The Salt/Sodium Sham

"One may seek less after gold, but there is no one who does not wish to find salt."[1]

Cassiodorus, written AD 537/538

SALT and Sodium

Salt is always in the news. We hear about it and read about it all the time. And everyone has an opinion about it, although those opinions are typically not too helpful. In the end, the whole debate about what is a proper amount of dietary salt and sodium is very confusing.

The purpose of this "deep dive" research paper is two-fold: First, I want to help you understand the competing arguments in the debate. Second, I'll distill from those arguments what I have determined are the most salient scientifically supported conclusions to help you find value in my own research.

In the end, according to my wide-ranging research, there are some clear principles to understand and some simple concrete steps you can take to ensure you're using best health practices. In fact, the conclusions to all the research have led me to firmly conclude that, like so many other matters in the area of proper nutrition, much of it is "YOU" dependent.

We are going to address some fundamental questions about salt, including the following:

1. What is it? (pages 1-2)
2. What are different sources of salt, and is there a best source? (pages 2-4)
3. What are its benefits to human health? (pages 4, 12-20)
4. Why does the US Government regulate sodium? (pages 4-16)
5. What you should know about the recommended daily amounts published by the FDA? (pages 4-16)
6. I lead a very active lifestyle; how much sodium do I need? (pages 12-19)
7. What about the sodium in ELEMENTS MEALS? Is it a healthy amount? (pages 19-21)

Let's start with Salt … and what it is.

There are many kinds and sources of salt.[2] We'll address a few of the most relevant kinds and sources as they relate consumption rates and human health.[3]

Not all salts are created equal.

Table salt

Table salt is often referred to as an ionic chemical compound composed of two groups of oppositely charged ions: sodium and chloride: It's 97 percent to 99 percent sodium chloride.[4] It is made of one metal ion (sodium) and one non-metal ion (chloride). Your body needs both ions to function and produces neither, so you must get them from your food.

Contrary to popular belief, table salt is not just sodium chloride.

Table salt also contains additives[5] that are designed to make it more free-flowing . . .and dangerous: Ferrocyanide,[6] talc,[7] and silica aluminate[8] are often included in the "refining" process. Although "safely regulated" by the FDA, aluminum intake leads to neurological disorders, particularly when no selenium is provided to help the body to chelate it.[9] Aluminum bio-accumulates inside the body, causing further degeneration over time. Talc is a known carcinogen, though its effects upon ingestion have not been heavily studied. While it was once used in baby powders, most of these kinds of products now use cornstarch instead of talc, because of the known health risks. In fact, the FDA has a special provision to allow talc in table salt, even though it's prohibited in all other foods, because of its toxicity. According to current regulations, table salt can be up to 2% talc.[10]

Iodine is often added to refined salt in a public health preventive measure against iodine deficiency. A lack of iodine is the leading cause of hypothyroidism, mental retardation, autism, depression and anxiety. However, the amount of iodine added to refined salt is often insufficient to address these low-iodine health issues.[11]

Table salt sources.

"One of the main sources of table salt is the mineral halite or rock salt. Halite is mined. The minerals in mined salt give it a chemical composition and flavor unique to its origin. Rock salt commonly is purified, since halite occurs with other minerals, including some that are considered toxic."[12] Other chemicals that occur in refined rock sourced salt are man-made, and the list of possible additives and contaminants is a long and dangerous one.[13]

Rock Salt.

Unprocessed rock salt, such as pink Himalayan salt, generally has a lower sodium chloride-to-sodium ratio (which is very good) . . . along the range 74% sodium chloride and 22% pure sodium. The remainder is naturally occurring trace minerals your body also needs, including phosphorus and vanadium.

While there are other types of salt (sodium chemically bound not only with chloride but other minerals as well, e.g. calcium, magnesium, iron, potassium), this is the type we put in and on our food. In fact, it's one of the key ingredients in processed foods that helps them taste good . . . and salt is one of the ingredients that makes processed foods so darned unhealthy.[14] In the ultimate heart-health irony, low sodium products often contain monosodium glutamate, a sodium-based excitotoxin that causes heart attacks in people who do not have enough magnesium (from organic vegetables and sea salt).

Sea salts.

Sea salt naturally contains selenium, which helps to chelate toxic heavy metals from the body. It also contains boron which helps prevent osteoporosis, and chromium which regulates blood sugar levels. Sea salt is one of the few sources for safe copper ingestion, and copper helps the body to form new arteries whenever the main arteries become too clogged. Small quantities of sea salt will actually ***lower*** the blood pressure of most individuals, because it provides the trace minerals that aid with blood pressure regulation.[15] It can only stabilize the blood pressure when the industry-depleted salts are removed from the diet. Mineral deficiencies are partly responsible for the rising obesity epidemic. Obese people are invariably malnourished, and their bodies are starving, because regardless of how much they eat, they are not getting the minerals and nutrients that they need. The processed table salts and conventionally grown produce are a big part of the problems.[16] However, scientific studies have found that most retail "sea salt" is adulterated with non-visible micro-plastics.[17] [18] So, bear this in mind when choosing your salt source.[19] Still, sea salts generally have a very positive trace mineral profile.

Salt from fresh mineral streams

There are only a few naturally occurring pure, artesian mineral springs in the world that carry sodium and companion minerals in pure form, without any contaminants. The only natural spring of this kind in North America is found in Star Valley, Wyoming, in the Bridger Teton Forest. This artesian mineral spring rises 400 feet through prehistoric untouched sea deposits. Pristine water becomes pure sea water. Arriving in mineral pools, a salt producer named Yellowstone Salt,[20] uses only wood tools and the evaporative process to provide the purest organic salt on the planet. This is the salt Elements uses in its meals. It is the purest salt on planet earth, bar none. In addition to sodium, the salt Elements uses in its meals contains other health promoting minerals such as calcium, magnesium and potassium, along with many other trace minerals necessary for cell reproduction.

While Elements relies primarily on the naturally occurring sodium inherent in our whole food ingredients, when we do add a tiny pinch of salt to our meals, we use only Yellowstone Salt.

Compare.

So, let's compare the salts we've covered and see how they measure up, excluding the pure, mineral stream sourced Yellowstone Salt (because it is unquestionably the best salt on earth … seriously): Refined Table Salt, Maldon Salt (a common sea salt), Himalayan Salt, and Celtic (or

Grey) Salt. See the table below.[21] While this comparison may not be comprehensively dispositive about what salt is best, among these four specific salts, the best choice would be the Himalayan . . . because of its higher ratios of other trace minerals, particularly potassium.[22]

	Calcium	Potassium	Magnesium	Iron	Sodium
Table Salt	0.03%	0.09%	<0.01%	<0.01%	39.1%
Maldon Salt	0.16%	0.08%	0.05%	<0.01%	38.3%
Himalayan Salt	0.16%	0.28%	0.1%	0.004%	36.8%
Celtic Salt	0.17%	0.16%	0.3%	0.014%	33.8%

Invisible contaminants.

Not only is salt (and lots of it) in most processed foods, it is itself heavily processed,[23] and is filled with contaminants. Those contaminants include explosive residues, which occur through the mining process, micro-plastics which are ubiquitously found throughout our oceans, as well as agricultural chemicals, such as nitrogen, which enter U.S. water systems through agricultural run-off. When you choose the salt you to add to your food, also be aware of what other things are lurking among those white, pink, gray, crystals.

Choose your salt wisely!

Why is salt important to human health?

Salt, and more specifically, **sodium chloride,** is critical for many physiological functions, including: maintaining body water balance, regulating blood pressure, helping your brain communicate with your muscles (nerve impulse transmission), supporting the function of your adrenal glands, absorption of nutrients in the gut, and muscle contraction.[24] Salt's ionic mixture is "responsible for the fluid balance of the bodies of all living creatures. The human body is reckoned to contain about .04% sodium chloride, which means that a person weighing 50 kg would have some 200 g of common salt in the solution in the body – a surprisingly large amount if one imagines it as dry salt."[25] And this must be replaced since the body continually uses and excretes it from the body.

Salt goes to Washington

The U.S. departments of Agriculture (USDA), Health and Human Services (HHS) and Food and Drug Administation (FDA) produce and push the government's public policy regarding sodium.

In 1982, the FDA decided to pursue a public policy of U.S. population-wide salt reduction. One of its strongest please came in the cover story of Time magazine.[26] While the FDA issues guidelines to companies regarding the sodium content in food, it does not regulate those amounts.[27] In fact, the USDA and HSS regulate sodium policy, including the publication of sodium amounts contained in processed "foods," as well as recommended daily sodium intake.[28] The FDA advocates those departments' guidelines, i.e. **the Dietary Guidelines for Americans**,[29] revisions of which are released every five years.

In 2015, the USDA stated that Americans consume an average of 3,400 mg[30] of sodium per day, allegedly more than twice as much as the body requires.[31]

The Centers for Disease Control and Prevention (CDC), yet another federal government agency, says that *9 out of 10 U.S. adults* get too much sodium every day.[32] However, the USDA/FDA policy position, though clear, may not be grounded in sound science. In fact, recent studies raise the question about why the US government is involved in trying to control sodium consumption through a multi-generational public policy?

The USDA claims that 3,400mg/day of sodium is "an excessive amount that raises blood pressure and poses health risks."[33] The government also states that some Americans should limit daily sodium consumption to 1,500mg, specifically; "people aged 51 and older,[34] and anyone with high blood pressure, diabetes, and chronic kidney disease, and African Americans."[35] Moreover, the USDA additionally states that even active people require no more than 1,500 mg of sodium per day. In 2012, CDC Director Thomas R. Frieden, M.D., M.P.H., opined: "Too much sodium raises blood pressure, which is a major risk factor for heart disease and stroke."[36]

Furthermore, the USDA opines that 2,300 mg/day "this is an upper safe limit, *not a recommended daily allowance*."[37] (Emphasis added.)

Query: Why is the US government in the business of dictating sodium consumption anyway?

Have you asked yourself why the USDA and FDA and other US government agencies are involved in dictating daily sodium consumption? To address that question, let's take a look at the "scientific roots" of the government's sodium policy.

History lesson on Government Sodium "Recommendations"

In the late 1930s, Harry Goldblatt, M.D., C.M.,[38] created salt-induced hypertension in rats whose kidney mass had been reduced by five-sixths and then fed excessive sodium.[39] Read that again. Goldblatt created hypertension in rats by reducing their kidney size by five-sixths and feeding them more sodium, by orders of magnitude, than those rats would ever ingest naturally. Can you guess the outcome given these manufactured-extremes: the sodium filter capacity was reduced 800% and the sodium amount increased by 1,000%. Hypertension? Well, that was the outcome. These were the "early science days" on the subject. How this study translated to humans wasn't pursued, but the seeds of the government policy had been planted.

Then, in the mid-1940s, Walter Kempner M.D.[40] used extreme sodium *restriction* in a small cohort of patients with renal failure and pre-existing malignant hypertension. This study served to create the early clinical justification that high salt could induce hypertension and low salt could lower blood pressure. Kempner's work led to several decades of research focusing on the notion that sodium restriction could be used to manage hypertension. This hypothesis was based primarily on an array of *scientific models* in which extreme amounts of salt intake (8–12 times human intake) induced elevated blood pressure.[41] Big surprise!

There is an old saying that poison is usually a question of dosage.

Several decades later, the first randomized clinical trials of sodium restriction in *humans with pre-existing hypertension* were reported. These trials, however, began before the question of whether the blood pressure of a population, or prevalence of hypertension, tracked with salt intake. When completed, the INTERSALT (International Study of Salt) study *failed to document any association of salt intake with either the actual blood pressure of a population or the prevalence of hypertension*.[42] Read that sentence again.

Nevertheless, 167 sodium-restriction randomized clinical trials were subsequently reported.[43] Of these, only a few involved individuals with normal blood pressures. Moreover, virtually all the interventions required participants intaking a range of sodium never documented to be achievable in free-living individuals.[44] And all these forced, unnatural conditions produced *minimal reductions in blood pressure*. Minimal … like less than 1% decrease in blood pressure.

These facts paint a picture of a cure looking for a poison.

Check out this finding from this cited 2012 study – which has been used extensively, and strangely, to support the government's policy of reducing sodium intake among all American. ALL!

> "In conclusion, low- vs. high-sodium diet in Caucasians with normal [blood pressure ("BP")] *decreases BP <1%*. A significant concomitant and persistent increase in plasma renin, plasma aldosterone and to a lesser degree of plasma adrenaline and plasma noradrenaline may contribute to the small effect of sodium reduction on BP. Furthermore, sodium reduction resulted in a significant increase in plasma cholesterol (2.5%) and plasma triglyceride (7%), which expressed in percentage, was numerically larger than the decrease in BP. The increase in triglyceride was numerically unchanged in studies with a duration of at least 2 weeks and in studies with sodium reduction to moderate levels of sodium intake. *Due to the relatively small effects and due to the antagonistic nature of the effects (decrease in BP, increase in hormones and lipids), these results do not support that sodium reduction may have net beneficial effects in a population of Caucasians*. In Caucasians with elevated BP, short-term sodium reduction decreases BP by ~2–2.5%, indicating that sodium reduction may be used as a supplementary treatment for hypertension. In Asians and blacks, the effect of sodium reduction was greater*, but at present too few studies have been carried out to conclude different from that above*."[45]

What the …?

Yes, this authoritative study concludes that lowering sodium had only a small effect on reducing blood pressure while simultaneously significantly increasing plasma triglycerides – an "antagonistic effect," the study called it.

So, sodium reduction produces bad effects in people with normal blood pressure? Then whey the government campaign telling *everyone* to reduce their sodium intake?

USDA/FDA Sodium intake recommendations are based on computer simulations?

Yes. What does this mean? It means that the recommendations are created by something called the Coronary Heart Disease(CHD) Policy Model, among other things. It's a computer simulation of heart disease in U.S> Adults 35 to 84 years old, and an extension of the model that is used to assess stroke. Effects on the U.S. population were "estimated" and based on assumptions that were not evidentially supported by clinical trials.[46]

Government recommendations for reducing sodium intake are based on incorrect assumptions that are the result of computer modeling and not facts based verifiable scientific studies of real people? Yes.

"In a recent paper[47] based on *computer simulations of assumptions on associations between salt intake and BP*, and between BP and mortality, it was concluded that a daily teaspoonful of salt (3 g) was a bigger health risk than cigarette smoking. The sense of this conclusion can be judged by estimating the *lack of accordance of these simulated projected effects with the above-mentioned observed effects in populations*. The reason for this lack of accordance is probably that the authors overestimated the assumed linear relationship between salt intake and BP and ignored the possibility that salt reduction may induce adverse effects. The present meta-analysis indicates that the adverse effect on lipids, especially triglyceride, is not just an acute effect as previously assumed, but may be persistent also in longer-term studies. *Furthermore, reduced sodium intake seems to harm patients with heart insufficiency and diabetes type 1 and 2. In all three patient groups reduced sodium intake is associated with increased mortality*."[48]

Wrong direction: "In all three patient groups *reduced sodium intake* is associated with *increased mortality*."

Query: What could be the purpose of the government trying to regulate the consumption rate of a "killer" (sodium) when the truth is that it poses no threat to begin with?

Now the other side of the coin: The U.S. government's case.

Diseases linked[49] to sodium over-consumption kill more than 800,000 Americans a year.[50]

In 2008, the FDA's Frieden stated that the **"[heart disease and stroke] kill more than 800,000 [51] Americans each year and contribute an estimated $273 billion in**

health care costs."[52] Those are enormous numbers! Someone is making a lot of money. But what about now, in 2018?

Globally, more than 1.65 million deaths from cardiovascular disease each year can be *attributed* to sodium over-consumption.[53]

"'That's remarkably high, that's almost 1 in 10 of all cardiovascular deaths around the world,'" Dariush Mozaffarian, a study author and dean of the Friedman School of Nutrition Science and Policy at Tufts University [stated]. "'This suggests that a single factor in the diet [sodium] ***could be* contributing** to almost 10 percent of the cardiovascular burden.'"[54] These numbers should be sounding epidemic warnings around the globe, with actions to match. But what is really happening?

Key words: "COULD BE CONTRIBUTING"

consider InterSalt again: Revisit those paragraphs above.

Government's side continued…

Assuming the U.S. government's case has some scientific teeth in it, we need to ask if the FDA's claims about sodium-overconsumption infer a degree of severity that deserves more serious attention. For example, is the alleged sodium over-consumption more lethal than the opioid epidemic?

How about some context? Let's compare the 800,000+ deaths in the USA, to which allegedly sodium contributes, to the following numbers of deaths in the USA, by cause, in 2016:

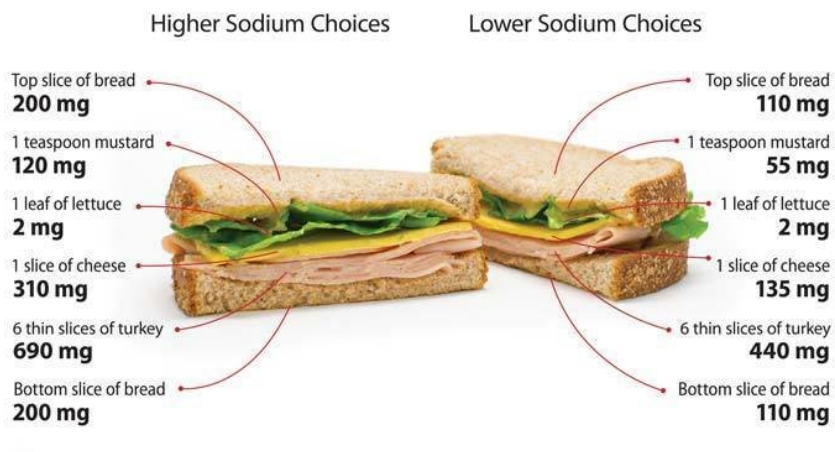
> Car accidents -- 37,461[55]
> Opioids -- 42,249[56]
> Heroin – 13,219[57]
> Gun shot -- 38,658 (including homicide, suicide (highest cause), accidental and intention-unknown)[58]
> Cancer – 595,690[59]

Well, those five numbers provide some context to the sodium debate. Right? Right? According to these numbers as reported by the CDC, the alleged sodium over-consumption contributed to more deaths in the US than cancer, gun shots, heroin, opioids and car accidents . . . *combined*.

THE $67,000 QUESTION: What's the major source of sodium in the American diet?

Most of the sodium in the American diet comes from two main sources: **restaurant food and highly processed, packaged edible products sold in grocery stores**.[60] In short, to a significant degree, this source of sodium is somewhat non-elective . . . because it's ubiquitous, i.e. it's in 95% of the items in grocery stores. You can't get away from it . . . unless you eat fresh, whole food. In fact, according to a 2012 CDC report, more than 40% of daily sodium intake came from the following 11 types of foods: pizza, bread, cold cuts and cured meats, soups, burgers, cheese, pasta dishes, meat mixed dishes like meat loaf with tomato sauce, snacks like chips, pretzels, and popcorn. Some of these types of foods are consumed several times a day.[61]

The illustration below demonstrates how common types of highly-processed edible products ("Phood") we eat sneak large amount of sodium into our bodies.[62]



This illustration demonstrates that a single, "healthy" turkey sandwich can easily include the FDA's recommended daily sodium allowance . . . a single sandwich!

The USDA is seeking to work with large edible-products manufacturers (such as General Mills, Kellogg's, Nabisco, Kraft Foods) and restaurants, to reduce sodium content in their respective products. The CDC supports the USDA's efforts.[63]

In 2012, Dr. Thomas R. Frieden, M.D., CDC Director, stated, "We're encouraged that some food manufacturers are already taking steps to reduce sodium. . . . Kraft Foods has committed to an average 10 percent reduction of sodium in their products over a two year period, and dozens of companies have joined a national initiative to reduce sodium. The leading supplier of cheese for pizza, Leprino Foods, is actively working on providing customers and consumers with healthier options. We are confident that more manufacturers will do the same."[64]

10% reduction over two years? That's effective change? That's progress? One would think that if over-consumption of sodium is killing 1.6 million people a year, maybe a little more effort is warranted.

Just how much is 1,500 milligrams of sodium?

Here are the approximate amounts of sodium in a given amount of refined table salt:[65]

- 1/4 teaspoon salt = 575 mg sodium
- 1/2 teaspoon salt = 1,150 mg sodium
- 3/4 teaspoon salt = 1,725 mg sodium
- 1 teaspoon salt = 2,300 mg sodium

As you can see, ingesting more than 1,500 mg of sodium per day is easy: it's only about 2/3 of a teaspoon of salt. The calculus you can use to determine the amount of sodium you're ingesting if you're measuring that amount based on the amount of sodium chloride (table salt) you're ingesting, is a multiple of 2.5.[66] This is useful to know since the super-majority of sodium consumed in Americans is added to the edible products ("Phood") they eat.[67] In fact, only small amounts of sodium, relatively speaking, occurs naturally in food. "Instead, sodium is added to make certain foods shelf stable, and it is ubiquitously used in the US food supply such that all food groups contribute to sodium intake levels."[68]

Is the USDA's recommendation of daily sodium consumption accurate and comprehensive?

Asked another way, according to the US government, what is the adequate intake for sodium of any given person, since people vary in manifold ways?[69]

This question begs another, more important question: Can, or should, dietary sodium even be determined by government policy?[70]

The answer to this question may begin with analyses of these facts: In 2004, the Food and Nutrition Board of the US Institute of Medicine (IOM) established an adequate intake for sodium and sodium chloride (salt) based on three criteria: (1) the amount needed to replace *normal losses* of sodium (through the skin, feces, and urine); (2) in *moderately active people*, and (3) *to achieve a diet that provides sufficient amounts of other essential nutrients*.[71] (See the discussion below at footnotes 98 through 104.) These recommended AI levels are below the average dietary intakes of most people in the United States.[72] Hence, the perennial government drumbeat for *all* Americans to lower the sodium consumption. The table below[73] attempts to set sodium intake levels for people by age only: such levels do not include genetics, specific diet, prescription medications, unhealthy practices (like tobacco and alcohol use), exercise frequency and duration, and more.

Table 2. Adequate Intake (AI) for Sodium and Sodium Chloride (Salt)

Life Stage	Age	Males and Females Sodium (g/day)	Males and Females Salt (g/day)*
Infants	0-6 months	0.12	0.30
Infants	7-12 months	0.37	0.93
Children	1-3 years	1.0	2.5

Children	4-8 years	1.2	3.0
Children	9-13 years	1.5	3.8
Adolescents	14-18 years	1.5	3.8
Adults	19-50 years	1.5	3.8
Adults	51-70 years	1.3	3.3
Adults	71 years and older	1.2	3.0
Pregnancy	14-50 years	1.5	3.8
Breast-feeding	14-50 years	1.5	3.8

In 1982, early advocates of sodium restriction began to call for a public health policy of a *population-wide* salt reduction . . . even though the evidence to support such a policy was lacking. The computer modeling was used to extrapolate these decisions, even though such modeling was based on "wide-ranging assumptions that hid or ignored data regarding potentially serious feasibility and health consequences." [74] In fact, that computer modeling "failed consistently to incorporate the published data that documents the adverse health outcomes associated with reduced sodium intake. In addition, [the modeling assumptions] routinely ignored published data on normal sodium intake and the neuroscience data that provided the biologic mechanisms supporting that intake was a physiologically set variable."[75]

Unsupported assumptions of USDA/FDA Sodium Policy

The unsupported assumptions upon which INTERSALT and the government's sodium-reduction policy rely include the following: (1) that current sodium intake levels are excessive; (2) that "unhealthy ranges" of sodium intake must be below current intake levels; (3) that sodium intake can be substantially reduced by public policy; (4) that human intake is dictated by the sodium content of the food supply; and (5) that, unlike all other essential nutrients in which a healthy range is defined by a Gaussian distribution,[76] lower sodium intake is always better.[77]

The assertion that the national policy regarding sodium intake is not founded on solid science is certainly concerning. Moreover, that assertion is premised on solid scientific methodologies without investment in the outcomes. The purpose here is not to try to infer some meaning or malintent being practiced by the USDA and FDA, or any other government agency. Nor is it this author's purpose to try to "mind read" the phalanx of scientists who have both made, and waded into, this fray.

The point here is this: There is a fray. Denying this fact would serve one party only … ignorance.

David Mccarron squared-up the policy/physiology argument this way:

> "The simplest answer as to whether public policy can change sodium intake is the American experience. Since the mid-1980s, the U.S. sodium-and-health policy focused on reducing salt intake, particularly in individuals at risk of cardiovascular disease. In the past decade, the effort was much broader, i.e., the entire population. However, sodium intake has not changed, despite the extensive public messaging effort, food labeling, and reformulation or introduction of hundreds of lower-sodium food products. Advocates of sodium restriction routinely and aggressively argued that the failure of the policy is the fault of the food industry. The more likely explanation is simply that public policy cannot change sodium intake because *intake is set by human physiology*. . . .
>
> "Setting aside the vehement objections to this synthesis of the scientific data by government agencies, such as the CDC and FDA, as well as major advocacy groups, such as the AHA (American Heart Association) and CSPI (Center for Science in the Public Interest), the sodium and health policy of our nation should no longer be based on decades-old assumptions and computer models based upon them but rather on proven, up-to-date science as articulated in the 2013 IOM Report on Sodium Intake in Populations[78] and recently validated in numerous publications. . . . 'The results argue against reduction of dietary sodium as an isolated public health recommendation.'"[79]

Salt and human health – and the physiological regulation of sodium

Buckle up. More geek-mode jazz.

Let's begin by addressing, in brief, some of the functions that sodium performs in the human body. First, it's an essential nutrient involved in the maintenance of normal cellular homeostasis and in the regulation of fluid and electrolyte balance and blood pressure. Its role is also crucial for maintaining extracellular fluid volumes because of its important osmotic action. It is also equally important for the excitability of muscle and nerve cells and for the transport of nutrients and substrates, e.g. phosphates, amino acids, glucose, and galactose, through plasma membranes.[80] As a point of final interest, the half-life of sodium turnover in humans, measured by urine sodium excretion, is approximately 1.5-3 days.[81]

Now, let's put salt/sodium chloride in real context . . . the human body. Did you know that the adult male body has a mean sodium content of 92 grams?[82] This bulk amount is distributed in three staging areas of the body. First, half of it, or (46 g), is located in the body's extracellular fluid at a concentration of 135–145 mmol/L. Another 11 g is found in the *intracellular* fluid at the concentration of approximately 10 mmol/L. Finally, about 35 g is found in the skeleton. The concentration gradient between the extracellular fluid and intracellular fluid is maintained by the sodium–potassium pump activity. This "activity" transfers sodium and potassium, respectively, from inside to outside the cell and vice versa against the concentration gradient, using the energy supplied by ATP.[83]

Sodium absorption occurs almost quantitatively in the distal small bowel and the colon.[84] In the polarized cells of the intestinal wall (the renal tubular epithelium), sodium enters the cell from the tubular lumen--or from the gut--through specific channels or other transport mechanisms. It is then extruded by the pump's action from the cell into the adjacent capillaries, which is mainly distributed on the basolateral sides of the cell. In these cells, sodium transport is mostly associated the transport of other "substrates," e.g., phosphates, amino acids, glucose, and galactose.

The body's sodium balance is closely linked to that of water. It's maintained with remarkable finesse by the kidneys. Sodium filtered by the kidney's glomeruli is reabsorbed in a proportion ranging from 0.5% to 10% according to the needs at the tubular level, in which an orchestra of angiotensin II, norepinephrine, aldosterone, and insulin stimulate reabsorption. Simultaneously, dopamine, cAMP, the cardiac natriuretic peptides, and prostaglandins exert a natriuretic effect.[85] Generally, we lose small amounts of sodium through feces and sweat; these losses increase with increasing sodium intake, although part of them are obligatory.[86]

As you see, sodium is fundamental to the complex of human functions, i.e. neurological, circulatory, digestive, nutritional distribution, and so much more. And yet, it's a single micronutrient. Cell replication and body functions require dozens and dozens of other micronutrients. How does sodium play in that mix?

Sodium appetite.

This is a real term. In a research study titled "Central Regulation of Sodium Appetite,"[87]

Trace minerals, including potassium

There is significant scientific evidence supporting the conclusion that the **trace minerals occurring together with sodium chloride (salt) are critical to the health aspects of sodium**.[88] In fact, one study of nearly 2,000 elderly people showed a decrease in mortality caused by cardiovascular disease when a switch was made from regular salt to **potassium-enriched salt**.[89] Potassium[90] levels are naturally high in vegetables and fruits, and sodium levels in those same foods are naturally low. Of course, none of these foods bear the nutritional charts required by the USDA/FDA on processed foods. And more to the point, those FDA nutritional labels identify, at most, 12 trace minerals, or micronutrients. The FDA has recommended daily intakes for these 12 minerals (calcium, iron, phosphorous, iodine, magnesium, zinc, selenium, copper, manganese, chromium, molybdenum and chloride). Sodium and potassium are treated separately. But there are at least 42 other minerals in our bodies that you'd find quite easily on the periodic table.[91] What about those? "[It] may be due to the fact that a biochemical function has not been defined by experimental evidence," said Victoria Drake from the Linus Pauling Institute at Oregon State University.[92]

These trace elements come primarily from vegetables. Unfortunately, Western diets, which are generally low in fruits and vegetables, have low potassium intake. . . . Consumption of white vegetables is *associated* with decreased risk of stroke, *possibly* related to their high potassium content.[93] There is research that associates potassium-to-sodium intake ratios are more strongly related to cardiovascular disease risk than either nutrient alone.[94]

Currently, Nutrition Facts labels are not required to list the potassium content of foods. But often foods that are highest in potassium are those that don't carry a label: Good sources include vegetables and fruits, especially leafy green vegetables (spinach, collards, and the like), orange and white vegetables (sweet potato, winter squash, cauliflower), and citrus fruits (oranges and grapefruits), as well as dried beans.

A recent study finds that low sodium is a greater risk to cardiovascular health.

In July 2016, The Lancet published a study which found the following: "Compared with moderate sodium intake, high sodium intake is associated with an increased risk of cardiovascular events and death in hypertensive populations, **while the association of low sodium intake with increased risk of cardiovascular events and death is observed in those with or without hypertension**. These data suggest that lowering sodium intake is best targeted at populations with hypertension who consume high sodium diets."[95] In short, low sodium intake is also associated with negative cardiovascular events and death.

Another study reached these conclusions: "Several epidemiologic studies suggested that higher sodium *and lower* potassium intakes were *associated with*[96] increased risk of cardiovascular diseases (CVD). Few studies have examined joint effects of dietary sodium and potassium intake on risk of mortality."[97] (Emphasis added.) So, do the "daily allowances" apply to you if you lead an active lifestyle involving regular training?

Query: If you exercise regularly, do the USDA recommended sodium daily allowances still apply to you?

Because sweat/sodium losses are individualistic, any generic guidelines on the replacement of sodium and fluid should always viewed with caution and healthy skepticism. You're going to lose sodium in three ways: through sweat and your bodies liquid and solid excretions.[98] Whether you exercise or are sedentary matters … it affects how your body processes and rids itself of sodium – which it has to do. In fact, in sedentary individuals, almost all dietary sodium intake is excreted by natriuresis, i.e. urination.[99] Want to move your sodium more efficiently and healthily? Move around! In fact, research has proven that when an additional sodium excretion path, like sweat, is introduced to a sedentary body, the average plasma soidum concentration, and hence natriuresis, decrease.[100]

A 2017 study found that athletes who adequately replaced the sodium lost in their sweat finished a middle-distance triathlon an average of 26 minutes faster than those who didn't.

There are many scientific studies on this topic.[101] Now that we have your attention, here are some facts about why sodium is so important to performing at your best.

First, your body contains lots of water, between 50% and 70%, depending on the amount of muscle and fat that you have. Approximately one-third of that water exists outside your cells, i.e. in extracellular fluids like your blood.

Second, sodium is the main electrolyte in your extracellular fluid.[102] In fact, much of your body's total sodium reserves are found here too. Moreover, the total volume of extracellular fluid in your body is directly related to the amount of sodium your body has available at any given time.[103]

Bottom line, more sodium equals more fluid; less sodium means less fluid.

Third, in addition to maintaining body-fluid balance, sodium is critical for the absorption of nutrients in the gut, maintaining cognitive function, nerve impulse transmission, and muscle contraction, i.e. every physiological function you need for an active lifestyle, and to perform as an athlete.

Fourth, sweating is the main way we lose sodium and fluids during exercise.[104] That's why the sodium needs/allowances for those who train regularly are very different from those those who don't.

Fifth, everyone loses a different amount of sodium in their sweat. Every person, whether active athlete, active life style, or passive athlete or less active life style,[105] has a different sweat rate.[106] Those rates vary not only by person, but also by environment and situation, as well. Sweat rates can vary from nearly nothing (in low intensity training and/or cool environments) to several liters/hour (in high intensity training and/or hotter environments). When you combine differences in sodium concentration with those in sweat rates, the potential variance in the total net sodium losses experienced from one person to another can vary radically.[107] [108]

The take aways . . .

Your personal sodium intake needs are individualistic; do the USDA/FDA population-wide recommendations apply to you?[109]

In virtually all cases, sweat rates and volumes of someone who engages in physical conditioning regularly is higher than sedentary folks who train less or not at all.[110] This is why the standard government guidelines for sodium consumption should be viewed cautiously by athletes. It's more than possible to lose the daily 2,300mg of sodium recommended by the existing government guidelines in just 1 hour of exercise, if you're sweating heavily. Loses during a longer period of exercise really can be massive.

As you pursue regular exercise ask yourself this question: What determines human sodium intake, government policy or physiology?[111]

In a 2014 study, author David A. McCarron states that the USDA/FDA's sodium policy is built on several long-standing, though scientifically unsupported, assumptions:

> "(1) that current [sodium] intakes are excessive; (2) that the 'healthy range' [of sodium] must be below current intakes; (3) that sodium intake can be substantially reduced by public policy; (4) that human intake is dictated by the sodium content of the food supply; and (5) that, unlike all other essential nutrients in which a healthy range is defined by a Gaussian distribution, lower sodium intake is always better."[112]

McCarron's conclusion: Based on worldwide surveys that assess sodium intake by 24-hour urinary sodium measurements, it is now evident that, across 45 societies and 5 decades, humans consume a reproduceable, narrow range of sodium: approximately 2,600 – 4,800 mg/day. This range "is independent of the food supply, verifiable in randomized controlled trials, consistent with the physiological regulations of sodium intake and not modifiable by public policy interventions. These findings indicate that human sodium intake is controlled by physiology and cannot be modified by public health policies."[113]

Our conclusion.

Consider the following:

(1) Stay curious and be informed . . . read;

(2) Eat and enjoy whole foods mostly;

(3) Don't eat much processed phood;

(4) Enjoy regular exercise . . . get your heart rate up and get after some resistance work; and

(5) Serve others daily.

Remember, your blood volume is gradually reduced as your sweat losses increase. That's because sweat is drawn from your blood plasma.[114] This increases the strain on your cardiovascular system, making it harder to pump blood to your skin to cool you down and to your working muscles.

Other physiological consequences occur as well when significant imbalances between fluid and sodium occur.

Balancing body liquids while exercising may take more than only water.

Up to a certain point, drinking plain water is enough to mitigate sweat losses. However, depending on your individual exercise intensity and environment, those losses can start to mount up – accelerate. You need to replace sodium too. If you don't replace your lost sodium, your blood will become diluted. This is a potentially danger condition called hyponatremia. This condition can and will affect your body's functions and your athletic performance. So you need to learn your body's sweat practices.

How much sodium should you consume daily?

Figuring out whether your net water and sodium losses are likely to be low, moderate, or high is a great starting point for homing in on the level of sodium and fluid replacement that will work best for you in different circumstances.[115] The fact is, as stated earlier, sodium needs differ dramatically person-to-person. Those differences are a result of age, genetics, general health, physical activity, weather/environment (cold, moderate, hot), what a person eats, and several other factors. **There is no one-size-fits-all number of sodium intake for you**.[116]

There are two main data inputs that your personal net sodium losses:

First, discover the total amount you sweat. This is a factor of your sweat rate and the number of hours you spend sweating during a given timeframe.

Second, calculate your sweat sodium concentration. Figuring out this ratio of sodium-to-sweat is a sensible place to start. Here's what you want to discover and know: The ratio of sodium milligrams you excrete per liter of sweat produced.

Calculating the volume of sweat you lose can be a bit awkward and hit and miss, but there are plenty of online calculators that get you to a reasonable estimate.

Your sweat sodium concentration is largely genetically determined and doesn't vary much at all (we've tested pro athletes training in frozen Michigan, then retested them years later in the humidity of Florida and seen consistent results, for example), which means that, while you can only find it out by getting your sweat tested, you only need to get tested once.

Hydration and Rehydration timing

Exercise in the heat is usually associated with reduced performance; both dehydration and hyperthermia adversely affect mental and physical performance. For athletes from temperate climates, the negative effects of heat had humidity can be attenuated by a period of acclimatization. This requires up to 10-14 days. Endurance-trained individuals already show some of the adaptations that accompany acclimatization, but further adaptation occurs with training in the heat. Prior dehydration has a negative effect even on exercise of short duration where sweat losses are small. The athlete must begin exercise fully hydrated and regular ingestion of fluids is beneficial where the exercise duration exceeds 40 min. Dilute carbohydrate-electrolyte (sodium) drinks are best for fluid replacement and also supply some substrate for the exercising muscles. Post-exercise rehydration requires electrolyte as well as volume replacement. In extreme conditions, neither acclimatization nor fluid replacement will allow hard exercise to be performed without some risk of heat illness.[117]

Whew … Back to the Beginning

So, the USDA, with help from the US National Health and Nutrition Examination Surveys (NHANES) and the Food and Nutrition Board of the US Institute of Medicine (IOM), determines the daily amount of sodium a person should consume. The USDA and FDA emphasize and educate the US population through its mandated nutrition charts on all food products and making sodium a specific line item on that chart. Those numbers establish a recommended daily floor and ceiling for sodium consumption, 1,500mg and 2,300mg respectively.[118] Consider these numbers with a degree of skepticism, and at most, as general guidelines; they are not specific required intake levels. Moreover, we certainly should not consider them as idiosyncratically derived for each of us individually … because they are not.[119]

A final, closer look at USDA/FDA sodium recommendations.

Indeed, the NHANES even states that all of its sodium consumption numbers are calculated based on "the amount needed to replace *normal losses* of sodium (through the skin, feces, and urine) in *moderately active* people and to achieve a diet that provides *sufficient amounts of other essential nutrients*."

Note: Key words used by USDA/FDA for "recommended" sodium intake levels

1. *Normal* losses of sodium[120]

2. In *moderately active* people[121]

3. To achieve a diet that provides *sufficient* amounts of *other essential nutrients*.

Let's apply some grade-school analysis here. **First**, what is a "normal loss" of sodium? **Second**, what is the specific definition of "moderately active people"? **Third**, is there a gradient of moderate activity that applies to obese people that is radically different from moderate activity of a professional athlete, or a 42 year-old man who is "fit" and trains 5 days a week? Or a mother of 3 children who runs 3-5 miles a day? Or … or … or…. The very idea of a relevantly defined "normal loss" of sodium could require hundreds of categories for which "normal loss" would be defined differently. Hence the idea of "normal loss" is a potentially useless marker.

The point: There is no meaningful definition of what a "normal loss" of sodium is for anyone, much less such a loss as applied to an undescribed group of "moderately active people." Given that the term "moderately active people" is also without any scientific or meaningful definition, this kind of advice in a professional health care setting would boarder on, or constitute, negligence. But not Uncle Sam. Operating on partial truths never stopped the federal government from making enormously bad decisions regarding health recommendations.[122] And this doesn't account for the third prong of this three-legged sodium recommendation stool: achieving a diet that provides enough of other "essential nutrients?" This third prong begs the question, what is "sufficient amounts of other essential nutrients"? And a potential fourth analytical prong arises: what specifically are the other "essential nutrients" to which the USDA/FDA is/are referring?

Can we all agree that the USDA/FDA recommendations are not individually relevant recommendations? Consider them, as with any generalizations, … with caution.[123]

Best approach: Measure and *know your* personal sweat rate so *you know* your personal sodium, and other micronutrients, intake needs.

Enter Elements Meals for Athletes. The Athlete.

Elements Meals for Athletes are made for health-conscious people, including high-performance, active people … athletes. Active, high-performance people have daily sodium consumptions needs much different than the general US population (who don't exercise, who are overweight obese, and … fill in the blank). Now, maybe the USDA's guidelines apply somewhat to the majority of the US population; If so, I think we must conclude that they fail as accurate guidelines for active, high-performance people. Consider the following fundamental facts:

1. Active, high-performance people sweat between 400-2400 mL per hour of exercise, on average 1200 mL per hour;[124]

2. The main electrolyte lost in sweat is sodium;

3. From person to person, the sodium concentration of sweat varies substantially, i.e. from 115 mg to more than 2000 mg per 1000 mL of sweat;

So, an active, high-performance person with a high sweat rate and high sodium concentration in his/her sweat, can easily lose much more sodium during an hour of physical activity/training than the USDA recommends for total daily intake. And take note: the consequences of low sodium intake can be dire, even dangerous.[125]

These facts starkly show why knowing your sweat rate and sodium concentration is so critical.[126] They also demonstrate the danger of blindly following government guidelines.

Consider the following example

Joann, female marathoner who sweats approximately 800mL per hour in 85 degree weather is hoping to do a 3-hour marathon. She knows she sweats a lot during physical exercise, but doesn't know her sweat rate or sodium concentration. In preparation for her marathon, she calculates her sweat rate and volumes. She discovers that her sweat has a 1500mg of sodium/1000mL of sweat ratio. Her muscles have cramped up in previous races around mile 20.

Doing the math, Joann now understands that during her 3-hour marathon, she'll lose about 2400mL of fluid . . . which means she'll lose about 3600mg of sodium during the race.

If she limits her diet and consumes only the recommended daily intake of 1500mg of sodium, she is going to have some serious problems and will probably be unable to finish. If she doesn't plan to prevent such depletions, she'll experience nausea, clouded thinking and disorientation, muscle cramping, exhaustion, and more.[127] On non-race days, when she trains an hour or more a day, she now knows that she'll likely sweat between 800mL to 1,200mL per hour, and lose between 1,200mg to 1,800mg of sodium.

Bottom line: Active, high-performance people's daily sodium needs are idiosyncratic and exceed government guidelines.

So, what about that Elements Meals/Sodium intersection?

Currently, all Elements Meals for Athletes include animal proteins: turkey, chicken, pork, whole eggs and egg whites. Moreover, we have several more recipes that are finalized and awaiting production scheduling that include beef, clean pork sausage, and chicken. AND . . . one of the new meals is vegetarian!

The most important point to understand here regarding Elements Meals for Athletes and sodium is this: over 95% of the sodium occurs naturally in the whole food!

While some of our meals include added salt, the amount in miniscule. If you check out our ingredient lists (organized in descending order by weight), you'll find salt is always one of the last three ingredients.

So let's look at naturally occurring sodium in our whole food ingredients.

Animal proteins and naturally occurring sodium.

Chicken, Turkey and Other Poultry

Fresh poultry is naturally low in sodium. For example, 3 ounces of light meat chicken have 64 mg of sodium, while 3 ounces of turkey breast have 54 mg of sodium. A similar-size serving of duck meat has slightly less sodium, with 50 mg, and a 3-ounce portion of Cornish game hen has 54 mg. Elements meals contained cooked chicken and turkey breast meat, which is then freeze dried. These ingredients contain the highest amounts of protein and essential amino acids per gram compared to other portions of the bird (legs, wings, thigh, etc.)[128]

Beef and Pork

Cuts of beef will be similar in the amount of sodium they contain. Some examples include 3 ounces of grilled porterhouse steak with 57 mg of sodium, and the same-size serving of bottom round roast with 31 mg of sodium. Natural pork loin meat has slightly more sodium, with 63 mg in a 3-ounce serving. Elements meals use premium cuts of high quality beef. A full panoply of amino acids are served in each meal.[129]

Eggs

A large hard-boiled egg contains 62 mg of sodium. One large hard-boiled egg also contains 6.28 grams of protein, and all nine essential amino acids: histidine, isoleucine, leucine, lycine, methionine, phenylalanine,threonine, tryptophan and valine. Of the four nonessential amino acids, eggs have alanine, aspartic acid and glutamic acid. As you all know, the egg is a fabulous source of whole protein and amino acids. Eat up!

Vegetables

Elements meals do include carbohydrates. Just check our macro counts or our nutritional chart. In fact, in our non-vegetarian meals, vegetables are the only carbohydrates in Elements Meals. If you want to add other types, such as lentils, legumes, grains, rice, seeds and other stuff, go for it. We give you that liberty. Our vegetarian and vegan meals will contain legumes and lentils. They are a great source of quality, naturally occurring proteins, carbohydrates and fiber.

Bottom line for Sodium contained in Elements Meals for Athletes

The lion share of the sodium in Elements Meals occurs naturally in the whole food ingredients. So feel good . . . really good . . . about eating and enjoying our High-Performance Food. It will bless your body, your mind and soul.

GET IT!

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[1] "Potest aurum aliquis minus squaerere, nemo est qui salem non desideret invenire." Cassiodorus, *Variae* Epistolae, 12.24, written AD 537/538.

[2] At least on article identifies at least 9 kinds and sources of salt: Table, Sea, Himalayan Pink, Grey (a.k.a. Celtic salt), Fleur de sel, Black, Red, Persian blue, Smoked. *See* https://www.ecowatch.com/9-different-kinds-of-salt-which-is-the-healthiest-1891079937.html. In a formal study for the Pennsylvania Department of Environmental Protection, the following was written. "For the purpose of tracking production, *there are four types of salt* (sodium chloride) classified according to the methods of extraction or recovery used to obtain it. Rock salt (halite) is obtained from underground room and pillar mining, or surface mining of bedded halite, or halite domes. Solar salt is obtained in areas of low precipitation and high evaporation rates from solar evaporation of seawater or inland salt water lakes. Brine salt is obtained from solution mining of underground salt formations. This brine salt is used as a feedstock for mechanical evaporation processes that produce vacuum pan salt, which is in flake rather than cubic form and is preferred for food applications. The least expensive source production method of salt is by solar evaporation. However, the limited areas where this method is viable means it cannot provide the quantity of salt necessary for many purposes. Underground mining of rock salt is relatively inexpensive and can produce vast quantities of salt. Consequently, this is the source of the overwhelming majority of rock salt used for winter road de-icing in the United States." (Emphasis added.) http://files.dep.state.pa.us/Water/Wastewater%20Management/WastewaterPortalFiles/Rock%20Salt%20Paper%20final%20052711.pdf.

[3] The adult human body contains lots of water. Between 50-70% of it is made up of the stuff in fact, depending on the amount of muscle and fat that you have. Around one-third of that water exists outside your cells, in extracellular fluids like your blood. The main electrolyte in this extracellular fluid is sodium and much of your body's total sodium reserves are found here. This makes it rather 'salty' and the total volume of extracellular fluid in your body is directly related to the amount of sodium you have on board at a given time. So, more sodium equals more fluid; less sodium means less fluid. See https://www.precisionhydration.com/blogs/hydration_advice/115861124-is-sodium-important-for-athletes. For a great read on salt and its history, check out Anthony F. Harding's *Salt in Prehistoric Europe,* Sidestone Press, Lieden, 2013.

[4] See http://files.dep.state.pa.us/Water/Wastewater%20Management/WastewaterPortalFiles/Rock%20Salt%20Paper%20final%20052711.pdf, p.11.

[5] "Commonly purchased iodized salts, available at super markets or sitting on the table of your favorite restaurant, have synthetic chemicals added to them. These chemicals include everything from manufactured forms of sodium solo-co-aluminate, iodide, sodium bicarbonate, fluoride, anti-caking agents, toxic amounts of potassium iodide and aluminum derivatives. It may come as a shock, but most table salt is not only unhealthy, but can sometimes be toxic." *The Health Dangers of Table Salt*, Global Healing Center, Dr. Edward Group DC, NP, DACBN, DCBCN, DABFM. Last Updated on January 24, 2017 https://www.globalhealingcenter.com/natural-health/dangers-of-salt/.

[6] Ferrocyonide's chemical names, Hexacyanoferrate(II); Hexacyanoferrate II; Hexazyanoferrat(II); Hexacyanoferrate(4-); Hexacyanidoferrate(II). Chemical formula $C_6FeN_6^{-4}$ See https://pubchem.ncbi.nlm.nih.gov /compound/ ferrocyanide#section=Computed-Properties.

[7] Talc is a clay, a hydrous magnesium silicate mineral, with a chemical composition of $Mg_3Si_4O_{10}(OH)_2$. https://geology.com/minerals/talc.shtml.

[8] Silica aluminate is *anti-caking agent*. It's also known as sodium aluminosilicate, aluminum sodium salt, aluminosilicic acid, aluminum sodium silicate. This compound contains aluminum. Aluminum consumption has been linked to Alzheimer's Disease. *See* Ferreira PC; Piai Kde A; Takayanagui AM; Segura-Muñoz SI (2008). "Aluminum as a risk factor for Alzheimer's disease". *Rev Lat Am Enfermagem*. 16 (1): 151–7. doi:10.1590/S0104-11692008000100023. PMID 18392545. Archived from the original on 26 May 2009; *see also* https://web.archive.org/web/20090526071931/http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-11692008000100023 &lng=en&nrm=iso&tlng=en.

[9] CFR Title 21 – Food and Drugs, Chapter 1 – Food and Drug Administration, Department of Health and Human Services, Vol. 3, Part 177 – Indirect Food Additives: Polymers; Subchapter B – Substances Use as Basic Components as a Single and Repeated Use Food Contact Surfaces, Sec. 177.1200 Cellophane (revised as of April 1, 2017). "*Cellophane* may be safely used for packaging food in accordance with the following prescribed conditions: . . . (1) Substances generally recognized as safe in food." (Emphasis added.)

[10] Title 21 – Food and Drugs, Chapter 1 – Food and Drug Administration, Department of Health and Human Services, Subchapter B – Food for Human Consumption; Part 182 – Substances Generally Recognized as Safe; Subpart C – **Anticaking Agents, Sec. 182.2437 Magnesium silicate. "(a) Product. Magnesium silicate. (b) Tolerance. 2 percent. (c) Limitations, restrictions or explanation. This substance is generally recognized as safe when used in table salt when used in accordance with good manufacturing practice."** *See* https://www.accessdata.fda.gov/scripts/cdrh /cfdocs/cfcfr/CFRSearch.cfm?fr=182.2437. **Page last updated August 8, 2017.**

[11] "The potassium iodide that is added to table salt is not adequate to compensate for most iodine deficiencies. It is usually sufficient to stop goitrous boils from swelling in the neck, which are caused by an extreme deficiency. However, not enough iodine can be obtained from table salt to maintain optimal health, unless a dangerous amount of sodium is consumed. Naturally-occurring iodine is present in unadulterated sea salt with complimentary minerals, but even the vastly superior and healthier sea salt may not be enough for a tiny fraction of people who have extreme iodine deficiencies, which are caused by fluoride toxicity and other mitigating factors." https://healthwyze.org/reports/115-the-truth-about-table-salt-and-the-chemical-industry.

[12] *What is Table Salt*, ThoughtCo., August 3, 2017, Anne Marie Helmenstine, Ph.D.; *see* https://www.thoughtco.com/what-is-table-salt-604008. "The chemical composition is not constant and there may be health risks from some of the impurities, which can be up to 15 percent of the mass of the product." Id.

[13] "One of the most common additives is iodine in the form of potassium iodide, sodium iodide, or sodium iodate. Iodized salt may contain dextrose (a sugar) to stabilize the iodine. Iodine deficiency is considered the biggest preventable cause of mental retardation. Salt is iodized to help prevent cretinism in children as well as hypothyroidism and goiter in adults. In some countries, iodine is routinely added to salt (iodized salt) and products that do not contain this additive may be labeled 'uniodized salt.' Uniodized salt has not had any chemicals removed from it; rather, this means supplemental iodine has not been added. Another common additive to table salt is sodium fluoride. Fluoride is added to help prevent tooth decay. This additive is more common in countries that don't fluoridate water. 'Doubly-fortified' salt contains iron salts and iodide. Ferrous fumarate is the usual source of iron, which is added to help prevent iron-deficiency anemia. Another additive may be folic acid (vitamin B_9). Folic acid or folicin is added to help prevent neural tube defects and anemia in developing infants. This type of salt may be used by pregnant women to help prevent common birth defects. Folicin-enriched salt has a yellowish color from the vitamin. Anti-caking agents may be added to salt to prevent the grains from sticking together. Any of the

following chemicals are common: calcium aluminosilicate, calcium carbonate, calcium silicate, fatty acid salts (acid salts), magnesium carbonate, magnesium oxide, silicon dioxide, sodium aluminosilicate, sodium ferrocyanide or yellow prussiate of soda, tricalcium phosphate." Id.

[14] "Processed foods are very high in sodium, but it is always in the form of table salt, artificial flavors, or flavor enhancers." Id.

[15] "Healthy sea salts selectively make a body a hostile environment for pathogens, such as bacteria and parasites. Its specific toxicity to pathogenic life forms is why salt is such an excellent preservative, while leaving the healthy foods completely intact. Even mainstream medical doctors will admit these things when probed, but their institutionalized attacks upon salt continue unabated." *Truth About Salts and the Chemical Industry*, The Health Wyze Report, December 6, 2008, https://healthwyze.org/reports/115-the-truth-about-table-salt-and-the-chemical-industry.

[16] Id.

[17] In fact, research published in *Scientific Reports* (Article number: 46173 (2017)), studied 17 brands of salt from 8 different countries and found microplastics in all but one brand. 72 particles were extracted from the salt samples: 41.6% were plastic polymers, 23.6% were pigments, 5.50% were amorphous carbon, and 29.1% remained unidentified. "The most common plastic polymers were polypropylene (40.0%) and polyethylene (33.3%)." While the study concluded that the small annual per person intake from the salts (maximum 37 particles) warranted "negligible health impacts," wouldn't using salt not laced with plastics be a much better option? We think so.

[18] *The Presence of Microplastics in Commercial Sea Salts from Different Countries*; See https://www.nature.com /articles/srep46173; *See also* Scientific Reports*,* fn. 14 *supra.* "The widespread distribution of MPs in aquatic bodies is well documented, such as in the Celtic sea, Laurentian Great Lakes, Persian Gulf, and in sub-tropical gyres. Accordingly, it is expected that products originating from the contaminated water bodies are also loaded with MPs." Id.

[19] While sea salt may sound health and "organic," it's neither. Better options include salts obtained from unadulterated land and inland underground water sources. Himalaya salts have been evaluated and found to be a cleaner, better source than sea salt. It's a rock salt mined from the Punjab region in Pakistan, particularly in the Khewra Salt Mine. Melody R, "*Himalayan Salt Vs. Sea Salt: Is There Really A Difference?*," Eat Your Kale, December 8, 2015. *See* http://www.medicalnewstoday.com/articles/315081.php. In fact, research published in *Scientific Reports* (Article number: 46173 (2017)); Ninety-eight percent of Himalayan salt is sodium chloride, while the remaining percentage accounts for trace minerals like potassium, magnesium, calcium, phosphorus and vanadium. http://eatyourkale.com/himalayan-salt-vs-sea-salt-is-there-really-a-difference; *see also* https://authoritynutrition. com/different-types-of-salt/. *See* https://articles.mercola.com/sites/articles/ archive/2016/05/05/sodium-reduction-guidelines-salt-intake.aspx.

[20] See https://www.youtube.com/watch?v=7eWmNgEFS7A.

[21] "*9 Different Kinds of Salt: Which is the Healthiest*?" Care 2, April 9, 2016, republished in EcoWatch, https://www.ecowatch. com/9-different-kinds-of-salt-which-is-the-healthiest-1891079937.html.

[22] One study of nearly 2,000 elderly people showed a decrease in mortality caused by cardiovascular disease when a switch was made from regular salt to potassium-enriched salt. *See Effect of potassium-enriched salt on cardiovascular mortality and medical expenses of elderly men,* Chang HY, Hu YW, Yue CS, et al*. Am J Clin Nutr. 2006;83:1289-96.*

[23] "Table salt is created by superheating natural salt to 1,200 degrees Fahrenheit, which destroys most beneficial compounds. Fortified with essential iodine, table salt is also bleached and devoid of trace elements, so it's certainly not the healthiest salt you can shake. This type of salt can often contain additives to slow moisture absorption so it is easy to sprinkle in your salt shaker." *See* EcoWatch, fn. 14.

[24] See *Sodium Chloride*, Linus Pauling Institute, Micronutrient Information Center, Oregon State University. http://lpi.oregonstate.edu/mic/minerals/sodium.

[25] Salt in Prehistoric Europe, Anthony Harding, Sidestone Press, Lieden, 2013, pp. 14-15.

[26] http://time.com/3957460/a-brief-history-of-salt/.

[27] Draft Guidance for Industry: *Voluntary Sodium Reduction Goals: Target Mean and Upper Bound Concentrations for Sodium in Commercially Processed, Packaged, and Prepared Foods, US Food & Drug Administration*, https://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ ucm494732.htm.

[28] In 1983 the Center for Science in the Public Interest petitioned the FDA to add sodium to foods' product labels. The FDA, in 2014, claimed they were close to releasing the sodium-reduction guidelines, but nothing has been released to this day. *See* Politico April 3, 2016.
[29] Id.
[30] Id.
[31] https://www.livestrong.com/article/385815-how-much-sodium-per-day-with-high-blood-pressure.
[32] https://www.cdc.gov/media/releases/2012/p0207_sodium_food.html.
[33] More than 75% of the sodium Americans eat comes from some processed, prepackaged and restaurant foods – not from the salt shaker. Most of our salt comes from processed, prepared foods such as crackers, cheese, canned foods, breakfast cereals, and restaurant foods. Even processed foods that don't taste "salty" — like breakfast cereal — can have surprisingly high sodium levels. Additionally, foods eaten numerous times a day, such as bread, can add up to higher sodium intake even though an individual serving is not high in sodium. In fact, according to a recent CDC report (see *supra* fn. 13), more than 40% of sodium comes from the following 10 types of foods: Breads and rolls, cold cuts and cured meats such as deli or packaged ham or turkey, Pizza, Fresh and processed poultry, Soups, Sandwiches such as cheeseburgers, Cheese, Pasta dishes, Meat mixed dishes such as meat loaf with tomato sauce, Snacks such as chips, pretzels, and popcorn. *See also* https://www.hsph.harvard.edu/nutritionsource/salt-and-sodium/take-action-on-salt/#ref14. Choosing foods with lower sodium doesn't mean losing flavor. Human taste buds aren't sensitive enough to notice a minor (30 percent) reduction in salt, and for many types of foods, salt reductions of up to 30 percent won't taste noticeably different. That means home cooks, professional chefs, and the food industry can easily make significant sodium reductions with minimal impact on flavor.
[34] "High blood pressure can start developing in childhood; and becoming conditioned to high-salt tastes early in life can make it more difficult to cut back later. Childhood is an important time to focus on preventing the development of high blood pressure, but cutting back on salt and sodium can have a significant impact for people of all ages." https://www.hsph.harvard.edu/nutritionsource/salt-and-sodium/take-action-on-salt/#ref14.
[35] https://www.cdc.gov/media/releases/2012/p0207_sodium_food.html
[36] Id. The evidence supporting this statement is not only ambiguous, but conflicting. More about that below.
[37] These numbers cause us to wonder . . . a lot. If American consume an average of 3,400mg of sodium per day, is there really an average American to whom this number applies? If you're an athlete, someone who engages in regular conditioning and training, whether it's daily, or 3-5 times a week, you clearly are NOT AVERAGE. The "average" American is statistically more likely to be obese.
[38] Goldblatt experimented in the early 1930s to discover the cause of essential hypertension, learning that clamping off part of the main arteries to the kidneys caused high blood pressure. Goldblatt tried to prove that renin, in normal kidneys, was the origin of essential hypertension. In 1965, with Dr. Erwin Haas, he isolated 4,000 ampoules of renin and Goldblatt units became the international standard of measurement of human renin. https://case.edu/ech/articles/g/goldblatt-harry.
39 Studies on Experimental Hypertension: V. The Pathogenesis of Experimental Hypertension Due to Renal Ischemia, Harry Goldblatt, M.D., C.M., Ann Intern Med., vol. 11, pp. 69-103, July 1, 1937.
40 Walter Kempner M.D., Treatment of hypertensive vascular disease with rice diet, Am J Med, 1948, vol. 4, pp. 545-77.
41 Id.
[42] Intersalt: an international study of electrolyte excretion and blood pressure. Results for 24 hour urinary sodium and potassium excretion. Intersalt Cooperative Research Group, July 30, 1988, vol. 297, pp. 319-28. See PMC1834069. "The relations between 24-hour urinary electrolyte excretion and blood pressure were studied in 10,079 men and women aged 20-59 sampled from 52 centres around the world based on a highly standardised protocol with central training of observers, a central laboratory, and extensive quality control. Relations between electrolyte excretion and blood pressure were studied in individual subjects within each centre and the results of these regression analyses pooled for all 52 centres. Relations between population median electrolyte values and population blood pressure values were also analysed across the 52 centres. Sodium excretion ranged from 0.2 mmol/24 h (Yanomamo Indians, Brazil) to 242 mmol/24 h (north China). In individual subjects (within centres) it was significantly related to blood pressure. Four centres found very low sodium excretion, low blood pressure, and little

or no upward slope of blood pressure with age. Across the other 48 centres sodium was significantly related to the slope of blood pressure with age but not to median blood pressure or prevalence of high blood pressure. Potassium excretion was negatively correlated with blood pressure in individual subjects after adjustment for confounding variables. Across centres there was no consistent association. The relation of sodium to potassium ratio to blood pressure followed a pattern similar to that of sodium. Body mass index and heavy alcohol intake had strong, significant independent relations with blood pressure in individual subjects." Id. (Emphasis added.)

[43] Effects of low-sodium diet vs. high-sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride, Graudal N. A., Hubeck-Graudal T., Jürgens G. (Cochrane Review), Am J Hypertens Vo. 25, Issue 1, pp. 1-15, 2012. https://academic.oup.co m/ajh/article/25/1/1/238666; https://doi.org/10.1038/ajh.2011.210

[44] Id.

[45] Id.

[46] *Projected Effect of Dietary Salt Reductions on Future Cardiovascular Disease*, N Engl J Med 2010, vol. 362, pp. 590-599, February 18, 2010. See *DOI: 10.1056/NEJMoa0907355*; *https://www.nejm.org/doi/full/10.1056/nejmoa0907355*.

[47] Id.

[48] Id.

[49] See footnote ___ *infra* regarding epidemiological studies … they cannot prove causation. They can only show possible "association" between a studied input and an output. Hence the ambiguous term "linked." "Epidemiology relies heavily on statistics for establishing and quantifying the relationships between risk factors and disease, and for establishing whether or not there is an excessive amount of a particular disease occurring in a specific geographic area. Medical records can provide invaluable historical data for establishing trends in the incidence of diseases. There are vast collections of medical record information all over the world, and sorting through the data can be a very expensive and time-consuming process. In addition, what can be gained from the records is only as good as the information that they contain, and often the information is scanty or impossible to verify." http://pmep.cce.cornell.edu/profiles/extoxnet/TIB/epidemiology.html

[50] Id.

[51] Let's provide some context for these 800,000 deaths caused by heart disease and stroke. Total deaths in the United States in 2015 were 2,712,630. In 2015, the top 15 causes of death were as follows: 1. Diseases of heart (heart disease); 2. Malignant neoplasms (cancer); 3. Chronic lower respiratory diseases; 4. Accidents (unintentional injuries); 5. Cerebrovascular diseases (stroke); 6. Alzheimer's disease; 7. Diabetes mellitus (diabetes); 8. Influenza and pneumonia; 9. Nephritis, nephrotic syndrome and nephrosis (kidney disease); 10. Intentional self-harm (suicide); 11. Septicemia; 12. Chronic liver disease and cirrhosis; 13. Essential hypertension and hypertensive renal disease (hypertension); 14. Parkinson's disease; 15. Pneumonitis due to solids and liquids. See National Vital Statistics Report vol. 66, no. 6, November 2017, pp.1-6; https://www.cdc.gov/nchs/data/nvsr/nvsr66/nvsr66_06.pdf.

[52] https://www.cdc.gov/media/releases/2012/p0207_sodium_food.html.

[53] "In 2010, the estimated mean level of global sodium consumption was 3.95 g per day, and regional mean levels ranged from 2.18 to 5.51 g per day. Globally, 1.65 million annual deaths from cardiovascular causes (95% uncertainty interval [confidence interval], 1.10 million to 2.22 million) were attributed to sodium intake above the reference level; 61.9% of these deaths occurred in men and 38.1% occurred in women. These deaths accounted for nearly 1 of every 10 deaths from cardiovascular causes (9.5%). Four of every 5 deaths (84.3%) occurred in low- and middle-income countries, and 2 of every 5 deaths (40.4%) were premature (before 70 years of age). The rate of death from cardiovascular causes associated with sodium intake above the reference level was highest in the country of Georgia and lowest in Kenya." N Engl J Med 2014;371:624-34, p. 624. DOI: 10.1056/NEJMoa130412. See https://www.nejm.org/doi/pdf/10.1056/NEJMoa1304127.

[54] *Death by Salt*? *New Study Finds Too Much Salt is a Global Killer*, Alyson Aubrey, August 13, 2014, https://www.npr.org/sections/goatsandsoda/2014/08/13/340164014/death-by-salt-new-study-finds-too-much-sodium-is-a-global-killer.

[55] https://www.usatoday.com/story/money/cars/2018/02/15/national-safety-council-traffic-deaths/340012002/

[56] https://www.cdc.gov/drugoverdose/data/statedeaths.html

[57] https://www.cdc.gov/drugoverdose/data/heroin.html; https://www.cnn.com/2017/09/08/health/heroin-deaths-samhsa-report/index.html.
[58] https://www.cdc.gov/nchs/fastats/injury.htm.
[59] https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2016.html.
[60] See *supra* footnote 30.
[61] https://www.hsph.harvard.edu/nutritionsource/salt-and-sodium/take-action-on-salt/#ref14.
[62] See https://www.npr.org/sections/thesalt/2012/09/14/161152679/u-s-kids-eat-nearly-as-much-salt-as-adults-putting-health-at-risk.
[63] Id.
[64] Id.
[65] *See* https://sodiumbreakup.heart.org/how_much_sodium_should_i_eat?utm_source=SRI&utm_medium=HeartOrg&utm_term=Website&utm_content=SodiumAndSalt&utm_campaign=SodiumBreakup.
[66] Most sodium is consumed in the form of sodium chloride (salt). The salt content of foods can be calculated by multiplying the sodium content by 2.5. Example: 2,000 mg (2 g) of sodium x 2.5 = 5,000 mg (5 g) of salt. For more information on the sodium content of foods, search the USDA composition databases at https://ndb.nal.usda.gov/ndb/.
[67] US Food and Drug Administration. Lowering salt in your diet. March 29, 2016. See http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm181577.htm. Accessed 6/10/18.
[68] Id.
[69] A natural follow question to this posited one is "can dietary sodium even be determined by government policy?" This is a most compelling and momentous question. We'll address it further below. See footnote 71, *infra*.
[70] *What Determines Human Sodium Intake: Policy or Physiology?* Advances in Nutrition an International Review Journal, vol. 5, issue 5, Sept. 1, 2014, pp. 578-584.
[71] Find the specific analysis of this three-prong approach used to calculate daily sodium intake below, referencing footnotes 83 through 87.
[72] "Combined data of the US National Health And Nutrition Examination Surveys (NHANES) 2007-2008 and 2009-2010 indicated average dietary sodium intakes of 3.1 g/day in children (ages, 3-18 years), 3.8 g/day in adults (ages, 19-50 years), and 3.3 g/day in older adults (>50 years) (23). These intakes are well above the current recommended tolerable upper intake level (see The tolerable upper intake level for sodium). Usual intakes were estimated to be 4.4 g/day and 3.1 g/day in adult men and women (ages, 19-50 years), respectively. Overall, sodium intakes among males of all age groups were found to be 20%-45% higher than among females. Finally, the surveys revealed that only about 22% of children, 8% of adults, and 15% of older adults consume less than the current life stage-specific tolerable upper intake level for sodium (see The tolerable upper intake level for sodium) (23)
[73] This table was republished in *Sodium Chloride*, Linus Pauling Institute, Micronutrient Information Center, Oregon State University. See http://lpi.oregonstate.edu/mic/minerals/sodium#reference22.
[74] *What Determines Human Sodium Intake: Policy or Physiology?* Advances in Nutrition an International Review Journal, vol. 5, issue 5, Sept. 1, 2014, pp. 578-584. https://academic.oup.com/advances/articles/5/5/578/4565774.
[75] Id.
[76] "The Gaussian distribution is also commonly called the 'normal distribution' and is often described as a 'bell-shaped curve.'. . . If the number of events is very large, then the Gaussian distribution function may be used to describe physical events. The Gaussian distribution is a continuous function which approximates the exact binomial distribution of events." *Gaussian Distribution Function*, Hyperphysics, Dept. of Physics and Astronomy, Georgia State University. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html.
[77] *What Determines Human Sodium Intake: Policy or Physiology?* Advances in Nutrition an International Review Journal, vol. 5, issue 5, Sept. 1, 2014, pp. 578-584. https://academic.oup.com/advances/articles/5/5/578/4565774.
[78] *IOM Report on Sodium Intake in Populations*, May 14, 2013. http://www.iom.edu/Reprots/2013/Sodium-Intake-in-Populations-assessment-of-Evidence.aspx.
[79] *Sodium,* Adv Nutr. 2014 Mar; 5(2): 188–190, Pasquale Strazzullo, Department of Clinical Medicine and Surgery, Excellence Center of Hypertension, Federico II University of Naples, Naples, Italy. Published online 2014 Jan 6. doi: 10.3945/an.113.005215; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3951800/.

[80] *Sodium,* Adv Nutr. 2014 Mar; 5(2): 188–190. "Sodium is the major cation of extracellular fluid [ECF[2] (1 mmol, or molar equivalent, corresponding to 23 mg of sodium)]. The mean body content of sodium in the adult male is 92 g, half of which (46 g) is located in the ECF at a concentration of 135–145 mmol/L, ∼11 g is found in the intracellular fluid at the concentration of ∼10 mmol/L, and ∼35 g is found in the skeleton. The concentration gradient between the ECF and intracellular fluid is maintained by the sodium–potassium pump activity, which transfers sodium and potassium, respectively, from inside to outside the cell and vice versa against the concentration gradient, using the energy supplied by ATP. In the polarized cells of the renal tubular epithelium or the intestinal wall, sodium enters the cell from the tubular lumen or from the gut through specific channels or other transport mechanisms and is then extruded from the cell into the adjacent capillaries attributable to the action of the pump, which is mainly distributed on the basolateral sides of the cell. In these cells, sodium transport is mostly associated with that of other substrates, e.g., phosphates, amino acids, glucose, and galactose.

[81] *Does Replacing Sodium Excreted in Sweat Attenuate the Health Benefits of Physical Activity?* International Journal of Sport Nutrition and Exercise Metabolism, Martin J. Turner and Alberto P. Avolio, 2016, Vol. 26, No. 4, pp. 377-389. http://dx.doi.org/10.1123/ijsnem.2015-0233

[82] *Sodium,* Adv Nutr. 2014 Mar; 5(2): 188–190. *See supra* fn. 79.

[83] Id.

[84] Id.

[85] "Natriuretic: Causing natriuresis, the excretion of an excessively large amount of sodium in the urine. A hybrid of the Latin natrium = sodium and the Greek ouresis = a making water." https://www.medicinenet.com/script/main /art.asp?articlekey=20993.

[86] Id.

[87] *Central regulation of sodium appetite*, Experimental Physiology, Vol. 93, Issue 2, pp. 177-209, February 2008, https://doi.org/10.1113/expphysiol.2007.039891.

[88] *Effect of potassium-enriched salt on cardiovascular mortality and medical expenses of elderly men.* Am J Clin Nutr., Chang HY, Hu YW, Yue CS, et al. 2006;83:1289-96; *see also* http://files.dep.state.pa.us/Water/Wastewater%20Management/WastewaterPortalFiles/Rock%20Salt%20Paper%20final%20052711.pdf, ("The main purpose of this study [was] to analyze various rock salt sources to determine the existing composition of rock salt.")

[89] *See* Chang, fn. 49.

[90] "Potassium was identified as a shortfall nutrient by the Dietary Guidelines for Americans 2010 Advisory Committee. The committee concluded that there was a moderate body of evidence of the association between potassium intake and blood pressure reduction in adults, which in turn influences the risk of stroke and coronary heart disease. Evidence is also accumulating of the protective effect of adequate dietary potassium on age-related bone loss and reduction of kidney stones. These benefits depend on organic anions associated with potassium as occurs in foods such as fruits and vegetables, in contrast to similar blood pressure-lowering benefits of potassium chloride. Benefits to blood pressure and bone health may occur at levels below current recommendations for potassium intake, especially from diet, but dose-response trials are needed to confirm this." *Potassium and Health*, Adv Nutr. 2013 May 1;4(3):368S-77S. doi: 10.3945/an.112.003533. See https://www.ncbi.nlm.nih.gov/pubmed/23674806.

[91] https://www.livescience.com/3505-chemistry-life-human-body.html.

[92] Id.

[93] *Effect of potassium-enriched salt on cardiovascular mortality and medical expenses of elderly men.* Am J Clin Nutr., Chang HY, Hu YW, Yue CS, et al. 2006;83:1289-96; *see also* http://files.dep.state.pa.us/Water/Wastewater%20Management/WastewaterPortalFiles/Rock%20Salt%20Paper%20final%20052711.pdf.

[94] Id.

[95] *Associations of Urinary sodium Excretion with Cardiovascular Events, in Individuals with and without hypertension: A Pooled Analysis of Data from Four Studies*, The Lancet, Vol. 388, No, 10043, p. 465-475, July 30, 2016. *See* https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)30467-6/supplemental.

[96] Note the language, "associated with," in reference to the finding of the epidemiological study itself. "Associated with" is not a proof of scientific causation. Indeed, epidemiological studies cannot and do not prove causation. "The science of epidemiology was first developed to discover and understand possible causes of contagious diseases like

smallpox, typhoid and polio among humans. It has expanded to include the study of factors associated with non-transmissible diseases like cancer, and of poisonings caused by environmental agents. *Epidemiological studies can never prove causation*; *that is, it cannot prove that a specific risk factor actually causes the disease being studied*. Epidemiological evidence can only show that this risk factor is associated (correlated) with a higher incidence of disease in the population exposed to that risk factor. The higher the correlation the more certain the association, but it cannot prove the causation." *Epidemiology*, Toxicology Information Brief, A Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. Major support and funding was provided by the USDA/Extension Service/National Agricultural Pesticide Impact Assessment Program. http://pmep.cce.cornell.edu/profiles/extoxnet/TIB/epidemiology.html.

97 https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/1106080.

98 *Does Replacing Sodium Excreted in Sweat Attenuate the Health Benefits of Physical Activity?* International Journal of Sport Nutrition and Exercise Metabolism, Martin J. Turner and Alberto P. Avolio, 2016, Vol. 26, No. 4, pp. 377-389. http://dx.doi.org/10.1123/ijsnem.2015-0233.

[99] Id. at 378.

[100] Id.

101 Sweating Rate and Sweat Sodium Concentration in Athletes: A Review of Methodology and Intra/Interindividual Variability, Sports Med. 2017; 47(Suppl 1): 111–128. Published online 2017 Mar 22. doi: 10.1007/s40279-017-0691-5, Baker, L.B. Sports Med (2017) 47(Suppl 1): 111. https://doi.org/ 10.1007/s40279-017-0691-5.

102 The primary objective of a recent study was "to provide a review of the literature regarding the effect of laboratory and field sweat-testing methodological variations on sweating rate (SR) and sweat composition (primarily sodium concentration [Na+])." Id.

103 The National Center for Biotechnical Information published a study that reviewed scientific literature concerning "the interactive effects of sodium and fluid ingestion in maintaining fluid homeostasis during and following exposure to heat and exercise. Heavy sweating during exercise combined with heat exposure commonly produces fluid deficits corresponding to 1-8% loss in body mass. Studies in this area suggest that if water is consumed, the volume ingested needs to exceed the fluid deficit by approximately 150% to compensate for the urinary losses that will occur with water ingestion. Inclusion of sodium chloride and other solutes in the rehydration beverage reduces urinary water loss, leading to more rapid recovery of the fluid balance. Data are presented in this paper that suggest a quantifiable interactive relationship between sodium content and fluid volume in promoting rapid recovery of fluid balance after exercise and thermal-induced dehydration." (Emphasis added.) *See* https://www.ncbi.nlm.nih.gov/pubmed/16772634.

[104] Id.

[105] "Marie Spano, R.D., points out that sweat losses, both in fluid and sodium, range dramatically between people, and both over-hydrating and under-hydrating can lead to poor performance and potential negative health consequences. *'I think many Americans are so afraid of sodium because of the press around salt. I have to remind them that the average person is overweight or obese and inactive.*'" See, *How Much Salt do Runners Really Need*?, Runner's World, Sept. 6, 2016, A. C. Shilton, https://www.runnersworld.com/news/ a20821089/how-much-salt-do-runners-really-need/. (Emphasis added.)

[106] See *The Importance of Salt in the Athlete's Diet*, Curr Sports Med Rep. 2007 July; https://www.nlm. nih. gov/. "High sweat rates in athletes result in loss of both fluids and sodium. Fluid replacement with hypotonic solutions will lead to incomplete rehydration and possible complications such as hyponatremia, decreased performance, heat cramps, or other heat-related illness. There is significant individual variation in sodium loss during activity. In some the losses can be replaced by normal dietary intake, whereas in others the losses can be dramatic and increased dietary intake is essential. There are various methods to increase sodium intake, such as increased use of table salt on foods, salty snacks, adding salt to sports drinks, and use of salt tablets. Emphasis on replacement of fluids is also important, but care must be taken to avoid overhydration. Simple measures such as recording daily pre- and post-exercise body weight can aid in making fluid and sodium ingestion decisions; in some cases, a comprehensive evaluation is necessary."

[107] Id.

[108] *Does Replacing Sodium Excreted in Seat Attenuate the Health benefits of Physical Activity?* International Journal of Sport Nutrition and Exercise Metabolism, 2016, vol. 26, pp. 377-389.

[109] "International guidelines suggest limiting sodium intake to 86–100 mmol/day, but average intake exceeds 150 mmol/day. Participants in physical activities are, however, advised to *increase* sodium intake before, during and after exercise to ensure rehydration, replace sodium lost in sweat, speed rehydration and maintain performance. A similar range of health benefits is attributable to exercise and to reduction in sodium intake, including reductions in blood pressure and the increase of blood pressure with age, reduced risk of stroke and other cardiovascular diseases, and reduced risk of osteoporosis and dementia. Sweat typically contains 40–60 mmol/L of sodium, leading to approximately 20–90 mmol of sodium lost in one exercise session with sweat rates of 0.5–1.5 L/h. Reductions in sodium intake of 20–90 mmol/day have been associated with substantial health benefits. Homeostatic systems reduce sweat sodium as low as 3–10 mmol/L to prevent excessive sodium loss. "Salty sweaters" may be individuals with high sodium intake who perpetuate their "salty sweat" condition by continual replacement of sodium excreted in sweat. Studies of prolonged high intensity exercise in hot environments suggest that sodium supplementation is not necessary to prevent hyponatremia during exercise lasting up to 6 hr. We examine the novel hypothesis that sodium excreted in sweat during physical activity offsets a significant fraction of excess dietary sodium, and hence may contribute part of the health benefits of exercise. Replacing sodium lost in sweat during exercise may improve physical performance, but may attenuate the long-term health benefits of exercise." *Does Replacing Sodium Excreted in Sweat Attenuate the Health Benefits of Physical Activity*?k Human Kinetics Journals, vol. 26, issue 4, pages 377-389. See Abstract at https://doi.org/10.1123/ijsnem.2015-0233.

[110] Id. *See also Why Sodium is Crucial to Your Performance*, Precision Hydration, https://www.precisionhydration.com/blogs/hydration_advice/115861124-is-sodium-important-for-athletes, "We see athletes who lose from as little as 200mg of sodium per liter of sweat to as much as 2000mg/l. I personally lose 1,842 mg/l and I often suffered from hydration issues in hot climates as a result."

[111] *What Determines Human Sodium Intake: Policy or Physiology?* Advances in Nutrition an International Review Journal, vol. 5, issue 5, Sept. 1, 2014, pp. 578-584. *See also, Central regulation of sodium appetite*, Experimental Physiology, Vol. 93, Issue 2, pp. 177-209, February 2008, https://doi.org/10.1113/expphysiol.2007.039891.

[112] Id. at 578.

[113] Id. at 578.

[114] "During prolonged exercise, fluid and salt losses through sweating reduce plasma volume which leads to heart rate drift in association with hyperthermia and reductions in performance. Oral rehydration with water reduces the loss of plasma volume and lessens heart rate drift and hyperthermia. Moreover, the inclusion of sodium in the rehydration solution to levels that double those in sweat (i.e., around 90 mmol/l Na(+)) restores plasma volume when ingested during exercise, and expands plasma volume if ingested pre-exercise. Pre-exercise salt and fluid ingestion with the intention of expanding plasma volume has received an increasing amount of attention in the literature in recent years. In four studies, pre-exercise salt and fluid ingestion improved performance, measured as time to exhaustion, either during exercise in a thermoneutral or in a hot environment. While in a hot environment, the performance improvements were linked to lowering of core temperatures and heart rate, the reasons for the improved performance in a thermoneutral environment remain unclear. However, when ingesting pre-exercise saline solutions above 0.9% (i.e., > 164 mmol/l Na(+)), osmolality and plasma sodium increase and core temperature remain at dehydration levels. Thus, too much salt counteracts the beneficial effects of plasma volume expansion on heat dissipation and hence in performance. In summary, the available literature suggests that pre-exercise saline ingestion with concentrations not over 164 mmol/l Na(+) is an ergogenic aid for subsequent prolonged in a warm or thermoneutral environment. https://www.ncbi.nlm.nih.gov/pubmed/23075561.

[115] "In 2004, the Food and Nutrition Board of the US Institute of Medicine (IOM) established an adequate intake (AI) for sodium and sodium chloride (salt) based on the amount needed to replace *normal losses of sodium* (through the skin, feces, and urine) *in moderately active people* and to achieve a diet that provides sufficient amounts of other essential nutrients. These recommended intake levels are well below the average dietary intakes of most people in the US." (Emphasis added.) See *Sodium Chloride*, Linus Pauling Institute, Micronutrient Information Center, Oregon State University. http://lpi.oregonstate.edu/mic/minerals/sodium.

[116] "Most of the sodium and chloride in the diet comes from salt. Very little sodium occurs naturally in food. Instead, sodium is added to make certain foods shelf stable, and it is ubiquitously used in the US food supply such that all

food groups contribute to sodium intake levels. It has been estimated that 75% of the salt intake in the US is derived from salt added during food processing or manufacturing, rather than from salt added at the table or during cooking. The lowest salt intakes are associated with diets that emphasize unprocessed foods, especially fruit, vegetables, and legumes. Combined data of the US National Health And Nutrition Examination Surveys (NHANES) 2007-2008 and 2009-2010 indicated average dietary sodium intakes of 3.1 g/day in children (ages, 3-18 years), 3.8 g/day in adults (ages, 19-50 years), and 3.3 g/day in older adults (>50 years) (23). These intakes are well above the current recommended tolerable upper intake level (see The tolerable upper intake level for sodium). Usual intakes were estimated to be 4.4 g/day and 3.1 g/day in adult men and women (ages, 19-50 years), respectively. Overall, sodium intakes among males of all age groups were found to be 20%-45% higher than among females. Finally, the surveys revealed that only about 22% of children, 8% of adults, and 15% of older adults consume less than the current life stage-specific tolerable upper intake level for sodium." Id.

[117] *Exercise in the heat: strategies to minimize the adverse effects on performance*, J Sports Sci. 1995 Summer; 13 Spec No:S55-62, https://www.ncbi.nlm.nih.gov/pubmed/8897321.

[118] "The US Institute of Medicine (IOM) established an adequate intake (AI) for sodium of 1.2 to 1.5 grams (g)/day in adults, equivalent to 3.0 to 3.8 g/day of sodium chloride (salt). The IOM established an upper level of sodium intake (UL) of 2.3 g/day (5.8 g/day of salt) for adults based on the adverse effects of high sodium intakes on blood pressure, a major risk factor for cardiovascular and kidney diseases. Current sodium intakes of the US population far exceed the UL for all age and gender groups. Due to adverse health outcomes associated with excess sodium, sodium has been identified as a nutrient of public health concern for overconsumption. See *Sodium Chloride*, Linus Pauling Institute, Micronutrient Information Center, Oregon State University. http://lpi.oregonstate.edu/mic/minerals/sodium.

[119] Daily sodium and other micronutrient intake levels simply cannot be accurately generalized. Such generalizations cannot and do not hold between races much less individuals. For example, how can micronutrient levels, including sodium, be determined for very active people when "[f]or more than 25 years, more than half of the adult [US] population has been overweight or obese. Obesity is most prevalent in those ages 40 years and older and in African American adults and is least prevalent in adults with highest incomes. Since the early 2000s, abdominal obesity[a] has been present in about half of U.S. adults of all ages. Prevalence is higher with increasing age and varies by sex and race/ethnicity. In 2009-2012, 65% of adult females and 73% of adult males were overweight or obese. In 2009-2012, nearly one in three youth ages 2 to 19 years were overweight or obese." *Dietary Guidelines for Americans 2015-220, Eighth Edition*, p.2. See https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary Guidelines.pdfDietary. "The scientific consensus from expert bodies, such as the IOM, the American Heart Association, and Dietary Guidelines Advisory Committees, is that average sodium intake, which is currently 3,440 mg per day, is too high and should be reduced." Id. at p. 34.

[120] Notwithstanding the USDA's sodium intake recommendations as published by the USDA, note this statement in its official publication: "The recommendation for adults and children ages 14 years and older to limit sodium intake to less than 2,300 mg per day is based on evidence showing a linear dose-response relationship between increased sodium intake and increased blood pressure *in adults*. In addition, *moderate evidence suggests* an *association* between increased sodium intake and increased risk of CVD in adults. However, this *evidence is not as consistent as the evidence on blood pressure*, a surrogate indicator of CVD risk." What is lacking is an exact definition of "adults." And note that the evidence relied on to make its recommendations is qualified as "moderate" and that it merely "suggests an association" between sodium consumption and increased risk of CVD. First, what is moderate evidence? Second, when moderate evidence creates an "association" between two points, but no cause and effect relationship between them, one must call into question the value of that evidence and any conclusions derived from its use.

[121] "The IOM set an Adequate Intake (AI) level for sodium to meet the sodium needs of healthy and moderately active individuals. Because of increased loss of sodium from sweat, the AI does not apply to highly active individuals and workers exposed to extreme heat stress, estimated to be less than 1 percent of the U.S. population. Institute of Medicine. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington (DC): The National Academies Press; 2005." *Dietary Guidelines for Americans 2015-220, Eighth Edition*, p. 34, footnote 27. See https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf.

[122] In her book, *The Big Fat Surprise*, Nina Teichholz illuminates how a dietary thesis unsupported by scientific evidence gained enough non-scientific credibility that it became the official diet of the USA for 50 years, plunging the country into the obesity epidemic, among other similar health disasters: "[President Dwight] Eisenhower was extremely supportive of the [American Heart Association] throughout his presidency: he presented the AHA's annual "Heart of the Year Award" from the Oval Office, held opening ceremonies for the AHA's "Heart Fund Campaign" in the white House, attended the AHA board meetings, and assumed the AHA post of Honorary Chairman of the Future. Members of his cabinet also served on the AHA board. The AHA's official historian concludes, "Thus, the top leaders of the United States government were active Heart campaigners." See *Big Fat Surprise: Why Butter, Meat & Cheese Belong in a Healthy Diet*, pp. 48-49, footnote, *citing* Moore, "*The Cholesterol Myth*," 1989, and Moore, *Heart Failure*; Anon, Associated Press., 1989) (*see* , pp. 69 footnote). The number of studies pursued and completed contemporaneous with Ancel Keys's "prudent diet" (allegedly linking dietary saturated fat with heart disease) that found no evidentiary support for Keys's conclusions is formidable. Many were published in credible periodicals such as *The American Journal of Clinical Nutrition* and *The Journal of the American Medical Association*. Nonetheless, hard scientific evidence, or the lack of it, could not stop the political momentum and Keys and his biased followers had marshalled. The Prudent Diet became official US government policy. *See id.* at pp. 54-55. Keys's bias became institutionalized by the AHA and the National Institutes of Health. Id. at pp. 68-69. Finally, George Mann, a scientist whose professional career Keys destroyed through multiple means, stated, at the end of his career in 1978, "a 'heart Mafia' had 'supported the dogma' and hoarded research funds. 'For a generation, research on heart disease has been more political than scientific,' he declared." *The Big Fat Surprise*, p. 71.

[123] In 1977, the Senate Select Committee on Nutrition and Human Needs took up the question of diet and disease in America. Led by Senator George McGovern, with "committee staff made up of lawyers and former journalists who knew little more than interested laymen on the subject of fat and cholesterol, and nearly nothing about the scientific controversy that had been simmering on this topic for years, embraced Keys's view of a healthy diet" … which view were unsupported by actual scientific findings. *The Big Fat Surprise*, pp. 104-105.

[124] https://www.coach.ca/sodium-facts-for-athletes-p154692.

[125] Sodium (Na^+) and chloride (Cl^-) are the principal ions in the extracellular compartment, which includes blood plasma, interstitial fluid (fluid between cells), and transcellular fluid (e.g., cerebrospinal fluid, joint fluid). As such, they play critical roles in a number of life-sustaining processes, including; maintenance of concentration and charge differences across cell membranes, absorption of chloride, amino acids, glucose, and water; renin-angiotensin-aldosterone-system maintenance and function; secretion of anti-diuretic hormone (ADH; also known as arginine vasopressin [AVP]) by the posterior pituitary gland; and dopaminergic system maintenance; hyponatremia (a serum sodium concentration ($[Na^+]$) <136 mmol/liter (mM), may result from increased fluid retention (dilutional hyponatremia) or increased sodium loss). See *Sodium Chloride*, Linus Pauling Institute, Micronutrient Information Center, Oregon State University. http://lpi.oregonstate.edu/mic/minerals/sodium#AI.

[126] Lancet medical journal recently published a controversial study where the results supported a mid-range salt intake to protect your heart and your health. While high-salt diets are not healthy for your body, it turns out that low-salt diets are dangerous as well. *See Dangers of Restricting your Salt Too Much*, Lancet Medical Journal, https://doi.org/10.1016/S0140-6736(16)30467-6. "Increased sodium intake was associated with greater increases in systolic blood pressure in individuals with hypertension (2·08 mm Hg change per g sodium increase) compared with individuals without hypertension (1·22 mm Hg change per g; $p_{interaction}$<0·0001). In those individuals with hypertension (6835 events), sodium excretion of 7 g/day or more (7060 [11%] of population with hypertension: hazard ratio [HR] 1·23 [95% CI 1·11–1·37]; p<0·0001) and less than 3 g/day (7006 [11%] of population with hypertension: 1·34 [1·23–1·47]; p<0·0001) were both associated with increased risk compared with sodium excretion of 4–5 g/day (reference 25% of the population with hypertension). In those individuals without hypertension (3021 events), compared with 4–5 g/day (18?508 [27%] of the population without hypertension), higher sodium excretion was not associated with risk of the primary composite outcome (≥7 g/day in 6271 [9%] of the population without hypertension; HR 0·90 [95% CI 0·76–1·08]; p=0·2547), whereas an excretion of less than 3 g/day was associated with a significantly increased risk (7547 [11%] of the population without hypertension; HR 1·26 [95% CI 1·10–1·45]; p=0·0009). Compared with moderate sodium intake, high sodium intake is associated with an increased risk of cardiovascular events and death in hypertensive populations (no association in normotensive

population), while the association of low sodium intake with increased risk of cardiovascular events and death is observed in those with or without hypertension. These data suggest that lowering sodium intake is best targeted at populations with hypertension who consume high sodium diets. . . .

[127] A 2015 study found that athletes who adequately replaced the sodium lost in their sweat finished a middle-distance triathlon an average of ***26 minutes faster*** than those who didn't. See *Why Sodium is so Crucial to Your Performance*, (emphasis added), https://www.precisionhydration.com/blogs/hydration_advice/115861124-is-sodium-important-for-athletes.

[128] *A Comparison of the Essential Amino Acid Content and the Retention Rate by Chicken Part according to Different Cooking Methods*, Korean J Food Sci Anim Resour. Vol. 37, Issue 5, pp. 626–634. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5686320/. Published online October 31, 2017. *See* doi: 10.5851/kosfa.2017.37.5.626

[129] *Composition of free and peptide-bound amino acids in beef chuck, loin, and round cuts'*, Journal of Animal Science, Volume 94, Issue 6, 1 June 2016, Pages 2603–2613. See https://doi.org/10.2527/jas.2016-0478.