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The GH-Method

Viscoelastic or Viscoplastic Glucose Theory (VGT #156): For Overweight or Obese Patient: Every Pound or 0.5 kg of Weight Reduction or Every 0.6 inches or 1.5 cm of Waistline Reduction will Gain One Year of Your Life Expectancy – A Study of Longevity versus Both Body Weight and Waistline Using a Space-Domain Energy Analysis Tool Based on the GH-Method: Math-Physical Medicine (No. 749)

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Keywords: Viscoelastic; Viscoplastic; Overweight; Waistline; Body weight; Time domain; Space domain; Frequency domain; Fast Fourier transform

Abbreviations: FFT: fast Fourier transform; FD: frequency domain; SD: space domain; TD: time domain; MPM: math-physical medicine

1. INTRODUCTION

Human health maintenance or improvement starts from body weight and waistline control. If a person is overweight (BMI > 25) or obese (BMI > 30), the likelihood of having chronic diseases, such as diabetes, hypertension, and hyperlipidemia will be greatly increased. As a result, these metabolic conditions will easily develop into many complicated and deadly diseases, such as heart attack, stroke, kidney failure, and even cancers and dementia. In the US, about 70% or ~2 million people died from chronic conditions or metabolic-induced diseases annually. For patients who have these issues, their hope to achieve longevity is at risk. After all, isn't longevity the ultimate goal for most of us?

During Y2020, the total number of US deaths was 2,506,540 (100%) which includes a new category of 350,831 (14%) from COVID death. The subtotal death cases that directly or indirectly resulted from various metabolic disorders and complications are 1,748,553 (69.8%) which includes heart 696,962 cases (28%), cancers 602,350 cases (24%), strokes 160,264 cases (6%), Alzheimer's disease dementia 134,242 (5%), diabetes 102,188 (4%), kidney 52,547 (2%); (Source: Mortality in the United States, 2020, data table for Figure 4).

Other than body weight (BW) itself, there is another related biomarker, waist circumference (waistline or waist). For men or women who carry a "belly" is an important sign of either having or developing bad health conditions. In this article, the author will not address those feasible medical conditions, including heart disease and type 2 diabetes, which are related to a large waistline. In general, for men, a waistline < 37 inch (94 cm) is "low risk", 37-40 inch (94-102 cm) is "high risk, > 40 inch (> 102 cm) is "very high risk". For women, a waistline < 31.5 inch (80 cm) is "low risk", 31.5-34.6 inch (80-88 cm) is "high risk, > 34.6 inch (> 88 cm) is "very high risk".

In 2010, the author's weight was 220 lbs. (100 kg) with a waistline of 44 in. (112 cm). His daily average glucose (eAG) was 280 mg/dL and his HbA1C was 11%. In 2010, His calculated health age was 73 while his biological age was only 63 (the age difference

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is +10). Currently, in 2022, his weight is 176 lbs. (75.8 kg) with a waistline of 34 in. (86.4 cm). His daily average glucose (eAG) is 103 mg/dL and his HbA1C is 5.9%. His calculated health age is 65 while his biological age is already 75 (the age difference is -10). In summary, over the past 13 years, he has extended his life expectancy by 20 years (i.e. 10+10). His personal data can be served as a testimony in this article.

Since his complete data collection started on 1/1/2012; therefore, this research article's time span is only 11 years, from 1/1/2012 to 10/12/2022.

The developed equation for this health age is listed as:

Health Age
= Chronological real Age * (1+((MI-0.735)/0.735)/2)

Age difference
= health age - real age

where MI is the metabolism index value calculated using 500 detailed elements of 4 categories of medical conditions and 6 categories of lifestyle details, with over 3 million data stored in his database of biomarker values and extended data. The numerical digit of 0.735 is the dividing line of MI value between healthy condition and unhealthy condition.

After completing his data preparation task, the actual data processing for energy analysis work itself is 100% dependent on his recently developed VGT software tool on his iPhone which has reduced his data processing time from a normal 5-6 hours to less than 1 minute. Therefore, he can spend this saved amount of extra time to conduct a deeper investigation and/or explore a better interpretation of his observed phenomena and analyzed findings.

Regarding the energy associated with both single output and two inputs, the author has decided to use the following three energy models described in some detailed manner in the section of Methods. But, he only provides a detailed illustration of the SD-VGT results.

The first time-domain (TD) model uses a rudimentary physics definition of energy associated with a wave that is directly proportional to the square of wave amplitude. The second space-domain (SD) model utilizes the hysteresis loop area of the time-dependent strain-stress curve with viscoelastic and viscoplastic engineering material behaviors. The third frequency-domain (FD) model uses his defined new variable of strain (output) multiplying with stress (stress input is the strain change rate multiplying with the normalized viscosity input) and the fast Fourier transform (FFT) operation of wave theory in physics.

It should be noted that his two normalization factors utilized in this study are 170 lbs. (BMI = 25) for his body weight and 37 in. (the dividing line between low risk and high risk) for his waistline.

In summary, there are 3 noticeable findings regarding the energy study regarding longevity versus body weight and waistline:

1. From the waveforms and collected data of longevity output versus two inputs of body weight and waistline, his average age difference is 19.84 years (~20 years of life), the average body weight difference is 20.45 lbs (~20 lbs.), the average waistline difference is 11.22 in. (~11 in.), over the 11-year period from Y2012 to Y2022. The age difference here is defined as the maximum health age minus the minimum health age. Therefore, using a calculation of linear average change rate, two conclusions can be drawn here: "Every one pound of his body weight reduction or every 0.6 inches of his waistline reduction extends one year of his lifespan." In the author's case, the turning point is around Y2016 when both his weight and his waistline reached their respective low-end positions of the selected 11-year period.

2. The SD-VGT diagram and analysis results show that his SD energy ratios are body weight = 49%; waistline = 51%. This means that his body weight and his waistline have contributed almost equal amounts of influence on his longevity. Statistical results have shown that nearly 65% to 80% of patients with chronic diseases have problems of either being overweight (BMI =25-30) or obese (BMI > 30). Almost all obese people have excessive waistlines. Therefore, for those patients, reducing their body weight and their waistline is the first and far-most important step toward their goal of longevity.

3. Again, from his SD-VGT time-zone analysis, the degree of influences from two distinct time periods are Y12-Y16 = 96%, and Y17-Y22 = 4%. This means that his accomplishment on weight reduction and waistline reduction contributed 96% to the goal of improving his longevity during the earlier period of 5 years, and the later period of 6 years contributed 4% only. Interestingly, the mid-period of 2016-2017 is the turning point of his observed SD energy analysis results which are identical to the TD observations.

The conclusive statements of this article are, "longevity is the ultimate goal for most people. Human health maintenance or improvement starts from body weight control and waistline control. For the obese patient: Every pound or 0.5 kg of weight reduction or every 0.6 in. or 1.5 cm of waistline reduction will indeed gain one year of life expectancy."

2. METHODS

2.1 The author's case of diabetes and complications

The author has been a severe T2D patient since 1996. He weighed 220 lb. (100 kg, BMI 32.5) at that time with a one-time glucose reading of 380 mg/dL. By 2010, he still weighed 198 lb. (BMI 29.2) with average daily glucose of 250 mg/dL (HbA1C of 10%). During that year, his triglycerides reached 1161b (hyperlipidemia) and albumin-creatinine ratio (ACR) at 116 (kidney issues). He also suffered from five cardiac episodes within a decade from 1993 through 2003 caused by work stress and diabetes. In 2010, three independent physicians warned him about his urgent need for kidney dialysis treatment and the risk of his life-threatening health situation such as dying from his severe diabetic complications. Other than the cerebrovascular disease (stroke), he has suffered most of the known diabetic complications, including both macro-vascular & micro-vascular complications, nerve damage as in retinopathy and foot ulcer, as well as a hormonal disturbance, e.g. hypothyroidism.

In 2010, he decided to launch his self-study on endocrinology, diabetes, and food nutrition to save his own life. After developing the metabolism model in 2024, during 2015 and 2016, he developed four prediction models related to diabetes conditions: weight, PPG, fasting plasma glucose (FPG), and A1C. As a result, from using his developed mathematical metabolism index (MI) model in 2014 and the 4 prediction tools, by end of 2016, his weight was reduced from 220 lbs. (100 kg, BMI 32.5) to 176 lbs. (89 kg, BMI 26.0), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger glucose reading from 250 mg/dL to 120 mg/dL, and lab-tested A1C from 10% to ~6.5%. One of his major accomplishments is that he no longer takes any diabetes medications as of 12/8/2015.

Around that time (2014-2017), he started to focus on preventive medicine instead of blindly trusting and depending on medication treatments only. He also gambled on his belief that most human organs have strong inherent abilities to self-repair themselves through lifestyle improvements by taking good care of them - even though it can only accomplish a certain degree of repairing or healing dependent on certain organ cells and their status of damage, such as pancreatic beta cells.

In 2017, he has achieved excellent results on all fronts, especially glucose control. However, during the pre-COVID period of 2018 and 2019, he traveled to approximately 50+ international cities to attend 65+ medical conferences and made ~120 oral presentations. This hectic schedule inflicted damage to his diabetes control, through dining out frequently, post-meal exercise disruption, jet lag, and along with the overall metabolic impact due to his irregular life patterns through a busy travel schedule; therefore, his glucose control and overall metabolism state were somewhat affected during this two-year heavy traveling period.

Since 1/19/2020, living in a COVID-19 quarantined lifestyle, not only has he written and published ~500 medical papers in 100+ journals, but he has also reached his best health conditions in the past 26 years. By the beginning of 2022, his weight was further reduced to 168 lbs. (BMI 24.8) along with a 5.8% A1C value (beginning level of pre-diabetes), without having any medication interventions or insulin injections. During the period from 1/1/2022 to 8/20/2022, his average FPG is 93 mg/dL, PPG is 113 mg/dL, and daily glucose is 106 mg/dL. These good results are due to his non-traveling, low-stress, and regular daily life routines. Of course, the accumulated knowledge of chronic diseases, various complications, practical lifestyle management experiences, and development of many high-tech tools along with his medical research academic findings have contributed to his excellent health status since 1/19/2020, the beginning date of his self-quarantined life.

On 5/5/2018, he applied a continuous glucose monitoring (CGM) sensor device on his upper arm and checks his glucose measurements every 5 minutes for a total of ~288 times each day. He has maintained the same measurement pattern to the present day. In his research work, he uses his CGM sensor glucose at a time interval of 15 minutes (96 data per day). Incidentally, the average sensor glucoses between 5-minute intervals and 15-minute intervals has only a 0.6% difference (average glucose of 111.86 mg/dL for 5 minutes and average glucose of 111.18 mg/dL for 15 minutes with a correlation of 94% between these two sensor glucose curves) during the period from 2/19/20 to 7/22/22.

Therefore, over the past 13 years, he could study and analyze his collected 3+ million data regarding his health status, medical conditions, and lifestyle details. He applies his knowledge, models, and tools from mathematics, physics, engineering, and computer science to conduct his medical research work. His research work has a goal of achieving both "high precision" and "quantitative proof" in the medical findings for the ultimate objectives of "preventive medicine".

The following timetable provides a rough sketch of the emphasis in his medical research during each stage:

2000-2013: Self-study diabetes and food nutrition, developing a data collection and analysis software.

2014: Develop a mathematical model of metabolism, using engineering modeling and advanced mathematics.

2015: Weight & FPG prediction models, using neuroscience.

2016: PPG & HbA1C prediction models, using optical physics, artificial intelligence (AI), and neuroscience.

2017: Complications due to macro-vascular research, such as Cardiovascular disease (CVD), coronary heart diseases (CHD), and stroke, using pattern analysis and segmentation analysis.

2018: Complications due to micro-vascular research such as kidney (CKD), bladder, foot, and eye issues (DR).

2019: CGM big data analysis, using wave theory, energy theory, frequency domain analysis, quantum mechanics, and AI.

2020: Cancer, dementia, longevity, geriatrics, DR, hypothyroidism, diabetic foot, diabetic fungal infection, and linkage between metabolism and immunity, learning about certain infectious diseases, such as COVID-19.

2021: Applications of linear elastic glucose theory (LEGT) and perturbation theory from quantum mechanics on medical research subjects, such as chronic diseases and their complications, cancer, and dementia.

2022: Applications of viscoelastic/viscoplastic glucose theory (LEGT) on 142 biomedical research cases and 5 economics research cases.

Again, to date, he has spent ~40,000 hours self-studying and researching medicine and he has read 4,000+ published medical papers online. He has collected and calculated more than 3+ million pieces of data regarding his own medical conditions and lifestyle details. In addition, he has written and published 700+ medical research papers in 100+ various medicine, physics, mathematics, and engineering journals. Moreover, he has also given 120+ presentations at 70+ international medical conferences. He has continuously dedicated his time (11-12 hours per day and work each day of a year, without rest during the past 13 years) and efforts to his medical research work and shared his findings and learnings with other patients worldwide. In addition, he has also spent the past 12 years developing and maintaining a medicine and health software APP on his iPhone which functions as his private numerical laboratory to process the various experimental datasets of his medical conditions and lifestyle details.

2.2 Brief introduction of math-physical medicine (MPM) research

The author has collected 3+ million data regarding his health condition and lifestyle details over the past 13 years. He spent the entire year of 2014 developing a metabolism index (MI) model using a topology concept, nonlinear algebra, algebraic geometry, and finite element method. This MI model contains various measured biomarkers and recorded lifestyle details along with their induced new biomedical variables for an additional ~1.5 million data. Detailed data of his body weight, glucose, blood pressure, heart rate, blood lipids, body temperature, and blood oxygen level, along with important lifestyle details, including diet, exercise, sleep, stress, water intake, and daily life routines are included in the MI database. In addition, these lifestyle details also include some lifetime bad habits and certain environmental exposures. Fortunately, the author has none of these lifetime bad habits and an extremely low degree of exposure to environmental factors. The developed MI model has a total of 10 categories covering approximately 500 detailed elements that constitute his defined "metabolism index model" which are the building blocks or root causes for diabetes and other chronic disease induced complications, including but not limited to cardiovascular disease (CVD), chronic heart disease (CHD), stroke, chronic kidney disease (CKD), diabetic retinopathy (DR), neuropathy, foot ulcer, hypothyroidism, dementia, and various cancers. The end result of the MI development work is a combined MI value within any selected period with 73.5% as its dividing line between a healthy and unhealthy state. The MI serves as the foundation for many of his follow-up medical research work.

During the period from 2015 to 2017, he focused his research on type 2 diabetes (T2D), especially glucose, including fasting plasma glucose (FPG), PPG, estimated average glucose (eAG), and hemoglobin A1C (HbA1C). During the following period from 2018 to 2022, he concentrated on researching medical complications resulting from diabetes, chronic diseases, and metabolic disorders which include heart problems, stroke, kidney problems, retinopathy, neuropathy, foot ulcer, diabetic skin fungal infection, hypothyroidism, diabetic constipation, dementia, and various cancers. He also developed a few mathematical risk models to calculate the probability percentages of developing various diabetic complications based on this MI model. From his previous medical research work with 700+ published papers, he has identified and learned that the associated energy of hyperglycemic conditions is the primary source of causing many diabetic complications which lead to death. Therefore, a thorough knowledge of these energies is important for achieving a better understanding of the dangerous complications.

2.3 TD, SD, and FD analysis tools

This section has brief descriptions of TD correlation analysis with other observational results, SD VGT analysis with hysteresis loop area's energy results, and FD analysis with frequency curve area's energy results.

First of all, by using a TD analysis tool, we can examine the curves' moving trend and pattern visually along with their correlation numerically. We can also study the extremely high or low data values in the dataset. The visual observation or calculation-derived interpretations are a part of statistical analysis results which can indeed provide some useful hints or even derive some accurate conclusions. However, we must be aware of the limitations of the selected data size and time window and also be cautious of the appropriate statistics tool we choose.

Regarding the TD energy, we can apply the rudimentary definition of physics that "the wave carried energy is directly proportional to the square of wave's amplitude". However, the data quantity % of each wave category should be considered and included in order to obtain a more accurate TD energy value.

The author would like to describe the essence of his developed "hybrid model" that combines both the SD viscoelastic/plastic VGT analysis method and FD fast Fourier transform (FFT) analysis method together with a comparison against the traditional time-domain statistical correlation analysis.

It is described in 10 steps in the English language instead of using mathematical equations to explain it. In this article, he has applied both the SD-VGT operations (steps 1-7) and the FD-FFT operations (steps 8-10). As a result, it is aimed at readers who do not have an extensive background in the academic subjects of engineering, physics & mathematics.

The first step is to collect the output data or symptom (strain or ε) on a time scale. The second step is to calculate the output change rate with time (dε/dt), i.e. the change rate of strain or symptom over each period. The third step is to gather the input data or cause (viscosity or η) on a time scale. The fourth step is to calculate the time-dependent input or cause (time-dependent stress or σ) by multiplying dε/dt and η together. The "time-dependent input or cause equation" of "stress σ = strain change rate of dε/dt * viscosity η" is the essential part of this "time dependency". The fifth step is to plot the input-output (i.e. stress-strain or cause-symptom) curve in a two-dimensional space-domain or SD (x-axis versus y-axis) with strain (output or symptom) on the x-axis and stresses (time-dependent inputs, causes, or stresses) on the y-axis.

The sixth step is to calculate the total enclosed area within these stress-strain curves or input-output curves (i.e. the hysteresis loops), which is also an indicator of associated energies (either created energy or dissipated energy) of this input and output dataset. These energy values can also be considered as the degrees of influence on output by inputs. The seventh step is the assembly of the area values of the selected periods to compare the "historical progression and contribution of medical condition" over certain time periods. For the frequency domain, the eighth step is to define a "hybrid input variable" by using "strain*stress" which yields another accurate estimation of the energy ratio similar to the SD-VGT energy ratio associated with the hysteresis loop. The ninth step is to present these hybrid models' results of (strain*stress) in TD then perform the FFT operation to convert them into FD. The enclosed area of the frequency curve (where the x-axis is the frequency and the y-axis is the amplitude of energy) can be used to estimate the total FD-FFT energy. The tenth step is to compare these FD energy results against the SD-VGT energy results, or even TD energy results.

After providing the above 10-step description, the author would still like to use the following set of VGT stress-strain mathematical equations in a two-dimensional SD to address the selected medical variables:

Strain
= ε (time-dependency characteristics of individual strain value at the present time duration)

Stress
= σ (based on the change rate of strain multiplying with a chosen viscosity factor η)
= η * (dε/dt)
= η * (d-strain/d-time)
= (viscosity factor η using individual viscosity factor at present time duration) * (strain at present quarter - strain at previous time duration)

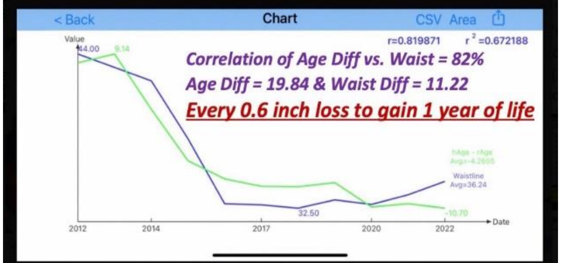
Some of these inputs (causes or viscosity factors) are further normalized by dividing them or being divided by a normalization factor using certain established health standards or medical pieces of knowledge. Some examples of normalization factors are 6.0 for HbA1C, 120 mg/dL for glucose, 25 for body mass index (BMI), 4,000 steps after each meal, 10,000 or 12,000 steps for daily walking exercise depending on time-period selection, 13 grams to 20 grams of carbs/sugar intake amount per meal depends on time-period selection. If using the originally collected data, i.e. the non-normalized data, it would distort the numerical comparison of the hysteresis loop areas. Using this "normalization process", we can remove the dependency of the individual unit or certain unique characteristics associated with each viscosity factor. This process allows us to convert the originally collected variables into a set of "dimensionless variables" for easier numerical comparison and result interpretation.

Note: For a more detailed description, please refer to the "consolidated method" section which is given at the beginning of the special issue.

3. RESULTS

Figure 1 displays data tables and waveforms of 3 curves, age difference, weight, and waistline.

Figure 2 shows SD-VGT analysis results for longevity versus weight and waistline.



	Weight in the morning	hAge - rAge
Avg	174.83	-4.27
2012	189.03	8.01
2013	182.57	9.14
2014	177.23	2.04
2015	175.40	-4.59
2016	172.94	-6.93
2017	174.29	-7.88
2018	171.09	-7.94
2019	172.57	-7.41
2020	170.02	-10.54
2021	168.58	-10.12
2022	169.44	-10.70

	Waistline	hAge - rAge
Avg	36.24	-4.27
2012	44.00	8.01
2013	43.00	9.14
2014	42.00	2.04
2015	37.68	-4.59
2016	32.83	-6.93
2017	32.75	-7.88
2018	32.50	-7.94
2019	33.12	-7.41
2020	32.78	-10.54
2021	33.50	-10.12
2022	34.50	-10.70

Figure 1: Data tables and waveforms of 3 curves, age difference, weight, and waistline.

Correlation	100%	94%	95%			Strain Rate	Strain	Stress 1	Stress 2	Height 1	Height 2	Area 1	Area 2	FD 1	FD 2	SD
10/12/22	Age diff	BW	Waist	N. 1	N. 2	Age diff rate	Age diff	BW	Waist	BW	Waist	BW	Waist	BW	Waist	Time-Zone
Y12	8.01	189.03	44	1.11	1.19	0	8.01	0	0	0	0	0	0	0	0	
Y13	9.14	182.57	43	1.07	1.16	1.13	9.14	1.21	1.31	0.61	0.66	0.69	0.74	11.09	12.00	
Y14	2.04	177.23	42	1.04	1.14	-7.1	2.04	-7.4	-8.06	-3.09	-3.37	21.97	23.95	-15.10	-16.44	Y12-Y16
Y15	-4.59	175.4	37.68	1.03	1.02	-6.63	-4.59	-6.84	-6.75	-7.12	-7.41	47.21	49.1	31.40	30.99	168
Y16	-6.93	172.94	32.83	1.02	0.89	-2.34	-6.93	-2.38	-2.08	-4.61	-4.41	10.79	10.33	16.50	14.39	96%
Y17	-7.88	174.29	32.75	1.03	0.89	-0.95	-7.88	-0.97	-0.84	-1.68	-1.46	1.59	1.39	7.67	6.63	
Y18	-7.94	171.09	32.5	1.01	0.88	-0.06	-7.94	-0.06	-0.05	-0.52	-0.45	0.03	0.03	0.48	0.42	
Y19	-7.41	172.57	33.12	1.02	0.9	0.53	-7.41	0.54	0.47	0.24	0.21	0.13	0.11	-3.99	-3.52	
Y20	-10.54	170.02	32.78	1	0.89	-3.13	-10.54	-3.13	-2.77	-1.3	-1.15	4.06	3.6	32.99	29.23	Y17-Y22
Y21	-10.12	168.58	33.5	0.99	0.91	0.42	-10.12	0.42	0.36	-1.36	-1.2	-0.57	-0.5	-4.21	-3.85	7
Y22	-10.7	169.44	34.5	1	0.93	-0.58	-10.7	-0.58	-0.54	-0.08	-0.08	0.05	0.05	6.19	5.79	4%
Avg	-4.27	174.83	36.24	1.03	0.98	-1.7	-4.27	-1.75	-1.72	-1.72	-1.7	86	89	2422	2223	175
		30566	1313	1.1	1.0						SD-E:	49%	51%			
			TD-E:	52%	48%								FD-E:	52%	48%	

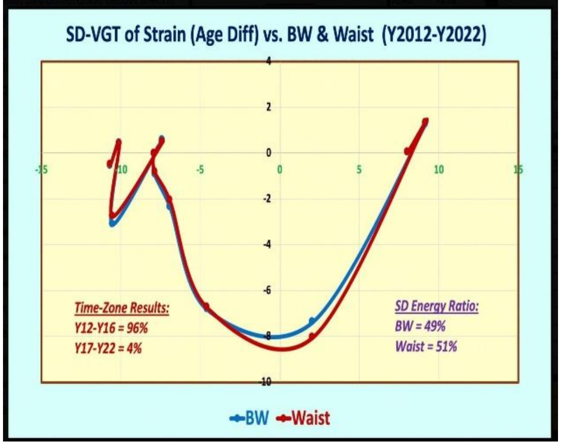


Figure 2: SD-VGT analysis results for longevity versus body weight and waistline.

4. CONCLUSION

In summary, there are 3 noticeable findings regarding the energy study regarding longevity versus body weight and waistline:

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5. REFERENCES

For editing purposes, the majority of the references in this paper, which are self-references, have been removed. Only references from other authors' published sources remain. The bibliography of the author's original self-references can be viewed at www.eclairemd.com.

For reading more of the author's published VGT or FD analysis results on medical applications, please locate them through three published special editions from the following three specific journals:

(1) Special Issue. The GH-Method. (https://www.theghmethod.com).

(2) Journal of Applied Material Science & Engineering Research (contact: Catherine).

(3) Advances in Bioengineering and Biomedical Science Research (contact: Sony Hazi).

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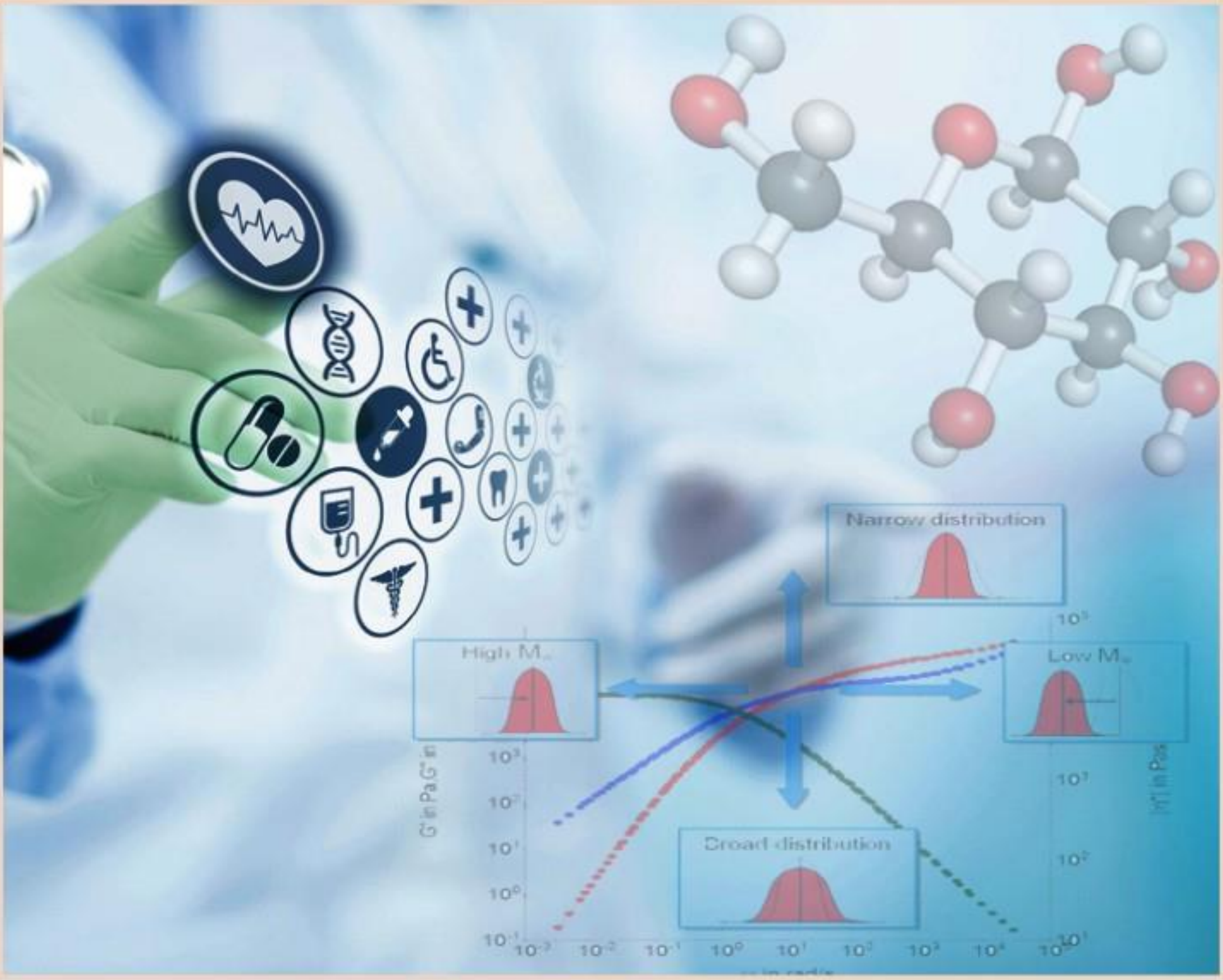

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2022