00:05 Sarah Crespi: Welcome to the Science Podcast for April 10th, 2020. I'm Sarah Crespi. First up this week we talked with staff writer Robert Service about the debate over airborne transmission of the novel Coronavirus. Then news writer Jennifer Couzin-Frankel joins us to talk about the genetics and brain circuitry behind anorexia nervosa, an eating disorder that affects about 1% of people in the United States. Now we have staff writer Robert Service, he wrote this week on a debate over whether the novel Coronavirus is transmissible by air. Hi Bob.

00:42 Robert Service: Hi Sarah.

00:42 SC: This has come up before, this idea that COVID-19 might actually go through the air from person to person. What has brought this idea back to the forefront?

00:52 RS: I think part of it is just that people continue to learn lots more about this virus as time goes on, and so the wealth of understanding about it and how it likely spreads continues to increase. And I think what you're seeing is public health officials and policy people trying to be flexible and trying to be responsible to pay attention to the latest data and perhaps err on the side of caution.

01:18 SC: So how do you decide if something is transmitted through the air? We know that respiratory droplets can carry this virus, but what changes the definition to airborne transmission?

01:31 RS: What has been clear from the outset of this pandemic has been that this virus transmits pretty readily from what they call respiratory droplets, when people cough or sneeze. So these are much larger, sometimes when you sneeze, you can actually see the things coming out of your mouth. That's been the primary understanding as the main root of transmission. And those larger droplets which can be on the order of 100 micrometers or even up to a millimeter or something like that, they are big enough whereas gravity will essentially pull them to the ground pretty quickly. And so that's where the whole social distancing recommendation for keeping two meters apart from each other, that's where that comes from.

02:13 SC: So it's related to the drop size and how long they stay in the air?

02:16 RS: And basically how heavy they are, and so all these drops tend to be encased in saliva and mucus, and so the gravity pulls them to the ground. What has been less clear is what about smaller droplets? So when we breathe or talk or sing or what have you, we give off a continuous mist of ultra fine droplets, maybe on the order of a micron or so, below five microns is what they call an aerosol. And so these droplets are so small and lightweight that they can essentially spend for up to hours in air and sort of dance around like little dust particles that you might see or something like that. And so then that raises the question of, okay, is this happening with COVID? Is the virus being transmitted in these droplets? And so that's where some of this new information comes in, new studies and now new recommendations.
03:10 SC: Right. So there's a recommendation from the National Academies of Science, the US National Academy of Science, to consider that this might be in aerosol size particles.

03:18 RS: Correct. They have a standing committee that is now looking at emerging infectious diseases, trying to offer the best insight they can do to help guide policy makers on recommendations for public health. They gave a central letter to the White House on Wednesday saying...

03:34 SC: April 1st.

03:35 RS: April 1st, but this is not an April fools joke unfortunately. [chuckle] But they did send a letter saying, the evidence they see is consistent with aerosol spread of the virus. So that doesn't mean that it's nailed down for sure, but they're trying to... I think, I'm not... I can't really speak for them, but I think what they're trying to do is err on the side of caution and say look, it looks like this might be happening in some cases, so we need to let people know about this.

04:02 SC: What kind of evidence did they see that it might be in aerosols?

04:06 RS: There's several different lines of evidence here. Back in March, some researchers from the NIH wanted to explore this question and so they measured aerosol droplets below five micrometers and they found that yes in fact, these could suspend in air for up to three hours with active virus. Now that doesn't necessarily mean that if you or I were in that situation, and we breathed those in, that we would necessarily get sick. We can't say that. We don't know how many viable particles it takes to get...

04:39 SC: We don't know if infectious patients are actually producing these either.

04:44 RS: A couple more studies they looked at did try to get at that a little bit. In one, some researchers led by folks at the University of Nebraska, they sampled the air and surfaces in the rooms of patients isolated with Coronavirus disease. The patients were bedridden and so they sampled beyond two meters away. So this would then assume an aerosol transmission and they found hard to reach surfaces up high or down low, or things like that, they did isolate viral RNA. And they also did air sampling again for more than two meters away and registered viral RNA.

05:24 SC: But there you are with RNA instead of actual viral particles. So it sounds like a lot of pieces are coming together from separate kinds of studies.

05:31 RS: So they were careful to say that they did not isolate live active virus, but they did isolate viral RNA. So that does suggest that the virus is being transmitted, so that is again suggestive of the fact that you can have aerosol transmission. And then another study that came out in March from researchers at the University of Wuhan in China suggested that personal protective equipment, so the gowns, masks, things that medical workers who are being heavily exposed to Coronavirus, when they take them off after a shift, that could be re-aerosolising the Coronavirus again because it's so light and it can re-suspend particles in the air. And so that they found some evidence that that
might be occurring as well. Taken together I think the National Academies just wanted to let the White House know that this is a possible root of transmission. It's hard to say that this is what's going on in the majority of cases. And so I think that played into the White House's decision last week or the CDCs decision to make a recommendation that is voluntary, that when people go out in public, that they recommend that they wear cloth masks.

06:42 SC: Are they helping prevent the spread from infected people, or are they protecting uninfected from infected people, or are they doing both if this aerosol spread is possible?

06:53 RS: So there was another study that the National Academies looked at that tried to address this point and that was work by folks at the University of Hong Kong that was published yesterday I believe.

07:05 SC: So Friday the 3rd.

07:05 RS: Yeah, 3rd. Yes, that was published yesterday. They took respiratory samples from patients with a variety of respiratory illnesses and some of these people were wearing face masks and some of them weren't. Not all these patients had Coronavirus, but with those who did have Coronavirus, they found RNA from the virus in respiratory droplets both from the larger droplets and from aerosols. What they found was that the masks reduced the Coronavirus RNA in respiratory droplets and aerosols. That's suggestive of the fact that masks might be playing a role here in reducing transmission. So I think the pretty accepted notion is is that cloth masks are so porous, they're not really gonna prevent viral particles from getting in if you're breathing them in. But what they could do is they could trap some of the respiratory drops as they emerge. So if you and I go out in public and we're wearing a mask, if we're asymptomatic, we could still be spreading the virus, and it might help reduce that transmission there. And so I think that's why public health officials are saying "Look, be a good citizen. Do your best to try to wear a mask and just do everything we can to reduce transmission everywhere we can."

08:20 SC: Okay, thank you so much, Bob.

08:22 RS: You're welcome, any time.

08:23 SC: Robert Service is a staff writer based in Portland, Oregon. Also in our recent Coronavirus coverage, staff writer Gretchen Vogel describes a study being launched by the World Health Organization that will broadly test for antibodies to COVID-19 with the aim to find out the viruses true spread, and how long immunity might last. You can find links to Bob's stories, Gretchen's stories, and all our Coronavirus coverage at sciencemag.org/podcast. Stay tuned for an interview with staff writer Jennifer Couzin-Frankel about the beginnings of a new biological understanding of anorexia nervosa.

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09:04 SC: Now we have staff writer Jennifer Couzin-Frankel. She wrote a feature this week on the eating disorder anorexia nervosa. Hi Jennifer.
Jennifer Couzin-Frankel: Hi, thanks for having me.

SC: This is a really interesting story. A few facts that you presented right upfront really surprised me that anorexia effects about 1% of US population, that the affected or about 90% girls and women, and shockingly 10% of these patients die, which is a really high number for a psychiatric condition, right?

JC: Yes, it's actually pretty startling. That's the highest death rate for any psychiatric condition other than substance abuse. And when you think of it compared to other conditions, particularly those that affect young people, it's actually comparable to the mortality from childhood leukemia, which we often mentally might put in a very different category.

SC: How do people die from this disorder?

JC: Most of them really die from the effects of starvation on their bodies and in particular, it can cause heart problems, and cause all sorts of other problems as your body tries to cope with the effects of prolonged starvation.

SC: One of the themes that you touch on a few times is low levels of funding for research into this disorder. Why does it get so much less money than other psychiatric diseases with comparable occurrence like schizophrenia?

JC: Yeah, that was something that really struck me. So, like you say anorexia nervosa, it's thought to affect just under 1% of the population and when you look just at funding from the National Institutes of Health, which is kind of a good benchmark, in 2019 anorexia got about $11 million in research funding. And if you compare that to say, schizophrenia, which has a pretty similar incidents, and it also affects adolescents in particular, although more later or older adolescents, that disease got over $250 million. As to why it doesn't get much funding, that's a question I asked a lot of people. And of course we're all guessing here. I think there are a few reasons. One reason is that, historically, anorexia and eating disorders I think in general, have been thought of as these kind of culturally driven conditions.

SC: So they're predominantly, although not entirely it's important to say, in girls and women. There might be people who have or are thought to have this ideal body weight and they're influenced by fashion magazines and maybe their parents are pushing them a lot in different ways. There's this whole narrative surrounding anorexia. They haven't historically been thought of as biological conditions in the way we think of schizophrenia or anxiety or any number of other psychiatric conditions, we no longer challenge that those are often rooted in biology. But it's only recently, and this was really the thrust of my story that people have begun to recognize that anorexia is rooted in biology. But if the funding agencies haven't come around to see that, then they're less likely to support them.

JC: And I think another factor is that often advocacy groups have had a big impact on funding across all different conditions... Breast cancer, autism, you name it. And in eating disorders,
there aren't as many advocacy groups. I certainly wouldn't blame the families for that, but part of it is that there is still this stigma around these disorders.

12:22 SC: Well let's turn to why the narrative seems to be changing on how this disease is understood. One of the points you made was so interesting to me was, do people have the will power to override the hunger drive?

12:36 JC: Yeah, so of course that's been a prevailing idea that many of us just grew up with that these are people who are just sort of mentally saying to themselves "I'm not gonna eat, I don't wanna eat." and not eating. The people who have been in this field treating patients, and also doing research, several of them have started to question that. And there was one researcher Cynthia Bulik, a clinical psychologist said to me "The idea that patients could use will power to override this very basic drive of hunger that we all as humans share," just never rang true to her, it just didn't feel plausible. It felt like there was something else going on, and this wasn't just about having some sort of mental ability to push back against hunger. And she and others started to think that there was biology here that was really behind this illness.

13:28 SC: We're all seeing these magazines but only some people get anorexia. So could there be an interaction with genes, environment, upbringing, all those things?

13:38 JC: Yeah, and I think in a lot of ways, this is just like a lot of other more common chronic conditions that we know are driven by a mix of genes and environment, so many cancers, heart disease, many other psychiatric conditions. Most of the common conditions out there have a genetic link and then they have these environmental factors, which we may or may not understand. And so, the people doing the research here aren't saying that environment isn't important, but they're saying that this is not about fashion magazines or just an ideal. There's more than that going on. And even that those factors when you layer them atop somebody who already has other risks, those could be relevant. But in many other people, they don't seem to be relevant at all.

14:27 SC: That brings me to another great quote in your story about how anorexia has been the same for 200 years.

14:34 JC: Yeah, I mean, that's something that's really striking. And a number of researchers also said to me it's interesting that the way a lot of patients present with anorexia nervosa is very similar. The features are very similar, it's a very homogeneous disorder for the most part. And the fact that it seems to have at least from what we know from medical reports historically, and so on, there are these common features that have persisted over time, even though, of course, our culture has changed.

15:03 SC: Obviously they're looking at genetics to look at the biology of this and they looked at heritability using twin studies, what do they see there?

15:13 JC: There have been some twin studies in anorexia and there are others that are ongoing and those have found that it appears to be really highly heritable... That about 50 to 60% of the risk of developing anorexia, seems to be due to genetic factors.
15:29 SC: And that's higher than breast cancer.

15:31 JC: Yeah, it's higher than a lot of other conditions that we already assume and know have a genetic component.

15:37 SC: Now that's the heritability, but have they been able to tease out any genes that might be involved in anorexia nervosa?

15:45 JC: Yes, so that's some of the most recent work. The biggest study on the genetics of anorexia nervosa came out last summer. It was what's called a genome-wide association study, where you take these very large populations of people, a group of people in this case with anorexia and then a group of people who did not have anorexia. And you do these big genome scans, and look for patterns in their genetics that might give you hints as to what genes or genomic regions are predisposing to anorexia.

16:18 SC: What kind of patterns did they see? Were they able to pull out any specific gene variance that might predispose people to this disorder?

16:26 JC: They found an overlap with the genetics of other psychiatric illnesses including obsessive-compulsive disorder and depression. That wasn't really much of a surprise because anorexia does seem to share certain features with other psychiatric conditions. But what was interesting were these overlapping associations with DNA that controls different metabolic features and that includes things like BMI body mass index or lipid biology.

16:54 SC: So that suggests that they may deal differently with nutrients.

16:58 JC: Yeah, it suggests that there may be metabolic differences in people who develop or are predisposed to anorexia, that it's not just about the brain and psychiatry. Are people who later develop anorexia may be somehow genetically predisposed to a low BMI? Is there something different about their metabolism? There are a lot of questions that it raises that are really interesting.

17:26 SC: I was surprised that you didn't mention that there was any sex linked genes involved in anorexia, because we see so many women and girls suffering from this that didn't come through in the genetics.

17:39 JC: That's a really good question. The genetic study did find some hints of associations with genes that are relevant for sex hormones, and that does fit with what some researchers believe which is that sex hormones could help explain why this is more predominant in females. The question of why more women and girls are affected is a really interesting question. And again, it's probably a mix of nature and nurture, like we were talking about before.

18:10 SC: Another avenue researchers are taking is to look at brain activity. Let's talk about the kinds of studies they're doing. They're asking questions like, what happens in the brain when someone with anorexia is hungry or when they have just eaten something.
18:26 JC: They're looking at a number of different things as best they can. And these can be tough studies to do. For example, one group has found with MRI scanning that the region of the brain associated with selecting foods is different in people who have anorexia versus those who do not.

18:42 SC: When you say the region is different, do you mean they use a different region or...

18:42 JC: Yes. Yeah, they're using a different region of the brain than healthy people are using. And that has sort of led them to suggest that these people are really using different circuits when they make decisions. In this case, that can make it less amenable to change, it can make it harder to kind of break out of that and that may help explain why it's not uncommon for patients who have recovered to later struggle with a relapse. There are other people who are really interested in the reward system.

19:18 JC: One researcher said to me that he thinks that people with anorexia miscode food as being risky rather than rewarding. Most of us find food rewarding and we enjoy it, and people with anorexia may not feel that way. It can really induce a lot of anxiety, and even fear, to be faced with food that you're expected to eat and be a really difficult experience.

19:40 SC: This is a good point, I think, for us to talk about the current treatment for anorexia, it's called Family-Based Treatment, and it could be pretty successful when attempted early on. Can you describe how this works?

19:51 JC: So Family-Based Treatment, essentially what it does is it asks parents, normally, to set aside many of their day-to-day activities, which could mean scaling back on work, on school, on hobbies, and essentially to sit with their affected child, requiring her to eat. It's really about presenting food as medicine. If you think of parents whose child has cancer and needs to get chemotherapy, the child cannot refuse to have chemotherapy, they need that chemotherapy. And no one's gonna argue with that. It's kind of taking that same frame of mind.

20:28 JC: And with this treatment they do often start to eat again, even though that can be a tremendously difficult experience for them, but they can do it. It's sometimes a little hard to get the exact rates, but in about half of people who try Family-Based Treatment in adolescents, it seems to be effective. And in those who try it really early in the course of illness, it's effective in about 70%.

20:52 SC: It works but it doesn't work for everyone, especially older women or if your family structure might not be amenable to that kind of treatment. How can the research that we've talked about today, the genetic research, or looking at brain circuits, how can that contribute to new treatments?

21:07 JC: There is definitely effort to try and develop new treatments. Now, some of these are other kinds of talk therapies, like cognitive behavioral therapies, that could be included along with Family-Based Treatment or could be instead. There are some very preliminary clinical trials that are testing other approaches. There's one small trial looking at a psychedelic drug in patients, in part because its early data has suggested that the drug holds promise in helping smokers quit and in
treating alcoholism, and there is some sense that anorexia might share certain features with drug addiction. It's obviously different, but there may be a bit of overlap.

21:47 JC: Another approach is a very small study in people who have very severe enduring anorexia to try deep brain stimulation. The rationale for that study is that deep brain stimulation seems to work in certain people with obsessive compulsive disorder, which is another disorder that anorexia may have some overlap with.

22:08 SC: That's great. And I feel like it might be too early for the gene, the genetic results, to give us a direct line to a treatment at this point.

22:18 JC: Yes, I think it's too early, which is often the case with these genetic studies, they can't quickly translate into some sort of new medication. But I think what's hopeful about them is they can help give us a bigger picture of what this disorder is, and while it shares overlap with other conditions, of course, it's its own illness. By looking at what it is and what's really happening here, both in the brain and metabolically, and maybe in other ways we haven't yet figured out, that can point the way to new treatments to help patients who really need it.

22:54 SC: Thank you so much, Jennifer.

22:55 JC: Thanks so much for having me.

22:57 SC: Jennifer Couzin-Frankel's a staff writer at Science. You could find a link to her story at sciencemag.org/podcast. And that concludes this edition of the Science Podcast. If you have any comments or suggestions for the show, write to us at SciencePodcast@aaas.org. You can listen to the show on the Science website, that's sciencemag.org/podcast. There you'll find links to the research and news discussed in the episode. And, of course, you can subscribe to the podcast at Overcast, Stitcher, Spotify, Pandora, Apple Podcasts, you get the picture.

23:31 SC: The show was edited and produced by Sarah Crespi with production help from Podigy, Meagan Cantwell, and Joel Goldberg. Jeffrey Cook composed the music.

23:39 SC: On behalf of Science Magazine and its publisher, AAAS, thanks for joining us.