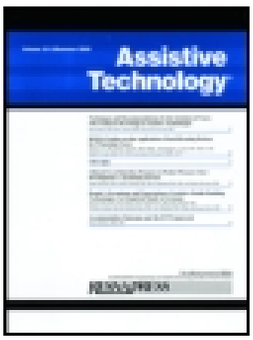

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A pilot study of children and parents experiences of the use of a new assistive device, the electro suit Mollii

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ABSTRACT

Electrical stimulation has been used for many years to treat spasticity in children with cerebral palsy and some improvements have been noted. Building on the benefits of electrical stimulation, a new assistive device, a suit with imbedded electrodes designed to reduce spasticity through electrical stimulation of the antagonistic muscles, has been tested.

Aim: The aim of this study was to describe experiences from children with cerebral palsy and their parents regarding the use of the suit. **Methods**: Individual interviews were conducted with six children 5 to 10 years of age and their parents. The interviews were transcribed and analyzed using a qualitative content analysis. **Results**: The analysis resulted in three themes: (1) the suit's impact on image, (2) changes that make a difference and (3) dealing with a desire for change. Each of the themes included subthemes. **Conclusion**: All children reported some impact on their body and self and/or in some activities after the use of the suit. The parents also saw improvements during the trial period. However, the results are inconclusive and a larger study is needed to determine if the suit is useful from a longer perspective and whether it can affect activity and participation in daily activities for children with spasticity.

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KEYWORDS
children with CP; assistive device; electrical stimulation; qualitative research

Cerebral palsy (CP) describes a group of permanent disorders in the development of movement and posture, causing limitations in activity due to a non-progressive neurological disorder that occurred in the developing brain. The motor disturbance is often accompanied by other disorders such as epilepsy and secondary musculoskeletal problems (Rosenbaum et al., 2007). In Sweden, one out of 400 children are diagnosed with CP, making it the most common cause of impaired motor function in children (Hägglund, 2013). Common impairments associated with CP are muscle weakness, incoordination, and spasticity, causing difficulties with everyday activities that can lead to activity limitations and restrictions in participation (Moreau et al., 2016). Restriction due to spasticity may, for example, create walking difficulties for the child (Beckung, Brogren, & Rösblad, 2002). These difficulties can negatively affect the child's health and affect their ability to keep up with peers (Moreau et al., 2016). Spasticity generally involves sudden involuntary movements or convulsive muscle contractions. At present, there is no cure for spasticity, but there are different ways to try to manage it (Jacobs, 2001).

Commonly used treatments to manage spasticity in children with CP are physiotherapy, orthoses, serial casting, intramuscular injections of botulinum toxin type A (Botox) or phenol, and orthopedic surgery (Boyd & Hays, 2001). There is evidence that use of different assistive devices, such as orthosis and standing devices that enable stretching or mechanical loading, can reduce spasticity (Paleg, Smith, & Glickman, 2013). Additional evidence supports that electrical stimulation helps reduce spasticity and improve function, strength, and range of motion (Wright, Durham, Ewins, & Swain, 2012). In a review by Moll et al. (2017), it was shown that electric stimulation had a positive impact on body structures and functions such as motor control, balance, and gait kinematics, but decreased walking speed.

Electrical stimulation has been used for many years to treat spasticity in children with CP. By attaching surface electrodes to the intact nerve innervating the target muscle, the electrical current produces muscular contractions. To reduce spasticity, it is unclear whether the electrical stimulation should be applied to the agonistic (Seifart, Unger, & Burger, 2009) or antagonistic muscles (Ozer, Chesher, & Scheker, 2006), or both (Bayram, Sivrioglu, Karli, & Ozcan, 2006). Despite this, the method has been shown to be associated with measurable clinical benefits such as improved gait performance and improved knee position (Alabdulwahab, 2011; Al-Abdulwahab & Al-Khatrawi, 2009).

Building on the benefits of electrical stimulation, a new assistive device has been tested, hereafter referred to as the "suit" or "electro-suit." In a recent randomized, controlled double-blind study, individuals with CP and post-stroke tested the electro-suit, and the results showed an improvement in the 10-meter gait test and goal achievement. However, the differences between the active and non-active group were not significant (Ertzgaard, Alwin, Sörbo, Lindgren, & Sandsjö, 2017) (Figure 1).

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Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/UATY.

Figure 1. A child wearing the suit while playing.

For decades, interventions for children with disabilities have focused on training different parts of the body to normalize and get a body that is "good enough" (Paulsson, 1995)"), not considering the children's and parents' experiences. However, the major goal when trying to manage spasticity is to improve the child's participation in daily life activities. Another important goal is that the intervention involves a family-centered approach, a key concept when treating a child with CP, in which a partnership between the child, parents, and other family members is an important aspect. Previous research has shown that involving the whole family in planning different interventions is important for the initiation and continuation of the treatment (Kruijsen-Terpstra et al., 2014). A study by Huang, Sugden, and Beveridge (2009) concluded that when considering the usability of an assistive device, it is important to consider the interaction between the person, the device and social and physical factors in the environment. It is, therefore, of significance to find out, when a new assistive device is being considered, what impact it has on the child's participation in daily activities and the family, regarding psychological issues, possible social limitations, and the time the intervention demands (Jacobs, 2001). Therefore, the purpose of this study was to describe experiences of children with CP and their parents regarding the use of the suit.

Methods

In this study, a descriptive approach to illuminate children's and parents' experiences of a new assistive device – the electro-suit called Mollii – was used (Interventions *AB*, Stockholm, Sweden). Interviews with the children and their parents were conducted at the end of a three-month trial period, and data was analyzed using a content-analysis approach (Graneheim & Lundman, 2004).

The suit

This suit is a CE-marked device, designed to reduce spasticity through electrical stimulation of the antagonistic muscles. The letters CE show that the manufacturer or importer has complied with the essential requirements contained in the EU directives, such as health, safety, function, and environment. Using the device should facilitate reciprocal inhibition, so muscles on one side of a joint relax to accommodate contraction on the other side of joint. The suit consists of a control unit, a jacket, and a pair of trousers with long zippers to facilitate dressing. Fifty-eight electrodes are embedded in the suit, for stimulation of selected muscles, with an electrical frequency of 20 Hz and a pulse width between 20–75 ms (www.inerventions.se). The electrodes are positioned to be activated where needed, whether the spasticity is in the arms, legs, or trunk. Activation of the electrodes is individually programmed for each child, depending on the location and degree of spasticity. The recommendation from the manufacturer is that the suit should be used about 1 hour every other day. If the suit becomes a prescriptive device, it is, according to Swedish guidelines for assistive devices, at no cost.

Participants

The children were recruited by physiotherapists from two habilitation centers in northern Sweden. The children had to meet these criteria: (1) be able to walk with no assistive device (GMFCS score I or II[1]) (Palisano et al., 1997); (2) give their consent to refrain from treatment with botulinum toxin during the study; (3) be at least 104 cm tall; (4) have the ability to formulate goals; and (5) be able to express their experiences in using the suit. Exclusion criteria were botulinum toxin injections within three months of starting the study. Other criteria for exclusion were if the child had an implant, such as an intrathecal baclofen pump. The inclusion criteria for parents were that they had to have their child use the suit during the evaluation period and be willing to share their experiences. In all, six children, five boys and one girl, aged 5 to 10 years, and seven parents participated in the interviews (Table 1). One parent of each child participated in the interviews, except with one child, where both parents wanted to share the experiences of their child's use of the suit.

Procedure

The first author collected all data. Collection started with a semi-structured interview with each parent while the child played at the hospital's children's center. After that, a semi-structured interview was performed with the child. The

Table 1. Participating children and their parents.

Subject	Age	GMFCS-level*	Time since last Botox treatment	Examples of goals- be able to;	Participating parent
1	10	II	3 months	Run with club and ball when playing floor-ball	Father
2	7	I	5 months	Catch up with friends to the dining room	Father and mother
3	7	I	3 months	Somersault to standing position	Mother
4	5	I	5 months	Skate and slide	Father
5	10	I	>12 months	Stretch the muscles without pain	Mother
6	7	I	3 months	Wiggle the toes with both feet	Mother

*Gross motor function Classification System (GMFCS) (Palisano et al., 1997) classifies limitations in gross motor function at five severity levels, from I with least limitations to V with most limitations.

interview questions encouraged the participants to talk about their experiences with the suit. All interviews started with the question: "Could you please tell me about your experiences with the suit?" The interview covered questions about the perceived impact on the body or various activities such as play and exercise. The narration was supported with questions such as, "Can you please explain more?" or "What happened then?". The interviews lasted about 15 min with the children and about 30–40 min with the parents.

Data analysis

The verbatim transcriptions were analyzed with qualitative content analysis inspired by Graneheim and Lundman (2004) to discover the underlying meaning of the text. Initially, meaning units related to the aim of the study were identified, and then the meaning units (words, sentences, and paragraphs) were condensed using a description close to the text to maintain the meaning of the original text (Table 2). The condensed meaning units were coded and sorted into different categories identified through discussion and reflection between the authors. Throughout the analysis, the authors went back to the original text to validate the findings in the categories.

This study was approved by the Regional Ethical Review Board in Stockholm, Sweden (Dnr. 2014/1282-31/4). The parents received written and verbal information regarding the study and provided both written and verbal informed consent. The children also received verbal information and gave verbal consent to participate in the study.

Table 2. Example of a meaning- unit, condensed meaning- unit, code, and category from the content analysis of the interviews held with children and parents.

Meaning unit	Condensed meaning unit	Code	Category
I can feel it, I have become much stronger…I can do things where you have to be stronger…things I showed you before (child)	Feeling stronger and being able to do things	Feeling strong	The suits impact on image
We have experienced that … the greatest change is that he doesn´t have pain any more at night. He has had problems with pain at night … especially in the left leg but also in the right leg and I can say that it has decreased. The last month he has not been having any pain at all (parent)	The greatest change is that he doesn´t have pain in his legs any more	Being pain free	Changes that make a difference
But once again it is a child in this situation…and the botox is good if there is no other possibility.But for those who are just barely able to walk and be independent this one [the suit] can help them further, it's worth so much (parent)	Botox is good but the suit can help them further	The pro and cons of Botox	Dealing with a desire for change

Results

The findings from the analysis resulted in three categories describing the children's and parents' experiences of the suit: (1) the suit's impact on image, (2) changes that make a difference, and (3) dealing with a desire for change. Each category contained several subcategories, which covered different aspects of the use of the suit (Table 3).

The suit's impact on image

This category included two subcategories: *feeling like a superhero and expectations and fear of appearing different*. The subcategories describe the children's experience with the suit itself and the impact it had on their self-image. The category also describes parents' expectations and fears of what the suit might entail. The experience of the suit's image was divided, but the analysis found that both children and parents reflected on the suit's impact and everyone saw both pros and cons.

Feeling like a superhero

Regarding expectations about the suit, the children did not know what they could expect; mostly experiences in the present determined how they valued the suit. The suit was perceived to be tight and warm, and all children pointed out that the suit was difficult to take on and off. Some children saw this as a problem, while others only established facts. However, the interviews revealed that the children used the suit one hour every other day with few exceptions, the compliance seemed to be high. The children did not report any expectations, but one child shared his concern about trying on the suit, and said: *I thought it should hurt, but it did not.*

The suit seemed to draw attention to the children and affected their experience of self in different ways. Some children reported the suit making them feel like a superhero and that wearing the suit was positive. One child said: *I feel a little bit like Superman, but it [the suit] is just a bit tight"*. The children also referred to the suit as something they wanted to show to others, something to be proud of. One child reported that he wanted to show the suit to his friends, so he took a picture with his mobile phone and sent a group message to his friends and said:

> *When sending this picture, I wrote, 'This is me with the suit before going to the hospital.' My friend Amanda, she wrote, 'Nice… I think it's rather fine-looking'.*

Table 3. Illustration of results.

Category	Subcategories
The suits impact on image	Feeling like a superhero Expectations and fear of appearing different
Changes that make a difference	Experiences of a strong and pain free body Experiences of a participating and performing body
Dealing with a desire for change	A medical "quick fix" A family worry

Expectations and fear of appearing different

According to the results, the parents' expectations affected how they valued the results of the three-month evaluation period. They hoped that using the device would affect the child's motor skills in such a way that walking ability would be improved. They still had the fear that the child's way of moving around would differ from the way other children move around. As one parent said:

> *I had very high expectations…One always hopes that there will be great results, and especially on the left side, which is very stiff, and we do not see any results on that side, I would say. However, we have noted improved mobility and balance in general. I had huge expectations, and I thought…finally, it's just to turn off a switch… but it was not so, of course; that is not how it works.*

Another parent reported that the impact of the suit had been much better than the expectations they had prior to the study and said,

> *The future can only be better because he can build muscles and build stability due to this…[the suit] also.*

However, several parents mentioned the importance of being like other children; they were concerned that the suit would further enhance the image of their child being different. They saw the suit as something that would be stigmatizing for the child and could negatively affect the child's perception of his/her body and self-image. One parent expressed:

> *"My child is at a stage in life when he starts to become aware of himself and that he is a bit different from his peers. I think when he wears the suit, he feels that he is more different, and that is why he doesn't want to reveal that he has this suit"*

Changes that make a difference

This category describes changes in performing activities during the trial period. Both the children and parents described these changes in different ways, some of little significance and some with greater significance. These were related to the subcategories: *experiences of a strong and pain-free body* and *experiences of a participating and performing body*.

Experiences of a strong and pain-free body

Most children talked about being stronger, and one child expressed it this way:

> *The suit is good. It makes me faster and stronger, and so I can feel it…I can do things where you need to be strong.*

The parents also described changes in the child's body functions, and recounted that the child was stronger and could maintain a sitting position more easily. One parent mentioned that in the past, the child dropped the upright posture rather quickly and ended up seated in a crouched position.

> *"If you take his posture in the body, he is sitting much more straight up now, instead of collapsing"*

Another parent talked about how the electric stimulation of the trunk helped the child coordinate the muscles in the stomach.

> *"He can control the abdominal muscles much better. Before, he couldn't pull in his stomach or tighten the abdominal muscles. He had no control over it, but now he can also do sit-ups"*

Pain reduction was something the parents also noted. One parent said that the pain in the child's leg had decreased in the last month.

> *"He has never been pain-free for so long a time before. I think it is a clear improvement"*

Some parents also noted that their child was sleeping better at night. They described how they usually were awakened by the child's crying several nights during the week. One parent said:

> *"It has meant that before [the suit] when he had pain, he could not sleep in his own bed. Now he is sleeping in his bed, and that is good. It was fantastic that he was without pain…But I am not sure that he has the same experience. They forget so fast sometimes"*

The children did not mention sleep but as one parent said:

> *"Maybe it [the child waking up in the night] is a problem for us as parents"*

Experiences of a participating and performing body

Several children participated in leisure activities such as swimming, martial arts, gymnastics, and floor ball. All children expressed an increased ability to perform the activity in which they engaged. They talked about doing things easier and faster than before and that it was easier to walk and move around. Almost all parents also talked about their child's improvements in different activities:

> *"We have noticed an enormous difference lately because our child is practicing swimming, and our child has become more mobile in the body in making the arm strokes. Before it was impossible to pull the arm back and lift the elbow … it works now"*

The child said:

> *"I have my legs in the water and now they do not go up, and I can swim – what´s it called – the crawl"*

Some parents talked about how they perceived the suit's impact on play with siblings or friends at home. They could see that some things had become easier after using the suit for some time. One child had the goal to become better at running with the club and ball while playing floor ball. Here, one parent expresses how the suit affected the child's goal:

> *"My child had a goal with the floor ball, and there is a big difference, and at home, he is playing with his little brother. And the goal my child had set up was to be able to run with the club and ball, and he manages that splendidly.*

Another parent stated that the child was faster in dressing now, and this could make it easier for him to keep up with his peers.

The experiences of walking and moving around differed. Some children expressed that it was the same as usual, while most children said they had an increased ability. One child said:

> *"It has been a difference because when I had the simple electrodes, it took ten minutes [to come down on the whole foot], but when I wear the suit, it works fine immediately…Then I walk outward with my feet, and they are straight"*

The same child also mentioned a good thing was that it was easier to walk a while after he used the electro-suit, but a bad thing was that the effect only lasted a short time, and it was the same as usual by the next day.

According to one parent, using the suit energized the child, and he referred to a text message from school. He expressed that the teachers wrote how positive it was now, how much energy the child had at school and the child said:

> *"I have become better in my legs. When I was out walking, I had no pain in my legs"*

Dealing with a desire for change

This category describes the children's and parents' experiences of the pros and cons of the suit in relation to Botox treatments. The category reveals that the experiences of treatment with the suit were twofold. This category consists of two subcategories: *a medical "quick fix"* and *a family worry.*

A medical "quick fix"

When the study was completed, the children had discontinued Botox treatment for at least six months. Both children and parents highlighted the discomfort of getting injections and being sedated before receiving treatment with Botox. One child reflected about being sedated before his treatment and said:

> *"I get sad when they are going to pull out the needle, then you are awake, and it really hurts…but later you get an ice-cream, and you can get chocolate.*

Some parents' experiences regarding treatment with Botox revealed that the child must relate to three phases. One parent describes these phases:

> *"First you lose power, then everything is fine and then…then he begins to languish for the medicine [Botox] and says, 'I need to get medicine; my legs are stiff'*. The parent pauses for a while and then continues. *That is so fascinating…he has not asked a single time. It is almost nine months ago since he got Botox.*

A family worry

All parents expressed either a more stable condition (compared to Botox) or some improvements in performing activities when using the suit. However, some improvements were small and not seen as important, and the use of the suit required effort from the children and their parents every other day. One parent talked about the child's lack of motivation to wear the suit.

> *"I ask why, and our child says, 'I don't want to wear it just now.' We have as well as forced him to wear it, so it's become a bit of a constraint when we told him that now you must wear it, and he did not have the opportunity to choose when he felt ready to wear it. You know, it makes a break in everyday life – now you must. As an adult, you maybe know that this is something good"*

The interviews revealed that all children and parents noticed changes and improvement for the child during the study. However, parents reflected on the reasons behind the results. Some parents expressed doubts about what the suit could provide:

> *One thinks that you have practiced a way to walk and that triggers various systems and how can it [the suit] change that?*

Another thought that what might have been expressed were the results and improvements due to parents spending more time training with the child when he was wearing the suit.

> *"What would happen if the child received more frequent physiotherapy instead?*

The parents also talked about the expected deterioration they were accustomed to when their children did not receive treatment with Botox. One participant said:

> *If I put it this way, there has not been a single deterioration, to our knowledge…and that was something we had expected, that the natural course [without Botox] was deterioration.*

Discussion

The purpose of this study was to describe experiences of children with CP and their parents on use of the suit. All children reported some impact on their body and self in some activities and participation after use of the suit. The parents also saw improvements during the trial period.

Is identity affected?

The results of the study showed two diametrically different experiences regarding identity when using the suit. The children who felt that the suit turned them into superheroes found themselves able to perform activities they had set as goals, thus boosting their experiences of the body. According to Hammar, Ozolins, Idvall, and Rudebeck (2009) it is common for children and adolescents to compare themselves to others, and young people with disabilities may think they are different. On the one hand, the children who described themselves as superheroes had positive experiences with the suit, and as Mulderij (2000) stated, a focus on the body is not necessarily negative; it can also be rewarding and positive. Children connect with the world, develop mental competence, and gain identity through the body (Mulderij, 1996). The results of the study show that the suit had a positive impact on some children's identity. This concurs with Phelan and Kinsella (2014), who believe that occupations/activities are involved in shaping identity for children with disabilities.

On the other hand, the results showed that the suit was perceived as negative for some children and parents. The suit may have brought more attention to the child and enhanced feelings of being different, which is in line with Hammar et al. (2009), who found that adolescents with CP experienced their bodies as dependent on help from others, less reliable, less vital, and more apt to catch people's attention. The parents were also concerned that the electro-suit would enhance the perception that the child was different.

Adopting the device?

Both children and parents pointed out the difficulties with putting on and taking off the suit. Despite the difficulties, compliance of using the suit was high in this study, and the participants expressed some positive improvements in activities of daily life. This is contrary to the study by Ertzgaard et al. (2017), where compliance was low, and the measurable effects regarding body functions were small. If participation in activities is the main goal, it is important to view all interventions in light of that goal and ask whether the intervention is an obstacle or a facilitator in performing activities (Pless & Granlund, 2011). From a user perspective, a person will adopt an assistive device and use it on a regular basis if it improves the person's ability to do things and the possibility to be proud of the device (Kintsch & de Paula, 2002). In a review by Pape, Kim, and Weiner (2002), successful integration of an assistive device into a person's daily life requires users to experience meaning and realistic expectations with the device, and a positive influence on their identity. In light of this study, it is questionable if problems with using the suit would become too much of a problem and, therefore, families would discontinue its use if the benefits were not substantial.

What justifies treatment?

In this study, use of the suit was compared to previous treatments with Botox. The parents considered the treatment with Botox to be effective in reducing spasticity, which is in line with a systematic review of interventions for children with CP (Novak et al., 2013). Both Botox and electrical stimulation have been shown to improve motor function and reduce muscle tone, but the long-term effects for both treatments are still under investigation (Lin & Yan, 2011; Ping, Chung, & Kam Kwan Cheng, 2010). The parents in this study talked about how stiff and hyper-toned their children became when the Botox treatment was delayed for some weeks. The findings revealed that use of the suit allowed for a stable condition regarding spasticity, and the clear ups and downs in relation to the treatment with Botox were not seen. There are different options when it comes to spasticity treatment. However, one of the most important factors to consider is if the treatment supports children in increasing peer interaction and childhood fun (Jacobs, 2001; Rosenbaum & Gorter, 2012).

According to the parents, the children who had experienced pain when the study started had reduced pain. As a result, the reduced pain helped the children sleep better, which led to better sleep for the parents. Reduced pain could be explained by the electric stimulation from the suit; nerve fibers that sense touch are stimulated, which has been shown to provide pain relief for patients with lower back pain (Moore & Shurman, 1997). Sleep problems associated with pain are common for children with CP, and their parents often experience poorer health and psychological exhaustion. This is, according to Mörelius and Hemmingsson (2014), a problem rarely noted in clinical settings. The result of this study indicates that the suit might have an impact on the children's sleep, as well as a positive impact on the parents.

The results showed that the suit may have provided some improvement, and the children expressed improvements toward some of their goals. This could be explained by the fact that electric stimulation can positively affect gait, muscle contraction strength, sensory feedback, and control systems for stimulation (Pierce et al., 2004). According to the results, some parents expressed that the child at least did not get worse, which they had expected since the treatment with Botox was delayed for several months. According to Ahl, Johansson, Granat, and Carlberg (2005), current treatments performed on biomechanical disabilities are concerned with fixing something, such as abnormal walking, muscle weakness, or spasticity, but that transfer between treatment and functional ability is limited. In a review by Wright et al. (2012), electrical stimulation for children with CP is cautiously advocated to minimize impairment and activity limitations during gait. Another way to look at changes after a treatment has been suggested by Rosenbaum and Gorter (2012), and instead of using "F" in the word "fix", they suggest the use of five new "f-words": *function*, what the child is doing; *family*, the child's environment; *fitness* structures in the body and children with disabilities being less fit than they should be; *fun*, what the particular child likes to do; and *friends*, a term that should be considered to enhance the child's opportunities to develop meaningful connections with peers. Perhaps the result in this study fits better with the five F´s than with the notion that the suit fixed something.

In this study, the participants expressed changes in either the body or in the performance of activities, from small changes to improvements that made a difference in activities in everyday lives. As professionals in health care, we need to consider both the child's and the parents' experiences, and together determine for whom the suit provides benefits. Therefore, it is important that each child receive an individual assessment of his/her abilities and needs, and that goal-setting is relevant. According to Damiano (2009), we cannot justify treatment if it gives no change in activity, participation, or health-related quality of life for the person receiving the intervention.

Limitations

It is important to point out that this was a pilot study with few participants. Larger studies with a control group are necessary before we can draw any general conclusions from the intervention. Regarding the perceived improvements, we need to consider that clear goal-setting alone has an impact on results (Ahl et al., 2005). Furthermore, attention can positively influence a person participating in a study. However, the results are inconclusive, and a larger study is needed to determine if the suit is useful from a longer perspective and whether it can affect activity and participation in a positive way for children with spasticity.

The exploratory nature of this study, limited sample size, and the homogenous group in GMFS classifications limit the generalizability of study findings. The strength of this study is the insider perspective provided by children's and parents' descriptions of their experiences. The authors strived to ensure trustworthiness through all stages of analysis by describing the

participants, data collection, and the analysis process and by illustrating how meaning units, condensation, and abstractions were made. This is in line with Morse, Barrett, Mayan, Olson, and Spiers (2002), who argued that at the end of a study, it may be too late to correct errors and ensure trustworthiness.

Conclusions

The findings revealed that the suit affected children´s identity, both positively and negatively, and some parents and children felt the positive impact on the child's spasticity. The children and their parents had both positive and negative experiences of the use of the suit. We can conclude that it is important to listen to how the children express their thoughts about a new assistive device in relation to performing activities and participation. Furthermore, it is important to recognize how the intervention fits into the child's and family's daily lives. It is, therefore, essential for pediatric therapists to acknowledge both the children's and parents' experiences when introducing a new device or intervention.

Note

Gross Motor Function Classification System (GMFCS) (Palisano et al., 1997) classifies limitations in gross motor function at five severity levels, from I with least limitations to V with most limitations. GMFSC I; walks without restrictions; restrictions on more advanced gross motor skills. GMFCS II: walks without walking aids; restrictions on walking outdoors and outside the community.

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References

Ahl, L. E., Johansson, E., Granat, T., & Carlberg, E. B. (2005). Functional therapy for children with cerebral palsy: An ecological approach. *Developmental Medicine & Child Neurology*, *47*(9), 613–619. doi:10.1111/j.1469-8749.2005.tb01213.x

Alabdulwahab, S. S. (2011). Electrical stimulation improves gait in children with spastic diplegic cerebral palsy. *NeuroRehabilitation*, *29*(1), 37–43. doi:10.3233/NRE-2011-0675

Al-Abdulwahab, S. S., & Al-Khatrawi, W. M. (2009). Neuromuscular electrical stimulation of the gluteus medius improves the gait of children with cerebral palsy. *NeuroRehabilitation*, *24*(3), 209–217. doi:10.3233/NRE-2009-0470

Bayram, S., Sivrioglu, K., Karli, N., & Ozcan, O. (2006). Low-dose botulinum toxin with short-term electrical stimulation in poststroke spastic drop foot: A preliminary study. *American Journal of Physical Medicine & Rehabilitation/Association of Academic Physiatrists*, *85*(1), 75–81. doi:10.1097/01.phm.0000193505.85874.61

Beckung, E., Brogren, E., & Rösblad, B. (2002). *Sjukgymnastik för barn och ungdom* (Physiotherapy for Children and Youth). Lund: Studentlitteratur.

Boyd, R., & Hays, R. (2001). Current evidence for the use of botulinum toxin type A in the management of children with cerebral palsy: A systematic review. *European Journal of Neurology*, *8*(s5), 1–20.

Damiano, D. L. (2009). Rehabilitative therapies in cerebral palsy: The good, the not as good, and the possible. *Journal of Child Neurology*, *24* (9), 1200–1204. doi:10.1177/0883073809337919

Ertzgaard, P., Alwin, J., Sörbo, A., Lindgren, M., & Sandsjö, L. (2017). Evaluation of a self-administered transcutaneous electrical stimulation concept for the treatment of spasticity: A randomised placebo-controlled trial. *European Journal of Physical Rehabilitation Medicine*. doi:10.23736/S1973-9087.17.04791-8

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, *24*(2), 105–112. doi:10.1016/j.nedt.2003.10.001

Hägglund, G. (2013). Positiv utveckling med CPUP. *Läkartidningen*, *110* (15), 765–766.

Hammar, G. R., Ozolins, A., Idvall, E., & Rudebeck, C. E. (2009). Body image in adolescents with cerebral palsy. *Journal of Child Health Care*, *13*(1), 19–29. doi:10.1177/1367493508098378

Huang, I., Sugden, D., & Beveridge, S. (2009). Children's perceptions of their use of assistive devices in home and school settings. *Assistive Technology*, *4*(2), 95–105.

Jacobs, J. M. (2001). Management options for the child with spastic cerebral palsy. *Orthopaedic Nursing*, *20*(3), 53–61.

Kintsch, A., & de Paula, R. (2002). A framework for the adoption of assistive technology. In *SWAAAC 2002: Supporting Learning through Assistive Technology*, Winter Park, CO. Retrieved from http://www.cs.colorado.edu/~l3d/clever/assets/pdf/ak-SWAAAC02.pdf

Kruijsen-Terpstra, A., Ketelaar, M., Boeije, H., Jongmans, M., Gorter, J., Verheijden, J., … Verschuren, O. (2014). Parents' experiences with physical and occupational therapy for their young child with cerebral palsy: A mixed studies review. *Child: Care, Health and Development*, *40*(6), 787–796. doi:10.1111/cch.12097

Lin, Z., & Yan, T. (2011). Long-term effectiveness of neuromuscular electrical stimulation for promoting motor recovery of the upper extremity after stroke. *Journal of Rehabilitation Medicine*, *43*(6), 506–510. doi:10.2340/16501977-0807

Moll, I., Vles, J. S., Soudant, D. L., Witlox, A., Staal, H. M., Speth, L. A., & Vermeulen, R. J. (2017). Functional electrical stimulation of the ankle dorsiflexors during walking in spastic cerebral palsy: A systematic review. *Developmental Medicine & Child Neurology*. doi:10.1111/dmcn.13501

Moore, S. R., & Shurman, J. (1997). Combined neuromuscular electrical stimulation and transcutaneous electrical nerve stimulation for treatment of chronic back pain: A double-blind, repeated measures comparison. *Archives of Physical Medicine and Rehabilitation*, *78*(1), 55–60.

Moreau, N. G., Bodkin, A. W., Bjornson, K., Hobbs, A., Soileau, M., & Lahasky, K. (2016). Effectiveness of rehabilitation interventions to improve gait speed in children with cerebral palsy: Systematic review and meta-analysis. *Physical Therapy*, *96*(12), 1938. doi:10.2522/ptj.20150012

Mörelius, E., & Hemmingsson, H. (2014). Parents of children with physical disabilities–Perceived health in parents related to the child's sleep problems and need for attention at night. *Child: Care, Health and Development*, *40*(3), 412–418. doi:10.1111/cch.12079

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13–22. doi:10.1177/160940690200100202

Mulderij, K. J. (1996). Research into the lifeworld of physically disabled children. *Child: Care, Health and Development*, *22*(5), 311–322.

Mulderij, K. J. (2000). Dualistic notions about children with motor disabilities: Hands to lean on or to reach out?. *Qualitative Health Research*, *10*(1), 39. doi:10.1177/104973200129118237

Novak, I., Mcintyre, S., Morgan, C., Campbell, L., Dark, L., Morton, N., … Goldsmith, S. (2013). A systematic review of interventions for children with cerebral palsy: State of the evidence. *Developmental Medicine & Child Neurology*, *55*(10), 885–910. doi:10.1111/dmcn.12246

Ozer, K., Chesher, S. P., & Scheker, L. R. (2006). Neuromuscular electrical stimulation and dynamic bracing for the management of upper-extremity spasticity in children with cerebral palsy. *Developmental Medicine & Child Neurology*, *48*(7), 559–563. doi:10.1017/S0012162206001186

Paleg, G. S., Smith, B. A., & Glickman, L. B. (2013). Systematic review and evidence-based clinical recommendations for dosing of pediatric supported standing programs. *Pediatric Physical Therapy: the Official Publication of the Section on Pediatrics of the American Physical Therapy Association*, *25*(3), 232–247. doi:10.1097/PEP.0b013e318299d5e7

Palisano, R., Rosenbaum, P., Walter, S., Russell, D., Wood, E., & Galuppi, B. (1997). Gross motor function classification system (GMFCS). *Developmental Medicine and Child Neurology*, *39*, 214–223.

Pape, T. L. B., Kim, J., & Weiner, B. (2002). The shaping of individual meanings assigned to assistive technology: A review of personal factors. *Disability & Rehabilitation*, *24*(1–3), 5–20. doi:10.1080/09638280110066235

Paulsson, K. (1995). "*Dom säger att jag ser mer normal ut med benproteser"; om samhällskrav kontra barns behov* ("They say I look more normal with artificial legs": children's needs versus society demands). Stockholm: Pedagogiska institutionen, Stockholms universitet, p. 204. ISSN 1104-1625;73.

Phelan, S. K., & Kinsella, E. A. (2014). Occupation and identity: Perspectives of children with disabilities and their parents. *Journal of Occupational Science*, *21*(3), 334–356. doi:10.1080/14427591.2012.755907

Pierce, S. R., Orlin, M. N., Lauer, R. T., Johnston, T. E., Smith, B. T., & McCarthy, J. J. (2004). Comparison of percutaneous and surface functional electrical stimulation during gait in a child with hemiplegic cerebral palsy. *American Journal of Physical Medicine & Rehabilitation/Association of Academic Physiatrists*, *83*(10), 798–805. doi:10.1097/01.PHM.0000137318.92035.8C

Ping, H., Chung, B., & Kam Kwan Cheng, B. (2010). Immediate effect of transcutaneous electrical nerve stimulation on spasticity in patients with spinal cord injury. *Clinical Rehabilitation*, *24*(3), 202–210. doi:10.1177/0269215509343235

Pless, M., & Granlund, M. (2011). *Handbok i att använda ICF och ICFCY* (Manual in using ICF and ICF-CY). Stockholm: Studentlitteratur. ISBN:9789144056371

Rosenbaum, P., & Gorter, J. (2012). The 'F-words' in childhood disability: I swear this is how we should think! *Child: Care, Health and Development*, *38*(4), 457–463. doi:10.1111/j.1365-2214.2011.01338.x

Rosenbaum, P., Paneth, N., Leviton, A., Goldstein, M., Bax, M., Damiano, D., … Jacobsson, B. (2007). A report: The definition and classification of cerebral palsy april 2006. *Developmental Medicine and Child Neurology. Supplement*, *109*(suppl 109), 8–14.

Seifart, A., Unger, M., & Burger, M. (2009). The effect of lower limb functional electrical stimulation on gait of children with cerebral palsy. *Pediatric Physical Therapy: the Official Publication of the Section on Pediatrics of the American Physical Therapy Association*, *21*(1), 23–30. doi:10.1097/PEP.0b013e31818de3ea

Wright, P. A., Durham, S., Ewins, D. J., & Swain, I. D. (2012). Neuromuscular electrical stimulation for children with cerebral palsy: A review. *Archives of Disease in Childhood*, *97*(4), 364–371. doi:10.1136/archdischild-2011-300437