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Body Weight Reduction During Nightly Sleep Versus Sleep Score, Sleep Hours, Wake-Up Times During Sleep Using Viscoplastic Energy Model of GH-Method: Math-Physical Medicine (No. 1018, Viscoelastic Medicine Theory #416)

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Category: Obesity

Abstract

The body weight reduction during sleep at night is primarily due to two factors: respiration, which occurs through breathing, and perspiration, involving the release of moisture through sweating. Both of these functions expel water from the body, leading to a decrease in body weight during sleep.

Over a period of 9 years from 1/1/2015 to 12/31/2033, the author observed a reduction in his body weight during nightly sleep, amounting to a loss of 2.42 pounds over 6.35 hours of sleep, ***averaging a reduction of 0.38 pounds per hour.***

In the author's development of the Chronic AI software on his iPhone, the sleep category contains 16 elements. The duration of sleep hours is the most influential element affecting the overall sleep score, contributing around 50%, followed by the wake-up time at night, accounting for approximately 25%. Notably, the wake-up time had a significant impact during the period of suffering from his kidney problems, bladder infections, and urinary tract infections. The remaining 14 elements collectively make up about 25% of the sleep category's contribution to his overall metabolism health.

In the space-domain viscoplastic medicine theory energy model analysis (SD-VMT), the author selected body weight reduction as the output symptom (strain), with sleep score, sleep hours, and wake-up time serving as the three inputs (stresses). To standardize and compare these inputs, three normalization factors have been employed:

- Sleep score divided by 0.25
- 7 divided by sleep hours
- Wake-up times divided by 2.

In summary, *the energy ratios of his body weight reduction during nightly sleep versus the three selected sleep inputs are as follows:*

- Sleep score = 57%
- Sleep hours = 26%
- Wake-up times = 17%

The time-zone energy distributions are:
- Y2015-Y2019 = 87%
- Y2020-Y2023 = 13%

The energy associated with his weight reduction during sleep is primarily contributed by the previous five

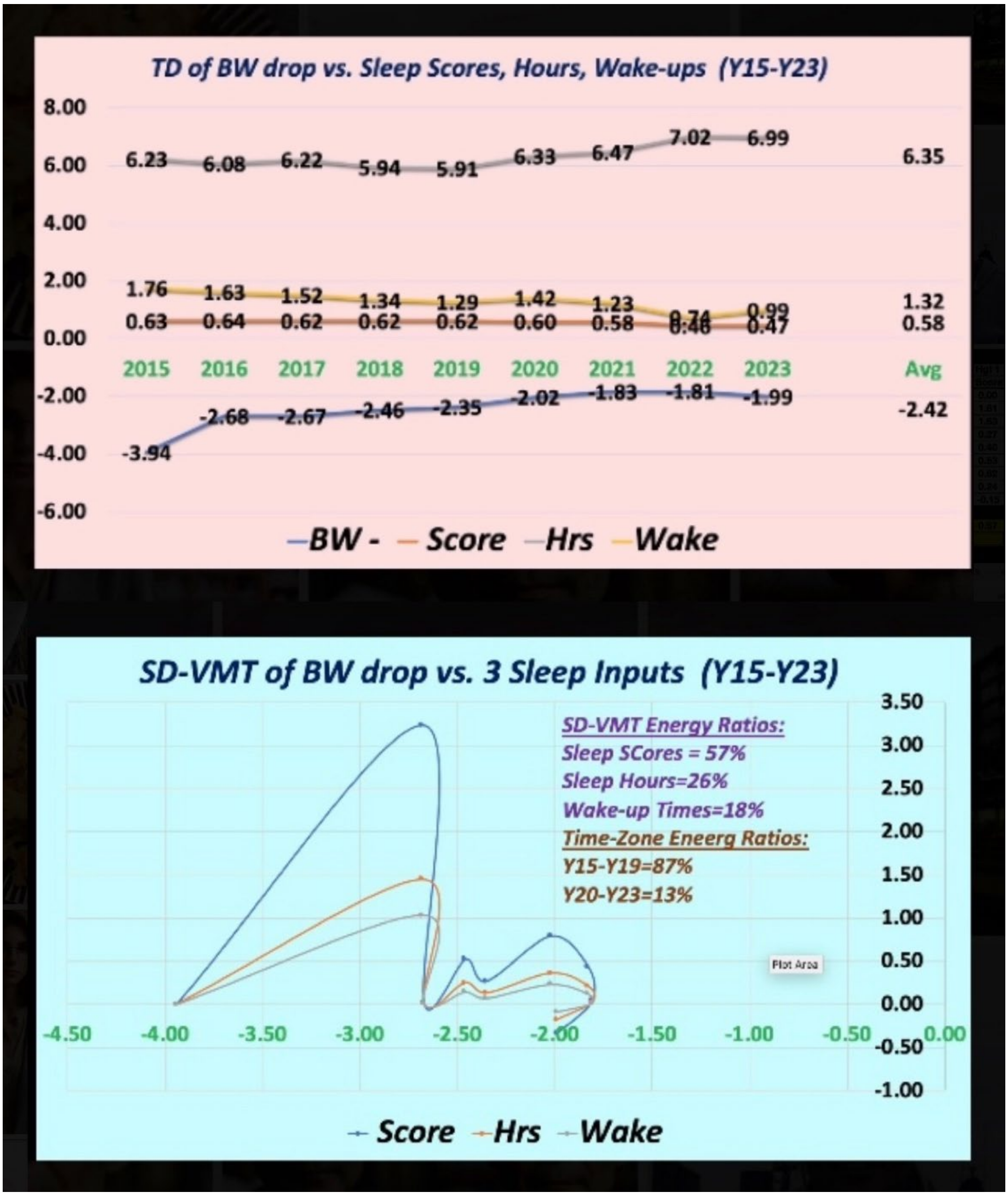
years, making up 87% of the total, while the recent four years contribute only 13% of the total energy.

During this selected period of 9 years (from 1/1/2015 to 12/31/2023), his predicted weight reduction using the SD-VMT Method are:

Measured BW reduction: -2.42 lbs
Predicted BW reduction: -2.56 lbs
SD-VMT Prediction accuracy = 94%
Correlation between 2 values = 94%

Key Message

In the author's case, his overall sleep score (composed of 16 sleep elements) contributed the most, with 57% influence on his body weight reduction during nightly sleep. His sleep hours served as the second significant contributor at 26%, while his wake-up times (disruptions) contributed the least at 17%. Notably, sleep duration and overall sleep quality are important influential factors for metabolism health, not just for body weight reduction during nightly sleep.



1. Introduction

The body weight reduction during sleep at night is primarily due to two factors: respiration, which occurs through breathing, and perspiration, involving the release of moisture through sweating. Both of these functions exp1.el water from the body, leading to a decrease in body weight during sleep.

Over a period of 9 years from 1/1/2015 to 12/31/2033, the author observed a reduction in his body weight during nightly sleep, amounting to a loss of 2.42 pounds over 6.35 hours of sleep, *averaging a reduction of 0.38 pounds per hour.*

In the author's development of the Chronic AI software on his iPhone, the sleep category contains 16 elements. The duration of sleep hours is the most influential element affecting the overall sleep score, contributing around 50%, followed by the wake-up time at night, accounting for approximately 25%. Notably, the wake-up time had a significant impact during the period of suffering from his kidney problems, bladder infections, and urinary tract infections. The remaining 14 elements collectively make up about 25% of the sleep category's contribution to his overall metabolism health.

In the space-domain viscoplastic medicine theory energy model analysis (SD-VMT), the author selected body weight reduction as the output symptom (strain), with sleep score, sleep hours, and wake-up time serving as the three inputs (stresses). To standardize and compare these inputs, *three normalization factors have been employed:*

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1.1 Engineering and Biomedical information

The following sections contain excerpts and concise information drawn from multiple medical articles, which have been meticulously reviewed by the author of this paper. The author has adopted this approach as an alternative to including a conventional reference list at the end of this document, with the intention of optimizing his valuable research time. It is essential to clarify that these sections do not constitute part of the author's original contribution but have been included to aid the author in his future reviews and offer valuable insights to other readers with an interest in these subjects.

2. Pathophysiologically, What are the Connections between Body Weight and Sleep?

The connections between body weight and sleep are complex and bidirectional, meaning that changes in one can affect the other, leading to a cycle of influence. Here are some pathophysiological connections between body weight and sleep:

Hormonal Regulation: Sleep deprivation can lead to dysregulation of hormones that control hunger and satiety, such as ghrelin and leptin. Ghrelin, which stimulates appetite, is increased with decreased sleep, while leptin, which suppresses appetite, is decreased. This can lead to an increased appetite and potentially overeating, contributing to weight gain.

Insulin Sensitivity: Poor sleep quality and duration can affect insulin sensitivity and glucose metabolism. Reduced insulin sensitivity can lead to higher blood sugar levels and potentially contribute to the development of obesity and metabolic syndrome.
Energy Balance: Disrupted sleep can affect the body's energy balance, leading to alterations in energy expenditure and intake. This imbalance can contribute to weight gain or hinder weight loss efforts.
Physical Activity: Lack of sleep can lead to decreased motivation and energy levels, which may result in reduced physical activity and exercise. This can have implications for weight management and overall health.
Appetite Regulation: Sleep deprivation can lead to increased cravings for high-calorie and carbohydrate-rich foods, potentially contributing to weight gain.
Circadian Rhythms: Disruption of circadian rhythms, which can occur with poor sleep patterns and irregular sleep schedules, can impact metabolism and lead to weight gain.

Understanding the complex interplay between body weight and sleep is important for addressing issues related to obesity, metabolic health, and overall well-being. Both adequate sleep and healthy weight management are important for maintaining good health.

3. Relationships between Body Weight Reduction and Sleep Conditions

The reduction in body weight during sleep hours is primarily due to the factors of respiration and perspiration. The primary reasons for reduced body weight during sleep - respiration and perspiration - occur regardless of the specific sleep conditions. These two factors are related to the body's ongoing physiological processes during sleep rather than the timing or duration of sleep itself.

However, it is important to note that various sleep-related and lifestyle factors can influence overall body weight through their impact on metabolism, energy balance, and hormonal regulation. These factors can include sleep duration, sleep quality, circadian rhythms, and nighttime eating habits. Disruptions to the normal sleep-wake cycle, such as shift work or irregular sleep patterns, can affect overall body weight and metabolism.

While the reduction in body weight during sleep hours is primarily due to respiration and perspiration, overall sleep conditions can have broader effects on body weight and overall health. It is essential to maintain healthy sleep habits and address any sleep-related issues to support overall well-being and weight management.

During sleep, wake-up times can disrupt the natural sleep cycle and may impact respiration and perspiration, but these disruptions are generally not significant enough to affect body weight changes at night. It is important to note that the body's basic metabolic functions, including respiration and perspiration, continue during sleep to maintain essential physiological processes.

While brief awakenings during the night might alter respiration and perspiration temporarily, they are unlikely to have a substantial effect on body weight changes. The primary factors contributing to changes in body weight during sleep are related to the body's ongoing physiological processes, such as respiration and perspiration, rather than isolated wake-up times.

However, frequent or prolonged awakenings during the night can disrupt overall sleep quality and may have broader effects on metabolism, energy balance, and hormonal regulation, potentially influencing body weight in the long term. Consistent disturbances to sleep continuity can impact the body's ability to maintain a healthy weight and overall metabolic balance.

In summary, while wake-up times during sleep can momentarily disrupt respiration and perspiration, the impact on body weight changes during the night is likely minimal compared to other factors influencing metabolism and sleep quality. Prioritizing healthy sleep habits, maintaining regular sleep patterns, and addressing any underlying sleep disturbances are essential for overall well-being and weight management.

Longer sleeping hours can result in increased respiration, leading to weight reduction. During sleep, the body continues to consume energy and oxygen for respiration, which can contribute to weight loss over time. However, it is important to note that a balanced and healthy sleep schedule should be maintained for overall well-being.

Several factors contribute to good quality and sufficient sleep:
- Consistent Sleep Schedule: Going to bed and waking up at the same time every day, including weekends, helps regulate the body's internal clock.
- Comfortable Sleep Environment: A comfortable mattress, pillows, and a peaceful, dark, and quiet sleeping space can promote better sleep.
- Relaxing Bedtime Routine: Engaging in calming activities before bed, such as reading, warm bath, or meditation, signals the body to wind down for sleep.
- Limiting Stimulants: Minimizing caffeine, nicotine, and heavy meals close to bedtime can improve sleep quality.
- Managing Stress: Reducing stress through relaxation techniques and managing anxiety can improve the ability to fall and stay asleep.
- Avoiding Screen Time: Limiting exposure to electronic devices with screens, such as smartphones and computers, before bed, as the light emitted from these devices can disrupt the sleep-wake cycle.
- Physical Activity: Engaging in regular physical ***activity during the day can promote better sleep*** but vigorous exercise close to bedtime should be avoided.
- Balanced Diet: Eating a balanced diet and avoiding heavy meals or excessive alcohol consumption before bedtime can positively impact sleep quality.

These factors can contribute to achieving a good quality and sufficient amount of sleep, promoting overall well-being and optimal health.

4. Difference between Respiration and Perspiration

Respiration and perspiration are two distinct physiological processes that serve different functions in the human body:

Respiration

This refers to the process of breathing, specifically the exchange of gases (oxygen and carbon dioxide) between the body and the environment. In human respiration, oxygen is taken in from the air and carbon dioxide is expelled. This exchange occurs in the lungs and is essential for providing oxygen to the body's cells for energy production and removing carbon dioxide, a waste product of metabolism.

Perspiration

Also known as sweating, perspiration is the body's way of regulating its temperature. When the body's temperature rises, such as during physical activity or exposure to heat, sweat glands release moisture onto the skin's surface. As the sweat evaporates, it cools the body, helping to maintain a normal temperature. Perspiration also plays a role in excreting certain waste products and toxins from the body.

In summary, respiration involves the exchange of gases to support cellular function, while perspiration is a regulatory mechanism for cooling the body and eliminating waste products. Despite their distinct functions, both processes contribute to the body's overall balance and homeostasis.

5. Can Nocturia Disturbs Body Weight Reduction at Nightly Sleep Through Disturbing Respiration or Perspiration?

Nocturia, which is the frequent need to urinate during the night, can potentially affect body weight reduction during sleep through its impact on sleep disruption and fluid balance. However, the main mechanism through which nocturia may affect body weight reduction is through sleep disruption rather than perspiration (sweating).

Sleep Disruption: Nocturia can disrupt the continuity of sleep, leading to fragmented sleep patterns and reduced overall sleep duration. This can impact the body's hormonal regulation and appetite control, potentially affecting weight management.

Fluid Balance: Nocturia may lead to increased fluid loss through urination, potentially impacting overall fluid balance. This could affect hydration levels and, in turn, certain metabolic processes related to weight management.

It is important to note that while fragmentation of sleep and changes in fluid balance due to frequent urination may have some impact on weight management, the primary factors affecting body weight reduction are diet, physical activity, and overall metabolic rate.

However, any significant sleep disruption, including that caused by nocturia, can lead to changes in metabolic, hormonal, and appetite regulation, which may have implications for weight management. Managing and treating the underlying causes of nocturia is important for overall health and well-being, including potential impacts on weight management.

6. MPM Background

To learn more about his developed GH-Method: math-physical medicine (MPM) methodology, readers can read the following three papers selected from his published 760+ papers.

The first paper, No. 386 (Reference 1) describes his MPM methodology in a general conceptual format. The second paper, No. 387 (Reference 2) outlines the history of his personalized diabetes research, various application tools, and the differences between biochemical medicine (BCM) approach versus the MPM approach. The third paper, No. 397 (Reference 3) depicts a general flow diagram containing ~10 key MPM research methods and different tools.

7. The Author's Diabetes History

The author was a severe T2D patient since 1995. He weighed 220 lb. (100 kg) at that time. By 2010, he still weighed 198 lb. with an average daily glucose of 250 mg/dL (HbA1C at 10%). During that year, his triglycerides reached 1161 (high risk for CVD and stroke) and his albumin-creatinine ratio (ACR) at 116 (high risk for chronic kidney disease). He also suffered from five cardiac episodes within a decade. In 2010, three independent physicians warned him regarding the need for kidney dialysis treatment and the future high risk of dying from his severe diabetic complications.

In 2010, he decided to self-study endocrinology with an emphasis on diabetes and food nutrition. He spent the entire year of 2014 to develop a metabolism index (MI) mathematical model. During 2015 and 2016, he developed four mathematical prediction models related to diabetes conditions: weight, PPG, fasting plasma glucose (FPG), and HbA1C (A1C). Through using his developed mathematical metabolism index (MI) model and the other four glucose prediction tools, by the end of 2016, his weight was reduced from 220 lbs. (100 kg) to 176 lbs. (89 kg), waistline from 44 inches (112 cm) to 33 inches (84 cm), average finger-piercing glucose from 250 mg/dL to 120 mg/dL, and A1C from 10% to ~6.5%. One of his major accomplishments is that he no longer takes any diabetes-related medications since 12/8/2015.

In 2017, he achieved excellent results on all fronts, especially his glucose control. However, during the pre-COVID period, including both 2018 and 2019, he traveled to ~50 international cities to attend 65+ medical conferences and made ~120 oral presentations. This hectic schedule inflicted damage to his diabetes control caused by stress, dining out frequently, post-meal exercise disruption, and jet lag, along with the overall negative metabolic impact from the irregular life patterns; therefore, his glucose control was somewhat affected during the two-year traveling period of 2018-2019.

He started his COVID-19 self-quarantined life on 1/19/2020. By 10/16/2022, his weight was further reduced to ~164 lbs. (BMI 24.22) and his A1C was at 6.0% without any medication intervention or insulin injection. In fact, with the special COVID-19 quarantine lifestyle since early 2020, not only has he written and published ~500 new research articles in various medical and engineering journals, but he has also achieved his best health conditions for the past 27 years. These achievements have resulted from his non-traveling, low-stress, and regular daily life routines. Of course, his in-depth knowledge of chronic diseases, sufficient practical lifestyle management experiences, and his own developed high-tech tools have also contributed to his excellent health improvements.

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. Furthermore, he extracted the 5-minute intervals from every 15-minute interval for a total of 96 glucose data each day stored in his computer software.

Through the author's medical research work over 40,000 hours and read over 4,000 published medical papers online in the past 13 years, he discovered and became convinced that good life habits of not smoking, moderate or no alcohol intake, avoiding illicit drugs; along with eating the right food with well-balanced nutrition, persistent exercise, having a sufficient and good quality of sleep, reducing all kinds of unnecessary stress, maintaining a regular daily life routine contribute to the risk reduction of having many diseases, including CVD, stroke, kidney problems, micro blood vessels issues, peripheral nervous system problems, and even cancers and dementia. In addition, a long-term healthy lifestyle can even "repair" some damaged internal organs, with different required time-length depending on the particular organ's cell lifespan. For example, he has "self-repaired" about 35% of his damaged pancreatic beta cells during the past 10 years.

8. Energy Theory

The human body and organs have around 37 trillion live cells which are composed of different organic cells that require energy infusion from glucose carried by red blood cells; and energy consumption from labor-work or exercise. When the residual energy (resulting from the plastic glucose scenario) is stored inside our bodies, it will cause different degrees of damage or influence to many of our internal organs.

According to physics, energies associated with the glucose waves are proportional to the square of the glucose amplitude. The residual energies from elevated glucoses are circulating inside the body via blood vessels which then impact all of the internal organs to cause different degrees of damage or influence, e.g. diabetic complications. Elevated glucose (hyperglycemia) causes damage to the structural integrity of blood vessels. When it combines with both hypertension (rupture of arteries) and hyperlipidemia (blockage of arteries), CVD or Stroke happens. Similarly, many other deadly diseases could result from these excessive energies which would finally shorten our lifespan. For an example, the combination of hyperglycemia and hypertension would cause micro-blood vessel's leakage in kidney systems which is one of the major cause of CKD.

The author then applied Fast Fourier Transform (FFT) operations to convert the input wave from a time domain into a frequency domain. The y-axis amplitude values in the frequency domain indicate the proportional energy levels associated with each different frequency component of input occurrence. *Both output symptom value (i.e. strain amplitude in the time domain) and output symptom fluctuation rate (i.e. the strain rate and strain frequency) are influencing the energy level (i.e. the Y-amplitude in the frequency domain).*

Currently, many people live a sedentary lifestyle and lack sufficient exercise to burn off the energy influx which causes them to become overweight or obese. Being overweight and having obesity leads to a variety of chronic diseases, particularly diabetes. In addition, many types of processed food add unnecessary ingredients and harmful chemicals that are toxic to the bodies, which lead to the development of many other deadly diseases, such as cancers. For example, ~85% of worldwide diabetes patients are overweight, and ~75% of patients with cardiac illnesses or surgeries have diabetes conditions.

In engineering analysis, when the load is applied to the structure, it bends or twists, i.e. deform; however, when the load is removed, it will either be restored to its original shape (i.e, elastic case) or remain in a deformed shape (i.e. plastic case). In a biomedical system, the glucose level will increase after eating carbohydrates or sugar from food; therefore, the carbohydrates and sugar function as the energy supply. After having labor work or exercise, the glucose level will decrease. As a result, the exercise burns off the energy, which is similar to load removal in the engineering case. In the biomedical case, both processes of energy influx and energy dissipation take some time which is not as simple and quick as the structural load removal in the engineering case. Therefore, the age difference and 3 input behaviors are "dynamic" in nature, i.e. time-dependent. *This time-dependent nature leads to a "viscoelastic or viscoplastic" situation.* ***For the author's case, it is "viscoplastic" since most of his biomarkers are continuously improved during the past 13-year time window.***

Time-Dependent Output Strain and Stress of (Viscous Input*Output Rate)

Hooke's law of linear elasticity is expressed as:

Strain (ε: epsilon)= Stress (σ: sigma) / Young's modulus (E)

For biomedical glucose application, his developed linear elastic glucose theory (LEGT) is expressed as:

PPG (strain) = carbs/sugar (stress) * GH.p-Modulus (a positive number) + post-meal walking k-steps * GH.w-Modulus (a negative number)

Where GH.p-Modulus is reciprocal of Young's modulus E.

However, in viscoelasticity or viscoplasticity theory, the stress is expressed as:

Stress = viscosity factor (η: eta) * strain rate (dε/dt)

Where strain is expressed as Greek epsilon or ε.

In this article, in order to construct an "ellipse-like" diagram in a stress-strain space domain (e.g. "hysteresis loop") covering both the positive side and negative side of space, he has modified the definition of strain as follows:

Strain = (body weight at certain specific time instant)

He also calculates his strain rate using the following formula:

Strain rate = (body weight at next time instant) - (body weight at present time instant)

The risk probability % of developing into CVD, CKD, Cancer is calculated based on his developed metabolism index model (MI) in 2014. His MI value is calculated using inputs of 4 chronic condition s, i.e. weight, glucose, blood pressure, and lipids; and 6 lifestyle details, i.e. diet, drinking water, exercise, sleep, stress, and daily routines. These 10 metabolism categories further contain ~500 elements with millions of input data collected and processed since 2010. For individual deadly disease risk probability %, his mathematical model contains certain specific weighting factors for simulating certain risk percentages associated with different deadly diseases, such as metabolic disorder-induced CVD, stroke, kidney failure, cancers, dementia; artery damage in heart and brain, micro-vessel damage in kidney, and immunity-related infectious diseases, such as COVID death.

Some of explored deadly diseases and longevity characteristics using the ***viscoplastic medicine theory (VMT)*** include stress relaxation, creep, hysteresis loop, and material stiffness, damping effect ***based on time-dependent stress and strain*** which are different from his previous research findings using ***linear elastic glucose theory (LEGT) and nonlinear plastic glucose theory (NPGT).***

9. Results

Figure 1 shows sleep elements, data table, inputs and SD-VMT energy output diagram.

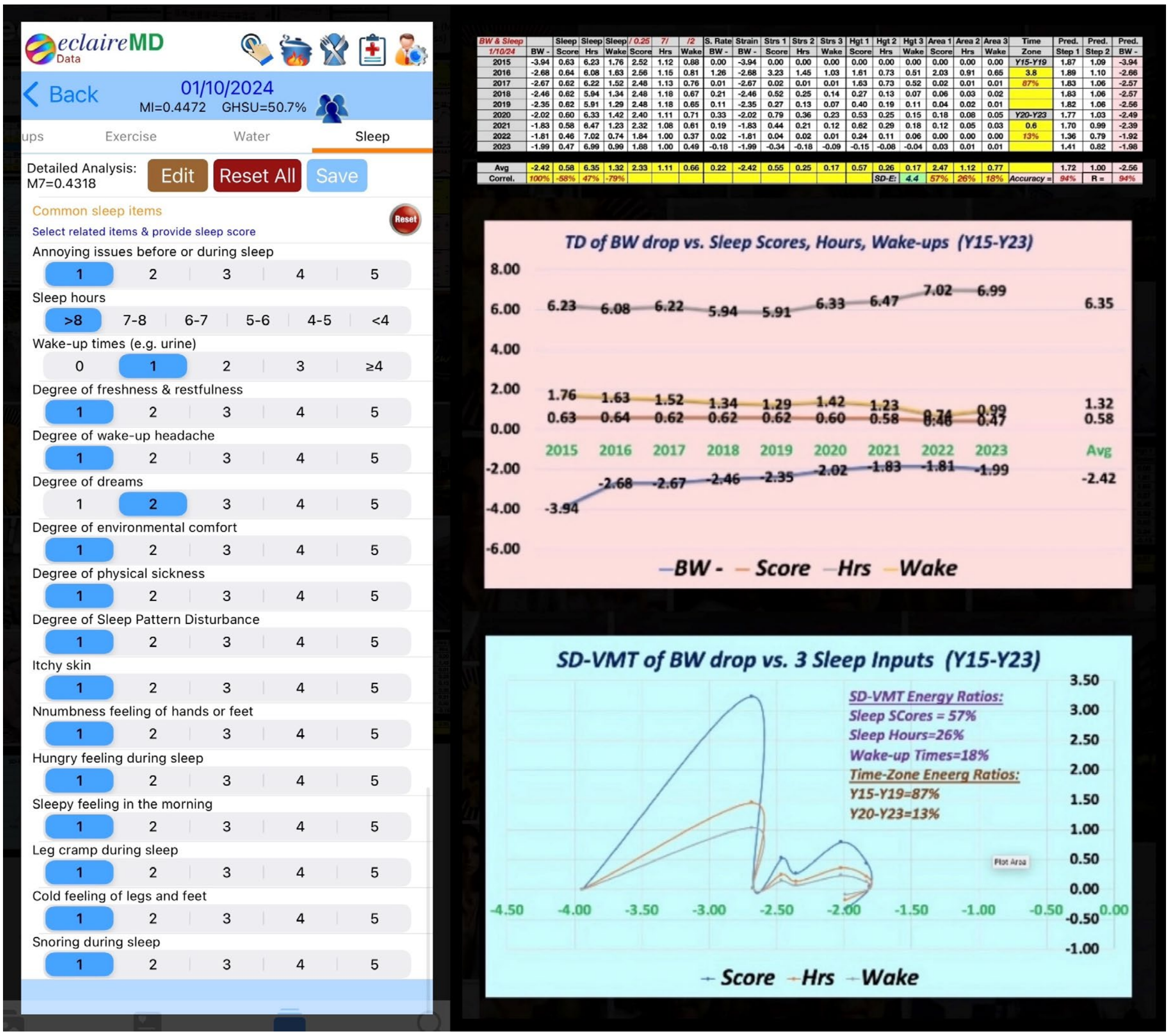

Figure 1: Sleep elements, data table, inputs and SD-VMT energy output diagram

10. Conclusions

In summary, the energy ratios of his body weight reduction during nightly sleep versus the three selected sleep inputs are as follows:

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Predicted BW reduction: -2.56 lbs
SD-VMT Prediction accuracy = 94%
Correlation between 2 values = 94%

References

For editing purposes, 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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