Review Article

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Using Math-Physical Medicine to Study the Risk Probability of Having a Heart Attack or Stroke based on Three Approaches, Medical Conditions, Lifestyle Management Details and Metabolic Indexes

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Introduction

The author spent eight years collecting and processing ~1.5 million data and researching medical conditions and lifestyle management details on a patient (himself), who has three chronic diseases such as hyperlipidemia, type 2 diabetes (T2D), and hypertension. The same individual suffered five cardiac episodes from 1994 through 2006. This paper focuses on his risk probability of having a heart attack or stroke due to his overall metabolic and health conditions based on three sets of input data: (1) his medical examination records since the year 2000; (2) his lifestyle management details collected since the year 2012; (3) and based on a term the author defined as Metabolism Index (MI), which combines the patient's medical conditions and lifestyle management details together to study not only data but also their combined inter-relationships.

The author is a research scientist in the field of endocrinology, diabetes, and metabolic disorders. His major assessment in this paper emphasizes on the quantitative link between metabolic syndrome and risk probability of having a heart attack or stroke.

Method

Baseline Conditions

Initially, the author established a "static baseline condition" based on the patient's age, gender, race, family history, unhealthy habits, and waistline. This part of the total data belongs to the traditional term of "genetic conditions". He then assigned a weighting factor within this category. Afterwards, he tried various weighting factors to observe the impact from detailed elements of genetic conditions. It should be noted that unhealthy personal habits, such as smoking, drinking, illicit drug use, and waistline are considered part of the "genetic" conditions in his analysis due to their severe impact on health and the difficulty of either modifying people's unhealthy habits or reducing their waistlines within a short period of time. This is the reason the author decided to include these "pseudo-permanent" conditions into this "genetic baseline" category.

Medical Conditions

He applied the hemodynamics concept to develop a dynamic progressive mathematical model to macro-simulate the situation of blood blockage and artery rupture. Based on his readings from different medical publications, he has made two following assumptions:

First, by using fluid dynamics concept, the author hypothesized that the major causes of blood flow blockage are due to high glucose and high cholesterol. The immune cells in the blood vessel detect high glucose in the blood flow as an "intruder" and fight against it, causing inflammation along the wall to have uneven surfaces. The high amount of cholesterol then starts to deposit in these non-smooth areas and then forms a blood flow blockage. The possibility of having a heart attack and stroke caused by the blood flow blockage phenomenon has an approximate 70% - 80% probability.

Second, by using solid mechanics concept including elastic, plastic, and fracture mechanics, the author speculated that the major causes of artery rupture are due to high glucose and high blood pressure. The long-term exposure to high glucose will eventually cause the artery wall structure to become weaken and fragile along with the impact of aging. When the blood vessel wall then continually receives additional strain from high blood pressure, the weakened artery can easily rupture. The possibility of having a heart attack and stroke caused by the artery rupture phenomenon has an approximate 20% - 30% probability.

In order to conduct this part of research, he has utilized a total of 72,893 metabolic conditions (obesity, diabetes, hypertension, and hyperlipidemia) which he collected by himself and various health examination reports from laboratories or hospitals within 2,274 days (1/1/2012 - 3/25/2018). These data contain a small portion (~20%) of his mathematical metabolism index (MI) model which has a data set of ~1.5 million; however, this approach is actually similar to the Framingham Studies and following the majority of the medical community's method. He then computed the risk probabilities of having a heart attack or stroke based on all of his collected and processed data regarding metabolic conditions.

Lifestyle Management

He developed a customized software to collect his lifestyle management details which has a total of six major categories with ~500 detailed elements: food, water intake, exercise, sleep, stress, and regular life routines. Food is the most important yet complex category that has more than 100 measured elements. For example, carbs and sugar affect diabetes, salt affects hypertension, fat affects hyperlipidemia, and not to mention traveling, and being in different countries to eat at various places. Furthermore, we must keep a nutritional balance among all of these ingredients in our food and meals. Water is not only significant, but it also serves a detoxification effect. Exercise including type, intensity, duration, timing, and frequency helps with losing weight and burning calories. Walking exercise, particularly post-meal walking, has been emphasized here due to the fact that it is one of the best exercises for senior citizens who has diabetes conditions. Sleep has nine measured elements. Stress has ~40 measured elements which include ~20 for normal psychological situations (mainly resulting from inter-personal relationships) and other ~20 for abnormal psychological situations (mainly resulting from self-induced internal stress such as flashback memory of abuse or abandonment at an early age). Regular life pattern has 15 measured elements which are also particularly important for our health wellbeing and longevity. The above descriptions show some highlights of this lifestyle management software. Using this program, patients can collect and process a large amount of "clean data" in order to obtain a better and complete picture of their lifestyle management in terms of preventing or controlling their metabolic diseases.

The author has utilized a total of 295,620 lifestyle details (~80% of total data amount and consisting of food, exercise, water, sleep, stress, daily life routine) within 2,274 days (1/1/2012 - 3/25/2018). This lifestyle dataset is about four times bigger than the medical conditions dataset, but it is still a small portion of his developed mathematical metabolism index (MI) model. The MI model not only includes both medical conditions and lifestyle details but also contains the hidden complex inter-relationships by processing through many layers of calculations. As a result, this big dataset finished up with a total of ~1.5 million data.

He then computed the risk probabilities of having a heart attack or stroke based on his collected lifestyle management details. Due to the fact that most patients are incapable or unwilling to collect their lifestyle details, this approach and results are rarely seen in most of the published medical papers.

Metabolism Index

At first, the author describes his methodology of defining and developing this specific term of "Metabolism". Using the "energy" concept to simulate human metabolism state related to chronic diseases, he applied the "Finie Bêlement" concept of structural engineering modeling to convert this "analog" human system into a "digitized" mathematical system in order to get an approximate solution of a real human system by utilizing modern computer power and artificial intelligence (AI) technology. He spent the entire year of 2014 to develop a mathematical governing equation of metabolism model which contains 10 categories of lifestyle input and metabolic output. The final derived equation occupied a total length of 14 hand-written pages. Its input includes six lifestyle categories of food, water, exercise, sleep, stress, and life pattern regularity. Its output includes four metabolic categories of weight, glucose, blood pressure, and lipid. In addition to food and exercise, he also investigated the impact on his glucose and health from his traveling patterns, water intake, bowel movement, stress and tension, routine life pattern disturbance, and psychological effect on physiology, etc. Overall, these 10 categories contain ~500 elements and end up with ~1.5 million data collected and processed over seven years (2012-2018).

He has utilized the data within 2,274 days (1/1/2012 - 3/25/2018) to conduct his research. With such a large volume of data, a customized computer software program is necessary for handling the data collection, processing, analysis, and interpretation. He also defined two new terms known as the Metabolism Index (MI) and General Health Status Unit (GHSU). MI is a total score reflecting your body health condition (i.e. state of your metabolism) which combines all of those 10 categories and their inter-relationships. GHSU is a moving average value of past 90-days daily MI scores. The "health state" is expressed as the "break-even" line which is 73.5%; above this line is regarded unhealthy, whereas below the line is considered healthy. He then computed the risk probabilities of having a heart attack or stroke based on these ~1.5 million data related to his developed MI model.

Risk Calculations

Thus far, he has computed three different sets of risk probabilities based on metabolic conditions, lifestyle management, and MI, respectively. Finally, he integrated them into one overall risk probability.

It should be noted that, due to the concerns of high variance of all inputs, he also conducted many sensitivity analyses to cover the probability variance range by using different weighting factors on different categories, such as genetic, lifestyle, weight, glucose, lipids, and blood pressure.

Results

The author can discuss many findings from his analyses; however, he will focus only on risk probabilities of having a heart attack or stroke caused from chronic diseases, especially T2D, in this article. Although the final three probability datasets are somewhat similar but with slight differences resulted from three different approaches. These three trends of risk reduction are identical when time progresses forward, i.e. his risk probability is reduced year after year. This obvious improvement on his cardiovascular disease (CVD) risk reduction is from his rigorous and persistent effort on managing his lifestyle, by putting his severe chronic diseases, particularly T2D, under control.

During the period of 2000 to 2012, the overall risk probabilities are in the range of 62% to 83% (an averaged risk of 74%) regardless of which approach is applied. This explains why he suffered three cardiac episodes during 2001 to 2006. The author developed the MI model and five glucose prediction tools during the period of 2014 to 2015. By 2016, he had accumulated sufficient knowledge and learned enough practical methods to improve his lifestyle and control his chronic diseases effectively. That is why all of his risk probabilities from three different approaches yield a lower risk level (26% to 38%) during the period of 2016 to 2018 (Figure 4).

Medical Conditions

As shown in Figure 1, Significant Risk Probability of Heart Attack & Stroke based on Medical Conditions displays his calculated results of year-to-year and averaged risk probabilities based on his metabolic disorders (medical conditions).

1. 74% in 2000 (followed by three cardiac episodes during 2001 - 2006).
2. 62% in 2012 decreased to 26.4% in 2017.
3. The risk probability in 2017 is 26.4% using his mathematical dynamic models, which is compatible with 26.7% by Framingham Studies.
4. 31% in 2018 which is based on 3-month data only.
5. Seven-years averaged risk probability is 34%.
6. Sensitivity range from all of those weighting factor analyses +/- 10% to +/- 18%.

In comparison with the other two approaches, the "medical conditions" approach with ~70,000 data yields the lowest risk probabilities especially during 2016 to 2018. This is due to the "target standards" of medical conditions are clearly defined, less ambiguity, and easier to achieve the following listed targets. Therefore, this approach yields relatively lower risk probability.

Metabolic Targets:
25.0 for BMI (Weight),
120 mg/dL for glucose (FPG and PPG),
120/80 mmHG for blood pressure (SBP/DBP),
150/40/130/200 for lipid (triglyceride/HDL/LDL/total cholesterol).

Lifestyle Management
As shown in Figure 2, Significant Risk Probability of Heart Attack & Stroke based on Lifestyle Management displays his calculated results of year-to-year and averaged risk probabilities based on lifestyle management details.

1. 83% in 2000 (followed by three cardiac episodes during 2001 - 2006).
2. 70% in 2012 decreased to 33% in 2017.
3. The risk probability in 2017 is 33% by using his mathematical dynamic models based on lifestyle details which is slightly higher than 26.7% by Framingham Studies via medical conditions.
4. 33% in 2018 which is based on 3-months data only.
5. Seven-years averaged risk probability is 34%.
6. Sensitivity range from all of those weighting factor analyses: +/- 10% to +/- 18%.

In comparison with the other two approaches, the "lifestyle details" approach with ~300,000 data yields the highest risk probabilities, especially during 2016 to 2018. This is due to the "target standards" of lifestyle management of being more ambiguous and also difficult to abide by. For example, the definition and scope of stress, sleep, and daily life regularity are not easy to set clear targets for everyone. Even the food category alone has so many elements to be considered. Besides, the author has established a "higher" targets to meet for managing his lifestyle. However, during the period of 2016 to 2018, the actual differences between medical conditions and lifestyle details are within 2% to 7%.

Metabolism Index
This article displays his calculated results of year-to-year and averaged risk probabilities based on his developed metabolism index (MI) model in Figure 3: *Significant Risk Probability of Heart Attack & Stroke* based on *Metabolism* Index.
1. Risk probability % in 2000 could not be calculated, since his MI model was not developed until 2014, using only available data since 2012 (followed by three cardiac episodes from 2001-2006).
2. 74% in 2012 decreased to 34% in 2017.
3. The risk probability in 2017 is 34% using his mathematical dynamic models based on his developed MI model which is slightly higher than 26.7% by Framingham Studies using medical conditions.
4. 33% in 2018 which is based on 3-month data only.
5. Seven-years averaged risk probability is 52%.
6. Sensitivity range from all of those weighting factor analyses: +/- 10% to +/- 18%.

In comparison with the other two approaches, the "metabolism index (MI)" approach with ~1,500,000 data yields the middle-range risk probabilities, especially during 2016 to 2018. This is due to the MI model combining both basic characters and inter-relationships of medical conditions and lifestyle details. In theory, this nonlinear and complex mathematical model should yield the most accurate risk probability since it depicts a total picture of the patient's health status. During the period of 2016 to 2018, the actual differences between MI approach and medical conditions & lifestyle details are within 2% to 5%. However, during the period of 2012 to 2014, this MI approach yields the highest risk probabilities among these three approaches. The reasons are that both lifestyle management and medical condition of the patient were out of control. The findings of these two different periods actually confirm the author's earlier conclusion of "most reliable" results. On the other hand, this approach is also extremely difficult for other patients or healthcare professionals to use because of its mathematical complexity and difficulty of data collection and interpretation.

Conclusion
The calculated risk probability results have been validated by the patient's health examination reports provided from hospitals over a long period starting from 2000 through 2017. From this study of big data dynamic simulation approach using math-physical medicine, it can provide the author, who has chronic diseases, an early warning of having another heart attack or stroke in the future.

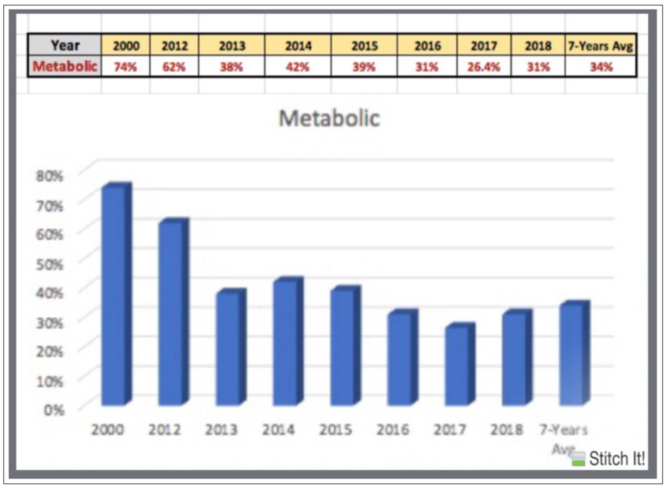

Figure 1: Significant Risk Probability of Heart Attack & Stroke (Medical Conditions Approach)

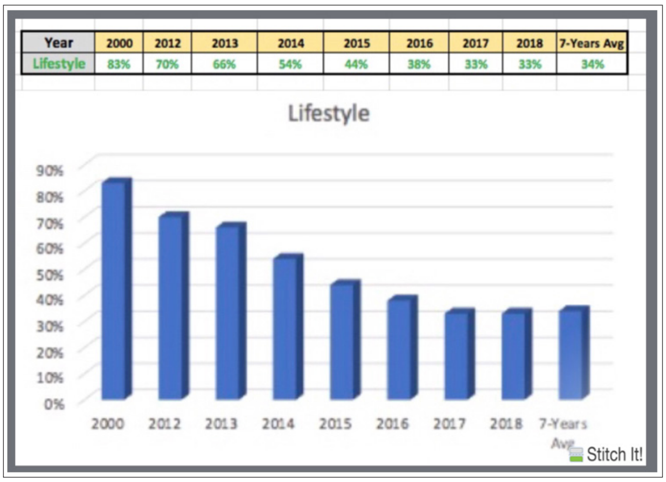

Figure 2: Significant Risk Probability of Heart Attack & Stroke (Lifestyle Details Approach)

Year	2000	2012	2013	2014	2015	2016	2017	2018	7-Years Avg
MI		74%	77%	59%	43%	36%	34%	33%	52%

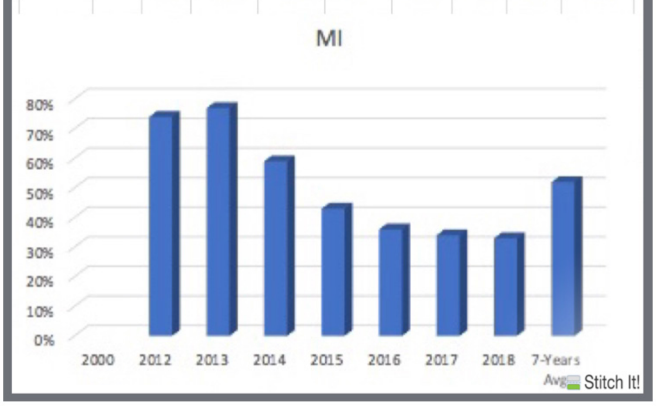

Figure 3: Significant Risk Probability of Heart Attack & Stroke (Metabolism Index, MI, and Approach)

Year	Probability	Probability	Probability	Year
	MI	Medical	Lifestyle	Averaged
2000		74%	83%	79%
2012	74%	62%	70%	69%
2013	77%	38%	66%	60%
2014	59%	42%	54%	51%
2015	43%	39%	44%	42%
2016	36%	31%	38%	35%
2017	34%	26%	33%	31%
2018	33%	31%	33%	32%
7-Years	52%	34%	34%	40%

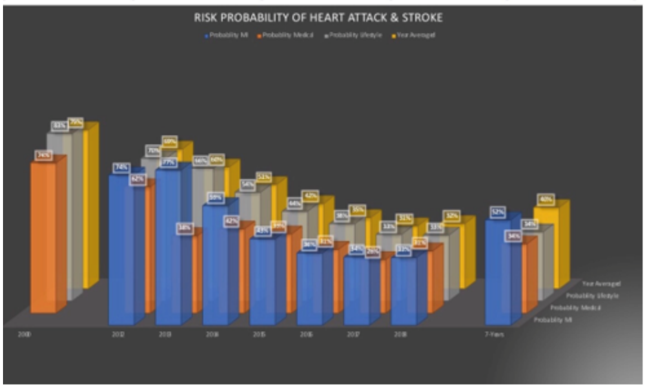

Figure 4: Results of Three Different Approaches

Biography

The author received an honorary PhD in mathematics and majored in engineering at MIT. He attended different universities over 17 years and studied seven academic disciplines. He has spent 20,000 hours in T2D research, initially studying six metabolic diseases and food nutrition during 2010-2013, then conducting his own diabetes research during 2014-2018. His approach is a "quantitative medicine" based on mathematics, physics, optical and electronics physics, engineering modeling, wave theory, energy theory, signal processing, computer science, big data analytics, statistics, machine learning, and artificial intelligence. He named it "math-physical medicine". His main focus is on preventive medicine using prediction tools. He believes that the better the prediction, the more control you have.

The author created this "math-physical medicine" approach by himself in order to save his own life. Although he has read many medical books, journals, articles, and papers, he did not specifically utilize any data or methodology from other medical work. All of his research is his original work based on data he collected from his body and using his own computer software developed during the past 8-years. Therefore, no major problems were associated with data interference or data contamination since he has been dealing with a homogenous genetic condition and lifestyle environment. He could delve into one single variable deeply to extract valuable information. In addition, his knowledge, information, technique, and methodology of mathematics, physics, engineering, and computer science came from his lifelong learning from schools and industries and should not be listed as medical references. This is the reason his references only contain his own published papers [1-4].

Limitation of Research

This article is based on data of metabolic conditions and lifestyle details collected from one T2D patient (himself). It does not cover genetic conditions and lifestyle details of other diabetes patients. However, the author's research approach is based on his solid inter-disciplinary academic background and successful industrial experiences. His academic background and working experience have prepared him to conduct his diabetes research with the following thorough process and carefully chosen steps:

1. Observing and identifying a system's basic characters as a physicist;
2. Developing related but rigorous mathematical equations as a mathematician;
3. Applying suitable engineering models and useful statistical models to address the real-world challenges, e.g. data variance, as an engineer;
4. Using modern computer science tools and sophisticated AI techniques to aid in problem solving.

Nevertheless, his conclusions and findings should be re-verified and used with caution when being applied to other patients who are under different metabolic conditions or lifestyles.

Other Declarations

During the past 8-years of studying and researching, the author has never hired any research assistant or medical research associate to help with his work. He applied his own invention of a "Software Robot" created during 2001-2009, his AI knowledge, and his previous programming experience (close to 1 million lines of code) to produce the system architecture, design structure, and some special code of this customized computer software. He used this software to collect and analyze his big data, conduct his medical research, and to control his diabetes disease.

This project was 100% self-funded by using his own money that was earned from a successful high-tech venture in Silicon Valley. He did not receive any financial assistance or grants from any public, private institution or organization. Therefore, there are no concerns regarding any conflict of interest.

Acknowledgement

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The author would also like to thank Professor James Andrews at the University of Iowa. He helped and supported him tremendously when he first came to the United States. His encouragement assisted the author to build his solid engineering and computer science foundation. He is forever grateful to his earlier mentor, who has a kind heart and guided him during the struggles of his undergraduate and first master's degree work at Iowa.

Finally, but not least, he would like to extend his appreciation to two medical doctors associated with Stanford University and its medical clinics at different periods. Dr. Jamie Nuwer provided him with encouragement for his continuous diabetes research work. Dr. Jeffrey Guardino advised him to write his research findings to share with other patients and medical professionals.

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