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Research Article

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Viscoelastic or Viscoplastic Glucose Theory (VGT #148): Energy Analyses of CVD Risk Versus Weight, Glucose, Blood Pressure, and Blood Lipids, based on Two ADA Guidelines with the Low-Density Lipoprotein Limits of 130 mg/dL for Normal People and 100 mg/dL for Type 2 Diabetes Patients using Data Collected from 1/1/2013 to 9/15/2022 and utilizing 3 Energy Analysis Methods of Time Domain, Space Domain, and Frequency Domain from the GH-method: Math-Physical Medicine (No. 739)

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Introduction

For the purpose of computer software debugging, the data was manually prepared using the Excel spreadsheet and utilizing the author's developed VGT software tool in this research article. ***The focus is to study the impact of two distinctive American Diabetes Association guidelines of low-density lipoprotein (LDL) cholesterol on the blood lipid value (m4), then further calculate the risk probability of developing cardiovascular diseases (CVD), along with influences by three other biomarkers, body weight (m1), glucose (m2), and blood pressure (m3).***

The lipid management in type 2 diabetes (T2D) published on January 1, 2006, from the American Diabetes Association (ADA) has set desirable LDL cholesterol, high-density lipoprotein (HDL) cholesterol, triglyceride levels as < 100, > 40 in men & > 50 in women, and < 150 mg/dl, respectively. ***The primary treatment strategy, as in the NCEP guidelines, is the lowering of LDL cholesterol from <130 mg/dL for normal people to < 100 mg/dL for T2D patients.***

The author has defined 4 primary biomarkers as follows:

m1 = body weight / 170 lbs. (BMI 25)
m2 = glucose / 120 mg/dL
m3 = (SBP/120 + DBP/80 + HR/60) / 3
m4 = (triglyceride/150 + 40/HDL + LDL/130 + total cholesterol/200) / 3

In this study, he further defines his calculated lipid metabolism index (m4) for T2D patients, such as himself, as:

m4 = (triglyceride/150 + 40/HDL + LDL/100 + total cholesterol/200) / 3

There is one prominent observation from this study regarding the output of the CVD risk % resulting from his selected 4 input medical conditions, i.e. m1, m2, m3, and m4. From the author's collected personal medical history and health data, ***his CVD case study has shown the following ranking order of individual energy ratios (degree of influences or contributions) from the time domain (TD) energy analysis:***

"m1 weight > m2 glucose > m3 BP > m4 lipid"

The ranking order of energy ratios from both space domain (SD) energy analysis and frequency domain (FD) energy analysis are identical:

"m2 glucose > m1 weight > m3 BP > m4 lipid"

More importantly, ***the difference of energy ratio (degree of influence) from m4 (including HDL Cholesterol) on CVD risk between using either 130 mg/dL or 100 mg/dL as two different HDL Cholesterol guidelines is only 2% from the TD result and even a smaller 1% from both the SD result and FD result.***

(Note: This particular ranking order reflects his personal case study of 4 input conditions on his CVD risk.)

Since the data of 4 metabolism input conditions were annualized before the energy calculations, there are no issues associated with the sensitivity of "data quantity %", i.e. all of these 4 mi values have 10 data points each. For a better numerical comparison of hysteresis loop area data, ***he has used an identical normalization factor of 0.01 for all 4 mi values (i = 1 to 4), These four normalized viscosities, i.e. mi / 0.01, would amplify the viscosity and stress values by 100 times.***

Consistently, by calculating and comparing the summation of the quantitative degree of contribution to his CVD risk from these 4 energy ratios within ***three different time zones (95% for Y13-Y16, 3% for Y17-Y19, and 2% for Y20-Y22),*** *he now knows that the 3 earlier years contribute the most on his CVD risk (95%), both of the 3 middle years and 3 recent years have contributed a minimal amount of a combined risk on his CVD (5%).* ***If he can continue the current health practice and lifestyle maintenance from Y2017 to Y2022, his CVD risk control task will become easier.*** *Nevertheless, he has noticed his elevated LDL levels since 2018; therefore, he must pay some attention to this important biomarker.*

Methods

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 those 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 medical treatments only. He also gambled on his belief that most human organs have the inherent ability 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 different organ cells and their status of damage.

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 theo-

ry, 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 128 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 3,000+ published medical papers online. He has collected and calculated more than three 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.

Brief Introduction of Math-Physical Medicine (MPM) Research

The author has collected 3+ million pieces of 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 CVD, CHD, stroke, CKD, 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.

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 FFT analysis method with a comparison against the traditional TD 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 those 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 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 and 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:

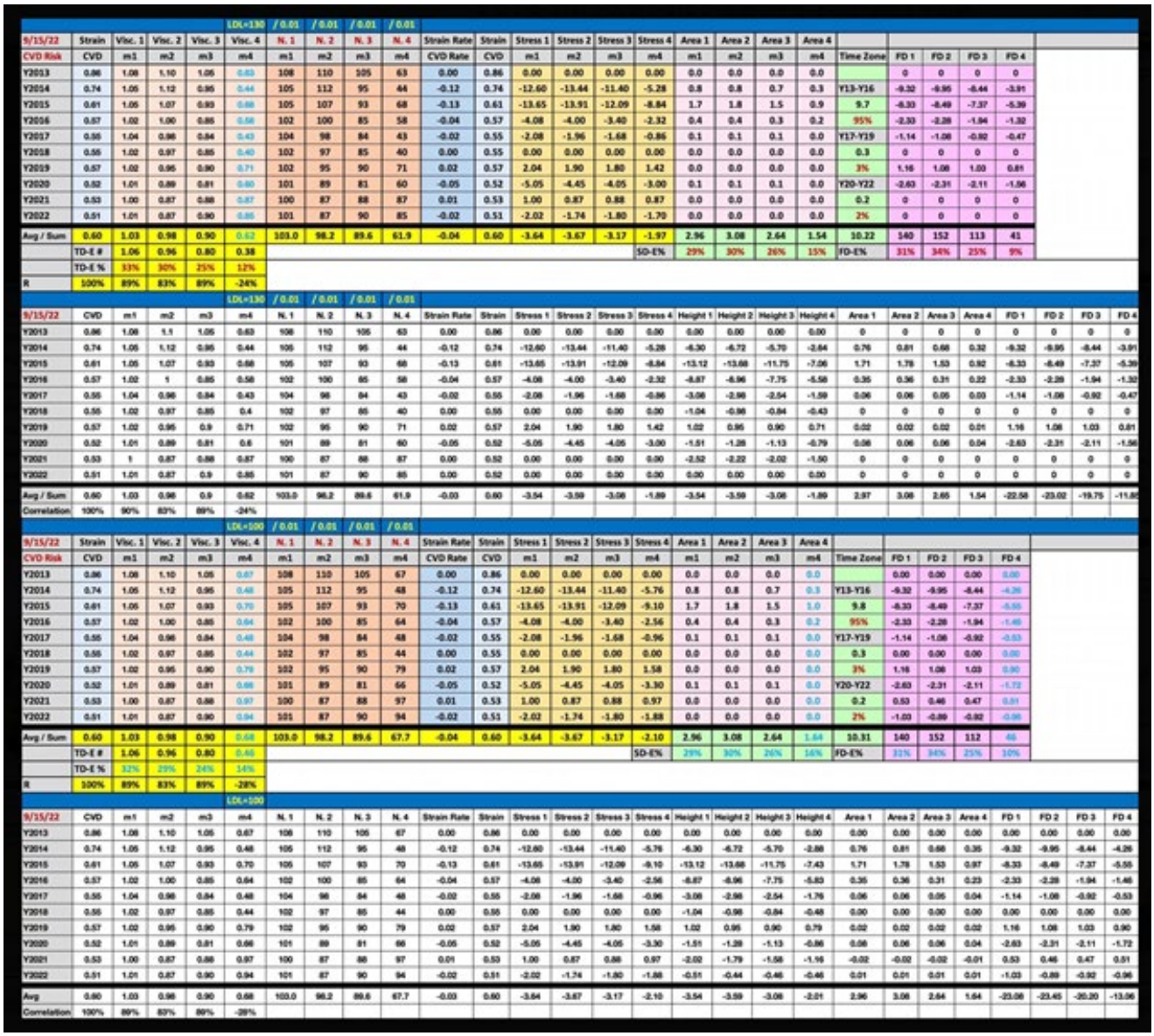
Strain
= ε (time-dependency characteristics of individual strain value at the present time duration)

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 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.

Results

Figure 1 shows 4 data tables (2 using Excel, 2 using VGT software) for both LDL guidelines of 130 and 100.



				LDL=130	/ 0.01	/ 0.01	/ 0.01	/ 0.01															
9/15/22	Strain	Visc. 1	Visc. 2	Visc. 3	Visc. 4	N. 1	N. 2	N. 3	N. 4	Strain Rate	Strain	Stress 1	Stress 2	Stress 3	Stress 4	Area 1	Area 2	Area 3	Area 4					
CVD Risk	CVD	m1	m2	m3	m4	m1	m2	m3	m4	CVD Rate	CVD	m1	m2	m3	m4	m1	m2	m3	m4	Time Zone	FD 1	FD 2	FD 3	FD 4
Y2013	0.86	1.08	1.10	1.05	0.63	108	110	105	63	0.00	0.86	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0		0	0	0	0
Y2014	0.74	1.05	1.12	0.95	0.44	105	112	95	44	-0.12	0.74	-12.60	-13.44	-11.40	-5.28	0.8	0.8	0.7	0.3	Y13-Y16	-9.32	-9.95	-8.44	-3.91
Y2015	0.61	1.05	1.07	0.93	0.68	105	107	93	68	-0.13	0.61	-13.65	-13.91	-12.09	-8.84	1.7	1.8	1.5	0.9	9.7	-8.33	-8.49	-7.37	-5.39
Y2016	0.57	1.02	1.00	0.85	0.58	102	100	85	58	-0.04	0.57	-4.08	-4.00	-3.40	-2.32	0.4	0.4	0.3	0.2	95%	-2.33	-2.28	-1.94	-1.32
Y2017	0.55	1.04	0.96	0.84	0.43	104	96	84	43	-0.02	0.55	-2.08	-1.96	-1.68	-0.86	0.1	0.1	0.1	0.0	Y17-Y19	-1.14	-1.06	-0.92	-0.47
Y2018	0.55	1.02	0.97	0.85	0.40	102	97	85	40	0.00	0.55	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.3	0	0	0	0
Y2019	0.57	1.02	0.96	0.90	0.71	102	95	90	71	0.02	0.57	2.04	1.90	1.80	1.42	0.0	0.0	0.0	0.0	3%	1.16	1.08	1.03	0.81
Y2020	0.52	1.01	0.89	0.81	0.60	101	89	81	60	-0.05	0.52	-5.05	-4.45	-4.05	-3.00	0.1	0.1	0.1	0.0	Y20-Y22	-2.63	-2.31	-2.11	-1.56
Y2021	0.53	1.00	0.87	0.88	0.87	100	87	88	87	0.01	0.53	1.00	0.87	0.88	0.87	0.0	0.0	0.0	0.0	0.2	0	0	0	0
Y2022	0.51	1.01	0.87	0.90	0.85	101	87	90	85	-0.02	0.51	-2.02	-1.74	-1.80	-1.70	0.0	0.0	0.0	0.0	2%	0	0	0	0
Avg / Sum	0.60	1.03	0.98	0.90	0.62	103.0	98.2	89.6	61.9	-0.04	0.60	-3.64	-3.67	-3.17	-1.97	2.96	3.08	2.64	1.54	10.22	140	152	113	41
	TD-E #	1.06	0.96	0.80	0.38										SD-E%	29%	30%	26%	15%	FD-E%	31%	34%	25%	9%
	TD-E %	33%	30%	25%	12%																			
R		100%	89%	83%	89%	-24%																		

				LDL=130	/ 0.01	/ 0.01	/ 0.01	/ 0.01															
9/15/22	CVD	m1	m2	m3	m4	N. 1	N. 2	N. 3	N. 4	Strain Rate	Strain	Stress 1	Stress 2	Stress 3	Stress 4	Height 1	Height 2	Height 3	Height 4	Area 1	Area 2	Area 3	Area 4	FD 1	FD 2	FD 3	FD 4
Y2013	0.86	1.08	1.1	1.05	0.63	108	110	105	63	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
Y2014	0.74	1.05	1.12	0.95	0.44	105	112	95	44	-0.12	0.74	-12.60	-13.44	-11.40	-5.28	-6.30	-6.72	-5.70	-2.64	0.76	0.81	0.68	0.32	-9.32	-9.95	-8.44	-3.91
Y2015	0.61	1.05	1.07	0.93	0.68	105	107	93	68	-0.13	0.61	-13.65	-13.91	-12.09	-8.84	-13.12	-13.68	-11.75	-7.06	1.71	1.78	1.53	0.92	-8.33	-8.49	-7.37	-5.39
Y2016	0.57	1.02	1	0.85	0.58	102	100	85	58	-0.04	0.57	-4.08	-4.00	-3.40	-2.32	-8.87	-8.96	-7.75	-5.58	0.35	0.36	0.31	0.22	-2.33	-2.28	-1.94	-1.32
Y2017	0.55	1.04	0.96	0.84	0.43	104	96	84	43	-0.02	0.55	-2.08	-1.96	-1.68	-0.86	-3.06	-2.96	-2.54	-1.59	0.06	0.06	0.05	0.03	-1.14	-1.06	-0.92	-0.47
Y2018	0.55	1.02	0.97	0.85	0.4	102	97	85	40	0.00	0.55	0.00	0.00	0.00	0.00	-1.04	-0.98	-0.84	-0.43	0	0	0	0	0	0	0	0
Y2019	0.57	1.02	0.95	0.9	0.71	102	95	90	71	0.02	0.57	2.04	1.90	1.80	1.42	1.02	0.95	0.90	0.71	0.02	0.02	0.02	0.01	1.16	1.08	1.03	0.81
Y2020	0.52	1.01	0.89	0.81	0.6	101	89	81	60	-0.05	0.52	-5.05	-4.45	-4.05	-3.00	-1.51	-1.28	-1.13	-0.79	0.06	0.06	0.06	0.04	-2.63	-2.31	-2.11	-1.56
Y2021	0.53	1	0.87	0.88	0.87	100	87	88	87	0.00	0.52	0.00	0.00	0.00	0.00	-2.52	-2.22	-2.02	-1.50	0	0	0	0	0	0	0	0
Y2022	0.51	1.01	0.87	0.9	0.86	101	87	90	85	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0
Avg / Sum	0.60	1.03	0.98	0.9	0.62	103.0	98.2	89.6	61.9	-0.03	0.60	-3.64	-3.59	-3.06	-1.89	-3.54	-3.59	-3.06	-1.89	2.97	3.08	2.65	1.54	-22.58	-23.02	-19.75	-11.8
Correlation	100%	90%	83%	89%	-24%																						

				LDL=100	/ 0.01	/ 0.01	/ 0.01	/ 0.01															
9/15/22	Strain	Visc. 1	Visc. 2	Visc. 3	Visc. 4	N. 1	N. 2	N. 3	N. 4	Strain Rate	Strain	Stress 1	Stress 2	Stress 3	Stress 4	Area 1	Area 2	Area 3	Area 4					
CVD Risk	CVD	m1	m2	m3	m4	m1	m2	m3	m4	CVD Rate	CVD	m1	m2	m3	m4	m1	m2	m3	m4	Time Zone	FD 1	FD 2	FD 3	FD 4
Y2013	0.86	1.08	1.10	1.05	0.67	108	110	105	67	0.00	0.86	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0		0.00	0.00	0.00	0.00
Y2014	0.74	1.05	1.12	0.95	0.48	105	112	95	48	-0.12	0.74	-12.60	-13.44	-11.40	-5.76	0.8	0.8	0.7	0.3	Y13-Y16	-9.32	-9.95	-8.44	-4.26
Y2015	0.61	1.05	1.07	0.93	0.70	105	107	93	70	-0.13	0.61	-13.65	-13.91	-12.09	-9.10	1.7	1.8	1.5	1.0	9.8	-8.33	-8.49	-7.37	-5.55
Y2016	0.57	1.02	1.00	0.85	0.64	102	100	85	64	-0.04	0.57	-4.08	-4.00	-3.40	-2.56	0.4	0.4	0.3	0.2	95%	-2.33	-2.28	-1.94	-1.46
Y2017	0.55	1.04	0.96	0.84	0.48	104	96	84	48	-0.02	0.55	-2.08	-1.96	-1.68	-0.96	0.1	0.1	0.1	0.0	Y17-Y19	-1.14	-1.06	-0.92	-0.53
Y2018	0.55	1.02	0.97	0.85	0.44	102	97	85	44	0.00	0.55	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.3	0.00	0.00	0.00	0.00
Y2019	0.57	1.02	0.95	0.90	0.79	102	95	90	79	0.02	0.57	2.04	1.90	1.80	1.58	0.0	0.0	0.0	0.0	3%	1.16	1.08	1.03	0.90
Y2020	0.52	1.01	0.89	0.81	0.68	101	89	81	68	-0.05	0.52	-5.05	-4.45	-4.05	-3.30	0.1	0.1	0.1	0.0	Y20-Y22	-2.63	-2.31	-2.11	-1.72
Y2021	0.53	1.00	0.87	0.88	0.97	100	87	88	97	0.01	0.53	1.00	0.87	0.88	0.97	0.0	0.0	0.0	0.0	0.2	0.53	0.46	0.47	0.51
Y2022	0.51	1.01	0.87	0.90	0.94	101	87	90	94	-0.02	0.51	-2.02	-1.74	-1.80	-1.88	0.0	0.0	0.0	0.0	2%	-1.03	-0.89	-0.92	-0.96
Avg / Sum	0.60	1.03	0.98	0.90	0.68	103.0	98.2	89.6	67.7	-0.04	0.60	-3.64	-3.67	-3.17	-2.10	2.96	3.08	2.64	1.64	10.31	140	152	112	46
	TD-E #	1.06	0.96	0.80	0.46										SD-E%	29%	30%	26%	16%	FD-E%	31%	34%	25%	10%
	TD-E %	32%	29%	24%	14%																			
R		100%	89%	83%	89%	-28%																		

				LDL=100																			
9/15/22	CVD	m1	m2	m3	m4	N. 1	N. 2	N. 3	N. 4	Strain Rate	Strain	Stress 1	Stress 2	Stress 3	Stress 4	Height 1	Height 2	Height 3	Height 4	Area 1	Area 2	Area 3	Area 4	FD 1	FD 2	FD 3	FD 4
Y2013	0.86	1.08	1.10	1.05	0.67	108	110	105	67	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Y2014	0.74	1.05	1.12	0.95	0.48	105	112	95	48	-0.12	0.74	-12.60	-13.44	-11.40	-5.76	-6.30	-6.72	-5.70	-2.88	0.76	0.81	0.68	0.35	-9.32	-9.95	-8.44	-4.26
Y2015	0.61	1.05	1.07	0.93	0.70	105	107	93	70	-0.13	0.61	-13.65	-13.91	-12.09	-9.10	-13.12	-13.68	-11.75	-7.43	1.71	1.78	1.53	0.97	-8.33	-8.49	-7.37	-5.55
Y2016	0.57	1.02	1.00	0.85	0.64	102	100	85	64	-0.04	0.57	-4.08	-4.00	-3.40	-2.56	-8.87	-8.96	-7.75	-5.83	0.35	0.36	0.31	0.23	-2.33	-2.28	-1.94	-1.46
Y2017	0.55	1.04	0.96	0.84	0.48	104	96	84	48	-0.02	0.55	-2.08	-1.96	-1.68	-0.96	-3.06	-2.96	-2.54	-1.76	0.06	0.06	0.05	0.04	-1.14	-1.06	-0.92	-0.53
Y2018	0.55	1.02	0.97	0.85	0.44	102	97	85	44	0.00	0.55	0.00	0.00	0.00	0.00	-1.04	-0.98	-0.84	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Y2019	0.57	1.02	0.95	0.90	0.79	102	95	90	79	0.02	0.57	2.04	1.90	1.80	1.58	1.02	0.95	0.90	0.79	0.02	0.02	0.02	0.02	1.16	1.08	1.03	0.90
Y2020	0.52	1.01	0.89	0.81	0.68	101	89	81	68	-0.05	0.52	-5.05	-4.45	-4.05	-3.30	-1.51	-1.28	-1.13	-0.86	0.06	0.06	0.06	0.04	-2.63	-2.31	-2.11	-1.72
Y2021	0.53	1.00	0.87	0.88	0.97	100	87	88	97	0.01	0.53	1.00	0.87	0.88	0.97	-2.02	-1.79	-1.58	-1.16	-0.02	-0.02	-0.02	-0.01	0.53	0.46	0.47	0.51
Y2022	0.51	1.01	0.87	0.90	0.94	101	87	90	94	-0.02	0.51	-2.02	-1.74	-1.80	-1.88	-0.51	-0.44	-0.46	-0.46	0.01	0.01	0.01	0.01	-1.03	-0.89	-0.92	-0.96
Avg	0.60	1.03	0.98	0.90	0.68	103.0	98.2	89.6	67.7	-0.03	0.60	-3.64	-3.67	-3.17	-2.10	-3.54	-3.59	-3.06	-2.01	2.96	3.08	2.64	1.64	-23.08	-23.45	-20.20	-13.06
Correlation	100%	89%	83%	89%	-28%																						

Figure 1: Data tables

Figure 2 displays three TD diagrams of the LDL curve, m4 (Triglyceride + HDL =nLDL) curve, and CVD risk with 4 mi curves, where i = 1 to 4.

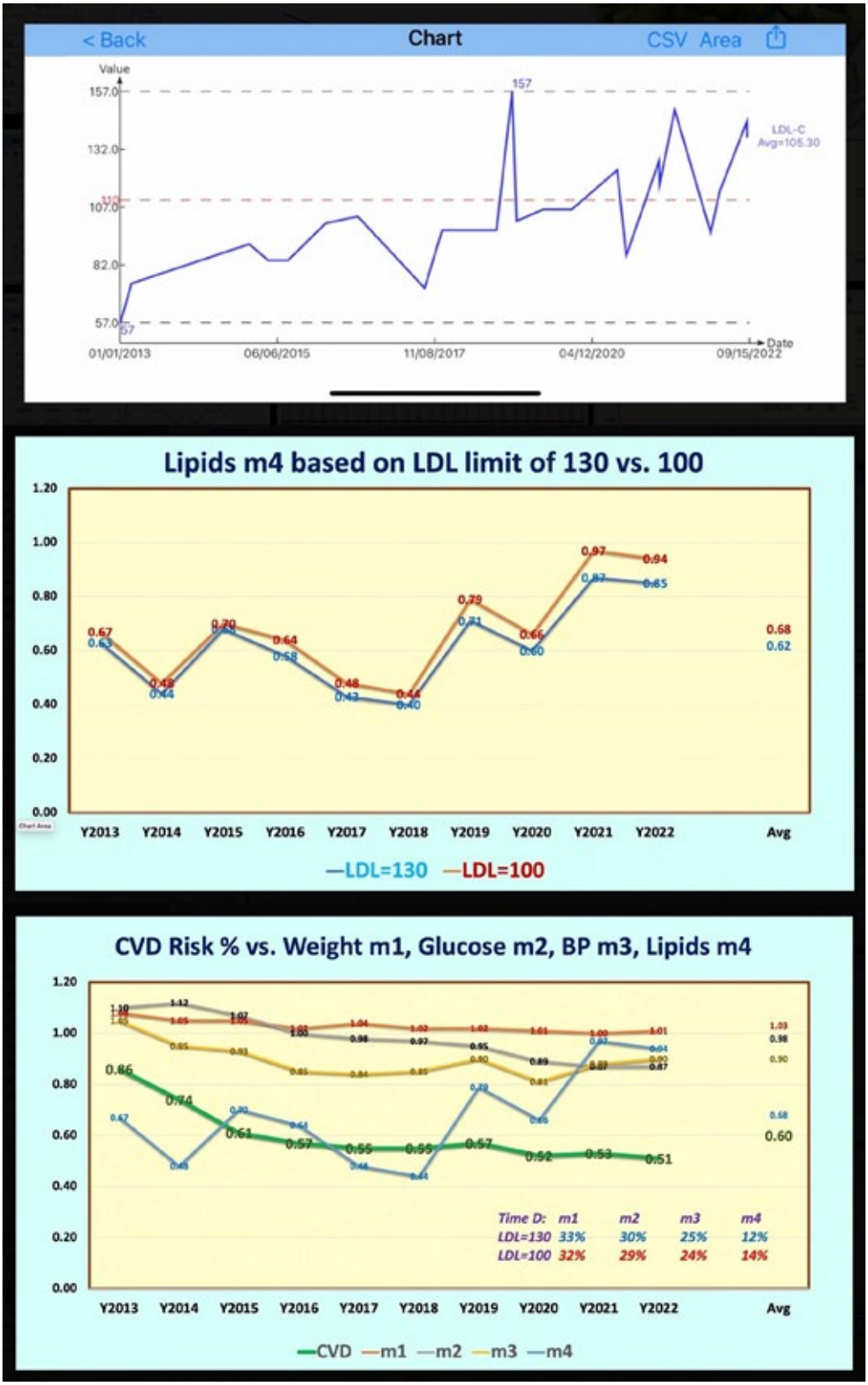


Figure 2: Time-domain result

Figure 3 reflects 2 SD diagrams with displayed energy ratios for both LDL guidelines of 130 and 100.

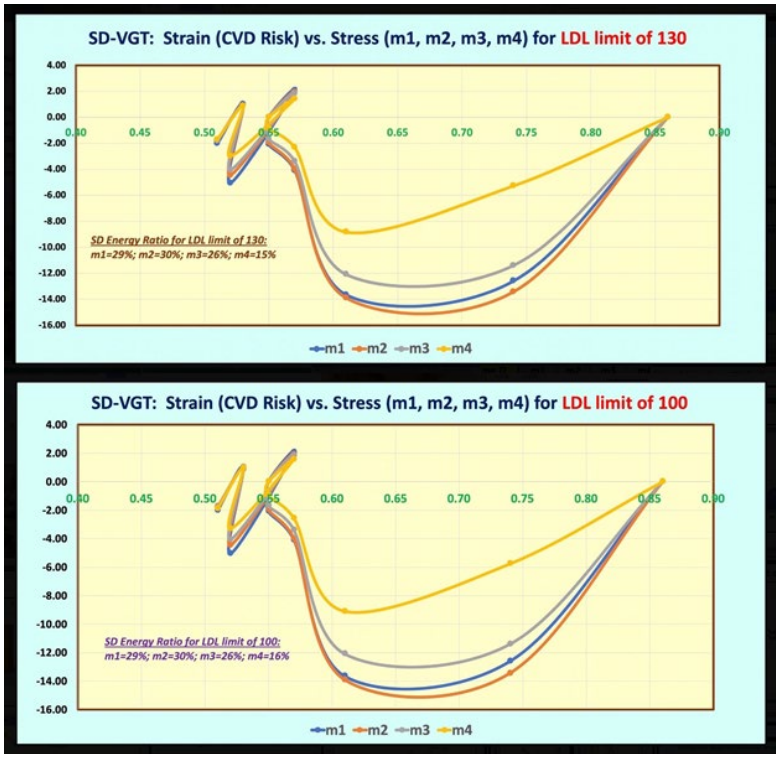


Figure 3: Space-domain VGT analysis result

Figure 4 depicts 2 FD diagrams with displayed energy ratios for both LDL guidelines of 130 and 100.

Figure 4: Frequency-domain analysis result

Figure 5 illustrates one data table of energy ratio comparison and 3 separate bar charts of energy ratios for TD, SD, and FD, respectively.

Time D	m1	m2	m3	m4
LDL=130	33%	30%	25%	12%
LDL=100	32%	29%	24%	14%
Space D	m1	m2	m3	m4
LDL=130	29%	30%	26%	15%
LDL=100	29%	30%	26%	16%
Feq. D	m1	m2	m3	m4
LDL=130	31%	34%	25%	9%
LDL=100	31%	34%	25%	10%

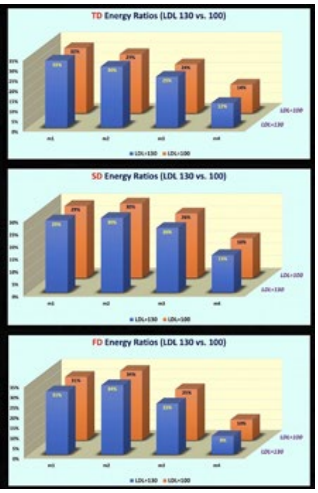


Figure 5: Comparison of energy ratios in TD, SD, FD with both 130 and 100 LDL guidelines

Conclusions

In summary, there are 4 observations listed regarding ***the CVD risk versus weight, glucose, blood pressure, and lipids (based on LDL guidelines of both 130 and 100).***

(1)From the TD diagram, ***his 2 squared amplitude energy ratios are: from using 130 mg/dL as his LDL guideline: m1 weight = 33%, m2 glucose = 30%, m3 BP = 25%, m4 lipid = 12%. From using 100 mg/dL as his LDL guideline: m1 weight = 32%, m2 glucose = 29%, m3 BP = 24%, m4 lipid = 14%.*** *The TD ranking order* ***is m1 > m2 > m3 > m4.***

(2)Applying the SD-VGT energy tool, the stress-strain diagram of 4 hysteresis loops has presented a ***"viscoplastic" behavior.*** Furthermore***, his 4 SD energy ratios are: from using 130 mg/dL as his LDL guideline: m1 weight = 29%, m2 glucose = 30%, m3 BP = 26%, m4 lipid = 15%. From using 100 mg/dL as his LDL guideline: m1 weight = 29%, m2 glucose = 30%, m3 BP = 26%, m4 lipid = 16%.*** *The SD ranking order is* ***m2 > m1 > m3 > m4. In addition, three time-zone energy ratios are Y12-Y16 at 95%, Y17-Y19 at 3%, and Y20-Y22 at 2%. This shows that the earlier 3 years contribute the most damage amount (95%), the middle 3 years contribute a much smaller amount of damage (3%), and the recent 3 years contribute the smallest amount of damage (2%).***

(3) Applying the FD-FFT energy tool and using a newly defined variable of (strain*stress) from SD, ***his 4 FD-FFT energy ratios are: from using 130 mg/dL as his LDL guideline: m1 weight = 31%, m2 glucose = 34%, m3 BP = 25%, m4 lipid = 9%. From using 100 mg/dL as his LDL guideline: m1 weight = 31%, m2 glucose = 34%, m3 BP = 25%, m4 lipid = 10%.*** *The FD ranking order is* ***m2 > m1 > m3 > m4*** *which is identical to the SD ranking order.*

*(1) The above 3 sets of energy ratios have shown that both SD and FD have the same pattern of ranking orders except for TD having m1 weight > m2 glucose. The TD square-amplitude approach can indeed provide a kind of "quick but not so dirty" energy picture due to its rudimentary definition of wave energy. The FD-FFT analysis can also indeed provide a "somewhat amplified" picture due to the author's defined FD variable as the (strain*stress).*

From the viewpoint of associated energy ratios, the author could apply his learned knowledge from this study to better control the risk probability of developing CVD by better managing his body weight, glucose level, blood pressure, and lipids, ***especially LDL.*** *An interesting finding is that* ***even considering both LDL guidelines of 130 mg/dL for normal people and 100 mg/dL for T2D patients, the differences in the energy generated by the same measured LDL values over the past 10 years*** *(varying between 57 mg/dL and 157 mg/dL with an average 105 mg/dL)* ***with two different ADA guidelines are still within a small range of 2% from each other.***

References

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

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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) Series of Endocrinology, Diabetes and Metabolism (contact: Patrick Robinson).
(2) Journal of Applied Material Science & Engineering Research (contact: Catherine).
(3) Advances in Bioengineering and Biomedical Science Research (contact: Sony Hazi).