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Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

Exploration of measurement instruments and the effects on sitting balance after hippotherapy intervention in children with Cerebral Palsy

Kaat Hombroux
Aude Van Dessel

Eerste deel van het scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie

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Research question

Which measuring instruments are used to evaluate the effectiveness of hippotherapy on the sitting balance in children with Cerebral Palsy?

Highlights

- Measurement instruments that could be used to assess the effect of hippotherapy on sitting balance in children with Cerebral Palsy are limited.
- Both technological and functional measurement instruments are sensitive to detect changes in sitting balance after hippotherapy in children with Cerebral Palsy.
- Currently, none of the measurement instruments available in literature are specifically designed to assess sitting balance on the back of a horse.

Names of the students: Kaat Hombroux & Aude Van Dessel

Promotors and co-promotors: Prof. dr. Katrijn Klingels, Msc. Katrijne Severi & dr. Evi Verbecque

CONTEXT

This systematic literature research is part of the broader research field: pediatrics rehabilitation.

Children with Cerebral Palsy (CP) face various difficulties in daily living, for example, maintaining sitting balance is one of the major challenges for this population. Even though hippotherapy is a relatively unknown training approach, it has proven to be an important one. It has been shown that hippotherapy intervention is an effective treatment strategy to improve balance problems in children with CP. However, the effect on sitting balance specifically is not widely described in literature. The trunk is a central key point in stability, which is impaired in children with CP. If stability is adequate, it forms a good base for mobility. For physical therapists it is important to know about the effects of hippotherapy on sitting balance and how the assessment takes place. In that way, therapists can provide the best possible patient-centered care. This systematic literature research aimed to explore different measurement instruments that assess the effectiveness of hippotherapy intervention on sitting balance in children with CP.

This study is part of the start-up research line “Children with CP” and is conducted at the request of and in cooperation with school and care institution Sint-Gerardus in Diepenbeek, Belgium. Further data collection will take place at the practical setting itself. A central format will be followed.

Research questions were formulated by the students in agreement with the promotors of this master thesis. Systematic literature search has been conducted independently by both students and disagreements have been solved in a consensus meeting. Additionally, the research protocol for this pilot study was described by both students and a consensus was also reached.

1. ABSTRACT

Background: Sitting balance deficits are a common problem in children with Cerebral Palsy (CP), for which hippotherapy is an effective intervention. However, its effectiveness cannot be assessed yet while seated on the back of a horse. Therefore, the current study aims to explore and analyze different measurement instruments used to evaluate the effectiveness of hippotherapy on sitting balance in children with CP.

Method: A systematic literature search was conducted in PubMed, Web of Science and Scopus. Methodological quality was assessed by the PEDro and SIGN-checklist. Characteristics of the population, interventions and measurement instruments were extracted.

Results: Functional and technological measurement instruments can be used to assess sitting balance. Three functional scales were reported: Sitting Assessment Scale, Segmental Assessment of Trunk Control and Gross Motor Function Measurement. Technological measurements included Center of Pressure movement/velocity and lateral trunk deviation. Both types of measurement instruments were sensitive to change.

Discussion and conclusion: Measurement instruments that could be used to evaluate the effect of hippotherapy on sitting balance in children with CP are limited and none are specifically designed to assess sitting balance on the back of a horse. Therefore, development of a new scale is recommended.

Aim of the study: Evaluation of the psychometric measurement properties of a new measurement instrument Hippotherapy Trunk Control (HippoTrunC) in children with CP.

Operationalization of research question: A hippotherapy intervention will be conducted to a single group of children with CP. Psychometric measurement properties of different items of HippoTrunC will be evaluated.

Keywords: “postural balance”, “equine-assisted therapy”, “hippotherapy”, “sitting balance”

2. INTRODUCTION

Cerebral Palsy (CP) is one of the most common causes of disability in childhood and is described as a range of non-progressive syndromes of posture and motor impairment (Koman, Smith, & Shilt, 2004). It is the result of a permanent lesion of the cerebral motor cortex that occurs prenatally, at birth or within two years postnatally (Koman et al., 2004). According to the International Classification of Functioning, Disability and Health for Children and Youth model (ICF-CY) (WHO-FIC.), children with CP experience impairments on function level, activity limitations and participation restrictions. The neuromuscular disease manifests itself in a wide spectrum of impairments. "More than 50% of patients with the disorder can walk without arm assistance; 25% cannot walk, and 30% are mentally impaired. Neurological problems are common and include seizures (35%), sensory impairment of the arms (97%), hydrocephalus (9%), autonomic dysfunction, impairment of visual perception (20-40%), and learning disabilities" (Koman et al., 2004, p. 1). Another common limitation in this population is the delay of a major developmental milestone, sitting (Banas & Gorgon, 2014). Poor selective motor control especially in the trunk contributes to poor sitting (Harbourne, 2010). Shumway-Cook and Woollacott (2017) defined balance as the ability to maintain the center of mass within the limits of base of support, which is dependent on the requirements of the task and environment. Adequate sitting balance is needed to safely manage activities of daily living and to engage in sport-related activities for example riding a bicycle (Kiss, Schedler, & Muehlbauer, 2018).

There is a wide range of treatment options to maintain or improve the functionality in children with CP. Traditional physiotherapy, bracing, and orthopedic musculoskeletal surgery are the most prescribed treatment strategies (Koman et al., 2004). Other approaches such as hippotherapy or horseback riding simulator as intervention for CP were supported by a moderate level of evidence (Dewar, Love, & Johnston, 2015). Moreover, Meregillano (2004) describes hippotherapy as a powerful treatment tool. The horse can be seen as a dynamic treatment tool which mimics human gait patterns and thereby stimulates motor and proprioceptive systems and improves flexibility, balance and muscle strength (Meregillano, 2004). The benefits of hippotherapy on balance are widely described and proven in literature. A lot of studies have investigated the effects on gross motor function, standing balance and gait (Dominguez-Romero, Molina-Aroca, Moral-Munoz, Luque-Moreno, & Lucena-Anton,

2019; K.-H. Kim & Lee, 2020; Zadnikar & Kastrin, 2011). In contrast with sitting balance, an outcome measure that is not often applied.

Given the importance of functional sitting balance and the benefits of hippotherapy, it is necessary that clinicians can evaluate sitting balance objectively with a standardized tool. Technological measurement instruments, such as computerized force platforms, measure each movement accurately but are expensive and not always feasible in clinical practice. Besides that, very few functional measurement tools are available for clinical use (Banas & Gorgon, 2014). Furthermore, little is known about scales specifically designed for assessing the effects of hippotherapy on the sitting balance problems in children with CP. Given the emergence of sports therapy as treatment for balance problems in children with CP, the benefits of hippotherapy should be objectively evaluated (K.-H. Kim & Lee, 2020).

An improved sitting balance can offer the children several benefits in activities of daily life, therefore the aim of this systematic literature review is to explore the different measurement instruments used to evaluate the effectiveness of hippotherapy on the sitting balance of children with Cerebral Palsy. Furthermore, it remains to be seen whether or not a feasible assessment tool is already available or needs to be developed in the future.

3. METHOD

3.1 Aim of the study

The aim of this literature search is to analyze different measuring scales used to evaluate the effectiveness of hippotherapy on the sitting balance of children with Cerebral Palsy.

3.2 Search strategy

A systematic literature search of articles was executed until January 19th 2021 using the following electronic databases: PubMed, Scopus, and Web of Science (WOS). Search terms were designed to include the **intervention** ('Hippotherapy' OR 'equine therapy' OR 'equine-assisted therapy' OR 'horse therapy' OR 'horse riding' OR 'horseback riding'), and **outcome** ('sitting balance' OR 'trunk control' OR 'core stability' OR 'postural balance' OR 'sitting position' OR (('sitting' OR 'sit' OR 'seated' OR 'trunk') AND ('balance' OR 'postural control' OR 'postural balance' OR 'stability' OR 'posture' OR 'postur*' OR control'))) of interest. The search string was adapted for each database, search strings and queries are shown in ***Table 1***. No filters were applied. The secondary searches included reference list checking of the included articles.

Table 1
Search strategy

Databases	Search string
PubMed	(("hippotherapy"[Title/Abstract] OR "equine therapy"[Title/Abstract] OR "equine-assisted therapy"[Title/Abstract] OR "equine-assisted therapy"[MeSH Terms] OR "horse therapy"[Title/Abstract] OR "horse riding"[Title/Abstract] OR "horseback riding"[Title/Abstract]) AND ("trunk control"[Title/Abstract] OR "core stability"[Title/Abstract] OR "sitting position"[Title/Abstract] OR "sitting balance"[Title/Abstract] OR "postural balance"[MeSH Terms] OR (("sitting"[Title/Abstract] OR "sit"[Title/Abstract] OR "seated"[Title/Abstract] OR "trunk"[Title/Abstract]) AND ("balance"[Title/Abstract] OR "postural control"[Title/Abstract] OR "postural balance"[MeSH Terms] OR "stability"[Title/Abstract] OR "posture"[MeSH Terms] OR "postur*"[Title/Abstract] OR "control"[Title/Abstract]))))
Web of Science	TS=((hippotherapy OR equine therapy OR equine-assisted therapy OR horse therapy OR horse riding OR horseback riding) AND (trunk control OR core stability OR sitting position OR sitting balance OR postural balance OR ((sitting OR sit OR seated OR trunk) AND (balance OR postural control OR postural balance OR stability OR posture OR postur* OR control)))) OR TI=((hippotherapy OR equine therapy OR equine-assisted

	therapy OR equine-assisted therapy OR horse therapy OR horse riding OR horseback riding) AND (trunk control OR core stability OR sitting position OR sitting balance OR postural balance OR ((sitting OR sit OR seated OR trunk) AND (balance OR postural control OR postural balance OR stability OR posture OR postur* OR control))))
Scopus	(TITLE-ABS-KEY (hippotherapy) OR TITLE-ABS-KEY ("equine therapy") OR TITLE-ABS-KEY ("equine-assisted therapy") OR TITLE-ABS-KEY ("horse therapy") OR TITLE-ABS-KEY ("horse riding") OR TITLE-ABS-KEY ("horseback riding")) AND (((TITLE-ABS-KEY ("sitting balance") OR TITLE-ABS-KEY ("postural balance") OR TITLE-ABS-KEY ("core stability") OR TITLE-ABS-KEY ("trunk control") OR TITLE-ABS-KEY ("sitting position"))) OR (((TITLE-ABS-KEY (sitting) OR TITLE-ABS-KEY (sit) OR TITLE-ABS-KEY (seated) OR TITLE-ABS-KEY (trunk))) AND ((TITLE-ABS-KEY (balance) OR TITLE-ABS-KEY ("postural control") OR TITLE-ABS-KEY ("postural balance") OR TITLE-ABS-KEY (stability) OR TITLE-ABS-KEY (postur*) OR TITLE-ABS-KEY (control)))))

3.3 Eligibility criteria and selection process

The selection criteria were applied by two independent investigators in two phases (phase 1: title and abstract, phase 2: full-text). After each screening phase, the results were discussed by the two investigators until a consensus was reached.

References of both included studies after phase 2 and studies excluded in phase 2 due to study (systematic) review design, were screened and included if they met the selection criteria.

Relevant studies were selected for inclusion if they fulfilled the following criteria:

1. **Intervention**: Hippotherapy intervention or hippotherapy simulators that mimic the walking of a real horse had to be reported. Interventions where no riding was described or horses only were used to assist children with socio-emotional difficulties were excluded.
2. **Outcome**: Measurement instruments for evaluating sitting balance had to be reported. Both functional and technological assessment tools specifically intended for measuring balance in the sitting position were included. All studies in which another outcome than sitting balance was evaluated e.g. standing balance, spasticity, alignment, gross motor skills, etcetera were excluded.
3. **Population**: Study participants were children diagnosed with CP. Participants were not excluded based on degree of disability. As such, children classified as Gross Motor Function Classification System (GMFCS) level I to level V were included in this study.

All studies were excluded in which not CP but another disorder was the primary population of interest e.g. elderly diagnosed with Multiple Sclerosis (MS), children diagnosed with Autism Spectrum Disorder (ASD), children diagnosed with Down Syndrome and other neurological or neurodevelopmental disorders.

4. **Study design**: Randomized and clinical, controlled trials and cohort studies were considered relevant. All other study designs were excluded, e.g. (systematic) reviews and meta-analyses, case-control studies etcetera.
5. **Publication language:** Studies had to be written in English or Dutch.

3.4 Methodological quality assessment of the individual studies

The PEDro scale (Cashin & McAuley, 2020) was used as a valid and reliable rating tool to assess methodological quality of randomized and clinical controlled trials included in this review. The scale consists of 11 items related to the internal validity (item 2-11) and external validity (item 1). Studies receiving a score lower than 4, were graded 'poor', 4 to 5 were graded 'fair', 6 to 8 were graded 'good', and a score 9 to 10 were graded 'excellent' (Cashin & McAuley, 2020).

To assess the risk of bias in cohort studies, the Scottish Intercollegiate Guidelines Network (SIGN) checklist for cohort studies was used (Scottish Intercollegiate Guidelines Network, 2014). The SIGN checklist is a validated risk of bias assessment tool. The checklist assesses internal validity and provides an overall quality assessment. The studies' overall quality can be rated as high quality when ≥ 8/10 criteria were met, as acceptable quality when 4-7/10 criteria were met, and as low quality when ≤ 3/10 criteria were met.

The methodological quality of the articles was evaluated independently by two investigators and differences were solved by consensus between these two investigators.

3.5 Data-extraction and -synthesis

After applying the selection criteria and methodological assessment, specific data were extracted from the included articles by one of the authors and checked by another one. First, population characteristics (sample size, number of participants per group, mean age, sex distribution, and type of CP) and characteristics of included intervention (type of intervention, duration, frequency, and sessions length) were mapped. Finally, type of outcome measures

including all kinds of assessment of sitting balance ability and their results were extracted. According to the International Classification of Functioning, Disability and Health (ICF), both measurements that assess function level and activity level were data of interest. Technological measurement tools were classified as measuring body function while functional measurement tools covered both function and activity level. Finally, change scores within-group and differences between-groups for each outcome variable were extracted.

4. RESULTS

4.1 Search results

A total of 427 articles were identified (PubMed: 91, Web of Science: 180, and Scopus: 156). After duplicates were removed, the titles and abstracts of 260 articles were screened. Of these, 69 articles met the eligibility criteria. Nine articles met the final inclusion criteria. The flowchart of studies is summarized in ***Figure 1***: Flowchart. Excluded articles after full-text screening are shown in ***Appendix Table 1***.

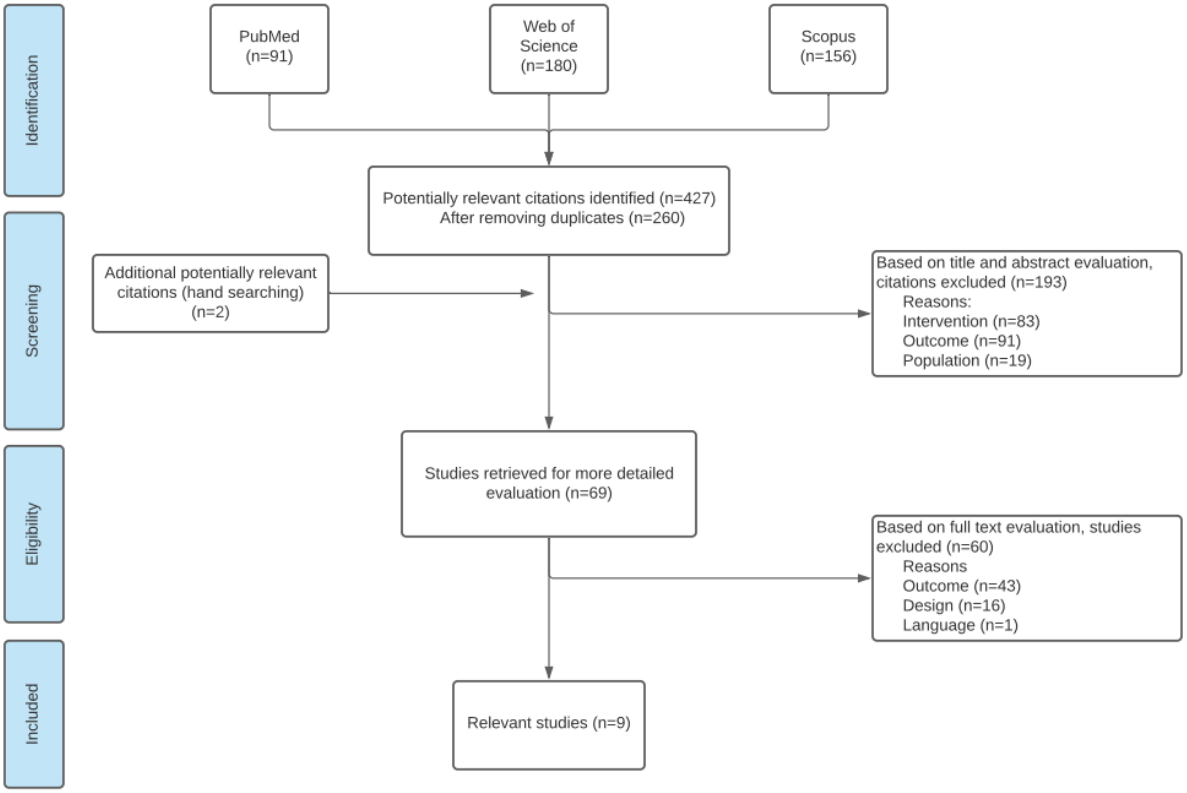

Figure 1: Flowchart

4.2 Methodological quality assessment

Table 2 provides an overview of the consensus of methodological quality assessment by the PEDro scale. Six studies were of good quality (Borges, Werneck, da Silva, Gandolfi, & Pratesi, 2011; Chinniah, Natarajan, Ramanathan, & Ambrose, 2020; Herrero et al., 2012; Kang, Jung, & Yu, 2012; Matusiak-Wieczorek, Dziankowska-Zaborszczyk, Synder, & Borowski, 2020; Temcharoensuk, Lekskulchai, Akamanon, Ritruechai, & Sutcharitpongsa, 2015) and two

articles fair (MacPhail et al., 1998; Matusiak-Wieczorek, Małachowska-Sobieska, & Synder, 2016). An overview of the individual methodological quality assessment by the PEDro scale is shown in ***Appendix Table 2***.

Table 2
Methodological screening PEDro scale – consensus score

	PEDro scale items												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total score**	**Methodological quality**
Borges et al. (2011)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
Chinniah et al. (2020)	Yes	1	1	1	0	1	0	0	1	1	1	7	Good
Herrero et al. (2012)	Yes	1	1	1	0	0	1	1	1	0	1	7	Good
Kang et al. (2012)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
MacPhail et al. (1998)	Yes	0	0	0	0	0	0	1	1	1	1	4	Fair
Matusiak-Wieczorek et al. (2016)	Yes	0	0	1	0	0	0	1	1	1	0	4	Fair
Matusiak-Wieczorek et al. (2020)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
Temcharoensuk et al. (2015)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good

Legend: 1 Eligibility criteria were specified; **2** Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received; **3** Allocation was concealed; **4** The groups were similar at baseline regarding the most important prognostic indicators; **5** There was blinding of all subjects; **6** There was blinding of all therapists who administered the therapy; **7** There was blinding of all assessors who measured at least one key outcome; **8** Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; **9** All subjects for whom outcome measures were available received the treatment of control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat"; **10** The results of between-group statistical comparisons are reported for at least one key outcome; **11** The study provides both point measures and measures of variability for at least one key outcome; **Total score** Total score of the PEDro scale (items 2-11); **Methodological quality** Methodological quality of the study. **"yes"** yes, eligibility criteria were specified; **"1"** yes, the criterion is fulfilled; **"0**" no, the criterion is not fulfilled.

The cohort study (Moraes, Copetti, Angelo, Chiavoloni, & David, 2016) had an acceptable quality on the SIGN scale.

All studies of *good quality* failed to blind the participants and five out of six failed to blind the therapists, but satisfied almost all other criteria (Borges et al., 2011; Herrero et al., 2012; Kang et al., 2012; Matusiak-Wieczorek et al., 2020; Temcharoensuk et al., 2015). Only two articles of good quality had concealed allocation (Chinniah et al., 2020; Herrero et al., 2012). Studies of *fair quality* failed to randomize the participants, provide concealed allocation, blind participants, therapists, and assessors.

Of the studies of acceptable to good quality, two articles did not report the degree of disability through the GMFCS level (Kang et al., 2012; MacPhail et al., 1998), and one article did not report the type of CP of the included individuals (Herrero et al., 2012).

4.3 Data analysis

4.3.1 Population characteristics

In total 305 children with CP were assessed. The sample size of the included articles varied from 13 to 45 (Kang et al., 2012; MacPhail et al., 1998; Matusiak-Wieczorek et al., 2020). The mean age (SD) of the articles was 7.6 years (2.6). Sex varied between 14.3% and 80% male individuals per group. Three studies compared diplegic with hemiplegic CP (Kang et al., 2012; Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016), three articles only included individuals with spastic diplegia (Borges et al., 2011; Chinniah et al., 2020; Temcharoensuk et al., 2015), one article compared diplegic with quadriplegic CP (MacPhail et al., 1998), and one article compared diplegic CP as well as hemiplegic and quadriplegic CP (Moraes et al., 2016). ***Table 3*** provides a description of the samples with respect to sex distribution, age, type of CP and degree of disability. One article included all five GMFCS levels (Herrero et al., 2012), another article included GMFCS level II until V (Borges et al., 2011), three articles included two GMFCS levels (Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016; Temcharoensuk et al., 2015), and one study included GMFCS level I, II and IV (Moraes et al., 2016). Finally, two articles did not report the GMFCS level (Kang et al., 2012), MacPhail et al. (1998) only included individuals with a functional mobility status .

Table 3

Population characteristics

Authors	Groups	Sample size	Mean age (Years ± SD)	Gender (Male%)	Topography			Degree of disability (GMFCS)				
					Hemiplegia	Diplegia	Quadriplegia	I	II	III	IV	V
Borges et al. (2011)	Control group	n=20	5.65 ± 2.48	45.0%		n=40§			n=8	n=16	n=14	n=2
	Intervention group	n=20	5.77 ± 2.29	40.0%								
Chinniah et al. (2020)	Control group	n=20	Between 2-4	25.0%		n=40§		n=2	n=5	n=8		
	Intervention group	n=20		40.0%				n=2	n=8	n=5		
Herrero et al. (2012)	Control group	n=19	9.05 ± (7.58-10.53)					n=2	n=2	n=3	n=3	n=9
	Intervention group	n=19	9.95 ± (8.80-11.10)					n=2	n=1	n=2	n=4	n=10
Kang et al. (2012)	Control group	n=14	7.8 1.5	50.0%	n=9	n=5						
	Intervention group 1 (HTG)	n=14	8.2 ± 1.1	50.0%	n=9	n=5						
	Intervention group 2 (PTG)	n=15	8.2 ± 1.2	53.3%	n=10	n=5						
MacPhail et al. (1998)	Control group	n=7	8.1 ± 1.8	14.3%				*				
	Intervention group	n=6	6.7 ± 1.1	33.3%		n=3	n=3					
Matusiak-Wieczorek et al. (2016)	Control group	n=20	8.3 ± 2.62	55.0%	n=15	n=5		n=11	n=9			
	Intervention group	n=19	8.42 ± 2.24	52.6%	n=13	n=6		n=12	n=7			
Matusiak-Wieczorek et al. (2020)	Control group	n=15	8.13 ± 2.56	53.3%	n=10	n=5		n=7	n=8			
	Intervention group 1	n=15	7.93 ± 2.6	60.0%	n=12	n=3		n=10	n=5			
	Intervention group 2	n=15	7.60 ± 1.84	53.3%	n=13	n=2		n=12	n=3			
Moraes et al. (2016)	Intervention group	n = 15	Between 5 and 10	80.0%	n=6	n=1	n=8	n=8	n=2		n=5	
Temcharoen suk et al. (2015)	Intervention group 1 (HR)	n = 10	10.7±1.7	50.0%		n=30§			n=5	n=5		
	Intervention group 2 (DHS)	n = 10	10.1±1.7	40.0%					n=5	n=5		
	Intervention group 3 (SHS)	n = 10	10.4±1.5	50.0%					n=5	n=5		

Legend: SD: standard deviation; n: number of participants; NR: not reported; *functional mobility status; § spastic type of CP; empty cells indicate these characteristics were not reported; HR: horseback riding group; CPT: conventional physical therapy group; DHS: dynamic horseback riding simulator; SHS: static horseback riding simulator

4.3.2 Intervention

A horse riding simulator was used in three studies for therapy (Borges et al., 2011; Chinniah et al., 2020; Herrero et al., 2012). Five articles reported horse riding therapy as intervention (Kang et al., 2012; MacPhail et al., 1998; Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016; Moraes et al., 2016). One article used both a horseback riding simulator as horse riding therapy (Temcharoensuk et al., 2015). Five of the nine included studies compared an intervention with a control group (Borges et al., 2011; Chinniah et al., 2020; Herrero et al., 2012; Kang et al., 2012; Matusiak-Wieczorek et al., 2020). These control groups underwent conventional physical therapy in three studies (Borges et al., 2011; Chinniah et al., 2020; Matusiak-Wieczorek et al., 2020). In two studies the control group did not get any treatment (Kang et al., 2012; Matusiak-Wieczorek et al., 2016). One study compared intervention with a combination of active trunk extension and the horseback riding simulator switched off (Herrero et al., 2012). One article compared three different types of intervention (Temcharoensuk et al., 2015), and one article did not compare different groups (Moraes et al., 2016). The frequency of intervention varied from a single session to three times a week (Chinniah et al., 2020; MacPhail et al., 1998; Temcharoensuk et al., 2015). Session duration varied from fifteen minutes to 45 minutes per session (Chinniah et al., 2020; Herrero et al., 2012). The total duration of the intervention period varied from one day to twelve weeks (Chinniah et al., 2020; MacPhail et al., 1998; Temcharoensuk et al., 2015). An overview of the interventions per study is shown in ***Table 4***.

Table 4

Intervention characteristics

Authors	Groups	Type of intervention	Frequency	Session duration	Intervention duration
Borges et al. (2011)	Control group	**CPT**	2 times/week	40 min	6 weeks
	Intervention group	**Horse riding simulator**			
Chinniah et al. (2020)	Control group	**CPT**	3 times/week	30 min CPT 30 min CPT + 15 min HRS	12 weeks
	Intervention group	**CPT + Horse riding simulator**			
Herrero et al. (2012)	Control group	**Horse riding simulator (off) + active trunk extension**	1 time/week	15 min	10 weeks
	Intervention group	**Horse riding stimulator + active trunk extension**			
Kang et al. (2012)	Control group	**No treatment**	2 times/week	30 min	8 weeks
	Intervention group 1 (HR)	**CPT* + Horse riding simulator**			
	Intervention group 2 (CPT)	**CPT***			
MacPhail et al. (1998)	Control group	**Horse riding therapy**	Single session	NR	1 day
	Intervention group	**Horse riding therapy**			
Matusiak-Wieczorek et al. (2016)	Control group	**No treatment**	1 time/week	30 min	12 weeks
	Intervention group	**Horse riding therapy**			
Matusiak-Wieczorek et al. (2020)	Control group	**CPT**	NR		
	Intervention group 1	**Horse riding therapy**	2 times/week	30 min	12 weeks
	Intervention group 2	**Horse riding therapy**	1 time/week		
Moraes et al. (2016)	Intervention group	**Horse riding therapy**	2 times/week	30 min	12 weeks
Temcharoensuk et al. (2015)	Intervention group 1 (HR)	**Horse riding therapy**	Single session	30 min	1 day
	Intervention group 2 (DHS)	**Dynamic horse riding simulator**			
	Intervention group 3 (SHS)	**Static horse riding simulator**			

Legend: CPT: conventional physical therapy; HRS: horseback riding simulator; HRT: horse riding therapy; NR: not-reported; *: strengthening and stretching exercises

4.3.3 Measurement scales for sitting balance

Technological measurement instruments

In four of the nine included articles technological instruments were used for the assessment of the sitting balance of participants (Borges et al., 2011; Kang et al., 2012; MacPhail et al., 1998; Moraes et al., 2016). Three articles used posturography to measure both **Center of Pressure (COP)** movement in the antero-posterior and mediolateral direction (Borges et al., 2011; Kang et al., 2012; Moraes et al., 2016) and two to measure the velocity of the displacement (Kang et al., 2012; Moraes et al., 2016). **Movement Analysis** with marker tracking to evaluate the lateral trunk deviation was reported once (MacPhail et al., 1998).

Functional measurement instruments

Besides technological instruments, several articles reported functional measurement instruments. **The Sitting Assessment Scale (SAS)** (Herrero et al., 2012; Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016), **Segmental Assessment of Trunk Control (SATCo)** (Temcharoensuk et al., 2015), and the sitting dimension of the **Gross Motor Function Measurement 66 and Gross Motor Function Measurement 88 (GMFM-66/GMFM-88)** (Chinniah et al., 2020; Herrero et al., 2012; Temcharoensuk et al., 2015) were used to evaluate the sitting balance of the children. In some assessments the child took place on a bench (SATCo) or a mat (GMFM-66 and GMFM-88) which is an unsupported starting position that requires a large amount of trunk control. When assessing sitting balance with the SAS, the child is positioned on a chair, allowing the child to support against the back of the seat. Besides the starting positions, different items evaluating sitting balance were mapped. All measuring instruments contain items that address static and active sitting balance but only one instrument evaluates the reactive sitting balance. Furthermore, all instruments measure head control, both static and active. Only one measurement tool, the GMFM, assesses the ability to make transfers, such as moving from prone to sit, supine to sit and from stance to sit. The Sitting Assessment Scale is the only instrument that uses video-analysis to score test items. Because none of these functional instruments are specifically designed for measuring the effect of hippotherapy, no assessment took place on the back of the horse. A detailed overview of the instruments is shown in ***Table 5***.

Table 5
Details of functional measuring instruments

	Functional measuring instruments			
Items	**SATCo**	**SAS**	**GMFM-66**	**GMFM-88**
Sitting position	Bench	Chair	Mat and bench	Mat and bench
Supported	**	x	x	x
Unsupported	x	x	x	x
Trunk control (global)	x	x	x	x
Trunk control: static	x	x	x	x
Trunk control: active*	x	x	x	x
Trunk control: reactive	x			
Head control (global)	x	x	x	x
Head control: static	x	x	x	x
Head control: active	x	x		
Transfers**			x	x
Supine to sit			x	x
Supine to prone			x	x
Stance to sit			x	x
Pivoting 90°				x
Video-analysis		x		

Legend: * reaching, grasping, lifting; ** manual support can be applied

4.3.4 Outcome

Performance on technological measurement instruments

The COP movements in antero-posterior and medio-lateral direction decreased significantly after hippotherapy and horse riding simulator-intervention (Borges et al., 2011; Kang et al., 2012; Moraes et al., 2016). Significant differences were found between intervention and control group for COP movement in both directions (Borges et al., 2011). Velocity of displacement was used in two articles to assess sitting balance and showed improvement in both hippotherapy intervention group and conventional physical therapy control group (Kang et al., 2012; Moraes et al., 2016). No differences were found in the pre- and postscores of COP velocity in the control group that did not receive an intervention (Kang et al., 2012). Movement Analysis with marker tracking showed a significant greater lateral trunk deviation for riders with CP in comparison to healthy controls (MacPhail et al., 1998). ***Table* 6** provides an overview of technological measurement instruments and their performance on them.

Table 6

Technological outcome measures

		Intervention					Controls		Between-groups
			Horse riding		Horse riding simulator				
Outcome measure	**Author**	**Outcome variable**	**Mean**	**P-value**	**Mean**	**P-value**	**Mean**	**P-value**	
P**osturography**	**Borges et al. (2011)**	COP movement (AP-ML)			COPap and COPml ↑	0.0110	COPap and COPml: ↑	0.1510	COPap: IG > CG (p<0.0001) COPml: IG > CG (p<0.0069)
	Kang et al. (2012)	COP movement (ml- total) Velocity of displacement (ml-total)	COPml and COPtot: ↑ VelCOPml and VelCOPtot: ↑	0.05 0.05			<u>CG1</u> COPml: ↑ COPtot = VelCOPtot: ↑ <u>CG2:</u> COP = Velocity =	<0.05 ** <0.05 ** **	COPmovement and COPvel: IG > CG (p < 0.05)
	Moraes et al. (2016)	COP movement (AP-ML) Velocity of displacement	COPml: ↑ COPap: ↑ VelCOP: ↑	0.001 0.006 0.004					
Movement Analysis-marker tracking	**MacPhail et al. (1998)**	Lateral trunk deviation			=				CG-group > CP-group for lateral trunk deviation (<0.05)

Legend: AP: antero-posterior; ML: medio-lateral; **: no p-values reported; CG1: physical therapy; CG2: no intervention; NS: non-significant; ↑: improved; =: no change; CP: Cerebral Palsy

Performance on functional measurement scales

One study using the SAS reported no differences after a horseback riding simulator intervention. Two other studies using the SAS as an assessment tool reported significant improvement after hippotherapy intervention in trunk control (Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016) and in head position control (Matusiak-Wieczorek et al., 2020). Total scores and subscores "static, active and reactive" on the SATCo also improved significantly after hippotherapy intervention, whereas the horseback riding simulator only significantly improved the active and reactive balance subscores but not the static balance (Temcharoensuk et al., 2015). Three studies found significant improvements in sitting balance assessed with the sitting dimension of the GMFM-66 and GMFM-88, using hippotherapy and horseback riding simulator interventions (Chinniah et al., 2020; Herrero et al., 2012; Temcharoensuk et al., 2015). Hippotherapy intervention was superior to conventional physical therapy or no intervention, significant differences of sitting balance were found between intervention and control groups (Chinniah et al., 2020; Matusiak-Wieczorek et al., 2016; Temcharoensuk et al., 2015). Details of the performance on functional measurement scales are shown in ***Table 7***.

Table 7

Functional outcome measurements

		Intervention				Controls		Between-groups
		Horse riding		Horse riding simulator				
Outcome measure	**Author**	**Change**	**P-value**	**Change**	**P-value**	**Change**	**P-value**	
SATCo	**Temcharoensuk et al. (2015)**	Static balance ↑ Active balance↑ Reactive balance ↑	0.038 0.026 0.006	Static balance = Active balance ↑ Reactive balance ↑	** 0.034 0.034	Static balance = Active balance = Reactive ↑	** ** 0.046	Reactive balance: IG > CG (p<0.004)
GMFM-66*	**Temcharoensuk et al. (2015)**	Dimension B ↑	**					IG > HRS (p<0.001) IG > CG (p=0.0001)
	Herrero et al. (2012)			Dimension B ↑	$<0.05^{x}$			
GMFM-88*	**Chinniah et al. (2020)**			Dimension B ↑	0.01			IG > CG-group (p<0.01)
SAS	**Herrero et al. (2012)**			=	**			
	Matusiak-Wieczorek et al. (2016)	Trunk control ↑	0.018			Trunk control ↑	<0.068	IG > CG-group (p<0.01)
	Matusiak-Wieczorek et al. (2020)	IG1: Head position control ↑ Trunk control↑ IG2: Trunk control ↑ Head position control =	 0.012 0.005 0.028 **			Trunk control =	**	

Legend: *: sitting dimension – B; **: no p-values reported; IG1: 2x/week intervention; IG2: 1x/week intervention; ↑ improved; = no change ; $^{x:}$:Effect size = 0.36; 95% CI(0.01 -0.7

5. DISCUSSION

5.1 Reflection of the quality of included articles

Some methodological characteristics of the articles may influence the level of evidence of the results obtained. The methodological quality of the majority of the studies was good, indicating that possible risk of bias of the included articles was relatively low. Nevertheless, none of the articles had an excellent score on the PEDro scale due to lack of blinding of both participants and therapists, which can constitute possible response and detection bias. Lack of concealed allocation, increases the risk of selection bias.

5.2 Reflection of findings related to research question

Maintaining a sitting position, required for the performance of many activities of daily living, is often a challenge for children with CP. Hippotherapy intervention is indicated to improve balance in children with CP, but its effects on sitting balance specifically are not well known to date (Dominguez-Romero et al., 2019; Zadnikar & Kastrin, 2011). Therefore, this review aimed to analyze different measurement scales used to evaluate sitting balance of children with CP who underwent some kind of hippotherapy. Therefore, the main outcome of this review is that sitting balance in individuals with CP can be assessed both with technological and functional measurement instruments.

Technological measurement instruments can objectively detect small changes in parameters of sitting balance of the individuals. However, the small changes take place on function level of the ICF, while the goal in rehabilitation is improvement and independence in daily life activities. Besides that, technological measurements are expensive and not adapted to evaluate sitting balance on the back of a horse. It would be an added value if further studies can design a technological measurement instrument that is user-friendly to evaluate sitting balance on the back of a horse in a practical school setting.

On the other hand, there are already several existing functional measurement instruments to evaluate sitting balance. Even if they are not specifically developed to measure the effects on the back of a horse, they may be more adaptable than technological measurements. Furthermore, functional measurement instruments assess changes in sitting balance at

activity level, which is interesting for accomplishing the patients' rehabilitation goals. In addition, given that physical therapists are working in different settings, it is important that the assessment can be performed easily and time efficiently. Although functional measurement instruments are slightly subjective. Therefore, this may result in lower interrater reliability compared to technological measurement instruments.

In summary, both technological and functional measurement instruments have their advantages and disadvantages. Due to the feasibility of functional measurement instruments in clinical settings, these instruments are preferred.

The Sitting Assessment Scale (SAS), Segmental Assessment of Trunk Control (SATCo), and Gross Motor Function Scale (GMFM) are standardized tools that measure different aspects of sitting balance. Starting positions vary between a supported and unsupported sitting position. An unsupported sitting position during the assessment provides more information on trunk control than a supported position. Additionally, different aspects of measuring sitting balance were mapped. Measuring instruments that cover all the different aspects are the most complete and helpful in clinical practice to get an overview of the child's abilities. Both the SATCo (Butler, Saavedra, Sofranac, Jarvis, & Woollacott, 2010) and the GMFM (Adair, Said, Rodda, & Morris, 2012) are valid, reliable and responsive tools. Psychometric properties of the SAS are not yet described in literature. Further research is needed to develop a standardized and reliable measurement instrument that combines different aspects of sitting balance on the back of a horse.

5.3 Strengths and limitations of the study

This is the first systematic literature search summarizing the different measurement instruments used to evaluate sitting balance in children with CP and their effects after hippotherapy intervention. When interpreting the results of this first study, some strengths and limitations should be considered.

By the use of three complementary databases and hand search, a comprehensive literature search was conducted. A total of nine articles were included and reviewed. Both the search strategy and the methodological scoring were performed in a blinded manner, to decrease the risk of detection bias.

First of all, the characteristics of the included participants and interventions show differences among studies. Most articles showed a similar age range and sex distribution, but differences are seen in included types of CP (e.g.: spastic, diplegic, quadriplegic). These different types of CP can result in different degrees of dysfunction. Therefore, findings should be interpreted with caution. However, the studies discussed included individuals with all GMFCS levels (II-III-IV-V), which promotes the generalization of the found results.

Another limitation is the heterogeneity of methodology among the included study articles. The studies have a limited duration of intervention with a maximum duration of twelve weeks. This is a relatively short follow-up to detect long term effects. The article of Chinniah et al. (2020) reported more improvement of the sitting ability in twelve weeks than eight and four weeks. Two articles had an intervention duration of one day, which may not be sufficient to find long term improvements. However, such short-term intervention has the advantage of providing information about the sensitivity of the measurement instrument on the effectiveness of one hippotherapy session, which is of interest to clinicians (MacPhail et al., 1998; Temcharoensuk et al., 2015). Other articles shows the sensitivity of the measurement instruments on a long term of twelve weeks (Chinniah et al., 2020; Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016; Moraes et al., 2016).

Finally, a wide range of interventions was investigated in the included studies. The greatest conspicuity seen is that none of the articles used the term ‘hippotherapy’ for the exact same kind of intervention. Therefore, a heterogeneity across the articles was present due to randomly used terms to describe hippotherapy. In this systematic review, all terms were included and consent to one term ‘hippotherapy’. Besides that, different types of hippotherapy were seen across the articles. Some articles included hippotherapy (Kang et al., 2012) or a horseback riding simulator (Chinniah et al., 2020) as an addition to the traditional therapy. Other articles used hippotherapy or the horseback riding simulator as an intervention on his own (MacPhail et al., 1998; Matusiak-Wieczorek et al., 2020; Matusiak-Wieczorek et al., 2016; Moraes et al., 2016; Temcharoensuk et al., 2015). The included articles mostly differ in intervention duration, session duration and frequency. Session duration is more similar across the studies; therefore, this cannot explain the differences across the articles. However, the differences among intervention duration and frequency can be a possible explanation for the differences across the included articles.

5.4 Recommendations for further studies

There are several recommendations for further studies in this area. First of all, it is recommended to clarify specific definitions of the used interventions. At the moment, terms to describe hippotherapy are used randomly through the articles with no exact definition or specific content of the intervention. Secondly, it is recommended to conduct separate studies, each including one specific type of CP. The distinction between these different types leads to a homogeneous research population and results in better generalization. Another recommendation is to design a technological measurement instrument that can be used in settings out of a lab, and eventually even on the back of a horse. The incorporation of technology needs to be further examined, this can be done by placing an accelerometer on the individual, allowing investigations into the COP displacement in combination with functional assessment. The combination of both a technological and functional measurement instrument could be an incredible added value in the assessment of the effect of hippotherapy on sitting balance.

6.CONCLUSION

Measurement instruments that could be used to assess the effect of hippotherapy on sitting balance in children with CP are limited. None of the instruments are specifically designed to assess sitting balance on the back of a horse. This review shows that both hippotherapy and horseback riding-simulator intervention have significant effects on improving sitting balance in children with CP. The present study strengthens the evidence for using functional measurement tools in clinical practice. Given the need to efficiently assess the effectiveness of hippotherapy intervention in an outdoor, practical setting, further research to develop a standardized, reliable, valid and responsive tool to evaluate sitting balance while seated on the back of a horse is desirable and recommended.

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APPENDIX

Appendix Table 1

Excluded articles after full-text screening

Reason of exclusion	Number excluded articles	References
Outcome	n = 43	Aegerter et al. (2020) Angsupaisal et al. (2015) Baillet et al. (2019) Bronson, Brewerton, Ong, Palanca, and Sullivan (2010) Champagne, Corriveau, and Dugas (2017) de Araújo et al. (2013) Hammer et al. (2005) Herrero et al. (2010) Homnick, Henning, Swain, and Homnick (2015) Lee, Kim, and Na (2014) Mi, Young, Yeon, Sik, and Yi (2019) Moriello, Terpstra, and Earl (2020) Muñoz-Lasa et al. (2011) Park, Lee, Lee, and Lee (2013) Pham et al. (2016) Portela-Pino, Bouzo-Gonzalez, and Pino-Juste (2020) Reubens and Silkwood-Sherer (2016) T. Shurtleff and Engsberg (2012) T. L. Shurtleff, Standeven, and Engsberg (2009) D. Silkwood-Sherer and Warmbier (2007) D. J. Silkwood-Sherer, Killian, Long, and Martin (2012) Wehofer, Goodson, and Shurtleff (2013) Ajzenman, Standeven, and Shurtleff (2013) Aleknaviciute-Ablonske, Savenkoviene, Mockeviciene, and Miliuniene (2015) Alexander et al. (2015) Araujo, Silva, Costa, Pereira, and Safons (2011) Baek and Kim (2014) Benda, McGibbon, and Grant (2003) Borges de Araujo et al. (2019) Burkland, Paasuke, and Eelmae (2005) Clayton, Kaiser, de Pue, and Kaiser (2011) de Araujo et al. (2019) De Milander, Bradley, and Fourie (2016) Debuse, Chandler, and Gibb (2005) Debuse, Gibb, and Chandler (2009) El-Meniawy and Thabet (2012) Flores, Dagnese, and Copetti (2019) H. S. Kim, Lee, and Lee (2014) Kuczynski and Slonka (1999) Lakomy-Gawryszewska et al. (2017) Moraes, Copetti, Angelo, Chiavoloni, and de David (2020) Sevenich and Fercher (2020) Viruega, Gaillard, Carr, Greenwood, and Gaviria (2019)
Design	n = 16	Cha, Stanley, Shurtleff, and You (2016) Champagne and Dugas (2010) Dewar et al. (2015) Dominguez-Romero et al. (2019) Erdman and Pierce (2016) Haehl, Giuliani, and Lewis (1999)

		Hamill, Washington, and White (2007) Hilliere, Collado-Mateo, Villafaina, Duque-Fonseca, and Parraça (2018) Martín-Valero, Vega-Ballón, and Perez-Cabezas (2018) Rigby and Grandjean (2016) Zadnikar and Kastrin (2011) Ferriero, Salgovic, and Solaro (2019) Gómez-Regueira and Viñas-Diz (2016) Ma, Wang, Li, and Wang (2020) T. L. Shurtleff and Engsberg (2010) Wood and Fields
Language	n = 1	Bednarikova, Janura, and Bizovská (2016)

Appendix Table 2

Methodological screening PEDro scale – individual scores

	PEDro scale items												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total score**	**Methodological quality**
Borges et al. (2011)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
Chinniah et al. (2020)	Yes	1	1	1	0	1	0	0	1	1	1	7	Good
	Yes	1	1	1	0	0	1	1	1	1	1	8	Good
Herrero et al. (2012)	Yes	1	1	1	0	0	1	1	1	0	1	7	Good
	Yes	1	1	1	0	0	1	1	1	0	1	7	Good
Kang et al. (2012)	Yes	1	1	1	1	0	0	1	1	1	1	8	Good
	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
MacPhail et al. (1998)	Yes	0	0	0	0	0	0	1	1	1	1	4	Fair
	Yes	0	0	0	0	0	0	1	1	1	1	4	Fair
Matusiak-Wieczorek et al. (2016)	Yes	0	0	1	0	0	0	1	1	1	0	5	Fair
	Yes	0	0	0	0	0	0	1	1	1	1	4	Fair
Matusiak-Wieczorek et al. (2020)	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
	Yes	1	0	1	0	0	1	1	1	1	1	7	Good
Temcharoensuk et al. (2015)	Yes	1	1	1	0	0	1	1	1	1	1	8	Good
	Yes	1	0	1	0	0	1	1	1	1	1	7	Good

Legend: 1 Eligibility criteria were specified; **2** Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received; **3** Allocation was concealed; **4** The groups were similar at baseline regarding the most important prognostic indicators; **5** There was blinding of all subjects; **6** There was blinding of all therapists who administered the therapy; **7** There was blinding of all assessors who measured at least one key outcome; **8** Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; **9** All subjects for whom outcome measures were available received the treatment of control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by "intention to treat"; **10** The results of between-group statistical comparisons are reported for at least one key outcome; **11** The study provides both point measures and measures of variability for at least one key outcome; **Total score** Total score of the PEDro scale (items 2-11); **Methodological quality** Methodological quality of the study. **"yes"** yes, eligibility criteria were specified; **"1"** yes, the criterion is fulfilled; **"0**" no, the criterion is not fulfilled.

RESEARCH PROTOCOL

1.INTRODUCTION

Children with Cerebral Palsy (CP) experience body function impairments and activity limitations. The loss of selective motor control and trunk control contributes to poor sitting balance and makes sitting independently a major challenge for this population (Harbourne, 2010). Given that adequate sitting balance is necessary to safely manage activities of daily living, an intervention that maintains or improves their functionality is needed. Hippotherapy has proven to be effective in improving gross motor function, standing balance and gait in children with CP (Zadnikar & Kastrin, 2011). In contrast, sitting balance is not often mentioned as an outcome measure and far less is known about the effects of hippotherapy intervention on sitting balance. Besides that, a recent review of literature found that existing functional and technological measurement instruments can be used to assess the improvements on sitting balance after intervention. However, no measurement instrument is developed yet to specifically evaluate the effectiveness of hippotherapy on sitting balance on the back of the horse and thus do not meet all the desired characteristics of a useful clinical tool. The long-term goal is to develop a measurement instrument that covers all the different aspects of sitting balance and can be used to assess the effect of hippotherapy intervention on children with CP.

The aim of this study is to investigate the feasibility of different items assessing sitting balance in children with CP after hippotherapy intervention in clinical practice.

2. AIM OF THE STUDY

2.1 Research question

What is the feasibility, reliability and responsiveness of different items of a new measurement instrument used to evaluate sitting balance in children with Cerebral Palsy after hippotherapy intervention?

2.2 Hypothesis

Some items of existing functional measurement instruments can be used to evaluate sitting balance on the back of a horse in a valid and reliable manner.

3. METHOD

3.1 Research design

A prospective, longitudinal study will be performed to establish feasibility, reliability and responsiveness of a newly composed measurement instrument for assessing sitting balance and trunk control while seated on the back of a horse. Participants will not be randomized in different groups, but will be involved in a single intervention group. All the individuals will receive hippotherapy and will be assessed. Different items of the measurement instrument will be evaluated before and after each hippotherapy intervention. There will also be an evaluation of the different items after twelve weeks.

3.2 Participants

3.2.1. Inclusion criteria

Individuals who meet the following inclusion criteria will be recruited: (1) Diagnosis of Cerebral Palsy; (2) Age between two and 21 years old; (3) Received hippotherapy at least once before start of the study: and (4) Able to communicate non-verbally or verbally in Dutch or English.

3.2.2. Exclusion criteria

Individuals will be excluded if they are not able to understand and follow short, simple instructions.

3.2.3. Recruitment

Participants will be recruited from a school and care institution “Sint-Gerardus” in Diepenbeek, Belgium. This institution provides hippotherapy to a heterogenous group of children with a diversity of recurring care needs. We aim to included a group of 40 participants. Specific sample size recommendations are not made. Thirty-five to forty participants per intervention group would be preferable (Hertzog, 2008). If the individuals meet the inclusion criteria, they or their parents will be asked to sign an informed consent.

3.3 Medical Ethics

Parents or participants have signed an ‘informed written consent’ before the individuals will be included in the study. This research still needs to be submitted to the University of Hasselt Medical Ethics Committee. Therefore, this study does not have a registration code yet. This

research complies with the standards set by the Helsinki Convention (World Medical Association, 2013).

3.4 Intervention

Participants will receive a hippotherapy session once a week for a period of twelve consecutive weeks. Each session will have a duration of 30 minutes. The sessions are individualized according to the abilities of each child. The sessions will be performed in an outdoor arena in the school and care institution “Sint-Gerardus” in Diepenbeek, Belgium and will be conducted by a qualified therapeutic team. The participants will be asked to maintain a proper sitting position during a few laps around the arena. If necessary, the therapist will provide support on the pelvis. Individuals with level V of the Gross Motor Function Classification System (GMFCS) or children who need more facilitation of the trunk will receive hippotherapy in pairs with a therapist.

The Hippotherapy Trunk Control (HippoTrunC) scale is composed of items of the Sitting Assessment Scale (SAS), Segmental Assessment of Trunk Control (SATCo) and Gross Motor Function Measure (GMFM). Items of both the SATCo (Butler, Saavedra, Sofranac, Jarvis, & Woollacott, 2010) and the GMFM (Adair, Said, Rodda, & Morris, 2012) are valid, reliable and responsive. Psychometric properties of the SAS are not yet described in literature. ***Table 1*** provides an overview of the items that will be evaluated to assess sitting balance.

Table 1
HippoTrunC

Name: Date of birth: Type CP and GMFCS level: Video-analysis consent: yes/no	**Scores**			
	None (1)	**Poor (2)**	**Fair (3)**	**Good (4)**
Head control: static “Look in front of you while the horse stands still’ 1. Unable to hold head erect or needs nek support 2. Holds head erect for < 10 sec 3. Holds head erect for < 60 sec 4. Hold head erect for > 60 sec				
Head control: active				

"Look in front of you while the horse moves" and "Look at (something left, something right" 1. Unable to hold head erect or need neck support when the horse moves 2. Holds head erect when the horse moves but displaces with rotation 3. Holds head erect and able to rotate to one side 4. Holds head erect and able to rotate				
Sitting balance: static "Sit upright and look forward" 1. Lacks control of trunk, needs back support of a person 2. Hold trunk erect but needs back support (higher back of the saddle) 3. Holds trunk erect without support for < 30 sec 4. Holds trunk erect without support for > 30 sec				
Sitting balance: active (reaching) "Try to touch the horses ear with one arm" 1. Unable to reach forward or to stretch arm towards the ear without losing balance or with manual support of the trunk 2. Able to stretch arm towards the ear with manual support of the trunk 3. Able to stretch arm towards ear without support 4. Able to reach forward in controlled movement				
Sitting balance: reactive "Try to sit upright while the horse moves" (Physiotherapist walks the horse on the hand and decides the movements) 1. Lacks control of trunk, needs back support of a person				

2. Holds trunk erect but needs back support (higher back of the saddle) 3. Holds trunk erect but can not always anticipate 4. Holds trunk erect and anticipates correctly				
Overall observation				
Total score				

3.5 Outcome measurements

3.5.1. Primary outcome measurements

First, feasibility of the scale will be assessed. Next, the scale's short- and long-term reliability and responsiveness will be examined.

Reliability of the instrument refers to the degree in which the instrument produces consistent results (Heale & Twycross, 2015). This includes the evaluation of test-retest and interrater reliability. Test-retest reliability refers to the consistency of the collected data of the individuals among two points of time without any intervention in between (Everitt & Skrondal, 2010). Interrater reliability refers to the consistency of the collected data of the individuals among the two observers (McHugh, 2012).

Finally, the responsiveness of the instrument will be evaluated. This refers to the degree in which an instrument can measure actual changes that are clinically relevant (Beurskens, Köke, & de Vet, 2006). Therefore several measurements of sitting balance will be conducted before and after a single intervention session. Secondly, measurements will be conducted at baseline (before first intervention) and after twelve weeks of intervention.

3.5.2. Secondary outcome measures

No secondary outcome measures can be reported.

3.6 Data-analysis

Data collection will take place before and after each intervention (short-term effects), and after twelve weeks of intervention (long term effects).

<u>3.6.1 Reliability</u>

First, the test-retest reliability of HippoTrunC on short term without any intervention will be evaluated. Therefore the individuals will be assessed before and after an interval of ten minutes without intervention in between. Secondly, the test-retest reliability of the measurement instrument will be evaluated over an interval of seven to 14 days, where no intervention is received.

Before the statistical analysis can be conducted, assumptions will be evaluated. Based on the assumptions, a statistical analysis of the results can be done.

Assumptions:

1. Residuals are normally distributed
    1. A Shapiro-Wilk test will be used to evaluate the normality of the residues.
2. Variance of the residues are constant
    1. A Brown-Forsythe test will be used to evaluate the constant variance of the residues.

Due to study design, the data will not be independent, indicating repeated measures. This results in a paired t-test used to evaluate the test-retest of the measurement instrument. JMP PRO 15.2 (SAS Institute Inc., Cary, NC, 1989-2019) will be the statistical program needed to conduct the statistical analysis.

To assess the **interrater reliability on item level**, quadratic weighted kappa will be used. It measures the agreement between two ratings. This metric varies from zero (random agreement between raters) to one (complete agreement) (Vanbelle, 2016). To do the statistical analysis, the program MedCalc for Windows, version 19.4 (MedCalc Software, Ostend, Belgium) will be used. The weights w_i are calculated as follows:

$$w_i = 1 - \frac{i^2}{(k-1)^2}$$

Where i: number of raters; and k: number of categories/items.

This software calculates the weighted Kappa according to Cohen (1968). Standard error and 95% confidence interval are calculated according to Fleiss, Levin, and Paik (2003). The scores of kappa can be interpreted as follows: <0.20: poor agreement; 0.21-0.40: fair; 0.41-0.60: moderate agreement; 0.61-0.80: good; 0.81-1.00: very good agreement (Altman, 1991).

To assess the **interrater reliability on scale level**, the intraclass correlation coefficient will be calculated. To do the statistical analysis, the program SPSS Statistics (IBM SPSS Statistics for Windows, Version 26.0) will be used. A two way mixed model is required because the two raters are permanent. This metric varies from zero (no agreement) to one (complete agreement), differences are attributable to inadequacies of the assessors (Hallgren, 2012).

To calculate the measuring error of both assessors, Bland-Altman plots with multiple measurements per subject can be made (Bland & Altman, 1986, 1995, 1999, 2007). The program MedCalc for Windows, version 19.4 (MedCalc Software, Ostend, Belgium) will be used. Averages of the two raters are plotted against the differences between the two raters. Confidence intervals can be displayed for the average difference between two raters (Zou, 2011).

3.6.2 Responsiveness

Finally we will assess the responsiveness of the instrument. Therefore, assumptions need to be evaluated before conducting a statistical analysis. In case the assumptions are met, a paired t-test will be used per individual, per item and for the scale in total. JMP PRO 15.2 (SAS Institute Inc., Cary, NC, 1989-2019) will be the statistical program needed.

Several measurements need to be taken to evaluate the responsiveness of HippoTrunC. First, measurements of the sitting balance will be conducted before and after a single intervention session to check the responsiveness of the scale on short term. Secondly, to assess the responsiveness on long term, measurements will be conducted at baseline (before first intervention) and after twelve weeks of intervention.

An Anchor-based method will be used to establish the responsiveness of the measurement instrument. An expert has to evaluate if there is a clinically relevant change of the scale after intervention. If so, a number of points will be linked to the clinically relevant change determined by the expert.

4. TIME PLANNING

When the University of Hasselt Medical Ethics Committee approves this study, participants can be recruited. Over a period of several months, intervention will be carried out. After intervention is ended, data-analysis will be conducted and the results will be summarized in an article. Details of the time planning are shown in **Table 2**.

Table 2
Time planning

	July 2021	August 2021	September 2021	October 2021	November 2021	December 2021	January 2022	February 2022	March 2022	April 2022	May 2022	June 2022
Submit to the University of Hasselt Medical Ethics Committee	x	x										
Recruitment			x	x								
Intervention					x	x	x	x				
Data-analysis									x	x		
Article										x	x	x

Legend: x: month in which it is performed

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ATTACHMENT 1: Contract Master's Thesis part 1

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CONTRACT WETENSCHAPPELIJKE STAGE DEEL 1

Datum: 09/11/2020

Student(e)1: Aude Van Dessel

Student(e) 2: Kaat Hombroux

Promotor: Katrijn Klingels/ Evi Verbecque

Copromotor: .....

Situering masterproef:

~~Vormt onderdeel van lopend onderzoeksproject, nl.~~ .....

Vormt onderdeel van opstartend onderzoeksproject, nl. Kinderen met CP

~~Individuele studie~~

~~Andere, nl.~~ .....

Nederlandstalige werktitel masterproef:

De ontwikkeling van een meetschaal voor het meten van het effect van hippotherapie bij kinderen met CP

Engelstalige werktitel masterproef (indien van toepassing)

.....

Voorlopige onderzoeksvraag literatuurstudie (indien gekend)

.....

Formatkeuze van format MP1

Centrale format (conform met masterproefrichtlijnen)

Alternatieve format (zie richtlijnen alternatieve format), nl.

.....

.....

.....

.....

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Uitsluitend van toepassing indien CENTRAL FORMATKEUZE

Doelstelling	Akkoord	Niet akkoord	NVT
1. De student(e) formuleert (in samenspraak met de promotor) een duidelijke vraag in functie van de literatuurstudie. Duid NVT aan indien de vraagstelling voor de literatuurstudie volledig door de promotor wordt aangereikt en formuleer een doelstelling voor de student(e):	x		
2. De student(e) voert een literatuurstudie uit conform de richtlijnen MP deel 1.	x		
3. De student(e) schrijft de literatuurstudie uit in academische taal conform met de richtlijnen MP deel 1.	x		
4. De student(e) formuleert, op grond van de gerealiseerde literatuurstudie een onderzoeksvraag voor het eigenlijke wetenschappelijke onderzoek (MP 2). Duid NVT aan indien de student(e) deelneemt aan een lopend onderzoeksproject en de onderzoeksvraag al geformuleerd is en formuleer een doelstelling voor de student(e):	x		
5. De student(e) kiest een onderzoeksdesign en maakt een kritische keuze van de te hanteren methodologie en materialen. Duid NVT aan indien de student(e) gebruik maakt van een uitgewerkt onderzoeksdesign (lopend onderzoeksproject) en formuleer een doelstelling voor de student(e)	x		
6. De student(e) schrijft de methodologiesectie van zijn/haar onderzoek uit conform de richtlijnen MP deel 1. Duid NVT aan indien de student(e) gebruik maakt van een uitgewerkt onderzoeksprotocol (lopend onderzoeksproject) en formuleer een doelstelling voor de student(e)	x		
7. De student(e) schrijft het onderzoeksprotocol uit in academische taal conform met de richtlijnen MP1.	x		
8. De student(e) voert reeds in deze fase (een deel van) de data acquisitie uit. Duid NVT aan indien de data-acquisitie voltooid wordt/werd zonder inbreng van de student(e) en formuleer een doelstelling voor de student(e).....	x		
9. De student(e) voert reeds in deze fase (een deel van) de data verwerking uit. Duid NVT aan indien de dataverwerking voltooid wordt/werd zonder inbreng van de student(e) en formuleer een doelstelling voor de student(e).....		x	
10. Bijkomende afspraken: ✓ ✓			x

Datum & handtekening student(e)(

Hamelrouk K.

Datum & handtekening promotor

Maak een kopie van het ondertekende contract voor de student(e), de promotor en het studentensecretariaat.
De kopie voor het studentesecretariaat wordt ter attentie van mevrouw Vicky Vanhille (gebouw D) ingediend.

ATTACHMENT 2: Declaration of honour – KH

Verklaring op Eer

Ondergetekende, student aan de Universiteit Hasselt (UHasselt), faculteit Revalidatiewetenschappen aanvaardt de volgende voorwaarden en bepalingen van deze verklaring:

1. Ik ben ingeschreven als student aan de UHasselt in de opleiding Revalidatiewetenschappen, waarbij ik de kans krijg om in het kader van mijn opleiding mee te werken aan onderzoek van de faculteit Revalidatiewetenschappen aan de UHasselt. Dit onderzoek wordt beleid door Katrijn Klingens en Evi Verbecque en kadert binnen Masterproef deel 1. Ik zal in het kader van dit onderzoek creaties, schetsen, ontwerpen, prototypes en/of onderzoeksresultaten tot stand brengen in het domein van Kinderen met CP (hierna: "De Onderzoeksresultaten").

2. Bij de creatie van De Onderzoeksresultaten doe ik beroep op de achtergrondkennis, vertrouwelijke informatie[1], universitaire middelen en faciliteiten van UHasselt (hierna: de "Expertise").

3. Ik zal de Expertise, met inbegrip van vertrouwelijke informatie, uitsluitend aanwenden voor het uitvoeren van hogergenoemd onderzoek binnen UHasselt. Ik zal hierbij steeds de toepasselijke regelgeving, in het bijzonder de Algemene Verordening Gegevensbescherming (EU 2016-679), in acht nemen.

4. Ik zal de Expertise (i) voor geen enkele andere doelstelling gebruiken, en (ii) niet zonder voorafgaande schriftelijke toestemming van UHasselt op directe of indirecte wijze publiek maken.

5. Aangezien ik in het kader van mijn onderzoek beroep doe op de Expertise van de UHasselt, draag ik hierbij alle bestaande en toekomstige intellectuele eigendomsrechten op De Onderzoeksresultaten over aan de UHasselt. Deze overdracht omvat alle vormen van intellectuele eigendomsrechten, zoals onder meer – zonder daartoe beperkt te zijn – het auteursrecht, octrooirecht, merkenrecht, modellenrecht en knowhow. De overdracht geschiedt in de meest volledige omvang, voor de gehele wereld en voor de gehele beschermingsduur van de betrokken rechten.

6. In zoverre De Onderzoeksresultaten auteursrechtelijk beschermd zijn, omvat bovenstaande overdracht onder meer de volgende exploitatiewijzen, en dit steeds voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding:

   - het recht om De Onderzoeksresultaten vast te (laten) leggen door alle technieken en op alle dragers;
   - het recht om De Onderzoeksresultaten geheel of gedeeltelijk te (laten) reproduceren, openbaar te (laten) maken, uit te (laten) geven, te (laten) exploiteren en te (laten) verspreiden in eender welke vorm, in een onbeperkt aantal exemplaren;

[1] Vertrouwelijke informatie betekent alle informatie en data door de UHasselt meegedeeld aan de student voor de uitvoering van deze overeenkomst, inclusief alle persoonsgegevens in de zin van de Algemene Verordening Gegevensbescherming (EU 2016/679), met uitzondering van de informatie die (a) reeds algemeen bekend is; (b) reeds in het bezit was van de student voor de mededeling ervan door de UHasselt; (c) de student verkregen heeft van een derde zonder enige geheimhoudingsplicht; (d) de student onafhankelijk heeft ontwikkeld zonder gebruik te maken van de vertrouwelijke informatie van de UHasselt; (e) wettelijk of als gevolg van een rechterlijke beslissing moet worden bekendgemaakt, op voorwaarde dat de student de UHasselt hiervan schriftelijk en zo snel mogelijk op de hoogte brengt.

- het recht om De Onderzoeksresultaten te (laten) verspreiden en mee te (laten) delen aan het publiek door alle technieken met inbegrip van de kabel, de satelliet, het internet en alle vormen van computernetwerken;
- het recht De Onderzoeksresultaten geheel of gedeeltelijk te (laten) bewerken of te (laten) vertalen en het (laten) reproduceren van die bewerkingen of vertalingen;
- het recht De Onderzoeksresultaten te (laten) bewerken of (laten) wijzigen, onder meer door het reproduceren van bepaalde elementen door alle technieken en/of door het wijzigen van bepaalde parameters (zoals de kleuren en de afmetingen).

De overdracht van rechten voor deze exploitatiewijzen heeft ook betrekking op toekomstige onderzoeksresultaten tot stand gekomen tijdens het onderzoek aan UHasselt, eveneens voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding.

Ik behoud daarbij steeds het recht op naamvermelding als (mede)auteur van de betreffende Onderzoeksresultaten.

7. Ik zal alle onderzoeksdata, ideeën en uitvoeringen neerschrijven in een "laboratory notebook" en deze gegevens niet vrijgeven, tenzij met uitdrukkelijke toestemming van mijn UHasseltbegeleider Katrijn Klingels en Evi Verhecque

8. Na de eindevaluatie van mijn onderzoek aan de UHasselt zal ik alle verkregen vertrouwelijke informatie, materialen, en kopieën daarvan, die nog in mijn bezit zouden zijn, aan UHasselt terugbezorgen.

Gelezen voor akkoord en goedgekeurd,

Naam: Kaat Hombroux

Adres: Dijkstraat 7, 3806 Velm

Geboortedatum en –plaats : 08/07/1998 ,Sint-Truiden 3800

Datum: 09/11/2020

Handtekening: Hombroux K.

ATTACHMENT 3: Declaration of honour – AVD

Verklaring op Eer

Ondergetekende, student aan de Universiteit Hasselt (UHasselt), faculteit revalidatiewetenschappen en kinesiterapie aanvaardt de volgende voorwaarden en bepalingen van deze verklaring:

1. Ik ben ingeschreven als student aan de UHasselt in de opleiding Revalidatiewetenschappen waarbij ik de kans krijg om [verwijderen wat niet van toepassing is: in het kader van mijn opleiding ~~OF extracurriculair~~] mee te werken aan onderzoek van de faculteit revalidatiewetenschappen aan de UHasselt. Dit onderzoek wordt beleid door Katrijn Klingels en Evi Verbecque en kadert binnen [verwijderen wat niet van toepassing is: het opleidingsonderdeel Masterproef deel 1 ~~OF mijn aanstelling in het statuut student-onderzoeker].~~ Ik zal in het kader van dit onderzoek creaties, schetsen, ontwerpen, prototypes en/of onderzoeksresultaten tot stand brengen in het domein van kinderen met CP (hierna: "De Onderzoeksresultaten").

2. Bij de creatie van De Onderzoeksresultaten doe ik beroep op de achtergrondkennis, vertrouwelijke informatie[1], universitaire middelen en faciliteiten van UHasselt (hierna: de "Expertise").

3. Ik zal de Expertise, met inbegrip van vertrouwelijke informatie, uitsluitend aanwenden voor het uitvoeren van hogergenoemd onderzoek binnen UHasselt. Ik zal hierbij steeds de toepasselijke regelgeving, in het bijzonder de Algemene Verordening Gegevensbescherming (EU 2016-679), in acht nemen.

4. Ik zal de Expertise (i) voor geen enkele andere doelstelling gebruiken, en (ii) niet zonder voorafgaande schriftelijke toestemming van UHasselt op directe of indirecte wijze publiek maken.

5. Aangezien ik in het kader van mijn onderzoek beroep doe op de Expertise van de UHasselt, draag ik hierbij alle bestaande en toekomstige intellectuele eigendomsrechten op De Onderzoeksresultaten over aan de UHasselt. Deze overdracht omvat alle vormen van intellectuele eigendomsrechten, zoals onder meer – zonder daartoe beperkt te zijn – het auteursrecht, octrooirecht, merkenrecht, modellenrecht en knowhow. De overdracht geschiedt in de meest volledige omvang, voor de gehele wereld en voor de gehele beschermingsduur van de betrokken rechten.

6. In zoverre De Onderzoeksresultaten auteursrechtelijk beschermd zijn, omvat bovenstaande overdracht onder meer de volgende exploitatiewijzen, en dit steeds voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding:

   - het recht om De Onderzoeksresultaten vast te (laten) leggen door alle technieken en op alle dragers;

[1] Vertrouwelijke informatie betekent alle informatie en data door de UHasselt meegedeeld aan de student voor de uitvoering van deze overeenkomst, inclusief alle persoonsgegevens in de zin van de Algemene Verordening Gegevensbescherming (EU 2016/679), met uitzondering van de informatie die (a) reeds algemeen bekend is; (b) reeds in het bezit was van de student voor de mededeling ervan door de UHasselt; (c) de student verkregen heeft van een derde zonder enige geheimhoudingsplicht; (d) de student onafhankelijk heeft ontwikkeld zonder gebruik te maken van de vertrouwelijke informatie van de UHasselt; (e) wettelijk of als gevolg van een rechterlijke beslissing moet worden bekendgemaakt, op voorwaarde dat de student de UHasselt hiervan schriftelijk en zo snel mogelijk op de hoogte brengt.

1

- het recht om De Onderzoeksresultaten geheel of gedeeltelijk te (laten) reproduceren, openbaar te (laten) maken, uit te (laten) geven, te (laten) exploiteren en te (laten) verspreiden in eender welke vorm, in een onbeperkt aantal exemplaren;
- het recht om De Onderzoeksresultaten te (laten) verspreiden en mee te (laten) delen aan het publiek door alle technieken met inbegrip van de kabel, de satelliet, het internet en alle vormen van computernetwerken;
- het recht De Onderzoeksresultaten geheel of gedeeltelijk te (laten) bewerken of te (laten) vertalen en het (laten) reproduceren van die bewerkingen of vertalingen;
- het recht De Onderzoeksresultaten te (laten) bewerken of (laten) wijzigen, onder meer door het reproduceren van bepaalde elementen door alle technieken en/of door het wijzigen van bepaalde parameters (zoals de kleuren en de afmetingen).

De overdracht van rechten voor deze exploitatiewijzen heeft ook betrekking op toekomstige onderzoeksresultaten tot stand gekomen tijdens het onderzoek aan UHasselt, eveneens voor de hele beschermingsduur, voor de gehele wereld en zonder vergoeding.

Ik behoud daarbij steeds het recht op naamvermelding als (mede)auteur van de betreffende Onderzoeksresultaten.

7. Ik zal alle onderzoeksdata, ideeën en uitvoeringen neerschrijven in een "laboratory notebook" en deze gegevens niet vrijgeven, tenzij met uitdrukkelijke toestemming van mijn UHasseltbegeleider Katrijn Klingels en Evi Verbecque.

8. Na de eindevaluatie van mijn onderzoek aan de UHasselt zal ik alle verkregen vertrouwelijke informatie, materialen, en kopieën daarvan, die nog in mijn bezit zouden zijn, aan UHasselt terugbezorgen.

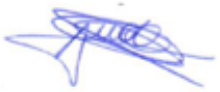
Gelezen voor akkoord en goedgekeurd,

Naam: Aude Van Dessel

Adres: Herentalsedijk 192, 2440 Geel

Geboortedatum en –plaats : 22/12/1999, te Herentals

Datum: 9/11/2020

Handtekening: 

ATTACHMENT 4: Progress form

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VOORTGANGSFORMULIER WETENSCHAPPELIJKE STAGE DEEL 1

DATUM	INHOUD OVERLEG	HANDTEKENINGEN
14/12/2020	Eerste meeting masterproef Hippotherapie.	Promotor: Copromotor/begeleider: Student(e): Student(e):
04/01/2021	Opstellen onderzoeksvraag, zoekstrategie op punt stellen.	Promotor: Copromotor/begeleider: Student(e): Student(e):
19/01/2021	Uitvoeren zoekstrategie in verschillende databanken.	Promotor: Copromotor/begeleider: Student(e): Student(e):
01/03/2021	Fase 2 screening (full tekst)	Promotor: Copromotor/begeleider: Student(e): Student(e):
15/04/2021	Op punt stellen screening full tekst	Promotor: Copromotor/begeleider: Student(e): Student(e):
22/04/2021	Bespreken methode + opstellen deadline volgende week.	Promotor: Copromotor/begeleider: Student(e): Student(e):
29/04/2021	Bespreken resultatensectie + eerste discussiepunten aanhalen.	Promotor: Copromotor/begeleider: Student(e): Student(e):
17/05/2021	Bespreken discussie	Promotor: Copromotor/begeleider: Student(e): Student(e):
04/06/2021	**Niet-bindend advies:** De promotor verleent hierbij het advies om de masterproef **WEL**/NIET te verdedigen.	Promotor: Copromotor/begeleider: Student(e): Student(e):

ATTACHMENT 5: Self-evaluation form

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BEOORDELING VAN DE WETENSCHAPPELIJKE STAGE-DEEL 1

Wetenschappelijke stage deel 1 (Masterproef deel 1- MP1) van de Master of Science in de revalidatiewetenschappen en de kinesitherapie bestaat uit **twee delen**:

1) De literatuurstudie volgens een welomschreven methodiek.
2) Het opstellen van het onderzoeksprotocol ter voorbereiding van masterproef deel 2.

Omschrijving van de **evaluatie**:

1) 80% van het eindcijfer wordt door de promotor in samenspraak met de copromotor gegeven op grond het product en van het proces dat de student doorliep om de MP1 te realiseren, met name het zelfstandig uitvoeren van de literatuurstudie en het zelfstandig opstellen van het onderzoeksprotocol, alsook de kwaliteit van academisch schrijven.
2) 20% van het eindcijfer wordt door de interne jury gegeven op grond van het ingeleverde product en de mondelinge presentatie waarin de student zijn/haar proces toelicht.

In de beoordeling dient onderscheid gemaakt te worden tussen studenten die, in samenspraak met de promotor, een nieuw onderzoek uitwerkten en studenten die instapten in een lopend onderzoek of zich baseren op voorgaande masterproeven of onderzoeksprojecten. Van deze laatste worden bijkomende inspanningen verwacht zoals bv. het bijsturen van de eerder geformuleerde onderzoeksvraag, de kritische reflectie over het onderzoeksdesign, het uitvoeren van een pilotexperiment.

Beoordelingskader:

Beoordelingskader: criteria op 20	
18-20	Excellente modelmasterproef
16-17	Zeer goede masterproef
14-15	Goede masterproef
12-13	Voldoende masterproef
10-11	Zwakke masterproef
≤ 9	Onvoldoende masterproef die niet aan de minimumnormen voldoet

ZELFEVALUATIERAPPORT

Onderstaand zelfevaluatierapport is een hulpmiddel om je wetenschappelijke stage -deel 1 zelfstandig te organiseren. Bepaal zelf je deadlines, evalueer en reflecteer over je werkwijze en over de diepgang van je werk. Check de deadlines regelmatig. Toets ze eventueel af bij je (co)promotor. Succes!

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LITERATUURSTUDIE	Gestelde deadline	Behaald op	Reflectie
De belangrijkste concepten en conceptuele kaders van het onderzoeksdomein uitdiepen en verwerken	14/12/2020	14/12/2020	Goed
De belangrijkste informatie opzoeken als inleiding op de onderzoeksvraag van de literatuurstudie	14/12/2020	14/12/2020	Goed
De opzoekbare onderzoeksvraag identificeren en helder formuleren in functie van de literatuurstudie	14/12/2020	20/12/2020	Matig: het exact definiëren van de onderzoeksvraag verliep moeizaam.
De zoekstrategie op systematische wijze uitvoeren in relevante databanken	05/01/2021	19/01/2021	Goed: het gebruik van een gekende databank zoals PubMed verliep vlotter dan het gebruik van Scopus of WOS
De kwaliteitsbeoordeling van de artikels diepgaand uitvoeren	22/04/2021	21/04/2021	Goed
De data-extractie grondig uitvoeren	29/04/2021	29/04/2021	Goed
De bevindingen integreren tot een synthese	29/04/2021	02/05/2021	Goed

ONDERZOEKSPROTOCOL	Gestelde deadline	Behaald op	Reflectie
De onderzoeksvraag in functie van het onderzoeksprotocol identificeren	20/05/2021	20/05/2021	Goed
Het onderzoeksdesign bepalen en/of kritisch reflecteren over bestaande onderzoeksdesign	20/05/2021	20/05/2021	Goed
De methodesectie (participanten, interventie, uitkomstmaten, data-analyse) uitwerken	24/05/2021	24/05/2021	Goed: statistiek verliep moeizamer.

ACADEMISCHE SCHRIJVEN	Gestelde deadline	Behaald op	Reflectie
Het abstract to the point schrijven	27/05/2021	27/05/2021	Goed
De inleiding van de literatuurstudie logisch opbouwen	17/05/2021	16/05/2021	Goed
De methodesectie van de literatuurstudie transparant weergegeven	22/04/2021	22/04/2021	Goed
De resultatensectie afstemmen op de onderzoeksvragen	29/04/2021	29/04/2021	Goed
In de discussiesectie de bekomen resultaten in een wetenschappelijke tekst integreren en synthetiseren	17/05/2021	20/05/2021	Matig: de discussie schrijven verliep moeizamer dan het schrijven van de andere secties
Het onderzoeksprotocol deskundig technisch uitschrijven	27/05/2021	27/05/2021	Matig
Referenties correct en volledig weergeven	27/05/2021	27/05/2021	Bij elke sectie nakijken

ZELFSTUREND EN WETENSCHAPPELIJK DENKEN EN HANDELEN	Aanvangsfase	Tussentijdse fase	Eindfase
Een realistische planning opmaken, deadlines stellen en opvolgen	Matig: gebrek aan ervaring leidde tot	Goed	Goed

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	inschattingsfouten over de planning		
Initiatief en verantwoordelijkheid opnemen ten aanzien van de realisatie van de wetenschappelijke stage	Goed	Goed	Goed
Kritisch wetenschappelijk denken	Matig	Goed	Goed
De contacten met de promotor voorbereiden en efficiënt benutten	Matig	Zeer goed	Zeer goed
De richtlijnen van de wetenschappelijke stage autonoom opvolgen en toepassen	Goed	Goed	Goed
De communicatie met de medestudent helder en transparant voeren	Zeer goed	Zeer goed	Zeer goed
De communicatie met de promotor/copromotor helder en transparant voeren	Goed	Zeer goed	Zeer goed
Andere verdiensten:			

ATTACHMENT 6: Registration form jury Master's thesis

UHASSELT
KNOWLEDGE IN ACTION

Inschrijvingsformulier verdediging masterproef academiejaar 2020-2021,
Registration form jury Master's thesis academic year 2020-2021,

GEGEVENS STUDENT - *INFORMATION STUDENT*

Faculteit/School: **Faculteit Revalidatiewetenschappen**
Faculty/School: ***Rehabilitation Sciences***

Stamnummer + naam: **1746759 Hombroux Kaat**
Student number + name

Opleiding/*Programme*: **1 ma revalid. wet. & kine**

INSTRUCTIES - *INSTRUCTIONS*

Neem onderstaande informatie grondig door.

Print dit document en vul het aan met DRUKLETTERS.

In tijden van van online onderwijs door COVID-19 verstuur je het document (scan of leesbare foto) ingevuld via mail naar je promotor. Je promotor bezorgt het aan de juiste dienst voor verdere afhandeling.

Vul luik A aan. Bezorg het formulier aan je promotoren voor de aanvullingen in luik B. Zorg dat het formulier ondertekend en gedateerd wordt door jezelf en je promotoren in luik D en dien het in bij de juiste dienst volgens de afspraken in jouw opleiding.
Zonder dit inschrijvingsformulier krijg je geen toegang tot upload/verdediging van je masterproef.

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Fill out part A. Send the form to your supervisors for the additions in part B. Make sure that the form is signed and dated by yourself and your supervisors in part D and submit it to the appropriate department in accordance with the agreements in your study programme.
Without this registration form, you will not have access to the upload/defense of your master's thesis.

LUIK A - VERPLICHT - IN TE VULLEN DOOR DE STUDENT
PART A - MANDATORY - TO BE FILLED OUT BY THE STUDENT

Titel van Masterproef/*Title of Master's thesis:* EXPLORATION OF MEASUREMENT INSTRUMENTS AND THE EFFECTS ON SITTING BALANCE AFTER HIPPOTHERAPY INTERVENTION IN CHILDREN WITH CEREBRAL PALSY

● behouden - *keep*

○ wijzigen - *change to:*

/:

O behouden - *keep*

O wijzigen - *change to*:

In geval van samenwerking tussen studenten, naam van de medestudent(en)/*In case of group work, name of fellow student(s)*: AUDE VAN DECSEL

● behouden - *keep*

O wijzigen - *change to:*

LUIK B - VERPLICHT - IN TE VULLEN DOOR DE PROMOTOR(EN)
PART B - MANDATORY - TO BE FILLED OUT BY THE SUPERVISOR(S)

Wijziging gegevens masterproef in luik A/*Change information Master's thesis in part A:*

O goedgekeurd - *approved*

O goedgekeurd mits wijziging van - *approved if modification of:*

Scriptie/*Thesis:*

O openbaar (beschikbaar in de document server van de universiteit)- *public (available in document server of university)*

O vertrouwelijk (niet beschikbaar in de document server van de universiteit) - *confidential (not available in document server of university)*

Juryverdediging/*Jury Defense:*

De promotor(en) geeft (geven) de student(en) het niet-bindend advies om de bovenvermelde masterproef in de bovenvermelde periode/*The supervisor(s) give(s) the student(s) the non-binding advice:*

O te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

O de verdediging is openbaar/*in public*

O de verdediging is niet openbaar/*not in public*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

LUIK C - OPTIONEEL - IN TE VULLEN DOOR STUDENT, alleen als hij luik B wil overrulen
PART C - OPTIONAL - TO BE FILLED OUT BY THE STUDENT, only if he wants to overrule part B

In tegenstelling tot het niet-bindend advies van de promotor(en) wenst de student de bovenvermelde masterproef in de bovenvermelde periode/*In contrast to the non-binding advice put forward by the supervisor(s), the student wishes:*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

O te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

UHvoorlev5 2/06/2021

LUIK D - VERPLICHT - IN TE VULLEN DOOR DE STUDENT EN DE PROMOTOR(EN)
PART D - MANDATORY - TO BE FILLED OUT BY THE STUDENT AND THE SUPERVISOR(S)

Datum en handtekening student(en)
Date and signature student(s)

02/06/2021 Hombroux K.

Datum en handtekening promotor(en)
Date and signature supervisor(s)

UHASSELT
KNOWLEDGE IN ACTION

Inschrijvingsformulier verdediging masterproef academiejaar 2020-2021,
Registration form jury Master's thesis academic year 2020-2021,

GEGEVENS STUDENT - *INFORMATION STUDENT*

Faculteit/School: **Faculteit Revalidatiewetenschappen**
Faculty/School: ***Rehabilitation Sciences***

Stamnummer + naam: **1746450 Van Dessel Aude**
Student number + name

Opleiding/*Programme*: **1 ma revalid. wet. & kine**

INSTRUCTIES - *INSTRUCTIONS*

Neem onderstaande informatie grondig door.

Print dit document en vul het aan met DRUKLETTERS.

In tijden van van online onderwijs door COVID-19 verstuur je het document (scan of leesbare foto) ingevuld via mail naar je promotor. Je promotor bezorgt het aan de juiste dienst voor verdere afhandeling.

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LUIK A - VERPLICHT - IN TE VULLEN DOOR DE STUDENT
PART A - MANDATORY - TO BE FILLED OUT BY THE STUDENT

Titel van Masterproef/*Title of Master's thesis:* EXPLORATION OF MEASUREMENT INSTRUMENTS AND THE EFFECTS ON SITTING BALANCE AFTER HIPPOTHERAPY INTERVENTION IN CHILDREN WITH CEREBRAL PALSY

● behouden - *keep*

○ wijzigen - *change to:*

/:

O behouden - *keep*

O wijzigen - *change to:*

In geval van samenwerking tussen studenten, naam van de medestudent(en)/*In case of group work, name of fellow student(s):* KAAT HOMBROUX

● behouden - *keep*

O wijzigen - *change to:*

LUIK B – VERPLICHT – IN TE VULLEN DOOR DE PROMOTOR(EN)
PART B – MANDATORY – TO BE FILLED OUT BY THE SUPERVISOR(S)

Wijziging gegevens masterproef in luik A/*Change information Master's thesis in part A:*

O goedgekeurd - *approved*

O goedgekeurd mits wijziging van - *approved if modification of:*

Scriptie/*Thesis:*

O openbaar (beschikbaar in de document server van de universiteit)- *public (available in document server of university)*

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Juryverdediging/*Jury Defense:*

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O te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

O de verdediging is openbaar/*in public*

O de verdediging is niet openbaar/*not in public*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

LUIK C – OPTIONEEL – IN TE VULLEN DOOR STUDENT, alleen als hij luik B wil invullen
PART C – OPTIONAL – TO BE FILLED OUT BY THE STUDENT, only if he wants to complete part B

In tegenstelling tot het niet-bindend advies van de promotor(en) wenst de student de bovenvermelde masterproef in de bovenvermelde periode/*In contrast to the non-binding advice put forward by the supervisor(s), the student wishes:*

O niet te verdedigen/*not to defend the aforementioned Master's thesis within the aforementioned period of time*

O te verdedigen/*to defend the aforementioned Master's thesis within the aforementioned period of time*

UHvoorlev5 2/06/2021

LUIK D - VERPLICHT - IN TE VULLEN DOOR DE STUDENT EN DE PROMOTOR(EN)
PART D - MANDATORY - TO BE FILLED OUT BY THE STUDENT AND THE SUPERVISOR(S)

Datum en handtekening student(en)
Date and signature student(s)
02/06/2021

Datum en handtekening promotor(en)
Date and signature supervisor(s)

ATTACHEMENT 7: Reply – Positive advice

EV

Evi VERBECQUE <evi.verbecque@uhasselt.be>
4/06/2021 12:59

Aan: Kaat Hombroux CC: Katrijne Severi; Katrijn KLINGELS; Aude Van Dessel

Beste Kaat en Aude,

Via deze weg geven we jullie toestemming om in eerste zit jullie masterproef deel 1 te verdedigen.

Met vriendelijke groeten,
Evi Verbecque, namens het begeleidend team

KK

Katrijn KLINGELS <katrijn.klingels@uhasselt.be>
4/06/2021 13:42

Aan: Kaat Hombroux CC: Katrijne Severi; Evi VERBECQUE; Aude Van Dessel

Beste Kaat en Aude,
Ook mijn gunstige advies voor indiening en verdediging van jullie MP.
Met vriendelijke groeten,
Katrijn Klingels

Prof.dr. Katrijn Klingels
Tenure track professor

Pediatrische Revalidatie - Faculteit Revalidatiewetenschappen

Onderzoeksgroep REVAL

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