Science Will Win Season 7
Episode 1: Beyond BMI: What is obesity, really?
Transcript

SFX and music evoking a middle school gymnasium—children shouting, rubber balls bouncing, squeaking of sneakers on waxed floor, teacher's whistle, etc.)*

JOE
We all had different feelings about middle school gym class. For some, it was the most exhilarating part of the day. Others huddled together on the bleachers, just waiting for it to be over.

But no matter if you were a gym class warrior or a dedicated benchwarmer, I'll bet that you and your classmates had to participate in some kind of routine fitness assessment every year.

And I'd also bet that that fitness assessment involved calculating a number known as your Body Mass Index—or BMI.

You and your classmates may have shuffled in line, one by one, pressing your backs against the gymnasium wall so your teacher could measure your height. You'd next step onto the scale, and your teacher would scribble down that number, too. Then, she'd do a quick calculation, and write down one last number—your BMI.

But while arriving at that number was simple enough, the *feelings* it inspired were anything but. Maybe you noticed your number was smaller—or bigger—than your classmates'. Suddenly, you're all sizing each other up. Based on this rubric your teacher provided, you're now assessing—even judging—who is considered healthy? And who is definitely *not?*

But how much can this one number—your BMI—*really* tell you about your body? Or more importantly…Your health?

Music change*

In today's episode, we're tackling these questions. For decades, BMI has been widely used to define obesity. But now, doctors and scientists are wondering if there is a better way. Recently, researchers have found more accurate ways of defining obesity, this disease that's currently impacting more than 100 million Americans[1]. And the better we understand what obesity really is and what causes it, the better doctors can provide the best treatment to help improve their patients' overall health.

Hi, I'm Joe Hanson— a science storyteller and a professionally curious person. I'm a molecular biologist, and I host PBS's *Be Smart* series[2], a show where we explore the deep answers to simple questions about science and the rest of the universe. I'm so excited to be hosting this season of *Science Will Win.*

And in this season, we're talking about obesity. But we're going way beyond what you talked about back in health class. We're examining the complex biological underpinnings of the disease. We'll be talking to

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[1] Adult Obesity Facts
[2] Be Smart | PBS

researchers and doctors on the frontlines of creating a better treatment landscape for patients dealing with obesity and its many comorbidities. Let's get into it!

Music change/transition

LISA

So essentially it's one of the most significant global health challenges of our time today. There's more than one billion people around the world that are living with obesity.

JOE

Before we dive into exactly *what* obesity is and what actually causes it, it's helpful to understand *why* researchers are so concerned with this area of medicine.

LISA

My name is Lisa Tarasenko, and I am a global medical affairs leader within Pfizer's internal medicine research unit. And I focus on the area of obesity.

JOE

Lisa and her Global Medical Affairs colleagues work to advance scientific understanding of obesity and support evidence-informed healthcare decisions.

LISA

Our role is to really help advance the scientific and medical understanding of obesity and support healthcare decisions with high-quality evidence. So we engage healthcare professionals, researchers, the patient community, scientific experts, like some of the top tier experts around the world to really better understand obesity as a disease, the complications that come along with it, and the outcomes that really matter most to people who are living with the chronic disease of obesity.

JOE

And a *lot* of us have a stake in the research that's happening around obesity, because it's affecting more and more people.

LISA

In the United States alone, it's four in 10 adults that are living with obesity, and that number continues to grow.

JOE

We all know someone who lives with obesity and the other health problems that come along with it—things like high blood pressure, cardiovascular disease, fatty liver disease, even sleep apnea. Maybe you're dealing with some of these things yourself.

But even though we're all familiar with the problem, actually *solving* it can be complicated—something that Lisa and her team know all too well.

LISA

One of the biggest challenges is that people just don't understand it, that obesity is a disease. So we have that same stigma that's associated with obesity, that it's really around lifestyle, that you should essentially just be eating better, eating less, but there's so much science around this disease that is not getting to people and essentially to healthcare professionals.

Music transition/change

JOE
Luckily, that's what *Science Will Win* is for—taking the science and breaking it down so that we can all be on the same page about what's going on with our bodies.

And when it comes to obesity, this is extra important. *Because* obesity, like Lisa said, is not just a number on your medical chart. It's a complicated and chronic disease. One that impacts your body's metabolism and other biological processes in ways that researchers are still investigating and learning more about today.

But before we can dive into the biological underpinnings, we need to be sure we all mean the same thing when we say "obesity." Which, it turns out, is actually a little tricky.

If you ask the average person to define obesity, they may recite a number back to you—which means we're back to talking about BMI.

GILES
So BMI is obviously "body mass index," which is your weight in kilograms divided by your height in meter square. And it's a way of normalizing your body size, and this is why I'm saying size for your height.

JOE
That's Dr. Giles Yeo. He's a professor at the University of Cambridge, where he studies molecular neuroendocrinology—say that three times fast.

He's here to help explain the limitations of using BMI to understand our bodies. So say you have your BMI…what is that number supposed to mean?

GILES
So famously below twenty, eighteen to twenty is underweight, twenty to twenty five is normal, twenty five to thirty is overweight, and thirty and above is having obesity, and above thirty five is morbid obesity.

JOE
So your BMI puts you in one of five ranges—"underweight," "normal," "overweight," "obese" and "morbidly obese." Simple enough.

But how did we get these classifications in the first place? Time for a mini history lesson!

Music shift

It all started in the mid-19th century with a Belgian statistician named Adolphe Quetelet—a man considered by some to be the founder of statistics as a scientific discipline. This guy *loved* numbers. He collected data on crime rates, marriage rates, mortality—you name it.[3] And he was especially interested in measuring the human body.

Quetelet became known for his concept (and pardon my French pronunciation) *l'homme moyen*—or, the average man. But we aren't talking "average" in the way you might think. For Quetelet, *l'homme moyen* would be the perfect representation of the human body. By determining the proportions and characteristics of this "average man," he[4]

In pursuit of this "average man", Quetelet gathered data on the height and weight of different populations. Even though he wasn't particularly interested in studying obesity, he was still the first person on record to devise the equation that would later be used to calculate body mass index.[5]

Music evolves

It wasn't a straight line from Quetelet's research to how we use BMI today. We have to fast forward more than a *century* to 1972, when another researcher named Ancel Keys and his colleagues popularized Quetelet's calculation.[6] Keys conducted a study of over seven thousand "healthy" men. According to Keys, BMI proved the most effective tool for assessing relative weight.[7]

BMI became an increasingly popular way for institutions—from medical organizations to life insurance companies[8]—to assess weight at the population level, which proved to be more and more important as obesity and its associated health risks became more prevalent as the 20th century progressed.

By the late 1990s, the World Health Organization formally recognized obesity as a global epidemic.[9] They'd also adopted BMI as the way they would measure and track this global health crisis.[10]

> **GILES**
> It should still be used, at least at population level, because on average, the higher your BMI, the more fat you will tend to carry, and the more fat you tend to carry, the less healthy you are likely to be. So now, if you are a policy maker, a government, or a city mayor, whatever it is, and you need to put an intervention. This could be pharmacological, this could be a supermarket, whatever it is, and you want to track someone's health by BMI, the BMI is the way to go.

JOE
That's Dr. Giles Yeo again.

> **GILES**

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[3] Adolphe Quetelet and the Evolution of Body Mass Index (BMI) | Psychology Today
[4] Adolphe Quetelet and the Evolution of Body Mass Index (BMI) | Psychology Today
[5] Adolphe Quetelet and the Evolution of Body Mass Index (BMI) | Psychology Today
[6] Adolphe Quetelet and the Evolution of Body Mass Index (BMI) | Psychology Today
[7] The History and Faults of the Body Mass Index and Where to Look Next: A Literature Review - PMC
[8] Adolphe Quetelet and the Evolution of Body Mass Index (BMI) | Psychology Today
[9] The History and Faults of the Body Mass Index and Where to Look Next: A Literature Review - PMC
[10] The History of BMI: From Social Physics to a Modern Health Tool

And it's used because it's free. You have a measuring tape and you have a weighing scale.

Now, where the BMI falls down is as an individual predictor, as an individual diagnostic. Because all it does is it gives you a range of risk. So a BMI is useful to measure risk, but you need to treat the person sat in front of you.

JOE
When you're a doctor trying to treat a patient, of course you want to be aware of how their body measurements compare to the rest of the population on average... But is that information enough to know if they're truly unhealthy?

First, it's important to remember that the studies that cemented the widespread use of BMI only took measurements from male bodies—and those participants were mostly white and European.[11] Which means a lot of bodies in our population just weren't considered when defining what is supposedly "normal" across a population.

Then there's the outlier cases. They can throw a wrench in our ability to use BMI to accurately predict if someone is obese.

GILES
Obviously, if you are a sports person or a big bulky person, if you've got a BMI of 30, but a waist size of 32, it's very unlikely you have a problem. Whereas if you have a BMI of 25, but have a waist size of 38, mmm, okay, well now you gotta start thinking. Do you carry a lot of fat or are you carrying a lot of muscle mass? So therein lies the problem with the BMI.

JOE
And what Giles just said there really hits home for me! I'm 6 foot 3, and I do a lot of strength training these days to try and stay in shape. But when I put my height and weight into the BMI formula… It puts me in the "overweight" category. And that seems like a mismatch, honestly.

Muscle is denser than fat[12]. So if you're a bodybuilder, you might have a BMI high enough to technically qualify as "obese." But, of course, that wouldn't be an accurate description for a dedicated athlete whose weight comes from muscle.

There are also anomalies across ethnic populations. For instance, health organizations have suggested lower cut-off points on the BMI scale for obesity for South Asian and East Asian adults. This is because people with South and East Asian ancestry are more likely to develop risks for conditions like diabetes and high blood pressure at lower BMIs compared to white adults.[13]

So that simple calculation you did with your height and weight to find your BMI? Suddenly, interpreting that number isn't so clear-cut.

GILES
And that is why we need to rethink the BMI when it comes to different ethnicities, different populations, for Pete's sake, different sexes. So the BMI designed for a very tiny sliver of society,

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[11] The really old, racist and non-medical origins of the BMI - ABC News
[12] The Difference Between Muscle Weight vs. Fat Weight
[13] The really old, racist and non-medical origins of the BMI - ABC News

I wouldn't throw it out, but we need to be cleverer about how we then take into account all these other complexities to tell us about someone's health.

JOE
Giles is far from the only expert calling for us to move beyond BMI when assessing an individual patient's health and needs.

GILES
I knew when I entered the field thirty years ago with obesity that BMI was problematic when it comes to an individual diagnosis.

It doesn't tell you about where you put your fat, and it doesn't tell you about your body composition. And more crucially, it doesn't tell you how much fat you can store safely. That's a more complex question.

Music change

JOE
After decades of pointing out these limitations, finally, a few years ago, the global medical community took a big step in creating a new standard definition for obesity—one that doesn't rely solely on BMI and that allows for a more nuanced and accurate assessment of patients' individual needs.

Well, the definition of obesity is a very controversial and hot topic right now. It seems strange that it should be. But exactly how it's defined has been unclear for my whole career.

JOE
That's Dr. David Cummings, a professor of medicine at the University of Washington.

DAVID
I'm also the founding director of the weight management clinic and program within the Seattle Tacoma VA system. And my research focus has throughout my career been on the mechanisms of body weight regulation and obesity research.

JOE
In 2022, David joined forces with dozens of other medical professionals and researchers from around the globe to tackle this big question: how, exactly, should we define obesity? The effort—known as the Lancet Obesity Commission—was established by the Lancet Diabetes and Endocrinology journal.[14]

DAVID
Well, we think BMI is troublesome, but we don't know how to replace it with something more useful. That's what the Lancet Obesity Commission attempted to do and rolled up our sleeves and worked for four years to struggle with a new definition that could be implementable in the world and practiced anywhere.

The actual report is about as long as War and Peace. The manuscript was 150 pages long. But I will crystallize its essence into one sentence: So the Lancet Commission recommends changing

[14] Definition and diagnostic criteria of clinical obesity

the definition of obesity from simply being relatively heavy for one's height, in other words, having a high BMI, to being ill from having too much body fat.

JOE
So we're thinking specifically about body *fat*. Remember, not distinguishing origins of weight – muscle vs. fat for example – was one of the biggest limitations of BMI.

DAVID
…it doesn't tell you anything about how the fat you have is distributed. And it's well known that if it's distributed in the belly, the sort of pot belly, that's more damaging metabolically than if it's distributed elsewhere.

So our Lancet commission's definition of obesity—it's basically two steps beyond a BMI. We didn't throw BMI out entirely. We think it's a good screening tool. If it's really high, let's say BMI over 40, we would call that obesity end of story. If it's really low, BMI under 25, we would call that person without obesity, end of story. It's in the middle that we have the gray zone. So that would be between a BMI of about 25 and 40.

JOE
If a patient happens to fall in that gray zone between 25 and 40 BMI, the commission recommends two additional steps.

DAVID
So the first step to define whether the relatively high BMI is as a result of having too much body fat is to use one of several what's called anthropometric measures, which are just simple measurements of body fat you can do in the clinic with a tape measure. So one is called waist circumference. Another one is called waist to hip ratio, the ratio of the circumferences of your waist versus your hips.

And the third one, which is increasingly popular these days and seems to be the winning the race among those three is waist to height ratio, how big your waist is for your height. So you've got a relatively high BMI. We then say, "Is that a result of excess adiposity or fatness as measured by one of these three anthropometric measures?"

JOE
Okay, let's pause because David just introduced a new term: "adiposity."

DAVID
So when doctors talk about body fat, they may use the term adiposity. It means body fat. Adipose tissue is our fancy way of talking about the tissue in which fat molecules are stored and which commonly is known as fat. If you have too much body fat, we would say you have too much adiposity.

JOE
And as David mentioned earlier, when we're talking about body fat, it's really important for doctors to consider *where* on a patient's body that adipose tissue is being stored.

DAVID

It's very well known that it's more unhealthy to carry a particular amount of extra body fat in your belly than in other parts of your body. And we're not talking necessarily about the fat that's under your skin above your belly, but inside your belly.

JOE
So this isn't saying everyone needs a flat stomach or toned abs. David is talking about a layer deeper, where fat risks gathering around vital organs.

DAVID
We call that visceral fat. It's in and around your organs. That does more metabolic damage and is much more associated with the risk of bad things like diabetes, high blood pressure, bad cholesterol, and other fatty liver disease, for example. And that may be one of the reasons why men tend to suffer more heart attacks and strokes for a given age than women do, because they tend to put their fat in the belly, whereas women tend to do so less so.

JOE
Now, it's worth asking: *why* is visceral fat so much worse for your health?

DAVID
The reasons exactly why visceral fat or belly fat is more harmful are pretty complicated. But one of the simple ones to think about is that fat secretes a bunch of molecules and some of them can be harmful to you. If the fat is in your belly, then whatever it secretes goes quickly to the liver and can damage the liver. So the liver's one of the most important sites that gets hurt from having too much body fat in your system. The common term is fatty liver disease, but it can lead to liver turning sort of scarred, that's called fibrosis, eventually cirrhosis. It used to be that the most common cause of liver transplant was alcoholism, but now for a long time, it's been surpassed by excess adiposity or obesity.

JOE
By taking into account how much body fat a patient has and where that adipose tissue is carried, doctors can better assess what kinds of interventions they need.

The Lancet commission proposed breaking down obesity into two separate diagnoses: clinical obesity and *pre*-clinical obesity.

To help us understand the distinction between these two diagnoses, David gave us two case studies: a patient named Janet and a patient named Frank.

Here's Janet's story:

DAVID
Janet has a BMI of 33, and in her case, that is because she has some extra fat, Janet has large breasts and buttocks and thighs, but she runs five times a week, and she runs marathons a couple times a year. And she is in no way ill as a resulting of having kind of a relatively high level of body fat.

So in the old classification, she would be deemed to have obesity, but we're not sure that would be a good idea.

JOE
Then there's Frank.

DAVID
So Frank has a lower BMI, his BMI is 28. So he would be considered not to have obesity. But Frank definitely has too much body fat and most of it his is in the belly, typical of men. And Frank can't get up a flight of stairs without pausing to breathe. And he's got aches in his muscle, his joints a lot. And he's got a fatty liver and his various metabolic numbers like his blood sugar and cholesterol levels are not wacky enough to diagnose diabetes, but they're off and they're putting him at risk for disease. Frank is suffering from having too much body fat here and now.

JOE
This is where those terms "preclinical obesity" versus "clinical obesity" come into play.

DAVID
In our definition, we would consider preclinical obesity, Janet, that's a risk factor for future disease. And clinical obesity, Frank, that's a disease in and of itself.

JOE
So we have two patients. Both have excess body fat. But they carry that fat differently and have unique symptoms and quality of life indicators.

DAVID
It's important to note that preclinical obesity, Janet, in other words, the one who has relatively heavy because of too much body fat, but not sick yet, we do not think that that's something that should be ignored. Janet absolutely should receive structured counseling and continued monitoring to see if her preclinical obesity evolves in time into obesity.

…these principles can also apply to deciding who's a good candidate for bariatric surgery and who's not. That's, you know, clearly an expensive and invasive technique. Um, so it should be allocated to those most in need, not simply those who are the biggest for their height.

JOE
So BMI has its place in defining broad categories at the population scale. But, with a more sophisticated definition of obesity—one that takes into account a patient's adiposity, additional health data, *and* the symptoms they're experiencing in their daily life—doctors can better identify the needs of individual patients. That can lead to better, more personalized care.

LISA
Overall purpose of treating a patient with obesity is not just to change the numbers on their scale, not just to get their weight down. Really, the overall and most important role is to improve their health, their wellbeing, overall how they're feeling functionally, and their overall outcomes long-term.

JOE
That's Dr. Lisa Tarasenko again. When we think of obesity not just as a number on a scale but instead as a complex disease that impacts your metabolic processes in all kinds of ways, we're better able to ditch

the stigma associated with it. And we can focus on the science with the greatest potential to improve people's lives.

LISA
Biology, genetics, environment, medications and behavior all contribute to this disease, yet stigma is still there, and it's hurtful to the patients that are living with this condition and being blamed for this disease that they have.

…It's so important that we as scientists move the conversation around obesity from blaming a person to talking about really what's happening behind the scenes in terms of the biology and the disease.

JOE
For our next episode, we're diving into the complex network of biological factors that drive obesity—and how things like weight and appetite can play out differently for different people.

I'm Joe Hanson, and this has been *Science Will Win!* See you next time!

End credits*
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