186: Resiliency Radio with Dr. Jill: Unlocking the Choline Connection with Gene Queen, Sarah Morgan!

Dr. Jill 00:12
Hello! Welcome to Resiliency Radio, your go-to podcast for the most cutting-edge insights in functional and integrative medicine. I'm Dr. Jill, and in each episode, we delve into the heart of healing and personal transformation. Today, we're talking to the Gene Queen, Sarah Morgan—not only the Gene Queen but a dear friend of mine—about unlocking the choline connection, a key to Alzheimer's in women, decoding its impact, genetic factors, and vital strategies for you out there for optimal brain health.

Dr. Jill 00:43
Sarah Morgan, the Gene Queen, is a clinical nutritionist, seasoned product innovator, founder, author, inventor, and thought leader in the field of health and wellness. And she's personally a dear friend who I can always count on for ideas and vision and to bounce things off of. She's one of my favorite people to talk to about innovative ideas. She has created patented technologies, dietary supplements, medical foods, and bioidentical hormones. Known for her innovative ideas that connect science to everyday life, she delivers impactful, science-based solutions for common health problems. Welcome, Sarah!

Sarah Morgan 01:17
Thanks so much for having me! It's so great to be here.

Dr. Jill 01:21
It is. It's like coffee with a friend, and everybody gets to listen in. And the funny thing is, this is like what we would be doing in a coffee shop anyway. This is true to life.

Dr. Jill 01:31
I want to dive into choline and women's health in particular. So many women out there need to know this information. Many of them may be experiencing brain fog, cognitive issues related to hormones, or, as we were talking about earlier, this lack of motivation that can sometimes come, [which is] all related to our hormones.

Dr. Jill 01:47
Before we dive in there, I always like to know your backstory. How did you get into innovation, nutrition, and all the things that you've done? Tell us a little bit about the journey there.

Sarah Morgan 01:57
Yes. I was originally planning on going to medical school. I come from a family of cardiologists. I worked in a neuropediatrics and trauma floor with a hospital associated with the Mayo Clinic. I realized I had a passion for nutrition and this idea that our food could be a foundational aspect of health.

Sarah Morgan 02:17
This was before it was actually cool or trendy, so I was this lone ranger. I made a really brave decision to say no to the path to medical school and find a program that taught nutrition and biochemistry because it really is biochemistry at its core. And it's the way that we can utilize it to optimize human health.

Sarah Morgan 02:39
I just jumped in, and I haven't looked back ever since. It's been so fun to utilize nutrition as this incredible tool to optimize human health in so many different ways. And on that journey, I got interested in genetics too—to apply that as a proper puzzle piece of the overall story.

Dr. Jill 02:59
I love that because, of course, you're known as the Gene Queen! And that brings so much, I think, impactful information to us in functional medicine. Even as doctors trained in medical school, we go back to the biochemistry, the physiology, and the stuff that you're talking about as well, because that's where we find the tools to solve these complex chronic issues, isn't it?

Sarah Morgan 03:20
Yes, absolutely.

Dr. Jill 03:22

Yes, I'm super excited. Today, our topic is choline. But before we go there specifically, I mentioned women's health. I'm now menopausal, so I'm right in this bucket as well as many of our listeners. Probably our primary constituent is the woman who is anywhere from 35 to 65 and either approaching menopause or full-blown into menopause. Why is this important topic especially relevant to women and our brains? Do you want to lay the groundwork for us?

Sarah Morgan 03:52
Yes, absolutely. If you're listening and you're in this demographic, please listen to this whole podcast episode because I believe it potentially has the ability to save your brain for decades to come.

Sarah Morgan 04:05
When we think about women, Jill, we have an increased risk of developing Alzheimer's and other forms of cognitive decline. We have twice the risk that men have. Currently, one in three seniors dies with Alzheimer's or another form of dementia, and it kills more than breast cancer and prostate cancer combined. When we think about that, it's like: "Why is this happening?" I think the world is trying to solve this because it's a massive problem.

Sarah Morgan 04:35
The first thing is that people talk about age. Women are now living longer than men. "As you get older, your risk goes up." Maybe that's part of it. I think another thing that we've looked into is immune system function. Women have stronger immune systems than men. We can brag about that a little bit, but it's also probably why we have more autoimmunity as females.

Sarah Morgan 05:00
There is a theory out there that I'm sure you have lots of thoughts on about [how] Alzheimer's could be the brain fighting an infection. I think those might be things that we want to look at and potentially say yes to. But I do think there's more happening below the surface with genetics and hormones as it relates to cognition and the risk of Alzheimer's.

Sarah Morgan 05:24
This was a really interesting 2020 study that I came across that suggested

childbirth may play a role in the risk of dementia for females. The more children you have, the higher the risk of different types of dementia, especially in females in Europe and Latin America. For me, one thing I think is that when you go through pregnancy as a female and when you're nursing your baby, there's massive demand for choline in that stage of your life.

Sarah Morgan 05:53
If we look at some of these variants in our genetics that we're going to talk about today, women of European or Latin American descent have higher rates of these mutations in these genes that I think are relevant to brain health. So there's a lot we can do, and there are a lot of things for us to know and be empowered by when it comes to our brain health.

Dr. Jill 06:16
What a great foundation! And a couple of things that you said are interesting. First of all, yes, autoimmune disease is four times or more more common in women than men. Hormones play some role in that. And like you said, we have this wonderful, robust immune system, but it goes through a lot of things because, during pregnancy, it has to calm down so that we can accept a fetus into our body—this foreign being in our uterus during that time. We often see this increase in autoimmunity [during] menarche—when people start their periods, which is hormone-related—after pregnancy, [and when women are] menopausal. There are these times when we know those links between the immune system, and we can dive into that.

Dr. Jill 06:55
The other thing that was surprising, as you just shared those statistics, is that we know breast cancer has a decreased risk with the more pregnancies that you have. If you are nulliparous, which means no pregnancies, like someone like myself who's never been pregnant, you have a higher risk of breast cancer. But it sounds like it's the opposite with dementia and Alzheimer's.

Sarah Morgan 07:15
Yes. It's really interesting, right? No matter what we do, there are risks.

Dr. Jill 07:19

I know. And it's funny because, for years, when I talk about hormone replacement and some of these topics as a woman who's had breast cancer 20 years ago, I often have to think about: What are the benefits to the brain? What are the benefits to the breast? Not that we have to choose, but there have been certain situations where I'll always say: "If I had to choose between the risk of breast cancer and the risk of Alzheimer's, I would choose my brain every time."

Sarah Morgan 07:42
Me too.

Dr. Jill 07:43
I can deal without these, but this thing I can't do without. I think that's relevant. One gene that a lot of people have heard about because it's been on the news and I think in some documentaries—certain famous people have talked about this—is ApoE. Tell us a little about this gene. First of all, if you have someone in your family with Alzheimer's, you can tell us the reasons why we need to maybe check our status. But what is this gene? Why does it matter to our brain health in particular?

Sarah Morgan 08:11
Yes. ApoE—Grey's Anatomy, I think, made it famous by nicknaming it the Alzheimer gene. It is a gene that has to do with lipid and cholesterol metabolism that also impacts our brain function and can increase our genetic risk of developing Alzheimer's. About 25% of people carry one copy of the ApoE4 variant, which is the risk factor copy, and about 2-3% of the population carries two copies. Whenever we think about carrying more than one copy, there tends to be more risk involved. It's important to remember that just because you have an ApoE4 variant doesn't mean you're going to get Alzheimer's. And if you don't have an ApoE4 variant, it doesn't mean you won't develop Alzheimer's.

Sarah Morgan 08:58
There are a lot of reasons for the development of this, and we're going to talk about several of them. But one we know is this ApoE. It's interesting because in individuals with ApoE4, their astrocytes—which are these cool star-shaped cells that are the powerhouses in our central nervous system—get junked up. ApoE3 [individuals] look a little bit more normal. A fascinating thing is that when individuals who have ApoE4 are given choline, these astrocytes are able to process lipids better, and they

don't have the accumulation that they would without choline. It's another connection, I think—even some of these variants that we see—[showing] how important choline can be in terms of our brain health.

Sarah Morgan 09:53
There are a lot of things you can do if you have ApoE4 status. It shouldn't be this thing that keeps you up at night that you're fearful about. I don't believe that at all. You need to sleep well, you need to move well, and you need to focus on your diet, your toxic load, getting your hormones optimized, and micronutrients. You can really set yourself up for great health for decades to come.

Dr. Jill 10:15
Yes, I couldn't agree more, Sarah. I do check this in my patients because I want to know. Even Dale Bredesen uses the ketogenic diet very frequently, which is very in high fat, sometimes up to 80% fat in the diet, to switch the metabolic processing of sugars into ketones. However, for those with ApoE4/4, I always feel like they're that unique class that we have to be careful with the lipids in the diet. Do you want to talk a little bit about why they might want to be on a lower-fat diet than average just because of this status?

Sarah Morgan 10:46
Yes, that's a great point. And I actually see this. This is why I love genetics. People are always like: "What kind of diet should you eat, Sarah? Do you like carnivore, paleo, vegan?" and all these different things. I'm like, "It depends on your genes." The reason that with ApoE4 you want to be careful with fats, and I would say especially saturated fats from animals—that would be things like red meat or even dairy saturated fats—is that you're going to have a harder time with lipid processing. I see a lot of these people who, if they go on a keto diet or a high-fat diet, their cholesterol goes up, and they'll even have issues with their insulin and metabolic health. We don't really have great imaging for the brain to see what's happening. But I think it's very reflective when we see that happening metabolically to also probably [understand to an extent] what's happening in the brain. I'm a big proponent of these people going for a much more Mediterranean-style diet. They tend to do really well without any check-ins on their blood markers.

Dr. Jill (pre-recording) 11:46
Hey, everybody. I just stopped by to let you know that my new book, *Unexpected:*

Finding Resilience through Functional Medicine, Science, and Faith, is now available for order wherever you purchase books. In this book, I share my own journey of overcoming a life-threatening illness and the tools, tips, tricks, hope, and resilience I found along the way. This book includes practical advice for things like cancer and Crohn's disease and other autoimmune conditions, infections like Lyme or Epstein-Barr, and mold- and biotoxin-related illnesses. What I really hope is that as you read this book, you find transformational wisdom for health and healing. If you want to get your own copy, stop by ReadUnexpected.com. There, you can also collect your free bonuses. So grab your copy today and begin your own transformational journey through functional medicine and finding resilience.

Dr. Jill 12:42
Gosh, I couldn't agree more. I do think, in general, we eat too many carbs, [especially] processed carbs. The U.S. standard American diet is more metabolically prone to induced diabetes. But this unique portion of people do better on almost more of a vegan or plant-based diet, even if they're doing less meat than the other types of people would do. It's very, very interesting.

Dr. Jill 13:08
And I did not know that this affects choline processing and that you can use choline as a nutrient to help these patients as well.

Sarah Morgan 13:16
Isn't that cool? [inaudible]

Dr. Jill 13:17
It's amazing. It all fits together. Let's dive into nutrients because genetics and nutrition are in your background. Let's talk a little about: What are some of the key nutrients and some of the key concepts around brain health and preventing Alzheimer's, especially in women, when it comes to nutrition?

Sarah Morgan 13:37
I became fascinated with choline as a nutrient about eight years ago. I started to dig into the scientific literature. Choline—think about it like a B vitamin. As I started digging in, I was like, "Okay, I'm not the only one." The American Medical Association, the American Academy of Pediatrics, and the FDA were all talking

about choline. The thing that they were saying was that it's an essential nutrient. We hadn't thought about it that way. The American Academy of Pediatrics was like: It's really critical for brain boosting and brain function. In children, when their brains are developing, that's really important, and in pregnancy, women need to get enough of it. We've now connected it: Choline should be viewed as equivalent to folate. It's important for the prevention of neural tube defects, or any birth defect because it is also a methyl donor. It functions in all these different methylation pathways that are very active in pregnancy.

Sarah Morgan 14:44
Looking into all this, my jaw was dropping. I was like: "Okay, what does choline do in the body? What are all the things that it's important for?" There are three things that you should remember about what choline does in the body. Number one is that it helps with our cell membranes. It's the building block of all of our cell membranes. We have trillions of them. If we're even slightly deficient in choline, we can, I believe, develop leaky cells, just like we have leaky gut. We even have this topic now about leaky mitochondria and leaky brain. All these things become leaky if we don't have the right nutrients, and choline is critical for that.

Sarah Morgan 15:25
The second thing is liver health. We have an epidemic in our world today of non-alcoholic fatty liver disease. I just heard something on the radio this morning [saying] that it's impacting kids as young as two years old, Jill, and that their livers are 60% fat. We believe part of this is that fructose gets turned into fat. These kids are on formula-fed diets that have high fructose corn syrup solids in their formula, they're eating processed foods, and they're not getting enough choline. What's the connection there? A choline-deficient diet increases your risk for non-alcoholic fatty liver disease, meaning it's not from alcohol that your liver is fatty. Choline helps move fat through the liver.

Sarah Morgan 16:16
Our liver is filtering and metabolizing fats. It's really important. It's a critical aspect of what our liver does every single day. But if we don't have enough choline, it gets all clogged up with fat, which is not a good thing. It also helps with bile flow. We make bile in our liver, it goes to our gallbladder, and it's released into the first part of our small intestines. It helps digest all of our fats. It's also really important in the

detoxification of environmental toxins. If we don't have enough choline, we don't get good bile flow. I think it's this missed piece of a lot of GI issues—choline, liver, gallbladder problems. If you look at women who go through pregnancy and have their babies, what happens a lot of times with their gallbladders? They have gallbladder attacks because they don't have enough choline, and they're using so much of it in pregnancy with those massive demands.

Sarah Morgan 17:13
The third thing to remember about choline that's really important is brain health. The reason it's important for brain health is that choline is used to make this critical neurotransmitter for memory, learning, and even mood regulation called acetylcholine. We talk a lot about serotonin, dopamine, and even adrenaline. I feel like acetylcholine is this forgotten neurotransmitter.

Dr. Jill 17:39
It's my favorite.

Sarah Morgan 17:40
It's so critical. It's my favorite too. I'm like, "We need to talk about it more," because I do think it's this breakthrough. I saw this pattern, Jill. I'm a pattern thinker. I was like, "Here's a woman's journey to Alzheimer's." You make choline in your liver. Some of us make more of it than others, depending on the status of a gene called PEMT. It stands for phosphatidylethanolamine N-methyltransferase. It's a mouthful. You don't need to remember. But you should know this gene status. I highly recommend it, especially if you're a female. And if you have mutations… You said you might have mutations in this, Jill.

Dr. Jill 18:22
Absolutely. It's just a matter of one or two copies. I'm not sure 100%. That's why, when you mentioned this topic, I was like, 'Yes!' because it's relevant to both you and me.

Sarah Morgan 18:32
Yes. I'm homozygous. I have two copies. I need a lot of choline from my diet because my liver doesn't make as much of it. The other thing about this is that today, Jill, 90% of women who are walking around are choline deficient. We talk

about vitamin D. We talk about magnesium. Nobody's talking about the fact that we are sucked bone dry of our need for choline, especially as women. We go into our 20s and 30s, and we have a pregnancy. We nurse that baby. Maybe we have another baby or another baby after that. We have these huge demands for choline. We don't get enough in our diet. We don't get enough in our supplements. And all of a sudden, we experience mommy brain. It's like: "I can't think. I have such severe brain fog that I walk into the kitchen and I'm like, 'What was I going to grab?' I can't remember my husband's name. I can't remember my name some days." And we laugh it off. But I think it's a sign of acetylcholine levels being low in the brain, and we're not recognizing it.

Sarah Morgan 19:41
Then, as females, after all that fun—when we're stressed and sleep-deprived and raising our kids and working in our careers—we go into perimenopause. Welcome! Even in your early 40s, your estrogen levels can decline. The massive connection here is this gene that makes choline for you; one of the inducers of PEMT so you can make more choline in your body is estrogen. When you have estrogen at higher levels as a menstruating female, you're naturally going to have more choline that's being made by your body. And you should, because you go through this childbearing season where you need more choline.

Sarah Morgan 20:28
Then you go into perimenopause, and your levels of estrogen start to drop—and so does choline. But we forget about that, and we start to have lower estrogen and lower choline production. We now know that women from 40 to 50 experience the biggest loss of brain volume of their entire lives because they start to lose these hormones. I also believe that it's because we start to lose choline and what acetylcholine does in our body. We see this even in our hippocampus. We have memory decline, our sleep worsens, and we lose our sense of self. That's our hippocampus—that gives us our sense of self. Choline and estrogen—there's this massive connection. I believe that in perimenopause and menopause, we really need both of them. Otherwise, as women, we walk ourselves into Alzheimer's over decades of choline deprivation. I think it's so fixable, Jill. It's so fixable.

Dr. Jill 21:32
I'm guessing you want to start at 30 or even before that. There are so many

thoughts as you were talking. First of all, I know you and I have talked about this, but not all prenatal vitamins contain choline, and that's a tragedy. If you're in preconception, you're in your 20s or 30s, you want to have babies, or you just got pregnant—talk just briefly about that. I think that's a tragedy when a woman's prenatal does not contain choline, right?

Sarah Morgan 22:00
Yes. And it's getting better. But I formulated a prenatal [multivitamin] years ago. I learned all this, and I was like: "We are going to put as much choline into the prenatal… "

Dr. Jill 22:09
I think you were the first one who mentioned that. I was like: "Duh, it makes so much sense."

Sarah Morgan 22:15
It's really important now. Some prenatals have choline, but they don't have enough of it. And this is where the dose is really important.

Dr. Jill 22:24
Give us some milligrams. Like, what are we talking about? I know what I'm using in the toxic patients and the menopausal patients, but what are you recommending for these different areas of life?

Sarah Morgan 22:33
I would say 450 milligrams of total intake is the absolute bare minimum for choline. If you're pregnant or even thinking about getting pregnant—you should start with this idea of conscious conception and prepping ahead of time because this also impacts gene expression before you're pregnant, which means you're going to have a healthier baby—I would say 550 [milligrams]. I would argue up to potentially 800 to 900 milligrams.

Sarah Morgan 23:07
In the third trimester, even if they have normal PEMT status, women need around 800 to 900 milligrams because of the rapid cellular growth. That baby is growing so much, and there's massive demand. Choline needs to come from supplements, diet,

and in women during this time. You need to look for a prenatal that has a good, hard-hitting dose of choline. Otherwise, it's not going to move the needle.

Dr. Jill 23:40
Thanks for your work on that. Thanks for being part of developing this because I remember our conversations realizing how powerful [it is] and looking at some of the prenatals that some of our companies use, and not all of them have choline, which is shocking.

Dr. Jill 23:51
Let's move on to the menopausal and perimenopausal women, the ones we talked about earlier. Should a woman be supplementing lifelong? What are food sources? What are doses? Give us an outline of that woman who's 35, 45, 55, or 65. What should they be doing?

Sarah Morgan 24:08
I believe in food first, always, in terms of what we should do. But I also think this is a great example of, if you know your PEMT status... I can't get enough choline from my diet alone. There's just no way for me to do it because I have such high needs. So I'm always going to supplement, once I learned this about myself. I really believe anybody who has variants in PEMT who's a female should be supplementing. You should be supplementing if you're going to be pregnant. After you've had your babies, if you're perimenopausal, if you're in and through menopause, I think it's one of the most critical nutrients you should supplement.

Sarah Morgan 24:51
Food sources: The best one is eggs. I think both of us now can't eat eggs. It's such a bummer because egg yolks specifically are where we get all of our choline. But there are other places, like organ meats, fish, chicken, and mushrooms. In some of the cruciferous vegetables like cauliflower, broccoli, and Brussels sprouts, it's at lower doses, but you still get some choline from that. I think it should be "both and." If you can tolerate eggs, I'm a huge fan. There are about 125 to 150 milligrams of choline per egg yolk. If you're pregnant, nursing, or in menopause, eat the omelets. Have the eggs as part of your diet. It's a great way to go. And make sure that you're getting choline in supplement form as well.

Dr. Jill 25:45
I love that. As I realized my own status, I've been supplementing. We use it for a whole different reason, which you alluded to. I deal with mold toxicity; it's one of my fortes. A lot of people who have mold toxicity have really unhealthy membranes, so they need an oil change. I think PC is core for mitochondria, for the brain, for membranes, and for the production of bile. I love that you mentioned that because—and people have heard me talk before, and you know this—our bile acid is where we dump the toxins. As we push the bile, number one, we sterilize the small bowel, so we prevent the overgrowth of bacteria and get things moving. We are also dumping toxins and excess cholesterol. If we aren't producing a good amount of bile, we're more likely to be toxic. I've used both oral and IV PC protocols with my really toxic patients.

Dr. Jill 26:34
I'd love to know your thought on this because I've felt like, in my clinical experience, there's a timing issue. If someone's really sick, really toxic, and has a significant leaky gut, PC, and phospholipids in general create liposomes—translocation. My thought has always been that if someone has a very dysbiotic overgrowth of bacteria in the gut or some problems with massive toxicity, sometimes there's a timing of PC, and it feels like you don't want to pour in a ton of this thing that creates more translocation across that permeable membrane until you clean up the garbage. What do you think of that? Any thoughts?

Sarah Morgan 27:13
I think it's totally right. We're talking about something called enterohepatic circulation. Eventually, I want to write a book on this called "Poop Out Your Problems" because that's how we do it.

Dr. Jill 27:22
I love it!

Sarah Morgan 27:24
Our blood is filtered through our liver. Our liver collects the garbage, and then the main dump truck is our bile. Then it goes into the gallbladder out in the GI tract, and it's like: "Goodbye! I hope you leave." But the problem is that we recycle 90–95% of it. I think the first step is to interrupt that recycling by binding in the gut and

helping ensure that that is happening. Then we can push more of the garbage to be mobilized later.

Sarah Morgan 27:59
I did this to myself. When I learned this, I went really hard, and I took a ton of choline. I took it at night because I didn't connect acetylcholine to feeling more awake. I lay in bed, and I was wide awake. But the craziest thing happened to me. I was grabbing my left arm because my ulnar nerve was firing every couple of seconds for about three hours. I was like, "What the heck is going on?"

Sarah Morgan 28:33
I think it was on one of our hikes—all of us ladies, we have a little brain trust here in Colorado—and Dr. Shelese Pratt was like: "Did you injure that arm?" I was like: "Yes, I did in a hockey injury." She said: "It was probably doing repair to your nerve." I was awake, and it did repair to my nerve. All these wild things, I think, can happen. I did take a megadose.

Sarah Morgan 28:55
I think it's all about dose and timing, absolutely based off of someone's history, genetics, and even some of their current symptoms. But I've seen choline supplementation done right change someone's... I have mommy brain and brain fog too. I feel like I've come back. I feel like myself again. It'll be within weeks if we do it right.

Dr. Jill 29:22
That makes so much sense. And what I really loved is that you talked about this connection. We started with ApoE, which has a lot to do with dysfunctional lipid metabolism and transfer. I know from talking about the gut for decades now that we have LPS—or lipopolysaccharide, a coating of bacteria in the gut—that is carried across the gut lumen into the bloodstream, which is part of the cause of fatty liver, because that's our filter. And it's carried more quickly by the saturated fats.

Dr. Jill 29:52
To me, this comes full circle because it's the higher risk of that translocation and why for those types of people, especially that saturated fat is only going to lead to more liver damage, brain damage, and all these kinds of things in that subset of the

population. The fact that choline is one of the regulators of fat transport makes a ton of sense, because, in my mind, it's almost like that's the brake pedal. If we're going to supplement, you want to make sure you don't have massive permeability or massive toxicity.

Dr. Jill 30:20
One of the things you mentioned as well is that there's mobilization of toxins and then excretion. I always think of it that way because it's easy for me to help patients understand that if we mobilize too quickly and we can excrete, we get really sick, right?

Sarah Morgan 30:33
Yes. I did that to myself too when I took all that choline. I was like: "Oh my gosh, I look like a 13-year-old teenager with all this acne!" I had a massive breakout because I pushed too much. I was mobilizing all these toxins, and I didn't know that I was supposed to bind it up. It's a journey. It's a learning experience. And I think that push and pull is something you have to figure out sometimes—an experimentation of what works.

Sarah Morgan 30:59
It's interesting what you mentioned too, because choline is very connected to insulin sensitivity and even things like diabetes, metabolic health, and heart health. I think it connects to the liver, to lipid metabolism, all the things that you're talking about, and even with the gut, right?

Dr. Jill 31:20
It makes so much sense. I've recently done some talks on nitric oxide and its importance. After the age of 40 in women and men, we decline by 50% production, and after the age of 60, it's a 15% production. Nitric oxide opens up vessels, allows us to have good blood flow, and prevents heart attack and stroke. It was one of those things where, when you look at the graphs, men's heart attack risk is above women's all the way until menopause. And then, guess what? If you look at a chart, women dramatically [increase] right around 45 to 55, which is when they hit menopause. I've always thought about it as being related to decreased nitric oxide production. But as you were talking about estrogen, PEMT, and choline, I think it's just as equally that decline in estrogen, which can cause hyperlipidemia in women

all of a sudden because they're not transporting. And if they have this underlying thing like you and I have, the PEMT...

Dr. Jill 32:16
In case you're listening and you want to write this down: PEMT—that's the gene you could have. Almost any of the gene tests now will test that. Sarah, a lot of times there are tests where there are [something] like four variants of PEMT. Are there quite a few different variants? Are there a few main ones?

Sarah Morgan 32:35
That's a great question. I think there are two main rsIDs that are the most clinically relevant in terms of your endogenous production in the liver and how well your body is going to make choline. I don't have them on the tip of my tongue or in my brain, but we could look them up and share them in the show notes.

Dr. Jill 32:53
Exactly. We'll include that in the show notes when we look it up. We'll make sure to link those there. You and I can both do a little research and make sure we have the right ones.

Dr. Jill 32:59
You mentioned some lifestyle factors, but that's where this can be a little overwhelming. Let's go back to: What can the average woman do who either wants to get pregnant, is pregnant, is in postpregnancy, or is in perimenopause or after to enhance choline?

Sarah Morgan 33:16
I would say to look for choline-rich sources of food to start adding to your diet. Everything matters in terms of even a little step of [considering]: "I haven't been eating eggs that often" or "I'm going to add more cruciferous vegetables to my diet." Those are things that are going to be helpful. I would also say to make sure that you're reading your supplement labels. Anything that I formulate now, I'm very passionate about putting choline in there because I think it's this missing piece that moves the needle so much for individuals. Make sure to look for that in your supplement.

Sarah Morgan 33:57
In terms of this connection to brain health, I think that the other thing that's good to do is make sure you're getting adequate sleep. That is such an important thing for your brain's health and your ability to repair. What's really interesting is that choline is used by the brain stem at night to get into proper REM sleep. If you're choline-deprived [when] perimenopausal or menopausal, I think there are hormonal factors, but one that we miss is that choline is directly used by the brain to get into that sleep cycle. It's like, "I'm working on my sleep, but I can't sleep." I think sometimes hormones are helpful, and then choline can help you get better sleep.

Sarah Morgan 34:43
Exercise and movement are really good for your brain. It moves everything around—that lymphatic flow. An anti-inflammatory diet. Another thing is that sugars and toxic fats are destroyers of brain health and even your liver—all these things that we've been talking about today.

Sarah Morgan 35:02
I also love to say, "Challenge yourself to learn something new." I think it's so good for our brains. Part of that is that, as adults, we forget to play. I think play is so important for our brains in all these different stages of our lives that we go through as women.

Sarah Morgan 35:20
I would say another one for brain health is—I'm not anti-alcohol, but we don't want to overdo it. I think that, as females, we are more sensitive. We have less of a tolerance. [It's about] being conscious of when and how much alcohol you're consuming and some of the lifestyle factors that can impact choline, your hormone health, and your brain health as this really important triad for your overall health and well-being for all the decades of life that you walk through.

Dr. Jill 35:51
Wow! This is such great practical information. I'm sure that a lot of people, like you and me, have mutations. Maybe they do or don't know it. We can mention it—do you have any particular gene reports or things that you like, particularly if someone wants to do a report themselves? What companies or labs do you use?

Sarah Morgan 36:11
Yes. My favorite that I use is Nutrition Genome. It's just NutritionGenome.com. Alex Swanson is the founder of that company, and he has a brilliant mind in the world of genetics and nutrigenomics. It is such a great research-backed report, and it really is focused on lifestyle and food first, which is what I love about it.

Dr. Jill 36:35
I'm glad you mentioned that, because I would agree. I totally love that. In fact, in our brain trust of women, we all like that test, don't we?

Sarah Morgan 36:40
Yes, we do.

Dr. Jill 36:41
We talk about it. You've been on the board and advising as well because you're so knowledgeable in that area. I always like to ask guests: Do you have any one last takeaway in life, brain health, or any topic at all? Is there any last bit of advice that you'd like to leave our listeners with?

Sarah Morgan 36:59
I would say that when it comes to genetics—I'm the Gene Queen—it is one of the most empowering things that you can know about yourself. And remember that it's your uniqueness that makes you you—and understanding those different strengths and weaknesses you have, even in your biochemistry. Every single time I go through one of these reports, it's like a magic unlock for someone to not only understand themselves but [also] take a step towards more optimized health. It's not something to be afraid of; it's something to be excited about if it's applied properly. Health can be really fun and hopeful when you do the right things and look at the information the right way.

Dr. Jill 37:42
I love that. And that's another thing about the report we're talking about. "Here are the pluses," right? It's not just doom and gloom. It's like, "There are these things you might want to work on." But I think they go above and beyond, like, "Here are your strengths," which is so cool.

Sarah Morgan 37:56
It's good to remember that we all have our strengths. We all have our unique superpowers.

Dr. Jill 38:00
Yes. Sarah, you are a wealth of knowledge! I'm so grateful for your friendship, your wisdom, and all of your innovation and ideas. Thanks again for taking the time today!

Sarah Morgan 38:11
Oh, thanks for having me on. It was so fun!