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Strength training in children with cerebral palsy

INDEPENDENT LEARNING MATERIAL FOR
PHYSIOTHERAPY STUDENTS

DEGREE PROGRAMME IN PHYSIOTHERAPY
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Strength training in children with cerebral palsy		
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<p>Abstract</p> <p>Cerebral palsy (CP) is the most common motor disability in children. CP is umbrella term for many different impairments that are causing difficulties in moving, maintaining posture and balance. The disorder itself is non-progressive, but secondary problems may cause the loss of functionality, which results in decrease of life quality. According to the studies loss of muscle strength is one of the most limiting factors in CP.</p> <p>The objective of this thesis was to collect evidence-based knowledge about strength training in children with CP. The literature that was used in this thesis was mostly published within 10 years, with some exceptions. The findings explained the benefits and reasons of strength training.</p> <p>The process began in August 2020, by collecting the ideas for the topic, literature was collected throughout December 2020 to November 2021. Learning material has been made for Satakunta University of Applied Sciences pediatric physiotherapy course, with H5P Moodle platform. It has been conducted in October 2021 and implemented in November 2021. The thesis was based on action research methodology which was supported by the evidence-based theoretical background and feedback that was collected about the learning material.</p> <p>Latest studies show positive effects of strength training in children with spastic CP, but further studies are needed to find out specific interventions and training programs.</p>		
<p><u>Key words</u> Cerebral palsy, strength training, physiotherapy, children</p>		

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INTRODUCTION

The definition of cerebral palsy: “Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behavior, and/or by a seizure disorder.” (Rosenbaum et al. ... 2005, 572.)

Cerebral palsy (CP) is thought to be the most common motor disability among children (Website of the Centers for Disease Control and Prevention 2019). In its nature CP is not a progressive neurological disorder, but due to the accompanying impairments it can lead to inactivity and additional difficulties later in life. Functional elements of activity and participation that are part of the International Classification of Functioning, Disability and Health framework (ICF) are the basis that therapeutic interventions are focusing on nowadays. Implementing ICF to therapy gives a better understanding of motor learning mechanisms for restructuring motor pathways with the use of task-specific and repetitive movements. (Booth, Buizer, Meyns, Oude Lansink, Steenbrink & van der Krogt 2018, 866)

CP children compared to their healthy peers have increased spasticity and decreased muscle strength, which leads them to bigger consumption of energy and loss of ambulation ability. Several studies have shown that strength training is accepted intervention in children with CP and that increased muscle power has a correlation with activity levels. Staying active helps children with CP to live fulfilling life with less restrictions and challenges. (Özal, Türker & Korkem 2016; Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar 2011, 1130–1139.)

1 AIM AND OBJECTIVES

The aim of this thesis is to produce independent learning material for physiotherapy students concerning the strength training in children with cerebral palsy (CP) based on the recent literature.

The objective of this thesis is to collect evidence-based knowledge about strength training in children with CP.

In this thesis the focus is on strength training of children with spastic CP, due to the fact that it is the most common type of CP.

The research question is to find out if strength training has positive effects on children with cerebral palsy.

2 CEREBRAL PALSY

Cerebral palsy (CP) is a most common motor and movement disability in children. It is neurological disorder that is caused by brain damage, that happens usually in the evolving fetal brain or in the postnatal period. Boys are more likely to get it than girls. The name cerebral palsy is umbrella term that represents different symptoms and disabilities, like difficulties moving, walking, speaking, hearing, seeing and learning. People with CP also might have cognitive impairments, mental health problems, epilepsy, deformities in spine and joint problems. (Website of the Cerebral Palsy Guidance 2020) In developed countries the present estimation of occurrence of cerebral palsy is 2 to 2,5 per 1000 live births (Website of the ICF Research Branch 2017). In Finland approximately 100-120 out of 2000 infants per year are diagnosed with CP. In total there are 6000-7000 people with CP from different age groups. (Website of the Suomen CP-liitto)

Even though the brain injury itself is not progressive in CP, there are secondary symptoms like impaired range of motion in joints and decreased muscle strength that may worsen over time. Both of these symptoms result in physical activity decrease, like impaired walking and climbing stairs ability, which increases the risk of cardiometabolic diseases and rise in the BMI (body mass index) levels. Therefore, it is very important to decrease these secondary symptoms with good therapeutic interventions, which will help them to sustain their functionality, independency, and live active life. (Valadão, Piitulainen, Haapala, Parviainen, Avela & Finni 2021.)

2.1 Types of Cerebral Palsy

2.1.1 Spastic

Spastic-type CP is most common among the people with CP, about 80 percent have it. Spasticity is usually described as hypertonia, which consists of three elements: inadvertent background activation, stretch hyperreflexia and altered mechanical

properties of muscles and tendons. It is thought that hypertonia and spasticity are the same, but actually spasticity is a type of hypertonia which is increased with movement because it is velocity dependent. It occurs due to the damage to the upper motor neurons, which affects the connection between the brain and the spinal cord, more specifically negative feedback system between alpha-motor neurons and muscle spindles affect the normal muscle activation. Due to the changes in muscle-tendon unit, severe contractions may occur and lead to the bone deformation. (Valadão, Piitulainen, Haapala, Parviainen, Avela & Finni 2021; Bhimani & Anderson 2014.) Furthermore, spasticity can lead to secondary problems like scoliosis, contractures in knees, dislocation of the hips and many more. (Tecklin 2015, 192.)

There are three forms of spastic cerebral palsy (Figure 1.). Spastic quadriplegia which affects the whole body, upper and lower limbs and it causes severe impairment in children. Spastic diplegia is a form that mostly affects lower limbs of the body. Children who have that form are usually still able to walk, but they might need some assistive devices to help them. Spastic hemiplegia has an impact on one side of the body, so both upper and lower limbs of the same side are affected. The majority of children with hemiplegia are able to walk. (Website of the Centers for Disease Control and Prevention 2019.)

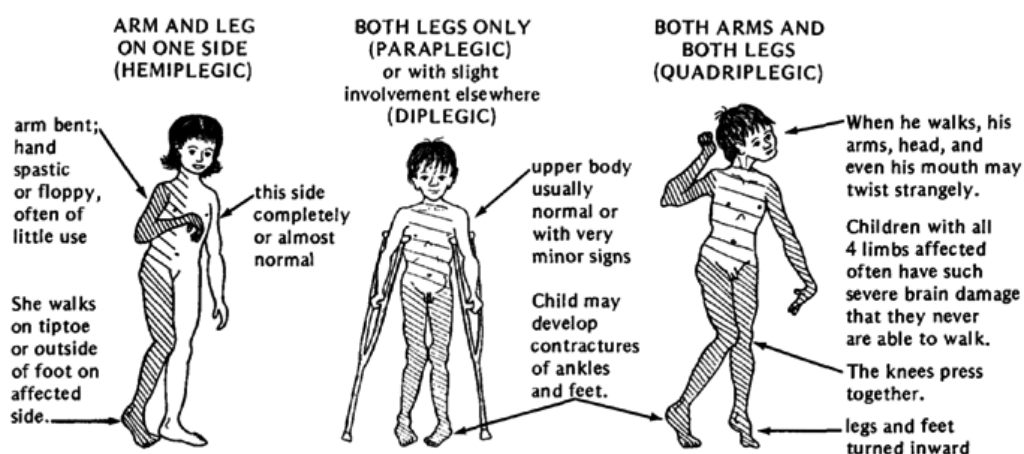


Figure 1. Forms of spastic cerebral palsy (Website of the How's Health 2021).

Most common out of these three is spastic diplegic CP. It happens because of brain damage that restrains correct upper motor neuron development functioning that affects

corticospinal tract, the basal ganglia and motor cortex. The upper body usually has normal range of motion and muscle tone, but it varies among the individuals depending on the severity. Due to the spasticity in the lower limbs, which affects the walking ability, there might be extra muscle tension in the trunk, because of the movements for compensatory stabilization. (Kannabiran, Nandhini & Nagarani 2016.)

2.1.2 Dyskinetic, ataxic and mixed

The second most common type of cerebral palsy is dyskinetic. It is characterized by symptoms like: athetosis, chorea, insufficient posture, wiggly movements, unpredictable movements, hard time swallowing or talking, motions that are repetitive and twisting, painful movements. Not as common type of cerebral palsy is ataxic type, which causes tremors, unsteady movements that are demanding to control, bad balance, and limited coordination. Symptoms of more than one type of cerebral palsy, which is called mixed type, may occur in some people with CP, such as spastic-dyskinetic or spastic-ataxic CP. (Website of the Centers for Disease Control and Prevention 2019.) Surveillance of cerebral palsy in Europe has come up with classification tree for sub-types of CP (Figure 2.) to help to classify mixed type of CP (Website of the Physiopedia 2021, d).

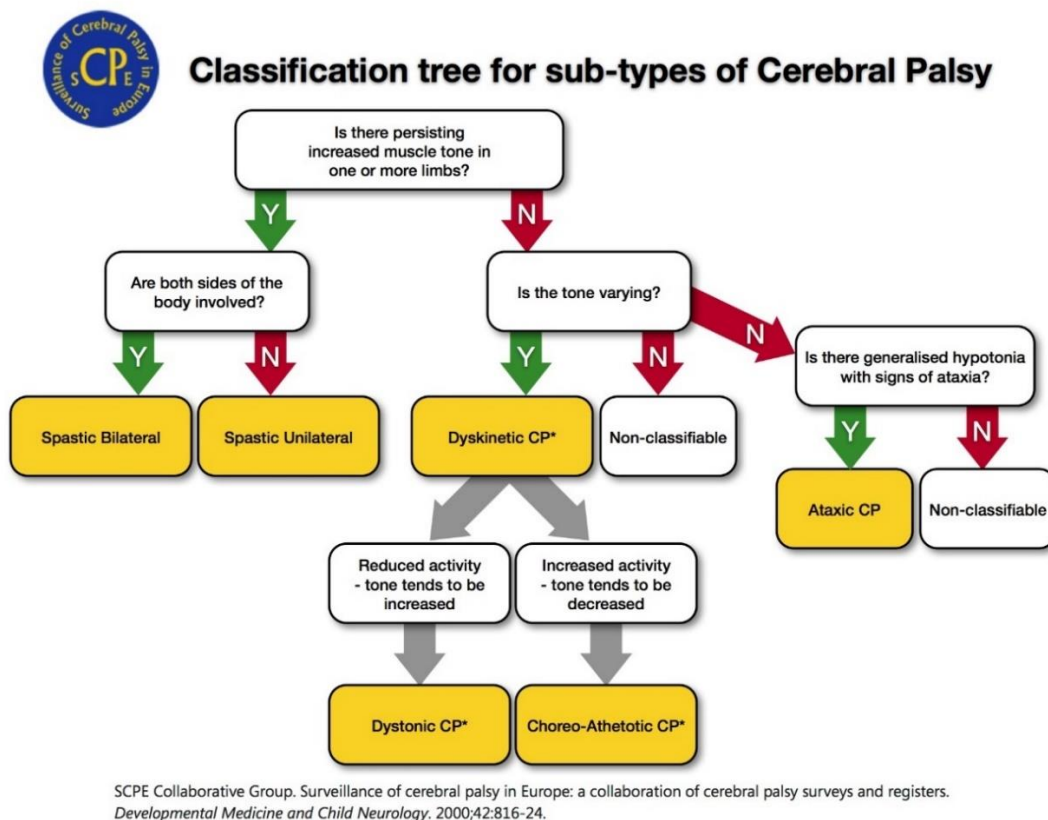


Figure 2. SCPE classification tree for sub-types of CP (Website of the Physiopedia 2021, d).

2.2 Aetiology and risk factors

For the precaution approaches it is essential to know the causes and neuroanatomy of CP, in addition knowing the background of the disorder helps to talk with the child, parents and other caretakers. Recognizing the risk factors from early on helps also to plan more beneficial rehabilitations and come up with good services that the children with CP may need during their life, to help with the management of the disorder. Frequent risk factors in CP are early term births, a fetus or an infant is smaller or less developed than normal for the baby's sex and gestational age, a pregnancy with more than one fetus or urinary tract infections. (Eunson 2012, 361.) Asphyxia was considered a leading cause of CP but has been found to occur only in less than 10% of the cases. Causes that have been found to be most common now are inflammations, clotting disorders and infections. (Brashear, Elovic, & Alter 2016, 439.)

Damage to the brain or problems in the development of the brain that are leading to cerebral palsy can occur before delivery of the baby, during the delivery, during one month after, or all through the first year when the child's brain is still evolving. When the damage or problems with development have happened during or before delivery it is called congenital CP, which is the most common (85% - 90%). Most of the time the exact reason is not known. If the damage to the brain or problems with development have happened after birth, it is called acquired CP. This happens in very small amount of the population of CP and is in most cases linked to injuries to the head or infections, such as meningitis. (Website of the Centers for Disease Control and Prevention 2019.)

2.3 Classification and assessment methods of CP

Helpful tool for both clinicians and families is Gross Motor Function Classification System (GMFCS). It gives well-defined report of the motor function of the child and a picture of what kind of assistive devices the children should use later in life, such as wheelchair, anterior/posterior walkers or crutches. (Website of the Cerebral Palsy Alliance Research Foundation 2018.) GMFCS has 5 levels of classification, which are meant to 5 different age groups. Before two years, between two and four years, between four and six years, between six and twelve years and between twelve and eighteen years. Differences between the levels are formed on movement quality, functional abilities and demand of assistive devices. (Website of the Physiopedia 2021, b.)

As illustrated in the Figure 3. child with level I GMFCS can walk out- and indoors, run, jump, climb stairs without assistance, but they have reduced co-ordination, balance and speed. Level II can walk out- and indoors as well but needs support from the railing to climb the stairs, they also have hard time to be in crowded places, on disproportionate surfaces or inclines. They have very little capacity to jump or run. Level III needs assistive technology to walk out- and indoors on even surfaces, they might be able to use stairs with the support from the railing. Possibly will need wheelchair to move on surfaces that are uneven or to go lengthier distances. Level IV has difficulties walking even using assistive technology, needs to use wheelchair the majority of time, may use their own power to push the device. They might take part in

transfers from standing position. Level V has decreased in every motor function area. Intentional movement control is limited by physical impairments as well as capacity to hold the head and neck independently against gravity. They cannot sit, stand or walk independently, they may be able to use powered mobility. (Palisano, Rosenbaum, Walter, Russell, Wood & Galuppi 1997, 221-222.)

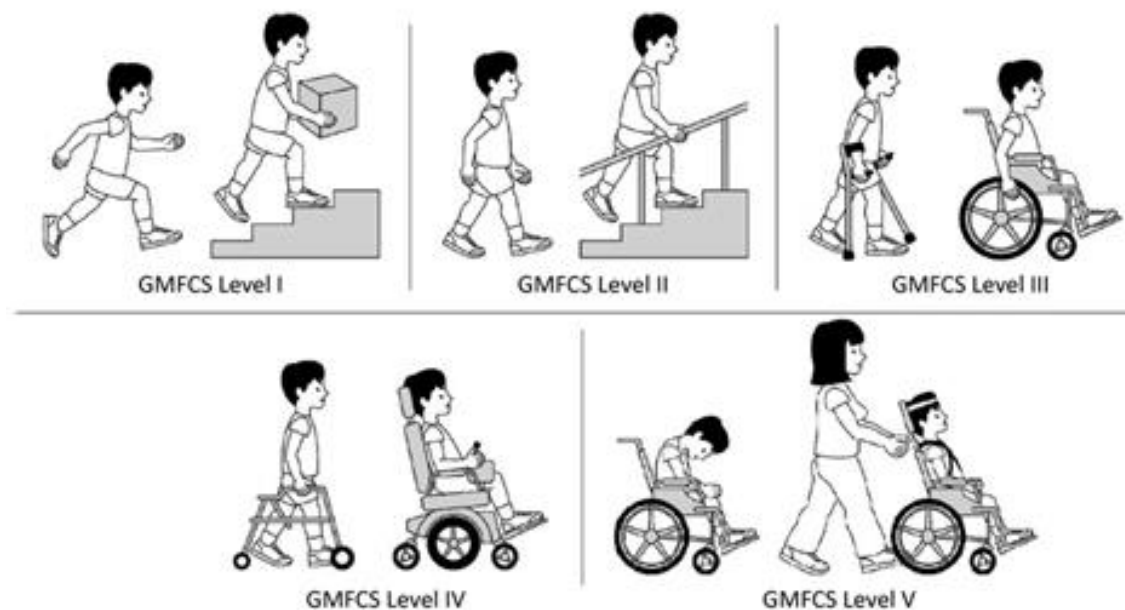


Figure 3. Level I-V GMFCS (Website of the International Cerebral Palsy Society 2020).

To enhance the effect of rehabilitation of the child with CP the assessment of motor function to monitor and adjust therapies is very important, in addition it helps to detect the changes in the development. (Website of the Physiopedia 2021, a) To assess the gross motor function changes, researchers have made a good measurement tool. It is called The Gross Motor Function Measure (GMFM). There are two types of the GMFM, original 88-item measure (GMFM-88) and the more recent 66-item GMFM (GMFM-66), difference between the two is just based on the items they consist of. This tool gives a chance to assess the challenging movements to CP children, for example: lying, sitting, crawling, standing, walking, running and jumping. (Rosenbaum, Russell & Wright 2013, 1-3.)

To assess the spasticity there are two scales used, Tardieu Scale (TS) and the Ashworth Scale (AS). TS assesses spasticity by passively moving the joints at three specified velocities, when AS grades the intensity of muscle tone through joint ROM at one non-specified velocity. To assess strength of the muscles manually there is The Medical Research Council Scale (MRCS), which is demonstrated in the Table 1. (Website of the Physiopedia 2021, c.)

Table 1. The Medical Research Council Scale for muscle strength evaluation (adapted from website of the Physiopedia 2021, c).

Grade	Description
0	No movement is observed
1	Only a flicker or trace of muscle movement is seen or felt in the muscle or fasciculations are observed in the muscle
2	Muscle can only move if the resistance of gravity is removed
3	Muscle strength is further reduced such that the joint can be moved only against gravity with the examiner's resistance completely removed
4	Muscle strength is reduced but muscle contraction can still move the joint against resistance
5	Muscle contracts normally against full resistance

2.4 Physiotherapy goals for children with CP

The overall goal of physiotherapy when treating children with cerebral palsy is to enhance the functional independence of the child and to guide the parents to provide the child with best help. When choosing the therapy methods as a physiotherapist, factors like the age of the child, presence of two or more diseases or medical

conditions, cognitive impairments, seizure disorders, contractures due to excess spasticity and other complications need to be taken into a consideration. Goals are individual, but they may include reducing the pain, avoiding chronic ulcers and contractures, promote walking with the toes and metatarsals flat on the ground, increase development in the motor control. (Brashear, Elovic, & Alter 2016, 440 - 441.) Other goals may be, hamstring muscle lengthening, increasing strength in certain muscle groups or muscles, improving blood circulation to body parts, increasing respiration ability and others. (Tecklin 2015, 205.)

By the International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY) (Figure 4.) a structural basis for physiotherapy planning has been given. It gives physiotherapist a common language and terminology to refer to difficulties based on the participation problems, limitations in activities, functional and structural aspects, which in addition helps to get good measurement tools for goal setting. (Franki et al. ... 2012.)

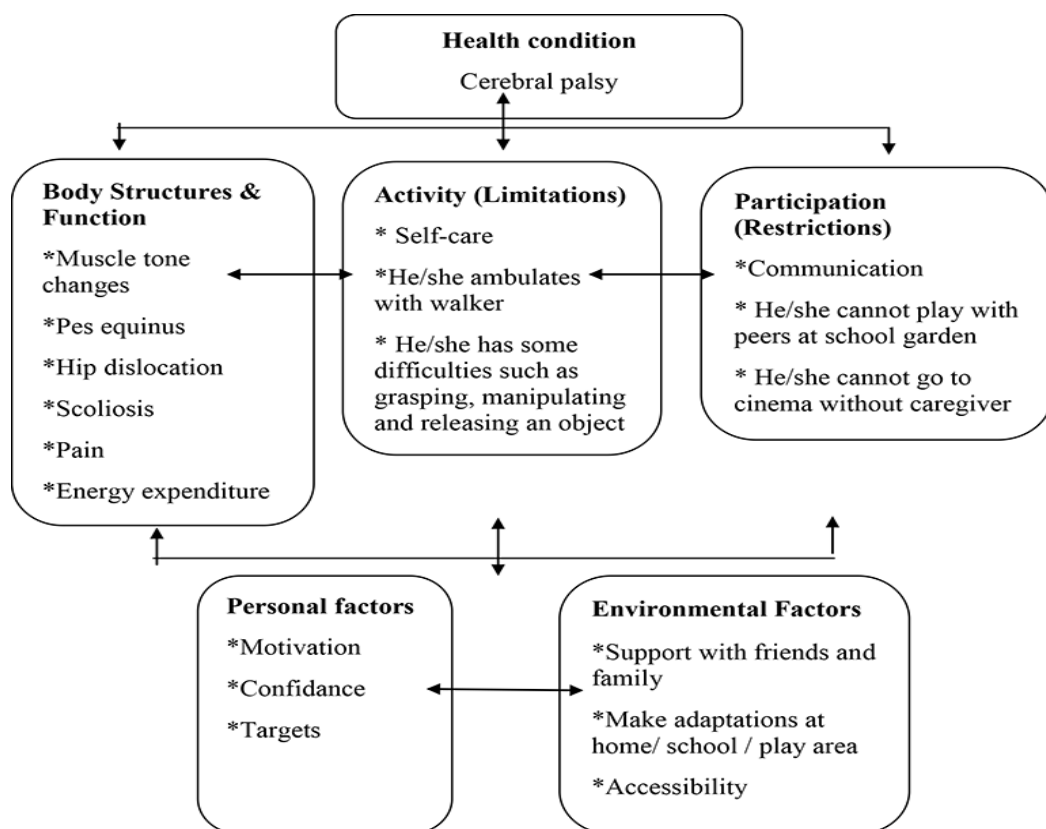


Figure 4. ICF-CY tree for cerebral palsy (Cankaya & Seyhan 2016).

3 CEREBRAL PALSY AND STRENGTH TRAINING

3.1 Strength training for children

Strength training for children is found to have positive outcomes; in an effort to prevent or reduce the severity of bodily injuries; developed functioning; and improvement in strength. Strength training is progressively adding resistance to muscle contraction to enhance the capacity to resist or exert force. Usually using different machines, weights or your own body while performing the exercise. (Gallahue, Ozmun & Goodway 2012, 256.) For children to progress in strength training multiple sets with small number of repetitions, like 3-8, and high loads must be used. To get better muscle endurance smaller loads and higher number of repetitions, eight to twenty, is needed before resting. Increase in the repetitions and loads can only happen with improvement. (Tecklin 2015, 208-210.)

Guidelines have been made for children by The National Strength and Conditioning Association (NSCA) to find out what the child must have to get effective response to strength training. Firstly, they have to be able to comprehend the process. Secondly, they have to be able to consistently give their maximal or near-maximal effort. Thirdly, they have to be able to attend to the task and be motivated. Fourthly, they need to have supporting family who supports the child and the program. Even though these guidelines are not based upon children with cerebral palsy, they are suitable to use in protocol development in CP as a starting point. (Tecklin 2015, 208-210.)

Muscle strengthening should not start before reaching motor skills like postural control and balance, which mature to close to adult levels by the age of 7. This is very important particularly in performing complicated motor tasks in training programs. It is not any different with people with CP when it comes to progressive resistance exercise training. (Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar 2011, 1130–1139.)

3.2 Strength training for children with cerebral palsy

It is very common for children with CP to have many impairments and reduced strength in muscles is one of them, furthermore it is one of the most limiting factors in CP (dos Santos, da Costa, Golineleo & Rocha 2013). The cause for decreased strength in muscles might occur because of the poor activation in motor units, changes in the length of the muscles causing deficit in the muscle force, reformed muscle structures, and deprived cocontraction of antagonist muscles. Some studies have shown that in people with CP strength training can enhance muscle strength. In addition, it also may help with management of the weight, bone mass maintenance, a person's view of his or herself or of any of the mental or physical attributes that constitute the self, health of the cardiovascular system, functionality of the gait, and even increase GMFM scores. One of the studies states that when the child has voluntary control in the muscles then strengthening can develop functioning and motor skills. (Tecklin 2015, 208-210.)

In research where twenty intervention studies and six systematic reviews were evaluated about the functional strength training, isotonic, - kinetic, - metric strength training and mixed forms of strength training, based on the ICF tree for cerebral palsy (Figure 4.), the results were as follows. For activity level, one study showed significant improvement in gross motor function where other high-quality RCT study showed good result in muscle strength, but only gradually improved gross motor function. For self-perception, leisure activities and participation in school, level four evidence was found. For isokinetic strength training level two evidence was found on all levels of the ICF. Most of the studies used 8-10 repetitions during 5,4 weeks of 2,4 times per week. No studies showed increase in spasticity when using any form of strength training. Strong evidence about strength training on body function and structure is demonstrated by the studies, but not as much was found on participation and activity. (Franki et al. ... 2012.)

Study made by Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar suggest using these following points, based on NSCA guidelines (Table 2), when doing strength training with children with CP. First point explains how using single-joint

strengthening exercises for children who may have a lot of compensational movements while doing multi-joint exercise, or for children who have weak muscles, might be more effective. Second point explains how CP children need more than 1 minute rest time between sets, depending on the motor impairment level and the difficulty of the exercise. Third point explains that extended period of intervention with adequate intensity might be necessary to see better results in the strength training progress. Fourth point explains that when using resistance training as intervention, children more than seven years old might be better suited. Fifth point explains how biofeedback, electrical stimulation and mental imagery can be used with children who cannot voluntarily contract their muscles due to more impairments. (Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar 2011, 1130–1139.)

Table 2. NSCA Guidelines for Strength Training Program (adapted from Tecklin 2015, 210).

Variables of Resistance Training	NSCA Guidelines
Warm-up	5 - 10 min of dynamic activities
Type	Single- and multijoint exercises utilizing concentric and eccentric contractions
Intensity/volume	1-3 sets of 6-15 repetitions of 50%-85% of 1 RM
Rest intervals	1-3 min
Frequency	2-4 times a week on nonconsecutive days
Duration	8-20 weeks
Progression	Increase resistance gradually (5%-10%) as strength improves
Age	7 years and older

In Figure 5. there are recommendations of strengthening methods for children with CP. Isokinetic resistance exercises has been discovered to be good and harmless way to strengthen bilateral movement patterns and to increase the endurance. Progressive resistance exercise training has shown stimulation in strength gain when intensity is step by step added. Stationary bike as a tool for therapy is used frequently in

physiotherapy for children with CP to enhance cardiovascular health. It is also used to strengthen lower limb muscles with the resistance provided by the bike. Treadmill exercises help to facilitate the walking through the whole range of motion and improve the balance. Weight training seems to be safe for children, but it needs to be done under appropriate supervision to ensure the safety even more. Exercising upper extremities (UE) is very important, especially for the functionality of the child. High number of repetitions have shown to be most efficient to enhance the exercise capacity in UE. Aqua therapy is very good for children with CP, because it takes off load from the joints, eliminates the effect of gravity and in general less body control is needed in the water. More difficult exercises can be performed, which can increase the confidence of the child. Sports and recreation are valid parts of the early stages in life for the general improvements and for the psychosocial benefits. Electrotherapy is needed for children with more impairments as alternative method of muscle strengthening and enhancing motor function. (Özal, Türker & Korkem 2016.)

It is recommended that for children with cerebral palsy, the following methods of strengthening be considered
Isokinetic training
Progressive resistance exercise
Bicycle and treadmill exercises
Weight training
Upper extremity strengthening
Aquatic training
Sports and recreation
Electrotherapy

Figure 5. Strengthening methods for children with CP (Özal, Türker & Korkem 2016).

3.2.1 Strength training for children with spastic CP

Can strength training be done with all types of CP is a question a lot of researchers are asking. Latest RCTs reviewed more of ambulatory children with CP, because this group has been trained. A lot of evidence shows that children do not react to the

training the same way. This is a reason why mostly children in the gross motor classification system GMFCS levels I-III, are chosen to participate in the studies. Level IV and V children may need other modalities, like neuromuscular electric stimulation, aqua therapy or biofeedback, because of their lack of motor control and ability to do voluntary movements. Current studies show that more research is needed on the effects of specific programs and types of strength training for children with CP. (Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar 2011, 1130–1139; Merino-Andrés, Mateos-López, Damiano, D. L. & Sánchez-Sierra 2021.)

In a study made in 2011, where six systematic reviews were evaluated about the resistance training for children with spastic CP in the lower limbs, five out of these showed that resistance training was effective and one of them, that was evaluating only randomized controlled trials, showed no effectiveness in the children with CP. Even though it showed no effectiveness, it was concluded that resistance training should still be a part of the exercise methods for the children with CP. (Verschuren, Ada, Maltais, Gorter, Scianni, & Ketelaar 2011, 1130–1139.)

In a most recent 2021 study, where 27 randomized clinical trials were analyzed, positive effects were found. Without increasing spasticity, muscle strength in lower limbs had increased, as well as speed of the gait, balance of standing, resistance to the maximum work and gross motor functions. The positive effects were found to be short term, so regular high-intensity strength training, correct number of repetitions and proper duration time of the program is needed to maintain the benefits. (Merino-Andrés, Mateos-López, Damiano, D. L. & Sánchez-Sierra 2021.)

Study for upper extremity strengthening in children with spastic hemiplegic CP, showed positive results. It implemented comprehensive hand repetitive intensive strengthening training system, 10 weeks, three times a week for 60 min a day. The outcome was measured with magnetic resonance imaging, standardized motor tests and ultrasound. They showed improvement in neuroplasticity, motor function, strength and size of the muscle. (Lee et al. ... 2014.)

3.2.2 The goals of strength training in physiotherapy

Different approaches and techniques are used to reach the common goal, which is functional independency of the child with CP and for them to be able to be contributing members of the community and the family. Strength training is just one of the approaches used to reach it, along with approaches like stretching, massage and so on. The goal of strengthening stays the same as the main goal. (Franki et al. ... 2012; Tecklin 2015, 237.)

Using a strength training program in physiotherapy for CP children is beneficial for many different reasons. For instance, it is very important after surgeries, such as intrathecal baclofen pump insertion, dorsal rhizotomy, bone and soft tissue surgeries, also after injecting Botox to reduce the spasticity. Doing strengthening after those can enhance functionality of the child. To get good results, exercises should be based on the goals that are set for the children. (Tecklin 2015, 210) If the goal is for example to increase the walking speed with the assistive device, then doing lower limb strengthening can help to reach the goal. (Booth, Buizer, Meyns, Oude Lansink, Steenbrink & van der Krogt 2018, 867)

4 PROCESS AND METHODOLOGY OF THE RESEARCH

4.1 Process

Thesis process, which is demonstrated in the Table 3, started from the personal interest of cerebral palsy due to the close connection for the author. The thesis topic was chosen in October 2020. Author decided to do literature review that was conducting a comprehensive search of the relevant literature in relevant databases using appropriate search terms and strings. Librarian was contacted to get some help with finding appropriate databases and search terms. Databases that were used in the thesis were Finna and Scholar. Search terms used: (“strength training” OR “strength exercise” OR strengthening OR “resistance training” OR “muscle strength” OR physiotherapy OR “physical therapy” OR “weight training” OR weightlifting) AND (“cerebral palsy” OR cp) AND (child OR children). Inclusion criteria: children and adolescences with CP. Exclusion criteria: adults and other types of trainings. Strategic approach was action research, because author wanted to do a learning material for physiotherapy students to deepen their knowledge about children with cerebral palsy and the strength training methods used with them. Collecting the literature started in December 2020, and it continued throughout the whole thesis process until November 2021. Creation of the learning material started in October 2021 and was piloted in November 2021. Thesis was finalized and presented in November 2021.

Table 3. Schedule of the thesis process.

Period	Topic
August 2020 - October 2020	Collecting ideas for the topic
October 2020 - December 2020	Putting thesis plan together
December 2020	Thesis plan presentation
December 2020 - March 2021	Theoretical background research
March 2021 - August 2021	Writing the background information
August 2021 – November 2021	Writing literature review
October 2021 – November 2021	Making learning material, piloting it, getting feedback
November 2021	Thesis presentation

4.2 Action research as method

The thesis was conducted as action research. Action research focuses on action planning, action itself, assessment and follow-up. The purpose of action research is to make a change and thus practical elements are always a part of it. Action research is influenced by people and the change is happening because of their involvement and feedback. Another important part of action research is that the conductor of the work has good understanding and knowledge about the topic to be able to notice the problems so the change could take place. (Kananen 2013, 42.)

This method was chosen, because the author wanted to make a good learning material that peer students could use in their studies. All the steps of action research were used in the thesis, like planning the learning material by collecting evidence-based research, implementing it, getting feedback and then making changes based on the feedback.

4.3 Learning material

Learning material has been made in H5P Moodle platform for pediatric physiotherapy course in Satakunta University of Applied Sciences (appendix 1). It is an independent learning material for physiotherapy students. It has been piloted on fourth year

physiotherapy students, because they have already done the pediatric course and have some of the knowledge about pediatric physiotherapy. Feedback has been collected anonymously from them with e-form questionnaire (appendix 2), made in elomake.samk.fi website.

Students who will use the learning material will get basic knowledge and information for completing the material. The assignments are made so they support the achievement of the learning goals that have been set in the beginning of the material. When doing the interactive book, students can access to different technological solutions such as texts, images, videos and audio. References are put to the end of the material. (Website of the eAMK 2017.)

4.3.1 Feedback

Learning material was sent to members of PH18 class and 6 people gave feedback, which can be fully seen in appendix 3. The first question: Name three things that were the most interesting about the learning material. Four students out of six mentioned videos. Two students mentioned pictures, example: “Real life examples with photos and videos”, “I liked the picture with hotspots that pointed out the clinical symptoms of CP”. One student mentioned exercises. One student mentioned that theory part was easy to read. Two students mentioned that they got better understanding about CP, example: “Generally good overview of basic CP symptoms”, “Getting a more in-depth understanding of spastic CP than what our neurological physiotherapy course provided”. One student mentioned: “The topics were in logical order and supported my learning.” One student mentioned different ways of training strength and how to set the program.

Second question: Was the learning material easy to read and go through? All six students answered yes, example: “Super easy to follow”, “The learning material was nicely structured which made it easy to go through”, “Yes, good use of pictures, videos and tests. Quick, but included relevant information”, “Yes. The material had a clear and logical structure.”

Third question: How useful was the learning material for you, did you learn something new? Two students out of six mentioned that it was nice and short, example: “Very nice and compact info package with the most relevant knowledge about the condition”. One student mentioned that there were different exercise modalities that helped positively. One student mentioned that he/she learned about the resistance training in CP clients, which will be useful in the future. One student mentioned that it reminded some basic information about CP and classifications, good overview of different training methods that are possible with CP patients. One student mentioned that it was useful, example: “I learned a bit of the physiological origin of spastic CP. For example, the upper motor neuron damage affects the feedback with the contractile forces of the muscles. I also learned that strength training can improve motor skills. Also, that it should be done with moderate intensity (50-80% of 1rm) and progressed according to the client's progress. So pretty much similar guidelines and strength training with a general population.”

Fourth question: Would you recommend it to other physiotherapy students? All six students would recommend this learning material for other physiotherapy students. Example: “Yes, if they are interested in neurological or pediatric PT”, “Yes, especially if the student is open to working with neurological clients. Finland has a bit under 7000 inhabitants with CP, so it is a potential future client group for many students.”

Fifth question: Other comments what you would like to add (both positive and constructive feedback are welcome). One of the students mentioned that in the “Fill in the gap” exercise he/she had answered correctly but got a wrong answer because of not putting a big letter. Two students mentioned that it could have been a bit longer, but one of them explained that: “Obviously more information could have been included, but then most likely less people would go through the whole course as it would take more time.” Two of the students mentioned that the material was well structured, and it was nice that it was not too long, but had the needed information, example: “Good that instead of a long text, you used bullet points and headings making it easier to understand the important stuff.” One student mentioned that he/she liked the interactive element of the learning material and explained it like: “When just reading, one might have a difficult time of information retention. However, having to

actually write or select the answers makes it easier to remember.” The same student also mentioned that the material was concise and focused on the most important elements, it was easily understandable and provided tools for working with CP clients. Few recommendations that the students gave: “Good program also, however with kids between 7-12 years, this type of strength training might be difficult as they might not be able to focus well enough,” and “Perhaps, the final quiz could have some sort of multiple-choice answers. In the current form, one could just logically see what words fit best without even reading the material. Maybe the "recommendations of strengthening methods" part could have more practical examples. Such as different exercises than what the sample workout had or videos of example a CP client cycling or aqua therapy for example.”

Feedback was also received from the pediatric course teacher. Teacher suggested to change wording of few questions, but overall gave good feedback. In conclusion, author did small changes to the learning material based on the feedback that was given by the students and the teacher.

5 DISCUSSION

The aim of this study was to find recent literature on strength training in children with cerebral palsy and based on that conduct a learning material for physiotherapy students who want to deepen their knowledge in that topic. Topic was chosen because of personal interests in cerebral palsy, but also due to the fact that it is the most common motor and movement disorder in children. In addition, author thought that it would be beneficial for other physiotherapy students to get to know about CP even more, because of the high prevalence of it in Finland. Topic was specified into strength training in children with CP, because decrease in muscle strength is found to be one of the most limiting factors among the CP population. Learning material was conducted because author felt like there is not enough information about CP in the pediatric course and found it relevant to give other students the possibility to enhance their knowledge with the learning material created.

Action research method was chosen because author wanted to conduct a learning material. Action research consists of steps like action planning, action itself, assessment and follow-up (Kananen 2013, 42). All of these steps were used in the thesis, such as collecting evidence-based articles to plan the learning material, piloting it, collecting feedback and making changes based on the feedback. Thus, author considered it to be the most appropriate method.

The research question was to find out if strength training has positive effects on children with cerebral palsy. Based on the latest studies, this hypothetical question did find confirmation. It is found that strength training increases muscle strength, motor function, gait and balance in children with CP (Merino-Andrés, Mateos-López, Damiano, D. L. & Sánchez-Sierra 2021).

For future studies or bachelor thesis's author recommends other students to search about strength training effects in children with GMFCS levels IV-V, as they are less studied due to the bigger impairment levels and less voluntary muscle control. It would

be very beneficial to see what the effects of strength training are and what kind of modalities they could use.

The whole process of creating the learning material for physiotherapy students has been a valuable learning experience. First of all, during the literature review process author gained a lot of new knowledge about cerebral palsy and strength training for children with CP. Author was also pleasantly surprised to find an ICF-CY tree for cerebral palsy, as it helps the physiotherapist to plan a client centered rehabilitation, which author thinks is very important. Second of all author had never used H5P Moodle platform before, so it was very beneficial to learn how to use it for future perspective. As author is planning to work in the neurological pediatric field of physiotherapy, she believes that the whole thesis process gave a good foundation for further professional development.

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Strength training in children with cerebral palsy

Learning material for physiotherapy students

By: Marleen Möttus

[Read](#)

APPENDIX 2

Feedback questionnaire

Strength training in children with cerebral palsy

1) Name three things that were the most interesting about the learning material.

2) Was the learning material easy to read and go through?

3) How useful was the learning material for you, did you learn something new?

4) Would you recommend it to other physiotherapy students?

5) Other comments what you would like to add (both positive and constructive feedback are welcome)?

APPENDIX 3

Answers to the feedback questions:

Question 1: Name three things that were the most interesting about the learning material.

1. Videos
2. Exercises and videos of them. Overall theory part easy to read. Has all the crucial information, video supports the theory part.
3. Real life examples with photos and videos. Also grafts showed examples and guidelines nicely.
4. The video about the condition. I liked the picture with hotspots that pointed out the clinical symptoms of CP. The topics were in logical order and supported my learning.
5. Different ways of training strength, the set strength training program and generally good overview of basic CP symptoms.
6. Getting a more in-depth understanding of spastic CP than what our neurological physiotherapy course provided. Strength training's importance for improving the functional ability. It might be easy for an inexperienced physiotherapist to think stretching would be the best way to treat hypertonic presentations. The NSCA guidelines to help build a custom workout for a CP client and the author's sample workout that went according to it.

Question 2: Was the learning material easy to read and go through?

1. Yes
2. Super easy to follow
3. The learning material was nicely structured which made it easy to go through.
4. Yes
5. Yes, good use of pictures, videos and tests. Quick, but included relevant information.
6. Yes. The material had a clear and logical structure.

Question 3: How useful was the learning material for you, did you learn something new?

1. Yes, I did, very nice and short.
2. There are different exercise modalities that help positively.
3. I learned about the resistance training in CP clients, which will be useful in the future.
4. Very nice and compact info package with the most relevant knowledge about the condition.
5. Reminded some basic information about CP and classifications. Good overview of different training methods that are possible with CP patients.
6. It was quite useful. I learned a bit of the physiological origin of spastic CP. For example, the upper motor neuron damage affects the feedback with the contractile forces of the muscles. I also learned that strength training can also improve motor skills. Also, that it should be done with moderate intensity (50-80% of 1rm) and progressed according to the client's progress. So pretty much similar guidelines and strength training with a general population.

Question 4: Would you recommend it to other physiotherapy students?

1. Yes
2. Yes
3. Definitely
4. Yes
5. Yes, if they are interested in neurological or pediatric PT.
6. Yes, especially if the student is open to working with neurological clients. Finland has a bit under 7000 inhabitants with CP, so it is a potential future client group for many students.

Question 5: Other comments what you would like to add (both positive and constructive feedback are welcome).

1. Maybe a bit longer?
2. The test wanted me to use big letters, so I did not get 7/7.
3. The learning material was well structured, it was nice that it wasn't too long, but still had the needed information. Obviously more information could have

been included, but then most likely less people would go through the whole course as it would take more time. Good job!

4. Really nice!
5. Good that instead of a long text, you used bullet points and headings making it easier to understand the important stuff. Good program also, however with kids between 7-12 years, this type of strength training might be difficult as they might not be able to focus well enough. Just a thought.
6. I liked the interactive element of the study material. When just reading, one might have a difficult time of information retention. However, having to actually write or select the answers makes it easier to remember. Perhaps, the final quiz could have some sort of multiple-choice answers. In the current form, one could just logically see what words fit best without even reading the material. The material was concise and focused on the most important elements. It was easily understandable and provided tools for working with CP clients. Maybe the "recommendations of strengthening methods" part could have more practical examples. Such as different exercises than what the sample workout had or videos of example a CP client cycling or aqua therapy for example.