

# The Efficacy of Lycra Garments in Children with Cerebral Palsy at Queen Sirikit National Institute of Child Health

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## Abstract

There are 3.7 million disabled people in Thailand or 5.5 % of the nation's population. About 140,000 are disabled children under the age of 15 (Office of Statistics, 2017) [1]. Cerebral Palsy (CP) is the most common motor disability of childhood. The incidence of CP is estimated to be 2 - 2.5 per 1,000 live births in developed countries, 1.5 - 5.6 per 1,000 live births in developing countries, and 2-7 per 1,000 live births in Thailand [2]. CP is a condition with impaired brain function that controls the movement system and causes muscle spasms commonly occur in 70 % to 80 % of children with disabilities. If left untreated, a complication may develop and cause permanent disabilities or limb deformation [3,4]. Several interventions were implemented to reduce the risk or severity of CP and prevent complications. Appropriate treatments [5,6] can restore function and improve motor skills which can help them reach their full potential and reduce caregiver burden. They were close-fitting suits which are measured to fit each individual. It has been recommended for CP children with athetosis, hypotonia, or spasticity. The goals are to reduce muscle contracture, improve postural alignment, proximal stability, and other body functions [9,10]. Parents of CP children encouraged their child to wear Lycra garments at home as a complementary treatment method [11]. Some studies from Virginia Knox [12] showed that half of CP children who achieved a wear time of 4 hours a day for 4 weeks had improved body balance, while the rest withdrew from the trial because of discomfort. After collecting feedback through an in-depth and semi-structured interview, cerebral palsy specialists and caregivers found that the garment should be wearable in hot and humid weather like in Thailand, easy to care and budget-friendly to encourage regular wear for more effective results. Based on this review, epidemiological evidence is needed for the clinical decisions on whether such garments are beneficial for CP children. However, there are only a few pieces of literatures available to inform these decisions. Therefore, QSNICH conducted this study to expand further epidemiological evidence on the efficacy of the use of Lycra garments in CP children.

## Objectives

- 1) To evaluate the clinical effects of Lycra garments on the posture and balance of CP children.
- 2) To evaluate product satisfaction, acceptance, and life quality of CP children before and after using the Lycra suits.

**Keywords:** lycra garments, children with cerebral palsy

## Material and Methods

### 1. Garment Materials

The garments were not only designed to meet the requirement of functionality, but also provide comfort to users. Power net fabric was selected to make the garment. It is strong enough for girdles and compression garments, which appropriate for postural corrections. Its honeycomb jacquard structure and tiny holes give the fabric an excellent air permeability with its OEKO-TEX standard. Various fastening devices (fasteners) including zips, hooks, and Velcro were added to the garment making it easier to put on and take off. Plastic

boning was sometimes used in specific parts for additional support over the trunk and posture in a sitting position.

### 2. Assessment Test

Physical therapists applied several clinical assessments before and after the completion of the intervention as follows:

**2.1 Functional Balance Grade [13] which consists of 5 levels from low to high:** level 0 (inability to balance posture), level 1 (still position which needed considerable assistance, level 4 (maintain

steady balance without handhold support.)

**2.2 Gross Motor Function Measure: (GMFM 66) [14]:** Children were assessed using the Gross Motor Function Measure (GMFM) which assesses gross motor abilities of children with cerebral palsy in five dimensions: (1) lie and roll, (2) sit, (3) crawl and kneel, (4) stand, and (5) walk, run, and jump. Assessing posture and balance at pre-trial and during trial of the participants. Additional surveys were distributed to the patient’s caregiver to measure their satisfaction and quality of life of their child after the trial:

**2.3 Satisfaction survey was distributed to parents at post-trial to measure:** ease of use, postural improvement and attitude which are assessed as follows: 1= poor; 2= fair; 3=good; and 4= very good.

**2.4 The Cerebral Palsy Quality of Life for Children-Thai version (CP QOL-Child Thai version) [15]:** was applied before and after wearing the garments.

**2.5 Sampling criteria**

The inclusion criteria were CP children as follows:

- A diagnosis of cerebral palsy
- Age between 3 - 10 years
- CP type of athetoid and diplegia
- Symptoms severity is at level 3-4 of Gross Motor Function Measure Classification System (GMFCS)
- No other complications: e.g., seizures vision or hearing impairment (Vision and hearing screening are performed by a specialist)
- Visited a physical therapist one time per week.

**Children were divided into 2 groups:** Five CP children in experimental group were asked to wear the garments during the trial, while five CP children in control group received only conventional exercise therapy without wearing the garments.

**Method**

**Research Design**

**Table 1:** Interpretation of Functional Balance Grades. The IRR (inter-rater reliability ) at pre-and post-trial of the target groups were measured by two specialists. The kappa statistic was used to test inter-rater reliability (Kappa values = 0.8)

<b>Normal Level 4</b>	<b>Static:</b> Patient able to maintain steady balance without handhold support  <b>Dynamic:</b> Patient accepts the maximal challenge and can shift weight easily within full range in all directions
<b>Good Level 3</b>	<b>Static:</b> Patient able to maintain balance without handhold support, limited postural sway <b>Dynamic:</b> Patient accepts the moderate challenge; able to maintain balance while picking an object off the floor
<b>Fair Level 2</b>	<b>Static:</b> Patient able to maintain balance with handhold support; may require occasional minimal assistance <b>Dynamic:</b> Patient accepts the minimal challenge; able to maintain balance while turning head/trunk
<b>Poor Level 1</b>	<b>Static:</b> Patient requires handhold support and moderate to maximal assistance to maintain position <b>Dynamic:</b> Patient unable to accept a challenge or move without the loss of balance
<b>Level 0</b>	<b>Static:</b> Patient inability to balance posture <b>Dynamic:</b> Patient unable to accept move without the loss of balance

A repeated measures design: pre-and post-intervention Assessments were conducted in the experimental and control group to measure Functional Balance Grade, GMFM 66, and CP QOL-Child. Intervention Protocol: The garments for children in the experimental group were adjusted to fit each individual. They were asked to put the garment on for 40-60 minutes and observed if there were any whether numbness, pain, or irritation caused by constriction and pressure on any part of the suit or if the children could move or change into various positions easily. The suits were adjusted at a specific point that was not concise. Cleaning and usage instructions were provided to the sample

group: handwashing is best to prevent excessive wringing and stretching. If using a washing machine, place the spandex garments in a mesh lingerie bag and use the gentle cycle. Use a mild detergent that contains no chlorine bleach and air-dry the garment away from direct heat and sun.

1. The experimental group was asked to wear a Lycra garment for 6-8 hours per day for 6 weeks. It could be taken off if there were any irritation, discomfort, or difficulty breathing, and put on again after the symptoms disappear until achieved the scheduled baseline time. The trial was monitored and reported to the

researchers every week.

- At the end of the intervention, both groups were asked to complete Functional Balance Grade, GMFM 66, satisfaction survey, and quality of life assessment.

### Study Participants

Ten CP children who visited the Child Development Centre at Queen Sirikit National Institute of Child Health (QSNICH) between January 1 and December 31, 2019, were enrolled. All of them were divided into two groups. Informed consent was obtained from parents.

### Statistical Analysis

T-test was used to compare the pre-and post-intervention results.

### Ethics

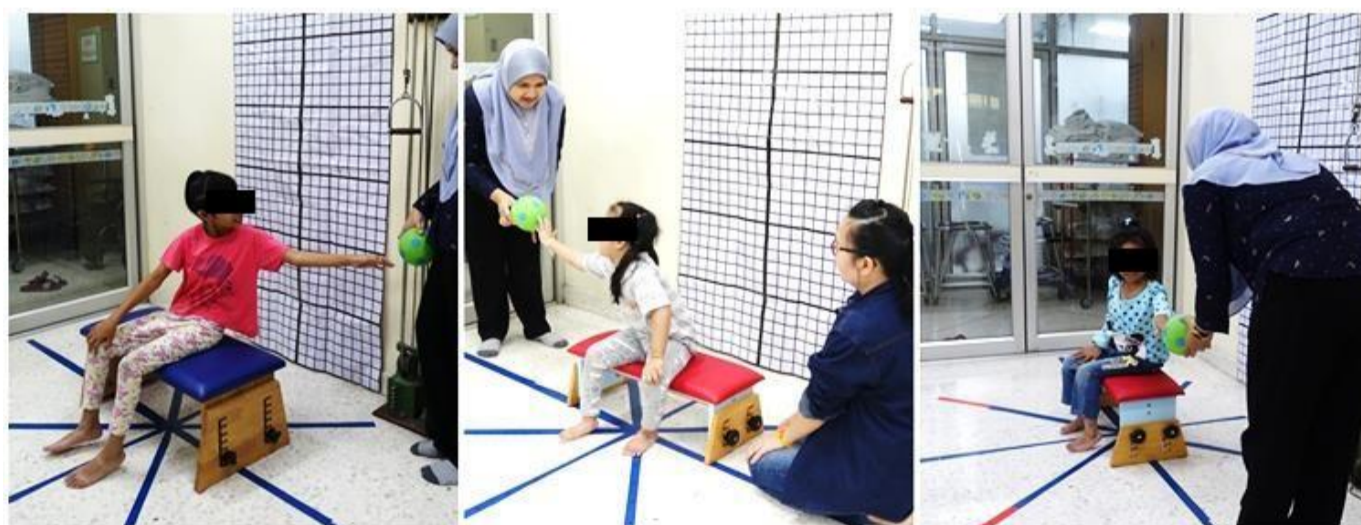
The present study was approved by the Office for Ethics in Human

Research, Ministry of Public Health, Thailand in 2017 (Ref. Code. 60- 039) and was conducted in accordance with the Declaration of Helsinki. Case 1 and 2 were CP children with athetoid. Their Functional Balance Grades were in level 3 (improvement in sitting balance after wearing the bodysuit) and improved to level 4 after wearing the suit. They were able to maximize the range of motion in all directions as shown in (Table 2)(Figures 1 and 2) showed the result of CP children with diplegias (Case3 to 5) before and after the intervention. During the trial, their sitting balance was improved from level 3 to level 4 (able to sit with the torso straight but still having trouble reaching to the left with the back slightly tilt to the left). After wearing the suit, the patients were able to maintain steady balance and widen the range of motions in all directions.

### Results

**Table 2:** Comparing of the balance ability between the experimental and control group

Experimental	Functional Balance Grade			Control	Functional Balance Grade		
	Posture	Before	After		Posture	Before	After
Case 1	Static	Level 3	Level 4	Case 1	Static	Level 3	Level 3
	Dynamic	Level 3	Level 4		Dynamic	Level 3	Level 3
Case 2	Static	Level 3	Level 4	Case 2	Static	Level 3	Level 3
	Dynamic	Level 3	Level 4		Dynamic	Level 3	Level 3
Case 3	Static	Level 3	Level 4	Case 3	Static	Level 3	Level 3
	Dynamic	Level 3	Level 4		Dynamic	Level 3	Level 3
Case 4	Static	Level 3	Level 4	Case 4	Static	Level 3	Level 3
	Dynamic	Level 3	Level 4		Dynamic	Level 3	Level 3
Case 5	Static	Level 3	Level 4	Case 5	Static	Level 3	Level 3
	Dynamic	Level 3	Level 4		Dynamic	Level 3	Level 3



**Figure 1:** Functional Balance Grades of the experimental group before the intervention



Figure 2 Functional Balance Grades of the experimental group after the intervention

Table 3: Gradual improvement of gross motor abilities

Experimental Group	Lying and rolling		Sitting		Crawling, kneeling		Standing		Walking, running, jumping		Mean±SD	P<=0.05
	Before %	After %	Before %	After %	Before %	Before %	Before %	After %	Before %	After %		
1	26.19	38.09	80.00	86.67	86.10	88.24	71.79	66.67	37.50	45.60	62.68±23.66	0.035*
2	95.24	97.62	88.33	96.67	95.00	96.00	71.80	81.79	33.06	54.44	81±21.83	0.013*
3	83.33	98.86	92.16	98.33	90.24	96.08	53.85	58.97	16.66	36.66	72.51±29.19	0.087
4	73.81	83.81	92.00	93.33	92.16	100.00	15.13	25.38	18.34	39.50	63.35±34.61	0.110
5	95.24	97.26	92.33	96.00	100.00	100.00	33.33	43.33	21.40	40.0	71.89±32.72	0.002*
Mean ± SD	74.76±25.58	83.12±23.17	88.96±4.72	94.2±4.10	92.7±4.66	96.06±4.29	49.18±22.16	55.22±19.41	25.39±8.33	43.24±6.31		
Control Group	Lying and rolling		Sitting		Crawling, kneeling		Standing		Walking, running, jumping		Mean± SD	P<=0.05
	Before %	After %	Before %	After %	Before %	Before %	After %	After %	Before %	After %		
1	82.30	84.50	81.20	82.50	28.90	30.25	72.30	71.03	35.45	37.68	60.61±24.21	0.314
2	96.3	97.0	86.70	88.00	93.20	92.70	72.65	73.58	40.36	43.28	78.38±21.05	0.275
3	90.00	91.00	90.12	91.30	82.50	83.76	52.91	53.42	18.54	22.69	67.62±28.76	0.087
4	89.98	90.10	91.65	92.50	75.20	76.83	18.85	19.86	0.00	0.00	55.50±40.39	0.297
5	96.00	95.00	91.50	90.12	94.63	95.20	32.50	34.62	0.00	0.00	62.96±41.33	0.086
Mean ± SD	90.92±5.11	91.52±4.33	88.23±3.94	88.88±3.52	74.89±24.07	75.75±23.67	49.84±21.43	50.50±20.75	18.87±17.02	20.73±18.22		
P<=0.05	0.031*		0.014*		0.117		0.093		0.004*			

(Table 3) shows a gradual improvement of gross motor abilities particularly on sitting, crawling, and kneeling, walking, running, and jumping of Case 1 and 2. The results before and after the intervention of participant 3 in the experimental group were improved. Lying, rolling, crawling, and kneeling abilities were better while wearing the suit and got higher scores during the trial. The GMFM66 showed a significant change in sitting, rolling, running, and jumping. However,

there were no significant changes in standing, crawling, and kneeling after the end of the trial. The results before and after the trial of the experimental group were significantly different, while the results of the control group had no significant differences statistically. The garment satisfaction survey was done by caregivers of 5 CP children with diplegia who wore the 3<sup>rd</sup> version of the suit for 6-8 hours per day for 6 weeks as shown in (Table 4).

**Table 4:** Satisfaction survey towards the use of the suits

CP Children	Satisfaction Rating		
	Function	Body	Psychology
Participant 1	Good	Good	Good
Participant 2	Very good	Poor	Very good
Participant 3	Good	Good	Very good
Participant 4	Good	Good	Good
Participant 5	Very good	Very good	Very good

The life quality of 5 CP children aged between 4-12 years old were increased at the end of the trial. The overall score of post-trial were higher than pre-trial as shown in the (Table 5 and Table 6). Parents were given an instruction before responding to the survey. The survey focused on children's attitude, not what they could do or could not do consisting of 10 areas:

1. Feelings toward friends and family (Total score of 144 points, pre-trial mean score = 88 points, post-trial mean score = 120 points, P = 0.001)
2. Social engagement (total score was 45, pre-trial mean score = 31 points, post-trial mean score = 39 points, with a significant difference of P = 0.001).
3. Communication Skills (Total score of 27, pre-trial mean score = 15.4 points, post-trial mean score = 6 points with a significant difference (P = 0.001).
4. Health (Total score = 90 points, pre-trial mean score = 54 points, post-trial mean score = 73 with significantly different of P = 0.003)
5. Feeling of body functions (Total score = 27 points, pre-trial

mean score = 18, post-trial mean score = 23.6 points with significant difference of P = 0.002)

6. Feelings towards daily life (Total score = 27, pre-trial mean score = 15.4, post-trial mean score = 22.85 with significant difference of P = 0.001)
7. Pain, annoyance, or boredom (Total score = 77 points, pre-trial mean score = 38 points, post-trial mean score = 21 with a significant difference of P = 0.001)
8. Service access (Total score = 54 points, pre-trial mean score = 21.4 points, post-trial mean score = 25.6 points, significant difference (P = 0.004)
9. Parents health (Total score = 36 points, pre-trial mean score = 23.8 points, post-trial mean score = 30.4 points, a significant difference (P = 0.003)
10. Parents confidence in responding to how your child feels. (Total score = 9 points, pre-trial mean score = 7.8 points, post-trial mean score = 8.8 with a significant difference of P = 0.008)

**Table 5:** CPQPL [15] - Child results of children aged 4-12 years.

Case Experiment		1. Feeling towards family and friends	2. Social participation	3. Communication	4. Health	5. Feelings towards gross mobility functions	6. Feelings towards ability to live a daily life	7. Pain or irritation	8. Access to services	9. Parents' health	10. Parents' confidence towards the answers		
Total scores		144	45	27	90	27	27	77	54	36	9	Mean ± SD	P ≤ 0.05
1.	Before	99	30	18	63	15	19	36	24	25	7	33.6±27.56	0.003*
	After	125	40	22	85	22	23	22	27	30	9	40.5±36.11	0.002*
2.	Before	85	31	15	48	18	13	35	22	23	7	29.7±22.79	0.001*
	After	110	40	20	65	22	21	20	27	28	9	36.2±30.07	0.000*
3.	Before	80	34	13	53	20	17	40	19	28	6	31±22.10	0.004*
	After	115	38	21	72	23	22	23	25	32	9	38±31.84	0.006*
4.	Before	98	28	16	48	17	15	43	20	22	7	31.4±26.63	0.001*
	After	120	36	22	70	25	23	18	24	29	8	37.5±33.29	0.002*
5.	Before	82	32	15	61	20	13	40	22	21	8	31.4±23.55	0.010*
	After	130	42	23	75	26	25	22	25	33	9	41±35.88	0.009*
<b>Case-Control</b>													
1.	Before	80	25	25	55	17	16	32	28	25	9	31.2±21.08	0.394
	After	85	25	27	55	18	14	29	28	25	9	31.5±22.44	0.621
2.	Before	92	28	22	60	19	22	50	30	28	9	36±24.68	0.799
	After	92	29	21	61	20	20	48	31	29	9	36±24.71	0.799
3.	Before	88	27	20	70	21	20	48	32	30	8	36.4±25.07	0.070
	After	87	27	18	72	22	18	49	32	31	7	36.3±25.54	0.109
4.	Before	95	30	18	50	21	21	63	45	33	7	38.3±26.02	0.394
	After	95	31	19	48	21	20	60	44	34	7	37.9±25.54	0.621
5.	Before	87	35	17	60	24	22	50	47	32	6	38±23.74	0.847
	After	88	34	18	62	24	23	52	48	28	6	38.3±24.34	0.374

**Table 6:** shows the means of CPQPL [15] - Child results before and after the trial

		Case Experiment After- Before Mean ± SD	Case-Control After- Before Mean ± SD	p-value
1.	Feelings towards family and friends	31.2±10.57	1.0±2.3	0.004*
2.	Social participation	8.2±2.49	0.2±0.84	0.003*
3.	Communication	6.2±1.79	0.2±1.64	0.010*
4.	Health	18.8±3.42	0.6±1.67	0.001*
5.	Feelings towards gross mobility functions	5.6±2.07	0.6±0.55	0.010*
6.	Pain or irritation	7.4±3.13	-1.2±1.30	0.001*
7.	Access to services	-17.8±4.32	-1.0±2.35	0.001*
8.	Access to services	4.2±1.30	0.2±0.84	0.005*
9.	Parents health	6.6±3.21	-0.2±2.17	0.045*
10.	Parents' confidence towards the answers	1.8±0.84	-0.2±0.45	0.022*

## Discussion

The development of motor and sensory skills of CP Children is different from normal children [3]. CP Children should be treated early to improve balance and muscle spasms. The development of intervention and technology was recommended to help loosen the muscles, stretch the muscles and joints, maintain a normal posture, prevent joint symptoms and future complications [20]. This research started with problem- focused which led to the development of lycra garments and intervention testing after using the garment. Standardized and non-standardized assessment tools were implemented to measure the pre-and post-trial outcomes [9,11,16,18,19,20,21,22] such as gross motor function, clinical observation, satisfaction survey, customer acceptance questionnaire [12]. The familiarization period of 1 week allowed children to be prepared to wear the garment for a long period of time. The adjustment occurred after outcome measurement / post-intervention testing [16,12,20,21]. In this study, Functional Balance Grades and GMFM 66 were performed after wearing the garment for 6-8 hours per day for 6 weeks. The results showed improvement in sitting balance: able to sit upright (level 4) and maintain balance after wearing the bodysuit. The results are similar to those of related research that found bodysuits help to maintain balance. The bodysuit is an alternative to support therapy in children with CP [7] developed from Lycra (Dynamic splint) that fits the body. A muscular brace and posture support improve balance and movement for proper limbs, reduce symptoms of muscle stiffness and movement that are out of control. Correct the imbalance of the body and keep the posture in the correct position. Improved stability and walking performance [7,9,10,19]. A literature review [8,9] stated that balance in standing, sitting, walking, running, and comparing before and after wearing a suit were improved at a higher level. The difference is significant after wearing the bodysuit. In comparison with the control group [8,9] studied the effect of the garment on physical mobilities. A trial of 15 children with cerebral palsy who wore Lycra garments showed

improvement not only in physical mobility but social skills and self-care too. Some studies [7] did not show any significant improvement in motor stability. Twenty-four patients aged 15 months to 14 years wore the garment for 4,3, and 6 weeks and assessed based on parental thoughts which showed no improvement by subjective video and measured by spirometry grip. According to the compliance [12] of CP, children found that four people left the study due to discomfort while wearing the suit. Four who completed the trial felt their balance was improved. In contrast, five patients who completed the trial were evaluated by an in-depth interview from parents or experienced specialists, then the bodysuit was adjusted such as materials that heat dissipation suitable for people in Thailand, made from non-stiff fibres, lightweight makes the child feel comfortable, not constrained and a zippered pocket when the child goes to the toilet, giving them more freedom to go to the toilet and help themselves better. The child can wear a normal outfit over the bodysuit and live their normal lives. The materials for the garments were carefully selected to ensure that they will support the body, especially the sitting position.

The fabrics must not cause irritation, stretchy and flexible for long-time wear. Power net fabric has breathable qualities with its honeycomb structure and is finished for moisture management and passed the OEKO-TEX® test according to European standards. It can be used with children from 3 years old. The sample group of cerebral palsy children can wear the prototype bodysuit continuously to reach the baseline without irritation, appropriate for humid and hot climate countries. This is a common problem in children with CP, so the design of the bodysuit

must be convenient and easy to use in order to enhance primary skills and self-help. Caregivers were instructed to clean and care for the bodysuit to keep them in good condition [9,11,16,18]. The appropriate size of the bodysuit and consistent wear help them achieve better balance and move independently while wearing them (Dynamic and independence). The printed pattern of the garments was designed

to attract children to wear them [11,16,20]. Besides clinical assessment, a satisfaction survey was also implemented covering 3 areas: function, body, and psychology. The results of the satisfaction assessment were high. Only one athetoid CP patient-rated low score because of their functional balance grades and severity of spasticity was quite high. The score of quality of life compared to before and after using the bodysuit was significantly different as in other studies. Quality of life is an individual's perception and well-being of the state in their life based on the context of culture and society and in relation to their goals, expectations, standards of society. In daily life, the family should be able to adapt and accept the changes that occur in life. For example, although unable to return to walk as before. However, the quality-of-life questionnaire for children with cerebral palsy was conducted by dividing the quality of life into 10 aspects. From this study, it was found that the quality of life before and after wearing the dress had an added value. It increased significantly in all aspects, assessed through parents as children under 9 years of feeling with friends and family. Social participation Communication Health scores

## Conclusion

Lycra garments were developed as a supportive device for children with cerebral palsy. The results of clinical assessment between the experimental and control groups were statistically significantly different. Functional Balance Grades and GMFM 66 results (sitting, supine, and rolling, walking, running, and jumping) were improved to a normal level. The satisfaction survey showed positive results particularly on ergonomics and aesthetic characteristics. Quality of life in all dimensions was higher after wearing the garment.

## Implementation

The development of innovative textile products for CP children was the integration of textile science technology medical knowledge. The outcome improves the efficiency of existing products, meets the users' needs, enhances the life quality of CP children in Thailand, and reduces the import cost of the products. Children with cerebral palsy are able to help themselves in everyday activities allowing them to use abilities to their fullest potential, continue their learning, develop, and increase chances to grow up into healthy citizens physically and mentally.

## References

1. National Statistical Office: (2019) National Disability Survey 2017.
2. Ubonwon W (2016) Capacity Development of Children with Cerebral Palsy 2016.
3. Dussadee K (2012) Effect of Physical Therapy Treatment by Stimulating the Motor Development in Thammasat University

were 90 points in terms of the feeling of use of parts of the body as well as a feeling of pain, annoyance, or boredom significantly ( $P = 0.007$ ) as well as feelings of access to services. Parental health Compare the quality-of-life studies among cerebral palsy among adults. The relationship between personal factors in terms of age, factors related to the quality of life are age, duration of the disability. Older people with disabilities tend to have a lower quality of life than younger disabled people, because of higher levels of dependencies. They often find themselves a burden to their families and society [22]. Population with longer periods of disabilities tend to have better life quality rather than those who do not found that the duration of disability is positively correlated with quality of life [23,24]. Children with cerebral palsy are supported and accepted by family, received continued therapy with family participation which allows them to adjust themselves better. Moreover, the therapy can be practiced at home which leads to life quality development in various dimensions.

## Study Limitations

The sample group is CP children with Athetoid and Diplegia (GMFCS at level 3-4) The garments were not very effective for CP children with severe spasms, nor applicable to other motor impairments. An analysis in this study only focused on the balance in a sitting position, not other posture movements such as balance standing and walking. The duration of the test should be studied over a longer period of time. A clinical evaluation should be performed after the trials complete to determine whether the clinical effect is still persistent.

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4. Romeo DM, Specchia A, Sini F, Bompard S, Di Polito A et al. (2018) Effects of Lycra suits in children with cerebral palsy. *Euro J pediatr neurol* 22(5): 831-836.
5. Tilton A (2009) Management of spasticity in children with



- cerebralpalsy. *Seminars in Pediatric Neurology*. 16(2): 82-89
6. Trabacca A, Vespino T, Di Liddo A, Russo L (2016) Multidisciplinary rehabilitation for patients with cerebral palsy: improving long-term care. *Multidisciplinary Healthc*. 9(1): 455–462.
  7. Blair E, Ballantyne J, Horsman S, Chauvel P (1995) A study of dynamic proximal stability splint in the management of children with cerebral palsy. *Dev Med Child Neurol* 37(6): 544-554.
  8. Marcucci A, Edouard P, Loustalet E, d'Anjou MC, Gautheron V, et al. (2011) Efficiency of flexible derotator in walking cerebral palsy children. *Annals Phys and Rehabil Med*, 54(6): 337-347.
  9. Nicholson JH, Morton RE, Attfield S, Rennie D (2001) Assessment of upper limb function and movement in children with cerebral palsy wearing lycra garments. *Dev Med Child Neurol* 43(6):384-391.
  10. Rennie DJ, Attfield SF, Morton RE, Polak FJ, Nicholson J (2001) An evaluation of lycra garments in the lower limb using 3-D gait analysis and function assessment (PEDI). *Gait Posture* 12(1): 1-6.
  11. Lochlainn, D.E.N (2005) Dynamic lycra splinting for children with cerebral palsy. NHS Quality Improvement Scotland.
  12. Knox V (2003) The Use of Lycra Garments in Children with Cerebral Palsy: a Report of a Descriptive Clinical Trial. *British Journal of Occupational Therapy* 66(2): 71-77.
  13. O'Sullivan, S.B. and Schmitz T.J. (2007) *Functional Balance Grades: Physical rehabilitation: assessment and treatment (5th ed.)*. Philadelphia: F. A. Davis Company.
  14. Wood E, Rosenbaum P (2000) The gross motor function classification system for cerebral palsy: a study of reliability and stability over time. *Dev Med Child Neurol* 42: 292-296.
  15. Suwanna K, Prasertsukdee S, Khajornkul P (2014) Test-Retest Reliability and Internal Consistency of Cerebral Palsy Quality of Life Questionnaire 9 (Thai version). *Thai Journal of Physical Therapy* 36(2): 60-69.
  16. Calvert J, Kelly J (2013) What is the clinical and cost effectiveness of dynamic elastomeric fabric orthoses (DEFOs) for cerebral palsy?
  17. O'Sullivan, S.B. and Schmitz T.J. (2007). *Physical rehabilitation: assessment and treatment (5th ed.)*. Philadelphia: F.A. Davis Company.
  18. MacKenzie C, McIlwain S (2015) Evidence-Based Management of Postural Control in a Child with Cerebral Palsy. *67(3)*: 245-247.
  19. Lee B-H (2016) Clinical usefulness of Adeli suit therapy for improving gait function in children with spastic cerebral palsy: a case study. *The Journal of Physical Therapy Science*, 28(6): 1949–1952.
  20. Rebeca de Barros Santos-Rehder, et al. (2015) Use of suit therapy in Cerebral Palsy rehabilitation: a literature review. *Journal of Society for development in new net environment in B&H* 9(1): 483-489.
  21. Coghill JE, Simkiss DE (2010) Do lycra garments improve function and movement in children with cerebral palsy? *95(5)*: 393-395.
  22. Khamwong W, Nusawad J, Pratanwonrapanya, Siripanya J (2010) Factor relating to quality of life of elderly. *Journal of Health Science Research*. 5(2): 30-40 (in Thai).
  23. Wachirukgul P (1998) Factors affecting quality of life of the disabled in Changwat Phitsanuloke. Master's thesis.
  24. Saadat S, Javadi M, Divshali BS, Tavakoli AH, Ghodsi SM, et al. (2010). Health-related quality of life among individuals with long-standing spinal cord injury; a comparative study of veterans and non-veterans. *BMC Public Health*. 10(6).