Mini Review

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Estimation of metabolism index and effective health age using a simple APP tool on the iPhone for chronic disease control and overall health maintenance (GH-Method: math-physical medicine No. 292)

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Abstract

The author developed a simple APP (application software) on the iPhone for chronic disease control, overall health maintenance, and longevity for users, with and without chronic disease. Using data from four key medical conditions based on health examination reports, and six lifestyle details of estimated input by the user, this tool can instantly provide both metabolism index (MI) score and effective health age.

The author has developed this APP based on his previous research results from 2014 (see references). The MI data allowed him to publish a paper on geriatrics (No. 223) regarding effective health age; and paper No. 286 regarding his inception of modeling and product design of this simplified tool.

This article describes his design of a simple tool utilizing sample data from the author and another patient to calculate their MI scores and effective health ages. The difference between their effective health age and biological real age are -9 years for the author (Case A) and +4 years for the patient (Case B) in 2020.

This tool can be used by people with and without chronic diseases. Metabolism is the fundamental building block for diabetes control, health maintenance, and longevity. Although this tool may provide a slightly lower degree of accuracy (98.4%), it is still based on solid scientific foundation and biomedical evidence that can serve as a useful APP for the general population's health maintenance. It should be pointed out that the author has inserted an amplification factor inside his calculation of effective health age for raising the users' awareness of metabolism importance on their longevity.

Introduction

The author developed a simple APP (application software) on the iPhone for chronic disease control, overall health maintenance, and longevity for users, with and without chronic disease. Using data from four key medical conditions based on health examination reports, and six lifestyle details of estimated input by the user, this tool can instantly provide both metabolism index (MI) score and effective health age.

The author has developed this APP based on his previous research results from 2014 (see references). The MI data allowed him to publish a paper on geriatrics (No. 223) regarding effective health age; and paper No. 286 regarding his inception of modeling and product design of this simplified tool.

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 conditions and serve as a useful research tool for his ongoing 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 variables, MI and GHSU, to describe a person's overall health status and also able to identify some shortcomings in a 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 key measured diabetes biomarkers, i.e. weight, PPG, FPG, and A1C. As a result from using his own developed prediction tools, within a decade, his weight reduced from 220 lbs. (100 kg) to 169 lbs. (77 kg), waistline from 44 inches (112 cm) to 32 inches (82 cm), glucose from 280 mg/dL to 109 mg/dL, and A1C from 10% to 6.4%. The most remarkable accomplishment is that he no longer takes any diabetes medications since 12/8/2015. As a result, he has enjoyed additional improvements on his overall health, particularly from 2017 to 2020, by controlling his diabetes and five of its various complications. In addition, through his geriatric research on effective health age, he is able to identify his perspective of life longevity (Reference 2).

In reference 286, he further described his idea, concept, and process on how to develop a simplified tool of this sophisticated eclaireMD system. Based on his eclaireMD's design architecture, he has evolved it into this simple and useful APP tool.

This product still contains ten metabolism categories, four for medical conditions and six for lifestyle details. He then copies the "engine" portion from his existing eclaireMD metabolism mathematical model as the "CPU" (central processing unit) of this simple tool in order to calculate the MI value quickly but still accurately. In the last step, he takes the "equation" cited in his reference paper No. 223 to calculate the effective health age based on MI score, see below.

Effective Health Age

= Real Biological Age *

(1+((MI-0.735)/0.735)/Amplification factor)

In order to keep the simplicity of this product, his design philosophy is just offering a "snap shot" of the user's health profile, including medical conditions, lifestyle, metabolism, and effective health age, at certain time instant. Although the user's input data can be stored on a remote cloud server, the study of the long-term history and trend of these variables are not the objective of this APP. Therefore, the GHSU (90-days moving average of MI) value is not calculated and displayed on the input/output (I/O) screen.

Sample results

First, the user can enter his input data for these 10 categories of one particular day or over a specific period of days. However, whatever time frame the users choose, they must be consistently using the same day or period throughout the entire data input phase. As an example, the author chose a period from 1/1/2020 to 7/8/2020; therefore, all of his input data are the average values for the same period.

Second, the user may choose to enter a portion of these 10 categories for data input, instead of all 10 categories, because this tool is capable of making automatic adjustment in order to calculate the corresponding MI score and effective health age.

Third, the author has adopted the common medical practice that a lower output value means a better condition.

Figure 1 shows the simple profile setting before the actual usage of this simple tool. It includes age and height to calculate the user's BMI for establishing target weight (M1), as well as personal bad habits. For example, the author is 73 years old and is 5'9" tall. Based on his height, his target weight would be 170 lbs. in order to maintain his BMI at 25.

Figure 2 depicts the I/O screen for the group of medical conditions which includes the following 4 categories. The outputs are Mi, where i = 1 through 4.

Weight: User can enter his/her daily weight or an average weight over a period (lbs. or kg, select a corresponding weight that provides BMI=25 as the target). For the author, his weight is 171.72 lbs., and therefore, his M1 value is 1.0161. His target weight is 170 lbs. which corresponds to 25.0 of BMI value.

Glucose: User can enter his/her average glucose of one particular day or the average glucose over a particular period. For the author, his glucose value is 110.51 mg/dL; therefore, his M2 value is 0.9209. His target glucose level is 120 mg/dL.

Blood pressure (BP): User can enter his/her daily measured SBP/DBP/Heart Rate at one time instant. For the author, his average BP values are 108.67/60.79/59.77; therefore, his M3 value is 08872. His target BP are 120/80/60 for SBP/DBP/heart rate.

Lipids: User can enter his/her quarterly measured HDL/LDL/total cholesterol/triglycerides from the hospital or laboratory reports. For the author, his average Lipid values are 49/120/120/110 for HDL/LDL/total cholesterols/triglycerides; therefore, his M4 value is 0.8745. His target lipid values are 40/130/200/150 for HDL/LDL/total cholesterols/triglycerides.

Figure 3 reflects the I/O screen of lifestyle details group which includes the following 6 categories. The outputs are Mi, where i = 5 through 10. The input data of this lifestyle group includes two different designed types, the users' record or selected "scale" based on their feelings or memories based on their performance. This performance scale has 5 levels, 1, 2, 3, 4, and 5, where 1 is the best and 5 is the worst.

Exercise: The author recommends walking as one of the best forms of exercise for most people, including people with and without chronic diseases. Users enter walking steps on one particular day or average walking steps over a selected period. For the author, his average daily walking is 16,359 steps; therefore, his M5 value is 0.6113. His target daily walking is 10,000 steps. The best performance is 20,000 steps and its corresponding M5 is 0.5000.

Water intake: For the author, his average daily water intake is 2,976 cc; therefore, his M6 value is 0.6720. His target daily water intake is 2,000 cc. The best performance is 3,000 cc and its corresponding M6 is 0.5000.

Sleep: Users can select his sleep hours among 5 levels, >7, 6-7, 5-6, 4-5, <4 sleeping hours per night. The author recommends sleeping at least 6 hours to strengthen immunity. The second selection is the number of wake-up times while sleeping. The higher number of wake-up times, the more disturbance and damage on your sleep quality. The third selection is the overall sleep quality, which includes annoying issues before going to bed, headaches or feeling refreshed after waking up, dreams, physical and environmental comfort level, and disturbance of sleep. User can make a scale level selection (1 through 5) based on his/her feeling or memory. For the author, on average, he sleeps 7.3 hours each night, wake up 1.2 times to go to bathroom, and his overall sleep quality is excellent. Therefore, he chose level 1 for all three items; therefore, his M7 score is 0.5000 (the best score). The best sleep performance of M7 is 0.5000.

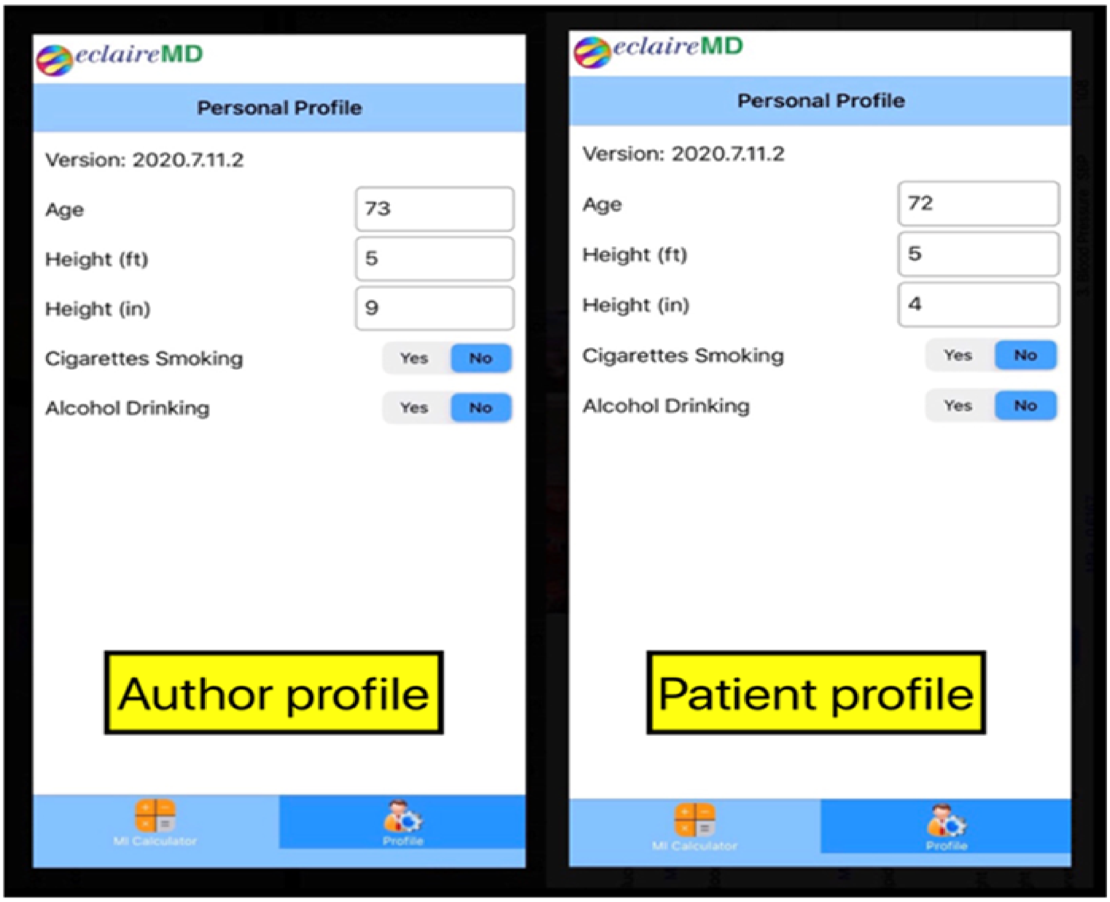

Figure 1 Profile setting for simple tool.

Stress: Users can select a scale level from 1 to 5, based on events that occurred on that day or during a period which may include various stressors, such as job, family, emotional, social, financial, health, travel, legal, or traumatic events. For the author, his scale is at level 1 (a stress-free life); therefore, his M8 score is 0.5000 (the best score). The best stress performance of M8 is also 0.5000.

Food: Users can enter their food quantity for each meal and snacks. For the author, his "target" of food average quantity (M9a) is around 80% of his normal portion (e.g. breakfast 40%, lunch 100%, dinner 50%, snacks 50%; average portion is 240%/ 3 = 80%). He also includes one additional target of <15 grams of carbs/sugar for his diabetes control. Regarding food quality (M9b), users can select a scale level from 1 to 5 which includes these basic principles - eat less fat and red meat, eat chicken, fish, egg, cheese, milk, and high-quality proteins, eats lots of vegetables and fruits (diabetes patients should avoid eating sweet 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 (Figure 4). Therefore, the author gets a combined M9 score of 0.6167 from (M9a + M9b)/2. The best food performance including both quantity and quality of M9 is 0.5000.

(10) Daily life routine regularity: the APP will provide a list for self-checking (Figure 4) and a scale level from 1 to 5 where 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. The author follows his established guidelines diligently as shown in Figure 4; therefore, he gets a perfect score of M10 of 0.7000. The best performance of daily routine category of M10 is 0.7000.

The final result of overall MI score is 0.5514 and his effective health age is 64 years old. His biological real age is 73 which means his metabolism management program has made his effective health age 9 years younger than his real biological age.

Figure 5 shows his another slightly different MI score of 0.5425 which is based on his complicated daily entries over 6+ months using his sophisticated metabolism research model (the eclaireMD system) containing the same 10 categories, but with ~500 detailed elements. This has demonstrated that his simple tool has reached to an accuracy level of 98.4% in comparison with the sophisticated metabolism model.

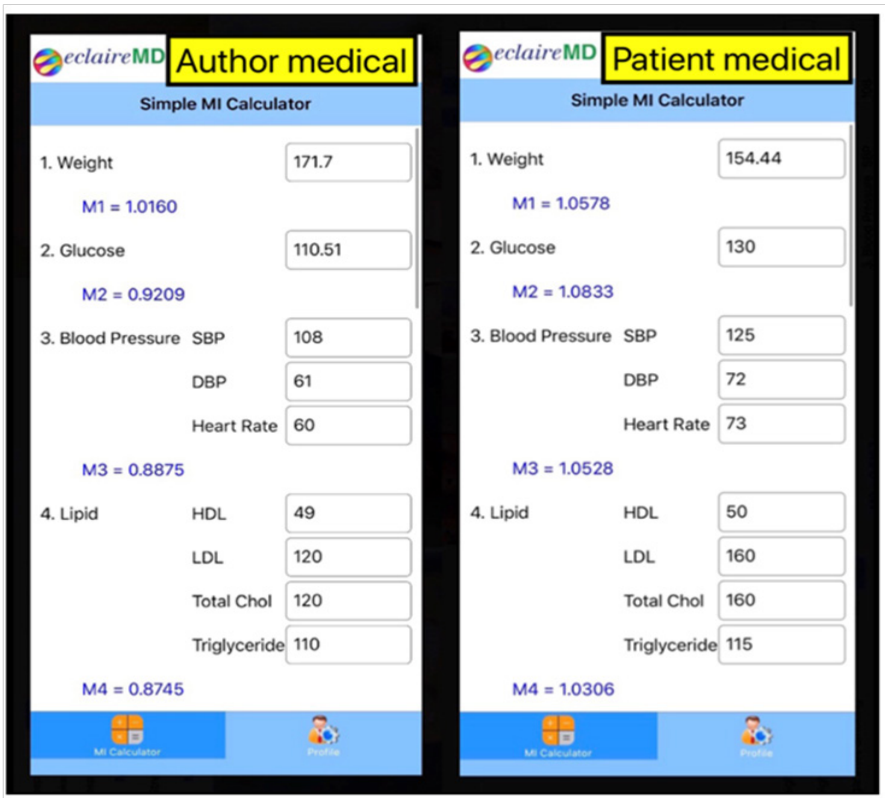

Figure 2 Medical conditions (M1 through M4).

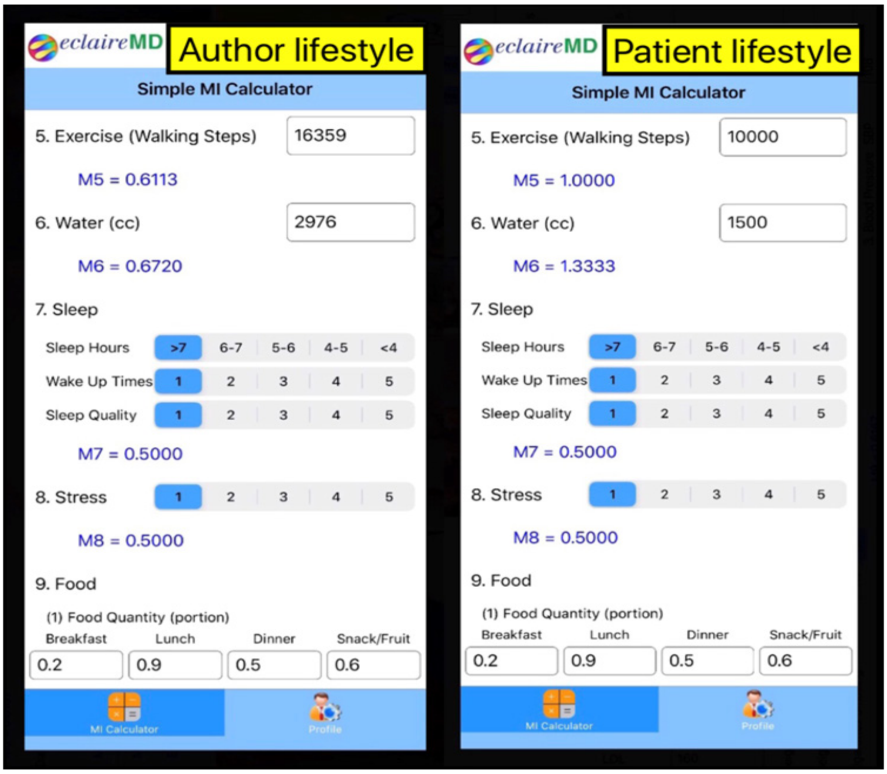

Figure 3 Lifestyle details (M5 through M10).

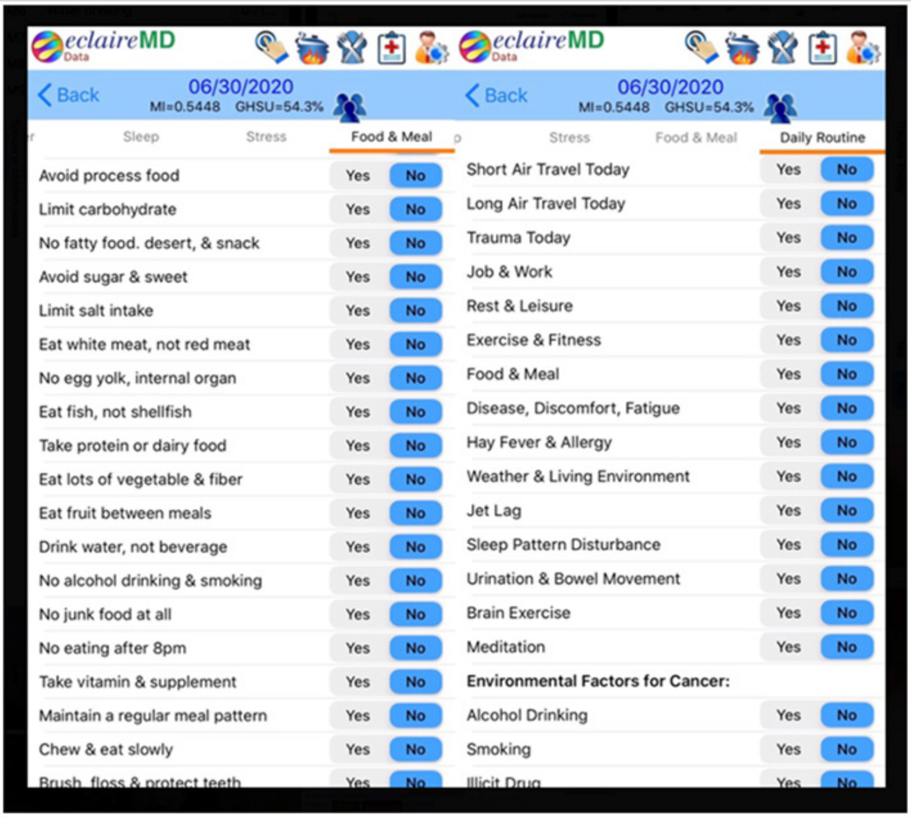

Figure 4 Food quality & daily life routines.

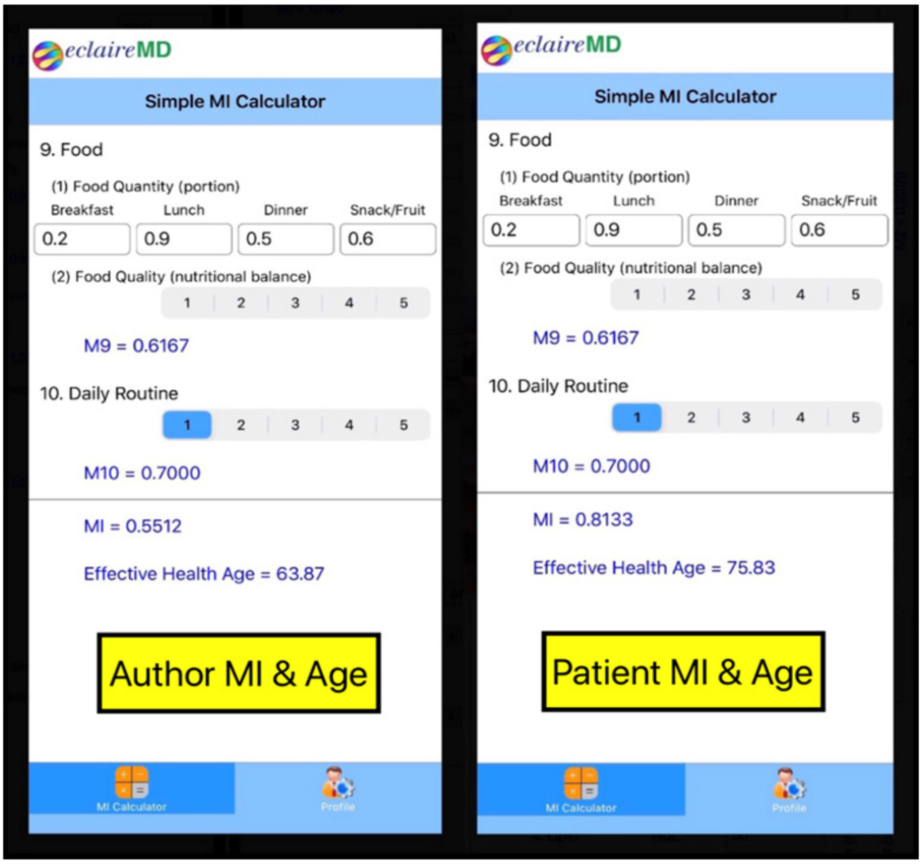

Figure 5 Final MI score & effective health age.

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Figure 6 illustrates two data tables. The top table shows the author's annual MI, real age, health age, and age difference during a period of 8.5 years (2012 through 2020). It is obvious that his health age changed from +8 years in 2012 to -9 years in 2020 with the period of 2014/2015 as the "turning point" of his health trend. The bottom table shows the comparison between two cases, the author (Case A) and another diabetes patient (Case B). From the comparison of each Mi category value, we can identify which category this patient B needs improvement. From this table, Case B's medical condition data is approximately 18% higher than the author A, but the patient's lifestyle details have vast differences from the author. The patient's walking steps are 64% less and water intake is half the amount of the author; however, sleep, stress, food, and daily routines are identical. The difference between health age and real age are -9 years for the author (Case A) and +4 years for the patient (Case B) in 2020.[1,2]

References 3, 4, 5, and 6 provide more detailed information regarding the MI model and its relationship with longevity.[3–6]

Year (The author)	2012	2013	2014	2015	2016	2017	2018	2019	2020 (7/8)
MI	0.9123	0.9348	0.7799	0.6363	0.5878	0.5703	0.5711	0.5844	0.5425
Real Age	65	66	67	68	69	70	71	72	73
Effective Age	73	75	69	63	62	62	63	65	64
Age Difference	8	9	2	-5	-7	-8	-8	-7	-9

Metabolism Category	Case A	The author	Case B	Patient	Comparison (A vs. B)
M1 (Weight)	171.7	1.0161	154.4	1.0578	4%
M2 (Glucose)	110.5	0.9209	130	1.0833	18%
M3 (BP)	109/61/60	0.8872	125/72/73	1.0528	19%
M4 (Lipid)	49/120/120/110	0.8745	50/130/160/115	1.0306	18%
M5 (Walking Steps)	16359	0.6113	10000	1.0000	64%
M6 (Watwer cc)	2976	0.6720	1500	1.3333	98%
M7 (Sleep)	>7/1/1	0.5000	>7/1/1	0.5000	0%
M8 (Stress)	1	0.5000	1	0.5000	0%
M9 (Food)	0.2/0.9/0.2/0.6/1	0.6167	0.2/0.9/0.5/0.6/1	0.6167	0%
M10 (Daily Routine)	1	0.7000	1	0.7000	0%
MI Score		0.5514		0.8135	48%
Real Biological Age		73		72	
Effective Health Age		64		76	
Age Difference		-9		4	

Figure 6 Comparison of two patients along with the author's historical record of MI & Effective Health Age (2012-2020).

Conclusion

This article describes his design of a simple tool utilizing sample data from the author and another patient to calculate their MI scores and effective health ages. The difference between their effective health age and biological real age are -9 years for the author A and +4 years for the patient B in 2020.

This tool can be used by people with and without chronic diseases. Metabolism is the fundamental building block for diabetes control, health maintenance, and longevity. Although this tool may provide a slightly lower degree of accuracy (98.4%), it is still based on solid scientific foundation and biomedical evidence that can serve as a useful APP for the general population's health maintenance. It should be pointed out that the author has inserted an amplification factor inside of his calculation of effective health age for the purpose of further raising user's awareness of metabolism importance on his longevity.[7]

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Conflicts of interest

The authors declare have no conflict of interest about the publication of this paper.

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