S3, E23 — Research Roundup: Shining A Light on Vision Problems in People With Cerebral Palsy

**Dr. Marie McNeely** 00:01

Hello and welcome to Changing What's Possible: The Disability Innovation Podcast brought to you by Cerebral Palsy Alliance Research Foundation or CPARF. I'm your host, Dr Marie McNeely, and this season, we are excited to bring you cutting-edge stories and insights on research, technology, and innovation for people with CP and other disabilities. Our Research Roundup episodes can help you stay up to date on what's new in CP research. All of the studies featured in today's Research Roundup represent interesting, innovative work happening in the CP research space outside of the projects that CPARF has funded.

Today, I'm going to talk about three new studies focusing on vision in people with CP. The first study we'll discuss today was conducted by researchers at the University of Brescia in Italy.

The visual system works by focusing light onto a light-sensitive layer of tissue in the back of the eye, or eyes. The cells in this tissue then convert that light into electrical signals. Next, the information is sent to different areas of the brain for processing that ultimately produces the picture of what a person sees in front of them.

Now, the visual system can be impacted at the level of your eye, called ocular visual impairment, where, for example, the shape of your eye can affect how light is focused and cause someone to have trouble seeing things clearly if they're far away. The visual system can also be impacted at the level of the brain, a condition called cerebral visual impairment, also known as cortical visual impairment, occurs when a brain injury happens, typically from infancy to age two, that involves brain areas that process visual information. There may be no damage to the eye, but the person may not be able to see well or at all. Our brains continue to develop and change after birth, and sometimes other parts of the brain can take over functions for damaged areas of the brain.

The goal of this study was to better understand how cerebral visual impairment changes over time in infants and young children with CP and to identify early visual signs or symptoms that are associated with cognitive visual disorders when children reach school age. These disorders include difficulty identifying things that they see or seeing things that aren't there. Fifty-one individuals with CP and cerebral visual impairment had their eyes, eye movements and visual function tested at three different time points.

The first time point was when they were anywhere from six months to less than three years old, then three to five years old, and finally, when they were six years old or older. Researchers found that the eye conditions they measured were generally stable over time. The only exceptions were strabismus, which is a condition where the eyes either aren't aligned or they may point in different directions, as well as differences in the back surface on the inside of the eye.

These two conditions became more prevalent over time. Features of eye movements, like fixation — the ability to focus on a single point, smooth pursuit — keeping your eyes fixated on a moving object, and saccades — quick simultaneous movements of both eyes improved over time.

Aspects of visual function also improved over time. These included visual acuity, or the clarity or sharpness of vision, contrast sensitivity, which is the ability to perceive sharp and clear outlines and visual field, which is the area that can be seen when the eyes are focused on a single point.

Additionally, the researchers found that early problems with eye movements were associated with cognitive visual disorders when children were six years or older. All participants in this study had a confirmed diagnosis of cerebral visual impairment at each time point, but it was heartening to see that multiple visual symptoms improved over time. In some cases, some of the variables the researchers measured for a participant reached complete recovery at the first or second follow-up visit.

Taken together, the results provide strong evidence, highlighting that cerebral visual impairment can change over time in people with CP, and this opens the door for the possibility of interventions and therapies that could help stimulate or enhance these improvements.

In the next study, scientists from the University of Nevada performed a systematic review and meta-analysis to shed light on the prevalence and types of strabismus in people with cerebral palsy. This type of study brings together and evaluates results from prior research studies, pulling data across multiple studies to get more comprehensive insights on a particular topic.

I mentioned earlier that strabismus is a condition where the eyes aren't aligned, or they point in different directions. This condition is more common in people with CP than in people without CP. People who have strabismus may experience double vision, blurry vision, headaches, difficulty reading, eye strain and other symptoms. Strabismus can be classified based on the direction that the eye or eyes are pointing, whether that's inward, outward, up, or down. Researchers were able to include data from 147 studies in people with CP that reported strabismus prevalence, or the ratio of cases with inward versus outward-pointing eyes. Using these studies, they analyzed the data based on region, categorizing a country's income level, and by ethnicity. They also calculated strabismus prevalence and estimated the global number of CP cases with strabismus. The authors estimated about 29.6 million CP cases worldwide, and their estimate includes recent data from lower-income countries where the incidence is higher than previously thought. From this total number, they estimated that there are about 12.2 million people in the world with CP who have strabismus. About 62% are males and 38% are females. They calculated the prevalence of strabismus in people with CP to be 49.8% in higher income countries and 39.8% in lower income countries.

The prevalence of strabismus is higher in countries with higher income levels. Strabismus with inward pointing eyes was more common in Caucasians, and strabismus with outward pointing eyes was more common in individuals of Hispanic some Asian and some African ethnicities. Improving our knowledge about the prevalence of strabismus in people with CP is important for guiding efforts for early detection and treatment of the condition. This could help reduce or prevent some of the negative effects of strabismus on vision and quality of life for people with CP.

In the last study we're covering today, researchers from KU Leuven in Belgium sought to better understand how visual functions, functional vision, and bimanual function are related in children with CP. So let's break this down a little bit first.

The three visual functions they tested were stereo acuity — the smallest depth difference that a person can detect using both eyes together, visual perception — which is the brain's ability to interpret and make sense of visual information from our eyes, and visual motor integration — and this reflects how well your eyes, brain, and hands can work together to guide your movements.

Functional vision is a person's ability to use visual information to perform daily tasks, and bimanual or two- handed function refers to the extent to which a person can use both hands in a coordinated way. They measured the three components, bimanual dexterity — or how well you can control and manipulate objects with both hands, bimanual coordination — which is how well you can use both hands together to complete a task, and functional hand use. This is the ability to use the hands in an effective and efficient way to complete daily tasks.

The researchers measured all of these different variables at one time point in 49 children who were between seven and 15 years old and had unilateral CP, which is a type of cerebral palsy that affects muscle control and function on one side of the body. The results showed that visual perception was related to bimanual coordination and functional hand use. So the better a person was at interpreting and making sense of visual information from their eyes, the better they were at using their hands together to do tasks and also doing everyday tasks, using their hands. Stereo acuity, visual perception, and visual motor integration were related to bimanual dexterity. So having strong depth perception using both eyes; good interpretation of visual information from their eyes; and their eyes, brains, and hands working well together to guide their movements, were all related to being better at manipulating and controlling objects using both hands.

Visual perception could also be used to predict a person's bimanual dexterity, bimanual coordination and functional hand use. In addition, functional vision correlated with functional hand use. So those who were better at using visual information to perform daily tasks were also better at using their hands effectively to do daily tasks.

Functional vision was also the main predictor of functional hand use. Looking at the results as a whole, both visual functions and functional vision are related to bimanual function in children with unilateral CP. Previous reports have indicated that up to 62% of children with unilateral cerebral palsy have problems with their vision, and these vision problems can impact their movements and how they interact with their world.

If a child is having problems with using their hands to accomplish their goals in everyday life, it's important for clinicians to assess and address the visual system factors as well as the motor factors that may be contributing to these difficulties.

And to summarize the papers we discussed today, cerebral or brain level visual impairments can change over time in people with CP. Strabismus is very common in CP and affects millions of people worldwide. And different aspects of a person's vision relate to and can impact how they move and use their hands. And now listeners, I'm thrilled to welcome back CPARF’s, Vice President of education, Jocelyn Cohen, to talk about the findings of these studies and what they could mean for people with CP or other disabilities.

**Jocelyn Cohen** 10:12

Thanks so much, Marie. I'm glad that we can bring attention to a topic that's not discussed enough in the cerebral palsy space. With a typical focus on leg, arm, and hand movement, discussions about eye function often get lost in the shuffle. And according to our friends at the Cerebral Palsy Research Network, up to 87% of people with CP have CVI.

It's important for people with cerebral palsy to understand how their eyes function and how their vision may be affected by CVI or other conditions. This will guide their medical care, the ways they choose to move throughout the world, the assistive devices they use, and the accommodations they seek.

Neurological ophthalmologists and low-vision specialists are often best placed to help with your diagnosis, management strategies, and other treatments depending on your eye-related conditions. Sight and depth perception affect spatial positioning, and this is a crucial component of life with CP. Because CVI often was undiagnosed for decades, many adults with cerebral palsy may have this c--occurring condition without realizing it.

Our friends at CVI now at Perkins School for the Blind have resources that can help you determine if you should see a medical professional. And you can also learn about CVI’s intersection with cerebral palsy by heading to our YouTube channel — @ResearchForCP — and checking out our community chat with CVI Now from July 2024.

**Dr. Marie McNeely** 11:36

Well, Jocelyn, thank you so much for joining us and sharing these resources with listeners and sharing your perspectives with all of us today.

**Jocelyn Cohen** 11:43

You're welcome. I hope this helps people get the care and the guidance that they need.

**Dr. Marie McNeely** 11:47

And listeners, thank you for joining us as well. You can find links to the abstracts for the papers we talked about today with the notes for this episode on CPARF’s website. And now I'd like to take a moment to tell you about three for CP, CPARF’s grassroots fundraising initiative for cerebral palsy research and disability innovation. Whether you level up a read-a-thon, a sip-and-paint event, a comedy show, or something else that you love, 3forCP gives you the chance to make a difference in your own signature way. Head to 3forCP.org to get started. That's the number 3, F, O, R, C, P, dot O, R, G. And we look forward to connecting with you again in our next episode of Changing What's Possible.