

Adjusting Autonomic Physiology with Diet and Minerals to Improve Health

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Abstract

The role of diet and mineral supplementation in modulating autonomic balance was commonly studied in the early 20th century, but is rarely discussed today. This paper reviews historical findings by academic researchers, such as Hans Eppinger, Leo Hess, André-Charles Guillaume, S.G. Zondek, and Francis Pottenger, connecting their discoveries to the dentist William Donald Kelley's dietary model and treatment methods, with further refinements by Nicholas Gonzalez and the author. The central hypothesis is that dietary composition and mineral supplementation—particularly of calcium, magnesium, and potassium—affect sympathetic and parasympathetic tone, thereby influencing disease susceptibility. Calcium and acid-forming diets stimulate sympathetic activity, whereas

magnesium, potassium, and alkalizing diets support parasympathetic function. Early physiologic research and modern studies on heart rate variability, electrolyte balance, and immune activation suggest that an imbalance in autonomic tone may underlie various forms of ill health. Research in this area declined following World War II, but renewed investigation into autonomic individuality may explain conflicting outcomes of dietary intake and mineral supplementation. This integrative model proposes that tailoring diet and mineral supplementation to restore autonomic balance can optimize physiological function, offering a biologically grounded approach to personalized health. **Keywords:** autonomic nervous system, medical history, magnesium, potassium, calcium, alkaline diet, acid diet

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Introduction

Why has autoimmune disease become more common over the last thirty years?¹ Why do some studies show calcium supplementation is associated with cardiovascular events, while others do not?^{2,3} Why are wildly divergent diets advocated as the key to good health for all humans?⁴

Theories about the impact of dietary intake on the autonomic nervous system can address all these questions, and more. This article provides a framework for diet and mineral supplementation to adjust autonomic balance and promote health.^{5,6}

Autonomic Nervous System

John Newport Langley, an English physiologist, clarified the functions of the autonomic nervous system in the late 1800s and early 1900s.⁷ The autonomic nervous system controls involuntary bodily processes such as blood pressure, heart rate, respiration, and digestion. The sympathetic nervous system is the “fight or flight” system, mobilizing the body to deal with stress. In contrast, the parasympathetic system is a “rest and digest” system, focusing on relaxation, digestion, and repair. The

sympathetic nerves arise from the spinal cord between T1 and L2. Parasympathetic innervation travels in cranial nerves III, VII, IX, and X, and the pelvic nerves, with 75% of parasympathetic nerve fibers in the vagus nerves (cranial nerve X).⁸ Langley described the sympathetic and parasympathetic systems as generally antagonistic.

Langley's investigations in animal models involved the use of various substances that either stimulated or suppressed the sympathetic or parasympathetic systems. As an example, adrenaline was found to stimulate the sympathetic nervous system, while pilocarpine, an alkaloid, stimulated the parasympathetic system.⁹

Differences in Autonomic Tone

It was not long before Langley's discoveries were applied to clinical practice. In 1910, in their book *Vagotonia*, Austrian scientists Hans Eppinger and Leo Hess reported differences in sensitivity to the effects of pilocarpine among both healthy people and those with medical problems.¹⁰ An English translation of *Vagotonia* became available in 1915, with a second edition in 1917, demonstrating its wide readership.

When Eppinger and Hess administered 0.01 mg of pilocarpine hypodermically, some subjects, but not all, responded with sweating and salivation. They labelled responders as vagotonic, having excess tone in the parasympathetic, or vagal nervous system.

Vagotonics were prone to various maladies, which the book reviews at length. However, some subjects thought to

be healthy also exhibited a vagotonic reaction. The “healthy” vagotonics were found, on closer examination, to have “*hyperacidity, eosinophilia, bradycardia, mild arrhythmias, especially respiratory, or sluggish bowel action, approaching spastic constipation.*”

While Eppinger and Hess focused on those who were hyperreactive to pilocarpine, they reported that other subjects were hyperreactive to adrenaline. However, none of their subjects were hyperreactive to both substances. “*Individuals who are very reactive to adrenalin [sic] will be less reactive to pilocarpin [sic], and strong pilocarpin reactions would imply reduced adrenalin reactions.*”

Since the functions of the endocrine glands were poorly understood a century ago, many details in their book are not correct. But evidently, in their studies, administration of adrenaline or pilocarpine provoked different degrees of reactions in different individuals.

After the publication of *Vagotonia*, many other scientists began to investigate autonomic imbalance, as detailed in André-Charles Guillaume’s 1928 book *Vagotonies, Sympathicotonies, Neurotonies*.¹¹ Those who reacted to minimal amounts of pilocarpine, showing an overactive parasympathetic system, Guillaume called vagotonics. Sympathicotonics reacted to minimal amounts of adrenaline, indicating an overactive sympathetic nervous system. The third category, neurotonics, showed an intermediate or mixed response to testing. Neurotonics were the majority, Guillaume stated, second being sympathicotonics, and third, vagotonics.

He described various reflexes that could be used to determine autonomic tone, such as the oculocardiac reflex. This reflex refers to the slowing of the heart caused by placing pressure on the eye, which causes the heart to slow, a manifestation of the parasympathetic nervous system. Theoretically, less pressure would be needed for a vagotonic’s heart rate to slow. However, Guillaume believed that differences in interpretation by practitioners made reflex testing unreliable.

Laboratory testing was in its infancy then, but Guillaume found that vagotonics had high eosinophils. Sympathicotonics tended to have higher blood sugar, as well as a mildly elevated white blood cell count with high neutrophils. As for personality, sympathicotonics were prone to anxiety, vagotonics to an apathetic depression. Guillaume reviewed the medical literature to show how his theories could explain previously described syndromes.

Guillaume did not discuss diet. As for minerals, he reported that calcium stimulates the sympathetic system, while potassium stimulates the parasympathetic system. He speculated that someday, supplementation of these minerals could be used to address illnesses.

Electrolytes and Diet

In 1927, the book *Die Elektrolyte*, by S.G. Zondek, reviewed the physiology of cations and anions.¹² In addition, it included an extensive discussion of colloids,

the proteins that make up the blood serum, and the substance of cells. Colloids are ampholytes: having both cationic and anionic properties, and serving as buffers. As an illustration of the strength of those buffers, in 1903, Friedenthal reported “*serum requires, to secure a given change of reaction, thirty to forty times as much NaOH, and 327 times as much HCl, as would be needed in water.*”¹³

Due to these powerful buffers, adding acidic or alkaline substances makes very small changes in the pH of the blood. Therefore, eating a highly acidifying or alkalinizing diet does not significantly affect serum pH; however, there would be a change in the buffering capacity. Since colloids are part of the buffering system, a change in the buffering capacity can alter the structure of the colloids, thereby influencing the function of the cells they comprise.¹²

In both *Die Elektrolyte* and a 1921 article, Zondek detailed his findings on the impact of stimulating the branches of the autonomic nervous system or adding calcium or potassium to tissues.¹⁴ Stimulating the vagus nerve created the same effect as when an excess of potassium was present. He reported that stimulating the sympathetic system had similar effects to an excess of calcium. Zondek also described a study in which either topical potassium or topical calcium was applied to wounds. Potassium stimulated inflammation on the wound surface, whereas calcium inhibited it.

Zondek also investigated the impact of magnesium on physiological function, finding that large amounts of magnesium, administered to an animal parenterally, caused sedation and muscular paralysis, reversible by calcium. Based on this, Zondek believed that magnesium behaves more like potassium in the body. He found this surprising, since magnesium and calcium both have two positive charges, unlike potassium, which has only one. Zondek speculated that magnesium may not fully dissociate from its accompanying anions.

Zondek’s work, as well as that of Eppinger and Hess, was reviewed by Francis Pottenger, Sr., in a 1946 textbook excerpt. Pottenger began with a comprehensive overview of autonomic structure, detailing the roles of potassium, calcium, and pH in regulating autonomic activity and cellular function. He discussed imbalanced autonomic function, referencing the theories and experimental findings of Eppinger and Hess, as well as the oculocardiac reflex mentioned in Guillaume’s book. He then reviewed clinical syndromes caused by hyperactivity of either the sympathetic or parasympathetic nervous systems. For patients with overactivity of the parasympathetic nervous system, he recommended administration of calcium, ammonium chloride, and a ketogenic diet. He suggested that bicarbonate of soda could address some aspects of an overactive sympathetic system, as could “*creating for the patient a proper psychology.*” However, Pottenger did not mention magnesium.¹⁵

Gellhorn and Other Psychiatrists

Around the same time as Pottenger wrote his textbook chapter, other researchers were studying the effect of magnesium deficiency on the autonomic nervous system. Ernst Gellhorn and Julius Feldman, in 1941, fed mice a magnesium-depleted diet. The animals' sympathetic systems became hypersensitive, evidenced by their response when subjected to various stressors.¹⁶

Over the following decades, Gellhorn went on to write several books discussing the autonomic nervous system and its connection with psychological states.¹⁷⁻¹⁹ He mainly focused on the use of pharmaceutical tests to determine whether an autonomic imbalance was present. However, he did not discuss therapeutic inventions with minerals or diet.

Working around the same time as Gellhorn, Losse and colleagues in Germany investigated alternative ways of determining autonomic tone.^{20,21} They believed that testing with medications resulted in rebound symptoms and, therefore, was unreliable. Instead, they measured several variables in a resting state among healthy participants, 98 men and 31 women, including some identical twins.

The testing included measurements of circulatory parameters, such as oxygen consumption and blood pressure, as well as serum potassium and calcium, and eosinophilia. Sympathicotonics had lower potassium/calcium ratios, as well as higher glucose, while vagotonics had a lower basal metabolic rate and cardiac output.

They classified 8% of the group they studied as vagotonics, and another 8% as sympathicotonics. The remainder were somewhere in between these extremes. Repeated evaluations of the same individuals over several days yielded the same results, with little fluctuation. Results were similar in identical twins.

They concluded that differences in autonomic tone could be determined less invasively than by provoking physical reactions with medications, and that most people are balanced. They did not mention diet or any form of treatment.

Other practitioners in this era published descriptions of autonomic testing and imbalances in the psychiatric literature, including Wenger, Lester, and Funkenstein.²²⁻²⁵ While their experimental findings also suggest differences between individuals, none of these authors suggested diet or electrolyte supplementation to address these imbalances.

In this century, discussions of imbalance in autonomic tone have focused almost exclusively on excess stimulation of the sympathetic nervous system. Heart rate variability is frequently used to assess cardiac vagal tone, and most articles imply that an increase in vagal tone is always better.²⁶ However, some studies point to excess vagal tone being problematic. In a 2013 article, Kogan et al report that individuals with moderate cardiac vagal tone had higher well-being than those with high or low cardiac vagal tone.²⁷ Articles published in 2021 and 2024 found

that the lowest incidence of depression and the greatest well-being were linked to intermediate levels of heart rate variability in women, but not in men.^{28,29} A 2021 publication proposed that both sympathetic and parasympathetic overstimulation can cause cardiac arrhythmias.³⁰

Lack of Continuing Research

Pottenger's article is the last among the older medical literature that discussed addressing autonomic tone with mineral intake and diet. Why did a field of inquiry go from multiple published books and articles to nothing? Some speculations follow about why this theoretical model disappeared.

(i) Diagnostic Methods

Eppinger and Hess described the administration of adrenaline (a sympathetic stimulant) and pilocarpine (a parasympathetic stimulant) to determine differences in autonomic tone among people. However, the symptoms that these medications could produce during testing were dramatic and unpleasant.^{10,11} Pilocarpine caused abdominal spasms and pain, angina, bradycardia, irregular pulse, excessive salivation, asthmatic attacks, diarrhea, sweating, and urgency of urination or defecation. Adrenaline injections caused dry mouth, goosebumps and chills, tremor, anxiety, chest pain, agitation, tachycardia, and high blood pressure.

Guillaume and Pottenger reviewed the use of these medications, as well as various reflexes such as the oculocardiac reflex.^{11,15} However, Guillaume reported that practitioners could interpret reflexes differently. In addition, Guillaume felt that a strong stimulus to one part of the autonomic nervous system caused a quick compensatory shift as the organism worked towards re-establishing equilibrium. While the reflexes described sound less unpleasant than the medications, they still would be unpalatable to a modern mindset.

Losse et al concurred that medications as a method of testing could be unreliable due to rebound symptoms.^{20,21} Unfortunately, their method of assessing autonomic tone by measuring many different physiological parameters would be too cumbersome for use in a clinical setting.

(ii) World War II

Much of the seminal work of practitioners on the autonomic nervous system was done in interwar Germany and Austria. The social and political turmoil of the 1930s affected the investigators.

Hess, who was appointed full professor at the University of Vienna in 1929, lost his privileges after Germany annexed Austria.³¹ He came to the United States in 1939, becoming a professor at Beth Israel Hospital in Boston. He continued to write articles about the autonomic nervous system, describing its relationship to angina, multiple sclerosis, and uremia, in the 1940s and 1950s.³²⁻³⁶

Zondek lost his professorship in Berlin in 1933. Later that year, he and his brothers took positions at the

Manchester Victoria Memorial Jewish Hospital in England.³⁷ He finished his career in Tel Aviv, publishing articles on hypertension during the 1940s and 50s.³⁸

Eppinger was a Nazi, housing “Nazi student cells” before the Anschluss in Vienna.³⁹ During World War II, he committed atrocities involving water restriction while in the research department of the Army High Command. He died of suicide in 1946, shortly before he was to go on trial at Nuremberg.³⁹

Losse et al, writing in the mid-1950s, mentioned Eppinger’s work, but did not discuss his Nazi affiliation or his death. They commented that his book, *Vagotonia*, presented extremes of autonomic functioning as a pathological state rather than as a normal variant.²⁰ Indeed, the closing remarks of *Vagotonia* include the statement: “We feel also that vagotonia is the expression of an inferior constitutional make-up.”¹⁰

Unfortunately, the concept that autonomic tone varies among individuals could have fed into the enthusiasm for eugenics before World War II. There is a vast difference between recognizing differences to improve health and well-being and judging some people as inferior. Nonetheless, the horrors of the Nazi era may have cast a pall upon this area of research in the post-war period.

(iii) Pharmaceuticals

Another consideration is that the 1940s and 50s corresponded with the rise of pharmacology. Certainly, the introduction of antibiotics for infectious diseases was an impressive step forward. Patients and doctors came to believe that pharmaceuticals would provide decisive and speedy solutions for numerous illnesses. Doctors like Pottenger continued to use diet and minerals, but they were slow to work, whereas pharmacology promised rapid resolution. Zondek, in *Die Elektrolyte*, commented that electrolytes would require more consistent and frequent dosing, while compounds such as digitalis had a more durable effect.¹²

Moreover, the medical world can be quite contemptuous of the clinical observations and skills of older generations of physicians. Guillaume commented on this phenomenon in his 1928 book.¹¹ With the rise of pharmacology and biomedical science in the 1940s, this tendency became more pronounced, as described in Lewis Thomas’s book *The Youngest Science*.⁴⁰

Nonetheless, the clinical observations by Zondek, Guillaume, Gellhorn, and Losse et al are striking and should not be so easily dismissed. In his 1979 book, *The Nervous Body: An Introduction to the Autonomic Nervous System and Behavior*, neuropsychologist C. Van Toller commented on the lack of recognition of Gellhorn’s work, stating:

*This is a pity for few theorists have built up such an imposing array of experiments and collected so much evidence. ... it is difficult to predict what theories will survive; intellectual disposition or predisposition can be most fickle.*⁴¹

(iv) Theoretical Critiques

Some scientists argued that the effects of diet or mineral supplements can only be minimal due to the body’s great capacity for buffering and the large amount of minerals already present.⁴² Zondek, in *Die Elektrolyte*, addressed this concern, speculating that an acid or alkaline diet might not change measured serum pH, but that the buffering capacity of the body would change.¹² Since amphoteric colloids are a part of the buffering system, these alterations could change the structure of the colloids, affecting cellular function. A sustained extreme diet would have more effect than a single meal.

Two articles published in 2013 and 2018 describe subclinical metabolic acidosis and its sequelae. In this situation, both blood pH and serum bicarbonate remain normal; however, the body’s alkaline reserves get depleted in the setting of chronic kidney disease. The articles describe its effects on bone and muscle, and on the development of heart disease.^{43,44}

While a 2025 article, “*Frustration in physiology and molecular medicine*,” does not explicitly discuss electrolytes or acid-base physiology, it does review how slightly unstable, “locally frustrated” sections of protein molecules are essential parts of the mechanism of action.⁴⁵ Even small alterations in serum or cellular pH, or the concentrations of cofactors such as magnesium, could affect these “locally frustrated” areas of proteins.

William Donald Kelley

The conventional medical world gradually forgot or dismissed these theories about variations in autonomic physiology. However, one practitioner, William Donald Kelley, an orthodontist, made them a centerpiece of his treatment model.^{46,47}

Kelley believed that patients with highly developed and overactive sympathetic nervous systems were more acidic on a cellular level, tended to be nervous and irritable, and would develop certain types of illnesses, including carcinomas. Other patients with an overactive parasympathetic system were more alkaline and were likely to develop autoimmune disorders or cancers of the immune system, such as leukemia or lymphoma. Kelley believed that when the body is more alkaline, cell membranes become more permeable, susceptible to foreign proteins and viruses.^{46,47}

In Kelley’s model, all humans exist on a spectrum between these two extremes. Optimal health is achieved when the sympathetic and parasympathetic systems are balanced. To affect autonomic tone, Kelley used oral magnesium, potassium, and calcium. He believed that magnesium tones down an overactive sympathetic system, potassium stimulates the parasympathetic system, and calcium stimulates the sympathetic system.^{46,47}

Kelley also stated that a more vegetarian diet, with minimal animal protein, would tone down an overactive sympathetic system, while a diet high in animal protein

but low in carbohydrates would tone down an overactive parasympathetic system. His recommendations were based on whether a diet was alkalinizing. A vegetarian diet would be alkalinizing; a diet including meat could be slightly alkalinizing to acid-forming, depending on the type of vegetables consumed.⁴⁸

Figure 1 represents the effects of diet, calcium, magnesium, and potassium on autonomic balance.

To summarize: in Kelley’s model, an individual who is sympathetic-dominant should eat a variety of nuts, seeds, fruits, vegetables, and grains, minimal animal protein, and take high doses of magnesium and potassium, with minimal calcium. A parasympathetic-dominant individual should eat large amounts of animal protein, root vegetables, and crucifers, minimal leafy greens, fruits, and grains, and take high doses of calcium, but minimal magnesium and potassium. A patient whose nervous system was balanced should maintain it with a more intermediate approach.

In Kelley’s training materials, he reported that various other trace minerals and vitamins would affect autonomic balance.^{46,47} I have included this information in Table 1, but further review is beyond the scope of this article.

Support for Kelley’s Theories

How did Kelley validate or support what he was saying? In the early 1980s, Kelley trained other practitioners using manuals that referenced Pottenger’s book *Symptoms of Visceral Disease*.^{46,47,49} While he reported having read articles from the 1920s and 1930s, he did not provide citations, and he did not mention Pottenger’s textbook section, which was far more thorough on this topic than *Symptoms of Visceral Disease*.¹⁵

Kelley relied on extensive clinical experience, using anecdotes about his treatment to illustrate his principles. However, most of the conclusions Kelley drew about the effect of diet and supplements on autonomic physiology were drawn before him. Since then, more research has produced findings that support his theories.

(i) Autonomic Tone and Illness

Observations in Eppinger and Hess’ book, *Vagotonia*, that correspond with Kelley’s theories include:

Carcinomatosis was seen in patients with an overactive sympathetic system.

Vagotonics had an overactive immune system: “It is remarkable that we often find some evidence of a persistence [sic] thymus. Many vagotonics are of lymphatic constitution, as shown by the enlarged tonsils, large lingual follicles, as well as the solitary lymph nodes of the tongue, and by the condition of the lymphatic apparatus of the conjunctiva.”¹⁰

Both Zondek and Kelley described serum sickness, hay fever, urticaria, and asthma as vagotonic conditions.¹² A 1997 article concluded that asthmatics tend to have an

Figure 1. Effects of diet, calcium, magnesium, and potassium on autonomic balance

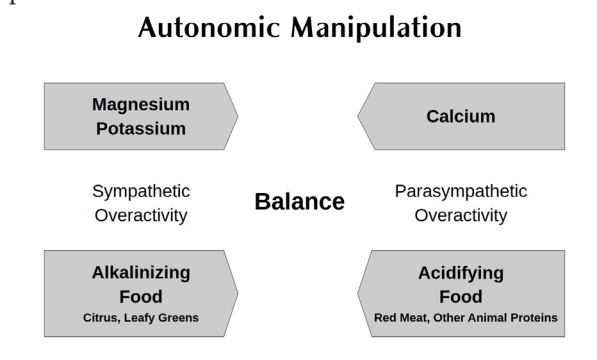


Table 1. Trace minerals and vitamins would affect autonomic balance

Beneficial for Sympathetic Dominant	Beneficial for Parasympathetic Dominant
Magnesium	Calcium
Potassium	Phosphorus
Chromium	Zinc
Manganese	Calcium Ascorbate
Niacin	Niacinamide
Sodium Ascorbate	Pantothenic Acid
Vitamin B1	Vitamin A
Vitamin B6	Vitamin B12
	Vitamin E

overactive parasympathetic system,⁵⁰ while a 2007 article found that patients with allergic rhinitis were hypoadrenergic.⁵¹

In Kelley’s model, both allergies and hematological malignancies are more common in patients with an overactive parasympathetic system, due to overstimulation of the immune system. A 2013 article described an association between these two disorders.⁵²

Kelley believed that parasympathetic overactivity would make carcinomas less likely. Interestingly, a 2023 article found that allergies were associated with a decreased risk of gastrointestinal cancers.⁵³

In the more recent medical literature, three articles report that the sympathetic nervous system stimulates breast and prostate cancer, aligning with Kelley’s view that those with an overactive sympathetic system are prone to carcinomas.⁵⁴⁻⁵⁶

(ii) Electrolytes

Kelley’s comments about the roles of potassium, calcium, and magnesium match those in Zondek’s *Die Elektrolyte*.¹² Zondek, while discussing clinical roles for calcium, mentioned that calcium counteracts histamine and that calcium administration could be useful for vagotonic conditions. Kelley concurred with the usefulness of calcium supplementation in these conditions.

In addition to the Gellhorn article from the 1940s mentioned above, a 1999 article showed that magnesium-depleted rats developed a hypersensitive sympathetic nervous system.^{16,57} A 2021 systematic review and meta-

analysis of the use of intravenous magnesium sulfate during laparoscopic surgery confirmed that it blunts the sympathetic nervous system response.⁵⁸ A 2004 article described how magnesium inhibits norepinephrine release at sympathetic nerve endings.⁵⁹

In a 2012 publication, Kim et al reported that low serum magnesium and high serum calcium correlated with low heart rate variability, suggesting that magnesium suppresses and calcium stimulates sympathetic activity.⁶⁰

As for calcium supplementation, some studies have shown an association with increased cardiovascular events, while others have not.^{2,3,61} In the introduction of the publication of one of the negative studies, the authors commented:

*Most previous studies examining associations of calcium supplementation with negative CVD outcomes have focused on predominantly European populations. ... MESA is a community-based cohort study ... which recruited men and women aged 45-84 from four major race/ethnicity groups from six different locations in the United States.*³

In Kelley's model, calcium supplementation would be deleterious in individuals with high sympathetic tone, neutral in those with a balanced autonomic nervous system, and beneficial in those who were excessively vagal. The model predicts variation depending on the populations studied.

(iii) Diet

Eppinger and Hess commented that for vagotonics, "a diet almost exclusively made up of carbohydrates is very poorly borne."¹⁰ Kelley also advised such patients to minimize carbohydrates in the diet. Pottenger recommended an acid-forming diet for patients with vagotonia, because "lessened alkalinity accompanies sympathetic action. This may be done by a high protein high fat diet."⁴⁹ This again matches Kelley's recommendations.

More recently, two studies have demonstrated that initiation of the ketogenic diet was followed by a decrease in heart rate variability, indicating an increase in sympathetic tone, supporting Kelley's theory about the effect of an acid-forming diet.^{62,63}

My Clinical Experience

In the 1980s, my colleague, Nicholas J. Gonzalez, reviewed Kelley's clinical records and assembled a manuscript describing 50 cancer patients who had extraordinary outcomes under Kelley's care.⁵ Gonzalez also took part in Kelley's training seminars and exhaustively reviewed the manuals Kelley provided.

I met Gonzalez towards the end of his investigation of Kelley's results. As mentioned above, Kelley presented his theories about the autonomic nervous system, diet, and electrolytes, as based on his own observations. Gonzalez and I were willing to accept Kelley's premises because of

the remarkable results in his files. However, Kelley's failure to properly acknowledge his predecessors and their experimental results in his discussions of the autonomic nervous system led to some unnecessary criticisms. As an example, one reviewer, in a 2002 article about the history of complementary and alternative medicine for cancer treatment, commented:

*Kelley drew on prescientific ideas of human differences. However, his theory of human typing was also extrapolated from general knowledge about the autonomic nervous system, so it was an odd hybrid of scientific and folk racial theory.*⁶⁴

In the late 1980s, the relationship between Kelley and Gonzalez deteriorated, and they went their separate ways in 1987.⁵ Gonzalez began to see patients, with the goal of reproducing Kelley's methods and results. I joined him in practice after completing my medical residency.

Before treating patients, we needed to decide which forms of the various electrolytes to supplement. Different salts of these minerals would have different effects on acid-base metabolism. For example, citrates would be alkalinizing, while carbonates would potentially be more neutral.^{65,66}

Kelley's training materials and the catalog of supplements he used in the mid-1980s did not specify which anions of magnesium, potassium, and calcium he used.^{46,47,67} As an example from the catalog, the product K-COM contains 99 mg of Potassium: "In a base specially formulated to complement metabolic type concepts, containing trace mineral in specific proportions. **Acetates, Ascorbates, Bicarbonates, Carbonates, Chlorides, Citrates, Gluconates, Lactates, Oxides, or Propinates [sic] as mineral sources."⁶⁷

Gonzalez and I chose different forms of magnesium, potassium, and calcium, depending on the patient's autonomic state. A sympathetic-dominant individual would take magnesium citrate, while those with an overactive parasympathetic system would be given large amounts of calcium carbonate. Patients with a more balanced metabolism would be on a mixture of magnesium, potassium, and calcium, both citrates and carbonates.

My clinical experience applying Kelley's model has been very positive. As an example, two of my patients, whose histories were both included in a 2007 case report series, were on different diets and supplement protocols.⁶⁸ One was diagnosed with biopsy-proven cancer of the exocrine pancreas in early 2001, receiving no conventional treatment such as surgery, radiation, or chemotherapy. She died in late 2023, from complications after hip surgery, but her 23-year survival was remarkable. She adopted a diet and supplement protocol for a sympathetic-dominant patient, with minimal animal protein, along with 1000 mg of magnesium (as citrate), 150 mg of potassium (as citrate), and 150 mg of calcium (as phosphate) daily.

Another patient, diagnosed with follicular lymphoma in 1995, was classified as parasympathetic-dominant. He was told to minimize carbohydrates but to eat as much

animal protein as he wanted. He took around 50 mg of magnesium (as carbonate), 30 mg of potassium (as the salt of para-aminobenzoic acid), and 1400 mg of calcium (in different forms, but mostly as carbonate) daily. He has never received conventional therapy and has had several CT scans that show complete resolution of the disease. His 30-year remission is also remarkable, and he is currently in robust health.

These patients also took large amounts of a pancreas glandular product and performed various routines designed to help the body process wastes.^{69,70} Their diets and mineral supplementation were different, but their outcomes were both excellent.

Assessing Autonomic Tone

As clinicians, we wish to know how best to determine autonomic balance to advise people on the diet and supplements most aligned to their needs. Researchers in the early to mid-1900s used pharmacologic methods and reflexes, as described above, with caveats. Losse et al used various physiologic measurements, which might or might not be practical today.^{20,21}

In the psychological literature, various investigators studied whether autonomic tone corresponds with personality characteristics.^{18,25,71} In the 1970s and 1980s, Kelley employed a computerized method that analyzed results from elaborate questionnaires about personality characteristics, dietary choices and preferences, and laboratory work. His observations regarding blood chemistry were included in his training manual (see Table 2).

A 1977 book, *Dr. Kelley's Self Test for the Different Metabolic Types*, included questions about personality characteristics as well as physical symptoms.⁷² Kelley believed that people with an overactive sympathetic system were energetic, focused on facts rather than relationships, easily angered, anxious, and driven. Those with an overactive parasympathetic system were more cautious, intuitive, agreeable, relaxed, and, if not functioning well, apathetic and depressed.

Over the years, I have seen patients who have used *Dr. Kelley's Self Test*. The results they got did not always match my impressions or what I would have expected with their cancer diagnoses. Patients with carcinomas, usually a condition of sympathetic-dominance, would argue that *Dr. Kelley's Self Test* said they were balanced. I speculate that they did not answer the personality questions accurately. Sympathetic-dominants are typically decisive, determined, and sure that they are right, much like a person in sympathetic overdrive, responding to an emergency, moving quickly, and heeding no advice. In the 1970s, when Kelley created the *Self Test*, these characteristics were more socially acceptable. Current seekers of alternative medicine are told that a more peaceful approach to life is desirable. Therefore, to look more like the ideal, patients misrepresent themselves, and the *Self Test* is no longer accurate.

Table 2. Dr. Kelley's blood chemistry observations

Test	Sympathetic	Parasympathetic
CO2	Lower	Higher
Calcium	Lower	Higher
Potassium	Lower	Higher
Sodium	Higher	Lower
Chloride	Higher	Lower
Glucose	Higher	Lower
Phosphorus	Higher	Lower
WBC	Higher	Lower
Eosinophils	<2%	>2%

According to a 2024 book by Eric Wood and Pamela McDougale, later in Kelley's career, he advocated starting all patients on the same diet, which can be summarized as lacto-ovo-vegetarian. After six months, he recommended assessment and modifications as needed.⁷³ The diet Wood and McDougale describe in their book is suitable for cancer patients who have an overactive sympathetic system. While this course would be best for most cancer patients, many people would be dreaming of steak after a few weeks or months.

My own approach is informed by extensive clinical experience, but there is always an adjustment needed. This is especially true if patients have been on an extreme diet that affects metabolism, whether it be vegan, ketogenic, or carnivore. It can take some time to sort out the long-term plan.

Returning to the questions raised in the introduction: Why would calcium in some studies correlate with an increased rate of cardiac events, and in other studies show no such association? Adverse events would be observable in a population with a higher proportion of sympathetic-dominants, because calcium would stimulate the already overactive sympathetic system. However, if the population studied comprised a larger number of balanced and parasympathetic-dominant patients, then no effect or a small benefit would likely be seen. Calcium supplementation is valuable for some people but not for others.

How could this model explain the increase in autoimmune disorders? Dinse et al evaluated stored serum samples from three periods: 1988-1991, 1999-2004, and 2011-2012.¹ They found that serum anti-nuclear antibodies, a marker of autoimmunity, increased over that time. Over these decades, I believe that three changes in diet and supplementation have occurred:

- (a) Decrease in calcium supplementation
- (b) Increase in magnesium supplementation
- (c) Decrease in consumption of red meat

All these changes move metabolism towards the parasympathetic side. An overactive parasympathetic system, in Kelley's model, causes overstimulation of the immune system and autoimmune disorders.

Finally, why are wildly divergent diets each being promoted as the secret to health for all humans? What benefits some will not benefit others. Most practitioners

advocate for the diet that works well for themselves. They see some of their patients do well on that diet because those patients continue to seek their care. Those who do not do well will simply find a new doctor. Practitioners can blame the lack of success on poor adherence.

The effects of diet and supplements on the autonomic nervous system can provide a theoretical framework to help practitioners recognize why patients might not do well with a particular set of recommendations. Much of the population has a slightly or strongly overactive sympathetic nervous system. They will do well on a diet light in animal protein, along with large amounts of magnesium and potassium. However, some people, more parasympathetic by nature, will not tolerate this. And with time, many of those who initially benefited will become fatigued and foggy, as their metabolism shifts further into parasympathetic dominance.

In his practice, Kelley initially advised everyone to eat the same ovo-vegetarian diet and take the same supplements that were beneficial for him. But when the woman who would eventually become his wife developed worsening allergies and fatigue while following his advice, he changed his recommendations—and she recovered.⁴⁶ That led him to rediscover and refine the model in this article. I have found it immensely helpful, both for myself and as I guide patients to improve their health.

Of course, there is enormous room for refinement and clarification. Newer methods of testing, such as genomics and microbiome assessment, may prove useful in determining autonomic predispositions and imbalances. I hope this article will inspire other investigators to study this further.

Author Disclosure Statement

No conflicts of interest to declare.

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