Diet Doctor Podcast
with Lucia Aronica, PhD
Episode 50

Dr. Bret Scher: Welcome to the Diet Doctor podcast, I am your host, Dr. Bret Scher. Today my guest is Prof. Lucia Aronica. She is a PhD and professor at Stanford University, but she's taken sort of her circuitous path to get there. She's originally from Italy and you will hear in her lovely accent that she is pure Italian, and then she got her PhD in molecular biology in Austria.

She trained at Oxford and then found her way to Stanford, specifically to do genetic and epigenetic analysis of the DIETFITS study. So in this interview we get into the science, she loves science, and you're going to see her passion for the science and epigenetics, and we talk a lot about what epigenetics are and the research behind them.

But we also talk about some very simple concepts like gender stereotypes and how that impacts the DIETFITS results and how you structure diets and how that even-- sorry, how you structure studies and how that even is going to impact the results. I think you'll enjoy her passion.

If you get a little lost in the science stick with it, because she has some great gems at the end where her personality shines in about how we just should be acting as human beings and as scientists, acting as kids for the love of knowledge and not so much about the wars and the battles, which I think is great for all of us. So enjoy this episode with Prof. Lucia Aronica.

Lucia Aronica, welcome to the DietDoctor podcast. Thank so much for joining me.

Prof. Lucia Aronica: Thanks for having me, Bret.

Bret: That's my pleasure. So as a Stanford alumni, I always love having Stanford faculty on. It doesn't happen often, but when I get the chance to do it, I welcome it. I just wish you would've been there 20 years ago, when I was at college. I would've loved to have taking your course which I want to get to, but first give us a little bit of your background, how someone came from, presumably a pasta eating family in Italy to get a PhD, to end up at Stanford and now to be studying low-carb. Give us a little bit of your journey.

Lucia: Yes, I use actually to describe my professional journey as a love story between food and science. My first love was food. I was born in Italy, where we value food as a key component of health and happiness. And then my second love was science. I moved from Italy first to the University of Vienna and then to the University of Oxford to study epigenetics. And epigenetics changed the way I looked at food. I started to realize that actually food is not only calories but biological information. Is one of the most potent signals to our genes.

And then finally I was able to combine my love for food as medicine and the science, epigenetics by joining the group of Prof. Christopher Gardner at Stanford University and study how a low carbohydrate diet and low-fat diet can change our epigenetics and affect our health.

Bret: Now, did you also have a personal experience with the low-carb or keto diet that sort of also helped your enthusiasm for the subject?

Lucia: Yes, I did. During my PhD I was not only experimenting in the lab, but also experimenting in the kitchen. Actually at that time I did a bodybuilding program. I was actually very strong, I'm still strong and lift weights and love my squats and deadlifts. But at that time I was really serious with my workouts. And I experimented with the ketogenic diet as many athletes do. Actually the ketogenic diet was very popular in the 80s in the bodybuilding community. And by doing that I realized something was very counterintuitive for me.

So by eating less carbohydrates, my triglycerides, which are lipids... So, I was eating more fat, but my fat, the fat in the blood, my triglycerides, went down three times. So I started with a healthy value of 80, 90 mg/dL of triglycerides and I ended up with 30 mg/dL of triglycerides. Which I maintain now. And my HDL skyrocketed from a healthy value of 60 mg/dL to a value of 135 mg/dL, which I maintain today.

And I also learned something about what is normal, considered normal, like, I was in the normal range and I felt very, very healthy and then suddenly, I found myself having abnormally healthy values. Every time I went to a doctor, my doctor used to asked me, "What do you do for your health?" And so I was motivated by that and also my mother... My mother had a brain stroke in 2014.

She also had very high triglycerides and high HDL and the doctor recommended her to go on a low-fat diet and to take cholesterol-lowering drugs. Inspired by my transformation story, I advised my mother to try instead a low-carb high-fat diet. And after two months her triglycerides went down, she went to her doctor and her doctor asked her, "What did you do?"

And she told her doctor, "I did the opposite of what you told me to do. I went high-fat and no medicine." So, of course, this story also motivated me to join the group of Prof. Christopher Gardner who was just launched in 2014, the largest study ever undertaken to compare low carbohydrate and low-fat diets for weight loss.

Bret: Yeah, so I definitely want to get into that study, but first a couple of things about what you said. I mean, as a cardiologists I've never seen anything reduce triglycerides and raise HDL as well as low-carb diets. And it was frustrating to me that I wasn't taught that. It's just something we're not taught. And that's what I love about your story. You approach it from a scientific standpoint and from a personal standpoint, and I see that so often.

When people actually study and learn the science and become aware of the science that's out there and then they realize there's something to this and get the personal experience; that's what makes such like a heartfelt success that will make people really passionate about promoting low-carb diets.

At least it does for me and it does for a lot of other people, because it's not talked about enough and I really appreciate that approach. But you mentioned a couple of words, big words... I want to go back and review... about your progress. You talked about epigenetics, you talked about food as a biological substance, as medicine, as affecting our genes. So give a sort of the overview of

those topics and how you see their importance to health.

Lucia: Yes, the prefix "epi" means on the top. So epigenetic marks are molecular switches on the top of our DNA that can turn genes on and off. Just like a dimmer switch modulates lights up and down in the room. And these can explain why DNA isn't destiny. Why, for example you have the same DNA molecule in every single cell of your body and yet your skin cells look different from your brain cells.

So just think of your DNA as hardware and then the epi genome, the epigenetics, is the software. That is different in every single cell of your body and turns on and off different genes in different cells, so that they look and perform differently. And even animals and people that have the same genetics, but different epigenetics, can look very different from each other.

Think of identical twins, but also the caterpillar and the butterfly, queen bees and worker bees... They have all the same DNA but can look very different from each other. Even identical twins can develop different predispositions to diseases as they get older. And I think one exciting property of epigenetics is that some epigenetic marks are permanent, as if written with a pen, but some others are written with a pencil, so they are potentially reversible.

It's good news that some epigenetic marks are written with a pen, so that for example your skin cells don't suddenly turn into brain cells, but it's also good news that some epigenetic marks are written with a pencil. Because it means that lifestyle can change your epigenetics. It means that lifestyle is biological information.

So food is not only calories, but biological information. Exercise also is not only about burning calories, but it's biological information. Emotions are biological information. And our health is actually a book in progress that we write every day using our genes as the paper, our lifestyle as information and epigenetics is either the pen or the pencil.

Bret: A great description. And I think that's so important because so many people think their genetics is their destiny. And it's clear that that's not the case, that we can change in the way you said it. Food can change our gene expression, exercise can change our gene expression and even how we feel and our emotions can change our gene expression. Now, that's something we didn't know, what, even maybe 10 years ago? Like how new of a study is this?

Lucia: No, it's-- The field of epigenetics has been booming slowly in the last 20 years and then probably in the past 10 years has been really booming. And I... I was actually very lucky to start my PhD when the Nobel Prize for RNA interference, which is just a kind of epigenetic information, was awarded in 2006. So I felt thrilled about starting to work in this field.

Bret: Yeah, right place at the right time to kick off this great career. So that interest is what brought you to Stanford to work on the DIETFITS study. And I'll give a quick summary and then you can sort of take it from there I guess. But it was a follow-up to the A-to-Z trial. The A-to-Z trial showed that people who were on Atkins lost more weight than Ornish and Zone and other trials. And the DIETFITS as you mentioned was the largest study to compare low-carb versus low fat in a randomized trial.

And at the end it was considered a negative study, that there was no difference. But I think the details kind of speak a little bit differently. So tell us a little bit about your perspective of the DIETFITS trial, what it shows and what it doesn't show and kind of what you're looking at is the next step.

Lucia: In the primary analysis of the study, which was published in 2018, we didn't find any significant difference in weight loss between the low-carb and the low-fat groups. But to interpret these results we need to consider an important aspect of the study design that led to some overlap in macronutrients distribution between the low-carb and low-fat diets. And this is for two reasons. First both diets were focused on quality, so whole food.

And they both minimized refined grains, and carbohydrates, and sugar, so they were both lower in carbohydrates compared to standard American diet. Second, the participants were instructed to strictly limit their carbohydrate or fat intake only during the first three months of the study and then they were allowed to slowly titrate back carbohydrates and fat up to a level that they thought was sustainable for life.

The goal here was to make the results actionable for most people and relevant for public health. And in any dietary intervention there is some trade-offs between science and public health. A more science focused design, such as for example in a metabolic ward study, is better at addressing the question of whether a diet is effective, whereas a more public health focused design is more effective at addressing the question of whether a diet is sustainable.

But the thing is important to stress is that these are two very different questions and that the question of whether a diet is sustainable or not and what constitutes a sustainable diet, is a very tricky one. For sample, for you guys in Sweden it might be easier to embrace a low carbohydrate diet. And for us in Italy, because we love our pizza, spaghetti and tortellini. But this doesn't mean that Italian people cannot enjoy a low-carb diet.

After all my family and I have been enjoying a low-carb diet now for more than 10 years. And here I have perhaps a piece of advice to share with anybody, anyone who wants to reduce their refined carbohydrate intake. Whether it's about spaghetti, macaroni and cheese, bread. So it's become smart hedonist. So, my Italian friends always tell me, Lucia, I prefer to keep eating my spaghetti and have a shorter but happier life.

And I always tell them I also love pleasures. I just use my pleasures and don't let them use me. I am a smart hedonist. I think that we, humans, love having same routine, wearing the same clothes and having similar foods every day and we can use this nature to select and stick to those habits that make us happier and healthier in the long run. After all I think we can all agree that feeling great and having the energy to work, exercise and take care of our family are life's greatest pleasures.

Bret: Great point, that's what's priceless. And that's why there's not one diet for everybody.

Lucia: Yes, absolutely.

Bret: And when we promote low-carb diets, we promote it as an option for people that I think we need to talk about more as a potential option, but not as the one diet for everybody. And that's part of what bothers me about some pushing vegan diet is the one diet for the whole world, like with the Eat Lancet report. And that's just bound to fail because there isn't one diet for everybody. Now, to rewind for a second, to talk about the set up for the DIETFITS study, you said it in a very polite and balanced way.

But the way I would say it is this makes me mad. I mean this really upsets me the way that they started at 30 g per day, ended at 130 g and the low-fat group was at 210 g of carbohydrates. So it was 130 versus 210 and they still reported as low-fat versus low-carb. Because then this becomes

a misnomer; it's no longer a low-carb study. So that's part of what really bothers me about this trial.

And I get it, they designed it to be sort of a real world sustainability trial, but if you design it in a way that when you interact with people and you say, look this is a pretty hard diet to stick with. So I want you to start with 30 carbs, do it just for three months and then you don't have to do it anymore because I know it's hard to do.

Versus, restricting carbs may seem hard at first, but look at all these examples, these hundreds and hundreds if not thousands of people who have done it for years. It's something people can stick to if you really stick with it. And the reason why I make a big point about that is because it's the same with a physician, it's the same with a nutritionist.

If you sit down with them and they say, this is really hard to stick with, I don't think you're going to be able to do it, that's like a self-fulfilling prophecy. So the same for the study. So I'm sort of just venting here and I'm probably preaching to the choir with you, but I think that's a problem with the study design.

But you're not accepting just on face value that it was a negative trial with no difference in terms of weight loss or in terms of benefit for insulin resistance or genetics, because it sounds like you're taking it to the next step to analyze things even further. So what is on the horizon for you with how you're analyzing the data further to find more nuance in detail.

Lucia: I'm working on three personalized nutrition projects within the Stanford DIETFITS to look at whether biological differences between people, epigenetics, genetics, sex differences, can affect the response to a low carbohydrate or a low-fat diet. For an epigenetic project I'm focusing on an epigenetic biomarker of type 2 diabetes and asking, is this biomarker written with a pencil? Can we reverse it with a weight loss diet? Is there a difference between the low-carb and the low-fat diets?

We have a hint that this might be the case because this epigenetic biomarker has been shown to go up, so the risk of type 2 diabetes goes up when triglycerides go up, and HDL goes down. And we see that these two blood lipids are more beneficially affected by a low-carb than a low-fat diet. I'm also going to work on another epigenetic project and look at whether after weight loss people become epigenetically younger.

Epigenetics provide a way of measuring our age biologically. This is called biological age. It is the age of our cells and tissue. And it can be very different from our chronological age, which we typically measure by counting our birthdays.

I'm going to work on this project with Prof. Karlheinz Wagner at the University of Vienna and Prof. Steve Horvath who recently gave a Ted talk on the topic of biological age and also a lecture for my online course on diet and gene expression. You can find this lecture on my YouTube channel. I think it's a very exciting and informative lecture.

The second project is the project with the genetics and I'm starting this project with Prof. José Ordovás at Tufts University. We're going to expand on our primary analysis, in which will look at only three genes and we couldn't find any effect of genetics in response to a low-carb or a low-fat diet.

Bret: I want to interrupt for a second right there because I think that's such an important point. There were three genes that were tested in the original DIETFITS study. So to say that the nutrition

with a low-carb had no relationship to genetics, like that's just a broad statement, no relationship to genetics, as opposed to say no relationship to the three genes that we studied–

Lucia: Exactly.

Bret: Two totally different statements.

Lucia: Yeah, yeah, I get mad every time I read the health news. I'm trying to teach my students how to read the health news.

Bret: Yeah, that's important, that's probably the most important lesson you can teach them. So how many genes are you going to study then in this secondary trial... secondary analysis?

Lucia: We don't know yet. Hundreds or potentially thousands. So this new approach is called genome-wide polygenic course, GPS course. So we are going to see which-- Include as many genes as possible to increase the predictive power of our predictions. And so there's a lesson here for those that are using or want to use personalized health reports that are now widely available on the Internet.

Most of those reports are based only on a few genes, which makes them highly inaccurate. For example, according to 23andMe I'm 75% likely to have straight hair. And now I have two sisters that are curlier than me and so this illustrates the point very well. But things can even get less predictive when it comes to genes that predict the response to diet.

For example, most of the genetics variance that are claimed to be a contraindication for high-fat or ketogenic diets were identified only in observational studies with no replication in intervention studies. And in the context of diets that were high in both fats and carbohydrates. These diets are called obesogenic high-fat diets and there's a reason for that. Because they're bad for our health independently of which genes we have.

This doesn't mean that I think the field of personalized nutrition based on genetics is all smoke and mirrors. We do have already some examples of well-researched genetic variance that can re-affect how people respond to diet for example, whether people are lactose intolerant or not, whether they can use effectively Omega-3s from plants, such as Chia seeds, flax seeds.

Most Caucasians can't. And this is relevant for example for vegan people. On the other side some other people are at higher risk of low-grade inflammation when they eat vegetable oils or an excess of vegetable oils rich in Omega-6s. And this is the case of almost all of the African people. And it might explain why African people are at higher risk of cardiovascular disease when they eat a Western diet which is typically high in vegetable oils and the Omega-6s.

Bret: Yeah, there's so much in what you just said, that the majority of these genetic profiles that people get, focus far too much on one gene rather than looking at the whole picture. And the context is so important and I love-- I have to repeat what you said, that most of the studies were observational studies on high carb high-fat diet. So how do we know at all if that applies to a healthier low-carb high-fat diet?

And we don't, just because it hasn't been studied. But it doesn't mean you can throw out the whole genetic profile, because there are some genes that make a difference and especially when it comes to Omega-6, the polyunsaturated fatty acids. There's so much debate, there's so much mechanistic evidence that they are inflammatory and oxidizing and dangerous and we should avoid them, and then you go to the clinical trials in the human data and it doesn't translate.

We don't see necessarily this overwhelming danger of eating Omega-6 fats in the clinical trials. So, there's a disconnect. And part of it could be genetic variation, which definitely could be the case, and part of it could just be where's the food coming from and the volume and so forth. But that's were genes can play a role.

So, it's good to see or good to hear someone like you who knows this inside and out, knows the details that these are the genes-- There are genes in these areas that we can and should pay attention to that may inform us clinically. Because that's what people want to know. If I get this genetic profile, what can I change to help me? And that's a hard question to answer.

Lucia: Yeah, it is. I used to say to my students, always assess context, avoid confusion, achieve control... when you read a context. And then to question what was tested, in which context and for which people. It's so important.

Bret: Right. And then the third part of the study that you are working on that we haven't gotten to yet, which I think is one of the most interesting that you presented at Low-Carb Denver, and we have that talk on our website at DietDoctor.com for our members to see, they can see your whole talk there, but you looked at the gender specificities of how people responded to the low-carb diet, how they complied with it and the response they got. So can you tell us a little bit about that? I thought that was fascinating.

Lucia: Yes. That study is currently under review, so stay tuned. It will be hopefully published soon. We compared weight loss in men and women and found something surprising. So first, the men lost significantly more weight on a low carbohydrate diet than on low-fat, whereas the women lost similar amount of weight on low-carb and low-fat.

And second, the women had the lowest adherence to the diet of all groups, which begs the question of whether they might, like the men, have lost more weight on the low-carb than on the low-fat diet, had they only behaved well on low-carb? Now, we don't know, we cannot answer to this question, but we have a possible explanation as to why the women didn't behave well on low-carb.

Several studies indicate that women avoid fats more than men and also the women in our study reported to avoid fats more than men in our food questionnaires. Which might have made it for them more difficult to stick to a low carbohydrate diet, which is also high in fat. And everyone can test this hypothesis. Next time you go to the supermarket, just look around. It's no coincidence that every low-fat yogurt is pink, but rather a very smart strategy of the low-fat industry.

Bret: So, really speaks to gender stereotypes. It's not just what toys kids play with, but it's how we get marketed to and what we eat as adults. And it's maybe stereotypically a little harder for the woman to sit down and order the big ribeye with butter on it, whereas the man wouldn't think twice about doing that.

So stereotypes really do play a role, and how people are portrayed on TV and movies and it's always I'll take the salad with the dressing on the side. And it really does affect society, it affects how people think and I think that was reflected in that analysis, which is so interesting. **Lucia:** Yeah, it's interesting. And I think becoming aware of this stereotype can help people escape their pitfalls and take control of their health, but women, especially women.

Bret: Now, you've also said before that you teach a couple of classes at Stanford. And one of which I thought was so interesting was one of the ketogenic diet and the fasting mimicking diet.

And it's a very interesting combination to teach both of them.

And first that's awesome that there is a class about that. I think that's amazing and it shows how far we've come in the science of nutrition. But tell us a little bit about this class. What you like about it? What are some of the things you teach and some of the main premises?

Lucia: Yes, first of all fasting mimicking diets are diets that reproduce, mimic, the biological effects of fasting and its benefits. And I teach that the hallmark of all fasting mimicking diets is ketosis. So the production of ketone bodies. Therefore there are many ways of doing a fasting mimicking diet, because there are many ways of producing ketones. Nutrition is a toolbox and there's almost never only one way of doing a diet.

And so you can do a fasting mimicking diet by restricting what to eat, for example carbohydrates in case of a ketogenic diet, when to eat, for example with time restricted feeding, also known as TRF, where you limit your eating window to 8 hours or 10 hours in the day, or how much you eat. There are some protocols, for example of the prolonged diet by the prof. Valter Longo, which is based on a strict calorie restriction, up to 500 cal for five days.

All these modalities induce the production of ketone bodies. But also exercise induces the production of ketone bodies. At least, for example, go into ketosis after a workout. And exercise has some fasting mimicking benefits, including autophagy. So all these modalities can actually synergize together. Now, of course the degree of ketosis and the modalities of ketosis, whether it's a continuous nutritional ketosis or intermittent ketosis, will differ on these diets.

And also ketosis is not the only hallmark of the fasting mimicking diet. There is also epigenetics, gene expression... For example, we see that fasting and a ketogenic diet induce very similar changes in gene expression in children that are affected by epilepsy. There is autophagy, which is a mechanism of removal of a cell trash, which makes our cell stronger and younger.

And then there is the IGF-I, stem cells. And all these effects also differ between people. For example, we hear very often that fasting produces a beneficial spike in the growth hormone in the first two days, which preserves muscles and lean tissue. But this was shown only in young, lean people.

And it seems not to be true for obese and older people at least in the studies that were published. So therefore, for example... This might explain why athletes that are trying more and more TRF in combination with a fasted workout, they are seeing great results. This doesn't mean that-- I'm just pointing out again, context is important. I think, for obese people, fasting can be very beneficial.

But perhaps, they don't need to count-- They don't care whether they also lose a little lean tissue in the process, because they won't lose weight. And they can go for longer fasting, which usually is more associated with metabolic benefits and longevity. Whereas the short fast, like TRF, is more for body composition. So it's maximizing-- Usually it's coupled with exercise. And it is a way of basically creating a storm in your body, in which you start to really activate lipogenesis.

Then with the fasted workout these effects are even greater. And then, after the workout, you have the biggest meal of your day. You have super composition and then activation again of... ...like cellular processes that build muscle, so that you have benefits in body composition. So with fast loss--

Bret: And that's a great point.

Lucia: Maximum fat loss before and then maximum muscle building after workout.

Bret: So going back to context, too, like if you are worried about losing muscle mass with fasting in these studies that have shown a correlation there, what were they doing for exercise? Were they doing any element of resistance training? Because it probably doesn't take much resistance training to counteract that loss or maybe even gain some lean muscle mass even while fasting, especially for the shorter fast.

So I think again, like you said, context is important. Now one interesting point about fasting versus ketogenic diet and how they relate, when it comes to insulin, both are going to lower insulin and mimics fasting. But when it comes to other elements like mTOR or AMP kinase, for those I wonder if the ketogenic diet isn't going to impact those as much as fasting will and does that matter? What is your take on that?

Lucia: We don't know. Actually there are not so many studies in humans. There are lots of studies in mice. From the studies in mice, actually we know that a ketogenic diet does induce autophagy and does induce stem cell renewal, especially in the gut. Gut cells have higher production of ketones always. So higher than the other cells.

And apparently this is necessary to maintain their "stemness", their state of stem cells. And recently there was a recent paper I think published in Cell in 2019, showing that in mice ketones are metabolized that instruct cell feed, so maintain "stemness" in the gut.

Bret: That's really important, because the stem cell regeneration is like the fountain of youth. That's how we keep ourselves young, that's how we keep regenerating tissue. And that's one of the main votes in favor of a fasting mimicking diet because they showed their formulation in rats help with stem cell regeneration.

So have the same-- or maybe mice... rats or mice, I forget. But if the same can be shown for a ketogenic diet, that's really interesting; I wasn't aware of that. So are you saying that those are pretty equivalent then, as far as the literature is concerned?

Lucia: These studies were done in mice. So, again, I'm interested in the science. I think there are some potential mechanisms. There is a lot of overlap. From the epigenetics point of view we see a lot of overlap with the genetic and fasting. From the autophagy also; there are studies showing in mice that fasting and the ketogenic diet, both trigger autophagy.

Studies in mice also show that fasting and the ketogenic diet both induce stem cell renewal. So from a biological point of view there's a lot of overlap. I would love to see more studies in humans really comparing all these modalities. There are no studies of this kind so far. The largest studies in humans were only done... For example with the fasting mimicking diet by the professor Valter Longo, but there was no comparison with another diet.

People improve their blood lipids and IGF-I which is a marker of aging. But I also want to caution people that IGF-I is also very good for our skin muscles, so there's a trade-off there. But anyway, IGF-I went down, so people have beneficial effects, but this was true only for those those... for which these values, so triglycerides, IGF-I, were high at baseline. Which means... Probably, why these values were high at baseline?

Perhaps their diet was also related to that. Perhaps they had a bad diet. It makes sense. If they just stop their bad diet for five days they're going to have good results. Whereas those that have

a good diet and stop eating for five days don't see any benefits. I didn't see any analysis of the habitual diet of the people and now that might have affected the result.

I didn't see any comparison with other interventions. So this is what I teach in my course. And just asking questions. What was tested? How the baseline values may affect what we see? Just asking, asking questions. I think helps a lot to put things into context.

Bret: So why do you think that is? I mean that's a great example of how difficult nutritional science is to interpret and how apparently hard it is to perform a really good a nutritional intervention study. Does it does all come down to money because these are expensive trials and there's no big pharmaceutical company to sponsor it... is that the main factor there? What do you see is as the sort of hindering aspects of this?

Lucia: This is a difficult question. I think there are many reasons. Lack of funding is for sure a problem. Then there is the nature of science that is more really about asking questions than thinking of having the answers. And sometimes it's also normal that we all have our biases that are also going to affect the study design.

I think it's important is just to always try to challenge our beliefs and make sure that we don't let too much of our biases to influence also the study design; I think this is important. And then science is also a learning process, as everything in life. So we then use what other studies or previous studies have found to then to add new ideas and test new hypothesis so that we can make sure that there is a progressive advancement in size in the long-term.

Bret: Yeah, that's a wonderful point about recognizing our own biases. And it applies to scientists too, because you can design a trial in a way that favors one outcome over another simply by the interventions you do, the length of the intervention, what markers you measure. I mean these are important factors when you design a trial and bias can really creep into there.

So as someone who has a personal experience with the keto diet, I imagine this is something you have to fight with yourself too, to make sure you're not trying to just find a study that promotes a keto diet, but actually to use legitimate scientific techniques in the most unbiased way possible... That's something you wrestle with?

Lucia: Oh, yes of course, of course I do. And especially-- But I think that teaching helps me to check on my own biases and I also learn a lot from my students. For example some of my most engaged students are actually vegans. So for example for the class on the ketogenic diets, by getting interested in the biology of the ketogenic diets and framing ketosis as one of the most powerful biological signals of fasting, they actually become open-minded.

They try a ketogenic diet, they get that the ketogenic diet is not necessarily all about meat and butter and you can have a pescatarian version of keto, even a plant-based version of keto. And they really thank me for the thought-provoking course, which makes me very happy. Because I think that using an inclusive language is so important for improving science in society in general, not only in the classroom.

But on social media, or even for scientists at a conference. I can give you an example. I think most scientists use a lot of scientific jargon when they give a presentation. And this is an exclusive language. So they never get clever questions from the audience, because they're just not communicating with the audience.

I try to use an inclusive language even when I present at conferences and then get the best questions. Because my message lands where I want it to land and I learn a lot from the audience. So if you want to learn more and improve science and society, we need to be more inclusive in the way we communicate.

Bret: Yeah, that's a great point. And I've heard you say before sort of your philosophy on science and scientists and we need to be more like children and be more curious. Tell us a little bit about your insight there and your philosophy there, because I think it's so interesting.

Lucia: Yes, I think-- You know, I might be an idealist, but I think that humans have a born love for knowledge and we can use this knowledge to improve our lives. So we have all been children and we have all loved to ask questions to our parents and I think we can awaken our inner child every time we read the health news or even every time we challenge our beliefs, we review our habits and thoughts.

And just asking questions I think can help us improve the way we do nutrition, we communicate with people. And my message, I think the final closing remark I would like to make, is that making questions can help us move from polarization to personalization nutrition and make love, not war with food.

Polarization is what we see in the health news and social media, it's a natural human instinct. It's our need of belonging to a tribe, a group of people with similar beliefs that make us feel safe and supported. But I think that polarization comes with a high cost for the public health and goes against the essence of science. Which is more about asking questions than thinking of having the answers. So, I think that by asking questions we can bring everyone into the conversation and change science in society.

Bret: It's a wonderful way to end it on that note. Very cheerful, optimistic note of what science can be and how we can all learn, as scientists and individuals. We can all learn by asking questions and not being so dogmatic, but actually searching for answers, I think that's wonderful. Now, you mentioned the YouTube channel.

So, tell us what the YouTube channel is and if there's any other places people can find you, because I know after this interview people are going to be interested in hearing more about you and your perspectives and all your amazing research that you're doing.

Lucia: Yes, I have a website where people can find a mailing list, to receive updates about my projects, publications and courses. I have a Facebook and Instagram page @epiwellness of my online course on diet and gene expression, where I share some projects of my students and some knowledge, bites about epigenetics.

And I have this YouTube channel where I upload some of my presentations and some videos. I'm not very active on social media, so it's a good idea to subscribe to those channels to get a notification when I do have something meaningful to share.

Bret: Very good, thank you so much for your perspective and your knowledge. Good luck with all the research projects you have going on and I'll really look forward to seeing what comes of those. That should be very exciting. Thank you for taking the time to join me.

Lucia: Thanks for having me.