Bobath And Pilates Therapy On Sitting And Standing Balance In Children With Cerebral Palsy

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Abstract.

Cerebral Palsy is the most common neurological disorder in children that affects movement and posture due to damage to the brain which controls motor skills, causing balance problems when sitting and standing. This balance is affected by the strength of the erector spine and abdominal muscles that straighten and control the trunk. If low trunk muscle tone causes problems with balance and mobility so that the child has difficulty sitting, playing in a sitting position, functional hand movements such as eating and activities of daily living. This research is an experiment with a pre test – post one group design which aims to analyze the effectiveness of bobath and pilates therapy on sitting and standing balance in children with cerebral palsy. A total of 17 children with cerebral palsy were given bobath and pilates therapy for 16 weeks, with a dose of: 1 time/day, 3 times a week with a treatment time of 45 minutes for each child. The research subjects were children with cerebral palsy with the following criteria: 1-year old, unbalanced sitting and standing. It will be carried out from February to June 2023. Sitting balance is measured with a sitting level scale and standing balance with a pediatric balance scale. The research subjects consisted of 13 men (76.47%) and 4 women (23.53%) with the GMFCS categories being III and IV. The average age of research subjects: 36.5758 ± 15.02504. The results of statistical tests with Wilcoxon obtained a value of p = 0.001 at the sitting level of the scale and p = 0.002 on the pediatric balance scale. Conclusion: Bobath and pilates therapy are effective in increasing the value of the sitting level of the scale and the pediatric balance scale in children with cerebral palsy.

Keywords: *Bobath therapy, Pilates,sitting,standing,and cerebral palsy.*

I. INTRODUCTION

Cerebral Palsy is the most common neurological disorder in children that affects movement and posture due to damage to certain parts of the brain that control motor skills. One of the main problems faced by children with cerebral palsy is balance problems when sitting and standing. Poor balance can make it difficult for them to carry out daily activities and participate in physical and social activities [1,5].This balance is affected by the strength of the erector spine and abdominal muscles that straighten and control the trunk [1], [2], If low trunk muscle tone causes balance and mobility problems [3], and if there is leg spasticity in children with cerebral palsy it will affect body mobility the lower part and inhibits motor development to stand and walk independently [4].Cerebral palsy children have poor postural control, decreased joint range of motion and muscle contractures that affect children's motor development significantly [5], [6], due to weak muscle strength, changes in nerve control and inadequate body position [7]. Postural control of children with cerebral palsy involves control and orientation of the body to achieve balance stability [8]. When the trunk is stable, the upper and lower limbs can be used freely for activities, but children with cerebral palsy show hypotonic symptoms, weakness of the trunk muscles, increased muscle tone of the upper and lower extremities, loss or delay of postural reflexes and loss of body stability so that the child have difficulty sitting, playing in a sitting position, functional hand movements such as eating and activities of daily living such as sitting in a wheelchair[9] Of all diagnosed cases of childhood disability about 57% are related to cerebral palsy[10] and occur 2 and 3 per 1000 deliveries[11].

Approximately 1 in 500 newborns may be affected by cerebral palsy with an estimated prevalence of 17 million people worldwide which establishes it as the most common motor disability during childhood[12]. At the Makassar City Disabled Children's Education Foundation, the bobath method is generally used, but

the Pilates method has not been implemented. To date, there have been very few studies examining the differences in the effects of bobath exercises and Pilates exercises in children with cerebral palsy and interventions used in clinics for cerebral palsy generally target the extremities, but trunk disorders are neglected and only a few studies focus on trunk exercises in the cerebral palsy population.Research on this usually uses games and virtual to train the trunk [13].Various physiotherapy intervention methods used in cases of cerebral palsy include bobath exercises, passive stretching, core stability, trunk mobilization, and pilates exercises [15].Two therapeutic methods that have been widely studied are Pilates and Bobath Exercises. Pilates is a series of exercises aimed at increasing core strength, flexibility and body awareness. Pilates Exercises are effective in improving balance and gross motor function in diplegic cerebral palsy [4], [15] and according to A. N. Dos Santos, S. S. Serikawa, and N. A.C. F. Rocha states that Pilates can be an alternative rehabilitation technique to increase strength and postural control[14].Pilates therapy is effective in improving balance and gross motor function in children with cerebral palsy diplegia [4] and there is no difference in giving bobath exercises and pilates to improving sitting balance in children with diplegic spastic cerebral palsy [15].

Bobath therapy improves motor function skills, the level of independence in activities of daily living, and also balances abilities in children with cerebral palsy[16],[17], is also effective in gross motor learning, increases muscle tone, reflexes and reaction patterns and movement[18]. Both of these methods have shown potential to help improve balance in children with cerebral palsy, but direct comparisons of their effectiveness need further investigation.Understanding the effectiveness of bobath and pilates methods on sitting and standing balance in children with cerebral palsy can help physiotherapists determine the appropriate treatment modality and which will provide the most effective benefits in a rehabilitation program specifically for children with cerebral palsy. Therefore the aim of this study was to analyze the differences in the effects of bobath exercises and pilates exercises on sitting and standing balance in children with cerebral palsy during the 16-week intervention period.Although these therapeutic methods have been known and used for some time, their combination has become increasingly relevant and has received increased attention in research and clinical practice in recent years.The combination of these two therapies is considered promising because they can complement each other to achieve better results in improving balance, mobility, and motor function of children with cerebral palsy. This holistic therapy approach combines aspects of neuroplasticity and improvement of functional body movements, so that it can provide more comprehensive benefits for children with cerebral palsy. Therefore this study aims to evaluate the effectiveness of Bobath and Pilates Therapy in improving sitting and standing balance in children with cerebral palsy.

II. METHODS

This type of research is pre-experimental with pre-post test one group design by providing Bobath therapy with pilates in children with cerebral palsy. A total of 17 children with cerebral palsy aged 1-7 years who met the inclusion criteria, namely not being able to sit balanced and stand, were able to understand commands and were included in level III - IV of the GFMCS classification. This research was conducted from February to June 2023 at the Children's Clinic Daya Makassar and YPAC Makassar.Research procedure This research was conducted from February to July 2023. A total of 17 children with diplegia were at the Makassar City Disabled Children Education Foundation and the Child Growth and Development Clinic in Daya, Makassar City. During this study, no children from the two research groups dropped out.

The research procedure is carried out starting from:

1. Preparation of research administration, namely research ethics, research permits, research schedules and research materials. This study received ethical approval from the Health Research Ethics Commission of the Makasar Health Polytechnic with Ethical Approval Recommendations No. 111 / KEPK-PTKMS / III /2022 dated 31 March 2022.
2. Pre test

Sitting balance measurement using the level sitting of the scale and standing using the pediatric balance scale which is recorded in the measurement form.

3. Research Implementation

Prior to implementing pilates exercises and bobath exercises, passive movements of both arms and legs and trunk mobilization were given as preliminary exercises. The research subjects were 17 children with cerebral palsy who were given a combination of Bobath and Pilates exercises. Treatment of each child with a dose: 1 time/day, 3 times a week with a treatment time of 45 minutes for each child for 16 weeks.

4. Implementation of Post test

After treatment of the research subjects, sitting and standing balance measurements were taken which were recorded on the measurement blank according to the physiotherapy examination form used in the Makassar Health Polytechnic Physiotherapy Study Program, Indonesia.Data analysis and statistical tests were performed using Wilcoxon with the significance level for all statistical tests set at $p < 0.05$.

III. RESULT AND DISCUSSION

This research was conducted from February to July 2023. A total of 17 children with diplegia were at the Makassar City Disabled Children Education Foundation and the Child Growth and Development Clinic in Daya, Makassar City.

1. Characteristics of research subjects

Table 1. Characteristics of research data

Characteristics	Bobath therapy and pilates (mean ± SD)
Umur (tahun)	36.5758 ± 15.02504
GMFCS level III	10 (58.82 %)
GMFCS level IV	7 (41,18 %)
Gender	
Male	13 (76,47 %)
Female	4 (23,53 %)
Total	100 %

2. Balance sitting and standing after being given Bobath and Pilates Therapy

Table 2. Wilcoxon test results for research subjects

		N	Mean Rank	Sum of Ranks	Z	P
Level sitting of scale	Negative Ranks	0[a]	.00	.00		
	Positive Ranks	12[b]	6.50	78.00	--3.217	0.001
	Ties	5[c]				
	Total	17				
Pediatric balance scale	Negative Ranks	0a	.00	.00		
	Positive Ranks	10b	5,50	55.00	-3.162	0.002
	Ties	7 c				
	Total	17				

Balance is the ability to maintain a stable body position when sitting, standing or moving. This ability involves a complex integration between the central nervous system, musculoskeletal system, and sensory system. Good balance allows us to carry out everyday activities with ease, such as walking, running, lifting things, or even just standing straight. In children with CP, the disorder is caused by damage to certain parts of the brain. After being given bobath therapy combined with Pilates exercises, our findings show that there are significant changes in the balance of sitting and standing in children with cerebral palsy (Table 2). This finding is of interest because both methods have been used extensively in the rehabilitation of children with cerebral palsy, but there is not much evidence directly combining the effectiveness of the two. The combination of Pilates and Bobath works because the two methods target different aspects of the balance problems of children with cerebral palsy because Pilates focuses on improving postural control, core muscle, and flexibility, while Bobath emphasizes using normal movement patterns and finer motor coordination. The combination of the two can provide positive synergy and complement each other, thereby creating a more holistic approach to rehabilitation. The results of this study are consistent with previous studies conducted by

Adriana Neves dos Santos, Simoni Sayuri Serikawa, et.al, (2016)[2], Elizabeth Hornsby, Leanne M Johnston, (2019) 3, and Icut Maya Sari1, et al (2014 All the results of these studies indicate that pilates exercises can provide benefits for children with cerebral palsy [4]. Other studies regarding pilates exercises show increased muscle flexibility, strength and postural control, and reduced pain in children with musculoskeletal pathologies (Elizabeth Hornsby , Leanne M Johnston , 2019)

The results of research by Fatih Tekin, Erdogan Kavlak, et.all (2018) [5] that posture and balance exercises based on Neurodevelopmental Treatment for 8 weeks is an effective approach to increase functional motor level and functional independence by increasing postural control and balance in diparetic and hemiparetic cerebral palsy. Significant improvements in balance, gross motor function and functional independence were seen during the bobath and pilates therapy compared to the results before and after the intervention. Arbor and McLellan [6] applied Bobath therapy to 30 children with spastic cerebral palsy between 18 months - 8 years for 6 months divided into two groups (treatment and control group), and according to Bower E, McLellan D [6] there was no significant difference in gross motor skills. This can happen because bobath increases proprioceptive input and reduces spasticity, facilitates normal motor development and increases activities of daily living, improves posture and movements performed with abnormal muscle tone [3].In table 2 bobath exercises have an effect on improving the function of sitting and standing balance in children with cerebral palsy. Bobath therapy focuses on increasing the child's body awareness or proprioception by providing proper stimulation to the muscles and joints. By understanding and feeling their body position, children with cerebral palsy can more easily adjust their muscles to maintain balance when moving or being in certain positions with asymmetrical movements can help improve postural control, because it allows children to overcome imbalances and balance their bodies in various ways. situation.

Butler and Darrah stated that Bobath therapy develops postural control, balance and improves motor function, a level of independence in activities of daily living, and a balance of abilities in children with cerebral palsy [16], because balance is needed to explore and interact with the environment, and has been described as an anchor for purposeful movement and functional activity in children with cerebral palsy.Improvements were also seen in motor skills and physical development. Therefore, Bobath therapy can be recommended for spastic diplegia cerebral palsy [24]. Bobath technique is effective in motor development and bobath is more effective than conventional treatment [24].The results of this study are in accordance with the research of Labaf et al. (2015) who concluded that the bobath approach improves gross motor function in children with cerebral palsy in four dimensions, namely laying, rolling, sitting, crawling, kneeling, and standing, but walking, running and jumping did not improve significantly [23].Besios et al. (2018) stated that bobath can significantly increase the excitability of alpha motor neurons in central nervous system disorders. With this increase, motor learning processes can be formed as well as adaptation processes and plasticity in the nerves which can help restore movement activities in cerebral palsy patients [15] In maintaining balance, it requires information about the position of the body to the surrounding environmental conditions obtained from peripheral sensory receptors found in the visual, vestibular and proprioceptive systems.Vestibular has the greatest contribution in maintaining balance, followed by visual and proprioceptive. In neuro development treatment with a trunk stability approach, there are proprioceptive and extroreceptors.

Proprioceptive input stimulates the muscles, the stimulation is carried to the spinal cord. From the spinal cord stimulation goes to two branches, one to the cerebellum and one to the thalamus. The cerebellum aims to contract agonist-antagonist muscles that maintain body balance and regulate body posture, where the mechanism is in the form of: afferent input from the spinal cord via the dorsal serarcuatus externus. From the afferent spinal cord through two neurons, namely the spinal ganglion and the doral (homolateral) Arcuatus eternus fibers, one of which is directed to the cerebellum and the other is passed on to the thalamus. Afferent pathways to the cerebellum are carried back to the spinal cord and then to the thalamus. Arriving at the thalamus, afferents are sent through two branches, namely to the motor cortex and sensory cortex. in the motor cortex, afferents are brought to the brainstem, while afferents that go to the sensory cortex continue their journey to the cortical association area. Efferent continues stimulation to the basal ganglia and back to

the thalamus to return to the extroreceptive muscles which are obtained from contact of the patient's body with physiotherapy hands, balls, or rolls against the body, and gravity against the body. Where this receptor passes through 3 neurons, namely one neuron in the spinal ganglion, the posterior gray column, and the anterolateral nucleus of the thalamus.The first neuron contributes to the posterolateral tract of Lissouer. Second-order neuron axons cross obliquely to opposite sides in the anterior gray and alba commissures in the spinal segments. It then ascends in the third anterioatral white column in the ventral posterolateral nucleus of the thalamus through the posterior internal capsule and the corona radiata to reach the somasthetic area in the postcentral gyrus of the cerebral cortex.

Opposite as a tract, then ascend through the medulla oblongata together with the lateral spinothalamic and spinotectal tracts to form the spinal lemnicus (for tactile and pressure). Then the input goes to the third neuron in the form of the nucleu anteroposteriolateralis thalam to the radiata thalam which ends in the cerebral cortex in areas 1,2 and 3.Pilates is a form of exercise that trains the body from the inside out by focusing on the core muscles (such as the abs and back) and focusing more on exercise. The Pilates method is a body conditioning exercise, targeting deep postural muscles to achieve core stability and muscle strength with increased balance. Based on research by Santos, et al (2014) pilates can be an important rehabilitation technique for children with mild deficit cerebral palsy with the aim of increasing muscle strength and balance while sitting. Pilates aims to improve core stability, develop balance and flexibility, work the muscles to build strength and body control, and improve muscle control without causing excess muscle strain.In giving pilates input obtained from proprioception and muscle stimulation which affects muscle strength to maintain body alignment in maintaining balance sitting. Improved sitting balance that occurs because pilates stimulates the trunk muscles in defending the body against gravity resulting in an increase in the number of sarcomeres and muscle fibers (actin and myosin filaments needed in muscle contraction), with the formation of new muscle fibers, muscle strength can increase. increase which affects the trunk to maintain body alignment, besides that there is visual and auditory stimulation which gives impulses to the cerebellum and cerebral cortex.The response that occurs synergistically activates the agonist and antagonist muscles, especially the trunk stabilization muscles which respond to the vestibular which becomes activated by the muscles to contract, causing a muscle response and system adaptation in maintaining sitting balance.

Balance is influenced by visuals and head control, so when doing Pilates, you must pay attention to the correct alignment.In addition to getting prorioceptive (joint position) and extroreceptive (press and touch stimulation), patients get stimulation from awareness of the position of body parts obtained from visuals. Where the impulses coming from slowly adapting nerve endings in the cyanovia and ligaments. When awareness of joint position arises, it is hoped that the muscles will be stimulated to contract, causing a muscle response and system adaptation in maintaining sitting balance.According to Fatih Tekin, Erdogan Kavlak (2018) states that doctors and researchers who work with diparetic and hemiparetic Cerebral Palsy should focus more intensively on the bobath program to increase the level of motor development, postural control skills, balance and functional independence in activities of daily life [10].In the treatment of children with cerebral palsy, the bobath method provides direct improvements in equilibrium and righting reactions which will affect normal postural reflex mechanisms which will be the main support for normal movements in normal functional abilities [26]. Based on the research of Arı and Kerem Günel (2017) concluded that the addition of trunk exercises with the bobath approach in children with cerebral palsy affects motor function positively[8], so it is recommended that bobath treatment in people with cerebral palsy be carried out according to the right duration and as early as possible for better recovery [24].Pilates aims to improve core muscle stability, develop balance and flexibility, work the muscles to build strength and body control, and improve muscle control without causing excess muscle tension. The results of this study are similar to the statements of R. Sharma, J. Sharma, and V. Bharadwaj (2018), that Pilates exercises are useful for increasing muscle strength and postural control when standing in children with cerebral palsy [24] and pilates exercises help stabilize the segments spine by activating the abdominal muscles, increasing joint stability as well as increasing neuromuscular efficiency [22].

In addition, pilates training is more effective in improving balance and gross motor function in children with cerebral palsy diplegia compared to conventional therapy alone [23], so that it can be used as a rehabilitation technique for children with cerebral palsy who exhibit mild motor structural deficits and high functional levels, especially if the goal is is to improve muscle strength and postural control during standing [14].Previous studies reported that information coming from the body and the environment can be conveyed simultaneously to the neck and trunk to allow coordination between head and extremity movements, including neck muscle movements [23]. One of the functions of the neck muscles is to coordinate the position of the body and head against the surrounding environment and provide stable support for the visual and vestibular systems during postural control [24].In giving Pilates, the input obtained from proprioception and muscle stimulation affects muscle strength to maintain body alignment in an upright sitting position. This happens because pilates stimulates the trunk muscles in defending the body against gravity so that there is an increase in the number of sarcomeres and muscle fibers (actin and myosin filaments needed in muscle contraction), with the formation of new muscle fibers, muscle strength can increase which influencing the trunk to maintain body alignment, besides that there is visual and auditory stimulation which provides impulses to the cerebellum and cerebral cortex.Activate the agonist and antagonist muscles synergistically, especially the trunk stabilization muscles which respond to the vestibular muscles which become activated to contract, causing a muscle response and system adaptation in maintaining sitting balance. Balance is influenced by visuals and head control, so when doing Pilates, you must pay attention to the correct alignment. [15].

Pilates has a positive effect on parameters of physical fitness and postural evaluation in preschool children. This study shows that Pilates can be an alternative to physical activity in children aged 5-6 years [15].Pilates training is more effective in improving balance and gross motor function in children with diplegic cerebral palsy than conventional therapy alone [23]. Pilates may be an important rehabilitation technique for children with CP who exhibit mild deficits in motor structure and a high functional level, especially when the goal is to increase muscle strength and postural control during moderate standing [14]. Pilates combined with certain physical therapy programs improves gross motor function and balance compared to certain physical therapy alone [4]. In addition, Pilates exercises can be used to improve muscle strength and postural control while standing in children with cerebral palsy [24], can train the spinal muscles to improve neuromuscular efficiency.The combination of Bobath and Pilates therapy can stimulate brain plasticity, namely the brain's ability to experience structural and functional changes in response to exercise and stimulation. Thus, this combination can help improve brain connectivity and stimulate better motor development.The Bobath and Pilates combination therapy approach can be adapted to the individual needs and abilities of children with cerebral palsy. Every child has unique motor challenges, and this combination of therapies can be adapted to provide the right intervention according to the needs of each child. Bobath and Pilates therapy can provide a more holistic approach in improving the motor function of children with cerebral palsy. This includes strengthening muscles, improving balance, developing motor control, and improving the overall quality of body movement.

IV. CONCLUSION

Bobath and pilates therapy are effective in improving sitting and standing balance in children with cerebral palsy

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