PARENTS PACK

MONTHLY UPDATES ABOUT VACCINES ACROSS THE LIFESPAN

FEATURE ARTICLE: DO VACCINES CAUSE CHRONIC DISEASES?

May 2024

People concerned about vaccine safety sometimes mention that the number of vaccines and the rates of chronic diseases have increased over time. They then use that observation to conclude that vaccines must be the reason for increases in chronic diseases. While this sounds like a cause for concern, the notion suffers from a glaring error in logic because it assumes that when two things happen around the same time, they are related. This is known as a causal fallacy. We would also be guilty of causal fallacy logic if we concluded that:

- A rise in the number of senior citizens led to an increase in the popularity of pickleball.
- Fewer teens are going to college because fewer are getting driver's licenses.
- More vaccinations in childhood have led to increases in video game playing.

As you can see from these examples, just because two trends are moving in the same direction doesn't mean that they are related. However, some who purport that vaccine use has increased the occurrence of chronic conditions, including a few doctors, go further — providing "supporting evidence" or working to discredit information that does not agree with their hypothesis. So, in this issue of *Parents PACK*, we wanted to deconstruct three examples of unsubstantiated talking points used in support of the vaccines and chronic diseases argument.

Immune system responses to natural infection and vaccination: They're the same.

The immune system does not differentiate between antigens based on how they arrive in the body. This means that whether a protein ends up in our cell because it is part of an infection caused by a virus or bacterium or because it was delivered as part of a vaccine, our immune system does not care. It will be processed in the same way. Think about it like your local fire department. When they get to a fire, they don't worry about how the fire started — they work to put the fire out. The same is true of potential pathogens; our immune systems work to get rid of them, regardless of how they arrived.

Bacteria, viruses and their parts: How long do they linger after vaccination?

Another talking point is the suggestion that vaccines stay in the body for a long time, giving them the opportunity to cause chronic conditions. This, too, is inaccurate. To understand vaccine processing, it is important to consider how the pathogens typically behave in our bodies, so let's take a look.

Bacteria

Bacteria do not stay in the body. Some of them release toxins that cause illness (e.g., tetanus, diphtheria and pertussis), and others damage cells and tissues as they multiply (*Haemophilus influenzae* type b [Hib], pneumococcus and meningococcus). Routinely recommended vaccines against bacteria introduce the part that causes the damage (i.e., a form of the toxin) or the sugar coating found on the surface of some bacteria (i.e., a polysaccharide). These vaccines are processed within a few hours to days as the immune cells recognize the part of the bacteria as foreign and generate a response. While it takes a couple of weeks for the immune response to be complete, the parts of the vaccine are processed in the first few days after vaccination

Viruses

Viruses play more tricks with us than bacteria do. Recall that to reproduce, viruses need cells because they do not have the machinery necessary to make offspring. So, they enter cells, take over the machinery, and turn the cell into a virus-manufacturing facility. To survive as a species, this requirement means viruses always need access to cells, so they have developed different mechanisms for maintaining that access. Some viruses opt to stay in a single host, hiding in our bodies (e.g., varicella [chickenpox] virus) or reproducing at low levels (e.g., human papillomavirus [HPV]) — sometimes for decades! This means that, indeed, some viruses can cause delayed illnesses (e.g., shingles or cancer). So, what does this mean for vaccines? Because of the biology of viruses, we have developed more diverse ways of protecting ourselves with vaccines.

Parts of the virus or whole killed virus: Like those for bacteria, some viral vaccines only introduce part of the virus (e.g., HPV, hepatitis B, COVID-19 [Novavax], and some influenza vaccines), and like the bacterial vaccines, viral vaccines of this type are processed in the first few hours to days after vaccination with the immune response being complete in a couple of weeks. The same is also true for viral vaccines that introduce the whole virus in an inactivated (killed) form. Examples of this type include hepatitis A, polio (shot) and several influenza vaccines.

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Live, weakened virus: Another approach to viral vaccines involves the delivery of live, weakened viruses. Examples of routinely recommended vaccines of this type include rotavirus, influenza (FluMist), measles, mumps, rubella and chickenpox. When these vaccines are administered, the weakened viruses replicate as they would if they were introduced naturally. But, because they have been adapted in the lab, they do so less efficiently. As a result, they generate immunity without causing illness. However, because viral replication is part of the process, development of protective immunity takes longer. In this scenario, viral replication and immune response generation happen in parallel — similarly to what happens during a natural infection. Think about it like a seesaw on a childhood playground: At first the amount of virus will increase and the immune response will be low, but over time, the immune response will overtake the virus, leading to viral clearance and the development of immunologic memory. As a result, it can take one to two months for immunity to develop. Viral replication occurs during the first part of this time period, from the first few hours to about two weeks after vaccination. After viral replication has been stopped by the developing immune response, the remaining period (from about two weeks to two months) is dedicated to monitoring for any lingering virus and developing immunologic memory through the maturation of memory cells.

During the processing of live, weakened viral vaccines, the viruses from the vaccine, and those resulting from its replication, are dismantled by our immune system, so there is no lingering virus that could cause chronic effects — with one exception. Like varicella virus (the cause of chickenpox), varicella vaccine virus can still live silently in nerve cells. However, we know that long-term repositories of varicella virus do not cause chronic illnesses because anyone who had chickenpox lives with these repositories — indeed most adults live with varicella virus in our bodies. Most of the time, nothing happens, but on occasion, the virus can cause shingles, particularly as people age. In the case of the weakened vaccine virus, since it doesn't reproduce as well as virus introduced by infection, cases of shingles are typically less severe and of shorter duration than for those who experience shingles after natural infection.

Viral mRNA: Finally, COVID-19 vaccines from Pfizer and Moderna demonstrate yet another approach to viral vaccination. In this case, messenger RNA (mRNA) is delivered to cells, and their cellular machinery produces the spike protein from the virus that causes COVID-19. This protein-production process is the same as for other proteins that our cells make; however, the viral protein (e.g., spike protein) is immediately recognized as foreign, and our body mounts an immune response against it. During vaccine processing, protein production occurs for about the first three days after vaccination, but then the mRNA can no longer be used and is disposed of by our cells. Likewise, the proteins that are produced are broken into pieces and processed for the generation of immunity, so the spike protein does not stay in the body for a long time either. By about two weeks after vaccination, the immune response is generated and all that remains are immune memory cells that circulate in the body monitoring for a future exposure to the virus — similar to what is left after the processing of other types of vaccines. You can find out more about the processing of mRNA vaccines in this animation.

Side effects: They happen … but "there's no there there."

Another talking point related to vaccines as a cause of chronic conditions is that some side effects might not show up until much later and we won't know because studies don't look that far out after vaccination. However, if you look at the discussion in the previous section, vaccines are processed and the immune response complete a relatively short time after vaccination. So, it does not follow that a vaccine would cause a chronic condition significantly later in time — what is not there, cannot cause harm. Or to quote Gertrude Stein, "There's no there there."

Consider common side effects of vaccines, like fever or fatigue. Most of them happen in the hours to first few days after receipt of a vaccine. For some live, weakened vaccines, side effects can be a bit further removed in time because of the viral replication and longer processing time. For example, a fever or rash resulting from MMR vaccination is more likely to occur a week to a week-and-a-half after vaccination; these symptoms last about two days or so. Two other rare, but more severe, side effects of the MMR vaccine also demonstrate this temporal pattern. First, a small number of recipients will experience short-lived joint pain that tends to occur one to three weeks after vaccination, and a condition called thrombocytopenia, which causes a decrease in the cells that help blood clot, can begin anytime up to two months after vaccination. While this condition typically resolves on its own, it can take about six months for the person's cell count to return to normal levels.

Our historical experience with more severe side effects following vaccination also offers evidence. Anytime severe side effects have occurred, they have occurred within six to eight weeks of vaccination. We described this in a previous *Parents PACK* article, "Long-term Side Effects of COVID-19 Vaccine? What We Know."

Finally, some have suggested that mRNA vaccines can change people's DNA, causing delayed development of side effects, specifically cancer. However, the genetic material delivered in mRNA vaccines does not have the capacity to overcome the multitude of safety mechanisms in our cells. To find out more about this concern, check this page of our website (See "Do DNA fragments in COVID-19 mRNA vaccines cause harm?").

Some final thoughts

The idea that an increased number of vaccines has led to more chronic diseases is a hypothesis. It can be tested. Indeed, several studies have tested these ideas. Vaccines don't cause autism, attention-deficit disorder (ADD) or attention-deficit hyperactivity disorder (ADHD), autoimmune/inflammatory syndrome (ASIA), diabetes, Guillain-Barré syndrome (GBS), and multiple sclerosis (MS), among others. No evidence has supported the hypothesis. Unfortunately, some people continue to spread the idea. They use incorrect or partial explanations of basic science, rely on poorly constructed or disproven studies, dismiss studies that don't agree with their point of view, and apply errors in logic. They also tend to suggest cover-ups and wide-sprawling conspiracies. When evaluating information, look for these types of red flags, and if you see them, proceed with caution. Like searching for anything else — the more you look for these flags, the better you'll get.

For links and resources, visit bit.ly/vaccines-chronic-diseases.