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MEET ATHENA: A REALISTIC COMPUTER MODEL OF A CHILD

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YOUNG REVIEWERS:

SAROJINI, REVATI, AYESHA

AGES: 8–15

Have you ever wondered how doctors and scientists test new medical devices or study how the body works? They often use computer models, which are like digital dolls that simulate the human body. But did you know that there are only few computer models of children, especially of girls? That is where Athena comes in. Athena is a brand-new computer model of a healthy 3.5-year-old girl's body, made using real-life pictures of her brain and organs. We even had doctors check to make sure the model was accurate. Athena is so detailed that she has 267 parts, including 50 components of her brain alone. Scientists can use Athena to test the safety of new medical devices or to study how electricity affects children's bodies,

for example. And best of all, Athena will be free for everyone to use! So, meet Athena—and see what amazing things we can learn about the human body!

COMPUTER MODELS: EXPERIMENTING ON VIRTUAL HUMANS

Have you ever wondered how scientists study and solve complex problems without experimenting on real people or animals? They often use a powerful technique called a **computer model**. A computer model is based on data stored in a computer and it helps scientists to understand things by allowing them to do tests in a virtual environment before trying them in real life. Imagine playing a game on a computer, in which you get to be the scientist. You can create virtual humans and study how their bodies work, without actually having to do any tests on real people.

Computer models can help scientists with all sorts of things that are difficult or impossible to test on people. For example, they can help scientists understand the effects of **electricity** on the body, as in the case of electric shock. Computer models can also help scientists test the safety of new cars, by using models that look like people in test crashes. Computer models can also help us study how **magnetism** (the force that turns the compass needle to help you find which way is north) affects the body, or how our bodies respond to medical implants, such as materials or devices that help the body work better when it is sick or injured.

Our research team noticed that most of the computer models of humans were based on adults, so we developed a realistic computer model of a 3.5-year-old female child.

COMPUTER MODEL

Computer model is like a character that lives in a video game. They can be used to do experiments on a computer machine before we try them in the real world.

ELECTRICITY

A form of energy resulting from the movement of tiny particles called electrons. It powers our devices and can create light, heat, and sound.

MAGNETISM

A natural force produced by certain materials. It attracts or repels other objects and can make certain metals stick together or move without touching.

ARE CHILDREN SMALL ADULTS?

It is important to have computer models of young children because children are not the same as adults. But what are the differences?

First, have you noticed that a newborn baby's head looks larger relative to its body compared to the proportions of an adult (Figure 1)? This is because the head needs to accommodate the brain, which grows more rapidly in the early stages of life, and the rest of the body catches up later. But it is not just the size of their heads that sets children apart. Children have organs that adults do not have. For example, the thymus is an important part of the immune system that helps protect the body from infections like the common cold or an ear infection. As children grow into adulthood and the immune system matures, the thymus gradually becomes smaller and less active. Children are also still in

the process of growing. Have you ever wondered how your bones get longer, or how you get taller with time? Well, children have something called growth plates in their bones, which are areas of a soft tissue called cartilage that allow the bones to grow. In adults, growth plates turn into solid bone. These differences (and more!) between children and adults show why we cannot simply shrink adult computer models to create models of kids. Each part of the body grows and changes in unique ways as we age [1].

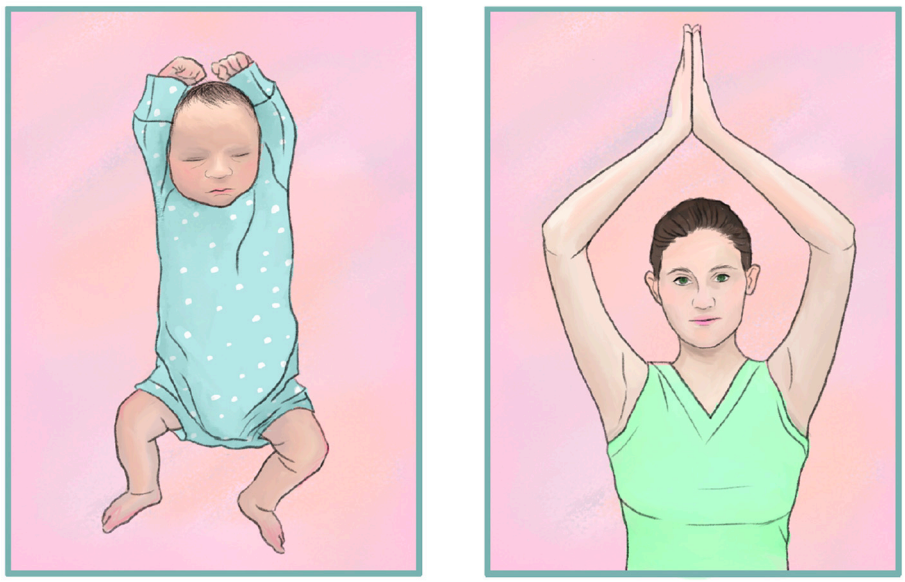

Figure 1

Figure 1

With age, the body parts change at different rates. For example, newborns have big heads compared to the rest of their bodies. Babies generally cannot close their hands above their heads, but adults can easily do so, since their arms are longer and their heads are smaller compared to their bodies. Other differences between children and adults include organs that children have and adults do not, such as the thymus, and how children get taller with time with the help of a special part of their bones, the growth plate, while adults stay at the same height.

Boys and girls also differ in the ways they grow and develop. Doctors even use different growth charts to assess the growth of boys vs. girls, because male and female children grow differently in terms of weight, height, and head size. As you know, each sex also has unique genital organs. So, it is important to have both male and female computer models because separate models are needed to accurately reflect these differences and make sure that everyone stays healthy and happy. This is why we initially developed Martin, a toddler male computer model, and then Athena, a toddler female [2, 3].

CREATING ATHENA

To create Athena, we first we found a 3.5-year-old girl with a normal, healthy body. This girl had special pictures taken of her body using two techniques. Some of the pictures were taken using **magnetic resonance imaging (MRI)**, which is like a super-duper camera that uses magnets and radio waves to create detailed pictures of a person's insides. MRI helps us see things like the brain, muscles, and organs

MAGNETIC RESONANCE IMAGING (MRI)

MRI is a machine that looks like a big donut. The acronym stands for Magnetic Resonance Imaging, which is nothing else than a camera that uses magnetism to take pictures.

(Figure 2). We also used **computational tomography (CT)**, which is like a special **X-ray** machine that takes many pictures from different angles. CT helps us see bones and other body parts in very high detail. Special doctors called **neuroradiologists** checked the all the pictures and said everything looked great.

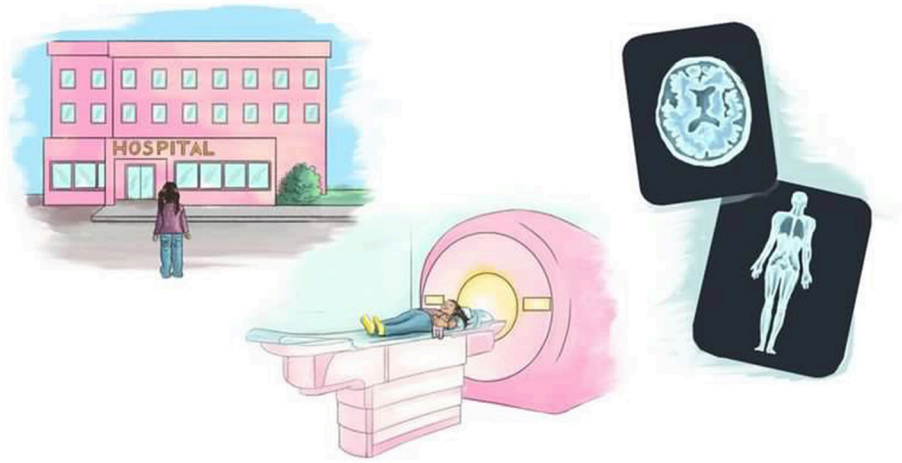

Figure 2

Then, with a computer, we used those images as stencils to draw all the parts of Athena's body. We paid special attention to the brain. At the end of the process, a doctor who is an expert in kids' bodies joined our team to do some special fine-tuning. To make sure the resulting computer model was accurate, we then had multiple doctors confirm that everything matched up perfectly. After all the hard work, we could see Athena's body in **3-Dimensions** on the computer.

MEET ATHENA!

And here is Athena (Figure 3)! We can see the brain with its 50 different tissues, the skull, and the rest of the bones of the body that help us stand and move. We can see the heart and the vessels that transfer blood to the organs, and we can see the child's head, arms, and legs. We can see the lungs within the chest and, in the abdomen, the organs that help us digest and absorb food: the stomach, liver, gallbladder, pancreas, and large and small bowels. The kidneys, which produce urine and help clean the blood, are also part of the model, as are the adrenal glands that sit on top of the kidneys, the urinary bladder that stores the urine, the intrabdominal fat that stores energy, and the spleen that helps fight infections. Finally, we can see the female genitalia with the ovaries, fallopian tubes, uterus, and vagina [4]. In total, Athena has more than 260 different tissues, which gives scientists great flexibility with their simulations and experiments. And best of all, Athena will be free for everyone to use!

COMPUTATIONAL TOMOGRAPHY (CT)

This is a machine that also looks like a big donut. It means Computational Tomography and uses X-rays to take detailed pictures of our bodies.

Figure 2

Athena is based on many images taken of a healthy female child at a hospital. Some of the pictures were taken using an MRI scanner, which looks like a big donut and uses powerful magnets to create detailed images of the whole body, including the brain.

X-RAY

X-ray a type of powerful, invisible light that can pass through our bodies, allowing doctors to see our bones and internal organs to help diagnose medical conditions.

NEURO RADIOLOGISTS

Those are doctors who are experts at looking at detailed images of the bodies of people, including children, and especially of their nervous system, brains, spine, and other nerves.

3-DIMENSIONS

3-dimensions refer to the ways we describe objects: length, width, and height. They help us understand how things exist and interact in space, like a virtual world you can explore!

Figure 3

Using our computer model, which we named Athena, you can see: **(A)** the skin; **(B)** the organs; **(C)** the bones; **(D)** the skull; **(E)** the heart; **(F)** the blood vessels; **(G)** the kidneys; **(H)** the urinary bladder; **(I)** the reproductive system, including the ovaries, uterus, cervix, and fallopian tubes; **(J)** the bowel; **(K)** the lungs; **(L)** the liver; **(M)** the pancreas; **(N)** the stomach; **(O)** the thymus; **(P)** the spleen; and **(Q)** the brain.

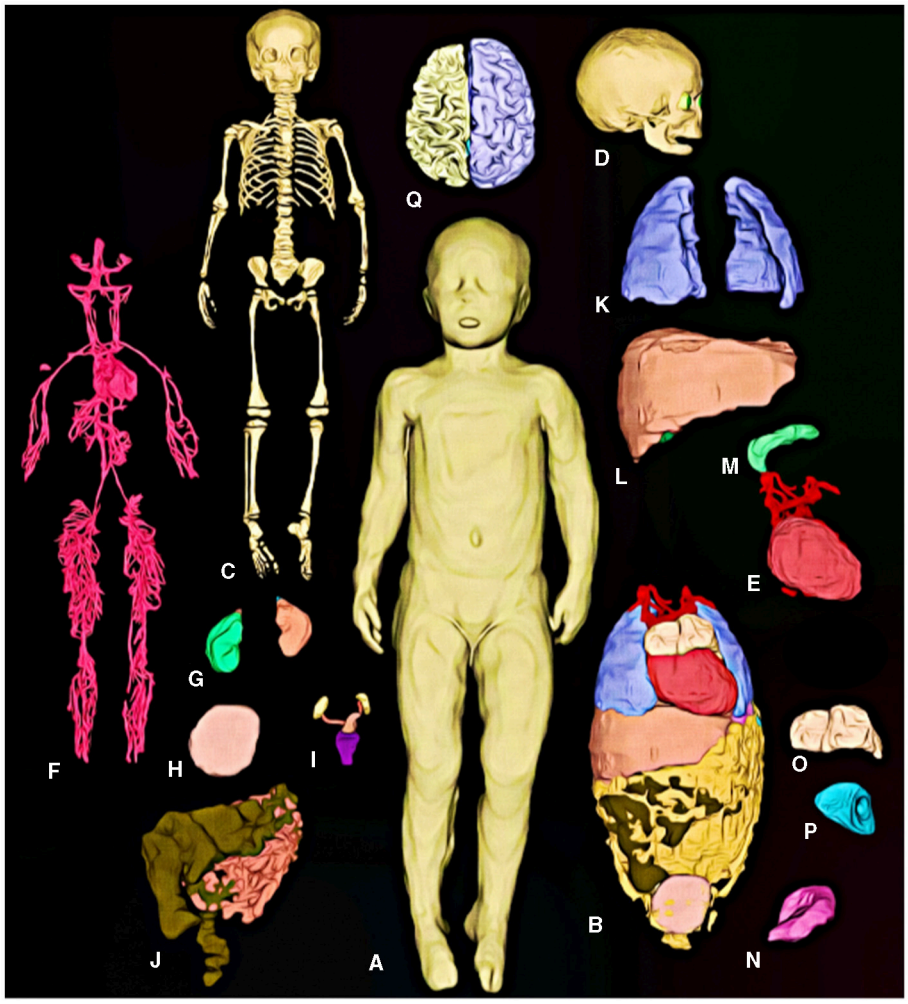

Figure 3

CONCLUSION

In a nutshell, we developed Athena, a computer model that is very detailed and similar to real children and can be used in experiments before we try new things on humans. We did that because there were not many computer models for children, and especially for girls. We also made sure that the access is open to this computer model so that anyone who wants it can have it. Athena can be used for different experiments, such as on how to make cars safer if they crash or to help children who are sick by testing new medical devices designed to make them get better.

ORIGINAL SOURCE ARTICLE

Ntolkeras, G., Jeong, H., Zöllei, L., Dmytriw, A. A., Purvaziri, A., Lev, M. H., et al. 2023. A high-resolution pediatric female whole-body numerical model with comparison to a male model. *Phys. Med. Biol.* 68. doi: 10.1088/1361-6560/aca950

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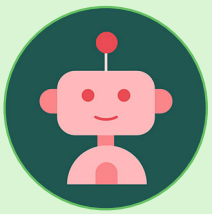
YOUNG REVIEWERS



SAROJINI, REVATI, AYESHA, AGES: 8–15

Sarojini and Revati, being sisters, share a common passion for medical devices and healthcare. Their curiosity and dedication to understanding these subjects stood out during the review process. It is evident that they have a genuine interest in the intricate world of medical technology. Ayesha, on the other hand, brings a unique skill set to the team. Her background in children's programming, specifically using the Python language, adds a dynamic element to the group. This diverse skill set not only showcases her technical abilities but also enriches the overall perspective of the review team.

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