
DANNY LENNON: Dr. James Hebert, welcome to the podcast. Thank you so much for joining me on the show.

JAMES HEBERT: You're quite welcome. Glad to be here. Thanks for inviting me.

DANNY LENNON: Maybe to set the stage, can you maybe just let people know an overview of your area of interest related to your research, what you're currently doing, where you're based, those types of things.

JAMES HEBERT: So I'm going to be pretty expansive and I will answer your question, so I got interested in food really early in life. When I was young my parents grew a lot of our own food, we had a canning pressure cooker and I was in charge of planting certain crops in the garden, I remember beans were one of them, carrots were one of them; and of all my siblings, I was the one that was the most drawn to that. So I had an interest in nutrition for a very long time. What I found growing up was I'm very active, still pretty active, and as a kid I would get injured a lot. And I noticed at the time that my injuries would resolve much more quickly at the end of the summer than they would at other times of the year either earlier in the

summer, in the spring, in the fall, in the winter, and I just sort of put that in my memory bank. I said, well, that's kind of interesting. I ended up getting a degree in biology and getting disenamoured with academics and wound up starting my own construction business in Colorado which I did for six years. And it's interesting that at this point in my career when people look at my CV they never ask me about the missing six years which I think is interesting in itself, but it was another opportunity to learn how things work in a different sort of way. I wasn't very fulfilled by that, I ended up going to graduate school at University of Washington. But before doing that, I sold the business and went around the world with a friend. We hitchhiked to India, Nepal, and I spent some time there, and I really fell in love with Indian food. I came back and went to graduate school at University of Washington because the weather's really bad there, and I figured after being away from school for so long it'd be very good to be in a place where the weather wasn't good. And it worked out great, the weather was really awful, and I spent a lot of time being really studious. I got into this program at UC Berkeley, I went back to India for a couple years, and ended up doing my master's degree field work there and my dissertation field work. It started out in environmental health, but it came back to nutrition, and I ended up getting a degree in nutritional epidemiology from Harvard. So that's where my doctorate's from. After working for the UN for a couple of years, I came back to the US, worked at the American Health Foundation which at the time was I think the second largest freestanding cancer research institute in the United States, and then left there to join the faculty of UMass Medical School where I was for 10 years, and then came to South Carolina where I am now 21 years ago.

DANNY LENNON: So we have lots of different areas we could get into – of course, I want to talk about the dietary inflammatory index, but maybe taking a

step back from that first to lay some groundwork for people listening. If we think about how best to describe or define inflammation, what misconceptions may be come up around inflammation – it's often seen as a buzzword nowadays – so when thinking about chronic inflammation, how this ties to diet and disease relationships as we're going to explore later, what are a couple of the first things you feel people should know about the concept of inflammation?

JAMES HEBERT: Well, I think you used a really important adjective there, and that is chronic inflammation. So I think it's really important to distinguish chronic systemic inflammation from a normal ordinary and necessary inflammatory response. So inflammation isn't a particular pathway or mechanism, it's a substrate for lots of other things to happen. And the irony of it is when you're in a state of chronic systemic inflammation, that is the signals that turn the inflammation on, in the first place, don't turn off usually in a matter of about 72 to 96 hours. And the other signals that enable it to go off, don't turn on, then we are in a state of chronic systemic inflammation which ironically prevents us from mounting an adequate inflammatory response. And most people say, wait a minute, you just told me that inflammation is necessary for my mounting an immune response, and if I'm always inflamed, then I'm always ready to go, aren't I? And the quick answer to that question is, no, you're not ready to go, you're in trouble. If you're in a state of chronic systemic inflammation, you can't mount an effective immune response. And that includes responding to insults such as bacteria and viral infections and things like that, but also newly arising cancer cells that may be coming from those causes and from other places. So I think that's one really important misconception that people have, that inflammation is one thing and it's always bad.

DANNY LENNON: And I think we're going to explore more of that context and nuance throughout this discussion,

particularly as we look at some of these different disease states. But if we turn to the dietary inflammatory index first, of course, we will maybe get into some of the specifics about what that is, but from the perspective of the history of that and your drive to create that index what was the need or what was the gap that that you were aiming to fill with that, what was the main driver behind wanting to create the DII?

JAMES HEBERT: Yeah, great question. So when I came to South Carolina, there's certainly was a literature on inflammation and health, and I'm a cancer epidemiologist so the result was smaller literature and inflammation cancer. And Virchow back in the 19th century described how inflammation could be related to cancer. And if you look at Ayurvedic texts and Chinese traditional medicine texts from thousands of years ago, they described inflammation. In the Western tradition it's been described too relatively more recently around 500 BC or so, so a long time ago also, and it was the scribe macroscopically in terms of what you could see as redness, swelling, but also pain and heat. So those are the four sentinel characteristics, and people have known about this for a very long time. And there was a literature on it when I came here, one of the reasons why I came to South Carolina is there was a group of people interested in cancer and many of them were also interested in inflammation. And remember, what I said in my introduction about recalling that I would heal quicker at the end of the summer. Well, it started to dawn on me that one of the reasons why is because I was able to mount a better inflammatory response at the end of the summer. Why the end of the summer? Because that's when the crops were coming in. That's when the most fresh fruits and vegetables were there. And so, there was literature enough back in those days to understand these connections existed. So I went online, this was probably 2003 to identify an index that I could use for my work and diet and inflammation and cancer. And lo and

behold, there was a literature on each one of those things or the combinations of two of them, but there wasn't anything on covering all three. There's nothing that connected the index to inflammation, to diet, to cancer or any other health outcome. So I went, oh well, that's – my first reaction was, well, that's a problem, I want to use this thing that doesn't exist that I went, oh it's an opportunity. So at that point, early 2004, we started moving towards developing this index. So my first communication to my NIH program officer at the National Cancer Institute describing what I wanted to do was I found was from December 2004. So this thing has been in gestation for, was in gestation, I would say, for about five years before we came out with the original DII which is in 2009, and I immediately didn't like it for a bunch of different reasons. I thought the general concept was good but how we executed it really left a lot to be desired. But to answer your question it's because I fell in with a bunch of people here who were interested in these topics, and I was hired as department chair, but I ended up working mainly in cancer, I came here with a set of skills that they wanted to use and in order for me to enable that to enhance the probability of that happening that developing this index would be an important thing to do.

DANNY LENNON: Yeah, there's a couple of points I want to touch on there, and I think for most of us looking at nutritional science, the real important thing here with this index is that it allows us to consider overall dietary patterns and their influence rather than what has been maybe a pitfall for understandable reasons in this area where there's been this reductionist mindset of looking at individual compounds. And I'm sure you were very mindful of maybe seeing some of those mechanistic links, but how does that actually apply to our overall diet – can you maybe touch on that importance of that viewpoint of overall dietary patterns versus a reductionist perspective on individual compounds?

JAMES HEBERT: Well, drawing from the wonderful world of cancer, if you look at the trials that have been done to try to examine the effect of particular antioxidant vitamins in particular, so beta carotene and alpha tocopherol are two really great examples, there were a couple of trials that were begun in the 1980s, and one was in Finland called the ATBC trial, and the other one was the carrot trial in the US. The Finnish trial was in 28000 heavy smokers, and a quarter of them got vitamin alpha-tocopherol, vitamin A, a quarter of them got beta carotene, a quarter of them got both, and a quarter of them got neither. In the carrot trial they were looking – I can't remember if they were all smokers, but they were people working in asbestos industry and I believe they were also smokers and was a similar sort of trial and both trials failed. And in fact, there was an increased risk of lung cancer in the ATBC trial, and this is consistent with every trial that's been done looking at patients particular dietary components. And so the Selenium trial, the SELECT trial was done to prevent prostate cancer, and it produced the same result. And I think there are several problems there, one of them is what you alluded to: these vitamins, these nutrients interact with one another naturally. And if you look at the ATBC trial, they were supplementing at the level of I think 25 milligrams a day which is the equivalent of three medium sized carrots, I mean, they weren't mega dosing on this stuff, there was no reason why it should have backfired. I have my theory as to why, and actually I wrote a letter to the editor of New England Journal of Medicine why and it got all the way to the copy editing stage before they didn't publish it. But in any event, these are not good examples, but they're not aberrations. Every single time we've looked at individual dietary components and those kinds of trials, they just come up short. I think beta carotene is an interesting example because we pointed beta carotene over and over and over again not because beta carotene is the one and only carotenoid or the only antioxidant vitamin but it's there in many datasets. So if

you look at the USDA dataset that we use in the US that forms the basis for most of what we do, and a lot of people around the world use that as well, there are a few hundred nutrients in there. Well, there are a few thousand carotenoids, so beta carotene is maybe a marker for something else, and maybe important in and of itself, but it usually doesn't exist alone, it exists in combination with other carotenoids and other compounds as well.

So I think that that the idea of patterning is very important, and it's come into a lot of favor in the recent past. So a lot of the literature is consistent with what I'm saying and what you alluded to in your question. And I think the DII is interesting because if you think about how patterns are defined, they're defined either according to a cuisine like a Mediterranean diet, for example, whatever that is, there are 21 countries that border the Mediterranean Sea, and many of those countries have multiple cultures with it, but okay, Mediterranean diet, having lived in Asia for many years, I'll just accept it, I won't argue, but there are many more good diets than just a Mediterranean diet, but I kind of get the gist of it. So that's one way to define it. Another way to define it is to come up with a pattern that you see within a particular dataset, so you analyze data, you do a principal components analysis, some statistical analysis, and you can see how things aggregate or consumed together in the diet, and you can define patterns that way. In every trial, every study that we've done where we've done a principal components analysis, it's pretty predictable, you'll get a green vegetable pattern, you'll get a whole grain pattern, you'll get a crappy eating salty food pattern and so on and so forth. So that's the second way. The third way is with diet recommendations. So that would be like the US dietary goals or the Brazilian ones or the UK ones. And then we come up with a way to describe diet relative to those recommendations, and they all have their problems, they all have their idiosyncrasies. So in case the patterns, we're constantly changing,

sorry not patterns, but in the case of recommendations, we're constantly backtracking and changing recommendations, things falling into favor, out of favor. Cuisines are unique to particular cultures, so there's some limitations there. And then if you see a pattern within a particular study, typically, it's described in terms of nutrients, but – well, or in terms of foods, it could be either – but the point is it's limited to that particular context. And the advantage of the DII is it's not culture bound, it was designed so that it could be used universally in any culture, and it was focused on a particular set of biological mechanisms related to inflammation. So it wasn't any of those three other things.

DANNY LENNON: To go back on that point you made about when we usually consume these nutrients, we don't consume them in the isolated form we may see in a particular trial but most often we're consuming in the context of foods and whole diets. And not only do they have many different types of nutrients, oftentimes there's synergistic effects or varying different mechanisms that we may be even unaware of for some of these. And that actually maybe leads us on to with the DII what came about when you create the second version of it, and what changes were made. So maybe to set the stage for people if they're not clear at this point, can you maybe describe how would you introduce people to exactly what the DII is if it's the first time that they're hearing about it, and then can you maybe talk about the development of the second version of the index?

JAMES HEBERT: Okay. So the DII is a way to quantify the effect of diet in relation to inflammation, and the way we created it originally was we looked at the then extent literature. So this was through 2007, and at that point I think there were 927 articles that related anything to do with diet. So it was wide open with regard to diet which is a complicated search to do, if you try to do a PubMed search with diet you're going to miss

just the term diet, you're going to miss 75 or 80% of the literature – which I tell my students all the time, I say, you want to see how to do it wrong, I'll show you how to do it wrong, then I'll show you how to do it right, you'll see there's a really pretty big difference. So when we did it at that time, we scanned the literature, and there were 33,000 articles that looked like they could qualify, that is they were related to these six inflammatory biomarkers, interleukin one beta, interleukin six, interleukin four, interleukin 10 C, C-reactive protein and TNF alpha tumor necrosis factor alpha. So those were fixed, those six markers, and the literature at that time, and the literature now is completely consistent and those are the right six to look at. So if one thing I've learned over these years is we got that part of it right, we really picked the markers well. But anyway, when we developed the index at the time and the goal again was to come up with something that would describe the effect of everything, that we could quantify and describe in diet in relation to these inflammatory biomarkers.

And there were, I think 3000 articles that could have qualified. We ended up, as I said, scoring 927 of them. And at the time I said, well, I don't like making assumptions that aren't good. I mean, the few in general – I'm an epidemiologist by training, so the fewer assumptions that we make that we're forced to make the better, so that's where I'm coming from. So I said, well, let's not make any assumptions about the amount of food that's eaten, we'll just accept whatever quantity is reported. Well, the problem with that of course is the difference between a milligram and a microgram is three orders of magnitude. It's a thousandfold different, so there were four, I don't remember exactly what the nutrients were, but there were four nutrients that we either had to multiply by a 100 or divide by 10 in order to get them to be reasonable, because otherwise they would exert way too big an influence or way too small an influence. So I

didn't like that, the more I thought about it more, I really didn't like that. And the other thing I didn't like was that the scores would increase within with decreasing inflammation. My thought was if this is an inflammatory index as the number should goes up, the inflammation should go up. So that was the – but the major problem was the assumption business. So when we developed it the second time we came back three years later, the literature had doubled in size in three years. So it's really proliferating fast and it's now, last time I looked, it's probably quintupled, but what was interesting is if you look at the effects in the data from the 927 qualifying papers in '07 versus the 1943 papers three years later, there were no inversions, there was nothing that was positive that became negative, nothing that was negative that became positive. Basically, just the relationships that we observed were getting stronger, and we had more parameters to look at these polyphenols and flavonoids and stuff. So that was encouraging, and then I said to Nitin Shivappa who's on virtually all those papers, as you know, I said, "well, what we're going to have to do Nitin" (he's a doctoral student at the time) "is we're going to have to go and identify databases from around the world that we could Z-score, so these are databases that would describe surveys in different countries that varied a lot according to their intake that we could then create a composite dataset where we could describe the mean of the distribution and the standard deviation of the distribution, and from that compute a Z score for everybody's reported intake.

And then we would take that and we would normalize it because most of these nutrients were skewed, so we want it to be a very symmetrical distribution, so we turned all those Z scores into simple proportion, the zero to one, and then we multiplied by two and subtracted one which made them a symmetrical distribution with a mean of about zero that went from zero to one and then we'd

use those as the multipliers. So it was way more complicated on the back end. But the front end was intuitively very appealing, easy to use, and so forth, but it did complicate it, but having done it once, we now have the algorithm and we can just keep doing it.

DANNY LENNON: So if we have now this ability to quantify with a score this inflammatory potential of different dietary patterns or how someone's diet may look, to give people an idea of how that relates to dietary patterns they may be familiar with, what types of diets would lead to the highest scores, the lowest scores, etc.?

JAMES HEBERT: Yeah, we published an article in, I think it was called Digest, it's an organ of the American Academy of Nutrition and Dietetics, and we compared – in that instance, we compared three different diets. So American fast food, which I think to be the archetypical worst diet you can eat; and a Mediterranean diet based on the former president of our university here, his wife wrote a number of different cookbooks, he is Greek, she's Irish – or she's Irish American, he's Greek American, he's from Cyprus, but they would do sabbaticals in Cyprus and she would collect these recipes. So we took recipes from her book. And then we also looked at macrobiotic diet which is kind of a modified Japanese diet with whole grains, short grain, brown rice and adzuki beans and lots of vegetables and stuff like that. If you look at the 11 countries that form that comparative database, the absolute lowest score you could get, the most anti-inflammatory was around minus nine I believe, and the most pro-inflammatory was positive eight. So that's the maximum distribution. The reality is you're never going to get – you're rarely going to get a whole diet that's below minus 5.5 or so or above positive 5.5 or so. So the American fast food diet's about positive five. The macrobiotic diet was around minus 5.5. And the Mediterranean diet was around minus 4.5.

We have since looked at other diets like vegetarian South Indian diet is the most anti-inflammatory and it's around minus six, and North Indian – and the reason why the Indian diets are lower than macrobiotic, it doesn't have anything to do with the macronutrients, but it has everything to do with spices. So spices are almost always anti-inflammatory. So in general, the spicier the food you eat, the more anti-inflammatory it will be. In macro, I don't know if you're familiar with macrobiotic food, but it's really bland.

DANNY LENNON: I have not put myself on that diet, but I'm familiar with what it looks like.

JAMES HEBERT: Yeah, I would rush to do that, although there are amazing stories of people recovering from cancer with a pretty strict macrobiotic diet. In fact, I'm talking to you from the Norman J. Arnold School of Public Health in Columbia, South Carolina, and Norman Arnold attributed his living for 30 years after a diagnosis of stage four adenocarcinoma of the pancreas to hooking up with Michio Kushi and eating a strict vegetarian diet for three years. So he had a death sentence that would have kill them – I mean, normally people with that diagnosis don't live more than three months, and he ended up living 30 years, so there are examples and we brought his case to the NCI, we actually went up there with boxes full of his medical records and slides and stuff like that, and they actually categorized them as the best case which means he was more than five standard deviations than what you would normally expect. So yeah, depending on your disease state and what your requirements are, the diet can exert very different influences. So I think that's really important to keep in mind. You're not just dumping these foodstuffs into an empty vessel.

DANNY LENNON: When we think about just foods generally, are there some that quite clearly oftentimes, if someone were to include more of them in the diet, would see a significant shift in that score

that their normal diet would have – so if someone's eating a standard typical diet, what are some of the maybe lowest hanging fruits, so to speak, of some changes that would lead to an improvement in the DII score?

JAMES HEBERT: I could take a sandwich like a turkey sandwich or something like that, and I could move it from a score of F which means that the DII score for that sandwich is above three, and I can move it into the A category by adding lettuce, red leaf lettuce, going with a leaner cut of meat, I'm starting out with one that's a little bit fatty, so a little bit leaner cut. And adding pickle would be a good example, and other spices, pepper would help, green pepper, both Asian pepper and New World pepper, capsicum containing pepper, those would help. And I can bring it from a really bad score to a good score, we were working with a group called Fruisers that make these whole fruit frozen snacks for kids, and they were coming up with these recipes that were C's. They were kind of middle of the road, not the greatest, I'm referring to our food grade system now, there's a pretty good correspondence between the numerical score and the letter grade. So a C would be middle of the road which is not great. So we worked with them and actually increase the amount of highly pigmented fruits, because the reason why fruits will be pro-inflammatory is they have a lot of sugar in them, and sugar itself is pro-inflammatory. So a banana, for example, a really sweet banana will have a worse score than say blackberries or blueberries. So by adding fruits that are more heavily pigmented and cardamom was another case, a cardamom both increases the palatability and digestibility, and it also decreases the DII score. So we were able to bring those foods from a category C down to Category A, so it'd be strongly anti-inflammatory. And about nine years ago, yeah, it's nine years ago, I gave up coffee for reasons kind of independent of this, and I substituted with masala chai, and the masala chai is really strong anti-inflammatory.

When I started using masala chai, I used to play squash every day, until this silly epidemic started, now I don't play at all, I just ride my bicycle, I used to take an NSAID every time I played, and I'm doing it once a day. And as I said, I lived in India for a while, in Africa and I had occupational, let's say, illnesses, like hepatitis and dengue fever and malaria and stuff, so my liver should not be trifled with. So when I switched the masala chai, I stopped needing to take these anti-inflammatories. So the masala chai has got the usual, and it's got cardamom, nutmeg, cinnamon, lots and lots of ginger, turmeric, black pepper, sometimes red pepper – tea itself which is slightly anti-inflammatory. So it's just this brew which is strongly anti-inflammatory and this one that I'm drinking now, this smoothie which I make before I go to class so I can drink while I'm in class, it has arugula in it which is strongly anti-inflammatory, it's got a little bit of kefir in it which is probably fairly neutral, some mango juice which is fairly neutral, and a lot of blueberries, and I put a little bit of cardamom in. So it probably is an A as well. So it tastes like a milkshake. And the other thing I'll mention which I think is really important is these spices trick your brain into thinking that whatever you're consuming is sweeter than it really is. So when I make this masala chai, it has one seventh of the sugar of what we call sweet tea down here the American South, which is about the same as sugar sweetened beverage. So it tastes like it's as sweet as that or maybe a little less sweet but it's only got one seventh of the sweetness. So there's something about the spices in addition to exerting this effect in terms of inflammation that change the flavor profile of the food, and that's something that people can play with. I think if you're an adventurous some sort of person, you can do that, and I'm moving away from the science now more to the practical side of if you're a consumer what can you do about that. So that's one of the things you can do about this.

DANNY LENNON: Incredibly helpful, and I think it goes to show that there are changes that don't have to be necessarily hugely dramatic to the diet that you've said making a few substitutions of different types of ingredients can have a big impact or including some more of these particular foods, and I think that will be very helpful. If we were to think about how diet relates to these various chronic diseases that often have an underpinning with inflammation, as you mentioned at the start of this, it's a huge area now whether it's the links between cancer and inflammation, insulin resistance inflammation, cardiovascular disease, we could name a whole host of them, inflammatory bowel disease, as the name suggests, so with those diseases, when we look at some of the nutritional epidemiology and how it relates to those different disease states, do we see a correspondence with that, and also the types of diets that would correspond to the highest or lowest inflammatory index to kind of corroborate what we're saying that, yes, it has this impact on inflammation, but we're also seeing that play out in the long term in terms of disease risk – if that question makes sense?

JAMES HEBERT: Yeah, no, it makes perfect sense. So one criterion among the criteria for judging causality that was developed by Bradford Hill when he was working with Sir Richard Doll and that that gang at Oxford, one criterion was consistency. So I think what you're doing is essentially invoking that, like, is there anything inconsistent about what we see when we look at ecological, large whole population level experiences in relation to diet on the one hand and these outcomes on the other? And I would say the answer to that is it's highly consistent. So you look at these Blue Zone diets from around the world, they're associated with populations that have really long lifespans and little disability as they get older, which I think is really crucially important. We're really obsessed in the West, at least in the US, but I think you're probably obsessed in the UK as well about living a long time. Well, I'm much

more concerned about not having disability as I get older than living a long time. And yeah, they're correlated, I mean, typically people don't have a lot of disability as they age, live longer. But we can keep people alive really effectively. If you've made a mess of yourself and you're wealthy and you live in the US, you can buy a lot of extra years of life and be miserable while that's happening. So you look at these Blue Zone places around the world, and yeah, they typically are eating a diet that's very low DII, lots of fruits and vegetables, and they have both long lifespans and little disability as they age. So completely consistent with that, and one of the nice things about the research with the DII is we start out with a known denominator, a lot of people complain that epidemiologists are cherry picking and there's a publication bias that we don't really know about, so on and so forth.

Well, we have, I think we're up to something like 25 studies that look at colorectal cancer outcomes. So I got the denominator and we try to publish everything whether it's a null or not, so I would say probably 15% of the articles that we've published are null, and that's about the proportion of null results we get. And we're working with a group now, they're mainly in Australia but there's one guy at Cambridge and we're doing an umbrella review of meta analyses. This is a meta analysis of the meta analyses, and I think what that's finding is that something like 68% of all the results are in – by that way of looking at things consistent with the hypothesis which is a little lower than what we're finding from the literature as a whole, because some of those other conditions that don't have a robust enough set of findings to warrant a meta analysis, they just haven't been analyzed yet.

DANNY LENNON: I mean, the fascinating thing here really is the fact that there is data now showing these links between a DII score, and potential risk for some of these chronic diseases, one of those meta analyses that I remember looking at was I

think on cardiovascular disease where they showed an increased risk of somewhere around 8% of CVD risk and mortality for every one point increase in the DII score, so with something like that, that alone would be amazing. But when we throw in the fact that inflammation isn't single cause of cardiovascular disease, there's many other things that influence that, the fact that just looking at this component of it and the impact of that through diet is pretty compelling, and to me at least was a kind of standout moment because cardiovascular disease as with all these other chronic diseases are multifactorial and very complex. So to be able to see quite clear associations there is quite impressive.

JAMES HEBERT: Yeah, absolutely, and an 8% shift for each point when I, you know, I've already said the total range is essentially 17 points, so you can move five, six, seven, eight points without it being a huge problem. I mean, you need to rearrange your thinking somewhat, you're not going to be going to Wendy's or Burger King or something on a regular basis, but if you can get past that it's really not that hard to do. And especially now, a lot of people are preparing their own food. And Colombia is a small city and within a few kilometers of our house we have a huge Asian market, we got an Indian market, we got – you're probably not familiar with some of these chains but Trader Joe's and Whole Foods, and you can get lots of, I mean, even in a little city like Columbia, South Carolina, I can get food from really anywhere. I mean, I can get durian from Southeast Asia here, really. So it's like paradise in a way, and this whole this whole idea, I'm going to digress a little bit here that it takes a lot of time and effort to prepare food, it's just not true. It just plain isn't. I used to have a watch that had a timer on it, and I would actually time how long it would take from the time I would acquire the food to actually preparing it, and it's less time than fast food. And this is without much of an economy of scale for one or two people, I mean, if you have a family of four or five people, it becomes

relatively inexpensive. And the other thing I'll say is these anti-inflammatory foods are colorful, and as we've already kind of alluded, but I'll come right out and say it, they're also very flavorful. So these are, if you're clever in how you put things together, combining, getting back to what you said about patterns, you can combine food in such a way that can be very pleasant for people at any age including kids who tend to be a little neophobic, let's say.

DANNY LENNON: Yeah, it's that small amount of upfront work of just familiarizing yourself with those types of foods and thinking creatively of where they can pop into your diet. But from there, it's relatively similar to probably what most people are doing already. The kind of final big thing I'll ask is in this, I suppose, the more general area of diet-disease relationships and diet-inflammation-disease relationship really, what are some of the important research questions you think are next to be explored over the next number of years whether that's through your group from others, what kind of research questions seem interesting to you that you don't think we have a really good answer to as of yet?

JAMES HEBERT: I think neuroinflammation is a real frontier area, I think that that will become more important, and I think the impetus is going to be from the fact that populations are aging everywhere, and people who are eating diets that are very pro-inflammatory, that are conducive to chronic systemic inflammation and aren't getting enough physical activity, and are more likely to be obese are going to be miserable, more miserable than they are now because the healthcare delivery systems are going to be failing. So if you look at the amount of money and trouble that's focused on type 2 diabetes in the United States, it's obscene – it's hundreds and hundreds of billions of dollars and it's completely avoidable, and to a large extent, reversible, and even some of the sequela, even some of the downstream effects are also reversible. So I think there's a lot of

potential there. So I guess, I'm alluding to two areas: neuroinflammation, neurodegenerative diseases, and then the other category would be the big public health elephant in the room, and there's a pun intended there, and that's type 2 diabetes which is not unrelated to that other thing.

DANNY LENNON: Before I get to the very final question of the podcast, for people that are interested to learn more about your work, more about the DII or anything else you'd like to let them know about, where's the best places to send them on the internet that you might want to divert their attention?

JAMES HEBERT: Well, they can access the National Library of Medicine through PubMed, that's a really good way to do it or Ovid, if they have Ovid if they're at an academic institution, it's a better search engine. So I like to go to the National Library of Medicine because a lot of what you get on surfing the internet can be misinformation, so I think that I will always tell people that people can always contact me, I'm fine with fielding information, and we have a company called Connecting Health Innovation, also known as CHI which also can help people on the clinical side. So if people want to actually get access to these tools like DII on demand and our screener which should be coming out soon and this Imagine program that they can go there, and that's just Connecting Health Innovations LLC, or imaginehealthy.org.

DANNY LENNON: And for people listening, I will link up to those things in the show notes of this episode so you can check those out. With that James, that brings me to the final question I always end the podcast on, and it's simply: if you could advise people to do one thing each day that would have a positive impact on any area of their life, what might that one thing be?

JAMES HEBERT: Wow, that's a great question. I think just to reduce total waste, and the reason why is because we're facing these severe

environmental problems that show up in climate change which has implications for our food supply and distribution and all kinds of things. And what I find, from just looking around, so this is kind of a weird way to answer your question, is we live in the United States, we put out our garbage in our recycling, garbage every week recycling every other week, and we put out a tiny, tiny fraction of what our neighbors do, I mean, like 1-20th. And it's not an accident that we produce so little waste and eat so well. They're related. The more heavily packaged things, the more wasteful your lifestyle is in other ways, the more damage you're doing to the environment. And there's going to be a day of reckoning from the way we farm and the way we distribute food. And you can see it, California is burning down. I don't know what proportion of the – I think half of the produce, no 40% of the produce in the United States comes out of California. The other 40% comes from this area, the southeastern part of the United States, and that's, talk about waste.

DANNY LENNON: Yeah, I think that particularly now it's at that tipping point where more and more it's just becoming the stark realization of, yeah, it's not this abstract idea that no we're actually getting close to the point where this can't be reversed, and something catastrophic could happen. So I very much echo that message, and I appreciate you for sharing that. With that James, let me say thank you so much for your time today and talking with this stuff with me. And like I said, it's been an honor, given all that you've done in the field, and I appreciate for all the work that you've done, that you've contributed to this field of nutritional science and epidemiology more broadly. So thank you for taking the time to talk to me today.

JAMES HEBERT: You're quite welcome. Thanks for inviting me.