Thank you for the opportunity to present this particular material about paleolithic nutrition more in the context of sunshine and vitamin D, and it starts basically from the traditional old story of evolution, and one of the best articles at least from an intellectual perspective, is this one, by Dobzhansky and you can look it up on Google by simply typing in the words "Nothing in Biology Makes Sense" - this is gonna be the first one on the hit rate for that.

The originator of Paleolithic nutrition in a lot of people's contexts is S. Boyd Eaton, who through the '1980s and '90s published the number of items looking at nutrition from the traditional evolutionary perspective.

But one thing that I feel that they've neglected was essentially vitamin D nutrition. I guess one reason why this picture is interesting, is everybody's bare naked, because that's how we evolved. We are the naked ape. We evolved in the tropics and even this scheme is wrong, because the original human beings were black and not Caucasian, light-skinned individuals, but modern, in the evolutionary sense, humans existed on this planet for 100,000 years.

And the graph that you see here, the figure indicates the parts of the world that are inhabited by apes and monkeys, our relatives as it were, and we are unusual in that we don't even have fur. We first, as Homosapiens, evolved in the Horn of Africa around 100,000 years ago, and I would contend that is the part of the world for which the human biology is optimized. And I'll get into that in a little bit to a greater detail later, but what we've done - here's a map of the world and you're looking at distributions of human populations through the decades. 1980s, 1960s, 2005, but you can see that human populations are increasing, and where are they particularly increasing? It's north of where we evolved, around 30 degrees North latitude, basically still south of Italy, but basically the latitude of Florida. We've moved northward, in the world, but I would contend, we've not evolved to accommodate to that.

And the key thing to bear in mind is sunshine and its consequences, one of them being vitamin D nutrition, and during the summer part of the year, people are always worried about the UV index. Putting on sunscreen. If you go out, make sure you put on your sun screen, etcetera. But this is a little concept that arose in Australia. They call it the sunshine rule and there are several peer-reviewed publications to justify it. You need a UV index, if you're a white skin person, you need an index of about three and you can tell that that's the index on the sunny day in most parts of the world, when the sun is 45 degrees above the horizon, ie when your shadow is about the length of your height, then you can start worrying about getting vitamin D, or burning your skin, and as your shadow gets shorter and shorter the UV index keeps going up and up, so if you're looking down and your shadow is simply around your feet, the UV index is probably around 12 or 13, maybe even 15.

Now as humans migrated northward, in the world, there was a problem to happen - of course they had less and less sunshine and had to wear clothing, because it was colder, and a couple hundred years ago during the industrial evolution, one thing they called "the English disease" happened and it was characteristic of bent long bones. A disease that happened because of a nutritional deficiency, partly due to lack of vitamin D because of the lack of sunshine and sometimes perhaps lack and calcium.

So the way bone grows is first, the protein matrix of bone is deposited and subsequent to that, the

bone initially is soft, but as the calcium and phosphorus deposit into that, bone gets harder and harder, but if it can't deposit quickly enough, especially along the epiphyses where the bone is growing, you get bowed limbs.

We have some story book characters that are almost certainly examples of rickets, from a couple of hundred years ago, one of them being Tiny Tim, from the story of Scrooge and another one being a character from Central Europe, Heidi, a Swiss story of a girl where she had a cousin named Clara who lived in the big city and she likewise, was very frail, ricketic, had weak muscles, and bear in mind, vitamin D deficiency is not just related to bone, it pertains something called proximal muscle weakness - you have a difficulty standing up because your proximal muscles, your thigh muscles, are weaker etcetera. And these children also were infection prone; one of the reasons for that might be that the vitamin D influences the immune system, but during the several decades and through the 1980s, people said, "Well the reason they're infection prone is that they've got a muscle weakness. If you're not able to cough properly to get the infection out of your chest, you're gonna be infection prone and more weak."

Now, this Clara vitamin D deficiency scenario that relates to a probable serum 25(OH)D level of less than 10 ng/ml or in more international units, 25 nmol/L. But the story goes on, that Clara went to live with her cousin up in the mountains and Clara got healthier - she could walk, she was having no issues, but the probability here is that her 25(OH)D likely went up higher than 30 ng/ml, just from sunshine, not even eating specific kinds of diets.

Now, with regard to rickets, the more ominous thing, the thing that's worse than having bent limbs is that for a woman, whose normal shape pelvis is this, her pelvis if she has rickets, is misshapen, and will not permit a natural vaginal delivery. A woman with severe rickets is going to die in child birth and not have any more children.

Now, the part of the world where we originated is the Horn of Africa; most of us, if we're Caucasian, came from this part of the world, far north. And here's a map of the world, indicating UV of sufficient intensity to make Vitamin D. So up in the north, we have relatively far scarcity of vitamin D.

I just wanna talk about evolution and natural selection here. A species is optimized in terms of its biology for the environment in which that species originated or emanated from.

So if you think about a given location, whether it's Africa or the Galapagos, where we got some of the natural selection theory, you have a menu of potential genetics for a species. And on this Y axis you have fitness - fitness is not inherently survival of the fittest that is survival of the ones who can have the most infants that then will go on to have babies of their own.

Okay, so within a given climate, you have this kind of diversity of genetics available, and this degree of fitness for that.

On the other hand, if you change the environment, you're not changing the genetics per se, what you are is forcing genetics to somehow select from the menu of what is available.

And Charles Darwin would say that perhaps is not exactly in the optimal location anymore. And the key thing here is if you change environment, you may have some adaptation. White skin in the

North, for example; it will adjust, but it may not be totally optimal for the biology of the species.

Here's what we know about latitude. If you look at the skin color of a person you can estimate the latitude from which their ancestors came. And here's a study that was done, published in the 1990s, and here what you see is skin reflectance. In other words, the more reflectance from skin, the lighter that skin is... People who live in the tropics have relatively darker skin with poor reflectance and on the other hand, those who live in Scandinavia you recognize them as blond, blue eyed.

So the contention is that the reason skin color of people varies is, because a lack of ultraviolet light selected for lighter skin colors - lighter, skin color allows more vitamin D to penetrate the skin, allows the pelvis to form better and they will survive dark skin color. In Sweden, a 1000 years ago, meant you probably died in childbirth.

However, the amount of vitamin D that you can make in the skin is independent of your skin color. The only thing that skin color does initially, if it is very black skin color, for people living in the tropics, it can take them two hours of being out in the sun to generate their maximum amount of vitamin D and for a given day. On the other hand, for a white person like me I only have to be in the sun on a day like mid-June, 10 minutes on my front, flip over with my bathing suit on, 10 minutes on the other side - I've maximized my yield of vitamin D. A black person living in Toronto, where I am, may require two hours of being out in the sun, and they're not likely to do that.

Now getting back to Human Biology, recognize evolution or natural selection hinges largely on the ability of a group of individuals or a species to have babies.

And it's interesting to note that if you are over 45 years of age evolution and natural selection really had no care about you, your biology is not designed to live to age 60, 70, 80, or 90, if they're healthy people.

Here's a table that's looking at ancient basically stone age populations and the calculations are that the maximum age of these populations was in the low 40s. So if you only live up to 40 years of age, how can vitality or anything be influenced by the biology of somebody older than that? It's those reproductive years. Recognize that... In the Stone Age, nobody reached menopause, everybody kept having babies, and if you didn't have babies oddly, you died.

I just wanna change pace here, a little bit, and address the issues about vitamin D and its biology.

Now, what is made in your skin or even on the lanolin that's taken from sheep when they're cleaning the wool that's gonna become a wool sweater, you get 7-dehydrocholesterol, a compound that is a precursor for cholesterol, within the skin, but it's unstable. And when ultraviolet light of the wavelength B, in other words around 300 nanometers hits it, is it breaks open the steroid type molecule and effectively becomes vitamin D3 passively by non-enzyme change. The Vitamin D3 in your body becomes the thing that we typically measure 25(OH)D because this lingers in your blood stream for a long time and it's the accepted measure of vitamin D nutrition - 25-hydroxy vitamin D. If you get a vitamin D blood test, it's kind of a misnomer, you're actually measuring 25(OH)D.

This is the raw material with which to make a hormone. A hormone is a signaling molecule, it's a molecule that controls the way things happen in your body. 1,25 (OH)2 D classically was produced by the kidney and its production went up when the kidney was relatively deprived of calcium, the

kidney recognized as filtering all the blood that’s in your body, and it's filtering it over and over again, so it's a fantastic sensor of calcium levels and it's a fantastic organ with which the hormone calcitriol, or 1,25 (OH)2 D is produced and what it does, it goes on through the circulations to signal the intestine to turn on the machinery to absorb calcium better.

So again, you have 7-dehydrocholesterol, an unstable molecule, and when ultraviolet light shines onto it, the molecule breaks open, you see the broken B ring of the molecule, the liver turns it into 25-hydroxy Vitamin D sticking on a hydroxyl group here. And the kidney, or some other tissues, can make calcitriol.

Now, recognize that the vitamin D system does many things, classically it's the raw material that you need in order to make the hormone, to absorb calcium, but over the years, many tissues have been discovered to respond to the Vitamin D hormone or even to synthesize the Vitamin D hormones in small amounts that are localized and used just by the tissue. For example, the prostate we've shown is capable in vivo in the whole body of taking 25(OH)D and I'm turning it into the hormone 1-25-D and in the prostate, that hormone reduces proliferation and improves the differentiation of prostate cells; likewise the colon, bone tissue, brain tissue, etcetera, can all utilized 25 hydroxide for their own signaling systems.

I like to use the analogy of paper. By itself, Vitamin D, or 25-hydroxy, doesn't do anything, just like a piece of paper doesn't do anything until you use it, to create a message.

And the problem, of course, is if you've got too little raw material with which to make messages - institutions if they were to lack paper, would be not able to communicate optimally, and mistakes will happen. In biology, a mistake is a disease.

So the question here is, well, okay, we're measuring the nutrition level for vitamin D, 25(OH)D. What's normal? Like any time you do a blood test, the first thing any doctor or user of that test is gonna ask is, "Well what am I use supposed to reference to? What that's normal?” And I created a review some years ago where I took all the literature I could find about non-human primates.

And these are graphs, they're called box plots. The middle box indicates half the population that you sample okay, 50% of the group is here, the top and lower whisker are the highest and the lowest, values that are not statistical outliers.

So if you had a healthy ape or monkey in a zoo, or if you capture them in the wild, their blood test result for vitamin D will typically be more than a 100 nmol/L, in American numbers, more than 40 ng/ml.

Now we've done studies and others have as well, looking at life guards and outdoor workers... Well, not quite outdoor workers, 'cause they tend to wear clothes, but people who go to sun tan parlors for two or three weekly treatments. The study of these through the 1970s trying to understand what's the biological amount of vitamin that humans produce, and the blood test results for adults exposing skin to sun or ultra-violet. Their blood test results were more than 80 or more than about 35 ng/ml.

Now, when I set up our labs, vitamin D assays, in Toronto, Toronto's on the same latitude as Rome or pretty close to the same as Omaha or even Boston to the degree or two off from them. And to my shock when I set it up my value was 39 nmol/L. I was way down here. And the recommendation for

the Institutes of Medicine, is you should have a level that's higher than 40 nmol/L for sure.

So these numbers, yet bear in mind that they were taken in February, and most people were less than 80 nmol/L.

We did help a couple of clinical trials, but this one on the right is the result of a clinical trial of people taking a 1000 units of vitamin D for six months, that's just a little bit more than the recommended dietary allowance, these days.

So by taking a 1000 units, you are reasonably assured that your blood test result is going to be more than 50 nmol/L or in American numbers, more than 20 ng/ml. That black line is the number that most of us surely, even the most conservative researchers would want us to be higher than. Next, we looked at 4000 units of vitamin D because when you think about it, a newborn baby, what's the recommended dietary allowance for mom, breastfeeding her baby. That baby should be getting 400 units of vitamin D per day, and as adults, we are about 10 times the size of a baby and logically, 4000 units seem to fit in what we'd recommend for healthy babies and indeed the blood test result that we got for an adult taking 4000 units is similar to what you'd have in babies getting a steady diet of 400 units of Vitamin D, the number was more than 80 nmol/L for most of them, and we averaged certainly closer to 120 nmol/L. 4000 units of Vitamin D given to Canadians who don't get that much vitamin D through winter and spring gave them an average value of about 110 nmol/L or about 45 ng/ml.

So getting back to humans, what's biologically normal? Probably a level that's 100 or so... And if we look back at some geography here, this is a nice diagram. I guess I get stuff on these kinds of things. This is a month of the year, January, March, May, July, September, this is... Latitude... And the vertical axis is the amount of light energy that's produced per day, all day, throughout the year, that's capable those wavelengths capable of making Vitamin D. So this Y axis is the vitamin D capacity within given areas, and recognize that in the tropics, where we evolved, the amount of ultraviolet light B energy that impinges on the surface of the earth is five times more than the UVB energy that we get in Europe or Canada or Boston, it's far more energy that we were evolved for and we're moving way down here, and we ask ourselves is, "Might there be a problem?". Well, for some people there's been adaptation, like white people adapted to less ultraviolet light by opening up our skin by becoming white, being selected to have white skin – recognize, there's no such thing as race. There's only a gene pool for which certain environmental factors influence some phenotypic characteristics.

You might ask yourself, "Okay we've got the original inhabitants, we perceive Stone Age man to have lived 000000 years ago. Question, what would their vitamin D levels have been? Well, we have to take modern-day examples of people that are reasonably close to that. And Muskit, a Netherlands anthropologist, had some graduate students from the middle of Africa, Luxwolda, and these are nicely done publications. They went to Africa, and looked at relatively native tribes and looked at their blood test results, and incidentally the lab assay that they used was the same assay that I was using in Toronto. So our numbers are totally comparable. So the Massai, those traditional, more herding nomadic individuals, had blood results that were about 44 ng/ml or 110 nmol/L, but they also tested Africans who lived in the city and the ones who lived in the city had blood test results that were more like average white Canadians. So in other words, black people who live in the big city in Africa have blood test results similar to Canadians. I'll get on to this a little bit more because here's the story. You have a traditional African culture. They moved to the big city. Their

25(OH)D levels approximate those of white Canadians. Incidentally, the graph on the right here - our University of Toronto students, healthy university students, with various ancestries - African ancestry, East Asian ancestry, South Asian, and those who didn't want to disclose what their ancestry was… Okay, so these healthy urban Africans with levels comparable to the roughly 60 nmol/L that white Canadians have, move over to North America and then end of having blood test results that are averaging in the 30s, 30 nmol/L. And as you can tell, a quarter of them easily have a 25(OH)D blood test result that, in a pediatric clinic, would be diagnostic of vitamin D, nutritional deficiency rickets. These are not kids with rickets, they're healthy, but their blood test result is crazy low during February.

An interesting observation that Luxwolda et al also found was that classically, you've got this old wife's tale. Sorry, ladies, I didn't mean it that way.

You've got an old story that says that as you get older people's vitamin D levels go down, but very strangely in the nomadic Africans in the tribes, the traditional tribes, as they got older, their 25(OH)D level actually trended up so that their average values in these groups was 100 nmol/L, but a trended upwards.

Furthermore, during pregnancy, there were three again, nomadic tribes tested in different parts of Africa, the non-pregnant group had average level is just under 100 nmol/L, but without taking a vitamin D supplement. These sun-rich individuals had blood test results that went up to 150 nmol/L on average and then declined after pregnancy.

It wasn't just that one group, but different populations worked in the same manner.

Why would vitamin D levels go up so sharply, up to well over 100 nmol/L in people not taking a vitamin D supplement? It's well worth considering they have a reason.

So you've got this cycle that goes on in natural human biology, but we don't have that.

If you look up the vitamin D blood test results for women in Europe or in the United States, this is the range that you'll get them in, especially for black women, they'll be lower down here.

And if you think that the data from the Netherlands was maybe just a little bit quirky, these are data from Chicago, Durazo et al. published this in Journal of Human Biology.

What we're doing here is looking at average blood test results, this is a frequency distribution and this is the blood test results here.

Blacks in Chicago, and they've done it in international units, on average had blood test results that were 29 nmol/L, which is about 12 ng/ml. They also had a group of people who went to Nigeria to measure the blood test results. And again, these urban Nigerians based on researchers from Chicago had the same kind of blood test results, that the paper from Luxwolda did and incidentally they're the same numbers as white, North Americans, on average. So if you wanna ask about racial discrepancies in a health measure, this one glares you straight in the face. Might there be a health consequence to having a lower blood vitamin D level? And why doesn't anybody tell people about it?

There's something else that goes on with latitude. What you have here is the Vitamin D effective ultraviolet light amount in other words, this is ultraviolet light intensity on that axis and this is the month of the year, okay, down at zero latitude, the sun is bopping over your head twice a year goes north to south, but you've got a substantial amount of ultraviolet light in in the place all year if you go up to 40 degrees north latitude which, is sort of New York City, et cetera, but what people might call a vitamin D winter. We have parts of the year where you don't have enough sunshine to produce Vitamin D in the skin, and it creates something else. It means that your blood test result for vitamin D hops up and down all year.

On the other hand, there's been a report, and this one's published by the Mayo clinic. They had data from men in Tobago. Look at the blood test results for men living in the Caribbean, 35 ng/ml, 34 ng/ml, 34….

Okay, so the point here is, even for westernized black people living in the Americas, but if they live in the south, they've got high vitamin D levels more than double almost triple the levels of what blacks have in Chicago, and those levels are not fluctuating all year. They're steady.

I want to address something because there's an interesting phenomenon.

It's called the Vitamin D Paradox, and it goes to say, basically, blacks have better bones than white people, maybe they have lower vitamin D, but so what - they don't need as much vitamin D 'cause we've got healthy black people and they're doing fine, and even no official societies are writing that "African-Americans need less vitamin D and calcium" they're fine, do they need less? And there's even papers published in the likes of New England Journal that says it's normal for blacks to have lower vitamin D levels is just the way their biology is.

For example, here's an illustration of the vitamin D paradox, where you're looking at the age of people, and yes, this is total body calcium, it's basically how much calcium you have in your bones, and as you can see, no matter what your age, if you're black, you have more bone than a white person. White people have less bone.

So there was a... A conference held, an American government-sponsored conference, that was asking... Well, why do blacks have less need for calcium and vitamin D and why do they have such great bones...

I would say that's the wrong question. You're never gonna answer an issue if you don't ask the right question, because where does it start? Who came first - blacks or whites? Well, you should be asking is, why do white people have weaker bones than black people?

Black was the original color, there was natural selection that selected for whiter skin. If white people have less bones there must have been a reason why they have less bone... So you got a fitness benefit. What determines fitness? Fitness is survival of the fittest, what can determine fitness with regard to bone?

Well, we know that with regard to osteoporosis, white people have smaller bones, less bone quantity different bone architecture, mineral apposition rates different, but there's something that goes on, there's a cost to it.

So for example, with regard to black, white women and in the United States are conversely black... Black are more at risk of pregnancy problems, higher risk of requiring a cesarean section.

Why do have a cesarean section? One reason is Cephalopelvic disproportion - your pelvis may not be the right shape for your babies head. White women have lower risk, or rates of Cesarean delivery than black women and furthermore, if you are relatively deprived of calcium with each pregnancy, you have somebody called osteomalacia, and with each pregnancy, the pelvis mishaps more, so traditionally, if you're already prone to Cephalopelvic disproportion, each subsequent pregnancy will make it worse, 'cause the fetus is a big demand on the calcium of the body, and you take calcium out of bone, and you may not be able to put it back.

So here's the rationale for the concept that less bone may be better.

So early on in life, you're forming bone, you've produced unmineralized matrix and that unmineralized matrix needs to have calcium deposited in it. The thoughts on this side indicate areas of bone that do not have enough calcium deposited in them and some animal work has shown that if you have bone it is not completely mineralized, or if it's osteomalacia, that bone is more prone to bending.

How does the pelvis mis-shape? It bends. If you have less bone you can more completely mineralized that bone, and it will be resistant to bending. For a woman in Europe, a 1000 years ago, she might have had less bone, but a better proportion, wider pelvis that would help her survive. The pelvis was not misshapen.

There's a price to this, you may have more bone it's not well mineralized, but later in life, eventually it does mineralized properly and blacks in the United States, there can be more bone, stronger bone, less risk of osteoporosis, but the price after menopause, which ancient societies hardly ever reached, the price of less bone is greater risk of osteoporosis and fracture.

So again, here we go. You can find the article by just googling “Vieth weaker bones” published just this year, you've got a normal pelvis, and the pelvis of a woman with osteomalacia, I just wanna get into a sort of a side as to the way you properly diagnose bone quality and osteomalacia is through a pelvic biopsy, they can actually drive a sort of a hollow core needle through the top of the pelvis, and get a bone sample on a population.

And this was done on a population of car accident victims in Germany, and I have to say, the Institute of Medicine review of 2010-2011 highlighted this paper by Priemel et al as a basis for their dietary recommendations, cross-sectionally. So firstly, you're seeing some examples of bone biopsy samples, you're looking at what a pathologist would look at under stain slides under a microscope where the pink indicates bone surfaces and bone areas that are not totally mineralized the UN-mineralized protein that was deposited into bone. Okay, now the next slide what we're showing is, firstly, the 25(OH)D blood level, the ages of the various accidental death victims that were sampled for this population. But the rest of the graphs are showing that pink area that I showed you on the previous slide. There are different ways of representing the pink area. Up here, this is osteoid volume, the pink area divided by the total bone volume. Down here, you're seeing the surface, the length of the pink area divided by all the bone surface, and here you see the thickness of that pink bone area. And in theory, if you're eating a recommended dietary allowance, quantity of a nutrient, only 2.5% of people should end up with the disease characteristic that is the primary

outcome. Bone disease is the primary outcome measure for a healthy vitamin D and calcium.

What do you see here?

It's not 2.5%, this is 50 nmol/L or 20 ng/ml, the Institutes of Medicine, the people who define the Recommended Dietary Allowance says, Okay, you take what we're telling you? And you're only gonna have 2.5% risk of osteomalacia. This is formally what the Institutes of Medicine contents. On the other end, you can count for yourself. There were six osteomalacia measures here versus 20 there. You've got a decent amount of risk of disease or you can say, "Well try a different measurement. Okay, this is six out of 28 again, 39% probability of some measure of osteomalacia and here we got 5 out of 23 measures 18% of osteomalacia. What saying is the people who did the calculations for the Recommended Dietary Allowance for vitamin D were wrong. It's a highly contentious issue but even the Journal of Nature had articles explaining it this way.

So, as I'm getting towards the end of the talk, I'm getting into something that you could have a whole talk on. Does it make sense that higher amounts of vitamin D are only good for bone? Because as I indicated, earlier, many tissues throughout the body, respond to the Vitamin D hormone.

So isn't it plausible that something might be happening?

Don't pay attention to this busy graph, but there's a beautiful article published in British Medical Journal by Theodoratou in 2014, and this is what's called a meta-analysis, putting together all kinds of research. You can look up the primary publications by going into this British Medical Journal article, but I'm just gonna try to summarize it for you. Let me take a moment with this slide.

So these are represented by forest plots. It starts off with a vertical black line that indicates a ratio, and it's the ratio of a disease event, a disease happening in the high vitamin D group divided by a disease happening in the low vitamin D group. If a ratio of vitamin D does nothing, people with high vitamin D are gonna have just as much disease as the low vitamin D group. In other words, the ratio is going to be one. It'll fall on to that black line but what I've shown you as a guide, as a yellow line, I've drawn down the slide, and that is just as a guidance that shows that the higher vitamin D group had 50% risk compared to the low vitamin D, in other words, in low vitamin D there was more disease happening. Now let's see what diseases might be affected. And you can start looking at these certain patients with aggressive prostate cancer, okay, the dot fell right on the Unity line – in other words, no difference in risk. For breast cancer, depending on quartiles, there was a number of studies, 21 studies that show more vitamin D lowered risk.

There were some other studies just to be fair, of course, post menopausal breast cancer, etcetera. If you wish to look at the details there were some situations where you couldn't find it.

So with regard to cancer, it's a little bit on the noisy side, it depends on how much you want to believe. Lymphoma ovarian cancer, another prostate cancer collection, rectal cancer. So we start to get interesting around the cardiovascular disease area of the research. And for those there's a pretty consistent lower cardiovascular disease events, such as myocardial infarction, stroke again, less disease with higher vitamin D. Continuing on down that graph, we're continuing the cardiovascular section here. But with regard to depression, people who have higher vitamin D have less depression, less diabetes at least cross-sectional and surveys, less bone fractures. And I think in particular, the

one to bear in mind, cross-sectionally, people with higher vitamin D are less likely to die. With regard to the Vitamin D hormone itself, it really did nothing with regard to the Vitamin D hormone measurement – it is a hormone, it is not related to nutrition and its levels relate to calcium, not these other factors. So don't think about 1,25D or calcitriol as having anything to do with cross-sectional health.

Just to emphasize the vitamin D and sunshine component. Here's a survey of 20,000 women in Sweden who 20 years prior to this publication from 2016 by Lindquist were basically asked by people interested in skin cancer prevention, but they were asked about sun behavior practices and they broke the groups of women into groups like: “I never go in the sun, it's bad for my skin, I don't do it. I’ll keep away.” and those who say, "Well yeah, I’m okay with the sun, one way or another” or if they go into the sun... “Oh yeah, I go into it, I love it.”

Okay, on the y-axis here, you see the probability of death, and then you can see the years follow-up. 0-5-10-15-20. years of follow-up.

So after 20 years of follow-up almost 25% of the women, these are post-menopausal women, of at least over age 50, had died of cardiovascular disease, cancer, or other conditions, those who are not afraid of the sun but didn't actively seek it out. There was about 18% of them still alive, and those who said I really like going out in the sunshine - it was about 14% were still alive. So you look at the mortality. 25-18-14, and essentially where was the protection? Well, not so much in cancer, but cardiovascular disease was greatest benefit, and then other death causes as well.

I think it's an important graph.

The previous graph that I showed you from British Medical Journal, has criticisms - people go, "It's not vitamin D... If you've got a high vitamin D blood test like you showed it’s because of your lifestyle, it's whether you're healthy, active outdoors. So it’s not vitamin D.”

On the other hand, this one's interesting because this is not looking at vitamin D, it's looking at healthy outdoors activity, and it has critiques as well.

There's people who go, wait, come on, we know that sunshine makes a vitamin D, to put these things together, it may be nice to say, it would be nice to have perfect randomized clinical trials on vitamin D, but like all of nutrition, you never get perfect clinical trials. The only nutrient that has benefited from randomized clinical trials is folic acid supplementation for pregnant women, and for that it only takes nine months for the outcome to happen. With regard to sunshine and vitamin D, these are long-term investments that take longer than the four years that you might have a clinical going for.

So again, as you go through life, you never know the future, but what you can do is at least do things that adjust the risks in your favor, being healthy and staying in the sun, taking some vitamin D, eating fish, these are all good things to happen. So live your life in a way that helps your vitamin D or... Or UV exposure, to stay out. Remember, we evolved in an environment that provided vitamin D supply that raised our blood test results to a minimum of 75, so if you've got a group - remember the box plot if the bottom of the group is gonna be 75, what's the average probably, about 110 nmol/L or about 45 ng/ml. Low ultraviolet light environments selected for white skin and for less bone. But that doesn't mean we should deprive black people of the knowledge that maybe they

need either more sun or an easy technology solution, a little bit more vitamin D.

So again, people who live their lives so that their blood test result is higher than 75, be it being out in the sun or taking a supplement or trying to eat a lot of fish have better health outcomes. There's no denying.

And I put this graph or I mean the figure on the left because you look up healthy sunshine tanning vitamin D, and you don't get that picture, you always get some, bikini-clad, babe, on the beach. But this picture is more important because if you do all those things that are the good things, you're gonna be this bikini clad babe on the beach and maybe your little grandson is gonna stick their tongue out you, but you'll be there to smile back at them. And with that, I'd like to let it go for Carole. You had a few words to say here.

Carole Baggerly: Thank you, Dr. Vieth, for your presentation, that I think gave us all a very clear answer to " How does the population who have darker skin tend to have problems with vitamin D levels?" that has nothing particular to do, or at least it has very much to do with their color of their skin, and which means it takes longer to be in the sun to get the required amount of vitamin D. That's very helpful in this time of challenge with various diseases that are coming up because... In our mind as vitamin D researchers and ongoing things is that we've got to solve the problem of the deficiency epidemic and the first problem to solve is to get people's attention, and unfortunately it takes some time, something of a disaster to help people get their attention to solving a very significant problem with many nutrient things of our body.

We started as a result, GrassrootsHealth started as a result of a meeting with a whole bunch of researchers back in 2007, and Dr. Vieth and I will show you some others in a minute, but we laid out at that time, a group of scientists really wanted to announce that there was such an epidemic a long time ago, and so GrassrootsHealth, and our thing was to go forward with... Okay, let's see what we can do to make it happen. We have the scientists, we have results of research that have been done, we've developed literature, we've gotten participation of thousands of people all over the world. Hopefully, we've educated a lot. We even now analyzed it and certainly we published it, and we are always taking action right now, we really need to move forward very quickly to help resolve this other problem that keeps coming up. At the point in time that we met over the course of in 2007 when we started, my husband and I, Dr. Baggerley was retired and a physicist, we traveled the country to meet with the scientists to say, what's the message?

And they said the message really is about the vitamin D level and the vitamin D level, the 25-hydroxy D is what we we're talking about, was the target range here was between 40 and 60 ng/ml, and that was primarily because that was the evidence that we could come up with at that point in time and one of the delights of working with this group was over the period of time in these publications from the people living in the African climate which had their skin exposed most of the time, indeed as Dr. Vieth showed, are essentially in that range.

I wanted to show you what some of these beautiful people are and I'm truly honored to have been at the forefront of vitamin D research and the necessity for it. Dr. Tony Norman and Dr. Holick were both part of the really early stages of putting vitamin D on the map. And what is it, and all of that. And Dr. Norman was probably the first person I met face-to-face.

And then Dr. Grant, who many of you know, has been responsible for a lot of sun information, and

then Dr. Garland, famous cancer researcher, Dr. Gorman, an associate of his... And I think you probably know him because we just talked with him.

Dr. Holick, Grant, are all people that have given us a substantial help and advice to be able to convert the academics to public health messages. Dr. Haney was our research director for four years, and we are again very privileged to have worked with him to get the information about how to approach looking at what a nutrient is. Dr. Lappe, Dr. Willett, Drs. Wagner, Hollis, and Newman from the Medical University of South Carolina, which has done substantial research with many things regarding the necessity of vitamin D and the birthing process, and also the biology.

Our really next step is, Okay, what are we gonna do about it?

There is a major issue with the idea of having a clinical trial, an RCT to demonstrate that this vitamin D level and the COVID 19 has, why does it happen to have anything to do with health disparities, and what we are trying to put together now, not trying, but we have put together is really a community project that will be done at the University of South Carolina in Charleston, with this first pass. But the design of it is going to be what Dr. Haney has always said needed to be according to how nutrients are measured, we have to measure the baseline measurement of 25(OH)D, like when someone enters the project for these community projects, to ascertain if vitamin D helped or not, especially with health disparities, why are twice as many people who are of dark color having more serious disease than others?

We need to measure the baseline and we will take groups that are not hospitalized. We're not talking about treatment, but we will take those that may have been diagnosed with antibodies meaning they've already had some infection or exposure, and or none, but they are not hospitalized, type people at this point in time. We'll do that measurements throughout and we will be doing measurements on a regular basis, not just at the beginning. And specifically if the measurement of the first tests that we do in their so-called control group is deficient or rank deficient, like less than 20 ng/ml, they will be tested again and in two months if they haven't gotten up well above that, they will be again supplemented, their dosing will be adjusted so that they will be able to have the same level of achievement as the others. In other words, we do not need to keep them at a deficient level throughout the study, we will also very importantly, measurement of the co-factors that GrassrootsHealth has very clearly demonstrated in our thousands of people cohort that it matters what your magnesium levels are - as measured right now, we're doing the whole blood magnesium not the serum magnesium, also Omega-3 Index and vitamin C and calcium, and the end point really is the target achievement in this group of 40 to 60 ng/ml based on individual factors and the dosing will be adjusted to those.

This trial is being presented as a randomized trial, to certainly, in collaboration with Medical University of South Carolina, but we... and they are prepared to support it in a group around the country that feels that they have a group that really wants to do this, and you can set up many different community areas like that. And the other category of this trial is one that we will be doing, which is what we have called a field trial where we work with groups like we have a very large number of people that we work with at the University of Florida where they're doing an RCT in house, but there's also an open field trial out in the field, which gathers thousands of people.

So please stay tuned for this, let us know if you are interested in doing this and you can touch base with GrassrootsHealth and we will have that information for you very shortly.

The real key that I see in this, it was an absolute joy to see that we have actually brought to the forefront of the whole world, as something that isn't just - take a medicine when you get sick, but let's include the nutrients and the co-factors to start really changing the goal of our lives, not to cure illness, but to create wellness. And my heart-felt thanks goes out to all the researchers and the population that have chosen to participate in this. Stay in touch.

Thank you