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Investigation of Expected Longevity Using Medical Conditions and Lifestyle Details to Calculate A Female Patient'S Health Age Based on GH-Method: Math-Physical Medicine (No. 490)

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Abstract

The author was a mathematician and an engineer. His view of longevity is similar to his past experience on designing and building a structure or a machine which he calls an "object". The expected lifespan of an object is similar to the longevity of a human being based on the following three factors:

(1) The availability of good and strong building materials that are similar to the genetic factors of a human body health conditions.
(2) The engineering design and site construction of this object are similar to the lifestyle, life-long habits, and environmental factors which are related to the health of the human body.
(3) The building's damaged cracks or the machine's malfunctioned parts under external forces are similar to the medical conditions and symptoms of disease in the human body. If the object suffers from operational problems due to external forces that is similar to the human body being affected by various diseases, then we can repair the object such as adopting the reinforcement of the building structural part or replacing the operational part of the machine. They are similar to the medical treatments including medication interventions, different surgeries, or organ transplants.

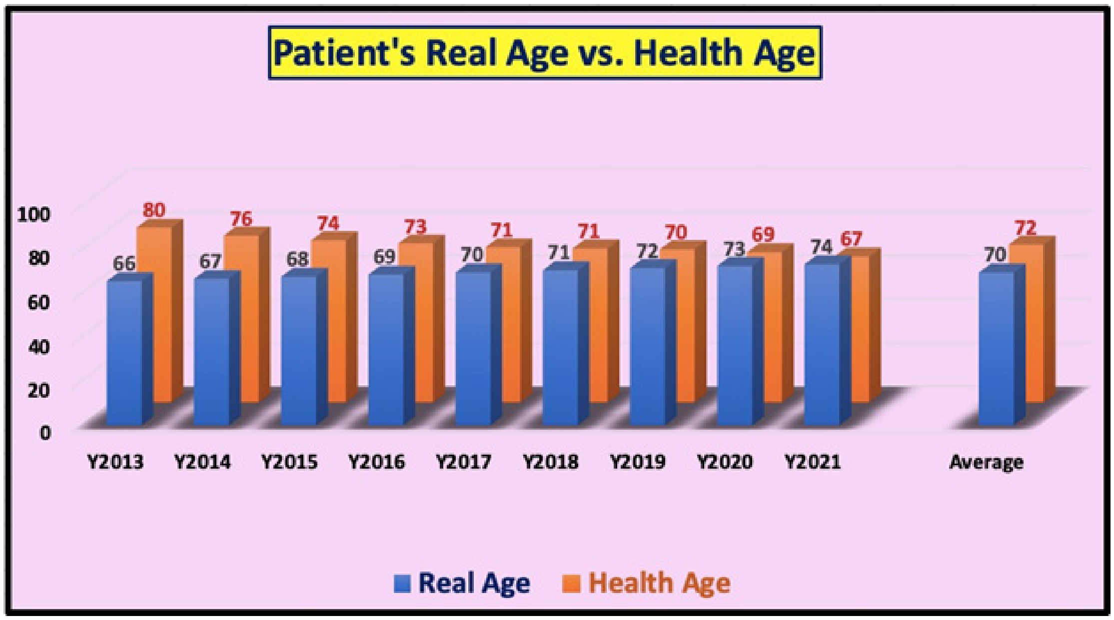
Once the author understood the analogy and similarity between an engineering object and a human body, he can then distinguish the differences among genetic reason, lifestyle maintenance, disease control, and medical treatments. It is extremely difficult, almost impossible at present time, to change our genes because we cannot select our biological parents; however, we can focus on our daily lifestyle management to either prevent from having diseases or controlling the progression of existing diseases.

In the US, approximately 10% among the total deaths each year, (~2.85 million deaths occurred in 2019), are caused by infectious diseases, while another 12% involved injuries or suicide. The remaining 78% of deaths are due to various diseases associated with internal organs.

However, among the 80% affected by diseases, there is about 10% of deaths related to malpractice of medical treatments - "195,000 patients die in hospitals each year because of preventable medical mistakes", from the national trial law, medical malpractice statistics, Dr. George Stanislaw, 2019". Generally speaking, genetic factors only contributes around 20% or less to various diseases while lifestyle management and health maintenance cause approximately 80% of deaths. The following simple math calculation can draw a conclusive fact that about 54% (0.8*(0.78-0.1)) of deaths caused by diseases are preventable through lifestyle management or improvements.

This particular article discusses the clinical case of a female patient's longevity which is closely related to the subjects on geriatrics, disease prevention, and lifestyle management. From this case study, we can clearly observe that, despite her "near-constant" state of her three chronic diseases (diabetes, hypertension and hyperlipidemia which are under medication interventions), her continuous improving lifestyle details has brought her "health age" on a consistent downward trend. This means that she becomes younger each year despite her real biological age getting one year older on her birthday.

Life is precious and health is important. A long and healthy life is a desirable goal for everyone. This article provides a logical and practical way to achieve longevity without suffering from many preventable or controllable diseases.



Introduction

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Methods

Death caused by disease and Longevity: As shown in Figure 1, approximately 2.85 million people died in 2019 from multiple causes of death in the United States. Among them, the first and largest group, ~1.4 million deaths or 50% of the total were directly related to metabolic disorders and their various complications. The second group, ~800,000 deaths or 28% were caused by a variety of cancers. Furthermore, within the cancer cases, at least about 45% of them were related to metabolic disorders. The third group, ~275,000 deaths or ~10% of the total deaths were caused by various infectious diseases (not including COVID-19). This group of infectious diseases requires excellent medical treatments and a strong body immunity to fight against infection from different virus or bacteria. The medical community has already proven that immunity and metabolism are closely related to each other, like two sides of the same coin (Reference 1). In summary, 88% of the total death cases are related, either directly or indirectly, to metabolism. The final remaining 12% of death cases are accidents and suicide which are not related to diseases.

Research method in this article: In this paper, the author described how to apply his engineering background, including mathematics, physics, and computer science to conduct his medical research on the subject of “effective health age” (i.e., expected lifespan). He reviewed 8.5-years of data from 1/1/2013 through 8/5/2021 belonging to a clinical case of a female patient with chronic diseases, where he focused on both metabolic conditions and health lifestyle details. It should be pointed out that her annual lifestyle scores were estimated by the author through an interview with the patient. After the initial data collection, he then created a simple model of “Effective Health Age” in comparison with her “Real Biological Age” using the GH-Method: math-physical medicine approach.

As a part of his medical research, he applied the acquired mechanical and structural engineering knowledge to develop several biomedical models to research diabetes and its complications. They include cardiac vascular disease (CVD), congenital heart disease (CHD), stroke, chronic kidney disease (CKD), diabetic retinopathy (DR), pancreatic beta cells impairment, and even risk probabilities of having cancer or dementia in order to be able to estimate the impact on human longevity. After all, longevity and deaths are closely related to many combined possibilities of having various diseases. That is why he considers longevity research as one of the concluding medical research projects based on many of his previous medical research results.

The engineering analogy of expected lifespan can be explained simply by using an example of a new machine or a new bridge. If we develop a monitoring system to continuously measure, record, and analyze the strength of material, as well as the relationship between force/stress (causes of disease such as lifestyle details) and deformation/strain (symptoms of disease such as medical conditions), we can then have a clear idea how long this machine or bridge will last which is their useful life or expected lifespan. Once we have learned how to perform a good maintenance job, then a long-expected lifespan is almost guaranteed.

The author self-studied chronic diseases, metabolism, and food nutrition for 4-years from 2010 to 2013. He started his medical research work by building a mathematical metabolism model in 2014. He named his research methodology as the “GH-method: math-physical medicine (MPM approach)”.

Over the past 11 years of his MPM research, he has learned that the most important factor is knowing how to apply physics principles and engineering modeling concepts to biomedical problems. This is different from inserting your biomedical data into some existing equations extended from theories and models. The reason for doing this is that the original equations associated with the inventor’s theory or model usually include his original boundary conditions. This may not fit into your biomedical situations directly or perfectly; therefore, you must understand the scope and applicability of these physical theories and engineering models first, and then find a suitable way to apply them. In other words, by learning other people’s wisdom first and then find a way to apply their wisdom to your own problem is the most practical way.

The simple numerical calculation of expected lifespan of a female patient is based on applications of physics law and engineering concept, big data analytics, and sophisticated mathematical metabolic model. It has depicted a possible way to extend our life expectancy via an effective metabolic condition improvement and lifestyle maintenance program. This practical method has already been applied and proven effectively in the author’s own case of diabetes control without medications.

The author hopes that this method can also be applied in the field of geriatrics, longevity, other chronic diseases control, or even dementia and cancer preventions. For example, if patients are able to collect sufficient data regarding their routine check-ups of chronic disease conditions, they can then directly plug the input data of M1 through M4. They can also utilize the same approach to deal with their own collected or guesstimated lifestyle data of M5 through M10. In this way, this longevity formula can then quickly calculate the effective health ages and life expectancies under their own disease conditions. This article provides one specific but real clinical case of a female patient using the above-described methodology.

Math-physical medicine: Topology is a newer branch of mathematics which was created around 1900. It studies key properties of “spaces”, such as metabolism of the human body space, which are invariant under any continuous deformation happened during the lifespan. Those few key properties or characteristics are not going to change as long as the space itself is not encountering a “break” situation, such as operational discontinuity of organs or death. Topology optimization is a mathematical method that optimizes material layout within a given design space, for a given set of loads/forces, boundary conditions and constraints with the goal of maximizing the performance of the system. As a matter of fact, topology optimization has been applied by some engineers on obtaining the best layout design of some automotive components (Reference 2). When we look into the human organs and try to figure out how to achieve certain predetermined health goals, we can recognize that it is also a form of topology optimization problem. This problem can then be solved by using some available mathematical programming method in combination with finite element engineering modeling method from both structural and mechanical engineering disciplines to conduct the targeted analysis to obtain an optimized human organ performance or biochemical response.

Based on the above learned academic knowledge and acquired professional experience, the author spent the entire year of 2014 to develop a mathematical metabolic model. This human metabolism model consists of a total of 10 categories, including 4-categories of disease (body outputs, like deformation/strain) and 6-categories of lifestyle details (body inputs, like force/stress). Similar to an engineering finite element model, these 10 categories further consist of about 500 detailed elements. Finally, utilizing complicated mathematical derivation and multiple programming techniques, he was able to proceed his topological response analysis and obtained his 14-pages long output sheets which was then used in 2014 for his software development task. This development task is a rather sophisticated job, but it still only obtains an approximated estimation of human metabolism.

A physical analogy of this mathematical metabolism model is similar to “using multiple nails that are encircled by many rubber bands”. For example, at first, we hammer 10 nails into a piece of flat wood with an initial shape of a circle with a center in the middle of the circle, then take 3,628,800 (=10!) rubber bands to encircle the nails, starting with 2 and 2+ nails and finally enclosing all of these 10 nails. The ~3.6 million rubber bands (i.e., small number of data elements of 10 but with a very big number of relationships among data) indicate the possible relationships existing among these 10 nails (i.e., 10 original metabolism data). Some rubber bands encircle 2 nails or 3 nails and so on, until the last rubber band encircles all of the 10 nails together (no rubber band to encircle a single nail is allowed). Now, if we move any one of the nails outward (i.e., moving away from the center of the nail circle), then this moving action would create some internal tension inside the encircled rubber band. Moving one nail ***"outward"*** means one of these ten metabolism categories is becoming ***"unhealthy"*** which would cause some internal stress to our body. Of course, we can also move some or all of these 10 nails outward at the same time, but with different moving scale for each nail. If we can measure and calculate the summation of all of these internal tensions which are created inside of the affected rubber bands, then this summarized tension force is equivalent to the metabolism value of human health. The higher tension means the higher metabolism value which creates an unhealthy situation. The author uses the above-described physical scenario of moving nails and estimating the stretches inside of their encircled rubber bands to explain his developed mathematical metabolism model of human health.

He developed his medical software APP on his iPhone in 2011 initially, he then began collecting his own health data of weight and glucose since 1/1/2012. After that, he then started category by category to enter his detailed lifestyle data for the period of 2013 to 2014. Thus far, he has already collected more than 2 million data regarding his own body health and lifestyle details. Finally, by the end of 2014, he compiled all the big data together and expressed them in terms of two newly defined biomedical terms: the ***metabolism index (MI),*** which is a combined daily score to show the body health situation, and general health status unit (GHSU), which is the 90-days moving average number to show the health trend. He has also identified a ***"break-even line" at 0.735 or 73.5%*** to separate his metabolic conditions between the healthy state (below 0.735) and unhealthy state (above 0.735).

With the 2+ million big data, initially, he focused on weight and glucose to conduct further analysis in order to put his severe diabetes under control which was his top priority. Like engineers looking at a project's dynamic design data or cardiologists reviewing a patient's EKG chart, he adopted the traditional time-series analysis approach. He then quickly realized that he could easily obtain a different conclusion dependent upon a specific time window he chose. On the other hand, if he analyzed all data using the entire long period of time with big data, he could easily see a bigger picture, such as the data's relationship and data moving trend from using a spatial analysis. Sometimes, the conclusion derived from a global view via spatial analysis might not be consistent with certain local views via time series analysis from a shorter time period.

One day, as he studied the history of medicine, he found a story about how Dr. John Snow from the UK discovered the cholera outbreak, which spread in the Broad Street area of London in 1854. He decided to adopt this similar concept, i.e., spatial analysis, from statistics as an additional tool to analyze his big and complicated medical data. An example of the close relationship between body weight and fasting glucose in the morning can be found and proved via spatial analysis. Spatial analysis is powerful to provide a rather clear view of the relationship and data moving trend provided that data size is large enough.

He also applied Fourier transform to convert a time domain data into a frequency domain in order to calculate and compare associated energy between high frequency with lower amplitude glucose components versus low frequency with higher amplitude glucose components. The energy theory from mechanical engineering is frequently applied to calculate different degrees of damage on the internal organs by different glucose components which carry different amounts of energy. This is how he connected the energy theory application of mechanical engineering with the wave theory application of electronics engineering.

Sometimes, he also utilized signal processing techniques from wave theory (electronic engineering, radio-wave communication, and geophysics) to decompose a glucose waveform into many component-based sub-waveforms in order to study the impact on glucose by food, exercise, etc. He even applied perturbation theory (one variable only with first-order to third-order polynomials) of quantum mechanics to build an approximate postprandial glucose waveform before the patients eat their meals. He also applied the perturbation theory's approximation method on his risk assessment of having CVD, CHD, CKD, stroke, and DR. Remarkably, it has achieved 95% to 99% of prediction accuracy.

The author has suffered many complications resulting from his obesity, diabetes, hypertension, and hyperlipidemia, including five cardiac episodes, critical kidney condition, bladder infection, diabetic foot ulcer, DR, hypothyroidism, diabetic constipation, diabetic fungal infection, and more. By using metabolism as the foundation, he is able to extend his research into many medical branches as long as the diseases share some or many overlapping causes. In the extended study of disease complication risks, genetic factors, and certain environmental influences were also included in his modeling.

Among the three chronic disorder diseases such as diabetes, hypertension, and hyperlipidemia, diabetes causes the most fundamental damage to our blood system. The blood cells carry both nutrition via glucose produced by the liver and oxygen transferred from the lungs, then circulate through the blood vessels in our bodies. When elevated glucose flows through the arteries, it would alert the immune cells within the artery wall; therefore, these cells will treat them as an "invader" and start to fight against them. This fight will result in a situation similar to the inflammation on the artery wall, causing the blood vessel wall to thicken with a non-smooth surface. This rough surface allows the buildup of lipids in the blood with the formation of plaque. As a result, the combination of high glucose and high lipids will create an artery blockage (~70% cases). When high blood pressure is added into the picture, an artery rupture becomes a possibility (~30% cases). These two situations can lead to a heart attack or stroke. For micro-vessels, elevated glucose may cause tiny, microscopic leakages instead. The kidney's normal functions are to discharge body waste and recycle protein back into the body. These microscopic leaking holes will reverse these two functions, which means the leaking of protein out of the body via urination and recycling body waste back into the body can be toxic. This is why dialysis is utilized to mechanically perform the kidney's normal expected functions. Other complications, such as erectile dysfunction, bladder complications, peripheral nervous damage, and retina damage are also based on similar interpretations and reasons.

As an engineer, the author visualizes an image in his mind with the analogy of acid (glucose), water pipe (blood vessel), water pressure (blood pressure), and butter flowing through the pipe (lipids in blood). This mechanical scenario of pipes is quite similar to the biomedical scenario inside our blood vessels.

In addition, if the damage is not too severe and only lasts for a shorter period of time, the body and organs are still in an "elastic state", which is similar to pre-diabetes conditions that can be reversed. However, when diabetes becomes extremely severe and lasts for a much longer period of time, then the body and organs are entering into a "plastic state" i.e., never fully reverting back to its original healthy state. By applying this structural engineering concept and using other math-physical techniques, the author can provide a guesstimate on the self-repair rate for his damaged pancreatic beta cells.

After the author compiled a large amount of data over the past 11 years, he builds up several mathematical models to understand the progression stages of his diseases and also predict the projection of development in the future. Therefore, his various disease risk probabilities can then be estimated with a reasonably high degree of prediction accuracy.

The information mentioned above depicts how a mechanical and structural engineer, physicist, computer scientist, and mathematician who lacks formal training on both biology and chemistry, has learned about disease deaths through various chronic diseases and their complications and is able to conduct all related medical research work, including geriatrics and longevity.

With all of his developed math-physical medicine research, his final goal is to fight against different diseases in order to survive by avoiding "pre-mature" death (at least around 55% to 80% of death cases). Living a healthier and longer life is everyone's ultimate objective. This is also his driving force in dedicating his entire efforts on medical research since 2010. After 11-years of self-study and continuous investigation and research, he could finally define a simple formula of "Effective Health Age" based on the evaluation of many years' collected medical examination reports and either collected (his own case) or estimated (other patients case) lifestyle information in order to estimate the correct "Health Age". This is different from the "Real Biological Age" or "Chronological Age" defined as the actual amount of time a person has been alive. It should be pointed out that genetic factors are not explicitly expressed through his life expectancy formula. However, the genetic factors were already implicitly included in ***the adjustment factor (AF) of metabolism.***

His simple equation to calculate this effective health age is listed below:

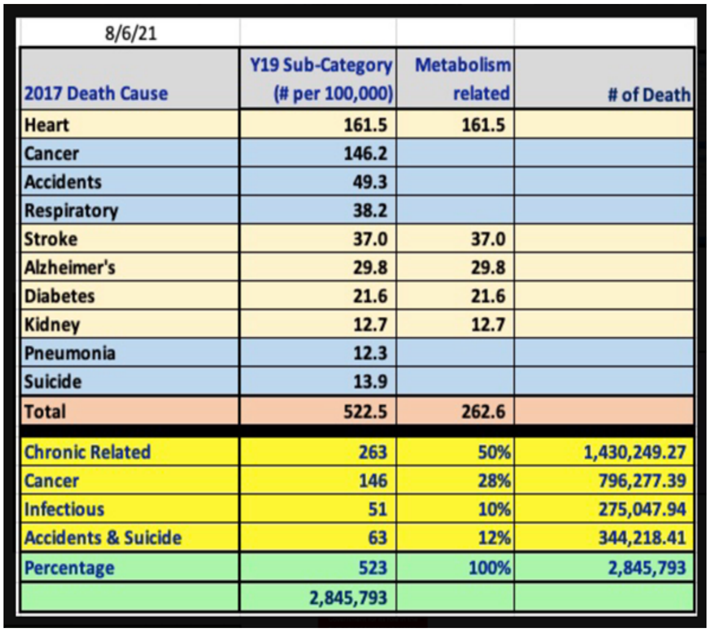
$$\begin{aligned}&\textit{Effective Health Age}\\&= \textit{Real Biological Age} *\\&(1+((MI-0.735)/0.735)/AF)\end{aligned}$$

$$\textit{Where } AF = 2$$

He then utilized the calculated annual MI scores to calculate the effective health age in order to compare against the real biological age.

Results

Figure 1 shows the deaths in the United States during 2019. It is clear that almost 50% of deaths caused by diseases are directly related to metabolic disorders. Furthermore, at least another 50% of deaths are caused by Cancer (28%) and Infectious diseases (10%) and are also related to metabolism. In conclusion, there are ~69% of total deaths caused by diseases that are either directly or indirectly related to metabolism; then there are 69% of deaths from diseases contribution i.e., (0.5+0.5 * (0.28+0.10)). Furthermore, as mentioned earlier, metabolism has about 80% contribution from lifestyle. Therefore, *the lifestyle management contributes ~55% of disease deaths, i.e. (0.69*0.8).*



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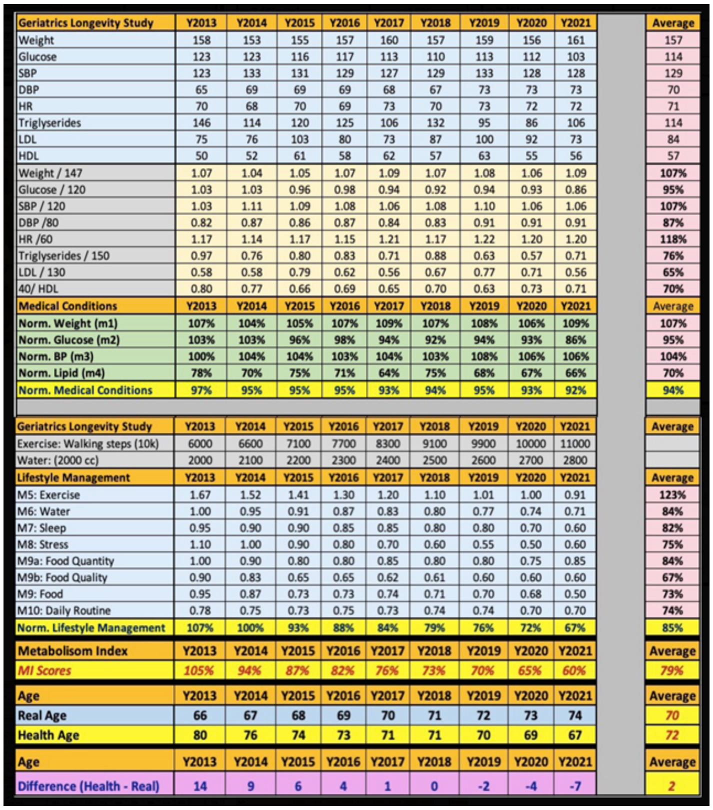
2017 Death Cause	Y19 Sub-Category (# per 100,000)	Metabolism related	# of Death
Heart	161.5	161.5	
Cancer	146.2		
Accidents	49.3		
Respiratory	38.2		
Stroke	37.0	37.0	
Alzheimer's	29.8	29.8	
Diabetes	21.6	21.6	
Kidney	12.7	12.7	
Pneumonia	12.3		
Suicide	13.9		
Total	522.5	262.6	
Chronic Related	263	50%	1,430,249.27
Cancer	146	28%	796,277.39
Infectious	51	10%	275,047.94
Accidents & Suicide	63	12%	344,218.41
Percentage	523	100%	2,845,793
	2,845,793		

Figure 1: US leading Disease Deaths During 2019

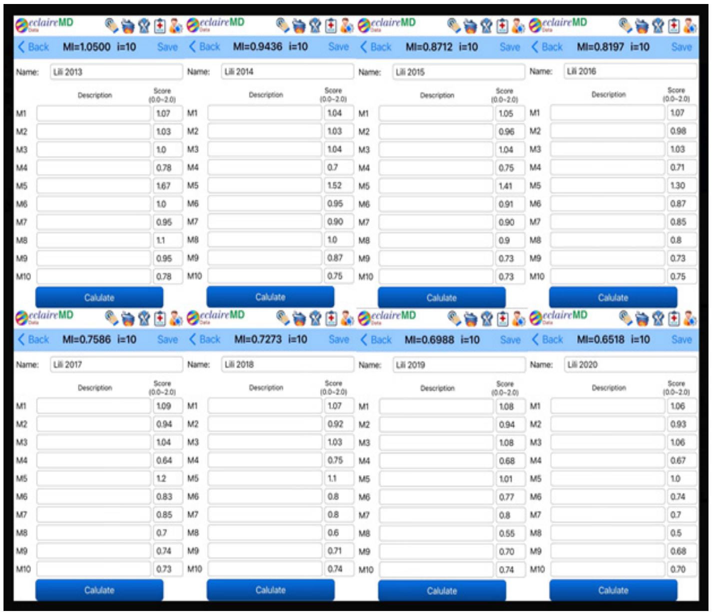
Figure 2 illustrates the input data and calculated data of 10 MI categories and the final results of MI scores from 2013 to 2021. It should be pointed out that her medical conditions are maintained at an almost equal level over the long period of 8.5 years from 2013 to 2021. This is due to her medication interventions for her diabetes, hypertension, and hyperlipidemia. Therefore, medications may be effective in controlling the external symptoms of the disease, but on the other hand, it also covers up the true causes of diseases. With this clinic case, her lifestyle details are undergoing improvement continuously year-after-year. This is the main reason for her longevity objective (i.e., her health age) is improving annually.



Geriatrics Longevity Study	Y2013	Y2014	Y2015	Y2016	Y2017	Y2018	Y2019	Y2020	Y2021	Average
Weight	158	153	155	157	160	157	159	156	161	157
Glucose	123	123	116	117	113	110	113	112	103	114
SBP	123	133	131	129	127	129	133	128	128	129
DBP	65	69	69	69	68	67	73	73	73	70
HR	70	68	70	69	73	70	73	72	72	71
Triglyserides	146	114	120	125	106	132	95	86	106	114
LDL	75	76	103	80	73	87	100	92	73	84
HDL	50	52	61	58	62	57	63	55	56	57
Weight / 147	1.07	1.04	1.05	1.07	1.09	1.07	1.08	1.06	1.09	107%
Glucose / 120	1.03	1.03	0.96	0.98	0.94	0.92	0.94	0.93	0.86	95%
SBP / 120	1.03	1.11	1.09	1.08	1.06	1.08	1.10	1.06	1.06	107%
DBP /80	0.82	0.87	0.86	0.87	0.84	0.83	0.91	0.91	0.91	87%
HR /60	1.17	1.14	1.17	1.15	1.21	1.17	1.22	1.20	1.20	118%
Triglyserides / 150	0.97	0.76	0.80	0.83	0.71	0.88	0.63	0.57	0.71	76%
LDL / 130	0.58	0.58	0.79	0.62	0.56	0.67	0.77	0.71	0.56	65%
40/ HDL	0.80	0.77	0.66	0.69	0.65	0.70	0.63	0.73	0.71	70%
Medical Conditions	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	Average
Norm. Weight (m1)	**107%**	**104%**	**105%**	**107%**	**109%**	**107%**	**108%**	**106%**	**109%**	107%
Norm. Glucose (m2)	**103%**	**103%**	**96%**	**98%**	**94%**	**92%**	**94%**	**93%**	**86%**	95%
Norm. BP (m3)	**100%**	**104%**	**104%**	**103%**	**104%**	**103%**	**108%**	**106%**	**106%**	104%
Norm. Lipid (m4)	**78%**	**70%**	**75%**	**71%**	**64%**	**75%**	**68%**	**67%**	**66%**	70%
Norm. Medical Conditions	**97%**	**95%**	**95%**	**95%**	**93%**	**94%**	**95%**	**93%**	**92%**	**94%**
Geriatrics Longevity Study	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	**Average**
Exercise: Walking steps (10k)	6000	6600	7100	7700	8300	9100	9900	10000	11000	
Water: (2000 cc)	2000	2100	2200	2300	2400	2500	2600	2700	2800	
Lifestyle Management	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	**Average**
M5: Exercise	1.67	1.52	1.41	1.30	1.20	1.10	1.01	1.00	0.91	123%
M6: Water	1.00	0.95	0.91	0.87	0.83	0.80	0.77	0.74	0.71	84%
M7: Sleep	0.95	0.90	0.90	0.85	0.85	0.80	0.80	0.70	0.60	82%
M8: Stress	1.10	1.00	0.90	0.80	0.70	0.60	0.55	0.50	0.60	75%
M9a: Food Quantity	1.00	0.90	0.80	0.80	0.85	0.80	0.80	0.75	0.85	84%
M9b: Food Quality	0.90	0.83	0.65	0.65	0.62	0.61	0.60	0.60	0.60	67%
M9: Food	0.95	0.87	0.73	0.73	0.74	0.71	0.70	0.68	0.50	73%
M10: Daily Routine	0.78	0.75	0.73	0.75	0.73	0.74	0.74	0.70	0.70	74%
Norm. Lifestyle Management	**107%**	**100%**	**93%**	**88%**	**84%**	**79%**	**76%**	**72%**	**67%**	**85%**
Metabolisom Index	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	**Average**
MI Scores	***105%***	***94%***	***87%***	***82%***	***76%***	***73%***	***70%***	***65%***	***60%***	***79%***
Age	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	**Average**
Real Age	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	***70***
Health Age	**80**	**76**	**74**	**73**	**71**	**71**	**70**	**69**	**67**	***72***
Age	**Y2013**	**Y2014**	**Y2015**	**Y2016**	**Y2017**	**Y2018**	**Y2019**	**Y2020**	**Y2021**	**Average**
Difference (Health - Real)	**14**	**9**	**6**	**4**	**1**	**0**	**-2**	**-4**	**-7**	**2**

Figure 2: Data table of MI (Metabolism Index) calculation

Figure 3 displays the software outputs of her calculated MI scores from 2013 to 2020. Due to space constraint, the author decides to omit the 2021 MI screenshot in Figure 3.



	MI=1.0500 i=10	MI=0.9436 i=10	MI=0.8712 i=10	MI=0.8197 i=10	MI=0.7586 i=10	MI=0.7273 i=10	MI=0.6988 i=10	MI=0.6518 i=10
Name:	Lili 2013	Lili 2014	Lili 2015	Lili 2016	Lili 2017	Lili 2018	Lili 2019	Lili 2020
M1	1.07	1.04	1.05	1.07	1.09	1.07	1.08	1.06
M2	1.03	1.03	0.96	0.98	0.94	0.92	0.94	0.93
M3	1.0	1.04	1.04	1.03	1.04	1.03	1.08	1.06
M4	0.78	0.7	0.75	0.71	0.64	0.75	0.68	0.67
M5	1.67	1.52	1.41	1.30	1.2	1.1	1.01	1.0
M6	1.0	0.95	0.91	0.87	0.83	0.8	0.77	0.74
M7	0.95	0.90	0.90	0.85	0.85	0.8	0.8	0.7
M8	1.1	1.0	0.9	0.8	0.7	0.6	0.55	0.5
M9	0.95	0.87	0.73	0.73	0.74	0.71	0.70	0.68
M10	0.78	0.75	0.73	0.75	0.73	0.74	0.74	0.70

Figure 3: Outputs of MI Scores for the Period from 2013 to 2020

Figure 4 is the conclusive graph of this study. It includes three diagrams. The top diagram is the comparison between her MI score and her health age. As he mentioned earlier in the Method section, the MI and GHSU scores of >73.5% would be considered as unhealthy and <73.5% would be healthy. This patient's MI curve started to pass through this break-even point in 2018 which is the year of her effective health age equals to her real biological age. Prior to 2018, she was unhealthy and have positive age difference and she became healthy post-2018 with negative age difference. This observation can be further supported by the detail lifestyle data in Figure 2. The middle diagram reveals the comparison between her real ages and her health ages. Her real ages are increased by one year for every passing year; however, her health ages are continuously decreasing year-after-year. Therefore, the bottom diagram in this figure has a +14-years in 2013 going through the 0-year of age difference in 2018 to a -7-years in 2021 [1, 2].

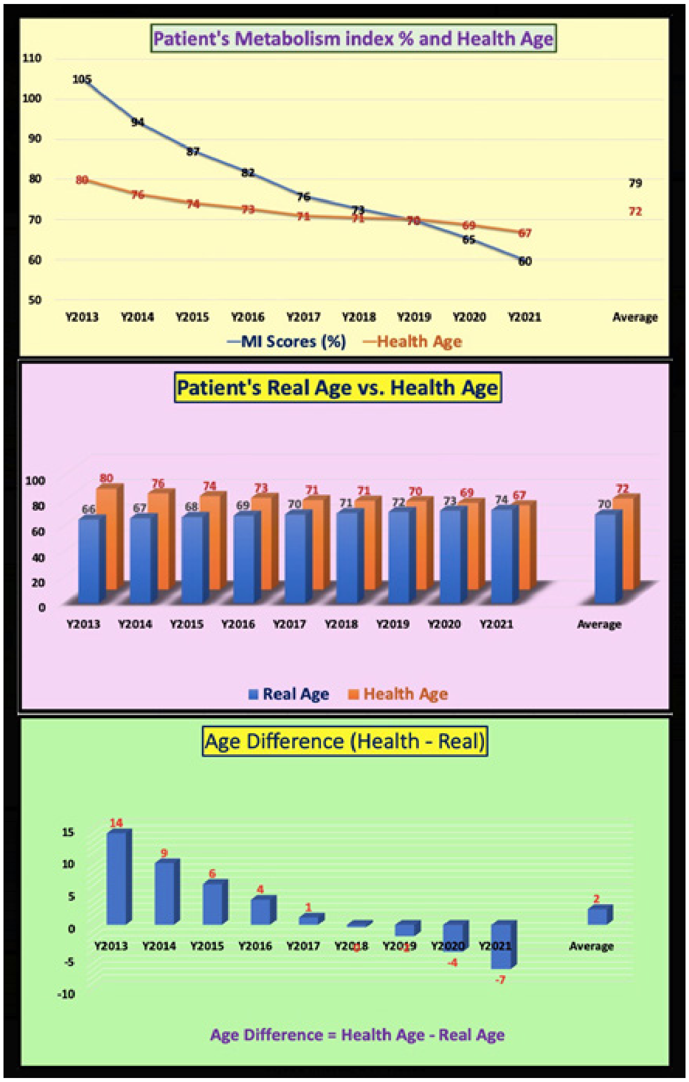


Figure 4: Graphic Results of MI curve vs. Health Age Curve, Bar Charts of Health Ages, Real Ages and Age Differences

Conclusions

This particular article discusses the clinical case of a female patient's longevity which is closely related to the subjects on geriatrics, disease prevention, and lifestyle management. From this case study, we can clearly observe that, despite her "near-constant" state of her three chronic diseases (diabetes, hypertension and hyperlipidemia which are under medication interventions), her continuous improving lifestyle details has brought her "health age" on a consistent downward trend. This means that she becomes younger each year despite her real biological age getting one year older on her birthday.

Life is precious and health is important. A long and healthy life is a desirable goal for everyone. This article provides a logical and practical way to achieve longevity without suffering from many preventable or controllable diseases.

References

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