

The GH-Method

Viscoelastic or Viscoplastic Glucose Theory (VGT #67): A Summarized Report of the Relative Risk Probability Percentages of Developing Five Cancer Types Associated with Pancreatic, Liver, Prostate, Kidney, and Ovarian/Uterine Using their Respective Risk Factors to Validate the Suitability of the VGT Tool on Cancer Research Based on GH-Method: Math-Physical Medicine (No. 656)

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Keywords: Viscoelastic; Viscoplastic; Cancer; Type 2 diabetes; Obesity; Diet; Exercise; Fasting plasma glucose; Postprandial plasma glucose

Abbreviations: T2D: type 2 diabetes; SD: space domain; TD: time domain; PPG: postprandial plasma glucose; FPG: fasting plasma glucose; MPM: math-physical medicine

1. INTRODUCTION

Recently, the author has conducted individual research work on five specific cancers related to 6 human organs: pancreas, liver, prostate (for male), kidney, and ovarian/uterus (for female). The major focus of his medical research work during the past 13 years has been preventive medicine supported by quantitative analyses using mathematics, physics, and engineering tools.

His first step is to search for suitable risk factors (i.e., influential factors) for each selected cancer type by reading through sufficient amounts of published articles and papers from medical societies and journals. Although the majority of these medical research publications have utilized various statistical data analysis tools to draw their observed conclusions, the statistical results are still useful in identifying certain risk factors related to each cancer type. To date, the author has read around 2,500 medical papers over the past 13 years. He has been a mathematician and an engineer, who has never received any formal education or training in medical school. Therefore,

everything he has learned about medicine is solely self-driven by reading thousands of published papers and publicly available academic information as well as his nearly 3 million health data collected from his own body.

For the second step, he has screened and re-organized the risk factors learned from the publications and only kept the modifiable risk factors for his study. Non-modifiable risk factors, such as race, gender, genetics, family history, etc. are removed since they cannot be changed. Modifiable risk factors, such as chronic inflammation and lifetime unhealthy habits (tobacco smoking, alcohol drinking, and illicit drug use) are also removed since the author does not have any of these issues. Therefore, he cannot conduct any meaningful follow-up analysis using these two risk factor categories due to the lack of input data. Based on the above-mentioned reasons, his cancer risk probability analysis results can still offer a partial view of an individual cancer type's relative risk level which is based on the chosen gender-independent and patient modifiable factors with available sufficient input data from himself.

In the third step, he conducted his cancer risk probability % analyses using the viscoelastic or viscoplastic tools. This VGT tool can generate different stress-strain curves with associated hysteresis loop areas for each different cancer type. The loop areas (or energy levels) can indicate the different degrees of influence on each cancer type via respective risk factors.

Pancreas, liver, prostate, and kidney cancer types are based on his collected biomarker data from his own body. Except prostate cancer type is for men, the other 3 cancer types, pancreas, liver, and kidney are gender-independent. However, gynecological cancer is a different situation that warrants a more detailed explanation as follows.

The author has learned that there are three general categories of risk factors related to ovarian cancer and uterine cancer.

The first risk category is the gender-dependent factors but without any collected data to support his analysis, such as the following 11 listed risk factors:

- things that affect female hormone level
- use of an intrauterine device (IUD)
- previous gynecological cancers, e.g. breast cancer
- previous radiation therapy
- having children later or never having a full-term pregnancy (after age 35)
- taking hormone therapy after menopause
- using fertility treatment
- pregnancies, breastfeeding, and taking birth control medications (lowering risk)
- increased number of menstrual cycles
- infertility
- certain medication effects

It is obvious that his collected data are not suitable to conduct a study on gynecological cancer under the 11 female-possessed risk factors.

The second risk category is the gender-independent with non-modifiable factors, such as the 3 risk factors which are not covered in his gynecological cancer analysis:

- aging
- race
- family history

The third risk category is the gender independent and modifiable by the patient which also contains sufficient data from his collection to conduct the analysis with the following 5 risk factors:

- obesity or being overweight
- diabetes conditions
- blood lipids
- diet
- exercise

The 5 risk factors are included in his selected cancer risk factors for developing ovarian and/or uterine cancers in this article.

The author is a male patient with various chronic diseases and is not licensed to treat patients. Therefore, he has not collected any data from female patients in this domain; therefore, he had no choice but to exclude the gender-dependent risk factors from this study. As a 27-year veteran of type 2 diabetes (T2D), who has also suffered from hypertension, hyperlipidemia, obesity, and heart diseases, he has collected nearly 3 million data related to his metabolism conditions and various chronic diseases. Since he has accumulated such a big amount of data related to the gender-independent risk factors, especially obesity, T2D, lipids, diet, and exercise, these would be useful resources to study the risk probability of developing ovarian and/or uterine cancer in women. At a minimum, it may offer a partial picture of these two gynecological cancer types. He decided to create a hypothetical case covering a female cancer patient and then apply his data to investigate these 5 gender-independent and modifiable risk factors for having ovarian and uterine cancers. Next, he will analyze her risk using obesity or being overweight via body weight, diabetes via HbA1C or glucoses, lipids of an averaged score of HDL, LDL, TG, diet via a combined score of food quality and quantity, and exercise via daily walking steps.

From the recent cancer papers, he has selected the following 8 prominent and modifiable risk factors for his study on these 5 cancer types:

1. Hyperglycemia (> 180 mg/dL)
2. Insulin resistance
3. Obesity (BMI > 30)
4. Metabolism index (>0.735)
5. Daily walking steps (>10,000 steps)

6. T2D (HbA1C >6.0)
7. Lipids for liver cancer
8. T2D+BP+ACR for kidney cancer

Based on different combinations of these 8 risk factors, the author can calculate his risk probability percentage by assigning respective weighting factors to each risk factor by cancer type. For example, for the gynecological cancer study, he has the 5 assigned weighting factors:

Obesity or being overweight: 30%
Diabetes (HbA1C): 25%
Lipids (combined LDL, HDL, TG): 15%
Diet including both quantity and quality of food and meals: 15%
Daily walking exercise: 15%

Therefore, his calculated cancer risk's general equation is described as follows:

Cancer risk %
= (risk factor 1 * weighting factor 1)
+ (risk factor 2 * weighting factor 2)
+ (risk factor 3 * weighting factor 3)
+ (risk factor 4 * weighting factor 4)

Of course, depending on his assigned weighting factors, his cancer risk and contributions by each risk factor will be altered.

The author's stringent lifestyle management efforts during the past 12+ years, including both diet and exercise, are directly beneficial to his weight reduction, glucose control, and metabolism improvements. It is necessary to provide a brief description of his health history here.

(Note: His historic data can apply to any male or female patient since most of his risk factors are gender-independent. The important objective of using his generic data is to quantitatively prove the relationship existed between these multiple risk factors and a selected cancer type.)

The author was diagnosed with T2D in 1997 with a random glucose check at a 300 mg/dL level; however, his T2D condition most likely began earlier. He suffered his first two chest pain episodes in 1993-1994 and three more heart episodes until 2007. His primary physician informed him that he had diabetic kidney issues in 2010. He then consulted with two more clinical doctors who advised him to

immediately start insulin injections and kidney dialysis. This was his wake-up call. He then decided to save his life by conducting his study and research on food nutrition and chronic diseases that same year. His health profile in 2010 was: body weight at 220 lbs. (BMI 32), average glucose at 280 mg/dL, fasting plasma glucose (FPG) in the early morning at 180 mg/dL, lab-tested HbA1C at 10%, triglycerides at 1160 mg/dL (target: <150 mg/dL), and his ACR at 116 (target: <30). In addition, by 2010, he has also suffered a total of 5 heart episodes, foot ulcer, hypothyroidism, diabetic retinopathy, etc.

Over the past 13 years, he has made significant lifestyle changes. For example, he consumes less than 20 grams of carbohydrates and sugar per meal, stops eating processed food, reduces his food quantity by 50%, walks 6-7 miles or 10-11 kilometers daily, sleeps 7-8 hours each night, and avoids stress as much as possible. As a matter of fact, he has never drunk alcohol, smoked cigarettes, or used any illicit drugs in his life.

As of April 25, 2022, his health profile for the first 4 months of 2022 was: body weight at 169 lbs. (BMI 24.95), daily average glucose at 106 mg/dL, FPG in the early morning at 94 mg/dL, lab-tested A1C at 5.8%, triglycerides at 108, and ACR at 16. A significant accomplishment is that he discontinued taking 3 different kinds of diabetes medications on 12/8/2015.

Most of the author's medical papers are based on his collected biomarker data from his own body over the past 12+ years. His research work is based on quantitative analysis of the collected data using a math-physical medicine research methodology, not a biochemical and statistical research approach. In other words, he describes his observed biophysical phenomena using 10 numerical digits instead of the traditional biochemical phenomena using the 26 English alphabet letters due to his lack of training in biology and chemistry. Based on his past 13-year of self-study and intensive research on internal medicine and food nutrition, he has observed that most biomedical problems follow the basic law and principles of physics which can be easily analyzed and interpreted using various mathematical tools from the foundation level and using various

engineering modeling techniques from the application level.

2. METHODS

To offer a simple explanation to readers who do not have a physics or engineering background, the author includes a brief excerpt from Wikipedia regarding the description of basic concepts for elasticity and plasticity theories, viscoelasticity, and viscoplasticity theories from the disciplines of engineering and physics, and his developed metabolism index (MI) Model in this method section.

2.1 Relationships between biomedical causes and biomedical symptoms

As a mathematician/engineer over 40 years and now conducting his medical research work for the past 13 years, the author has discovered that people frequently seek answers, illustrations, or explanations for the relationships between the input variable (force applied on a structure or cause of a disease) and output variable (deformation of a structure or symptom of a disease). However, the multiple relationships between input and output could be expressed with many different matrix formats of 1×1 , $1 \times n$, $m \times 1$, or $m \times n$ (m or n means different multiple variables). In addition to these described mathematical complications, the output resulting from one or more inputs can also become an input of another output, which is a symptom of certain causes that can become a cause of another different symptom. This phenomenon is indeed a complex scenario with “chain effects”. In fact, both engineering and biomedical complications are fundamentally mathematical problems that correlate or conform with many inherent physical laws or principles. In his medical research work, he has encountered more than 100 different sets of biomarkers with almost equal or more amounts of causes (or input variables) and symptoms (or output variables).

Since December of 2021, the author applied theories of viscoelasticity and viscoplasticity (VGT) from physics and engineering disciplines to investigate more than 60 sets of input/output biomarkers, including nearly 10 sets of cancer cases. The purpose is to identify certain hidden relationships between certain output biomarkers, such as cancer risk, and

its corresponding multiple inputs, such as glucose, blood pressure, blood lipids, obesity or overweight, and metabolism index of 6 lifestyle details and 4 chronic diseases. In this study, the hidden biophysical behaviors and possible inter-relationships among the output symptom and multiple input causes are “time-dependent” and change from time to time. These important time-dependency characteristics provide insight into the cancer risk’s moving pattern. It also controls the cancer risk curve shape, the associated energy created, stored, or burned inside during the process of stress up-loading (moving upward or increasing) and stress down-loading (moving downward or decreasing) of the input biomarkers with the output biomarker of cancer risk %. This VGT application emphasizes the time-dependency characteristics of involved variables. In the medical field, most biomarkers are time-dependent since body organ cells are organic in nature and change all of the time. Incidentally, VGT can generate a stress-strain curve or cause-symptom curve, known as a “hysteresis loop” in physics, in which area size can also be used to estimate the relative energy created, stored, or burned during the process of uploading (e.g., increasing glucose) and unloading (e.g., decreasing body weight) over the timespan of the cancer risk %. He calls this relative energy the “VGT energy”.

It should be emphasized here that both cancer risk % and its associated VGT energy are estimated relative values, not “absolute” values.

The following defined stress and strain equations are used to establish the VGT stress-strain diagram in a space domain (SD):

VGT strain
 $= \varepsilon$ (symptom)
 $=$ individual symptom at the present time

VGT stress
 $= \sigma$ (based on the change rate of strain, symptom, multiplying with one or more viscosity factors or influential factors)
 $= \eta * (d\varepsilon/dt)$
 $= \eta * (d\text{-strain}/d\text{-time})$
 $=$ (viscosity factor η using normalized factor at present time) * (symptom at present time - symptom at a previous time)

Where the strain is the cancer risk percentage and the stress is his cancer risk change rate multiplied by several chosen input biomarkers as the individual viscosity factor. In his VGT studies, sometimes, he carefully selects certain normalization factors for each input biomarker, respectively. The normalization factors are the dividing lines between a healthy state and an unhealthy state. For example, 170 lbs. for body weight, 6.0 for HbA1C, 120 mg/dL for glucose, 180 mg/dL for hyperglycemia, 73.5% for overall MI score, and 10,000 steps for daily walking exercise, etc.

2.2 Elasticity, plasticity, viscoelasticity, and viscoplasticity (LEGT & VGT)

The difference between elastic materials and viscoelastic materials (from “Soborthans, innovating shock and vibration solutions”).

What are elastic materials?

Elasticity is the tendency of solid materials to return to their original shape after forces are applied on them. When the forces are removed, the object will return to its initial shape and size if the material is elastic.

Medical analogy: The medical application is when cause or risk factors are reduced or removed, the symptoms of certain disease would be improved or ceased.

What are viscous materials?

Viscosity is a measure of a fluid’s resistance to flow. A fluid with large viscosity resists motion. A fluid with low viscosity flows. For example, water flows more easily than syrup because it has a lower viscosity. High viscosity materials might include honey, syrups, or gels – generally things that resist flow. Water is a low viscosity material, as it flows readily. Viscous materials are thick or sticky or adhesive. Since heating reduces viscosity, these materials don’t flow easily. For example, warm syrup flows more easily than cold.

What is viscoelastic?

Viscoelasticity is the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. Synthetic polymers, wood, and human tissue, as well as metals at high

temperature, display significant viscoelastic effects. In some applications, even a small viscoelastic response can be significant.

Medical analogy: Viscoelastic behavior means material has “time-dependent” characters. Biomedical data, i.e. biomarkers, are time-dependent due to body cells are organic which changes with time constantly.

Elastic behavior versus viscoelastic behavior

The difference between elastic materials and viscoelastic materials is that viscoelastic materials have a viscosity factor and the elastic ones don’t. Because viscoelastic materials have the viscosity factor, they have a strain rate dependent on time. Purely elastic materials do not dissipate energy (heat) when a load is applied, then removed; however, a viscoelastic substance does.

Medical analogy: Most of the biomarkers display time-dependency; therefore they have both change-rate of time and viscosity factor behaviors. Viscoelastic biomarkers do dissipate energy when a cause force is applied on it.

The following brief introductions are excerpts from Wikipedia:

“Elasticity (physics):

The physical property is when materials or objects return to their original shape after deformation.

In physics and materials science, elasticity is the ability of a body to resist a distorting influence and to return to its original size and shape when that influence or force is removed. Solid objects will deform when adequate loads are applied to them; if the material is elastic, the object will return to its initial shape and size after removal. This is in contrast to plasticity, in which the object fails to do so and instead remains in its deformed state.

Hooke's law states that the force required to deform elastic objects should be directly proportional to the distance of deformation, regardless of how large that distance becomes. This is known as perfect elasticity, in which a given object will return to its original shape no matter how strongly it is deformed. This is an ideal concept only; most

materials that possess elasticity in practice remain purely elastic only up to very small deformations, after which plastic (permanent) deformation occurs.

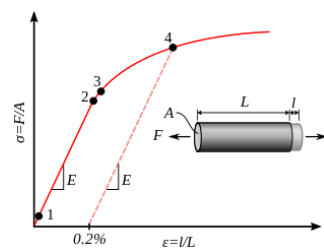
In engineering, the elasticity of a material is quantified by the elastic modulus such as the Young's modulus, bulk modulus or shear modulus which measure the amount of stress needed to achieve a unit of strain; a higher modulus indicates that the material is harder to deform. The material's elastic limit or yield strength is the maximum stress that can arise before the onset of plastic deformation.

Medical analogy: The elastic behavior analogy in medicine can be expressed by the metal rod analogy for the postprandial plasma glucose (PPG). Consuming carbohydrates and/or sugar acts like a tensile force to stretch a metal rod longer, while post-meal exercise acts like a compressive force to suppress a metal rod shorter. If lacking food consumption and exercise, the metal rod (analogy of PPG) will remain its original length, for a non-diabetes or less severe type 2 diabetes (T2D) patient.

Plasticity (physics):

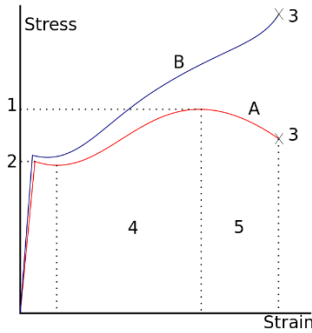
Deformation of a solid material undergoing non-reversible changes of shape in response to applied forces.

In physics and materials science, plasticity, also known as plastic deformation, is the ability of a solid material to undergo permanent deformation, a non-reversible change of shape in response to applied forces. For example, a solid piece of metal being bent or pounded into a new shape displays plasticity as permanent changes occur within the material itself. In engineering, the transition from elastic behavior to plastic behavior is known as yielding. Plastic deformation is observed in most materials, particularly metals, soils, rocks, concrete, and foams.



A stress-strain curve showing typical yield behavior for nonferrous alloys.

1. True elastic limit
2. Proportionality limit
3. Elastic limit
4. Offset yield strength



A stress-strain curve typical of structural steel.

- 1: Ultimate strength
- 2: Yield strength (yield point)
- 3: Rupture
- 4: Strain hardening region
- 5: Necking region
- A: Apparent stress (F/A0)
- B: Actual stress (F/A)

For many ductile metals, tensile loading applied to a sample will cause it to behave in an elastic manner. Each increment of load is accompanied by a proportional increment in extension. When the load is removed, the piece returns to its original size. However, once the load exceeds a threshold – the yield strength – the extension increases more rapidly than in the elastic region; now when the load is removed, some degree of extension will remain.

Medical analogy: A plastic behavior analogy in medicine is the PPG level of a severe T2D patient. Even consuming a smaller amount of carbs/sugar, the patient's PPG will rise sharply which cannot be totally brought down to a healthy PPG level even with a significant amount of exercise. This means the PPG level has exceeded its "elastic limit" and entering into a "plastic range".

Viscoelasticity:

Property of materials with both viscous and elastic characteristics under deformation.

In materials science and continuum mechanics, viscoelasticity is the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. Viscous materials, like water, resist shear flow and strain linearly with time when a stress is applied. Elastic materials strain when stretched and immediately return to their original state once the stress is removed.

Viscoelastic materials have elements of both of these properties and, as such, exhibit time-dependent strain. Whereas elasticity is usually the result of bond stretching along crystallographic planes in an ordered solid, viscosity is the result of the diffusion of atoms or molecules inside an amorphous material.

In the nineteenth century, physicists such as Maxwell, Boltzmann, and Kelvin researched and experimented with creep and recovery of glasses, metals, and rubbers. Viscoelasticity was further examined in the late twentieth century when synthetic polymers were engineered and used in a variety of applications. Viscoelasticity calculations depend heavily on the viscosity variable, η . The inverse of η is also known as fluidity, ϕ . The value of either can be derived as a function of temperature or as a given value (i.e. for a dashpot).

Depending on the change of strain rate versus stress inside a material, the viscosity can be categorized as having a linear, non-linear, or plastic response. In addition, when the stress is independent of this strain rate, the material exhibits plastic deformation. Many viscoelastic materials exhibit rubber-like behaviors explained by the thermodynamic theory of polymer elasticity.

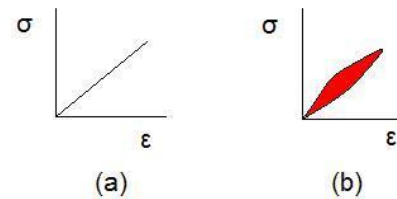
Cracking occurs when the strain is applied quickly and outside of the elastic limit. Ligaments and tendons are viscoelastic, so the extent of the potential damage to them depends both on the rate of the change of their length as well as on the force applied.

A viscoelastic material has the following properties:

- hysteresis is seen in the stress-strain curve
- stress relaxation occurs: step constant strain causes decreasing stress

- creep occurs: step constant stress causes increasing strain
- its stiffness depends on the strain rate or the stress rate.

Elastic versus viscoelastic behavior:



Stress-strain curves for a purely elastic material (a) and a viscoelastic material (b). The red area is a hysteresis loop and shows the amount of energy lost (as heat) in a loading and unloading cycle. It is equal to $\oint \sigma d\epsilon$ where σ is stress and ϵ is strain. In other words, the hysteresis loop area represents the amount of energy during the loading and unloading process.

Unlike purely elastic substances, a viscoelastic substance has an elastic component and a viscous component. The viscosity of a viscoelastic substance gives the substance a strain rate dependence on time. Purely elastic materials do not dissipate energy (heat) when a load is applied, then removed. However, a viscoelastic substance dissipates energy when a load is applied, then removed. Hysteresis is observed in the stress-strain curve, with the area of the loop being equal to the energy lost during the loading cycle. Since viscosity is the resistance to thermally activated plastic deformation, a viscous material will lose energy through a loading cycle. Plastic deformation results in lost energy, which is uncharacteristic of a purely elastic material's reaction to a loading cycle.

Viscoplasticity:

Viscoplasticity is a theory in continuum mechanics that describes the rate-dependent inelastic behavior of solids. Rate-dependence in this context means that the deformation of the material depends on the rate at which loads are applied. The inelastic behavior that is the subject of viscoplasticity is plastic deformation which means that the material undergoes unrecoverable deformations when a load level is reached. Rate-dependent plasticity is important for transient plasticity

calculations. The main difference between rate-independent plastic and viscoplastic material models is that the latter exhibit not only permanent deformations after the application of loads but continue to undergo a creep flow as a function of time under the influence of the applied load.

Medical analogy: In viscoelastic or viscoplastic analysis, the stress component equals the strain change rate of time multiplying with the viscosity factor, or

$$\begin{aligned} \text{Stress } (\sigma) & \\ &= \text{strain } (\epsilon) \text{ change rate} * \text{viscosity factor } (\eta) \\ &= d\epsilon/dt * \eta \end{aligned}$$

$$\begin{aligned} \text{The hysteresis loop area} & \\ &= \text{the integrated area of stress } (\sigma) \text{ and strain} \\ &(\epsilon) \text{ curve} \\ &= \oint \sigma d\epsilon \end{aligned}$$

2.3 Metabolism index (MI) model

This model was developed in Y2014 by the author using the topology concept, nonlinear algebra, geometric algebra, and engineering finite element method. In summary, the human body metabolism is a complex mathematical problem with a matrix format of m causes by n symptoms, plus sometimes, one symptom or many symptoms would be turned into causes of another symptom.

This MI model contains 10 specific categories, including 4 output categories of medical conditions (body weight, glucose, blood pressure, and lipids), and 6 input categories of lifestyle details (food quantity and quality, drinking water intake, physical exercise, sleep, stress, and daily life routines). These 10 categories are comprised of approximately 500 detailed elements. He has also defined two new resulting parameters: the metabolism index or MI, as the combined score of the above 10 metabolism categories and 500 elements using his developed algorithm, along with the general health status unit (GHSU), as the 90-day moving average value of MI.

A physical analogy of this complex 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, then take 3,628,800 (=10!) rubber bands to encircle the

nails, including all 10 nails. These ~3.6 million rubber bands (i.e. big number of relationships) 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 these 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 stress to our body. Of course, we can also move some or all of the 10 nails outward at the same time, but with different moving scales. If we can measure the summation of the internal tension created in the affected rubber bands, then this summarized tension force is equivalent to the metabolism value of human health. The higher tension means a higher metabolism value which creates an unhealthy situation. The author uses the above-described scenario of moving nails and their encircled rubber bands to explain his developed mathematical metabolism model of human health.

During 2010 and 2011, the author collected sparse biomarker data, but from the beginning of 2012, he has been gathering his body weight and finger-piercing glucose values each day. More complete data collection started in Y2015. In addition, he accumulates medical conditions data including BP, heart rate (HR), and blood lipids along with lifestyle details (LD). Since 2020, he has added the daily body temperature (BT) and blood oxygen level (SPO2) due to his concerns about being exposed to COVID-19. Based on the collected big data of biomarkers, he further organized them into two main groups. The first is the medical conditions group (MC) with 4 categories: weight, glucose, BP, and blood lipids. The second is the lifestyle details group (LD) with 6 categories: food & diet, exercise, water intake, sleep, stress, and daily routines. At first, he calculated a unique combined daily score for each of the 10 categories within the MC and LD groups. The combined scores of the 2 groups, 10 categories, and 500+ detailed elements constitute an overall “metabolism index (MI) model”. It includes the root-causes of 6 major

lifestyle inputs and symptoms from 4 lifestyle-induced rudimentary chronic diseases, i.e. obesity, diabetes, hypertension, and hyperlipidemia. Therefore, the MI model, especially its 4 chronic disease conditions, can be used as the foundation and building block for his additional research work that can expand into various complications associated with different organs, such as cancer.

Of course, the same methodology can be extended to the study of many other medical complications, such as various heart problems (CVD & CHD), stroke, neuropathy, hypothyroidism, diabetic constipation, diabetic skin fungal infection, various cancers, and dementia.

In general, some genetic conditions and lifetime unhealthy habits, which include tobacco smoking, alcohol drinking, and illicit drug use, account for approximately 15% to 25% of the root-cause of chronic diseases and their complications, as well as cancers and dementia.

His calculated risk probability % for CKD, CVD, DR, stroke, and various cancers have some differences in their root-cause variables, their associated weighting factors for each key cause, and certain biomedical interpretations and assumptions. Specifically, the CVD/Stroke risk includes two major scenarios that combine emphasized weighting factors, blood vessel blockage due to blood glucose and blood lipids, and blood vessel rupture caused by blood glucose and blood pressure. Some recent research work have identified the relationship between pancreatic cancer with hyperglycemia and insulin resistance phenomena of type 2 diabetes, and chronic inflammation. Some aggressive prostate cancers are linked with 5 types of bacteria. There is also an evidence of a relationship between BP and DR (Reference: BP control and DR, by R. Klein and BEK Klein from British Journal of Ophthalmology). The CKD risks include hyperglycemic damage to micro-blood vessels and nerves which causes protein leakage found in urine and waste deposit within the kidneys; therefore, it requires dialysis to remove waste products and excess fluids from the body. However, the cancer risk also consists of additional influences from environmental conditions, such as some improper medications, viral

infections, food pollution or poison, toxic chemical, radiation, air and water pollution, hormonal treatment, etc.

All of the above-mentioned diseases fall into the category of “symptoms” which are the outcomes of “root-causes” of genetic conditions, unhealthy lifestyles, and poor living environments.

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 shows four stress-strain diagrams and pie-charts of the risk % of having pancreatic, liver, prostate, and kidney cancer with a data table.

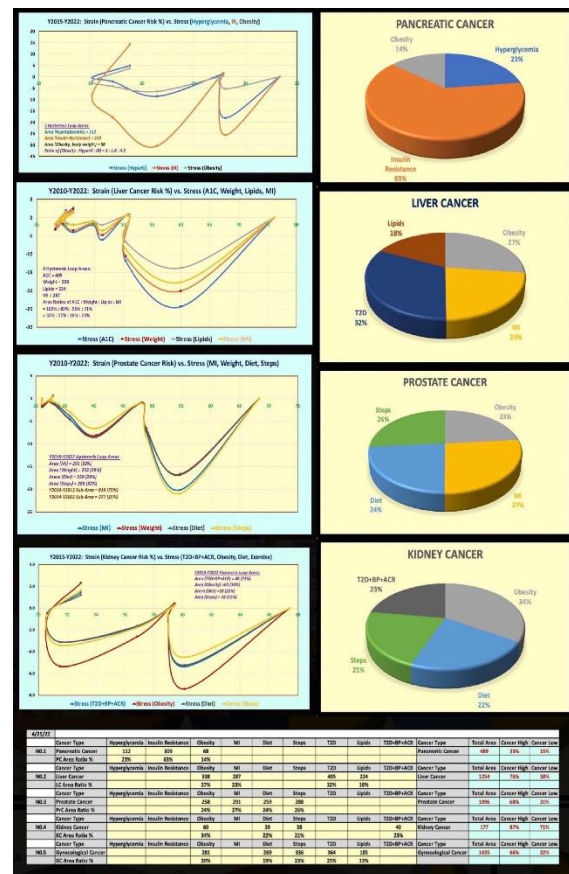


Figure 1: 4 stress-strain diagrams and pie-charts of cancer risk of pancreas, liver, prostate, and kidney, with data table.

Figure 2 depicts one stress-strain diagram and pie-chart of the risk % of having ovarian and/or uterine cancers with a data table.

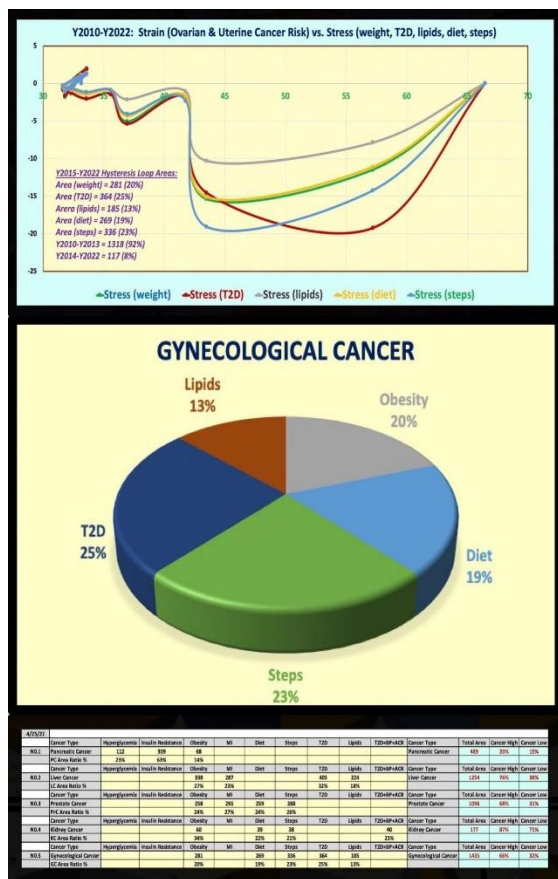


Figure 2: Stress-strain diagram and pie-chart of risk % of having ovarian and/or uterine cancers with data table.

Figure 3 illustrates the contribution distribution from 8 risk factors for the combined risks of 5 cancer types with a supporting data table.

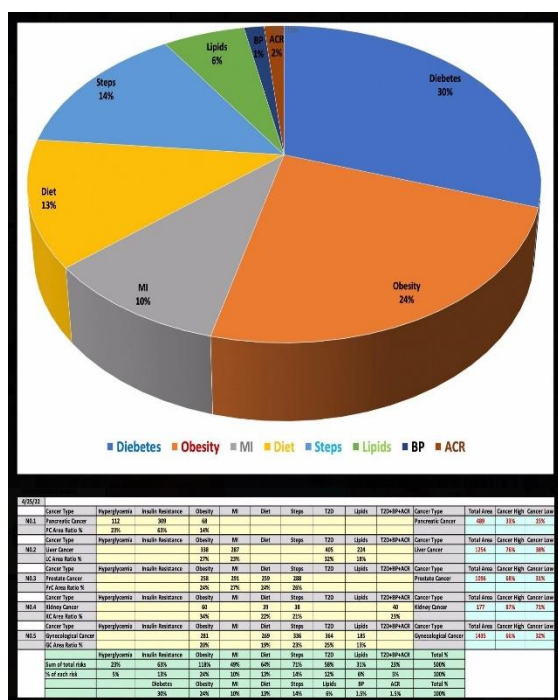


Figure 3: Contribution from 8 risk factors for the combined risks of 5 cancer types with supporting data table.

4. CONCLUSION

The following five described biophysical characteristics have demonstrated certain behaviors of these 5 cancer risk probabilities under 3, 4, or 5 chosen cancer risk factors via the viscoelastic or viscoplastic energy (VGT) tool:

(1) From the x-axis value or the strain value on the stress-strain diagram, these 5 cancer risks cover a range from the high-end in Y2010 to the low-end in Y2022 with a decreasing trend in between. All of these 5 cancer risks are relative risk numbers, not absolute risk numbers. This VGT analysis tool can provide a quantitative feeling regarding each cancer risk situation.

(2) From the y-axis (stress) values and their associated hysteresis loop areas, we can see that both the stress values and the hysteresis loop areas (i.e. energies) for the period of Y2010-Y2013 are much larger than the period of Y2014-Y2022. Furthermore, there are two sub-periods within the period of Y2014-Y2022: Y2014-Y2017 and Y2018-Y2022. These two sub-periods have similar magnitudes of both stress levels and hysteresis loop areas. From the perspective of cancer risks, the subject patient is “healthier” during the recent 8+ years than in the earlier 4 years.

(3) When we delve deeper into the comparisons among these multiple risk factors within each cancer type, we can further identify some additional details regarding these “efforts vs. results or causes vs. symptoms” from each risk factor by comparing the loop area size associated with each risk factor. Generally speaking, almost all of the chosen risk factors have hysteresis loop areas (i.e., degree of contribution) within the range of ~20% to ~30% for all 5 cancer risks, except for 63% of insulin resistance in pancreatic cancer, 14% of obesity on pancreatic cancer, 18% of lipids on liver cancer, and 13% of lipids on gynecological cancers.

(4) In a comparison of these five stress-strain diagrams, all of these 5 cancer risk curve shapes are quite similar to each other. This observation is a result of the author’s biomarker data having been continuously improved year after year for this long period

of 12+ years from 1/1/2010 to 4/25/2022. These improved biomarker values indeed bring benefits to the reduction of risks of developing into those various cancers.

(5) When the author combines all of these 5 cancer types, he obtains the following distributed contribution % from 8 individual risk factors on this combined cancer risk (ranking from higher % to lower %): Diabetes 30%, obesity 24%, exercise walking 14%, diet 13%, MI score 10%, lipids 6%, blood pressure 1.5, Albumin-to-creatinine ratio (ACR) 1.5%. Of course, these contribution percentages would be different case by case depending on the individual patient's biomarker data.

In summary, the unique "time-dependency" characteristic of strain change rate (i.e., cancer risk change amount over time) can be applied to cancer risk research and discovered some useful findings.

This summarized report of 5 cancer risks has demonstrated how the author utilizes the mathematics, physics, engineering, and VGT energy methodology, to construct and display his research results on 5 different cancer risks resulting from various multiple risk factors.

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.

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Viscoelastic and Viscoplastic Glucose Theory Application in Medicine

Gerald C. Hsu

