After the Fact | From Lab to Life: The Forgotten Organ that Built You

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TRANSCRIPT

Geetu Tuteja, professor, Department of Genetics, Development, and Cell Biology, Iowa State University: The placenta is establishing the connection between the mother and the baby. It does its thing during pregnancy, kind of like a control center for fetal development, and then it’s gone. It’s thrown away; it’s forgotten.

Dan LeDuc, host, The Pew Charitable Trusts: Welcome to “After the Fact.” For The Pew Charitable Trusts, I'm Dan LeDuc.

Geetu Tuteja is a professor at Iowa State University and a 2019 Pew biomedical scholar.

She studies an incredibly important yet temporary human organ: the placenta. Every one of us was connected with one before birth, and it turns out for being temporary, the placenta is potentially a treasure trove of information about a person's future health. And we recognize that this topic is serious and understudied.

Even though nearly one-third of human pregnancies are affected by placenta-related disorders, the placenta hasn't received a lot of attention from researchers.

Scientists like Geetu are working to better understand how the placenta functions and the causes behind these disorders, and what it all means for mothers and their children.

Geetu Tuteja: The placenta is important in so many ways. It's providing nutrients to the baby. If the baby's not getting nutrients at the proper rates, then the baby's not going to grow properly.

And this can have long-term consequences on the baby. You know, it's there for a short time, but its importance is much longer than that.

Dan LeDuc: There are placentas that perform better than others, and that has health implications both ways, maybe, right? Is certainly for the child or the baby, but both ways, help us understand more about that.

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Geetu Tuteja: Yeah, so studies have shown that birth weight was inversely associated with mortality rates from ischemic heart disease.

When you have changes in fetal size, so smaller babies, then the placenta is going to be involved in that. So, then studies also showed that yes, if you have these changes, those kids who had smaller placentas or even bigger placentas might have heart disease.

And, you know, you can look at the pathology after pregnancy and so those studies have been done on large populations, but then studies have also shown that there's correlations between placenta and other complications like asthma or brain disorders, things like that.

Dan LeDuc: So, the science is teaching us that the placenta is almost a little bit of a guidebook for the baby's life.

Geetu Tuteja: Yeah.

Dan LeDuc: Do we as a society make enough out of the knowledge that that presents for each and every baby that's born?

Geetu Tuteja: I don't think so. I mean, these things are definitely being looked at more than they used to. And definitely when there is a complication with pregnancy, the placenta is going to get sent for an analysis and, you know, they'll look carefully and try to look at lesions and things like that.

But if the pregnancy appears to be healthy, the placenta is not going to get looked at most likely, not in detail. But if some of the effects are being noticed later in life, you know, it is important to take a closer look at the placenta when it's delivered and, and more often than not, it's just discarded.

I think people aren't thinking about it. I mean, during pregnancy, you're thinking about the baby, which makes sense. You can feel the baby, you know, at some point you can feel it kicking or, um ….

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Dan LeDuc: Sure.

Geetu Tuteja: And you're planning, you know, you're thinking about the nursery and then you're delivering and you're thinking, well, I want this healthy baby and then you're holding the baby and the placenta is just, you know, it's called the afterbirth. It's like, whatever.

Dan LeDuc: But we're learning the importance of the placenta in a whole new way.

Geetu Tuteja: Exactly.

Dan LeDuc: I see you have studied computer science, genomics, computational biology, and all sorts of other things that I find very intimidating as a liberal arts major.

And I also think of them though as cross disciplines. Did you sort of come at things a little sideways?

Geetu Tuteja: Yeah, I definitely did, but you'll see that it's all related.

So I was always interested in biology when I was growing up, and then that interest kind of narrowed to human disease, as I started approaching university. So, I naturally thought that meant medical school.

During my first year, a friend suggested I tried a computer science class, and I really got hooked on the logical thinking that it involved. So, I became a computer science major, but I still stayed on the premed track, and I thought it was just going to be this kind of weird combination, and I'd be heading to medical school with a different background.

But then a year or two later, I learned about the Human Genome Project, and that was a turning point for me, because they were using computation to understand biology.

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So, the Human Genome Project was this really huge, scientific endeavor that mapped the entire sequence of human DNA. So, it's, you know, 3 billion base pairs. Before the project, we probably knew less than 2% of what that sequence was. And that helped identify all the genes in the human genome.

So, it really revolutionized our understanding of biology and medicine and gave this reference for studying genetic variations that can be linked to disease.

So, I got really interested in that and got involved in research to see if it was something I wanted to pursue, and I loved it. So that pushed me to my Ph.D. in genomics and computational biology, so now I'm combining the computer science and biology and interest in human disease that I had. And from there, I went on to study developmental biology and genomics for my postdoc, and that's where I became fascinated by the placenta, which is what I study now.

So, I've been here now at Iowa State for almost 10 years. My lab does computational biology and molecular biology to better understand placental development.

Dan LeDuc: What is it about this area that intrigues you and attracts you?

Geetu Tuteja: I think it's the puzzles that are involved. So yeah, science is a continuous journey of asking questions and uncovering answers. And, I mean, understanding the inner workings of a cell, it's really a puzzle.

And I think the fact that we know a lot, but there's so much that we don't know. Especially about fundamental processes about how life begins and develops and, and so I think that's what, you know, motivated me in science.

You know, like most people, I hadn't really thought about the placenta before, and then once you start thinking about it, you realize how important it is, and how much it does in such a short time.

Dan LeDuc: Tell us more about what you have chosen to focus on in your research.

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Geetu Tuteja: My lab is a basic science lab, so we don't do clinical work, but basic science is necessary to ultimately lead to these changes or understanding of what's going wrong in disease. So, we focus on understanding the genes and networks that are important in regulating different processes during placental development.

And beyond just identifying the genes, we're also focused on how they're regulated and what turns them on at precise moments during development. These DNA elements can help turn on the genes at the exact right time that they need to be turned on.

So, we're interested in identifying those elements and figuring out the mechanisms by which they turn those genes on. And we're doing this in normal placental development. Because you have to understand normal before you can understand what's going wrong in these pregnancy complications.

Dan LeDuc: Geetu told us this research could help improve treatments.

Geetu Tuteja: Yeah, it would be more about early detection of the disorders. So, you know, ideally the research would pave the way for new diagnostic tools. And so by understanding these detailed mechanisms, maybe, you know, and we know this gene is, it's supposed to be expressed, but it's not. Maybe we can detect that, earlier.

Right now, some of these placenta disorders are not detected until late in the second trimester, even third trimester. And the problems that are happening are happening early on. And so, if we can detect them earlier, then maybe we can intervene earlier.

Dan LeDuc: So, we're talking about like transforming neonatal care.

Women's health issues in general, and this is a woman's health issue, have always sort of lagged in our society.

Geetu Tuteja: Yes.

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Dan: You have been at this for a while. Have you seen society's interest in women's health issues growing, changing?

Geetu Tuteja: Definitely. I think there's been increased interest in the placenta, with respect to women's health and pregnancy. You know, when people work with mouse models, now there is a requirement that people work with males and females. So even when you're studying placentas, say in mice, if you're working with the National Institutes of Health, you need to make sure that you're working with placentas that are from male fetuses and female fetuses, because they're different.

So, this is definitely improving. But, you know, it's still not where it should be. So, it's improving and there's definitely more research in the area than there was, say, even 10 years ago.

And there's more push for studying women's health than there used to be.

Dan LeDuc: That's a positive thing for sure.

Your background, how is that cross-disciplinary approach, I guess, for lack of a better phrase, guiding your work, say, differently than if you had gone to med school?

I'm just curious, you know, I'm just curious how you do your daily work in your lab. That's sort of different because of the background you chose to follow.

Geetu Tuteja: Right. We do a lot of genomics work in our lab. And so that means that we do a lot of work where we, when we isolate the placenta tissue, we sequence it to try to find different things. So, the junk DNA that's the majority of the genome, right?

These nongenes, and they're not easy to just find. So, you have to use these approaches where you can sequence the entire genome in a way, to pinpoint where they are. And so those kind of approaches require generating these large data sets.

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So, we're able to use our computational expertise to narrow down what are the most interesting DNA elements and then further validate those. So when we're analyzing the data, we're thinking about placenta and the biology of the placenta. And that really helps us focus in to find things that might be relevant for understanding placental disease.

Dan LeDuc: What's it like for student researchers in your lab?

Geetu Tuteja: It is all about discovery. In my lab, the students are interested in learning new skills that they can apply for that bigger picture. So, you know, my students in my lab, they are interested in placenta, obviously.

But I don't know if that's their lifelong research goal to study placenta. But the kind of skills that they're learning, you know, and the big-picture questions that the kind of techniques that we use can address, that's what motivates them. And for most students, there's this idea of just discovering something new.

And it's about puzzles; you know, let me figure this out.

I'm there to foster their creativity. Help them ask bold questions, you know, question the things that they're telling me to help them think more critically. And so, you know, if they're self-motivated and they're driven by that bigger picture, that definitely helps.

Dan LeDuc: Yeah. That sounds fascinating and fun. And how many people get to go to work and say, you know, at the end of the day, I might learn something that makes people's lives better.

A lot of your research is going to help physicians detect things earlier in their pregnancies that could potentially be problems. How would that work?

Geetu Tuteja: Yeah, this idea of early detection has really advanced, in the last 10 or 20 years, in the field of reproductive biology. So we know that cells from the placenta, um, shed into the maternal blood during pregnancy. So that means that noninvasively, you can just collect blood from the mother.

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And then you can figure out, you know, what genes are expressed from the, those fetal cells from the placenta just by taking the maternal blood. So maybe we could look at specific genes that we've identified and look at how they're expressed, or even look at the activity of certain DNA elements that we've identified.

Again, simply by looking at the profiles in the maternal blood.

Dan LeDuc: What are your hopes for your future research moving forward?

Geetu Tuteja: The ultimate goal would be to develop tests that allow noninvasive testing during early pregnancy so we know more about what the pregnancy is going to look like and any interventions that, that need to take place. Anything that could go wrong in the placenta that could affect pregnancy, you know, that's what we're trying to understand so that there can be interventions early on.

Dan LeDuc: There's an opportunity, at least potential that you could prevent disease in people before they're born.

Geetu Tuteja: Yeah, that's the work of a lot of researchers in this area, and we're all trying to get there, and it's probably decades more of work, but that's not pie in the sky, so.

Dan LeDuc: Not at all.

This has been a fascinating conversation. You, you bring a lot of pieces together in the puzzles you're trying to solve. That's amazing.

Geetu Tuteja: Thank you.

Dan LeDuc: Thanks for listening. To hear more episodes featuring scientists and their research, visit www.pewtrusts.org/afterthefact.

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For The Pew Charitable Trusts, I'm Dan LeDuc, and this is “After the Fact.”