



**THE EFFECT OF MIDLINE EXERCISE THERAPY ON GLOBAL DELAYED DEVELOPMENT CHILDREN'S GROSS MOTOR**

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**ABSTRACT**

Global delayed development (GDD) is a developmental disorder in children characterized by delays in gross motor development. Gross motor development is based on the development of an optimal midline position, and in GDD this does not happen. This research objective to determine the effect of midline exercise therapy on improving gross motor skills in children with GDD at Haji Hospital Surabaya. This is experimental research purposive sampling research on 15 GDD children at RSUD Haji Surabaya with a one-group pre and post-test design. Midline exercise therapy is carried out twice a week for 6 weeks consisting of relaxing the neck extensors, adjusting the position to the middle of the body, and cortical level exercises. Tool for measuring children's gross motor skills with GMFM (gross motor functional measurement) sector A/lying down with scale 0-51 measured pre and post treatment. Data analysis with univariate and bivariate SPSS. For the results 3 subjects were boy and 12 girl with an average age of 13.1 months. There was an increase in the mean GMFM score from 4.2 to 6 (paired t-test  $p=0.000$ ) after 12 physiotherapy sessions.

Keywords: head control; global delayed development; gross motor skills; midline exercise therapy

**How to cite (in APA style)**

Abdullah, K., Swandari, A., Pane, R. V., Muzamil, A., & Darajatun, A. M. (2024). The Effect of Midline Exercise Therapy on Global Delayed Development Children's Gross Motor. *Indonesian Journal of Global Health Research*, 6(S6), 275-284. <https://doi.org/10.37287/ijghr.v6iS6.4578>.

**INTRODUCTION**

Gross motor skills are crucial for a child's movement development (Manggau, 2020 ). If gross motor skills do not develop according to the child's age, it can lead to delays in other movements (Veldman, 2019). For instance, children with head control balance disorders may experience difficulty swallowing food, breathing effectively, sleep disturbances, and functional hand disorders (Sun, 2017). Additionally, gross motor skills are closely linked to cognitive development and understanding (Veldman S. L., 2016). Recognizing the role of gross motor skills in development underscores the importance of mastering treatment with a gross motor functional improvement approach (Veldman S. , 2019).According to normal movement development, head control is the first milestone, followed by other body developments (Shin, 2020). One aspect of head control is the midline position, which refers to the head being in the middle of the body (Hong, 2014). Midline head development begins in the 3rd trimester of the fetus and continues until birth, and then reemerges in 3-month-old babies (Ali, 2019), (Formiga, 2015). This position is also known as the capital flexion position (Sun, 2017). Children with movement disorders such as global delayed development (GDD) may struggle to position their head and neck optimally in the midline position, leading to hindrances in subsequent movement development (Dannenbaum, 2016) (Sun, 2017). It is

crucial to address this issue promptly to prevent interference with other functional developments (Himmelman, 2006) (Liang, 2021).

GDD refers to a child's inability to follow age-appropriate developments (Choo, 2019). Children with GDD often experience challenges in their gross motor skills, which can in turn affect other areas of development such as fine motor skills, speech, and cognition (Mitiku, 2023), (Persha, 2004). The incidence of GDD varies across countries, with a higher risk among children in medium to low per capita income countries (Agarwal, 2018), (Sharma, 2023). Haji Surabaya Regional Hospital is a type B hospital that provides various healthcare services, including physiotherapy for children with movement disorders like GDD. Data shows that the number of visits by GDD patients to the medical rehabilitation clinic at Haji Hospital Surabaya increased significantly between May and June 2024. The increase was particularly notable in movement problems among GDD patients, specifically midline orientation issues.

The researchers found exercise therapy techniques from literature studies that involve adjusting the position, relaxing antagonistic muscle groups, and increasing movement awareness while stimulating the child's cortex (Hong, 2014) (Sun, 2017). The positioning is based on the baby's ability at 3 months of age, ensuring that the head and body are aligned along the midline of the body (Hong, 2014). Relaxing the antagonist group, such as the neck extensors, aims to make it easier for the head to be in a central position, while cortical stimulation involves activities like playing with toys to help the child adopt a new position unconsciously (Hong, 2014), (Dumuids-Verne, 2022). This type of exercise needs to be done regularly and should be supplemented with education for parents to continue at home. A case study (Abdullah, 2022) reported that midline exercise therapy in children with CP quadriplegia can reduce spasticity in trunk extensors and improve midline orientation of the head and body. Based on this background, the researchers wanted to investigate the impact of midline exercise therapy on improving the gross motor abilities of children with GDD at the medical rehabilitation clinic at Haji Hospital in East Java Province, Indonesia.

## **METHOD**

This study was an experimental field research with a one-group pre- and post-test design, involving a sample of 15 GDD's children receiving physiotherapy at the Medical Rehabilitation of RSUD Haji Surabaya from July to August 2024. Purposive sampling technique was used in this research. The sample was selected based on specific inclusion criteria: 1) Children diagnosed with GDD by a pediatrician and under 5 years old, 2) Regularly visiting the medical rehabilitation clinic at Haji Hospital Surabaya at least once per week, 3) Experiencing control disorders related to head movement, and 4) Having parents who consented to participate in the research. Exclusion criteria included children with spasticity, cerebral palsy, epilepsy complications, or overall poor health. The midline exercise therapy consisted of various exercises, such as relaxing the neck extensors, adjusting the body to the midline position with neck flexion, and cortical level exercises involving placing toys on the child's chest and stomach to encourage the child to reach for and grab the toy.

The exercise therapy sessions were conducted for 30 minutes, twice a week for 6 weeks, totaling 12 sessions. The research took place in the physiotherapy gymnasium of the medical rehabilitation at RSUD Haji Surabaya. The patient's gross motor ability was assessed using GMFM (gross motor function measure) sector A, which evaluates the subject's ability to lie down and roll over. GMFM sector A consisting of 17 observations of the child's ability in the supine position. Assessment of each criterion uses a scale of 0-3. If the child cannot do it, they

are given a score of 0, and a score of 3 for children who can do it independently. Data collected included patient characteristics, diagnosis, medical history, and pre- and post-GMFM evaluations. The data collection process involved assessing the GMFM scale before starting the exercise therapy to understand the participants' initial condition, then providing the midline exercise therapy 12 times, and ending with an evaluation of the GMFM scale after 1.5 months of intervention. This research obtained ethical approval from the health research ethics committee of Haji Regional Hospital, East Java Province, with reference number 445/161/KOM.ETIK/2024 dated July 8, 2024.

**RESULT**

The research collected treatment data from 15 patients diagnosed with GDD at the medical rehab polyclinic at RSUD Haji Surabaya. Out of the 15 subjects, 3 were boys and 12 were girls, with the average age of all subjects being 13.1 months. The diagnosis of GDD was confirmed through examinations by a pediatrician and a specialist in physical medicine and medical rehabilitation at the hospital. The risk factor for GDD is 50 percent due to birth factors (premature rupture of membranes, prolonged period) and 50 percent due to postnatal factors (pain, seizures, heat) Gross motor skills were assessed using GMFM sector A, which evaluates the subject's ability to lie down and rollover. Each participant showed an increase in GMFM values after the physiotherapy session (figure 1). Prior to treatment, the mean GMFM was  $4.2 \pm 2.8$ , and after treatment, the mean GMFM was  $6 \pm 2.2$  (figure 2). The paired t-test was used for the difference test, as the data is normally distributed, yielding a result of  $p=0.000$ . Based on these findings, it can be concluded that midline exercise therapy improves gross motor skills in children with GDD at Haji Hospital Surabaya.

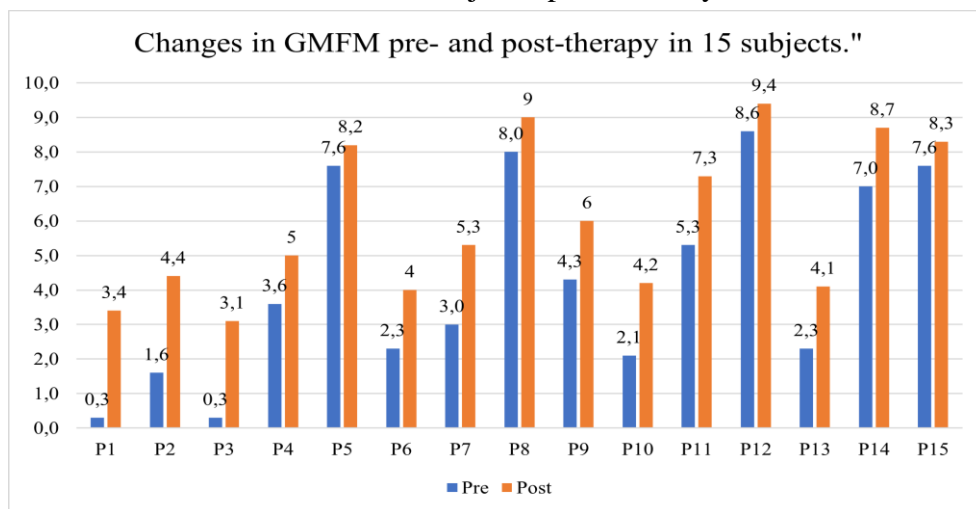


Figure 1: GMFM pre- and post-treatment for each subject

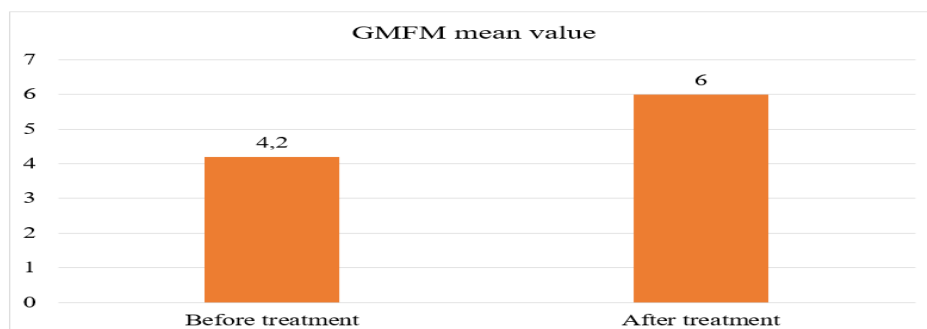


Figure 2: Changes in mean GMFM before and after treatment

Table 1.  
Statistical analysis

Variable	Mean	Paired t test pvalue
GMFM before treatment	4,2±2,8*	0,000
GMFM after treatment	6±2,2*	

## DISCUSSION

According to the results of the measurement of self-efficacy levels at Pandan Arang Hospital, the majority of respondents showed a high level of self-efficacy, namely 90 respondents (74.4%). In line with research conducted by Fatmawati, Suprayitna, and Istianah, (2021), our results of 22 respondents showed a high level of self-efficacy, namely 22 respondents or 73.3% of the total. This study found that age, gender, education level, and experience can be factors causing low self-efficacy in Mambalan Village. The results show that most people are aged 41 to 60 years. A person who has good experiences will have better health and be more motivated to live a healthier lifestyle. Conversely, people who have bad experiences will have lower health and motivation. The self-efficacy that is felt is the ability of a person to plan and apply effective behavior to achieve the desired results in various conditions that influence their lives and estimate the efforts and perseverance needed to achieve their life goals (Fajar & Aviani, 2022).

In the study of (Khoirunissa et al., 2023) it was found that 48 people with hypertension at the Ragunan Village Health Center showed high self-efficacy, namely 51.1% of respondents. The study states that high self-efficacy can describe a strong understanding of a person's potential so that they can carry out good health care and behavior. According to Bandura's 1994 theory, signs of individuals who have low self-efficacy are difficulty doing tasks, not trying to solve problems, not being able to learn from the past, being anxious, often stressed, and depressed. Conversely, individuals who have high self-efficacy are more active and creative in solving problems, which allows them to avoid stress and depression and achieve their best work results (Mahsunah & Musbikhin, 2023). Based on the results of measuring the quality of life in chronic kidney failure patients undergoing hemodialysis at Pandan Arang Hospital, the most results were with moderate quality of life, namely 77 respondents (63.6%). This is the research of (Enggraini et al., 2023) conducted at the Telaga Dewa Health Center, Bengkulu City, which showed moderate quality of life with 24 respondents (52.8%). It is stated that individuals are expected to participate in social activities to improve social interaction with their environment to maintain quality of life.

In the study of (Imanda & Susanti, 2024) the results of respondents with moderate quality of life were 42 respondents (71.2%). Self-care, medication, and diet are important factors in the quality of life of individuals suffering from type 2 diabetes mellitus at the Batu Panjang Rupa Riau Health Center. Many individuals who do not comply with these controls cause physical and mental disorders, which lead to a worse quality of life. A person's perception of their position in their life is known as quality of life. Both from the cultural context where they reside and engage in daily life, along with their aspirations, expectations, and standards focus of life relate to several aspects (aspects of physical, psychological, social, and environmental conditions in everyday life) (Ariyanto et al., 2020). The definition of quality of life according to the World Health Organization of Life Group (WHOQOL Group) theory is a person's perception of their function in their life based on the values and culture of the place where they live, relationships with others, carrying out their life goals, expectations, applicable rules, Physical well-being, mental condition, degree of independence, social connections, beliefs,

and more. Quality of life is a personal assessment made in the context of the environment, culture, and society (Umam et al., 2020).

The ongoing research findings concerning chronic kidney failure patients receiving haemodialysis at Pandan Arang Regional Hospital indicate a the relationship between self-belief and patients' quality of life. With a significant Spearman test result of with a value of 0.001 ( $p < 0.05$ ), it can be concluded that the null hypothesis is rejected, suggesting a connection between self-efficacy and quality of life. Patients with higher self-efficacy are likely to enjoy a better quality of life. In this research, it is in accordance with research conducted by (Dariska et al., 2023), the findings reveal a p-value of 0.002, which is less than 0.05, which signifies a notable correlation Between self-confidence and the standard of living among patients with cervical cancer. Additionally, the correlation coefficient achieved is 0.429, suggesting a moderate positive the connection between self-belief and the quality of life of these patients. In the study conducted by (Manuntungi, 2023), a significant association was found between self-confidence and the quality of life of patients. The recorded value of 0.005 falls below both 0.05 and 0.01, suggesting that increased levels of self-belief contribute to the maintenance of quality of life in individuals dealing with hypertension. An enhanced belief in one's abilities motivates patients to engage in constructive behaviours and pursue recovery following various treatment processes, ultimately leading to an improvement in their quality of life.

In the research conducted (Suardana et al., 2020) the Spearman Ranks test result is 0.05, so there is a strong relationship between self-efficacy and the quality of life of COPD patients at RSUD Mangusada Badung and the correlation coefficient value ( $r$ ) is 0.649. The better the self-efficacy, the patient will be able to take care of themselves and the quality of life will increase. Conversely, if self-efficacy is lacking, the condition will worsen and the quality of life will decrease. Research (Munir et al., 2020) in patients with type 2 diabetes militus in the internal room of the Makassar City General Hospital, the better self-efficacy, the better the quality of life. Self-efficacy can be an independent intervention to improve the patient's quality of life. The connection the relationship between self-belief and quality of life is particularly robust, as Self-efficacy plays an essential role in influencing an individual's quality of life. The more confident a person is in their ability to confront challenges or problems and achieve their desired objectives, the better their quality of life tends to be. This can be observed in aspects such as stress management, health maintenance, building social relationships, and achieving personal goals.

## **DISCUSSION**

The study involved 15 pediatric patients diagnosed with GDD (Global Delayed Development) by pediatricians. The average age of the patients was 13.1 months. All patients exhibited impaired head control and midline head orientation. After undergoing midline exercise therapy for 12 sessions (approximately 1.5 months), there was an improvement in head control, leading to enhanced gross motor skills as measured by GMFM sector 1. The mean GMFM value increased from 4.2 to 6, and the statistical results were significant. The midline exercise therapy involved positioning the patient's head and body in a straight line and providing relaxation to the neck and trunk extensor muscle groups to help the patient center their body at the midline (Hong, 2014). Additionally, toys and activities with bright colors and attractive sounds were used to stimulate the cortical level and improve gross motor skills (Hong K. , 2018).

Relaxation of the neck and trunk extensor groups is a crucial preparatory stage, especially for children with gross motor disorders such as GDD, as they often experience changes in their

body's midline position (Hong K. , 2018). It is essential for these children to relax their neck extensor group, as it allows them to consciously and purposefully position and control their head in the middle of their body (Sant, 2021) (Bingöl, 2018). By releasing tension in the neck extensor muscles, it becomes easier for the child to position their head according to the midline anatomical position (Hong, 2014). According to the theory of children's movement development, head control is a significant factor for further movement development (Shin, 2020) (Lacey, 2015). Children with impaired head and body orientation in the midline position will face difficulties in rolling, sitting, and walking (Sun, 2017). Head control depends on the reciprocal cooperation of the flexor and extensor muscles of the head, without dominance on one side (Lima, 2014). The 15 children with GDD included in this research experienced this orientation disorder. When positioned in the supine position, children tend to rotate or extend their head and neck, impacting the general muscle tone of the neck. To address this, patients were given relaxation in the extensor group at the beginning of therapy, with the hope of achieving a balance in the performance of the flexor and extensor muscles in the neck and head (Shakya, 2022).

Positioning the body correctly while lying on the back and engaging the deep neck flexor muscles will strengthen the ventral postural muscles, including the core abdominal muscles (Cruz, 2017). This will help stabilize the child's midline, allowing for more coordinated movements of the hands and feet, improved attention and eye contact, and easier initiation of rotational movements (John, 2022). Positions that engage the stabilizing muscles in the body's midline are crucial for the overall development of gross motor skills while lying on the back (Wadee, 2020). After 12 treatments using the midline concept, it was observed that almost all patients were able to position their heads in the middle of the body, as evidenced by an increase in the GMFM value in the supine position. The second stage of midline training involves training babies to look at and observe toys in the middle position of their body (Sun, 2017). This exercise can be referred to as cortical-level training or cortical stimulation (Sun, 2017). The goal of this exercise is to familiarize the baby with positioning their head and body on the midline by using toys as training aids (Hong K. , 2018). Toys are essential for motivating babies to move (Artemova, 2023) (Hong K. , 2018). By placing toys in the midline position, babies become interested in observing their favorite toys, which helps in establishing stability in their posture, specifically the connection between the baby's head-neck and body (Sun, 2017). This, in turn, enhances the baby's ability to move through their normal developmental stages (Ha, 2021). The study has shown that there is an increase in gross motor skills in the rolling sector, as indicated by the increase in the average GMFM.

The improvement in gross motor skills observed in this study is attributed to the repetitive nature of the training. Continuous and structured stimulation and exercise therapy can enhance movement memory (Dinse, 2018). According to the concept and theory of motor learning, repeated practice increases nervous system activity, leading to short-term potentiation and well-stored memory of the movements taught to children (Ohno, 2011). In this study, the repetition involved two physiotherapy sessions per week for six weeks, with each session lasting for 30 minutes.

The increase in gross motor skills in respondents is possible because children understand the midline position, which makes movements in the middle of their body stable and synchronous (Persha, 2004). This makes it easier to recruit the muscles of the middle part of the body, especially the co-contraction of the extensor and flexor muscles of the neck, which in turn makes it easier for children to move rotationally and leads to an increase in their gross motor skills (Persha, 2004). Some improvements in the lying sector include lying on the back,

bringing the fingers of both hands together on the midline of the body, and performing right and left hip and knee flexion at full range of motion. These two positions are the basis for gross motor development and movements in the advanced phase (Kobesova, 2014). This study's results align with findings from case study research (Abdullah, 2022), indicating that midline exercise therapy can enhance children's gross motor skills during the supine phase. The intervention involved 12 sessions over the span of one month, leading to significant improvements in the gross motor skills of children with cerebral palsy when positioned supine. The child's ability to recognize the center of their body is also enhanced by cortical-level training (Abdullah, 2022), (Hong J. S., 2014). In this exercise, the child attempts to look at a toy placed below their head while in a supine position (Hong J. S., 2014). This activity helps in setting and maintaining their position while stabilizing themselves, as the child is motivated to focus on the toy located at the inferior or caudal side (Abdullah, 2022). A weakness of this research is that researchers cannot control the subjects' activities at home, how parents treat their children, and the nutritional and medical factors given to children. Subsequent research could incorporate a control group to establish a valid cause-and-effect relationship.

## **CONCLUSIONS**

Midline exercise therapy enhances gross motor skills in children with global delayed development (GDD) at RSUD Haji Surabaya.

## **REFERENCES**

- Abdullah, K. (2022). Studi kasus: terapi latihan midline pada anak dengan CP spastic quadriplegia . *Jurnal Sinar Kebidanan* , 12-18.
- Agarwal, D. (2018). Prevalence of Developmental Delay and Factors Affecting. *National Journal of Community Medicine* , 11-17.
- Ali, M. S. (2019). Impact of core stability education on postural control in children with spastic cerebral palsy. 24(2).
- Artemova, L. (2023). The choice of toys by early childhood children. *Amazona Investiga* , 34-39.
- Bingöl, H. (2018). Effects of functional massage on spasticity and motor functions in children with cerebral palsy: a randomized controlled study. *Journal of Physical Therapy Science* , 135-142.
- Choo, Y. Y. (2019). Developmental delay: identification and management at primary care level. *Singapore Medical Journal* , 119-123.
- Cruz, S. P.-d. (2017). Cerebral palsy and the use of positioning systems to control body posture: current practices. *Neurologia*, 610-615.
- Dannenbaum, E. (2016). Vestibular Assessments in Children With Global Developmental Delay: An Exploratory Study . *Pediatr Phys Ther*, 171-178.
- Dinse, H. R. (2018). Repetitive Sensory Stimulation—A Canonical Approach to Control the Induction of Human Learning at a Behavioral and Neural Level. *Handbook of behavioral neuroscience*, 318-413.
- Dumuids-Verne, M.-V. (2022). Effects of Early Motor Interventions on Gross Motor and Locomotor Development for Infants at-Risk of Motor Delay: A Systematic Review. *Frontiers in pediatric*, 22-34.
- Formiga, C. K. (2015). *Motor Skills: Development in Infancy and Early Childhood*. Volume 15(2nd edition, ).
- Ha, S. Y. (2021). Vojta Approach Affects Neck Stability and Static Balance in Sitting

- Position of Children With Hypotonia. *Int Neurolog J* , 90-95.
- Himmelman, E. B. (2006). Gross and fine motor function and accompanying impairments in cerebral palsy. . *Dev Med Child Neurol*, 417-423.
- Hong, J. S. (2014). Cerebral Palsy Treatment Ideas from Normal Development. Korea .
- Hong, K. (2018). Tactile Toys: Therapy for Tactile Dysfunctions. *International Journal of Technology and Inclusive Education (IJTIE)*, Volume 7, Issue 2,.
- John, O. (2022). Global Developmental Delay and Assisting your Child in Improved Growth and Development. *Counsel Ling Journal* , 40-46.
- Kobesova, A. (2014). Developmental kinesiology : Three levels of motor control in the assessment and treatment of the motor system. . *Journal of Bodywork and Movement Therapies*, ., 23-33.
- Lacey, J. L. (2015). The early development of head control in preterm infants. *Early Human Development*, 199-212.
- Liang, X. (2021). Effectiveness Of Exercise Interventions For Children With Cerebral Palsy: A Systematic Review And Meta-Analysis Of Randomized Controlled Trials. *J Rehabil Med*, 2733.
- Lima, C. d. (2014). Early Development of Head Movements Between Birth and 4 Months of Age: A Longitudinal Study. *Journal of Motor Behavior*, 17-24.
- Manggau, A. (2020 ). Developing the Gross Motor Skills of Children by Simultaneously Training. *Journal of Educational Science and Technology*, page 205-216.
- Mitiku, K. (2023). Gross motor developmental delay and associated factors among under-five children attending public health facilities of Dessie city, Ethiopia. *BMC Pediatrics* , 1-8.
- Ohno, T. (2011). Short term plasticity and long term potentiation mimicked in single inorganic synapses. *Nature Materials*, 17-24.
- Persha, A. J. (2004). Visual Stimulation activities for infant and toddlers. India : National institute for mental handicap.
- Sant, N. (2021). Effectiveness of Early Physiotherapy in an Infant With a High Risk of Developmental Delay. *Cureus Journal* , 13-19.
- Shakya, S. (2022). Physiotherapy interventions for head and trunk control in children with developmental disabilities. *PMC Pubmed Central*, 23-28.
- Sharma. (2023). The Etiological Profile of Global Developmental Delay at a Tertiary Care Hospital in India: An Observational Study. *Cureus*, 23-28.
- Shin, H. L. (2020). Delayed Development of Head Control and Rolling in Infants . *Frontiers In Pediatric* , 65-71.
- Sun, H. J. (2017). New Ideas of Treatment for Cerebral Palsy I Capital Flexion of the Neck: The Key Link in Prematurity Treatment. *Journal Of Health Sciences*, 12-19.
- Veldman, S. (2019). Associations between gross motor skills and cognitive development in toddlers. *BMJ Open Sport* , 39-44.
- Veldman, S. L. (2016). Efficacy of gross motor skill interventions in young children. *BMJ OPEN Sport & Exercise medicine* , 1-7.
- Wadee, A. N. (2020). Influence of prone positioning on gross motor development in children with Spastic Diplegic Cerebral Palsy . *Journal of Advanced Pharmacy Education & Research*, 40-47.