

Meta-Analysis the Effect of Constraint-Induced Movement Therapy on Hand Function and Occupational Performance in Children with Cerebral Palsy

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ABSTRACT

Background: Children with cerebral palsy generally experience hand function which then affect the child's occupational performance. Hand function is the ability to use the hand in doing activities. To be able to perform occupational performance, good hand function are needed. To achieve this, interventions are needed, one of which is constraint-induced movement therapy (CIMT) which is hypothesized to be able to improve hand function and occupational performance. The purpose of this study was to determine the effect of CIMT on the hands function and the occupation performance of children with cerebral palsy.

Subjects and Method: This study used a systematic review design and meta-analysis using the PRISMA flow chart guidelines. The process of searching for articles was carried out between 2005-2020 using databases from PubMed, Science Direct, AJOT, Springer Link, and Google Scholar. Based on the database, there were 20 articles that met the inclusion criteria. This study involved 669 subjects of hand function and 440 subjects of occupational performance. The analysis was performed using the RevMan 5.3 software.

Results: A total of 20 articles conducted a meta-analysis review. A total of 18 articles conducted a meta-analysis showing that giving CIMT to children with cerebral palsy was significantly able to improve hands function of children with cerebral palsy (SMD = 0.40; 95% CI 0.09 to 0.71; p = 0.01). A total of 11 articles conducted a meta-analysis showing that giving CIMT to children with cerebral palsy was able to improve occupational performance abilities but it was not statistically significant (SMD = 0.18; 95% CI -0.17 to 0.52; p = 0.32).

Conclusion: CIMT can improve hand function and occupational performance of children with cerebral palsy.

Keywords: constraint-induced movement therapy (CIMT), hand function, occupational performance, cerebral palsy, meta-analysis

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BACKGROUND

Cerebral palsy is also often associated with stable conditions and non-progressive disorders of the brain of the fetus or developing baby so that they are considered normal children with special needs (Levitt and

Addison, 2019; Miller et al., 2020). The prevalence of cerebral palsy in the world reaches 2 per 1,000 births (Gulati and Sondhi, 2018). So that cerebral palsy is considered the most common cause of

disability in childhood (Levitt and Addison, 2019).

During development, children with cerebral palsy experience several growth and development disorders such as spasticity, muscle weakness and limitations in activities. More than 50% of children with cerebral palsy experience problems in the wrist or hand (Ervim in Duruöz, 2019).

Impaired hand function is the most frequent consequence of cerebral palsy in children (Klevberg et al., 2017). Hand function is the ability to use the hand to perform daily activities seen from anatomy, sensory, strength, dexterity and hand coordination (Duruöz, 2019).

When children experience impaired hand function, it is possible that they will experience difficulties in carrying out their daily activities and performance at work and leisure activities (Ervim in Duruöz, 2019). Occupational performance is the ability to perform and complete a series of tasks as a result of an alignment between individuals, the environment and the activity itself (AOTA, 2014).

One of the interventions for children with cerebral palsy is CIMT which is used to treat dysfunctioning limb non-use by limiting healthy limbs and exercising dysfunctional limbs (Christmas et al., 2018). CIMT has 2 key components, namely limb restriction that is less influential and structured and intensive therapy for the arm or hand that has a higher influence (Ilieva and Ilieva, 2020).

In a study by Al-Oraibi and Eliasson (2011), giving CIMT can significantly improve hand function ($p=0.016$) using the AHA instrument. In addition, Brandao et al. (2012) stated that giving CIMT is considered to significantly improve children's occupational performance ($p < 0.001$) by using the COPM instrument.

This study is expected to be able to prove the effect of giving CIMT to improve hand function and occupational performance of children with cerebral palsy.

SUBJECTS AND METHOD

1. Study Design

This study uses systematic review and meta-analysis with the PRISMA flow diagram guidelines. Search for articles using databases: PubMed, Science Direct, AJOT, Springer Link, and Google Scholar. Some of the keywords used are: "Constraint Induced Movement Therapy" AND "cerebral palsy", "hand function", "occupational performance", "randomized control trial.

2. Inclusion Criteria

The inclusion criteria for this research article were full paper randomized controlled trials (RCT), using CIMT intervention, the subjects were children with unilateral cerebral palsy or hemiplegic aged <17 years and outcomes were measured using standardized instruments.

3. Exclusion Criteria

The exclusion criteria for this research article were articles that were not in English, published before 2005, comparing the dose of intervention.

4. Operational Definition of Variables

Articles included in the study were adapted to the PICO. The article search was carried out by considering the eligibility criteria defined using the PICO model. The study population was children with cerebral palsy, using CIMT intervention and non-CIMT control and the outcomes were an increase in hand function and occupational performance.

Hand function is the ability to use the hands to perform daily activities as measured using standardized instruments.

Occupational performance is a person's ability to carry out productivity activities,

activity daily living and leisure activities measured using standardized instruments. **CIMT** is a treatment to treat non-use of sore hands by limiting healthy hands with published article guidelines.

5. Instruments

The study used PRISMA flow diagrams and the assessment of the quality of research articles used the Critical Appraisal Checklist for RCT Study tools (CEBM, 2014).

6. Data Analysis

The data in this study were analyzed using the RevMan 5.3 application, to calculate the

effect size and heterogeneity of the study. The results of data processing are presented in the form of a forest plot and a funnel plot.

RESULTS

The article review process was carried out using the PRISMA flow chart, which can be seen in Figure 1. The total articles obtained were 20 articles. For the distribution of articles on 4 continents included 7 from Asia, 4 from America, 6 from Europe, and 3 from Australia.

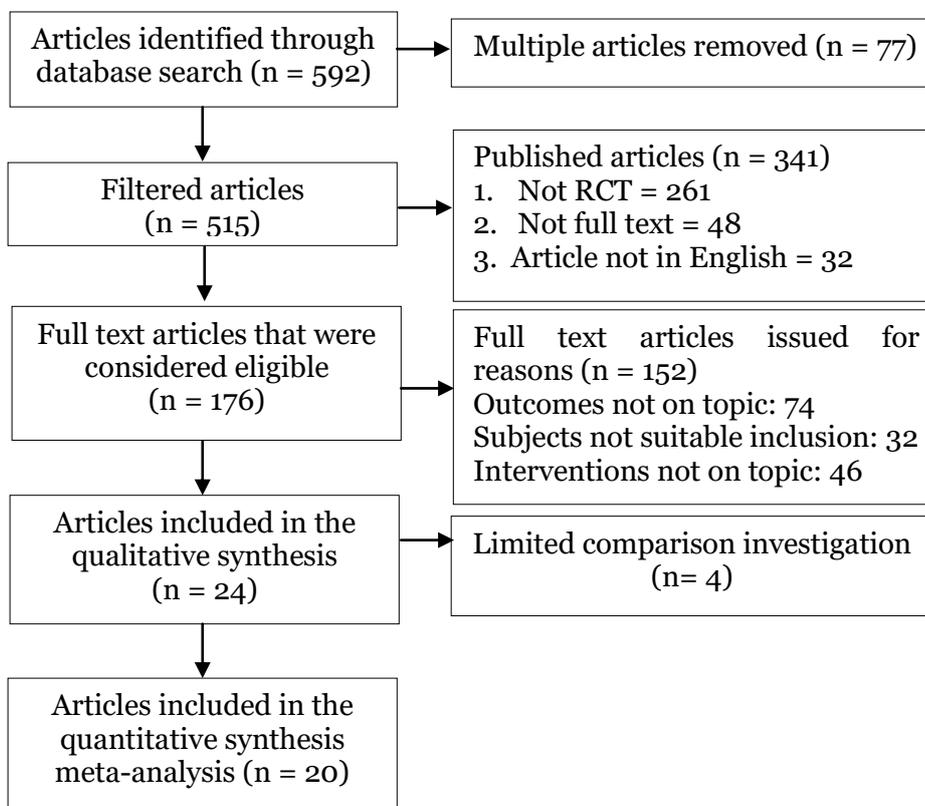


Figure 1. PRISMA flow chart

1. The effect of CIMT on the functional ability of the hands of children with cerebral palsy

Table 1 shows 18 RCT articles about the effect of CIMT on hand function of children with cerebral palsy (CP) that meet the qualitative and quantitative requirements.

Table 1. The effect of CIMT on hand function of children with cerebral palsy

Author, year	Country	Popula- tion	Instru- ment	Results			
				Intervention		Comparison	
Aarts et al., 2010	Netherland	CP unilateral	AHA	mCIMT -BiT	Mean : 60.1 SD : 15.3	UC	Mean : 53.1 SD : 22.2
Aarts et al., 2011	Netherland	CP unilateral	VOAA- DDD	mCIMT -BiT	Mean : 69.6 SD : 21.4	UC	Mean : 50.4 SD : 28.5
Al Oraibi & Eliasson, 2011	Jordan	CP unilateral	AHA	CIMT	Mean : 48 SD : 11.7	NDT/UC	Mean : 56.6 SD : 18.7
Brandao et al., 2010	Brazil	CP hemiplegic	JTHF	CIMT	Mean : 90.48 SD : 99.83	UC	Mean : 146.11 SD : 186.41
Charles et al., 2006	America	CP hemiplegic	JTTHF	CIMT	Mean : 268.6 SD : 238.0	UC	Mean : 260.3 SD : 153.0
Chen et al., 2012	Taiwan	CP unilateral	PMAL- AOU	CIT	Mean : 2.5 SD : 0.3	TR	Mean : 2.3 SD : 0.3
Chen et al., 2014	Taiwan	CP unilateral	BOTMP-8	hCIT	Mean : 8.87 SD : 2.26	TR	Mean : 7.86 SD : 1.64
Deppe et al., 2013	German	CP hemiplegic	AHA	CIMT	Mean : 58.4 SD : 9.1	IBT	Mean : 62.3 SD : 13.5
Eliasson et al., 2005	Sweden	CP hemiplegic	AHA	CI	Mean : -1.63 SD : 2.91	ST	Mean : -2.06 SD : 3.11
Eliasson et al., 2011	Sweden	CP unilateral	AHA	Eco- CIMT	Mean : 59 SD : 9	ST	Mean : 56 SD : 19
Fedrizzi et al., 2013	Italy	CP hemiplegic	Besta Scale-BU	CIMT	Mean : 2.74 SD : 0.84	ST	Mean : 2.97 SD : 0.68
Hsin et al., 2012	Taiwan	CP unilateral	BOTMP-8	hCIT	Mean : 10.6 SD : 1.6	TR	Mean : 8.9 SD : 1.1
Hwang et al., 2020	South Korea	CP unilateral	PMAL- HW	CIMT	Mean : 1.83 SD : 1.12	CT	Mean : 1.85 SD : 1.03
Rostami et al., 2012	Iran	CP hemiplegic	BOTMP-8	CIMT	Mean : 1.35 SD : 0.37	Control	Mean : 0.28 SD : 0.8
Sakzewski et al., 2011	Australia	CP unilateral	JTTHF	CIMT	Mean : 337.5 SD : 203.8	BIM	Mean : 306.8 SD : 179.8
Sakzewski et al., 2015	Australia	CP unilateral	AHA	CIMT	Mean : 62.7 SD : 13.2	SC	Mean : 62.2 SD : 18.4
Taub et al., 2011	USA	CP hemiplegic	PMAL	CIMT	Mean : 3.5 SD : 0.6	UC	Mean : 1.4 SD : 0.5
Wallen et al., 2011	Australia	CP hemiplegic	AHA	CIMT	Mean : 62.9 SD : 29.3	IOT	Mean : 52.0 SD : 28.9

a. Forest plot

Figure 2 shows that the results of the analysis show that giving CIMT to children with cerebral palsy can increase hand func-

tion by 0.4 times than non-CIMT interventions. These results were statistically significant (SMD= 0.40; 95% CI 0.09 to 0.71; p= 0.01).

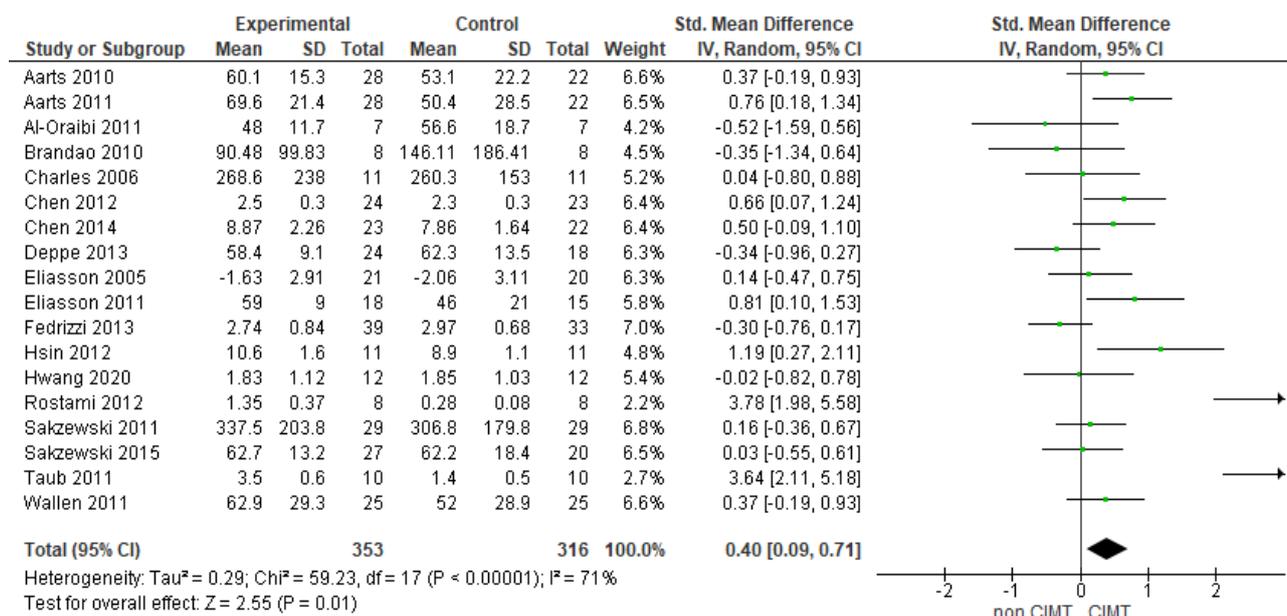


Figure 2. Forest plot of CIMT's influence on hand function of a child with cerebral palsy

b. Funnel plot

In Figure 3, the funnel plot graph looks symmetrical, which shows that there is no

publication bias because there are 9 points on the left side, 4 points parallel to the line and 5 points on the right.

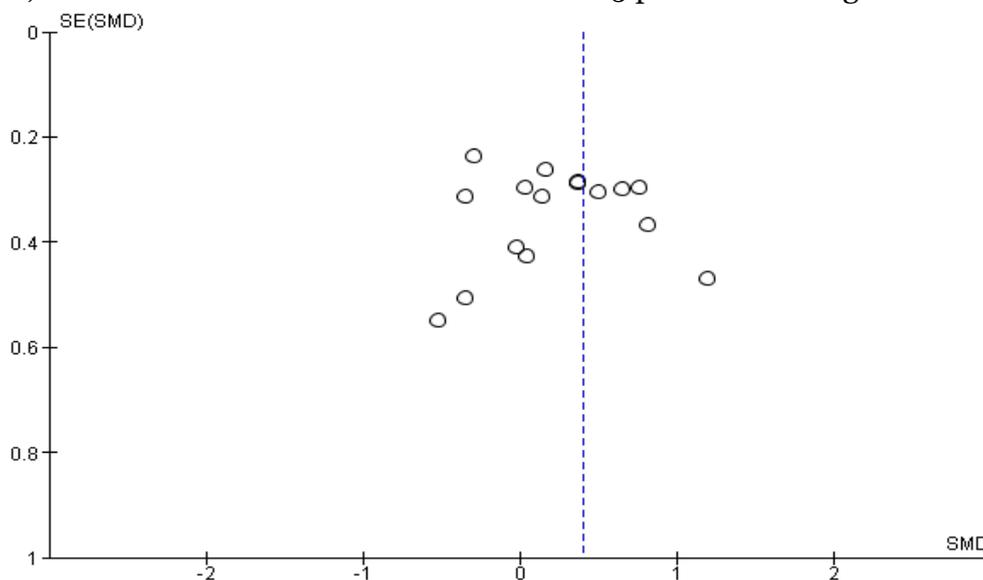


Figure 3. Funnel plot of the effect of CIMT on hand function of a child with cerebral palsy

2. Effect of CIMT on occupational performance of children with cerebral palsy

Table 2 shows 11 randomized control trial (RCT) articles on the effect of CIMT on

occupational performance of children with cerebral palsy that meet the qualitative and quantitative requirements.

Table 2. Effect of CIMT on occupational performance of children with cerebral palsy

Author, Year	Country	Population	Instrument	Results			
				Intervention		Comparison	
Aarts et al., 2010	Netherland	CP unilateral	COPM-P	mCIMT-BiT	Mean : 6.5 SD : 1.0	UC	Mean : 4.6 SD : 1.4
Brandao et al., 2010	Brazil	CP hemiplegic	PEDI-FA	CIMT	Mean : 77.36 SD : 9.32	UC	Mean : 70.8 SD : 7.24
Brandao et al., 2012	Brazil	CP hemiplegic	COPM-P	CIMT	Mean : 5.54 SD : 1.7	HABI T	Mean : 6.58 SD : 1.19
Chen et al., 2014	Taiwan	CP unilateral	WeeFIM	hCIT	Mean : 42.61 SD : 6.24	TR	Mean : 39.73 SD : 3.66
Deppe et al., 2013	Jerman	CP hemiplegic	PEDI	CIMT	Mean : 62.2 SD : 8.1	IBT	Mean : 63.2 SD : 8.3
Fedrizzi et al., 2013	Italy	CP hemiplegic	Besta Scale-ADL	CIMT	Mean : 2.4 SD : 0.95	ST	Mean : 2.38 SD : 0.83
Hwang & Kwon, 2020	South Korea	CP unilateral	PEDI-SC	CIMT	Mean : 17.92 SD : 12.47	CT	Mean : 16.25 SD : 9.27
Sakzewski et al., 2011	Australia	CP unilateral	COPM-P	CIMT	Mean : 6.3 SD : 1.9	BIM	Mean : 6.3 SD : 1.5
Sakzewski et al., 2015	Australia	CP unilateral	COPM-P	CIMT	Mean : 6.1 SD : 1.5	SC	Mean : 6.9 SD : 1.0
Wallen et al., 2011	Australia	CP hemiplegic	COPM-P	CIMT	Mean : 6.1 SD : 2.3	IOT	Mean : 6 SD : 1.7
Yu et al., 2012	Korea Selatan	CP hemiplegic	WeeFIM-SC	CIMT	Mean : 21.7 SD : 3.6	TT	Mean : 20.6 SD : 4.6

a. Forest plot

Figure 4 shows that the results of the analysis show that giving CIMT to children with cerebral palsy can improve occupational performance abilities by 0.18 times

than non-CIMT interventions. However, these results were not statistically significant (SMD= 0.18; 95% CI -0.17 to 0.52; p= 0.32).

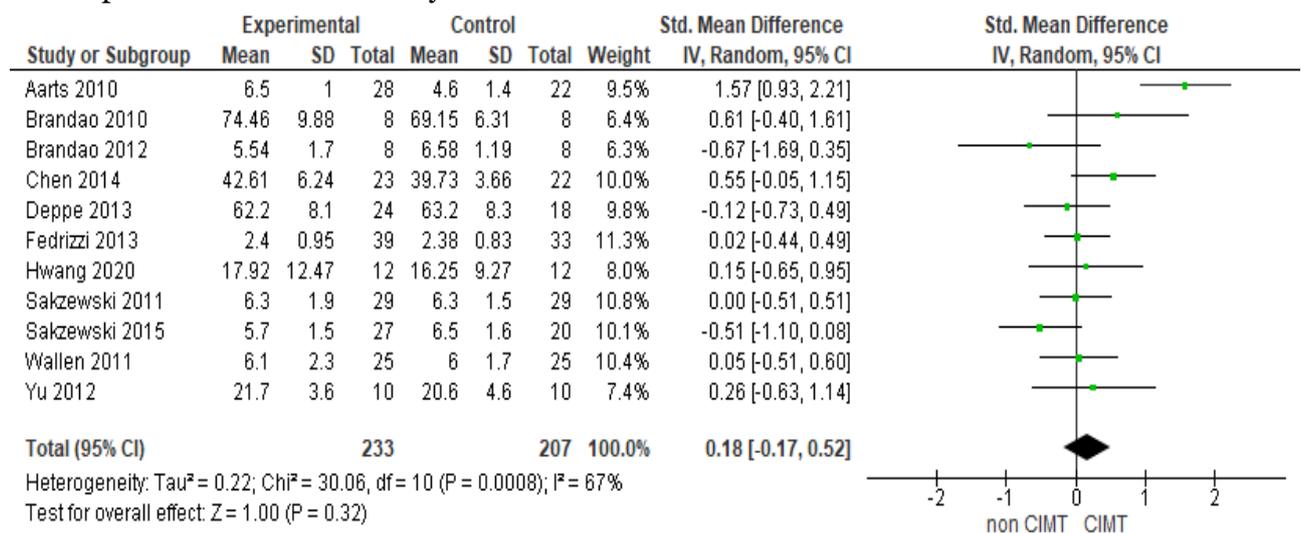


Figure 4. Forest plot of CIMT's influence on performance occupation of children with cerebral palsy

b. Funnel plot

In Figure 5, the funnel plot graph looks symmetrical, which shows that there is no

publication bias because there are 6 points on the left side, 1 point parallel to the line and 4 points on the right.

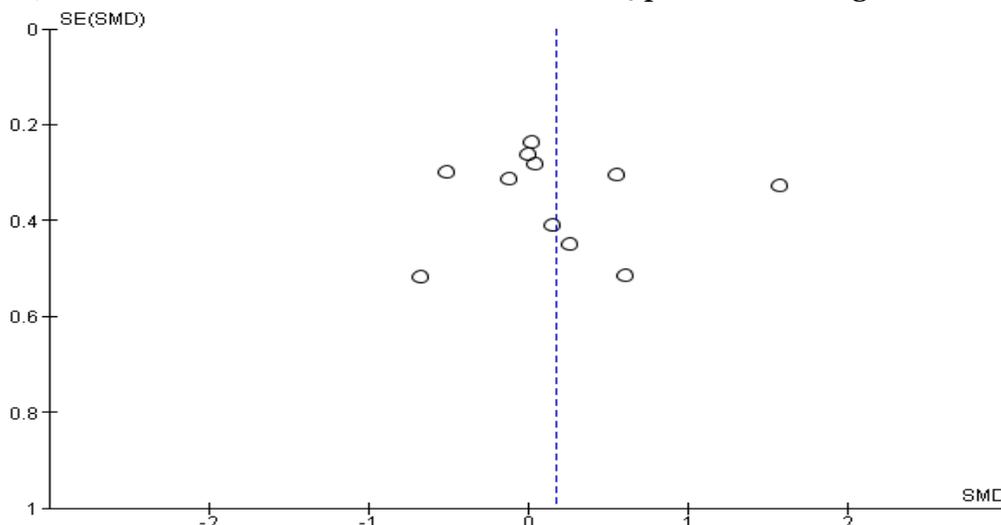


Figure 5. Funnel plot of the effect of CIMT on performance occupation of children with cerebral palsy

DISCUSSION

Cerebral palsy is a stable condition and a non-progressive disorder in the brain of a fetus or developing baby so that they are considered normal children with special needs (Levitt and Addison, 2019; Miller et al., 2020). In children with cerebral palsy, limited hand function is a common consequence of spasticity which complicates the child's fine motor movements such as grasping, writing, and cutting (Klevberg et al., 2017; Duruöz, 2019).

Some experts say that CIMT is a rehabilitation technique in the upper limb with a focus on improving the function of the affected limb (Miller et al., 2020). In this technique, repetitive motion exercises are given so that this can provide movement memory to the child. According to Arenz et al., (2017), these repetitive or repetitive movements can generate or create new neural pathways in the brain.

This study uses a systematic review and meta analysis study design with the aim of obtaining general conclusions as the basis for providing therapy / intervention

from various similar studies that have been carried out by previous researchers who tested the administration of CIMT in children with cerebral palsy in various countries.

Meta analysis is an epidemiological study that combines and combines statistically primary research data that discusses the same hypothesis so as to obtain quantitative summary results (Egger and Smith in Murti, 2018). The results of the research are presented in the form of a forest plot and a funnel plot.

Forest plots can show effect sizes and 95% confidence intervals or display the results of a meta-analysis study (Makowski et al., 2019). The funnel plot shows the effect size and precision of the effect size and makes it possible to evaluate the possibility of publication bias in the form of a symmetrical triangle graphic (Makowski et al., 2019; Li et al., 2020).

1. Hand function

Giving CIMT to children with cerebral palsy was significantly able to increase hand function by 0.4 times than non-CIMT

interventions. The results of this study are supported by the research of Aarts et al (2010) where giving CIMT-BiT to children with cerebral palsy can improve children's hand function 0.4 times higher than giving intervention or standard therapy. The provision of CIMT intervention also provides significant results on the home base model and school base model (Al-Oraibi and Eliasson, 2011; Gelkop et al., 2015).

Giving pure and combined CIMT provides benefits to weak sensory function even though it does not improve hand structure but can improve the ability to move the arms, hands and hand coordination of children with hemiplegi (Simon-Martinez et al., 2020; Wallen et al., 2011).

Comparison of CIMT doses (3 or 6 hours) did not provide a significant difference in results (Deluca et al., 2012). Basically, CIMT as a reference frame for occupational therapy is used in children because each exercise given is a play component that encourages the use of upper limb functionalities. Hemiplegic children to facilitate bimanual or upper limb performance (Arenz et al., 2017).

2. Occupational performance

Giving CIMT to children with cerebral palsy can improve occupational performance ability by 0.18 times than non-CIMT intervention although it is not statistically significant. In the research of Sakzewski et al. (2015) also wrote that giving hybrid-CIMT can improve occupational performance abilities even though this is not statistically significant.

However, there are differences in the research of Brandao, Gordon and Mancini (2012) which states that the provision of CIMT intervention can improve the ability of children's occupational performance and is statistically significant ($p < 0.001$) by using the COPM instrument.

The target of giving active CIMT intervention includes the ability in activity daily living such as bathing, defecating, dressing, eating, or cleaning and grooming; IADL such as raising animals, taking formal lessons, and playing (Arenz et al., 2017). When absorbing the ICF model in CIMT for children, the expected result of giving CIMT is to increase continuity in carrying out daily activities using the intervened domain or hand (Miller et al., 2020).

In longitudinal studies, CIMT showed results with a high functional level after approximately 3.5 years but this development was also influenced by the type of brain lesion (Eliasson and Holmefur, 2015). In addition, differences in age groups do not adequately affect the results of interventions on the aspect of occupational performance (Chen et al., 2015).

The limitation in this study is that there is still a language bias. It is hoped that further research can carry out research using a larger number of subjects and a higher period of time and follow-up. In addition, primary research on the effects of CIMT has never been carried out in Indonesia.

AUTHOR CONTRIBUTION

Mutiana Agustin Sholikah is the principal researcher who selects topics, explores and collects research data. Agus Kristiyanto and Hanung Prasetya analyzed data and reviewed research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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This study is self-funded.

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LIST OF ABBREVIATIONS

AHA	=	The Assisting Hand Assessment
BiT	=	Bimanual Therapy
BOTMP	=	The Bruininks-Oseretsky Test of Motor Proficiency
CEBM	=	The Centre for Evidence-Based Medicine
CI	=	Confidence Interval
CIMT	=	Constraint Induced Movement Therapy
COPM	=	Canadian Occupational Performance Measure
CP	=	Cerebral Palsy
HABIT	=	Hand-Arm Bimanual Intensive Therapy
JTHF	=	Jebsen-Taylor Hand Function
JTHFT	=	The Jebsen-Taylor Hand Function Test
mCIMT	=	Modification Constraint Induced Movement Therapy
mCIT	=	Modification Constraint Induced Therapy
NDT	=	Neuro Developmental Treatment
PEDI	=	Pediatric Evaluation of Disability Inventory
PICO	=	Population, Intervention, Control/Comparisons, Outcomes
PMAL	=	The Pediatric Motor Activity Log
PMAL-AOU	=	The Pediatric Motor Activity Log Amount of Use
PMAL-HW	=	The Pediatric Motor Activity Log- How Well
QUEST	=	Quality of Upper Extremity Skills Test
RCT	=	Randomized controlled trial
RevMan	=	Review Manager
SMD	=	Strandart Mean Difference

VOAA-DDD=Video Observations Aarts and Aarts- Determine Developmental
WeeFIM= Wee-Funtional Independence Measure

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