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Research Article

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Effect of Psychological Behavior Intervention on the Control of Chronic Diseases Resulting from the Adherence to Lifestyle and Medication Including Geriatric Longevity Study Via Effective Health Age, Using GH-Method: Math-Physical Medicine or Mentality-Personality Modeling (No. 392)

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Abstract

In this article, the author uses his 11 years of collected data from body weight and glucose with several prominent lifestyle details, mainly food portion/carbs & sugar intake amount, and daily/post-meal walking steps to address the reduction trend patterns of weight and glucose. This research project is based on progressive behavioral modifications of his lifestyle which is also a part of his developed Mentality-Personality Modeling (MPM) of psychology. He identified the quantitative linkage between the physiological phenomena of obesity and diabetes and their associated psychological lifestyle behavioral interventions of a patient with both obesity and type 2 diabetes (T2D). The physiological part uses his developed GH-Method: math-physical medicine (MPM) research methodology.

In addition, he utilizes the signal processing technique of wave theory to decompose the postprandial plasma glucose (PPG) wave into three primary sub-waves of food, exercise, and medications. Furthermore, he used his developed linear elastic glucose theory (LEGT) in 2020 to study the impact and adherence of medications on T2D for elderly patients.

To address the common concern of longevity among elderly people, he further applied his metabolism index (MI) model developed in 2014 to calculate the effective health ages of elderly people in comparison with their real biological ages in terms of reducing or prolonging their perspective lifespan.

For this research process, he creates a special geometric presentation model with the meal portion percentage and carbs/sugar intake amount as the x-axis, daily walking steps and post-meal walking steps as the y-axis, and daily weight and glucose data as the z-axis. He then "folds over" the z-axis and superimposes it with the x-y planar space in a "radio wave" format. These radio waves represent the different annual statuses of both weight and glucose. Under this created three-dimensional (3D) presentation on a two-dimensional (2D) planar space, the biomarker improvement patterns and moving trend of biomarkers, such as weight, glucose, and effective health age become ultra-clear. For effective health age, the same "pseudo-3D" geometric presentation model also applies. Instead, we can use medical conditions as the x-axis and lifestyle details as the y-axis.

Over the past 11 years (2010 - 2020), the path of his annual weight and glucose moving patterns started from the upper right corner (subregion E5 in 2010), moving with a downward angle of 30 to 45 degrees, and finally reaching the lower left corner (subregion A1 in 2020).

Through analyzing the distinctive daily weight and glucose trend patterns, the personality traits and related psychological behavior characteristics of this patient with both obesity and T2D can be revealed instantly and clearly. As a result, more practical guidance on progressive behavior modification can be provided to other patients to improve their medical conditions for chronic diseases, where some are caused by obesity.

He was dependent on diabetes medications from 2010 through 2015 with a reduction trend pattern in the types and dosages of medications. Finally, on 12/8/2015, he ceased taking any medications for his chronic disease control. The author's collected detailed data on diet, exercise, and medications began in 2014. From the decomposed PPG sub-component waves, during 2014-2015, the medication contributed a -21 mg/dL of PPG reduction. Thereafter, the combined contribution of diet and exercise replaced the role of medication.

It should be noted that his collected data covered the period of 2010 through 2020 where his real age was 63 to 73 years old. Therefore, the results from this research note are based on the realistic data of an elderly person.

This longevity study using the effective health age (eclaireMD APP tool) demonstrates that in 2012, his effective health age was 75, which is 9 years older than his real biological age of 66. However, in 2020, his effective health age of 63 became 10 years younger than his real biological age of 73. In other words, over 9 years (2012-2020), he gained 19 years of life expectancy through a stringent lifestyle management program, without adherence to any medication.

Introduction

In this article, the author uses his 11 years of collected data from body weight and glucose with several prominent lifestyle details, mainly food portion/carbs & sugar intake amount, and daily/post-meal walking steps to address the reduction trend patterns of weight and glucose. This research project is based on ***progressive behavioral modifications*** of his lifestyle which is also a part of his developed Mentality-Personality Modeling (MPM) of psychology. He identified the quantitative linkage between the physiological phenomena of obesity and diabetes and their associated psychological lifestyle behavioral interventions of a patient with both obesity and type 2 diabetes (T2D). The physiological part uses his developed GH-Method: math-physical medicine (MPM) research methodology.

In addition, he utilizes the signal processing technique of wave theory to decompose the postprandial plasma glucose (PPG) wave into three primary sub-waves of food, exercise, and medications. Furthermore, he used his developed linear elastic glucose theory (LEGT) in 2020 to study the impact and adherence of medications on T2D for elderly patients.

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Method

GH-Method: Math-Physical Medicine (MPM) Methodology

To learn more about the author's developed GH-Method: math-physical medicine (MPM) methodology, readers can refer to his articles to understand his developed MPM methodology in References 1 and 2.

Obesity & Diabetes Research

Since 1995, the author was a severe T2D patient, who was also obese. He developed many serious complications and finally, in 2010, they became life-threatening. Therefore, he spent the next eleven years self-study and researching obesity, diabetes, metabolism, and endocrinology to save his own life. He studied the following relationships between cause/reason and consequence/result (from top to bottom):

- Poor Lifestyle management
- Metabolic disorder
- Obesity
- Chronic diseases
- Complications
- Weak Immunity
- Various diseases leading to death

His first priority was to focus on learning both lifestyle and metabolism before dealing with his obesity and diabetes issues. He was then able to concentrate on his parallel research on obesity and diabetes.

The author immigrated to the United States as a young student with a body weight of 145 pounds and a BMI of 20.8. By 2010, he has had diabetes for over 15 years and weighed 220 pounds or a BMI of 32.5.

He then spent his first four years, from 2010 to 2013, self-study six chronic diseases, i.e., obesity, diabetes, hypertension, hyperlipidemia, cardiovascular diseases, stroke, as well as food nutrition. Food is probably the most important and complicated input element to influence these chronic diseases. After his first 4-years of self-study, he then spent the entire year of 2014 developing a complex model of metabolism. This mathematical model contains four biomarkers of medical conditions along with six lifestyle details. He applied the concept of topology and the engineering modeling technique of the finite element method to develop this metabolism model which became the cornerstone of his future medical research work. His overall health conditions started to improve remarkably after 2014.

Starting in 2015, he spent three consecutive years, from 2015 to 2017, exploring and discovering key characteristics and behaviors of this complex "wild beast" of glucose. His major objective is to truly understand the "inner and external characteristics" and the "root cause" of hyperglycemia, not just use the medication's chemical power to control the external biological "symptoms" of diabetes. His research work is similar to a horseman trying to tame a horse by understanding its temperament first, not just giving a tranquilizer to calm it down. As a result, during this period of 3-years, he has developed four prediction models, which include Weight, PPG, FPG, and HbA1C with an extremely high prediction accuracy (95% to 99%) to reach his purpose of *understanding glucoses.*

He estimated and proved that PPG contributes approximately 75% to 80% towards HbA1C formation. Therefore, he tried to unravel the mystery of PPG first. Through his diabetes research, he has identified at least 19 influential factors associated with PPG formation. Among those influential factors, diet (carbs/sugar intake amount) would provide ~38% and exercise (post-meal walking) would contribute ~41%. Combining these two primary influential factors, it covers ~80% of the PPG. Among the rest

of the 17 secondary factors, a "high" weather temperature would contribute ~5%, whereas poor sleep, high stress, and physical illness only make noticeable contributions when they occur.

For most T2D patients who take medications, its biochemical effect would become the most powerful and significant influential factor on the symptoms. However, as we know, medication cannot cure diabetes and only subdue or tame its external symptoms. Therefore, the author decided to focus on controlling diabetes at the most fundamental level by investigating its root causes. Previously, he has taken high doses of three prescribed diabetes medications for 18 years since 1997; however, in 2013, he started to reduce the number of prescriptions and dosages of his daily medications. By 12/8/2015, he finally ceased taking any diabetes medications.

From 2016 to 2017, he discovered a solid statistical connection between his FPG and his body weight with a >90% correlation coefficient. In addition, similar to his PPG research, he also recognized that there are about five influential factors of FPG formation with weight alone contributing >85% and "cold" weather temperature influencing ~5%.

A detailed explanation of his glucose research is provided here because weight and glucose are intertwined together and are based on lifestyle management which leads to metabolism balance. To achieve metabolism balance, we must pay attention to our metabolism using the concept of energy theory. A simple statement is that when we receive energy infusion through food, we must then expend energy via exercise.

Metabolism Model

In 2014, the author applied a topology concept of mathematics and finite-element method of engineering, to develop a ten-dimensional complex mathematical model of metabolism which contains four output categories (weight, glucose, BP, and lipids) and other lab-tested data (ACR, TSH, and others), and six input categories (food, water intake, exercise, sleep, stress, and routine life patterns), and in total, about 500 detailed elements. He has further defined two new parameters, metabolism index (MI), as the combined score of the above 10 metabolism categories and 500 detailed elements, and general health status unit (GHSU), as the 90-day moving average value of MI. Please noted that Mi (where i = 1 through 10) represents the individual metabolism score of each category. Since 2012, he has collected ~2 million data on his own biomedical conditions and personal lifestyle details. He utilized this sophisticated metabolism index (MI) model to calculate his risk probabilities of having cardiovascular disease (CVD), stroke, chronic kidney disease (CKD), and even metabolic-induced cancers (~40% of total cancer cases). All of the metabolism features (lifestyle inputs and medical conditions outputs) are interrelated, which is similar to the internal organs and chronic diseases.

Weight and Glucose Trend and Pattern Analysis

A typical patient with chronic disease faces three major challenges:
(1) Availability of accurate and precise disease information with either physical evidence or quantitative proofs, not just some general qualitative descriptions that may include false or commercial driven news over the internet (*a knowledge issue*).
(2) Awareness of the disease's specific status and overcoming self-denial to take effective actions. The most difficult part to overcome this hurdle is having willpower, determination, and persistence in lifestyle change (*behavior issues*).
(3) An effective, and ease-of-use technology-based tool to accurately predict biomedical outcomes and also guide patients (*a technology issue*).

The MPM methodology and its related diabetes research work cover the scope of this first issue, knowledge. The third issue, technology, has also been discussed and addressed in his previously published medical papers (Reference 3). This investigation report addresses the second issue, psychological behavior, specifically a patient's lifestyle behavioral intervention on his diet, exercise, and medications. Beyond acquiring accurate and sufficient knowledge of obesity and diabetes, the resistance to food temptation and diligence with daily exercise affect every patient daily. Both of these lifestyle behaviors regarding food and exercise require strong determination, willpower, and persistence to achieve the goal of controlling obesity and diabetes. These concerns are related to a patient's personality traits; however, lifestyle habits and behaviors can be learned and gradually modified (References 11 to 14).

The author has collected a total of two million data on his medical conditions and lifestyle details over the past 11 years (2010 to 2021). In this particular study, he only utilized three subsets of his collected and stored big data in a cloud server: body weight measured in the early mornings before breakfast, FPG in the early morning, meal portion percentage of the amount of his "normal" meal, and the daily total number of walking steps. For his glucose control, he measures his glucose four times a day, FPG in the morning and three PPGs at two hours after each meal, carbs/sugar intake amount for each meal, and daily three times a day of his post-meal walking steps. It should be noted that there are many different types of exercise. However, for elderly people like the author himself, who has suffered many severe diabetes complications in the past, found that walking is his best choice.

To demonstrate the results of his ***trend & pattern analysis,*** he created a modified 2D planar space that can present 3D data information. Initially, he set his x-coordinate as his meal portion percentage and carbs/sugar intake amount from low scale to high scale with five segments. Next, he set his y-coordinate as his daily walking steps and post-meal walking steps from high scale to low scale with 5 segments as well. Therefore, these x- and y-axes constitute a 2D planar space with a total of 25 sub-regions inside, such as A1 through E5. Lastly, he set his "pseudo-3D" z-coordinate as his daily body weight and average glucose levels from low scale (lower left corner) to high scale (upper right corner) in a "radio-wave" format with multiple segments.

In this special graphic presentation diagram, the reader of this article can easily observe the weight and glucose reduction trend and moving pattern from 2010 to 2020 along with their respective relationships with meals and exercises.

From observing this weight and glucose trend pattern diagram, patients can modify their behavior one step at a time, by taking little steps on a smaller scale. This is what the author defined as a "progressive behavior modification".

Behavior Psychology

On August 28, 2018, Dr. Bryn Farnsworth stated that "Behavioral psychology is the study of how our behaviors relate to our mind – it looks at our behavior through the lens of psychology and draws a link between the two."

FPM is an editorially independent, peer-reviewed journal published by the American Academy of family physicians. Here is an excerpt from the March-April 2018 edition, "Using these brief interventions, you can help your patients make healthy behavior changes" (Reference 10).

"Effectively encouraging patients to change their health behavior is a critical skill for primary care physicians. Modifiable health behaviors contribute to an estimated 40 percent of deaths in the United States. Tobacco use, poor diet, physical inactivity, poor sleep, poor adherence to medication, and similar behaviors are prevalent and can diminish the quality and length of patients' lives. Research has found an inverse relationship between the risk of all-cause mortality and the number of healthy lifestyle behaviors a patient follows."

Key Points

(1) Modifiable health behaviors, such as poor diet or smoking, are significant contributors to poor outcomes.
(2) Family physicians can use brief, evidence-based techniques to encourage patients to change their unhealthy behaviors.
(3) Working with patients to develop health goals, eliminate barriers, and track their own behavior can be beneficial.
(4) Interventions that target specific behaviors, such as prescribing physical activity for patients who don't get enough exercise or providing patient education for better medication adherence, can help patients to improve their health."

From the articles in References 10-13, we can see the close relationship between health and lifestyle behavior psychology.

However, the author feels that all of above excerpts are "qualitative" statements because they lack the needed "quantitative" proof and practical guidance with "precision" to persuade most patients.

PPG Decomposition and Study of Medication Contribution

In 2017, the author applied the signal processing technique of wave theory to decompose his collected PPG data and waveforms into 19 components or their sub-waves. Among them, the most prominent influential factors are three components: medication, diet, and exercise.

Medication adherence is a quick and powerful tool to treat symptoms of diabetes. However, based on his personal experience, pure medication intervention will not achieve the expected results without lifestyle management. It may be a fast and easy solution, but it will not last. The physician must continually change medications or adjust the dosage for progressive control of glucose levels. As a result, the internal organs are continuously damaged by chronic diseases. In his opinion, medication can only deal with the symptoms of chronic diseases as it is incapable of curing them and will not change their root causes. Only good lifestyle adherence can achieve the desired goal of "repairing" the damaged organs by recovering the overall health conditions, even though it is a slow process. Chronic diseases take a long time to become severe enough to damage the internal organs. When the symptoms appear, it would take even longer and require a bigger effort to repair or heal them. This is why the medical community labeled them as "chronic" diseases. The route of lifestyle changes and management requires strong willpower, persistence, knowledge, and discipline. The medication route is fast acting but it cannot repair the damaged organs, heal the "wounds", or make one healthy again. Then, why bother taking a pill? The author heard another disappointing argument that elderly people do not have many years left, so they do not need to consider the troublesome route of lifestyle. This statement is ridiculous because every life is precious, whether young or old, male or female. The author started his lifestyle adjustments when he was 63 years old. By the age of 67, he has already observed significant improvements. Between 70 to 73 years of age, he has reached the healthiest state in his past 30-year history. As a result, based on his longevity study using the effective health age approach, he has gained 19 additional years of perspective life. Who can say it is too late for any elderly person to start and try the lifestyle method?

Geriatrics and Longevity

From the Centers for Disease Control, the distribution map of chronic diseases for adults over 65 years (2007-2008) as follows:

A) Endocrine chronic diseases:
- Hypertension - 56%
- Heart diseases - 33%
- Cancer - 23%
- Diabetes - 19%
- Stroke - 9%

B) Non-endocrine chronic diseases:
- Arthritis - 49%
- Asthma - 11%
- Bronchitis - 9%

It is obvious that the endocrine-related chronic diseases are the major concerns.

The author became interested in geriatrics in 2019, especially regarding longevity. Since 2010, he studied and researched metabolism, endocrinology, and chronic diseases. His developed metabolism model in 2014 and his increased knowledge regarding chronic diseases during 2015-2018 allowed him to extend his research work into longevity and geriatrics beginning in 2019. He has found that his developed metabolism model is extremely useful for older adults (geriatric population) to keep their health conditions under control. The major differences between younger adults and elderly people are in the areas of aging influences and "abnormal" metabolism conditions associated with aging.

Therefore, the author has decided to expand and augment his AI system within three selected categories (exercise, regular check-ups, routine life pattern) and home safety to cover the geriatric concerns (Figure 1).

Figure 1 shows the screenshots of the EclaireMD APP regarding geriatric items. These augments can be used as a storage of input data for further data processing needs or as a reminder list for elderly people.

Figure 1: Three Geriatrics Augments in eclaireMD APP

First, the routine check-up for geriatric disorders includes the following pathophysiological changes:

(1) Cardiovascular and cerebrovascular
(2) Endocrine (glucose, BP, lipids)
(3) Brain and nervous system (dementia, pain)
(4) Mental functions (depression)
(5) Gastrointestinal
(6) Pulmonary
(7) Renal, urinary, and reproductive
(8) Sleep disorders
(9) Nutritional status & vitamin supplements
(10) Osteoporosis, musculoskeletal, dental, and integumentary
(11) Sensory changes (vision, hearing, taste, smell, touch)
(12) Emotional and psychological changes
(13) Special notes: Medications review (should be <4 different types & reduced dosage) and BMI (should be >20, but don't be too thin).

Second, to accommodate elderly people for the exercise requirement, he expanded the daily routine major exercise of "walking" to include tai-chi, yoga, water sports, and foot care to strengthen body balance, joint flexibility, and muscle strength (see list below).

Exercise for seniors is:
(1) Maintain major daily exercise (e.g., walking)
(2) Balance & joint flexibility (e.g., tai chi, yoga, water sports)
(3) Muscle and bone strength
(4) Feet, toenails, and comfortable shoes
(5) Physical therapy, if necessary.

Third, to prevent accidental injury or even fatality from falling, he added the following "Home Safety" items into his "Daily life routines".

Home safety for seniors:
(1) Avoid cords, wires, and loose rugs
(2) Install grab rails, and fall-proof devices
(3) Safe bath/shower room, use shower chair & bath brush for back and lower legs
(4) Good lighting
(5) Air conditioner and humidifier
(6) Cane or walker, walk on smooth and non-slippery pavements
(7) Caution with steps/stairs and moving traffic safety
(8) Emergency alarm or alert system linked to caretaker or healthcare personnel
(9) Easy accessibility for an ambulance.

The above-mentioned geriatric items serve as a daily status check or a reminder for elderly people to follow or install them. Through the eclaireMD APP on handheld devices, the overall quality of health and life extension for them can be easier to monitor and maintain.

In January 2020, he published his first paper on geriatrics, *Effective health age resulting from metabolic condition changes and lifestyle maintenance program (No.223),* and received interest from many readers and article reviewers.

Therefore, in July 2020, he decided to develop a simplified application software or the APP on the iPhone in estimating a patient's effective health age ("Health Age") with or without chronic diseases to compare against their biological real age ("Real Age"). He then published his work in his second geriatric paper, *Estimation of Metabolism Index and Effective Health Age using a simple APP tool on iPhone for chronic disease control and overall health maintenance (No. 292).* By using data from four key medical conditions based on the health examination reports of four biomarkers including weight, glucose, blood pressure, and lipids, along with six user input lifestyle details including food, water intake, exercise, sleep, stress, and daily life routines. This APP could instantly calculate and show both the metabolism index (MI) score and Health Age on an iPhone.

His third geriatric paper, *Calibrating the estimated health age via metabolism index using GH-Method: math-physical medicine (No. 313),* aims at calibrating the accuracy of his estimated health age by varying the amplification factor (AF) in his defined arithmetical formula:

Effective Health Age = Real Biological Age * (1+((MI-0.735)/0.735)/Amplification factor)

This "AF' is just a simple adjustment factor that makes the estimated health age to reflect the user's real medical and health conditions as accurately as possible. In the third paper, he tried 1, 2, and 4 as the AF values and found the AF value of 2 as the most suitable parameter to estimate his own health age.

As we know, metabolism is the fundamental building block for disease control, health maintenance, and longevity. The author spent three years developing this complex mathematical model of metabolism, and the simple formula above for estimating health age by himself; therefore, he must conduct research on this equation's most vital influential factor, metabolism indexes (m1 through m10). In his fourth geriatric paper, *"Comparison of effective health ages between the sophisticated model for researchers and simplified model for patients using GH-Method: math-physical medicine (No. 323)",* he focuses on the differences in metabolism indexes (m1 through m10) and their impact on health ages between the sophisticated software for researchers and simplified APP for patients.

A healthy person should have lower values on the biomarkers and lifestyle details, resulting in a lower MI score. The lower MI score is healthier, reflecting the health age to be lower than the real age and vice versa. By maintaining a good lifestyle program with healthy medical examination outcomes, the overall metabolism status will be better than the standard; therefore, the immune system will be strong and effective. With a strong immunity, the body will be able to defend against various diseases, including complications from chronic diseases (50% of death cases), cancers (29% of death cases), and infectious diseases (11% of death cases). As a result, by avoiding accidental deaths, healthy people will most likely become members of the "longevity club".

His complex mathematical metabolism model contains 10 categories and ~500 detailed input elements, while his simplified APP only requires 21 detailed input elements, about 4% of the originally developed model's requirements. Most users or patients do not want to be overwhelmed with a large amount of input data, except for scientific researchers. Obviously, by omitting 96% of the input data for "ease-of-use" concerns, this would hopefully only result in a "small" sacrifice for prediction accuracy. A portion of this specific longevity investigation is to decipher the amount of accuracy loss to the estimated health age by using the simple APP.

Results

Figure 1 shows the screenshots of the EclaireMD APP regarding geriatric items. These augments can be used as a storage of input data for further data processing needs or as a reminder list for elderly people.

Figure 2 depicts a sample calculation of effective health age using MI values of a corresponding year.

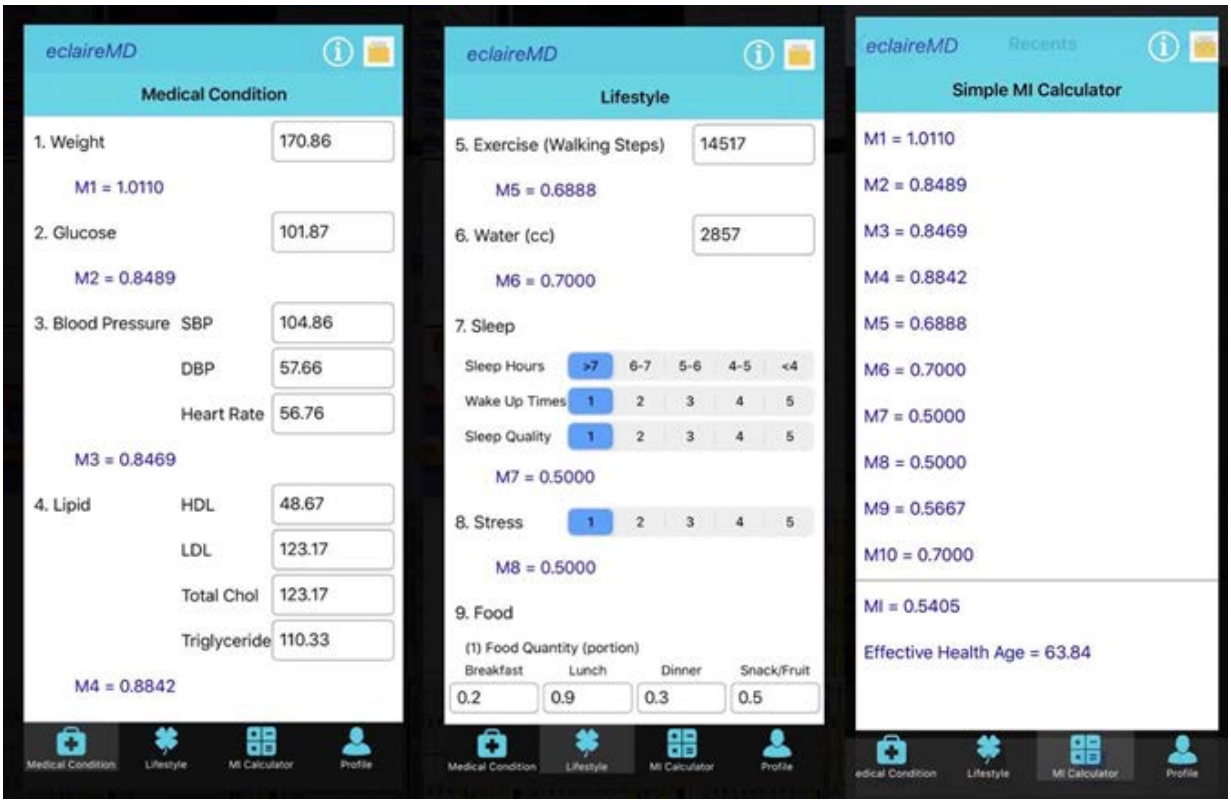

Figure 2: Effective Health Age Calculation in eclaireMD APP

Figure 3 illustrates the moving trend and pattern diagram of weight, glucose, and effective health age.

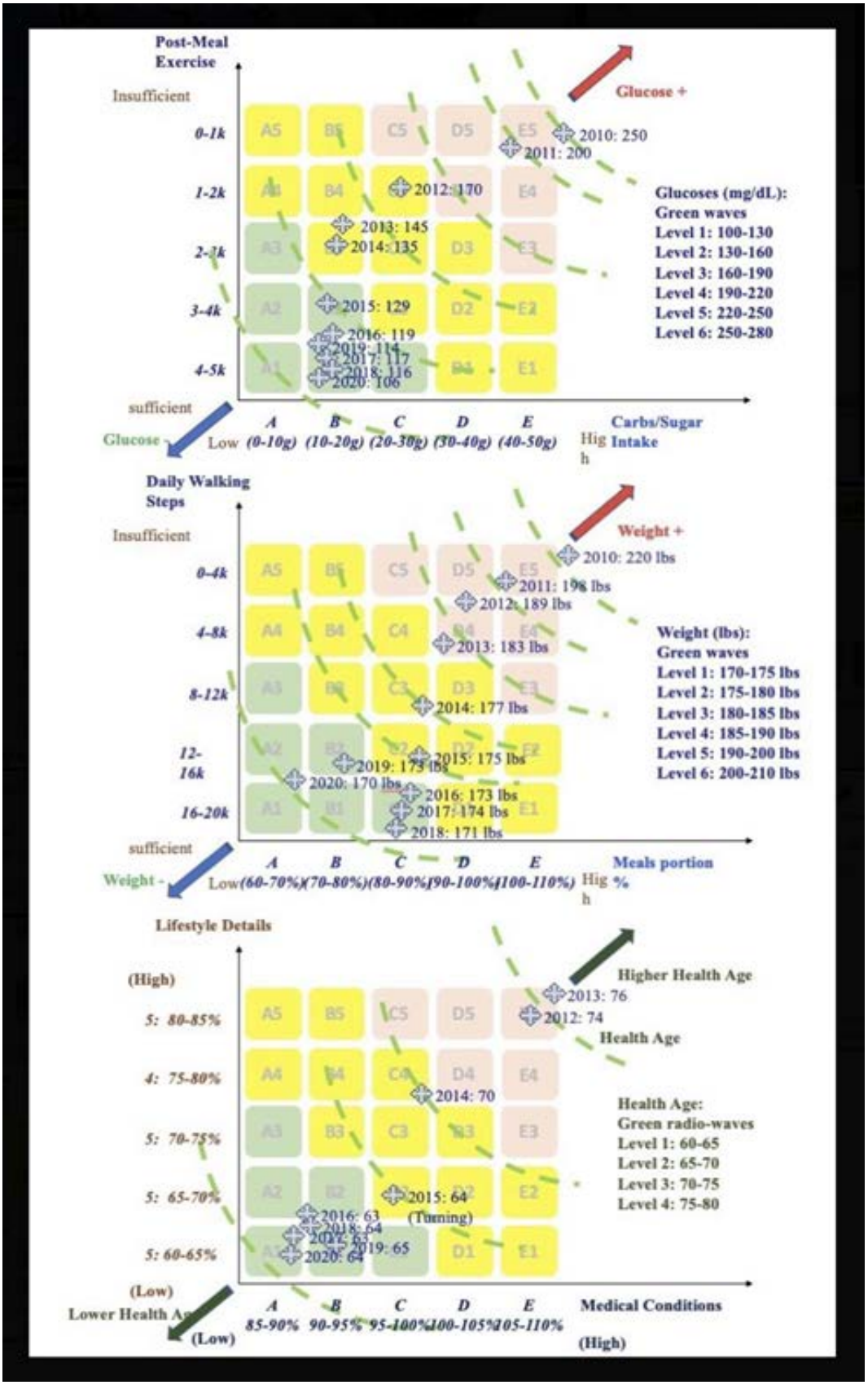

Figure 3: Pseudo-3D Presentation of Weight, Glucose & Health Age

In summary, the author's weight, glucose, and effective health age are moving along with similar paths.

Weight starts from the upper right corner of 220 lbs. in 2010, following a 30-degree downward angle to reach the reflection point of 177 lbs. in 2014, and then zig-zagging on a downward path to reach the lower left corner of 170 lbs. in 2020.

Glucose starts from the upper right corner of 250 mg/dL in 2010, following a 45- degree downward angle to reach the reflection point of 135 mg/dL in 2014, and then trending straight down to the lower left corner of 106 mg/dL in 2020.

Health age starts from the upper right corner of 74 years old in 2010 when his real age was 65 (age difference +9), following a 45-degree downward angle to reach the reflection point of 64 years old in 2015 when his real age was 68 (age difference -4), before reaching the lower left corner of 64 years old in 2020 when his real age was 73 (age difference -9). Please note that the age difference of 1 year is due to the slight difference of Mi values used in the calculation, i.e., annual data in excel calculations versus the daily data in the EclaireMD APP.

Both the weight and glucose reduction in this trend pattern diagram demonstrate what he has previously stated, *"to control obesity and diabetes from the most fundamental core level by reducing food portion and increasing exercise level."* It should be noted that medication has played an insignificant role in this analysis over 9 years, except during 2014-2015. The major contribution comes from lifestyle improvements.

In Figure 4, he combined three figures into one diagram. It provides a more detailed illustration of glucose, diet, and exercise.

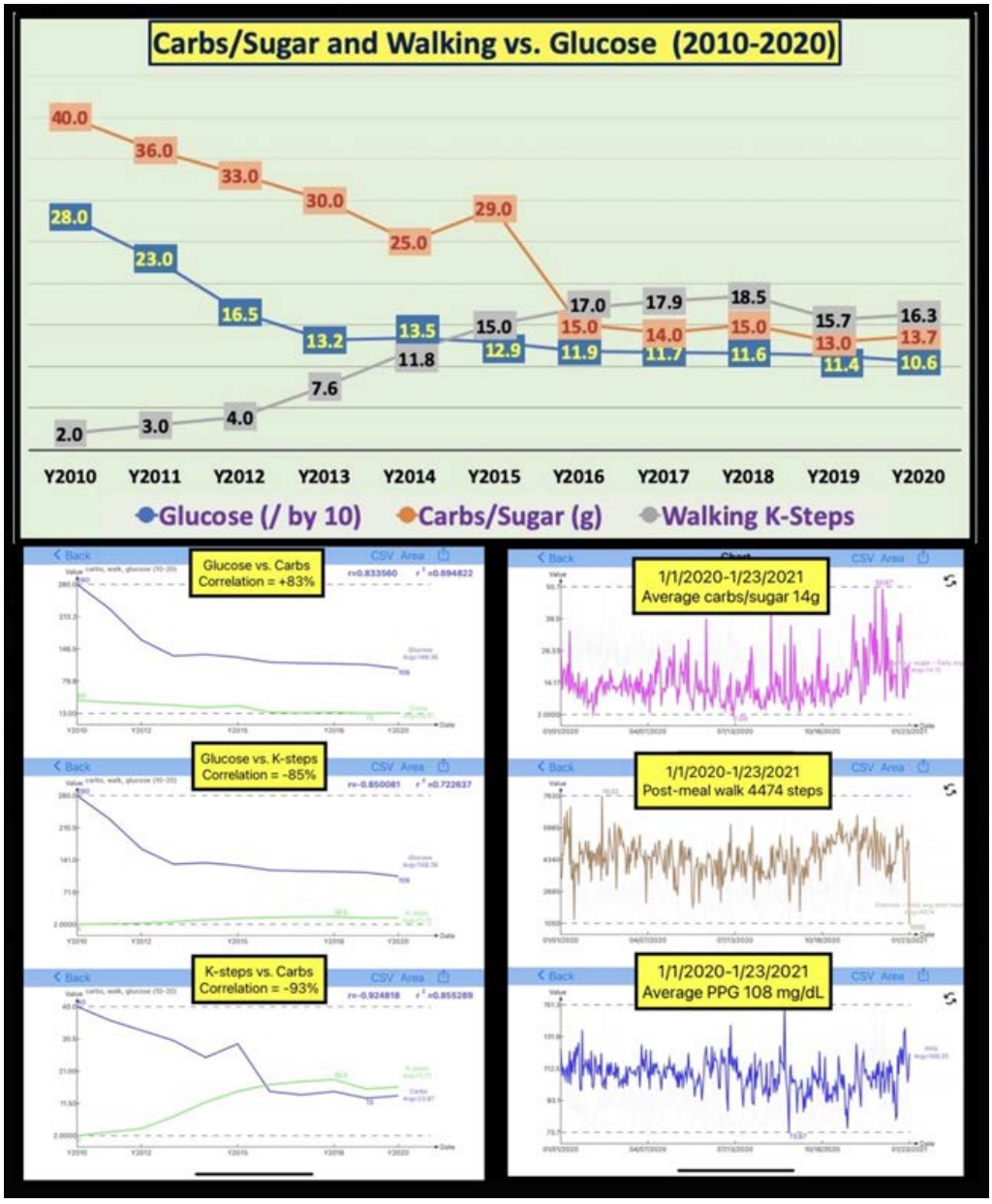

Figure 4: Relationship Between PPG and Carbs/Sugar and Walking

The lower left chart supports the upper diagram by three correlation coefficients as follows:

Glucose vs. Carbs/sugar: +83%
Glucose vs. Walking: -85%
Carbs/sugar vs. Walking: -93%

The above correlations not only prove the tight relationship between any two variables (either positive or negative), but they also indicate their strength of correlations.

The lower right chart shows his record for the special year of 2020. Due to the COVID-19 quarantine lifestyle, he has reached the best health conditions, including diabetes control for the past 30 years. His average carbs/sugar intake amount per meal was 14 grams and post-meal walking was 4,474 steps with an average PPG was 108 mg/dL (his daily glucose was 106 mg/dL), without medication intervention. This is the ultimate proof of diabetes control via lifestyle management instead of medication intervention.

Figures 5 and 6 further analyzed medication contribution to the PPG formation during the period from 6/1/2015 through 1/24/2021. Using the signal processing technique of wave theory, he has chosen to plot out only three major influential factors of PPG: medication, diet, and exercise.

As he described earlier, he started to take diabetes medication, Metformin, in 1997. Due to his uncontrolled hyperglycemia, his physician later added Januvia and Actoplus MET in early 2000. By 2010, his PPG reached 280 mg/dL with a daily glucose level of 250 mg/dL and HbA1C of 10%, while the other biomarkers for triglycerides were 1161 and ACR 116. By 2010, he suffered five cardiac episodes, renal problems, diabetic retinopathy, foot ulcer, bladder infection, and other complications. In mid-2019, he made a critical decision to save his own life through stringent lifestyle improvements. Starting in 2013, he cut off Januvia and followed by Actoplus MET. He also reduced the dosage of Metformin from 1000+ mg gradually down to 250mg by cutting a pill in half. Finally, on 12/8/2015, he totally ceased all diabetes medication.

The medications he took during 1997-2015 is shown in the lower part of Figure 5. The data explanation of medication contribution to his PPG formation during the one month from 6/1/2015 to 7/1/2015 is reflected in the top table of Figure 5. Using his developed linear elastic glucose theory (LEGT) in 2020, the top table also shows the different contribution levels of carbs/sugar intake amount, post-meal walking steps, and diabetes medication during this one month (<500 mg of Metformin). It also indicates the health status of his pancreatic beta cells at that time, i.e., 97% of FPG as the baseline PPG. The following list repeats the same information from this data table, where the LEGT equation is:

Predicted PPG = Baseline PPG (beta cells health status = GH.i Modulus * FPG) + (GH.p Modulus * carbs/sugar intake) - (post-meal K-steps * 5) - (Medication contribution)

And the computed data results are:

97% of FPG (87%) = 112 mg/dL;
12.4 g of carbs (23%) = 30 mg/dL;
700 walk-steps (3%) = 3 mg/dL;
Medication (8%) = 10 mg/dL;
PPG (both measured and predicted) = 129 mg/dL

Without Metformin (250mg - 500mg) in June of 2015, his PPG would be 139 mg/dL (i.e. 129+10). As a comparison, in 2010, his average PPG was 280 mg/dL while being on three different types of medications at full dosages without any meaningful lifestyle intervention. He could not even imagine how bad his hyperglycemia situation would be without any medication intervention at that time. That was why he suffered from various diabetic complications before 2010.

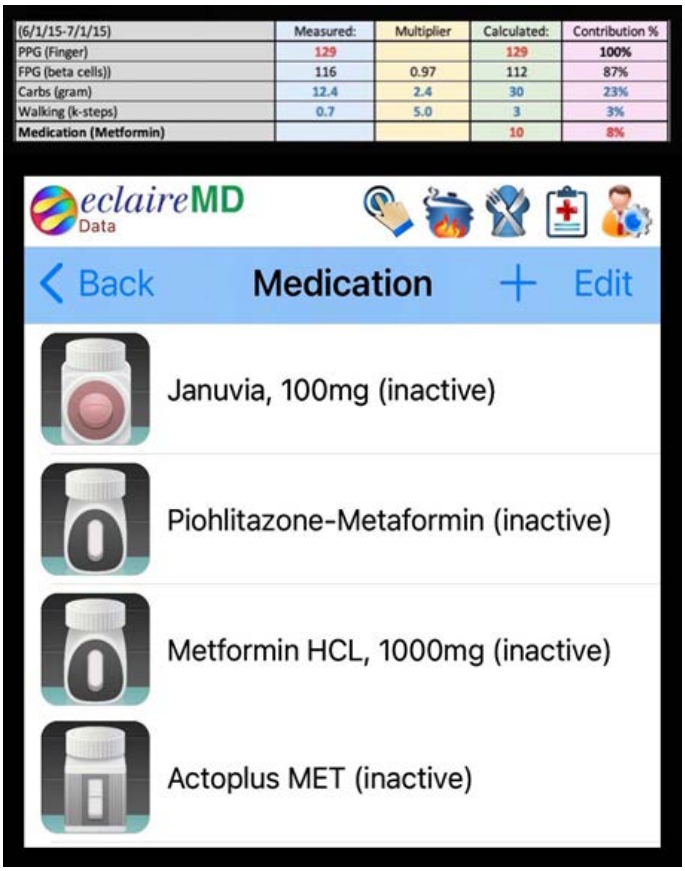

Figure 5: Diabetes Medications and their Contribution to PPG (10%) During 6/1-7/1/2015

From Figure 6, the pink curve in the top diagram is the medication component's sub-wave. In the beginning, medication contributes -21 mg/dL to his PPG formation. It was a noticeable contribution; however, his average PPG was still at 146 mg/dL on 6/1/2015 and 129 mg/dL for June 2015. After 12/8/2015, the pink medication curve turned into a flat straight line at zero value. The contributions from carbs/sugar intake and post-meal walking exercise replaced the role of medication. This demonstrates that medication adherence is important, but lifestyle behavior adherence is equally important, if not more important than medication.

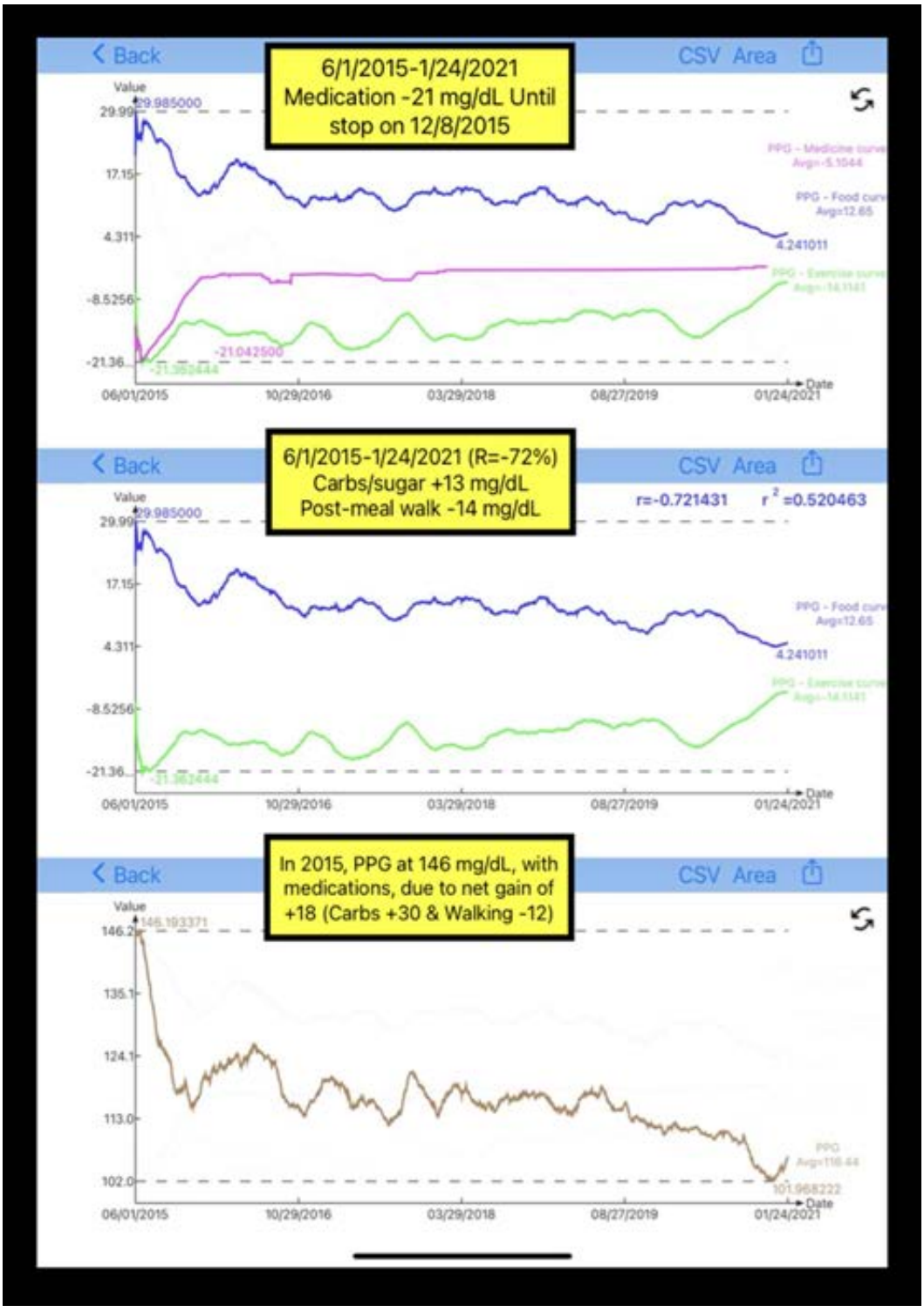

Figure 6: Diabetes Medication Contribution on PPG During 6/1/2015 to 1/24/2021

Figure 7 shows the comparison of his health age versus real age and the age difference during 9 years from 2012 through 2020. It results in the same conclusion as in Figure 3 of pseudo-3D diagrams.

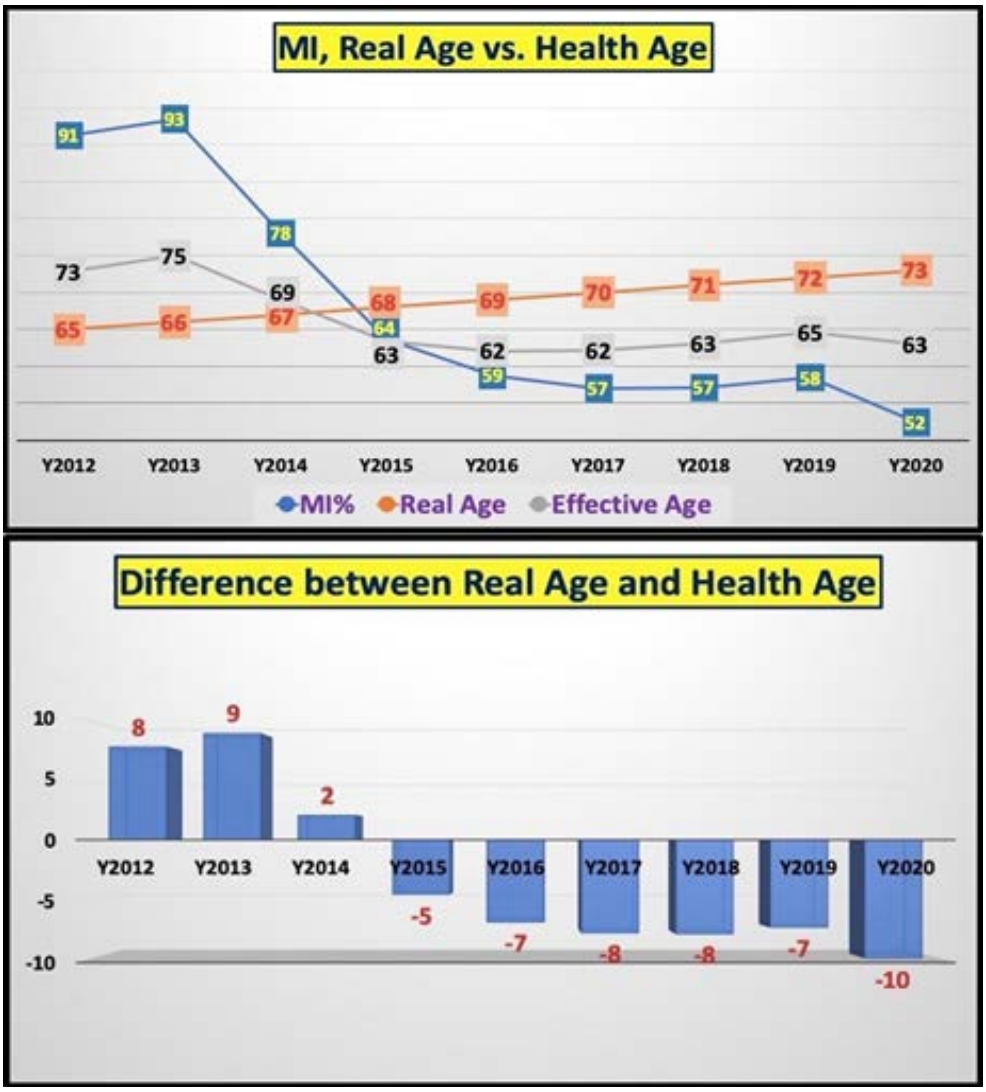

Figure 7: Comparison of Real Biological Age vs. Effective Health Age with Age Difference

Summary Comments

The author is a 26-year-old veteran of T2D, who has suffered many diabetes-induced complications, including five cardiac episodes, renal problems, bladder infection, foot ulcer, diabetic retinopathy, hypothyroidism, and more. In 2010, his weight reached 220 lb., BMI 32.5, waistline 44 inches, average daily glucose 250 mg/dL, ACR 116, and triglycerides 1161. During that year, three physicians warned him about this life-threatening situation which became his final wake-up call. By that time, he has been taking maximum dosages of three kinds of prescribed diabetes medications for 15 years. Obviously, there was something wrong with the basic and fundamental level of his internal organs and health situation. Therefore, he decided to save his own life by repairing his damaged organs and rebuilding his overall health from the root level. He made a vow to himself that over the next 10 years, he would find out and determine what is wrong with his body and his overall health situation through self-study and his dedicated research in internal medicine.

In the first four years (2010-2013), he conducted his self-study of endocrinology, chronic diseases, and food nutrition while focusing on the reduction of his weight and glucose level. He reduced his body weight by reducing food quantity, i.e., cutting off the meal's portion and walking 6 miles or 10 km per day as his daily exercise. Also, he decreased his glucose level by controlling carbs/sugar intake amount of fewer than 20 grams per meal and walking at least 4,000 steps after each meal.

He started to observe some obvious improvements in his glucose by 2012 and his weight by 2013. The period of 2013-2014 is his reflection point, i.e., turn-around time. Starting in 2013, he gradually reduced the dosage of his prescribed diabetes medications and slowly eliminated them one by one. After three years of continuous lifestyle management efforts and monitoring his body reactions carefully, finally on 12/8/2015, he was able to successfully terminate all of his medications. In summary, his initial success in lowering glucose levels took him two years,

reducing weight took three years, slimming his waistline took five years and eliminating medications took three years.

After 2016, he continuously controlled everything on a smaller scale of improvement to avoid shock to his body system along with a never-ending lifestyle management effort. As a result, he has proved that his damaged pancreatic beta cells have been self-repaired or recovered by ~18% over the past 7 years (~2.4% per year).

Not only are all of the internal organs and many chronic diseases interrelated, but lifestyle is actually the basic building block of health, including the influence on most of the existing diseases. In the US, almost 70% to 80% of annual deaths (prior to COVID-19) are either directly or indirectly related to chronic diseases which can be prevented or controlled through lifestyle management. In his personal opinion, lifestyle management deals with the internal root cause of many chronic diseases, while medications can only treat external symptoms and cannot cure chronic diseases.

Lifestyle management is vital in maintaining overall health. Many research results, including this particular study, have proven the strong linkage between lifestyle and chronic diseases. In fact, we do not have to focus on which is the cause or consequence, e.g., improving sleep and reducing stress first and then controlling weight and glucose, or vice versa. In the biomedical system, organs, diseases, and lifestyles are intertwined together; therefore, to achieve goals for overall health and longevity, we must focus on all of them as an integrated unit which was demonstrated via his developed metabolism model.

In his analogy, there are four legs on a table, where food/water, exercise, stress, and sleep support the tabletop for health and diseases. We should pay attention and work on these four weight-supporting legs at the same time to support the tabletop's weight of internal organs and chronic diseases.

This article only scratches the surface of the importance and sophistication of lifestyle; however, the author hopes to pass this vital message of having a persistent lifestyle management, not just relying on medications, to readers via this research note.

Conclusions

For this research process, he creates a special geometric presentation model with the meal portion percentage and carbs/sugar intake amount as the x-axis, daily walking steps and post-meal walking steps as the y-axis, and daily weight and glucose data as the z-axis. He then "folds over" the z-axis and superimposes it with the x-y planar space in a "radio wave" format. These radio waves represent different annual statuses of both weight and glucose. Under this created three-dimensional (3D) presentation on a two-dimensional (2D) planar space, the biomarker improvement patterns and moving trend of biomarkers, such as weight, glucose, and effective health age become ultra-clear. For effective health age, the same "pseudo-3D" geometric presentation model also applies. Instead, we can use medical conditions as the x-axis and lifestyle details as the y-axis.

Over the past 11 years (2010 - 2020), the path of his annual weight and glucose moving patterns started from the upper right corner (subregion E5 in 2010), moving with a downward angle of 30 to 45 degrees, and finally reaching the lower left corner (subregion A1 in 2020).

Through analyzing the distinctive daily weight and glucose trend patterns, the personality traits and related psychological behavior characteristics of this patient with both obesity and T2D can be revealed instantly and clearly. As a result, a more practical guidance on *progressive behavior modification* can be provided to other patients to improve their medical conditions for chronic diseases, where some of them are caused by obesity.

He was dependent on diabetes medications from 2010 through 2015 with a reduction trend pattern in the types and dosages of medications. Finally, on 12/8/2015, he ceased taking any medications for his chronic disease control. The author's collected detailed data on diet, exercise, and medications began in 2014. From the decomposed PPG sub-component waves, during 2014-2015, the medication contributed a -21 mg/dL of PPG reduction. Thereafter, the combined contribution of diet and exercise replaced the role of medication.

It should be noted that his collected data covered the period of 2010 through 2020 where his real age was 63 to 73 years old. Therefore, the results from this research note are based on the realistic data of an elderly person.

This longevity study using the effective health age (eclaireMD APP tool) demonstrates that in 2012, his effective health age was 75, which is 9 years older than his real biological age of 66. However, in 2020, his effective health age of 63 became 10 years younger than his real biological age of 73. In other words, over 9 years (2012-2020), he gained 19 years of life expectancy through a stringent lifestyle management program, without adherence to any medication.

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