomarker of glucose. It also proves that an ultimate mortality study is feasible starting from food quality research via optical physics AI technology, big data analytics, physics theories, and engineering models.

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 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).

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