

Katherine Sampson

Hey everybody, my name is Katherine Sampson and I met both the Erins in graduate school at the University of Illinois. I'm currently an AP Biology teacher down in Texas where I'm from. They asked me to share my story about my lactose intolerance throughout my life and of course I jumped at the opportunity to be on the podcast and share my poop stories with basically the entire universe. There was one part of my life that I think was one of the most formative defecation experiences I've ever had and it goes a little something like this.

My mom and I - hi mom - we were sitting in a restaurant eating lunch one day and I just ordered something off the menu that appealed to me. And maybe about 30 minutes later when my mom and I were shopping at the store that is very famous for selling containers of all varieties, we were walking down the gift wrapping aisle and I felt something kind of odd in my bowels. And so I thought to myself that's not normal but it'll be okay, just shake it off, just keep walking, everything's gonna be fine. And I remember thinking back about this moment and I went maybe that's why they call it a bowel movement, you know, because I physically felt my bowels moving inside my body.

So I continue walking and I start feeling like a build up of gas inside my body. And so for all the people out there who've ever felt that, you know what I'm talking about. And so you think for a moment well maybe if I let it out and I relieve that pressure inside my body then everything will be okay. But for me in that moment, if I can give y'all one piece of advice is to never really trust a fart. I unfortunately did trust this fart and it ended up being very bad for both me and my pants. So I ended up defecating myself in the middle of the gift wrapping aisle in some light blue jeans, very light blue jeans. And I remember walking up to my mom going, 'I think I just pooped my pants.' And I remember for the rest of my life she looked at me and laughed and went, 'What?' And I said, 'No mom, really, I just pooped my pants.' And she looks at me and she goes, 'Well I'm not done shopping, nothing is gonna change it right now, right Katie?' And I said, 'Okay, yeah.'

And so from that moment on I realize that I'm standing in the middle of public in Houston, Texas and I just pooped my pants and this was gonna be my life and so I should probably make some concerted decisions to recognize what I'm eating and tell people that I'm lactose intolerant. And so I started doing that, that was when I was 19 so 9 years ago. But nowadays when I go to restaurants I don't really get taken seriously a lot saying that I'm lactose intolerant by the waiters or something like that. So I usually just say I'm allergic to milk, I'm allergic to cheese, or if it's a hard day I just tell them I'm vegan and I go with it. So yeah, that's my poop story and I hope everybody out there can maybe relate to that a little bit and recognize that we shouldn't be ashamed if maybe pooping our pants in public. That's my story, y'all.

TPWKY

(This Podcast Will Kill You intro theme)

Erin Welsh

That was amazing.

Erin Allmann Updyke

As always.

Erin Welsh

As always. Thank you so much Katie for your always enjoyable stories.

Erin Allmann Updyke

The best not only poop stories but definitely the best poop stories.

Erin Welsh

Definitely the best poop stories without a doubt. Hi, I'm Erin Welsh.

Erin Allmann Updyke

And I'm Erin Allmann Updyke.

Erin Welsh

And this is This Podcast Will Kill You.

Erin Allmann Updyke And today we're talking about lactose intolerance.

Erin Welsh Or lactase persistence. Cause really that's the...

Erin Allmann Updyke There's so many names for this, I love it.

Erin Welsh Oh my gosh. I think we're gonna have to do some sort of primer or briefing on the names.

Erin Allmann Updyke A lot of the articles that I read had tables of all of the acronyms that they use because there are so many different ways to talk about it.

Erin Welsh I wish that the articles I looked at had tables because that would have made my life a lot easier. I was like oh no, what does this one stand for again? So to get us through this episode what are we drinking?

Erin Allmann Updyke Our quarantini of the day is Truth or Dairy.

Erin Welsh And appropriately it is essentially a milk punch. So it's got milk and rum and brandy or cognac and nutmeg.

Erin Allmann Updyke Listen, do you 'milk' or 'melk'?

Erin Welsh I say milk.

Erin Allmann Updyke Because I got made fun of this morning for saying 'melk'.

Erin Welsh For saying what?

Erin Allmann Updyke I guess I say it weird. 'Melk'.

Erin Welsh Oh great, so it's gonna be-

Erin Allmann Updyke It's gonna be another one of those episodes where Erin can't pronounce the thing we're talking about. It's fine, I'll just say dairy.

Erin Welsh There we go.

Erin Allmann Updyke Okay.

Erin Welsh We will post the recipe for the quarantini and the nonalcoholic placeborita on our website [thispodcastwillkillyou.com](http://thispodcastwillkillyou.com) and all of our social media pages so check it out.

Erin Allmann Updyke Yes, most definitely. Do we have any other business?

Erin Welsh No it don't think so, let's just get started.

Erin Allmann Updyke I don't think so. Okay. We'll take a quick break first.

TPWKY

(transition theme)

Erin Allmann Updyke

I'm very excited about this episode. This is the first non-crossover non-disease episode.

Erin Welsh

Wait a second.

Erin Allmann Updyke

Like we've had crossover episodes where we talk about poisons or things that will kill you.

Erin Welsh

I see what you mean.

Erin Allmann Updyke

But this is our first just me and you and we're talking about maybe not even a disease.

Erin Welsh

Well it's not really.

Erin Allmann Updyke

It's not. It's really not. Spoilers. So I figured that because this is a wonky episode where we aren't talking about a disease I would do the biology section in a bit of a wonky way. Okay?

Erin Welsh

Perfect.

Erin Allmann Updyke

Okay. So we're gonna start off the biology section where we usually end up and that is with the symptoms. Cause we usually kind of end with that. So if we're being honest we pretty much already know the symptoms of lactose intolerance aka lactose malabsorption aka lactase non-persistence aka hypolactasia, that's another term for it.

Erin Welsh

I've seen all of these, this is good. Nice refresher.

Erin Allmann Updyke

So we know these symptoms, Erin. What are the kinds of symptoms?

Erin Welsh

Bloating, rumbling tummy, diarrhea, farts.

Erin Allmann Updyke

Do you wanna know the fancy word for grumbly tummy?

Erin Welsh

I do.

Erin Allmann Updyke

Borborygme.

Erin Welsh

Can I get the etymology of that please?

Erin Allmann Updyke

Let me google that for you. (laughs) It's Greek.

Erin Welsh

Great.

Erin Allmann Updyke

It comes from the Greek 'borborygmos'.

Erin Welsh

Meaning what?

Erin Allmann Updyke

Meaning a rumbling or gurgling noise made by your tummy.

Erin Welsh

Wow so it really is specifically that word has one purpose.

Erin Allmann Updyke: That's what it means, yeah.

Erin Welsh: Amazing.

Erin Allmann Updyke: I know. Borborygmos. Yeah, that's a big one. That's the medical term for a gurgling tum. Abdominal pain I think you said.

Erin Welsh: Farting, diarrhea.

Erin Allmann Updyke: Diarrhea, farting. Diarrhea tends to be less common in adults at least according to the literature but we'll kind of talk about why you might see diarrhea even if you're an adult. Does that make sense? All right, cool. So we all know what we're dealing with here. But to talk about lactose intolerance or lactose malabsorption we have to actually take a step back and first talk about one of our favorite things, the gastrointestinal tract.

Erin Welsh: Yeah.

Erin Allmann Updyke: Okay. So your guts. Because lactose malabsorption is a gut problem, we're gonna talk about how it functions normally in order to understand what goes wonky in these situations.

Erin Welsh: But hold on.

Erin Allmann Updyke: Okay.

Erin Welsh: Lactose malabsorption is the normal state.

Erin Allmann Updyke: Okay yeah, this is gonna get confusing. Yes. I mean yes and no, right. Mammals can digest lactose for at least a portion of their lives.

Erin Welsh: Yeah.

Erin Allmann Updyke: Yeah. So as adults some mammals, most mammals, can no longer digest lactose. But let's talk about how your GI tract normally would handle lactose if it's able to digest it, okay?

Erin Welsh: Okay.

Erin Allmann Updyke: And just kind of how your GI tract handles sugars to begin with okay, we're going back to the very beginning here.

Erin Welsh: Okay.

Erin Allmann Updyke: Okay. So the main function of your GI tract is what?

Erin Welsh: To digest food?

Erin Allmann Updyke: Yeah, exactly.

Erin Welsh: Break it down, absorb nutrients, make waste?

Erin Allmann Updyke

Perfect. You know it all, Erin. Okay so your gut has three main divisions, right. You have your foregut, that's your mouth and maybe down to your stomach, right. Then you have your midgut, that's your small intestine, and then your hindgut which is your colon and your butt, okay.

Erin Welsh

Okay.

Erin Allmann Updyke

So digestion which is that main function of your gut starts at the very top in your mouth where you chew things and you physically and chemically start to break them down. And then it travels down to your stomach where that digestion process continues, like physically your stomach clenches in and out, plus you've got all that acid in there, right. Then as your food moves into the small intestine, your small intestine has two main goals: finishing up that digestive process and - this one's important - absorbing all those nutrients that you unlocked during that digestion process.

Erin Welsh

Okay.

Erin Allmann Updyke

So to do that your small intestine has a bunch of different enzymes which are responsible for breaking down all these nutrients into the smallest possible particles so that they can pass through the intestine wall and make it into our bloodstream. Okay? So some of these enzymes come from the pancreas and some of them come from cells in the wall of the intestines themselves. But these enzymes are all really important because your intestine basically acts as a filter and large particles can't make it through your intestine wall into your bloodstream. So everything has to be broken down into really small molecules. In the case of sugars it has to be broken down into monosaccharides, that means one piece of sugar. Cool?

Erin Welsh

Cool.

Erin Allmann Updyke

Okay. So anything that can't be digested or can't be broken down small enough will stay in your small intestine and keep traveling down to your colon. Your colon is the last part of your GI tract and it's basically responsible for sucking all the water out of the junk that's left in there so that you don't lose too much water.

Erin Welsh

Oh. Aka diarrhea.

Erin Allmann Updyke

Aka diarrhea. And then you have a whole bunch of bacteria in your colon which help break down any last particles that might have nutrients in there that you want so that you can absorb absolutely everything possible. And then what's left is poop and you poop it out. Okay?

Erin Welsh

Excellent.

Erin Allmann Updyke

So that's your GI tract in a nutshell. So what happens in lactose malabsorption or lactose intolerance? So lactose is a sugar, it's a disaccharide, so that means two sugars bound together, it's galactose and glucose if you care about that sort of thing.

Erin Welsh

Oh. I mean I didn't think I did and I don't think that I do but still interesting.

Erin Allmann Updyke

But you're good to know.

Erin Welsh

Yeah.

Erin Allmann Updyke

Okay and lactose is found in milk of course, milk, dairy products of all kinds.

Erin Welsh

I don't hear 'melk' and milk.

Erin Allmann Updyke

Thank you, I appreciate that cause I really got made fun of. And so since lactose is a disaccharide we know that it has to be broken down into monosaccharides, the two that it's made up of, galactose and glucose, in order to be absorbed by the small intestine. It turns out that this happens in our small intestine by a specific enzyme called lactase. So what happens right off the bat is that if lactase isn't able to break down lactose into its two component parts, then you will have undigested lactose, a disaccharide, that's left in your small intestines to travel down to the colon. Okay? That's the main thing that happens in lactose intolerance or lactose malabsorption. So the function of the colon is to absorb the water that's left and leave your poop behind. When you have undigested sugars like lactose they serve as a really great food source for bacteria.

Erin Welsh

Oh.

Erin Allmann Updyke

So the bacteria in your colon get super stoked and they will go nuts eating this sugar, this lactose, and they convert this sugar via biochem we're not gonna get into into fatty acids and hydrogen gas.

Erin Welsh

Aha.

Erin Allmann Updyke

So guess what it feels like when your intestinal bacteria start producing a bunch of gas?

Erin Welsh

I mean whatever the Greek word you said.

Erin Allmann Updyke

Yeah. (laughs) Borborygme.

Erin Welsh

Borborygme!

Erin Allmann Updyke

Exactly. You're literally going to have a bunch of gas in your colon, okay. And that is why you have these symptoms if you have a bunch of lactose that makes it all the way from your small intestine down into your colon. Now the other thing that can happen if you have undigested disaccharides like lactose in your colon is that it turns out that this sugar, this disaccharide, it's what we call osmotically active which means that it's going to draw water towards it. So if you have sugar left in the lumen of your gut, you're not going to be able to absorb water through the walls of your colon, rather water is gonna stay in your colon because in your body there has to be a balance between the solutes and water.

Erin Welsh

Right.

Erin Allmann Updyke

Okay.

Erin Welsh

That makes sense.

Erin Allmann Updyke

So what does that mean, Erin? If you've got a bunch of water left in your colon?

Erin Welsh

I think we both know where this is going. It's to the bathroom for some loose stool.

Erin Allmann Updyke: Exactly. Diarrhea. As a fun side note this is how osmotic laxatives work. So if you've ever taken MiraLAX or Lactulose, lots of kids take it cause kids are always constipated, that's exactly how they work. It's basically just big molecules that can't be broken down by our enzymes or our gut bacteria so then it draws a bunch of water into your colon. Pretty cool.

Erin Welsh: Wow, that sounds uncomfortable.

Erin Allmann Updyke: Yeah I mean it just cleans you out. It's what you use if you're having a colonoscopy.

Erin Welsh: Colon cleanse?

Erin Allmann Updyke: Yeah. Okay. So that is how lactose intolerance or lactose malabsorption happens, why it causes the symptoms that it causes. So now we have to get back to the beginning where we mentioned this isn't really a disease state, so why is it that some people have this and some people don't? Well turns out there's a few different ways. Let's talk about the least common first.

Erin Welsh: Okay.

Erin Allmann Updyke: First you could be born with very low levels of this lactase enzyme function that is congenital lactase deficiency. You can imagine that because mammals main food source is breast milk which has lactose, that would be pretty bad. So this is pretty rare.

Erin Welsh: Okay. How rare?

Erin Allmann Updyke: Good question, actually. I never did find out, I have asterisk epi numbers and I never found good epi numbers on this. It's most common in the Finnish population.

Erin Welsh: Really?

Erin Allmann Updyke: Yeah! I know.

Erin Welsh: Okay this is jumping the gun a little bit but in Northern European countries and Northern European populations, lactase persistence, so the ability to digest lactose is pretty high across the board.

Erin Allmann Updyke: Yes, yes.

Erin Welsh: But when I was living in Finland I saw so many lactose-free or low lactose milks and yogurts and blah, blah, blah, blah, blah.

Erin Allmann Updyke: We'll talk about it.

Erin Welsh: Okay, great.

Erin Allmann Updyke: Yeah.

Erin Welsh: I was like wait a second, but I thought... Yeah, okay.

Erin Allmann Updyke: So yeah, this congenital lactase deficiency, you can imagine you would recognize this pretty early on when a baby is an infant because they would have some pretty severe symptoms from breast milk. This is an autosomal recessive disorder so this is a genetic disorder.

Erin Welsh: Okay.

Erin Allmann Updyke: But again it's pretty rare, I don't have exact numbers. But that's one way that you could end up with lactose malabsorption. Another way is if you are a very premature baby, sometimes premature babies have what's called developmental lactase deficiency because their GI tract just isn't quite developed enough and it for some reason turns out that lactase is one of the last genes to get properly turned on during development. But this is something that would be rather transient.

Erin Welsh: Okay.

Erin Allmann Updyke: Okay?

Erin Welsh: Interesting that it's one of the last genes.

Erin Allmann Updyke: I know, you'd think it'd be an important one but also so is surfactant production and that's like essential for life, that's what allows your lungs to stay open so you can breathe.

Erin Welsh: That's pretty crucial I think.

Erin Allmann Updyke: Yeah, it doesn't happen til after 35 weeks of gestation. Another way that you could end up with being not able to absorb lactose very well is if you get a GI tract infection, for example Giardia.

Erin Welsh: Wow.

Erin Allmann Updyke: That kind of GI tract infection can cause damage to your small intestine where this enzyme is located so that even after clearance of that infection you don't have proper function of that lactase enzyme. So it basically just causes damage to the cells of your small intestine.

Erin Welsh: Okay, so in theory you could still produce lactase but the cells are so damaged that there's no way to produce lactase. Okay.

Erin Allmann Updyke: Precisely. But finally number four, the most common way that you can have lactose malabsorption is-

Erin Welsh: I feel like people are gonna get angry with us because we're describing the normal state of things.

Erin Allmann Updyke: Well then let me say this, Erin. The fourth option is you could be a normal human adult, okay.

Erin Welsh: Okay.

Erin Allmann Updyke: In most humans, in fact in most adult mammals it is totally normal for the activity of the lactase enzyme to downregulate as we age. What does that mean? It means that this enzyme works really well when we're babies and infants and literally by the time we're like 6 years old the action of this enzyme is substantially less than it was when we were babies.



Erin Welsh	Right.
Erin Allmann Updyke	So lactase persistence, which means that your lactase enzyme is on at high levels throughout your life, is actually the mutant state. And that is what is present in some populations. And Erin I'm pretty sure you're gonna talk about why and where this mutation came from.
Erin Welsh	Definitely.
Erin Allmann Updyke	Awesome. But yeah, the bottom line is if you can drink milk as an adult human and not have borborygme and tons of gas and abdominal cramping and possibly diarrhea, you're the mutant, we're the mutants. So I think that really fun. So I don't know, this episode is lactose intolerance but it's really like weird lactase persistence mutants.
Erin Welsh	Yeah. Maybe we'll just... Milk mutants. 'Melk' mutants.
Erin Allmann Updyke	Melk' mutants. But Erin what you mentioned about in Finland having really high levels of... seeing a lot of LACTAID-type products on the market.
Erin Welsh	Yeah, low lactose products.
Erin Allmann Updyke	It turns out that people are actually really bad at knowing if their symptoms are associated with lactose intolerance or not.
Erin Welsh	Right.
Erin Allmann Updyke	So when they've done studies to look at what your tolerance levels actually are it turns out that even people with lactose intolerance or lactase nonpersistence can actually tolerate about a cup or a little more than a cup, like 12 oz of milk a day.
Erin Welsh	I was gonna make that point or bring that up that lactose intolerance and lactase nonpersistence are different things. Like you can also have different levels of lactose intolerance even if you don't produce lactase into adulthood.
Erin Allmann Updyke	Exactly because lactose intolerance is essentially you having symptoms from after you drink milk.
Erin Welsh	Right.
Erin Allmann Updyke	But because your colon bacteria can actually digest lactose, as long as you're not drinking or eating so much lactose that you become symptomatic, then it's no problem, right. So the only problem is if you have so much that basically whatever your individual colon bacteria can handle, after that point is when you're going to become symptomatic. So for some people that might be like one piece of cheese and for other people even if their lactase enzyme is very low activity or no activity, they might still be able to drink a full glass of milk and not have any problems.
Erin Welsh	So the microbiome, the gut microbiome and lactose.
Erin Allmann Updyke	Yes.

Erin Welsh: The bacterial species that feed on the lactose... Have there been any studies that look maybe at different amounts of that type of bacteria or anything like that in association with symptoms or tolerance or whatever else?

Erin Allmann Updyke: Like whether you could give somebody probiotics and lessen their symptoms?

Erin Welsh: Yeah.

Erin Allmann Updyke: Yeah, there have been studies of it. To my knowledge, they're not... Like we don't have probiotic pill that you can take to be able to digest lactose with no problem at this point but there are definitely people looking into it because for sure differences in colon bacteria would lead to differences in symptoms. And there have been a number of studies that have shown that if you kind of train your colon bacteria over time then you might actually be able to tolerate greater levels of lactose although other studies have said maybe that's just a placebo effect.

Erin Welsh: In any case if you don't have the allele that allows you to produce lactase, you're not digesting on your own.

Erin Allmann Updyke: On your own you're not digesting it, yeah.

Erin Welsh: So tell me about LACTAID and the little pills, the little helper pills. What do those do?

Erin Allmann Updyke: So the LACTAID pills that you take are lactase enzyme.

Erin Welsh: Oh, okay.

Erin Allmann Updyke: So that's literally just going to break down the lactose before it makes it to your colon.

Erin Welsh: Okay.

Erin Allmann Updyke: There are other things that you can put in your milk like droppers, I don't know if it's a liquid or not, but that is yeast or bacteria that you can let sit in your milk and it'll digest the lactose for you. It was 'melk', wasn't it?

Erin Welsh: I am hearing 'melk'.

Erin Allmann Updyke: (laughs) I can't help it.

Erin Welsh: I mean you do you. There's that whole what part of the country dialect test are you from.

Erin Allmann Updyke: Yeah.

Erin Welsh: Isn't 'melk' a Midwestern thing?

Erin Allmann Updyke: I don't know. Brett and I are from the same place and he makes fun of me.

Erin Welsh: Maybe you've picked it up since living in Illinois, who knows.

Erin Allmann Updyke: Milk. 'Melk'. I just don't hear a difference quite honestly.

Erin Welsh: This episode is just gonna be 45 minutes of us saying milk, 'melk'.

Erin Allmann Updyke: Anyways Erin that's it, that's all I got. That's the biology.

Erin Welsh: Wow. Okay. Very interesting.

Erin Allmann Updyke: That was also some of the epi.

Erin Welsh: Are you ready to hear about the history of lactase persistence?

Erin Allmann Updyke: That's what I'm here for.

Erin Welsh: Okay, excellent. Let's take a quick break.

TPWKY: (transition theme)

Erin Welsh: All right. So I wanted to start off by talking a bit about milk and then about lactase persistence. And so for this part just to clear things up because most of the time when I'm talking about the history of lactose intolerance or lactase persistence I'm talking about the specific allele and not necessarily the disease itself.

Erin Allmann Updyke: Right.

Erin Welsh: And so I'll say 'lactase persistence' and that refers to people who have the allele that allows them to digest lactose throughout their lifetimes.

Erin Allmann Updyke: Right.

Erin Welsh: Okay. Milk is a pretty revered liquid if the myths and folklore surrounding it are any indication. The Greek word for milk is gála which forms the basis of the word 'galaxy' and ours is called the Milky Way. So yeah, isn't that cool? Because according to Greek mythology - yes - the Milky Way was formed when Hera spilled milk while breastfeeding Herakles, aka Hercules, with each drop of milk forming a star. Yeah. And the Ancient Greeks weren't the only ones to have creation myths with milk playing a central role. So for example in the Fulani people of West Africa there's a myth that the entire world began from one huge drop of milk.

Erin Allmann Updyke: Whoa.

Erin Welsh: And in Norse mythology a frost ogre named Ymir was kept alive by the milk of a cow made from falling frost.

Erin Allmann Updyke: Wait, wait, wait. The cow was made from thawing frost?

Erin Welsh: The cow was made from thawing frost.

Erin Allmann Updyke: And then the milk made...

Erin Welsh: The milk from that cow of thawing frost.

Erin Allmann Updyke

Okay.

Erin Welsh

Weird. That's my understanding. And milk was believed to be a type of blood for a really long time and so that also as we have talked about in the hepatitis episode also carried a bunch of weight. And it was used as the blood of Christ for a long period in the Catholic church until being replaced by wine.

Erin Allmann Updyke

I gotta tell you that my brain can't keep flipping between cow milk and human breast milk and it's grossing me out both ways, either time.

Erin Welsh

Yeah and that's the thing is like milk holds a lot of meaning for many human cultures and a lot of that is human breast milk.

Erin Allmann Updyke

Yeah.

Erin Welsh

But with some of these as with the cow made from thawing frost, it also shows that animal milk had a significance as well.

Erin Allmann Updyke

Right.

Erin Welsh

Okay so let's see. A refrigerator was built in the US in 1803, like the first time, for the purpose of keeping butter.

Erin Allmann Updyke

Butter?

Erin Welsh

Butter. The CIA once tried to poison Castro by slipping a poison pill in his ice cream. He was a huge fan of ice cream apparently.

Erin Allmann Updyke

Who isn't?

Erin Welsh

He ate like pints. There was a lot of power in milk. So in breast milk it was believed often that picking a wet nurse with the right temperament was incredibly important in the baby's personality and also goat's milk or sheep's milk or cow's milk was seen as nourishment and was also used as a sacrifice as well. And milk wasn't universally hailed as a wonder liquid though. So for instance for millennia fresh milk could pretty much only be consumed on farms and so it was held in low status as a peasant beverage.

Erin Allmann Updyke

Oh interesting.

Erin Welsh

Yeah. And this created cultural tensions or conflicts. So in Southern Europe the Romans looked down upon those in Northern Europe who drank more fresh milk because it was colder there and the milk kept better. And in addition to making people more quote "barbaric", milk was also thought to be bad for you health-wise.

Erin Allmann Updyke

Interesting.

Erin Welsh

And fresh milk wasn't the only thing that got labeled as a suspect food, cheese and other dairy products also got the stamp. But as you mentioned milk is crucial for humans in infancy just as it is for all mammal species. And this is just gonna be an influx of trivia.

Erin Allmann Updyke

Yes.

Erin Welsh: Not all mammal milk is created equally.

Erin Allmann Updyke: Yes!

Erin Welsh: So some are loads fattier than others like northern seals at 53.2% fat.

Erin Allmann Updyke: Oh my.

Erin Welsh: Humans for reference, 4.5%.

Erin Allmann Updyke: Whoa.

Erin Welsh: And you know that one of my favorite bits of trivia is that the breast milk of some whales has the consistency of toothpaste.

Erin Allmann Updyke: Toothpaste!

Erin Welsh: I love that image.

Erin Allmann Updyke: I'm imagining that in my fridge. Like we have a lot of milk in our fridge right now and you can see the fat as it rises to the top when it gets cold. And knowing that that's only 4%, imagine seal milk in your fridge.

Erin Welsh: 53.2%, yeah.

Erin Allmann Updyke: Imagine that butter. Oh man.

Erin Welsh: I mean just toothpaste consistency breast milk. I mean it makes a lot of sense cause if you're in the water you wouldn't want it to just immediately diffuse or whatever.

Erin Allmann Updyke: Right, yeah. Wouldn't want that. You want that toothpaste milk.

Erin Welsh: Did you know also that some pinnipeds like sea lions and walruses, lactose isn't present?

Erin Allmann Updyke: Really?

Erin Welsh: Yeah.

Erin Allmann Updyke: So what's their main carb?

Erin Welsh: I don't know, you want me to look it up?

Erin Allmann Updyke: Nah, it's okay.

Erin Welsh

I saw it and I was like, 'Oh cool.' Bit of information. That's it. Not reading any further. But humans are the only mammal that consume the milk of other species and continue to do so throughout their lives. And in retrospect it's kind of easy to see why this practice would have been popular. Milk of various ruminants like cows and reindeer could be used to make yogurts or butters or cheeses that would keep for a decent period of time and that could be especially important when other food was scarce. Side note, did you know that unsalted butter was a recent invention because basically refrigeration was the only way to keep unsalted butter fresh?

Erin Allmann Updyke

That makes so much sense because salt is a preservative so you'd have to have salted.

Erin Welsh

Yep. I hope that you go to trivia night, you and anyone who is listening, and you get asked a question about milk that this episode will give you.

Erin Allmann Updyke

Except the question is gonna be what carbohydrate do pinnipeds have?

Erin Welsh

Instead of lactose. Sorry guys! There's only so much I can do. Okay but of course the majority of humans can't actually digest lactose into adulthood and this feature or this whatever, this pattern has been recognized for millennia. Hippocrates in the 5th century BCE said, quote: "Cheese does not harm all people alike and there are some people who can eat as much of it as they like without the slightest adverse effects. Indeed it is a wonderfully nourishing food for the people with whom it agrees, but others suffer dreadfully."

Erin Allmann Updyke

As you heard in Katie's firsthand account.

Erin Welsh

I was gonna say as Katie can attest. And Galen who lived in the 2nd century CE observed and described lactose intolerance and there were many ancient writings that advise against the consumption of milk after weaning. So why can some of us digest lactose, approximately 35% of us? Okay so first to answer that, let's look at the global pattern of lactase persistence to see if that gives us any clues. So these are the proportion of people who can continue to digest lactose into adulthood. In Eastern Europe the frequency of lactase persistence is between 15-54% whereas in the British isles and Scandinavia that ranges from 89-96%.

Erin Allmann Updyke

Whoa!

Erin Welsh

Yeah.

Erin Allmann Updyke

That's even higher than I thought.

Erin Welsh

And in Northern India around 63% of people have lactase persistence compared to 23% in the south or the east.

Erin Allmann Updyke

Erin that makes so much sense for something that I was reading where I went, that's weird.

Erin Welsh

And in some pastoralist populations in Sudan, lactase persistence is around 64% but in a nearby nonpastoralist group that number is around 20%. So there's a common thread here and that thread is that lactase persistence might have something to do with pastoralism or dairy farming as a way of life. So what came first, milking or lactase persistence?

Erin Allmann Updyke

Ooh.

Erin Welsh

So one hypothesis which is kind of like a chicken and egg scenario is whether pastoralism only developed in those populations where lactase persistence was already high, this is called the reverse cause hypothesis. And this view kind of says that lactase persistence wasn't selected for necessarily and the explanation for variation in rates is just random through genetic drift. But another hypothesis, and this one is the one that has more support, is the culture historical hypothesis which states that lactase persistence emerged and was selected for after pastoralism was adopted, meaning that being able to digest lactose into adulthood made you more likely to survive and reproduce. And one piece of support for this is that archeologists have found organic residue in pottery from around 6500 BCE in Western Turkey where lactase persistence is low today. And so this suggests that animals were milked before lactase persistence arose. So when did milking begin then? Milking animals probably began in the Middle East, possibly Iraq or Iran, around 8000-10,000 years ago. So like Neolithic Revolution times.

Erin Allmann Updyke

Yeah. That's a long time.

Erin Welsh

A long time. But also not that long in terms of thinking about human evolution. So there was a long held belief or viewpoint that humans had basically stopped evolving 50,000 years ago but of course we know that that's not the case now, especially as genomic technology has really shown that evolution is happening on many different time scales. Anyway, lactase persistence is a great example of how humans have continued to evolve.

Erin Allmann Updyke

Yeah especially considering how widespread that allele now is in some populations, that it was that relatively recent.

Erin Welsh

Yeah. Okay so there's a depiction of people milking cows on the wall of a temple dating back 5000 years in Ancient Sumeria but milking probably began long before that and cows weren't the first. Goats and sheep were actually the first livestock to be domesticated around 11,000 years ago followed by pigs and cattle around 500 years after that.

Erin Allmann Updyke

I didn't know that.

Erin Welsh

And so people may have first tried milking goats or sheep or maybe even a camel. So the Bedouins for instance relied heavily on camel milk for their survival. 'Bedouin' means desert dwellers. Also Bedouin is a really amazing musical artist, her Tiny Desk Concert is incredible. And Bedouins were traditionally nomadic and many still are but that traditional way of life has declined. But while on the move, camels played a major role in every aspect of life: shelter, transport, warmth, and of course food production. And the milk produced by a camel is pretty incredible, camels themselves are pretty incredible. Camels feed on the spiky saltbush which gives their milk a salty taste, at times of food scarcity camels will dilute their milk to make it last longer, and in times of plenty that milk can be incredibly fatty and rich in protein. So yeah, more milk facts for you. I read a book literally titled 'Milk'.

Erin Allmann Updyke

Also I looked it up and pinnipeds and cetaceans just have the lowest amount of carbohydrates. That's why they don't have lactose.

Erin Welsh

Okay, cool.

Erin Allmann Updyke

Yeah. Go figure.

Erin Welsh

Go figure. So at some point after the advent of agriculture and domestication of livestock, a mutation emerged that allowed humans to continue to produce lactase into adulthood. So this is probably around 8000 or 9000 years ago in Central Europe, there are different models that kind of show a variation of ranges from 6000-10,000 years ago but that seems to be the central accepted range.

Erin Allmann Updyke

Okay.

Erin Welsh

And clearly this mutation had some benefits because it spread rapidly and widely throughout Europe and parts of Africa as well, reaching frequencies as I said of over 95% in some places. And so why would being able to consume lactose as an adult be advantageous? And there seem to be three main hypotheses for why continued milk consumption could be selected for. And the first is that in pastoralist society, so ones that keep cattle for milking and meat consumption, drinking milk would have meant more nutrition. If milk is a constant part of your diet but you have diarrhea and horrible stomach pains whenever you drink milk, it's easy to see how your health could be negatively impacted and that people who had the ability to digest lactose into adulthood might have a slightly higher fitness if you're relying that heavily on milk.

Another hypothesis is that drinking fresh milk could have been super beneficial to people in high latitudes like in Northern Europe where lactase persistence is high because it would have allowed them to get vitamin D during the long winter months and that would have prevented things like rickets and also helped calcium absorption. And it's true that you see more lactase persistence and fresh milk consumption in Northern Europe compared to the Mediterranean where lactase persistence is lower and cheese tends to be the main dairy product consumed, and cheese can have less lactose in it depending on how it is prepared.

Erin Allmann Updyke

By like a lot.

Erin Welsh

A lot, yeah. And finally another hypothesis about the evolutionary benefits of fresh milk is that for people living in arid environments, milk would have been a source of water. And if you had diarrhea every time you drank your only liquid source, you would be super dehydrated. Not good.

Erin Allmann Updyke

Yeah. Not good.

Erin Welsh

And we do see that in pastoralist groups in the hot, arid parts of the world, lactase persistence is pretty high. But it doesn't seem to be as cut and dry as lactase persistence evolving alongside the cultural tradition of drinking milk because as we've talked about, milk or dairy products are regularly consumed in groups that have low lactase persistence. But as we said, lactase nonpersistence and lactose intolerance are different things. So you can kind of up your tolerance but you'll never be able to digest lactose.

Erin Allmann Updyke

Right.

Erin Welsh

Okay. So anyway one paper I looked at tested these different hypotheses to see whether any of them are supported by patterns of where lactase persistence is high or low. And what they found was that the vitamin D hypothesis and the dehydration hypothesis weren't supported really.

Erin Allmann Updyke

I'll also say that milk is actually a cruddy source of vitamin D. We add vitamin D to milk.

Erin Welsh

Does that have anything to do with pasteurization?



Erin Allmann Updyke: No, I don't believe so.

Erin Welsh: Or the age of milk?

Erin Allmann Updyke: I don't believe so.

Erin Welsh: Okay.

Erin Allmann Updyke: Yeah. I mean even human breast milk is a crappy source of vitamin D cause we make it ourselves if you're in the sun.

Erin Welsh: But I think their point was that if you're in Northern Europe, there literally is no sun.

Erin Allmann Updyke: Right.

Erin Welsh: So maybe any vitamin D would be better than none.

Erin Allmann Updyke: Yeah. It's not a very good source of vitamin D.

Erin Welsh: Well regardless it doesn't seem to be supported.

Erin Allmann Updyke: Makes sense.

Erin Welsh: But they did find that the lactase persistence evolved in people who kept livestock, so that seemed to be the best supported hypothesis.

Erin Allmann Updyke: Okay.

Erin Welsh: So basically pastoralism led to the spread of the mutation that allowed for lactose digestion into adulthood. Makes sense. And we probably see different rates of lactase persistence geographically because selective pressures for lactase persistence may have been different in different regions which makes sense. So if you didn't rely heavily on milk for instance, then that selection pressure wouldn't be there. And the pressures probably weren't constantly applied so lactase persistence may have only been selected for during extreme circumstances like during a famine. But regardless it does seem that being able to digest dairy products into adulthood was beneficial and a couple papers I read argued that lactase persistence and the reliance on a dairy economy led to the widespread expansion of a group called the Proto-Indo-Europeans.

Erin Allmann Updyke: I have not heard of that.

Erin Welsh: This is an important group linguistically apparently, so I learned, I hope I don't really butcher this whole explanation.

Erin Allmann Updyke: Okay, okay.

Erin Welsh: But the Proto-Indo-Europeans were a group of people whose existence is mostly inferred from linguistics rather than from physical evidence.

Erin Allmann Updyke: Okay.

Erin Welsh

And they existed around the Late Neolithic so like 5000 or 6000 years ago and were among the first to domesticate the horse. And so from somewhere probably in Eastern Europe, these spread across Europe, Western Asia, and the Indian subcontinent. And wherever they spread, their culture did as well. Dairy farming grew particularly in places where it was favored such as Northern Europe and their language spread also. The language that they spoke would eventually give rise to hundreds of languages, among them the most commonly spoken on earth: Spanish, English, Hindustani, Portuguese, German, Russian, French, Persian, Bengali, the list goes on and on and on.

Erin Allmann Updyke

What?

Erin Welsh

So it's estimated that about half, so like 46% of the world's population, speaks a language that has its roots in the Proto-Indo-European language.

Erin Allmann Updyke

Weird.

Erin Welsh

And so that's how milk drinking shaped language across the world. There's your connections moment for the day. So even though lactose intolerance had been written about or known about for millennia, lactose the sugar was only discovered in the 17th century and lactose intolerance only got a formal definition in the 20th century. So not that long ago actually.

Erin Allmann Updyke

Yeah.

Erin Welsh

I think one of the interesting things that this has revealed is a pretty good amount of bias in medical advice. So milk was often recommended to prevent or treat certain conditions like peptic ulcers or to increase calcium or prevent osteoporosis or vitamin D or whatever else the case may be. But if you can't digest lactose, milk consumption is only going to make things a whole lot worse. But the assumption was that lactose digestion was the normal state.

Erin Allmann Updyke

Right.

Erin Welsh

And so it wasn't only until recently that we have sort of learned a bit more about maybe drinking milk isn't good for you if you can't digest it. But despite this, milk consumption continues at high rates in some places and even seems to be increasing in popularity where lactase persistence is low such as China. Like China is drinking a lot more milk, the US is drinking a lot less. Yeah. So Erin, why don't you tell me what the lowdown is on milk today? Are there treatments besides LACTAID?

Erin Allmann Updyke

Let's talk about it Erin.

Erin Welsh

Okay.

Erin Allmann Updyke

We'll take a quick break first.

TPWKY

(transition theme)

Erin Allmann Updyke

So let's reiterate to make it as clear as possible that globally lactase nonpersistence is the norm and probably around 70% of the global population does not have the lactase enzyme that stays on in adulthood. Okay?

Erin Welsh

Yeah.

Erin Allmann Updyke

Cool, okay. But like you said, this ranges a lot across the globe. And there's a really great map, I think there's probably a whole bunch of them that we can post, but what's really interesting is so I was looking into what milk production and consumption is like across the globe and by far the highest consumer country of milk is India.

Erin Welsh

Okay.

Erin Allmann Updyke

Like by a long shot, greater than the whole EU and the US by like twofold. And when I was looking at these maps I was like India has lactose malabsorption 61% nonpersistence overall. And I was like this doesn't make any sense but then you mentioned that between the northern and southern India it's very different. So that's super interesting!

Erin Welsh

Yeah.

Erin Allmann Updyke

So I wonder if they broke the map of milk consumption down if it would correlate with that and I bet that it probably would.

Erin Welsh

Yeah, that's really interesting though.

Erin Allmann Updyke

It is, yeah. But besides India, the EU, the US, overall actually milk consumption like you mentioned is going up worldwide. So milk consumption is on the rise and milk production is on the rise globally.

Erin Welsh

And this is like a per capita...

Erin Allmann Updyke

Yes, yeah.

Erin Welsh

Okay.

Erin Allmann Updyke

Some of the most recent data that I could find I have to say was from Statista. Is that a good website?

Erin Welsh

I don't know.

Erin Allmann Updyke

I couldn't get where they got their data from without signing up for an account and I didn't want to do that so the other source of this information is kind of old but it's from the FAO so at least that's a legit source of info. But it's like 10 years old so I don't know why they haven't updated their data in 10 years. Anyways in any case people drink a lot of milk around the globe. So because we know that the normal state is lactase nonpersistence there's a lot of interest in trying to treat or manage the symptoms of lactose malabsorption, right. And I do think that one of the most interesting pieces that I found was a number of meta analyses that show that in general even people who are self-identified as lactose intolerant, so they know that drinking milk gives them symptoms, can actually handle up to about 12 grams of lactose in a single sitting before they become symptomatic.

Erin Welsh

Okay.

Erin Allmann Updyke

So that's actually like a whole glass of milk. And it's kind of a ton of cheese because a lot of cheeses, especially aged cheeses like cheddar have about 0.5 grams of lactose per ounce.

Erin Welsh

Okay.

Erin Allmann Updyke

Whereas milk has 9-14 grams of lactose per cup of milk. So per serving.

Erin Welsh

And lactose intolerance or lactase nonpersistence is very different than allergy.

Erin Allmann Updyke

So when people have allergies to milk it's generally to the protein casein that's found in milk when they have a cow's milk allergy. And yes, that is very different.

Erin Welsh

Okay.

Erin Allmann Updyke

The other thing though and this is probably why products that are lactose-free have become more and more popular even in places where lactase persistence is really common is because the symptoms of lactose intolerance overlap with symptoms like IBS and it can actually be really difficult to tell what is it that's causing your symptoms. Is it really the milk or is it something different?

Erin Welsh

Gotcha, yeah. That makes sense.

Erin Allmann Updyke

Yeah. So there have been a big rise in products that are lactose-free, so whether it's cow's milk or goat's milk that have been treated with certain enzymes, the lactase enzyme, whether it's from bacteria or yeast, that actually break down that lactose into monosaccharides so that even if you are lactase nonpersistent you can drink that milk. You can also take it in a pill form like we said already and there has been some research on probiotics and things like that, we're just not from my understanding at least, what I've seen, we don't really have another good answer. But the other thing that's become really, really popular is just non dairy milks, right.

Erin Welsh

Yeah.

Erin Allmann Updyke

So there's a lot in the United States medical literature of like, 'Ooh, we have to make sure that we drink milk because it's such an important part of our diet!' Like hand-wringing at the idea of someone cutting dairy out of their diet.

Erin Welsh

Right.

Erin Allmann Updyke

And I think that that's very interesting because the vast majority of the world can't digest dairy and they do just fine. In the American diet cow's milk is our number one source of calcium. So if you're not drinking milk or eating cheese or getting your calcium from dairy, then yeah, you do need to make sure that you get your calcium from somewhere else. But that can be from a lot of other things that are calcium-fortified or just from a calcium supplement.

Erin Welsh

Yeah.

Erin Allmann Updyke

But that is the main nutrient that is found in milk that we don't see in a lot of other foods. So most other foods that we eat have a much lower amount of calcium. Vitamin D is actually something that we add to milk because calcium and vitamin D work together in your body for bone health so it makes sense. And because a lot of us live at northern latitudes and now we wear clothes and cover our bodies so we're not making as much vitamin D because normally you make it from sun exposure but we don't expose ourselves to the sun because skin cancer.

Erin Welsh

Question.

Erin Allmann Updyke

Answer.

Erin Welsh

So historically if people were not getting calcium from milk which probably not many people were, what was happening? I mean do we see a lot of the problems that we associate with a lack of calcium in skeletal remains of people historically?

Erin Allmann Updyke

So if you eat a lot of seafood or legumes or leafy greens, these are other things that also have good amounts of calcium. So probably in the past people just ate more things like that so then dairy wasn't their only source of calcium.

Erin Welsh

Gotcha.

Erin Allmann Updyke

Yeah. Because dairy is one of the main sources of calcium in the US and in some other countries, it's thought that not getting enough dairy could lead to calcium deficiency which is a risk for osteoporosis. But there have been some studies that have found that in places where people don't consume dairy, in places where lactase nonpersistence is more common, osteoporosis is not any more common. So they're getting their calcium somehow.

Erin Welsh

Interesting.

Erin Allmann Updyke

Yeah.

Erin Welsh

Very interesting.

Erin Allmann Updyke

Yeah. But then there is also things like cheese that have low levels of lactose because just of the way that cheese is prepared, a lot of yogurts have very low levels of lactose because the bacteria that are found in live culture yogurt actually convert lactose to lactic acid so there's low levels of lactose. And then there's lactose-free milk, there's soy milks and things that are fortified with almost all the same nutrients that you would find in cow's milk, there's a lot of options out there.

Erin Welsh

Speaking of options, we should mention that the milk in our quarantini could be swapped out for any non dairy alternative. I love oat milk.

Erin Allmann Updyke

You can use any milk you like.

Erin Welsh

Yeah.

Erin Allmann Updyke

Aren't they trying to have it not be called milk if it's from a nut or an oat because it's not milk?

Erin Welsh

Yeah, I saw something like that. It's just like this late in the game that's never gonna catch on.

Erin Allmann Updyke

Right?

Erin Welsh

I mean come on.

Erin Allmann Updyke

Plus I'm not gonna drink soy juice, that sounds way worse. Well this was a fun episode.

Erin Welsh

This was a fun episode. This was a short episode.

Erin Allmann Updyke Well it's time for one, we've had a lot of long ones lately.

Erin Welsh Yeah. All right, should we do sources?

Erin Allmann Updyke Yeah we definitely should.

Erin Welsh Okay. So I read a couple of books, one was called 'The 10,000 year explosion: How civilization accelerated human evolution' by Gregory Cochran and Henry Harpending. And also a book called 'Milk!' by Mark Kurlansky. And then a few articles, I just want to shout out a couple of them. 'The origins of lactase persistence in Europe' by Itan et al 2009 and 'Evolution of lactase persistence: an example of human niche construction' by Gerbault et al 2011.

Erin Allmann Updyke I read a number of articles, there's a good one from the American Academy of Family Physicians that's just called 'Lactose Intolerance' just for some basic background on what the clinical syndrome that we call lactose intolerance is. And we will post all of our references on our website [thispodcastwillkillyou.com](http://thispodcastwillkillyou.com) for this episode and all of our episodes.

Erin Welsh Thank you so much to Katie for coming on and sharing her amazing poop story.

Erin Allmann Updyke We love to hear from you. Seriously thank you so much.

Erin Welsh Yes. And thank you to Bloodmobile for providing the music for this episode and all of our episodes.

Erin Allmann Updyke And as always thank you to you, listeners, for sticking with us through all the... You know we didn't even talk about poop that much besides Katie's bit.

Erin Welsh I know.

Erin Allmann Updyke It's kinda surprising.

Erin Welsh Yeah.

Erin Allmann Updyke Well.

Erin Welsh Okay well with that, wash your hands.

Erin Allmann Updyke You filthy animals.

Katherine Sampson Oh god. I trusted that fart way too much.