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A Simplified Model for Estimated Metabolism Index and Effective Health Age Calculation Using GH-Method: Math-Physical Medicine

Gerald C. Hsu

Medical Research Scientist, EclaireMD Fondation, 7 Oak Haven Way, Woodside, CA 94062 USA.

**Corresponding Author: Gerald C. Hsu, Medical Research Scientist, EclaireMD Fondation, USA.*

Abstract

The author revised his work to simplify the mathematical metabolism model he developed in 2014. He combines it with his recent published geriatric papers on 1/1/2020 regarding effective health age. Based on this newly simplified approach, he will develop a user-friendly APP on the iPhone and PC, so that healthy people or patients with chronic disease can use it for disease control, health maintenance, or longevity prospects. This article describes his detailed design of a simpler MI system for both healthy people and diabetes patients. It also provides a calculator for estimated effective health age for longevity prospect. Metabolism is the fundamental building block for diabetes control, health maintenance, and longevity. Based on the author's 2020 MI data, his current effective health age is -9 years, whereas it is -7 years using his 2019 MI data. Here "minus" means his effective health age is "younger" than his real biological age. This simplified model may provide a somewhat lower degree of accuracy (~3%), yet it is based on solid scientific evidence and can serve as a useful tool for the general population's health maintenance purpose.

Introduction

This paper describes the author's revision work on simplifying his mathematical metabolism model developed in 2014. He then combines it with his recent published geriatric papers on 1/1/2020 regarding effective health age. Based on this newly simplified approach, he will develop a user-friendly APP on the iPhone and PC, so that healthy people or patients with chronic disease can use it for disease control, health maintenance, or longevity prospects.

Methods

The author spent ~30,000 hours over the past 10 years, from 2010 to 2020, to conduct his research on chronic diseases and complications, along with endocrinology, specifically focusing on metabolism and glucose.

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, cardiovascular disease (CVD) & stroke, and chronic kidney disease (CKD). In 2014, he allotted the entire year to develop a complex mathematical metabolism model which includes 4 body output categories (weight, glucose, blood pressure, lipids) and 6 body input categories (food, water, exercise, sleep, stress, daily life routine regularity). There are about 500 detailed elements included in these 10 categories. Since using a theoretical approach to deal with a dataset of 10 categories with 500 elements, the problem of identifying and solving all possible inter-relationships among them would be an immense task. In theory, this task would involve a big number of calculation steps of 500 !. This kind of pure theoretical approach is a huge undertaking without any obvious benefit; therefore, he adopted an approach of applying mathematical concept that is topology. In addition, he applied a practical engineering modeling technique such as finite element method to seek a quicker but still accurate solution for this complicated biomedical system. At the end, he was able to develop a mathematical metabolism model embedded in a specially designed application software ("eclaireMD") on the iPhone for his daily use in order to maintain his health status and serve as a useful research tool for his ongoing various medical research projects (References 1 and 3, 4, 5, and 6).

During the development process, he has defined two more new variables, metabolism index (MI) and general health status unit (GHSU), where GHSU is the 90-days moving average MI that is similar to the relationship between HbA1C and 90-days moving average glucoses. The results of this dynamic model can be expressed through these two newly defined simple variables, MI and GHSU, to describe a person's overall 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 four diabetes measurement conditions, weight, postprandial plasma glucose (PPG), fasting plasma glucose (FPG), and HbA1C (A1C). As a result from using his own developed prediction tools, his weight reduced from 220 lbs. (100 kg) to 176 lbs. (89 kg), waistline from 44 inches (112 cm) to 32 inches (82 cm), glucose from 280 mg/dL to 120 mg/dL, and A1C from 10% to 6.5%. The most remarkable accomplishment is that he no longer takes any diabetes medications since 12/8/2015. As a result, he enjoys additional improvements on his overall health from 2017 to 2020 by controlling his diabetes and five of its complications. In addition, through his geriatric research on effective health age, he has found that his perspective of life longevity improved from being 8 years older in 2010 to 7 years younger in 2019 (Reference 2).

Recently, his old friend from MIT, Dr. Toyohiko Muraki, who is also a senior citizen and a patient with chronic diseases, inspired the author to develop a simpler MI model for other people's personal use. The request triggered him to think about this idea further, write this article, and then convert the information into a practical and easy-to-use APP tool on mobile phone and PC.

A simplified version cannot cover all of his original 500 elements and their associated details, although the overall 10 categories can still be preserved. He has two ways to handle this big set of 500 influential elements. First, he could choose those primary elements and neglect all of the secondary elements; however, he is concerned about the accuracy of MI. Secondly, he could bundle and rearrange those secondary elements into a smaller number of groups and then combined them with the primary elements. In this way, he can still preserve the overall integrity and hopefully maintain the required accuracy of his original design as much as possible. As a result, for both the integrity and accuracy of the data, he decided to use the second approach. In his original design, the most complicated part is using finite element method of structural and mechanical engineering to deal with the complex inter-relationship among categories and elements. Fortunately, this part has already been designed and programmed into an independent core unit which hides behind the input/output (I/O) operations. Therefore, he does not need to change or modify this most complicated portion. In summary, he mainly needs to simplify the I/O parts without touching the core of data processing.

The "Results" section will discuss the new version of his input design and their logical reasons or biomedical conditions behind it.

Results

Figure 1 shows, in an icon configuration, the 10 logical building blocks of his system eclaireMD. The group of "medical condition" has the following four categories:

(1) Weight (for patients with obesity and healthy people): enter your weight in the morning (lbs. or kg, set a corresponding weight that provides BMI=25 as the target), and waistline (inches or cm, choose your targeted waistline). A larger waistline serves as a warning for increased health risks.

(2) Glucose (for diabetes patients, target at 120 mg/dL): enter your FPG after you wake up, and PPG in two hours after the first bite of food for each meal.

(3) Blood Pressure (for patients with hypertension): enter your daily measured SBP, DBP, Heart Rate when you wake up (target at 120/80/60 for SBP/DBP/heart rate)

(4) Lipids (for patients with hyperlipidemia): enter your quarterly measured HDL, LDL, total cholesterol, triglycerides from the hospital or laboratory reports (target at 40/130/150/200 for HDL/LDL/triglycerides/total cholesterol)

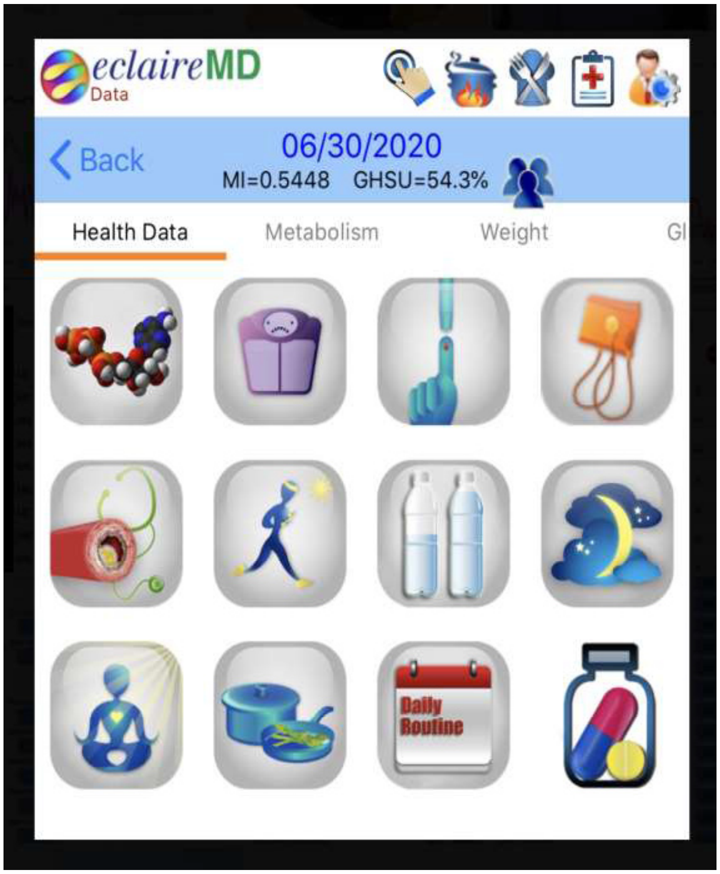

Figure 1. *icons for 10 categories of MI system*

The group of "lifestyle management" has the following six categories. Figure 2 shows a sample of some elements regarding sleep and stress. Figure 3 depicts a sample of some food quality and daily life routine items.

(5) Exercise: recommends walking as one of the best forms of exercise for most people. Either total walking steps per day for healthy people (target at 10,000 or more per day) or post-meal walking steps for diabetes patients (target at 2,000 to 4,000 step after each meal depending on the severity of diabetes conditions).

(6) Water Intake: suggested amount between 2,000 cc (4 bottles of 500 cc each) to 3,000cc per day (6 bottles of 500 cc each), enter your water intake amount per day.

(7) Sleep: select scale from 1 to 5, or enter number of sleep hours (target at 7+ hours per night), and number of wake up times per night (target at < 2 times per night), including overall sleep quality you feel (select scale 1 to 5) as shown in Figure 2

(8) Stress: select scale from 1 to 5, choose a number based on the day's events from various stressors such as job, family, emotional, social, financial, health, travel, legal, or traumatic events (see Figure 2).

(9) Food (food quantity for both healthy people and diabetes patients): meals quantity (target at 80% to 90% of normal portion, <15 grams of carbs/sugar for diabetes patients); food quality: select scale from 1 to 5 (see Figure 2) to include these basic principles - eat less fat and red meat, eat chicken, fish, and high-quality proteins, eats lots of vegetables and fruits, avoid using health supplement vitamins or minerals to replace eating vegetables and fruits, avoid "starchy" food, e.g. bread, noodle, rice, potato, and overly-sweet fruits for diabetes patients. (10) Daily life routine regularity: the APP will provide a list for self-checking (Figure 3) and a scale from 1 to 5 (1 being the best and 5 being the worst). Important reminders to avoid the following: cigarettes smoking, alcohol intake, illicit drugs use because of the increased risks of getting chronic diseases along with complications, cancers, and weakening of the immune system to fight against infectious diseases.

Figure 2. *Element example of sleep and stress*

Figure 3. *Element example of food quality and daily life routines*

In Figure 4, it illustrates the author's MI detailed scores and curves of 10 categories for the period from 1/1/2020 through 6/30/2020. He utilized the average scores of Mi (i from 1 to 10) over this 6-month period as input data for his final MI score calculation. At this stage, when you click your "MI results" button, your current metabolism index (MI) score will be shown on your iPhone screen (a sample result can be seen in Figure 5).

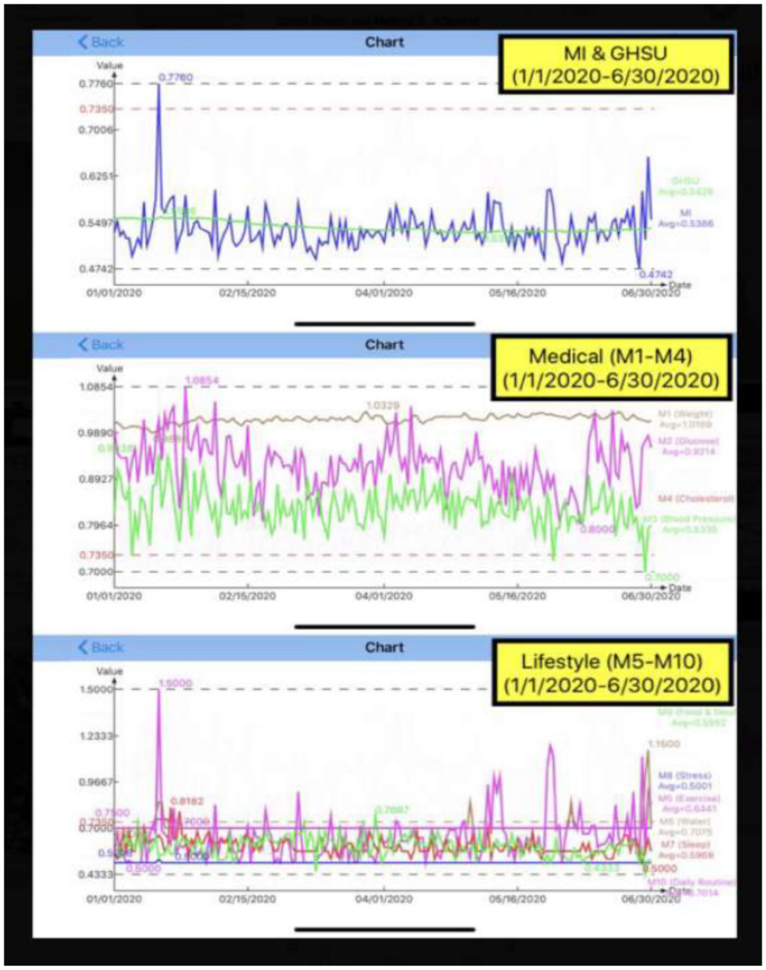

Figure 4. *Performance curves of M1 through M10 (1/1/2020 - 6/30/2020)*

Figure 5. *Final MI score (0.5569)*

If your MI score is less than 0.7350 (73.5%), you are healthy, otherwise if greater than 0.7350 (>73.5%), you are unhealthy. You can also check your performance scores of these ten categories (M1 through M10, i.e. Mi : where i = 1, 10), to see which category you may want to improve moving forward.

References 3, 4, 5, and 6 provide more detailed information reading to readers regarding his MI model and its relationship with longevity.

In one of his previously written and published article (Reference 2), he described his developed simple equation of "effective health age" as follows:

Effective Health Age

= Real Biological Age *

(1+((MI-0.735)/0.735)/2)

Now, he can plug in his calculated MI score from the above example into this simplified effective health age equation. It should be noted that this simplified MI score of 0.5569 (Figure 5) in comparison with the sophisticated eclaireMD system calculated MI score of 0.5386 (Figure 4) only has a ~3% of margin of error. Using his real biological age as 73, he will get an effective health age of 64 (-9 years). Here "minus" means his effective health age is "younger" than his real biological age. This means he has gained 9-years of life-extension via his improvements on his metabolism. It is interesting to notice and mention that the improvement on his effective health age was "-7 years" using his 2019 MI data (Reference 2). This further demonstrates how much improvement has occurred on his health conditions during COVID-19 quarantined period.

The following steps reflects the equation's numerical operations:

Effective health age

= 73*(1+((0.5569-0.7350)/0.7350)/2)

= 73*0.878843537

= 64.2

This shows his effective health age as "-9 years" using his 2020 MI data instead of the "-7 years" using his 2019 MI data. These two years improvements were achieved during the COVID-19 quarantine period.

The effective health equation will also be written into his newly developed APP software on the iPhone. In addition, he plans to include his simplified calculations of his risk probability of having CVD, stroke, CKD, and metabolic induced cancer on the same APP software for the iPhone or PC. In this way, the users, either healthy people or patients with chronic diseases, can determine their longevity prospects via the Metabolism status which is the combination of the medical conditions and lifestyle management details. This process verifies the author's belief, "You will harvest fruits from the seeds you planted underground and your continuous effort to take care of your fruit trees".

Conclusions

This article describes his design of a simpler MI system for both healthy people and diabetes patients. It also provides a calculator for estimated effective health age for longevity prospect. Metabolism is the fundamental building block for diabetes control, health maintenance, and longevity. This simplified model may provide a somewhat lower degree of accuracy (~3%), yet it is based on solid scientific evidence and can serve as a useful tool for the general population's health maintenance purpose.

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