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# Viscoelastic Medicine Theory (VMT #325): Energy Analysis of Periodontitis versus Obesity, T2D, Hypertension and Dyslipidemia from Y2012 through Y2023 Using Viscoplastic Energy Model of GH-Method: Math-Physical Medicine (No. 925)

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## Abstract

The author, like many others, had not previously recognized the connection between dental hygiene and overall body health. However, after reading several published articles, he has discovered that dental hygiene and conditions are directly linked to four crucial metabolic disorders: obesity, glucose, hypertension, dyslipidemia. Although further research is still needed in this general area. To further explore this topic, he has conducted a Viscoplastic Medical Energy Analysis (VMT) using his own collected data on body weight, glucose, blood pressure, blood lipids, and his estimated overall dental conditions, with a particular emphasis on periodontitis. These dental or periodontitis data are not his collected data, but rather based on his own recollection and impressions of his dental conditions over the past 14 years which may not be entirely precise. As a result, he has provided two sets of estimated periodontitis scores with slightly different rates of change over time, yet exhibiting a similar general trend or waveform. This article has two primary objectives. Firstly, the author aims to understand the relative importance of dental health output, specifically periodontitis, compared to those four basic metabolic inputs. Secondly, he seeks to determine whether the VMT-based predictive equation he developed for this particular problem achieves satisfactory results or not. In this context, "energy" represents impact, influence, or contribution, while "energy rate" signifies the degree of influence on specific health outcomes or medical symptoms. "Overall energy" represents 100% of the total energy, with higher levels indicating greater strain on bodily organs. In summary, there are three key observations: 1. Based on these two SD-VMT results, the energy ratios for body weight, glucose, blood pressure, and blood lipids are quite similar, ranging from 28% to 29% for body weight, 26% to 28% for glucose, 25% to 26% for blood pressure, and 17% to 20% for blood lipids. This finding aligns with the information found in the medical articles reviewed by the author. It is notable that blood lipids seem to have less influence on periodontitis. 2. The time-zone energy distributions from these two SD-VMT results are significantly different. The energy distribution for the time zone Y12-Y16 is 21% in one analysis and 34% in the other. For Y17-Y19, the energy distribution is 38% in one analysis and 29% in the other. For Y20-Y23, the energy distribution is 41% in one analysis and 37% in the other. This finding is attributed to the varying rates of change in periodontitis over time and leads to different stress-strain curve profiles. 3. Both the original curve and the predicted curve of periodontitis show a poor correlation (-47% from the original case and -64% from the other case). This observation is a direct result of the weak correlations between the periodontitis output and those four metabolic marker inputs.

**Keywords:** Viscoelastic; Viscoplastic; Periodontitis; Obesity, Type 2 diabetes; Hypertension; Cancer; Cardiovascular disease; Chronic kidney disease

**Abbreviations:** MI: metabolism index; CVD: cardiovascular diseases; CKD: chronic kidney diseases; T2D: type 2 diabetes; PPG: postprandial plasma glucose; FPG: fasting plasma glucose

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# 1. INTRODUCTION

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To further explore this topic, he has conducted a Viscoplastic Medical Energy Analysis (VMT) using his own collected data on body weight, glucose, blood pressure, blood lipids, and his estimated overall dental conditions, with a particular emphasis on periodontitis. These dental or periodontitis data are not his collected data, but rather based on his own recollection and impressions of his dental conditions over the past 14 years which may not be entirely precise. As a result, he has provided two sets of estimated periodontitis scores with slightly different rates of change over time, yet exhibiting a similar general trend or waveform.

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## 1.1 Biomedical information

The following sections provide concise information extracted from various reviewed medical articles, which the author has chosen to omit from the traditional reference section to save his valuable research time. It is important to note that these sections do not constitute the original work of the author of this article but are included to assist the author in future reviews and provide valuable insights to readers interested in this subject.

**Relationships between periodontal diseases and blood pressure:**

There is a growing body of evidence suggesting a relationship between periodontal diseases and blood pressure. Several studies have observed that individuals with gum diseases, such as periodontitis, have a higher likelihood of having elevated blood pressure levels or hypertension. Furthermore, research indicates that managing and treating periodontal diseases may lead to a reduction in blood pressure levels.

One possible explanation for this association is the presence of chronic inflammation in periodontal diseases. Periodontitis involves inflammation of the gums and the surrounding tissues, which can release inflammatory markers into the bloodstream. These markers can impact blood vessel function and contribute to elevated blood pressure.

Moreover, the oral bacteria involved in periodontal diseases can enter the bloodstream through infected gum tissues. These bacteria have been found in the arterial walls and can contribute to the development of atherosclerosis, a condition characterized by the buildup of fatty deposits in the arteries. Atherosclerosis can disrupt blood flow and potentially raise blood pressure.

Additionally, the oral health status may also indirectly impact blood pressure through behavioral factors. Individuals with poor oral health may experience discomfort while chewing, leading to dietary changes. Unhealthy dietary habits, such as high sodium and low potassium intake, can influence blood pressure levels.

However, it is essential to mention that further research is still necessary to fully understand the precise nature and mechanisms of the relationship between periodontal diseases and blood pressure. Despite this, the existing evidence suggests that oral health plays a role in blood pressure regulation, highlighting the importance of maintaining good oral hygiene and seeking treatment for periodontal diseases.

**Is cholesterol related to periodontitis?**

The relationship between cholesterol and periodontitis is an area of ongoing research and investigation. Some studies have suggested a potential association between cholesterol levels and the development or severity of periodontal diseases, while others have not found a significant correlation.

One possible connection between cholesterol and periodontitis is inflammation. Both periodontitis and high cholesterol levels are associated with chronic inflammation in the body. Inflammatory markers released during periodontal infections may contribute to systemic inflammation, which can impact cholesterol metabolism and increase the risk of developing high cholesterol levels.

Another factor that may link cholesterol and periodontitis is the role of oxidative stress. Both conditions involve oxidative stress, which occurs when there is an imbalance between free radicals and the body's antioxidant defenses. Oxidative stress can damage tissues and contribute to the development of inflammatory conditions.

Additionally, certain medications used to treat high cholesterol, such as statins, have been investigated for their potential effects on periodontal health. Some studies have suggested that statins may have anti-inflammatory properties that can benefit periodontal tissues and potentially reduce the severity of periodontitis.

However, it is important to note that the research on the relationship between cholesterol and periodontitis is still evolving, and more studies are needed to establish a clear connection. Other factors, such as obesity, diabetes, and lifestyle habits, may also influence both cholesterol levels and the risk of periodontal diseases.

In conclusion, while there may be some association between cholesterol levels and periodontitis, further research is required to fully understand the extent and mechanisms of this relationship. Maintaining overall good oral health and managing cholesterol levels through appropriate lifestyle choices and medical guidance remain crucial for overall well-being.

**Pathophysiological explanations and statistical data of relationships between dental health and obesity:**

While there is evidence to suggest a relationship between dental health and obesity, the exact pathophysiological explanations are still being studied and understood. Here are some potential explanations and statistical data on the relationships between dental health and obesity:

1. Shared risk factors

-Poor nutrition: Both dental diseases and obesity can be influenced by an unhealthy diet high in sugar, refined carbohydrates, and processed foods.

-Sedentary lifestyle: Lack of physical activity and a sedentary lifestyle can contribute to both obesity and poor oral health.

2. Systemic inflammation

-Chronic low-grade inflammation seen in obesity could potentially contribute to an increased risk of periodontal disease.

-Adipose tissue secretes pro-inflammatory cytokines that can impact the immune response and oral health.

3. Altered salivary composition

-Obesity may affect the composition of saliva, which could lead to changes in oral bacteria and susceptibility to dental diseases.

-Salivary flow rates and pH levels may be disrupted in obese individuals, potentially contributing to oral health issues.

Statistical data on the relationships between dental health and obesity:

-A study published in the Journal of Dental Research analyzed national survey data from the National Health and Nutrition Examination Survey (NHANES) and found that obese individuals had significantly higher rates of periodontal disease compared to non-obese individuals. The study also noted that the severity of periodontal disease increased with increasing body mass index (BMI).

-Another study published in the Journal of Periodontology examined middle-aged adults and found a positive association between periodontal disease and BMI. The study concluded that higher BMI was associated with increased odds of having periodontal disease.

-A systematic review and meta-analysis published in the Journal of Periodontal Research analyzed 36 studies and found a positive association between obesity and poor oral health indicators such as periodontal disease, dental caries, and tooth loss.

These studies provide some statistical evidence of an association between dental health and obesity. However, more research is needed to fully understand the underlying mechanisms and establish a causal relationship between the two conditions.

**Pathophysiological explanations and statistical data of relationships between dental health and diabetes:**

The relationship between dental health and diabetes is complex and multifaceted. Several pathophysiological explanations have been proposed to understand this relationship. Additionally, statistical data has shown a clear association between these two conditions.

1. Pathophysiological explanations

a. Inflammation: Both diabetes and periodontal disease are characterized by chronic inflammation. In diabetes, high blood sugar levels can weaken the blood vessels and impair the immune system, making individuals more susceptible to infections, including gum disease.

b. Impaired wound healing: Individuals with diabetes often experience impaired wound healing due to compromised blood flow and weakened immune function. This can extend to the oral cavity, leading to delayed healing of oral wounds and increased risk of periodontal disease progression.

c. Altered microbiome: Diabetes has been associated with changes in the oral microbiome, with an increase in harmful bacteria. This dysbiosis can contribute to the development of periodontal disease.

d. Increased glycation: Elevated blood sugar levels in diabetes lead to increased glycation, where sugar molecules attach to proteins. This process can affect the structure and function of collagen, the main component of gums and other oral tissues, leading to impaired gum health.

2. Statistical data

a. Prevalence of periodontal disease: Studies have consistently shown a higher prevalence and severity of periodontal disease in individuals with diabetes compared to those without diabetes.

b. Increased risk of tooth loss: Diabetes has been identified as a significant risk factor for tooth loss. Poor glycemic control and longer disease duration further increase the risk. Additionally, age can result into tooth bone loss as well.

c. Bi-directional relationship: Research suggests a bidirectional relationship between diabetes and periodontal disease. Not only does diabetes increase the risk of periodontal disease, but treating and controlling periodontal disease has also demonstrated improvement in glycemic control among individuals with diabetes.

d. Impact on overall health: Poor oral health, including periodontal disease, in individuals with diabetes has been associated with an increased risk of cardiovascular complications, kidney disease progression, and impaired metabolic control.

These pathophysiological explanations and statistical data highlight the interconnectedness of dental health and diabetes. Managing both conditions effectively requires comprehensive care that addresses the oral health needs of individuals with diabetes and emphasizes the importance of oral hygiene, regular dental check-ups, and coordinated care between dental and medical professionals.

**Pathophysiological explanations and statistical data of relationships between dental health and cardiovascular diseases:**

The relationship between dental health and cardiovascular diseases has gained significant attention in recent years. A growing body of evidence suggests that poor dental health, specifically periodontal disease, may contribute to the development and progression of cardiovascular diseases. Both pathophysiological explanations and statistical data support this association.

1. Pathophysiological explanations

a. Inflammation: Periodontal disease is characterized by chronic inflammation in the gum tissues. The oral bacteria and their byproducts that cause periodontal disease can enter the bloodstream through infected gum tissue, leading to systemic inflammation. This systemic inflammation may contribute to the development and progression of cardiovascular diseases, including atherosclerosis.

b. Endothelial dysfunction: The same inflammatory mediators released in periodontal disease can damage the endothelial lining of blood vessels. Endothelial dysfunction, characterized by impaired nitric oxide production and increased oxidative stress, is an early event in atherosclerosis and other cardiovascular diseases.

c. Bacterial translocation: Oral bacteria from periodontal pockets can translocate into the bloodstream, leading to bacteremia. These bacteria and their toxic components can directly infect the vascular endothelium and contribute to the development of atherosclerotic plaques.

d. Immune response: The immune response to periodontal pathogens involves the release of pro-inflammatory cytokines and acute-phase reactants. These immune responses can contribute to systemic inflammation and may accelerate the development of cardiovascular diseases.

2. Statistical data

a. Association with cardiovascular diseases: Numerous epidemiological studies have found associations between periodontal disease and various cardiovascular conditions, including coronary artery disease, stroke, and heart failure. These studies have consistently shown an increased risk of cardiovascular diseases in individuals with periodontal disease.

b. Risk of cardiovascular events: Longitudinal studies have reported that individuals with periodontal disease have a higher risk of experiencing cardiovascular events, such as heart attacks and strokes. The severity of periodontal disease has been positively correlated with an increased risk of adverse cardiovascular outcomes.

c. Common risk factors: Periodontal disease and cardiovascular diseases share common risk factors, such as smoking, diabetes, and obesity. Controlling these risk factors can contribute to better oral health and reduce the risk of cardiovascular diseases.

d. Treatment effects: Some studies have demonstrated that periodontal treatment, such as scaling and root planing, can improve markers of endothelial function, reduce systemic inflammation, and potentially lower the risk of cardiovascular events.

These pathophysiological explanations and statistical data support the association between dental health, particularly periodontal disease, and cardiovascular diseases. Maintaining good oral hygiene, seeking regular dental care, and managing common risk factors may play a vital role in reducing the risk of cardiovascular diseases and promoting overall health. Collaborative care between dental and medical professionals is crucial for comprehensive management.

**Pathophysiological explanations and statistical data of relationships between dental health and chronically kidney diseases:**

The relationship between dental health and chronic kidney disease (CKD) has also been explored in various studies. While the evidence is limited compared to the dental-health-cardiovascular-disease association, there are some pathophysiological explanations and statistical data supporting a link.

1. Pathophysiological explanations

a. Inflammation and immune response: Similar to cardiovascular diseases, periodontal disease is associated with chronic inflammation. This inflammation can lead to systemic effects, including the release of inflammatory mediators, which may contribute to the development and progression of CKD. Additionally, the immune response triggered by oral bacteria can increase the risk of systemic inflammation and kidney damage.

b. Bacterial translocation: Oral pathogens can enter the bloodstream through inflamed gums and contribute to systemic infections. These bacteria or their byproducts may reach the kidneys and cause damage, potentially leading to CKD.

c. Indirect mechanisms: Poor oral health, such as untreated dental infections or gum disease, may lead to poor nutrition and nutritional deficiencies. Malnutrition and poor general health can contribute to the development or worsening of CKD.

2. Statistical data

a. Prevalence of Oral Health Problems in CKD: Some studies have shown a higher prevalence of periodontal disease and other oral health problems in individuals with CKD compared to the general population. The underlying systemic conditions, such as diabetes or hypertension, that often accompany CKD can further increase the risk of oral health issues.

b. Association with CKD progression: A few studies suggest that poor dental health, particularly periodontal disease, is associated with an increased risk of CKD progression. These studies indicated that individuals with more severe oral health problems had a higher likelihood of experiencing a decline in kidney function.

c. Bidirectional relationship: Chronic kidney disease may also have an impact on oral health. The abnormal mineral metabolism, reduced salivary flow, and impaired immune response often seen in individuals with CKD can contribute to oral health issues, including tooth decay and gum disease.

While the evidence connecting dental health and chronic kidney disease is not as extensive as that for cardiovascular diseases, there is a growing awareness of the potential association. Further research is needed to better understand the mechanisms and establish a stronger evidence base. However, promoting good oral hygiene, regular dental care, and managing systemic conditions that contribute to both dental and kidney diseases can be beneficial for individuals with CKD.

**Evidence or statistics data of relationships between dental diseases versus obesity, diabetes, and CVD:**

There is a complex and bidirectional relationship between dental diseases, obesity, diabetes, and cardiovascular disease (CVD). The presence of one condition can increase the risk of developing another. Here are the relationships between these conditions:

1. Dental diseases and obesity

a. Poor oral health and increased risk of obesity: Studies have shown that individuals with poor oral health, particularly periodontal disease, are more likely to have higher body mass index (BMI) and increased risk of obesity. This relationship may be due to shared risk factors such as unhealthy diet, sedentary lifestyle, and systemic inflammation.

b. Potential mechanisms: The exact mechanisms linking dental diseases and obesity are not fully understood. However, chronic low-grade inflammation associated with periodontal disease may affect metabolism and energy balance, contributing to weight gain and obesity.

2. Dental diseases and diabetes

a. Bidirectional relationship: Diabetes and periodontal disease have a bidirectional relationship. Individuals with diabetes are more prone to gum disease and have a higher prevalence of dental problems. Conversely, individuals with periodontal disease may have difficulty in controlling their blood sugar levels, leading to poorly managed diabetes.

b. Shared risk factors: Obesity, unhealthy diet, and poor oral hygiene are common risk factors for both diabetes and dental diseases. Furthermore, chronic inflammation plays a role in the development and progression of both conditions.

3. Dental diseases and CVD

a. Periodontal disease and increased cardiovascular risk: Epidemiological studies have found an association between periodontal disease and an increased risk of developing cardiovascular diseases such as heart disease, stroke, and atherosclerosis. The inflammation caused by periodontal disease is thought to contribute to the development and progression of CVD.

b. Mechanisms: It is hypothesized that the bacteria and inflammatory mediators from periodontal infections can enter the bloodstream, causing systemic inflammation and promoting the formation of atherosclerotic plaques in blood vessels. Inflammation also contributes to the progression of endothelial dysfunction and vascular damage, increasing the risk of CVD.

c. Shared risk factors: Smoking, diabetes, and poor oral hygiene are common risk factors for both periodontal disease and cardiovascular diseases. These risk factors can further exacerbate the association between dental diseases and CVD.

Overall, the relationships between dental diseases, obesity, diabetes, and CVD are multifaceted and interconnected. Promoting good oral hygiene, maintaining a healthy weight, managing diabetes effectively, and addressing shared risk factors can contribute to better overall health outcomes and reduce the risk of these conditions.

There are some evidence and statistical data highlighting the relationships between dental diseases, obesity, diabetes, and cardiovascular disease (CVD):

1. Dental diseases and obesity

-A systematic review and meta-analysis published in the Journal of Clinical Periodontology found that individuals with periodontal disease have a higher risk of obesity, with a pooled odds ratio of 1.53 (95% CI: 1.31-1.79). The study included data from 21 observational studies.

2. Dental diseases and diabetes

-A systematic review and meta-analysis published in Diabetes Care found that individuals with diabetes have a significantly higher risk of periodontal disease compared to those without diabetes, with a pooled odds ratio of 2.27 (95% CI: 1.68-3.05). The study included data from 33 observational studies.

-A longitudinal study published in Diabetes Research and Clinical Practice followed individuals with newly diagnosed type 2 diabetes for five years and found that those with poor oral health had a higher risk of poor glycemic control and increased HbA1c levels compared to those with good oral health.

3. Dental diseases and CVD

-A systematic review and meta-analysis published in the Journal of Periodontology found that individuals with periodontal disease have a significantly higher risk of cardiovascular diseases, including coronary heart disease and stroke. The pooled odds ratio for coronary heart disease was 1.43 (95% CI: 1.17-1.74) and for stroke was 1.39 (95% CI: 1.09-1.77). The study included data from 40 observational studies.

-A prospective cohort study published in Circulation followed over 50,000 men for a median of 19.6 years and found that individuals with periodontal disease had a significantly higher risk of developing CVD, even after adjusting for traditional risk factors. The hazard ratio for myocardial infarction was 1.27 (95% CI: 1.02-1.58) and for stroke was 1.24 (95% CI: 1.03-1.50).

-The American Heart Association published a scientific statement in Circulation, acknowledging the association between periodontal disease and CVD. They stated that periodontal disease is an independent risk factor for CVD, and suggested that oral health assessments and management should be included in cardiovascular risk assessment and management guidelines.

These studies and statements provide evidence of the relationships between dental diseases and the risk of obesity, diabetes, and cardiovascular disease. It highlights the importance of oral health as an essential component of overall health.

**Pathophysiological explanations and statistical data of relationships between dental health and cancers:**

The relationship between dental health and cancers is a complex topic, and the specific pathophysiological explanations are still being investigated. However, here are some potential explanations and statistical data on the relationships between dental health and cancer:

1. Chronic inflammation and immune response

-Periodontal disease is characterized by chronic inflammation and infection in the gums, which could potentially contribute to an increased risk of certain cancers.

-Chronic inflammation can negatively impact the immune response and potentially promote the development and progression of cancer cells.

2. Oral microbiome

-The oral cavity hosts a diverse microbial community, and imbalances in the oral microbiome have been associated with various diseases, including oral cancers.

-Certain oral bacteria, such as Porphyromonas gingivalis, have been found in higher abundance in patients with oral cancers.

3. Shared risk factors

-Smoking and alcohol use: These are well-established risk factors for both oral cancers and certain dental diseases, such as periodontal disease and tooth loss.

-Poor oral hygiene: Inadequate oral hygiene practices can contribute to dental diseases and potentially increase the risk of oral cancers.

Statistical data on the relationships between dental health and cancers:

-The International Agency for Research on Cancer (IARC) recognizes that there is sufficient evidence to link poor oral hygiene practices, including the presence of dental plaque and periodontal disease, with an increased risk of oral cancers.

-A systematic review and meta-analysis published in the journal Oral Oncology analyzed 21 studies and found a significant association between periodontal disease and an increased risk of oral, head, and neck cancers.

-Another meta-analysis published in the journal Cancer Epidemiology, Biomarkers & Prevention analyzed 16 studies and reported an increased risk of oral cancer associated with poor oral hygiene practices, including smoking, betel quid chewing, and missing teeth.

These studies provide some statistical evidence suggesting a connection between dental health and certain cancers. However, it is worth noting that further research is required to fully understand the underlying mechanisms and establish a causal relationship between dental health and specific types of cancers.

### 1.2 Abstracts of some medical papers from PubMed

**Periodontitis and diabetes: a two-way relationship**
P M Preshaw et al. Diabetologia. 2012 Jan.

Abstract, PubMed
Abstract

Periodontitis is a common chronic inflammatory disease characterised by destruction of the supporting structures of the teeth (the periodontal ligament and alveolar bone). It is highly prevalent (severe periodontitis affects 10-15% of adults) and has multiple negative impacts on quality of life. Epidemiological data confirm that diabetes is a major risk factor for periodontitis; susceptibility to periodontitis is increased by approximately threefold in people with diabetes. There is a clear relationship between degree of hyperglycaemia and severity of periodontitis. The mechanisms that underpin the links between these two conditions are not completely understood, but involve aspects of immune functioning, neutrophil activity, and cytokine biology. There is emerging evidence to support the existence of a two-way relationship between diabetes and periodontitis, with diabetes increasing the risk for periodontitis, and periodontal inflammation negatively affecting glycaemic control. Incidences of macroalbuminuria and end-stage renal disease are increased twofold and threefold, respectively, in diabetic individuals who also have severe periodontitis compared to diabetic individuals without severe periodontitis.

 

Furthermore, the risk of cardiorenal mortality (ischaemic heart disease and diabetic nephropathy combined) is three times higher in diabetic people with severe periodontitis than in diabetic people without severe periodontitis. Treatment of periodontitis is associated with HbA(1c) reductions of approximately 0.4%. Oral and periodontal health should be promoted as integral components of diabetes management.

**The relationship between oral health status and body mass index among older people: a national survey of older people in Great Britain**
A Sheiham et al. Br Dent J. 2002.

Abstract, PubMed
Abstract

Aims: To assess the relationship between oral health status and Body Mass Index.

Material and methods: This paper relates to the free-living sample (participants who lived in their own home, rather than an institution) of the National Diet and Nutrition Survey: people aged 65 years and older.

Subjects: 629 adults.

Data collection: A probability random national sample of adults who had a dental examination, an interview and an anthropometric examination.

Data analysis: Fisher's exact test and multivariate logistic modeling.

Findings: Being underweight was relatively uncommon in this population. People without teeth were significantly (P=0.05) more likely to be underweight than those with 11 or more teeth; 12.3% and 2.9%. A highly statistically significant (P=0.001) difference was observed in BMI between dentate people with 1-10 teeth and with more than 10 teeth; 24% and 2.9% were underweight. Dentate people with less than 21 natural teeth were on average more than 3 times more likely to be obese than those with 21-32 teeth (P=0.036). There was no significant difference in both the proportion of overweight and obese adults between those who were edentulous and dentate with 21 or more teeth. A similar pattern was observed when the number of posterior occluding pairs was compared with BMI categories. Results of multiple logistic regression were adjusted for the confounding effects of age, social class, region of origin and partial denture wearing.

Conclusions: Older people in Britain with more than 20 teeth are more likely to have a normal Body Mass Index.

**Association of oral health with risk of incident micro and macrovascular complications: A prospective cohort study of 24,862 people with diabetes**
Alice A Gibson et al. Diabetes Res Clin Pract. 2023.

Abstract, PubMed
Abstract

Aims: To investigate the association between self-reported oral health and incident micro and macrovascular diabetes complications.

Methods: This prospective cohort study linked data from the 45 and Up Study, Australia, to administrative health records. The participants were 24,862 men and women, aged ≥45 years, with diabetes at baseline (2006-2009). The oral health of participants was assessed by questionnaire. Incident diabetes complications were determined using hospitalisation data and claims for medical services up until 2019. Hazard ratios for the association between oral health and incident complications were calculated using multivariable cox proportional hazards models.

Results: Almost 60 % of participants had <20 teeth, and 38 % rated their teeth and gums as fair or poor. Compared with those with ≥20 teeth, those with 0 teeth had an increased risk of cardiovascular disease (aHR 1.24, 95 % CI: 1.15, 1.35), lower limb (aHR 1.22, 95 % CI: 1.11, 1.33) and kidney (aHR 1.19, 95 % CI: 1.11, 1.29) complications. Individuals with 1-9 teeth had an increased risk of eye complications (aHR 1.14, 95 % CI: 1.07, 1.22). The associations were generally consistent for poor self-rated teeth and gums.

Conclusions: Self-reported oral health measures may be a marker of elevated risk of complications in people with diabetes.

Keywords: Cardiovascular disease; Cohort study; Diabetes complications; Diabetes mellitus; Epidemiology; Oral health; Tooth loss.


## 2. METHODS

### 2.1 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 describes his MPM methodology in a general conceptual format. The second paper, No. 387 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 depicts a general flow diagram containing ~10 key MPM research methods and different tools.

### 2.2 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.

**2.3 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.

**2.4 Time-dependent output strain and stress of (viscous input*output rate)**

Hooke's law of linear elasticity is expressed as:

Strain ($\varepsilon$: epsilon)
= Stress ($\sigma$: 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 conditions, 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).

**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 2 data table and results from both TD and SD-VMT models.

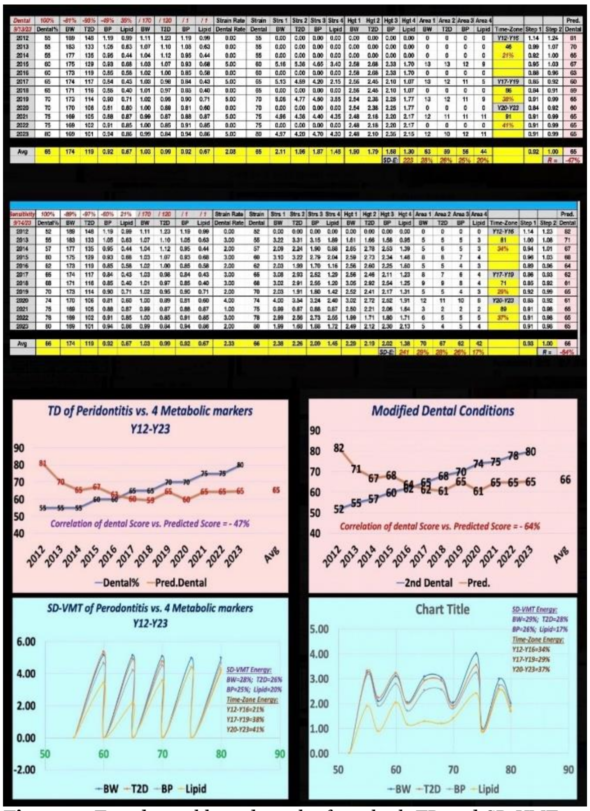


**Figure 1:** Two data table and results from both TD and SD-VMT models.

## 4. CONCLUSION

In summary, there are three key observations:

1. Based on these two SD-VMT results, the energy ratios for body weight, glucose, blood

 

pressure, and blood lipids are quite similar, ranging from 28% to 29% for body weight, 26% to 28% for glucose, 25% to 26% for blood pressure, and 17% to 20% for blood lipids. This finding aligns with the information found in the medical articles reviewed by the author. It is notable that blood lipids seem to have less influence on periodontitis.

2. The time-zone energy distributions from these two SD-VMT results are significantly different. The energy distribution for the time zone Y12-Y16 is 21% in one analysis and 34% in the other. For Y17-Y19, the energy distribution is 38% in one analysis and 29% in the other. For Y20-Y23, the energy distribution is 41% in one analysis and 37% in the other. This finding is attributed to the varying rates of change in periodontitis over time and leads to different stress-strain curve profiles.

3. Both the original curve and the predicted curve of periodontitis show a poor correlation (-47% from the original case and -64% from the other case). This observation is a direct result of the weak correlations between the periodontitis output and those four metabolic marker inputs.

## 5. 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.



For reading more of the author's published VGT or FD analysis results on medical applications, please locate them through platforms for scientific research publications, such as ResearchGate, Google Scholar, etc.

 

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The GH-Method

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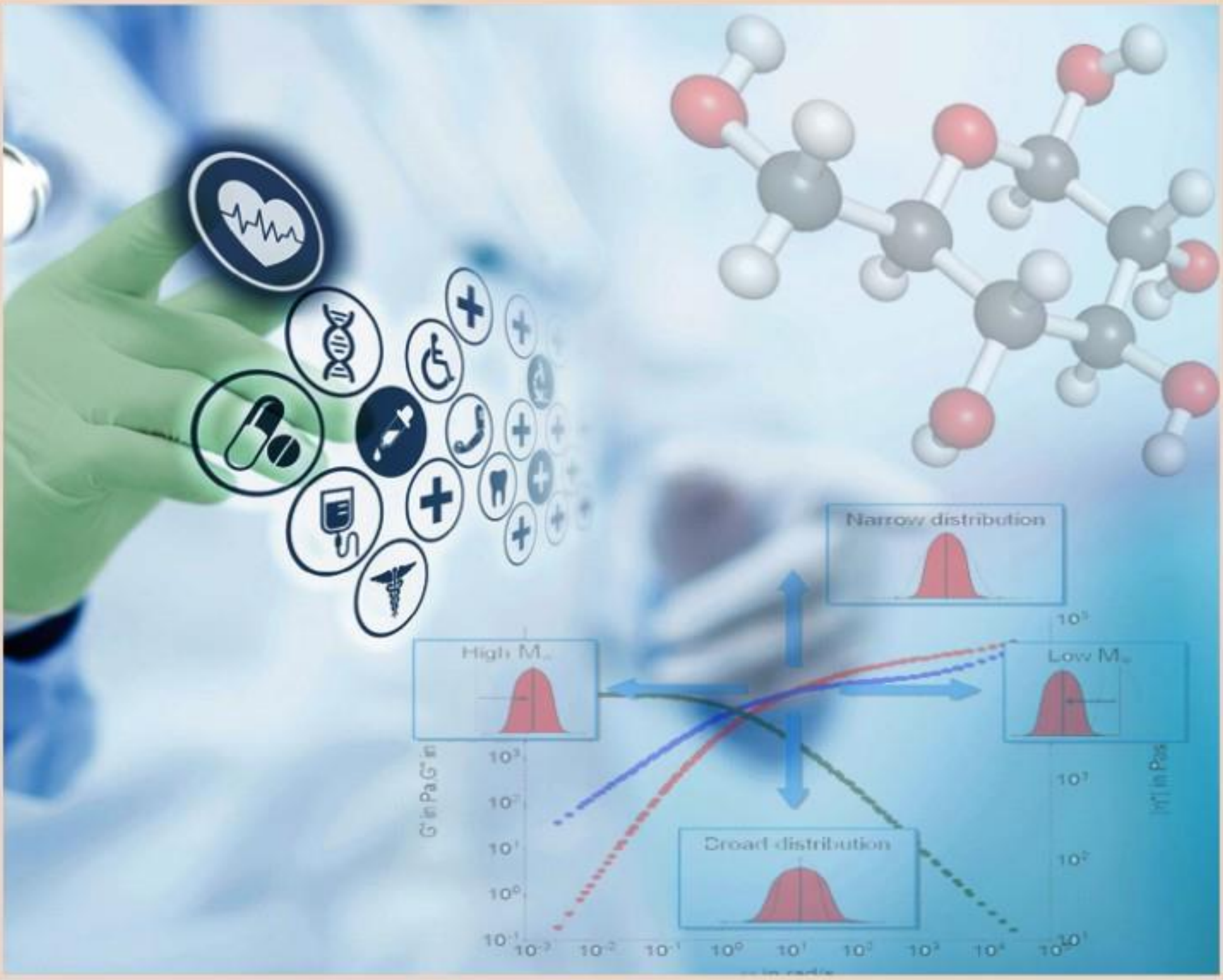


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