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Research Article

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Approximated Health Age Calculation Using Higher-Order Perturbation Equations from Quantum Mechanics and the 90-Days Moving Average Metabolism Index as its Primary Perturbation Factor Based on GH-Method: Math-Physical Medicine (No. 466)

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Abstract

The author became interested in geriatrics in early 2019, especially in regard to longevity. During the period of 2010-2013, he self-studied metabolism, endocrinology, chronic diseases, and food nutrition. In 2014, he applied topology concept and engineering finite element method to develop a mathematical model of metabolism. His collected big data of ~2 million on metabolism, chronic diseases, and lifestyle details allowed him to extend his research work into the area of longevity. In January 2020, he published his first geriatric paper, No. 223, regarding effective health age. Back in July 2010, he developed a simplified APP (application software program) on the iPhone for estimating a patients' effective health age (Health Age) with or without chronic diseases to compare against the biological real age (Real Age). He then published his findings in paper, No. 292, where the data were utilized from four key medical conditions based on the health examination reports of 4 biomarkers weight, glucose, blood pressure, and lipids; along with the input by the patient of six lifestyle details involving diet, water intake, exercise, sleep, stress, and daily life routines. The APP can instantly calculate and show the metabolism index (MI) score and Health Age on the iPhone. Furthermore, he published two papers, No. 313 and No. 323, regarding the amplification factor used in the equation for effective health age.

In December 2019, he wrote and published his first medical research methodology paper, No. 152, using the application of perturbation theory from quantum mechanics on glucose predictions. Since then, he has continued his research work on this subject and published 10 medical papers based on the perturbation applications in diabetes (FPG, PPG), obesity (weight), and cardiology (metabolism).

This particular paper aims at finding three extra-sets of his estimated health age by using a higher-order perturbation equation from quantum mechanics with one selected perturbation factor of MI. However, the daily MI values usually fluctuate more violently than its moving average curve. Therefore, instead of using MI directly, he decides to use another parameter of GHSU (90-days moving average of MI) in the following defined arithmetical formula for effective health age:

Effective Health Age= Real Biological Age * (1+((GHSU-0.735)/0.735)/2)

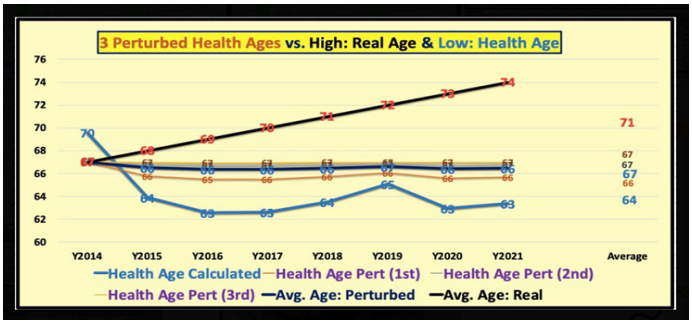
A healthy person should have lower values in the medical biomarkers and lifestyle details, which results in a lower MI score. This lower MI score (means healthier) would then make the health age below the real age, and vice versa. By maintaining a good lifestyle program with healthy biomarker outcomes from medical examinations, the overall metabolism status will be better (lower MI and GHSU); therefore, bodies will be able to deal with damages from various chronic diseases. Once metabolism state is in good conditions, then the immune system will be strong and effective. With stronger immunity, bodies will be able to defend against most of different infectious diseases.

These multiple chronic and infectious diseases and their complications would eventually lead into death, including chronic diseases (50% of death cases), cancers (29% of death cases), and infectious diseases (11% of death cases). The remaining 10% of death cases are resulted from injury, accident, or suicide. As a result, heathy people will most likely become members of the "longevity club".

In summary, despite of the author's real age increased by one every year, his effective health age curve has a wavy shape with its fluctuations according to his metabolism index score of each year. In 2014, his effective health age was 3 years older (70 - 67) than his real biological age, but in 2021, his health age is 11 years younger (74 - 63) than his real age due to the improvement made on his metabolism. Examine closely, however, his health ages in 2018 and 2019 did not follow its overall declination trend. These were resulted from his hectic traveling life on attending 65 international medical conferences and making 120 oral presentations. This has proven that ***lifestyle does affect health.***

His three perturbed health ages have achieved extremely high prediction accuracies between 95.7% to 99.6% in comparison against either the computed health age or the averaged perturbed ages.

This article has demonstrated the power of perturbation applications, even on the areas of geriatrics and longevity. *As a matter of fact, once we have an issue in hand with its collected or measured dataset along with its identified primary influential factor, we can then easily obtain an approximate solution by using perturbation theory of quantum mechanics in modern physics.*



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Methods

MPM Background

To learn more about his developed GH-Method: math-physical medicine (MPM) methodology, readers can read the following three papers selected from the published 400+ medical 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.

Patient's Background

The author spent ~30,000 hours over the past 11 years, from 2010 through 2021, to conduct his medical research on metabolic disorders induced chronic diseases and their various complications, specifically focusing on metabolism.

In the beginning, from 2010 to 2013, he self-studied internal medicine and food nutrition. He specifically focused on six chronic diseases i.e., obesity, diabetes, hypertension, hyperlipidemia, CVD & stroke, and chronic kidney disease (CKD) which

he has suffered since 1995. In 2014, he allotted the entire year to develop a complex mathematical metabolism model which includes 4 body output categories (weight, glucose, blood pressure, and lipids) and 6 body input categories (food, water, exercise, sleep, stress, and daily life routine regularity). There are around 500 detailed elements included in these 10 basic categories. By the end of 2014, he has finally developed a mathematical metabolism index (MI) model embedded in a specially designed application software "eclaireMD" on the iPhone for his daily use in order to improve and maintain his overall health conditions.

During the metabolism model development process, he has defined two new variables MI and general health status unit (GHSU), where ***GHSU is the 90-days moving average value of MI*** that is similar to the relationship between HbA1C (A1C) and 90-days moving average glucoses. The analysis results of this dynamic and complex model can be expressed through 2 health variables, MI and GHSU, to describe a person's health status and also identify shortcomings in any specific health area at any moment in time.

In the following two-year period, 2015 and 2016, he dedicated his time to research four prediction models related to his diabetes measurements i.e., weight, postprandial plasma glucose (PPG), fasting plasma glucose (FPG), and A1C.

As a result, from using his own developed metabolism model and 4 prediction tools, his weight reduced from 220 lbs. (100 kg, BMI 32.5) to 168 lbs. (77 kg, BMI 24.8), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger glucose from 280 mg/dL to 101 mg/dL, and A1C from 10% to 6.2%. One of his remarkable accomplishments is that he no longer takes any diabetes medications beginning on 12/8/2015.

By 2016, all of his diabetic complications, including cardiovascular episodes, kidney problems, bladder infections, neuropathy and foot ulcer, retinopathy, and hypothyroidism appeared to be under controlled.

In the year of 2017, he achieved even better performance scores on lifestyle management details, medical conditions via biomarkers, and lower MI/GHSU values due to his simple and enjoyable medical research work and its associated simple lifestyle which have no travel, no busy schedules, no presentations, and decreased social interactions with people who have certain ulterior motives.

During 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 both of his diabetes control and his overall metabolism score, through eating out frequently along with exercise disruption, and irregular life routines through travel and increased work schedule.

He has further defined a formula of the effective health age based on the MI score as shown below:

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

COVID-19 and Longevity

The author eluded the 2003 SARS threat in China and Taiwan. In early January 2020, when the strange "Wuhan pneumonia" rumors suddenly appeared on Eastern Asian news networks, he immediately recognized the danger associated with this newly found virus. The spread of this disease depends mainly on the physical contact among people. Therefore, he initiated his "self-quarantine" in the United States on 1/19/2020, about two months earlier than the majority of Europeans and Americans who became aware of its potential damage and severity. As of today, 6/11/2020, he has been self-quarantined for almost 6 quarters or 17 months. This COVID-19 quarantine life pattern with homecooked meals and persistent walking exercise of 7 miles or 11 km each day have made his conditions of diabetes control (from his glucose and A1C results) and overall metabolism (from his GHSU and MI results) reach to his "best-performed" situation over the past 25 years.

Lifestyle, Metabolism, Immunity, Diseases, and Death

As indicated in one of his published papers, "Linkage among metabolism, *immune system*, and various diseases using GH-Method: math-physical medicine", the most effective protection against COVID-19 is our *immune system*. The *immune system* is closely related to overall metabolism. We can safely say that metabolism and immunity are two sides of the same coin; when combined together, they contribute ~89% of the total annual death cases in US. In order to strengthen our overall metabolism, we must manage our daily *lifestyl*e to build a strong and firm foundation of metabolism and immunity to protect our health and prolong life.

In short, ***lifestyl***e is similar to the product quality and production capacity of an ***arsenal*** based on the overall educational, technological, and industrial power of a nation, whereas *metabolism* is similar to the effectiveness and destruction power of the weapons available to soldiers which are produced by an arsenal. Immunity is similar to the overall military strength of the ***armed forces*** (assembly of strong soldiers with powerful weapons), while ***diseases*** (chronic diseases and complications, dementia, cancer, and infectious diseases) are similar to an ***enemy's invasion force***. Lastly, the outcome of ***death*** is similar to the study of ***casualty of war***, which is the study of probability and rate of casualty, including wound and death.

Higher-Order Interpolation Perturbation Theory

The author applies the higher-order interpolation perturbation method to obtain his three "perturbed PPG" waveforms based on one perturbation factor of his calculated GHSU value (90-days average of MI) that is also the "Slope in Perturbation Equation". He uses the calculated CVD risks in Pre-COVID period as his reference baseline.

The following polynomial function is used as a generic perturbation equation:

A = f(x)
*= A0 + (A1*x) + (A2*(x**2))+(A3*(x**3)) + ... + (An*(x**n))*

Where A is the perturbed CVD risk, Ai is the calculated risk for certain tome segment, and ***x is the "perturbation factor"*** *based on different GHSU values.*

For this particular study, he choose his ***Ai where i=1 to 3***. Therefore, the perturbation theory equation from above can be simplified to the following form:

A = f(x)
*= A0 + (A1*x) + (A2*(x**2))+(A3*(x**3))*

Or, the third-order interpolation perturbation equation can then be expressed in the following general format:

A i = A1 + (A2-A1)*(slope 1) +
(A2-A1)*(slope 2) + (A2-A1)*(slope*3)

More specifically, the following formats of three perturbation equations are utilized in the calculations of this study:

A of first order
= A1+(A2-A1)*(slope 1)

A of second order
= A1+(A2-A1)*(slope 2)

A of third order
= A1+(A2-A1)*(slop 3)

Where:
A1 = original risk A at time 1
A2 = advanced risk A at time 2
(A2-A1) = (Risk A at Time 2 - Risk A at Time 1)

It should be noted that the first parameter of A1 must be modified by an initial condition or "initial conversion factor" of 0.96 (=67/70) in order to match his starting health age of 70 in 2014 which translates to his real age of 67 at 2014.

The perturbation factor of ***Slope*** is an arbitrarily selected parameter that controls the size of the perturbation. The author has chosen a function of GHSU, as his perturbation factor or slope, which is further defined as follows:

In this particular study, ***the author selects the GHSU value (90-days moving average MI) as his "perturbation factor". The high-bound GHSU is 1.029 (102.9%) and the low-bound GHSU is 0.497 (49.7%). The midpoint value between the high-bound and low-bound is 0.763 (76.3%); therefore, he adopts his selected value of GHSU at 0.6117 (61.2%).***

Furthermore, he uses his 7.5 years (1/1/2014 - 6/11/2021) dataset as his reference baseline.

The equations for 3 slopes are:

Slope 1
= (Selected GHSU - Low-bound GHSU) / (High-bound GHSU - Low-bound GHSU)

Slope 2
= (Slope 1 * Slope 1)
or (Slope**2)

Slope 3
= (Slope 1 * Slope 1 * Slope 1)
or (Slope**3)

Therefore, the 3 slope values are calculated as follows:

Slope 1 from Carbs = 0.22
Slope 2 from Carbs = 0.05
Slope 3 from Carbs = 0.101

Results

Figure 1 illustrates the Real Age versus Health Age, and MI versus GHSU during the period of 1/1/2014 to 6/11/2021.

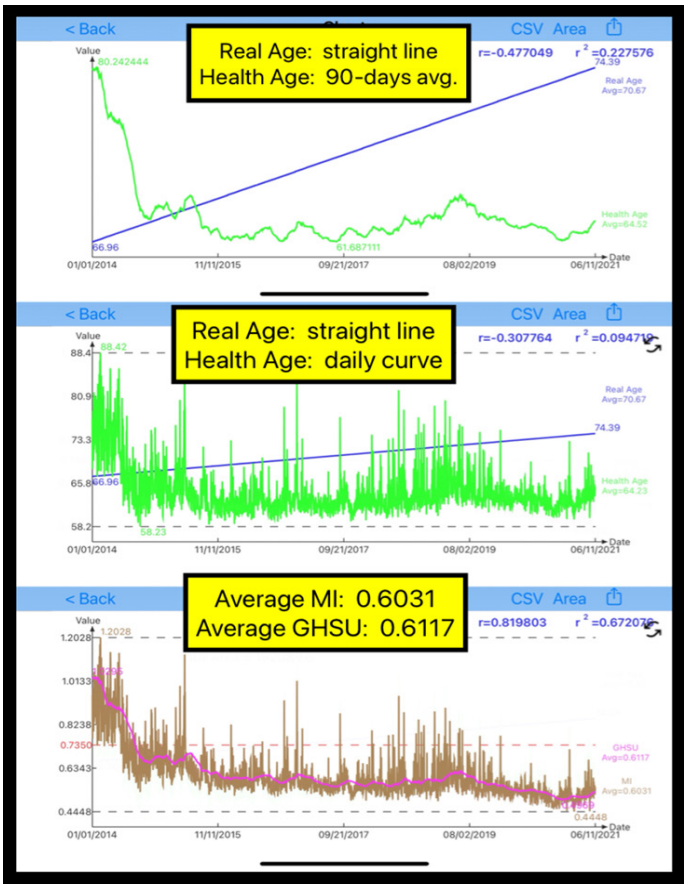
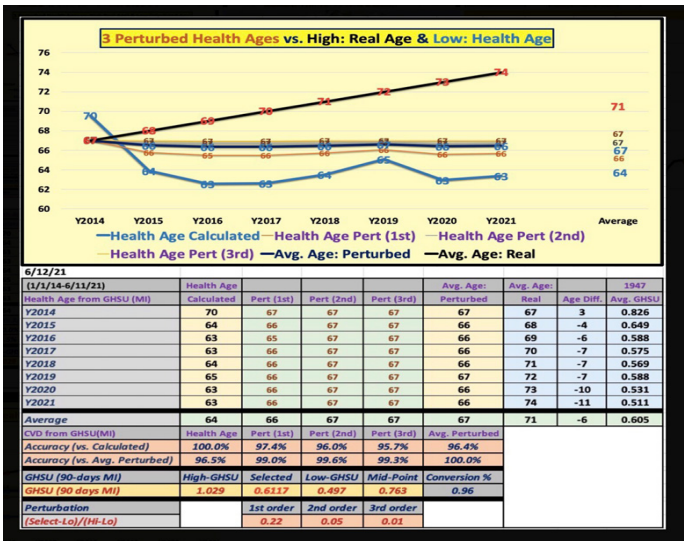


Figure 1: Real Age vs. Health Age and MI vs. GHSU

Figure 2 shows the analysis results based on his defined health age formula:



6/12/21 (1/1/14-6/11/21)	Health Age				Avg. Age:	Avg. Age:		1947
Health Age from GHSU (MI)	Calculated	Pert (1st)	Pert (2nd)	Pert (3rd)	Perturbed	Real	Age Diff.	Avg. GHSU
Y2014	70	67	67	67	67	67	3	0.826
Y2015	64	66	67	67	66	68	-4	0.649
Y2016	63	65	67	67	66	69	-6	0.588
Y2017	63	66	67	67	66	70	-7	0.575
Y2018	64	66	67	67	66	71	-7	0.569
Y2019	65	66	67	67	67	72	-7	0.588
Y2020	63	66	67	67	66	73	-10	0.531
Y2021	63	66	67	67	66	74	-11	0.511
Average	64	66	67	67	67	71	-6	0.605
CVD from GHSU(MI)	Health Age	Pert (1st)	Pert (2nd)	Pert (3rd)	Avg. Perturbed			
Accuracy (vs. Calculated)	100.0%	97.4%	96.0%	95.7%	96.4%			
Accuracy (vs. Avg. Perturbed)	96.5%	99.0%	99.6%	99.3%	100.0%			
GHSU (90-days MI)	High-GHSU	Selected	Low-GHSU	Mid-Point	Conversion %			
GHSU (90 days MI)	1.029	0.6117	0.497	0.763	0.96			
Perturbation (Select-Lo)/(HI-Lo)		1st order 0.22	2nd order 0.05	3rd order 0.01				

Figure 2: Three perturbed health age curves are located in between the upper-bound of real age and the lower-bound of health age

Effective Health Age
= Real Biological Age *
(1 + ((GHSU - 0.735) / 0.735) / 2)

After calculating his annual health age and average GHSU score, he then applies the higher-order perturbation equations to obtain 3 approximated health ages. His three perturbed health ages have achieved extremely high prediction accuracies between 95.7% to 99.6% in comparison against either the computed health age or the average perturbed ages.

Conclusions

In summary, despite of the author's real age increased by one every year, his effective health age curve has a wavy shape with its fluctuations according to his metabolism index score of each year. In 2014, his effective health age was 3 years older (70 - 67) than his real biological age, but in 2021, his health age is 11 years younger (74 - 63) than his real age due to the improvement made on his metabolism. Examine closely, however, his health ages in 2018 and 2019 did not follow its overall declination trend. These were resulted from his hectic traveling life on attending 65 international medical conferences and making 120 oral presentations. This has proven that lifestyle does affect health.

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This article has demonstrated the power of perturbation applications, even on the areas of geriatrics and longevity. *As a matter of fact, once we have an issue in hand with its collected or measured dataset along with its identified primary influential factor, we can then easily obtain an approximate solution by using perturbation theory of quantum mechanics in modern physics [1-10].*

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