THE EFFECT OF POSTURAL MANAGEMENT USING PROPER WHEELCHAIRS IN CHILDREN WITH SPASTIC CEREBRAL PALSY IN SAUDI ARABIA

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THE EFFECT OF POSTURAL MANAGEMENT USING PROPER WHEELCHAIRS IN CHILDREN WITH SPASTIC CEREBRAL PALSY IN SAUDI ARABIA

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ABSTRAK

KESAN PENGURUSAN POSTURAL MENGGUNAKAN KERUSI RODA YANG BETUL TERHADAP KANAK-KANAK SPASTIC CERTIFICAL PALSY DI ARAB SAUDI

Lumpuh serebrum (CP) adalah kecacatan kanak-kanak yang paling biasa. Lazimnya, anggaran global untuk CP adalah 2.1 untuk setiap sejuta kelahiran. Pengurusan postur dan khidmat rehabilitasi memainkan peranan penting dalam pengurusan kes CP, terutamanya kes kecacatan yang teruk. Kajian ke atas pengurusan postur sangat sukar didapati di timur tengah dan negara-negara yang sedang membangun. Kebanyakan kajian sebelum ini lebih menumpukan kepada aspek fizikal pengurusan postur dan sebahagian besarnya mengabaikan kesan terhadap kualiti hidup pesakit lumpuh serebrum dan keluarga mereka. Objektif kajian ini adalah untuk menilai kesan pemilihan kerusi roda yang sesuai terhadap kanak-kanak cacat yang lumpuh serebrum, terutama dalam aspek kualiti hidup dan fungsi motor. Kajian semasa telah dilakukan Di Bandar Kemanusiaan Sultan Bin Abdul-Aziz, ia adalah penyelidikan eksperimen. Pengumpulan data dilakukan melalui soal selidik elektronik yang ditadbir sendiri. Kes cerebral palsy spastik, berumur antara 4 dan 12 tahun, daripada kedua-dua jantina layak untuk dimasukkan ke dalam kajian ini jika mereka dimasukkan sebagai pesakit dalam. 35 kanak-kanak telah mengambil bahagian dalam kajian ini. Skor Pengukuran Fungsian Motor Kasar bagi kes yang disertakan adalah antara tiga dan lima, penilaian skala Ashworth yang diubah suai digunakan untuk spastik dalam semua penilaian kualiti hidup sendi dan cerebral palsy untuk mengukur kualiti hidup Setiap kes yang disertakan telah ditinjau pada tiga anggaran. Interim: pada hari pertama, selepas dua minggu dan selepas empat minggu dari permulaan intervensi pengurusan postur menggunakan kerusi roda yang betul mengikut protokol Pertubuhan Kesejahteraan Dunia. Langkah berulang ANOVA digunakan untuk membandingkan markah.. Purata umur peserta adalah 8.0 ± 2.7 tahun. Separuh daripada peserta kajian dibekalkan dengan kerusi roda berpiawaian dari Pertubuhan Kesihatan Sedunia. Setelah penilaian dibuat terhadap keperluan pengurusan postur mereka, sebanyak 34.3% daripada peserta kajian dibekalkan dengan kerusi roda jenis aktif piawaian, dan 20.0% daripada peserta kajian dibekalkan dengan kerusi jenis tolak. Pengurusan postur menggunakan kerusi roda yang sesuai dikaitkan dengan pengurangan dua hala yang signifikan secara statistik di dalam skor skala Modified Ashworth di antara paras garis asas, setelah 2 minggu dan setelah 4 minggu susulan terhadap sendi bahu, siku, pergelangan tangan dan pinggul (nilai-$p<0.001$). Skor kasar fungsi motor menurun dengan signifikan di antara permulaan, setelah 2 minggu dan setelah 4 minggu pengurusan postur penggunaan kerusi roda yang betul (nilai-$p<0.001$). Purata markah keseluruhan untuk kualiti kehidupan meningkat daripada 3083.9 ±206.6 pada permulaan kepada 3355.3±197.9 selepas 2 minggu hingga 3538.6 ±186.9 selepas empat minggu pengurusan postur dan kemajuan ini adalah signifikan secara statistik (nilai-$p<0.001$). Pengurusan postur dengan penggunaan kerusi roda yang sesuai telah membawa kepada kemajuan yang signifikan dalam skor kecacatan, skor fungsi motor, dan skor keseluruhan untuk kualiti hidup terhadap kanak-kanak cacat serebrum. Kemajuan ini lebih menonjol dalam kesejahteraan sosial, kefungsian, kesihatan fizikal, kesejahteraan emosi dan akses kepada domain perkhidmatan kualiti hidup. Keputusan daripada kajian ini boleh digunakan untuk menekankan berkenaan kelebihan

pemilihan kerusi roda yang betul untuk kumpulan manusia yang sangat memerlukan ini. Mereka juga boleh menggunakan keputusan ini untuk meningkatkan kesedaran mengenai pengurusan postur dan khidmat rehabilitasi pediatrik, termasuklah meningkatkan kesedaran terhadap kelebihan fisioterapi dan terapi pekerjaan

ABSTRACT

THE EFFECT OF POSTURAL MANAGEMENT USING PROPER WHEELCHAIRS IN CHILDREN WITH SPASTIC CEREBRAL PALSY IN SAUDI ARABIA

Cerebral Palsy is the most common childhood disability with an estimated global prevalence of 2.1 per one thousand live births. Postural management and rehabilitation services play a major role in the management of CP cases, especially in cases with severe disabilities. Studies on postural management cases are scarce in the Middle Eastern region and developing countries. Most of previous studies focused on the physical aspect of postural management and largely ignored the effect on the quality of life of cerebral palsy patients and their families. The objectives of the current study are to measure the effect of proper wheelchair selection on spasticity of children with spastic cerebral palsy, quality of life, and on gross motor function. The current study was done In Sultan Bin Abdul-Aziz Humanitarian City, it is an experimental research. Data collection was performed through a self-administered electronic questionnaire. Spastic cerebral palsy cases, aged between 4 and 12 years, from both genders were eligible to be included in this study if they were admitted as an inpatient. 35 children participated in this study. The Gross Motor Functional Measurement score of the included cases was between three and five, the modified Ashworth scale assessment used for the spasticity in all the joint and cerebral palsy quality of life assessment to measure the quality of live Each included case was surveyed at three estimation interims: on day one, after two weeks and after four weeks from the beginning postural management intervention utilizing proper wheelchair according to the World Health Organization protocol. Repeated measures ANOVA were utilized to compare the scores. The mean age of the subjects was 8.0 ± 2.7 years. Around half of the study subjects were provided with World Health Organization standard wheelchair type after proper assessment of their postural management needs, 34.3% were provided with active wheelchair type and 20.0% with pushchairs type. Postural management using a proper wheelchair was associated with a statistically significant bilateral reduction in Modified Ashworth scale score between the baseline, after two weeks and after 4 weeks of intervention in the shoulder, elbow, wrist and hip joints (p-value <0.001). The Gross Motor Functional Measurement score decreased significantly between the baseline, after two weeks and after four weeks of postural management using proper wheelchairs (p-value <0.001). The overall mean Quality of Life score increased from 3083.9 ±206.6 on the baseline to 3355.3±197.9 after two weeks to 3538.6 ±186.9 after four weeks of postural management (p-value <0.001). Postural management using a proper wheelchair has led to statistically significant improvement in the spasticity score, motor functional score and the total score of quality of life of spastic cerebral palsy children and this improvement was more prominent in the social wellbeing, function, physical health, emotional wellbeing and access to services. The results of this study can be used to highlight the benefits of proper selection of wheelchairs for this extremely vulnerable group. They can be used to increase awareness regarding the postural management and paediatric rehabilitation services, as well as increasing the visibility of physiotherapy and occupational therapy potential benefits.

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APPROVAL

I certify that an Examination Committee has met on 4th July 2022 to conduct the final examination of Majdeddin M. I. Ashqar, on his thesis entitled 'The Effect of Postural Management Using Proper Wheelchairs in Children with Spastic Cerebral Palsy in Saudi Arabia' in accordance with the regulations approved by the Senate of Universiti Sultan Zainal Abidin. The Committee recommends that the candidate be awarded the relevant degree, and it has been accepted by the Senate of Universiti Sultan Zainal Abidin as fulfilment of the requirements for the Master of Science. The members of the Examination Committee are as follows:

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DECLARATION BY CANDIDATE

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Sultan Zainal Abidin or other institutions.

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DECLARATION BY SUPERVISORS

This is to confirm that:

The research conducted and the writing of this thesis was under our supervision.

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LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
ADL	Activity of Daily Life
CP	Cerebral Palsy
CPQOL	Cerebral Palsy Quality of Life
GMFCS	Gross Motor Function Classification System
GMFM	Gross Motor Functional Measurement
MAS	Modified Ashworth scale
ROM	Range of Motion
SBAHC	Sultan Bin Abdulaziz Humanitarian City
SPSS	Statistical Package for the Social Sciences
UHREC	UniSZA Human Research Ethics Committee
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Introduction

Cerebral Palsy (CP) is the most common childhood disability. It was estimated that the global prevalence of CP is 2.1 per one thousand live births (Oskoui et al., 2013). Early description for CP goes back to Hippocrates writings (Panteliadis & Vassilyadi, 2018). However, due to the complex and multifactorial nature of CP, a formal description did not appear in the literature before the eighteenth century. William little was the first scientist to describe CP as a neuro-developmental illness formally. Meanwhile, the etiological and clinical course of CP was not properly investigated until the twentieth century (Korzeniewski et al., 2018; Michael-Asalu et al., 2019).

The majority of the Paediatric populations are born ‘straight’ and most will maintain this symmetry throughout their life. The actions of movement and daily living will ensure that the opposing muscle groups of the skeleton remain in equilibrium and ‘neutral’ in relation to postural instability. As a person loses their ability to move around freely, the likelihood of medical problems arising will increase. Not only will the muscle groups fail to remain ‘balanced’, but gravity will act with (and amplify) the weaknesses. A severe inability to move and reposition oneself is likely to dramatically increase asymmetry of the body, causing greater pressure in the skin where it comes into contact with any support surfaces – either a bed or seat. Increasing postural deformity will cause additional medical problems such as losses of lung, bowel & bladder function, joint pain, ability to communicate etc. These additional ‘costs’ (to both the client and the State) can be reduced through early intervention (through the

provision of suitable equipment and therapy) to counter the destructive tendencies and to delay or minimise the onset of the medical conditions. They will allow the person to interact with their world to the best of their ability.

The prescription of the correct wheelchair for a posturally compromised patient is a process that must be followed and will take significantly longer than just ‘issuing’ a wheelchair. The needs of each client (and those of their family/support) will be varied and should be met if they are to use the equipment as intended and to benefit from its purpose.

Postural management and rehabilitation services play a major role in the management of CP cases, especially in cases with severe disability (McDonald & Surtees, 2007; Vekerdy, 2007). The purpose of this chapter is to present a brief background about cerebral palsy and the implications of postural management to demonstrate the problem statement, objectives and significance of this research.

In 2005, a global conference defined cerebral palsy as “a collection of permanent conditions of the development of posture and movement, leading to activity restriction that is related to non-progressive disorders that took place in the developing fetal or infant brain. The motor conditions of cerebral palsy are frequently associated with disorders of cognition, perception, sensation, behaviour and communication, secondary musculoskeletal illnesses and epilepsy” (Graham et al., 2016; Michael-Asalu et al., 2019). Several methods were used to classify cerebral palsy. However, the most common and most straightforward classifications are according to muscle spasticity, were the main two categories are spastic and nonspastic cerebral palsy. Another standard classification for cerebral palsy is spastic, dystonic, and ataxic

cerebral palsy (Himmelmann, 2013). The most common type of CP is spastic CP. Spastic CP affects about 75% of people with CP (Schmidt et al., 2020, p. 1).

Meanwhile, the functional classification of paediatric cerebral palsy usually depends on the Gross Motor Function Classification System (GMFCS). The least affected motor function CP cases are considered class I according to the GMFCS classification while the most affected motor function cases are considered class V according to the GMFCS classification (Michael-Asalu et al., 2019). Lastly, the topography is also used to classify CP where hemiplegia, diplopia and quadriplegia are the most common CP topographic classifications (Korzeniewski et al., 2018; Michael-Asalu et al., 2019). Each of these classification systems aids with the clinical diagnosis and management process of CP cases (Smithers-Sheedy et al., 2014). Usually, the management of CP is a multidisciplinary and long-term management process that involves patients, families, physicians, nurses, physiotherapists, occupational therapists and other disciplines (Gulati & Sondhi, 2018).

1.2 Etiology of Cerebral Palsy

Researchers suggest that cerebral palsy has multiple and probably interacting etiological factors (Vitrikas et al., 2020). Recently, several studies examined the association between genetic factors and CP (Fahey et al., 2017; MacLennan et al., 2015). However, some of the well-studied etiological factors for CP are the low-birth-weight and pre-term birth (Himmelmann, 2013), yet some published studies reported a variation in CP etiological factors between developed and developing countries. For example, hyperbilirubinemia and neonatal infections are still common etiological factors for CP in developing countries. At the same time, the surge in IVF (full form) services increased the rate of multiple gestations and preterm birth in developed

countries and these are two known etiological factors for CP (Graham et al., 2016; Gulati & Sondhi, 2018). Historically, brain asphyxia was the only linked etiological factor with CP but researchers identified several other factors in recent decades, such as socioeconomic factors, inflammatory factors, respiratory distress syndrome (RDS) and postnatal trauma-related factors (Longo & Hankins, 2009; Marret et al., 2013).

1.3 Screening, Prevention and Diagnosis of Cerebral Palsy

The clinical screening was the only tool for cerebral palsy in the past. Nowadays, with the advancements in medical imaging technologies, screening relies on both clinical assessment and imaging screening (Wimalasundera & Stevenson, 2016). Magnetic resonance imaging (MRI) and neonatal ultrasound imaging have become routine screening tools for cases with suspected cerebral palsy (Korzeniewski et al., 2018). It is recommended to screen any paediatric case with developmental motor delays or with known risk factors and signs or symptoms of cerebral palsy as soon as the condition is suspected (Gulati & Sondhi, 2018). A previous study has shown that parents prefer to know their children's diagnosis as soon as possible so they can start the preparation for the rehabilitation services and help their children early on in their critical development process (Michael-Asalu et al., 2019).

Clinical research has identified several prevention methods for CP (Ellery et al., 2018). One of these methods is decreasing the body temperature of preterm neonates. It was hypothesized that the decreasing body temperature would reduce the harmful effects of the inflammatory process on the brain, and consequently, this would reduce the possibility of developing CP (Korzeniewski et al., 2018). Another prevention method is the administration of Magnesium sulphate in mothers suffering from preeclampsia. Magnesium sulphate might reduce the need for preterm birth and

therefore decrease the risk for developing CP (Fahey et al., 2017). Also, effective hyperbilirubinemia and neonatal infection management were also linked with the prevention of CP, especially in developed countries with advanced health care services (Graham et al., 2016; O'Shea, 2008).

Meanwhile, the diagnosis process of CP is considered as one of the well-known challenges that face health care works all over the world. It is hard to reach a definitive diagnosis of CP before the age of four years and this is considered a late diagnosis when compared with other causes of childhood disabilities (Smithers-Sheedy et al., 2014). Also, the heterogeneity and broad spectrum of presentation are two other complication factors for CP diagnosis (Byrne et al., 2017). However, the American Academy of Neurology (AAN) has produced a series of evidence-based guidelines and recommendations for early and accurate CP diagnosis, which depends on both clinical assessment and advanced imaging techniques (Ashwal et al., 2004; Whelan & Delgado, 2010).

1.4 Prevalence of Cerebral Palsy

An extensive systematic review estimated the global prevalence of cerebral palsy to be 2.1 per 1000 births (Oskoui et al., 2013). Other reports estimated CP prevalence to range between 1 and 3 CP cases per 100 live births (Graham et al., 2016). Despite the advances in medical, maternal and neonatal care, it seems that the CP prevalence is not changing over time. A possible explanation for this static prevalence of CP could be increased IVF services with their associated risks for CP (Himmelmann, 2013).

In the Middle East region, a previous population study estimated a 3.6 prevalence of CP in Egypt (El-Tallawy et al., 2014). Meanwhile, Serdaroğlu and colleagues reported

a 4.4 case or % prevalence in Turkey per 1000 live births (Serdaroğlu et al., 2006), while Ibrahim & Bhutta (2013) reported a 1.1 prevalence per 1000 live birth in Pakistan. In addition, Al Salloum et al. (2011) reported a 2.3 per 1000 live birth prevalence of CP in Saudi Arabia. The high prevalence of CP in Saudi Arabia is in line with other countries in the Middle East region and partially this could be explained by the high level of consanguineous marriage and its associated hereditary disease in addition to early maternal age (Al Salloum et al., 2011; el Rifai et al., 1984). It is worth mentioning that there are some contradicting reports about the association of CP prevalence with several ethnic and demographic factors, where scientists suspect that Latino and Afro-American ethnicities are associated with higher CP prevalence. However, this could be linked with the socioeconomic factors more than the ethnic factors (McManus et al., 2011; Oskoui et al., 2013, p. 1; Van Naarden Braun et al., 2016).

1.5 Cerebral Palsy Comorbidities

There is a strong association between cerebral palsy and several associated comorbidities. For instance, one-quarter of cerebral palsy cases suffer from epilepsy (Michael-Asalu et al., 2019). Bearden et al. (2016) reported that half of CP cases have a visual impairment, 16% have an auditory disability, and cognitive disabilities are also a common comorbidity among CP cases (Bearden et al., 2016).

1.6 Management of Cerebral Palsy

The management plan of cerebral palsy requires a multidisciplinary team and it needs to prioritize the family's needs and expectations (Schmidt et al., 2020). Physiotherapists play a major role in this management process and referral for

physical therapy usually happens as soon as a CP case is diagnosed or suspected in order to maintain or to improve the motor function of CP cases (Graham et al., 2016). Recently, occupational therapists are also being involved in CP management to provide the patients with tailored functions according to their needs (Chikwanha et al., 2015). Studies have shown that improving the motor function and muscular strengths alone do not necessarily mean better function so occupational therapy services aim to cover this gap between function and motor function improvement (Chikwanha et al., 2015; Kruijsen-Terpstra et al., 2014). In addition, respiratory complications are a common cause of morbidity and mortality in CP. The focus on improving or maintaining the respiratory function is a major role for the nursing, physiotherapy and clinical team in general (Gulati & Sondhi, 2018). Postural management has a substantial contribution to both motor function and respiratory care for CP cases. Several studies revealed that postural management significantly decreases CP complications, especially in cases with severe gross motor dysfunction (Gmelig Meyling et al., 2018; Ravi et al., 2017). In summary, management of CP focuses on complications and comorbidities prevention, improving motor, cognitive and social functions of CP cases, and providing them with better quality of life (Michael-Asalu et al., 2019).

1.7 Consequences of Cerebral Palsy

Nowadays, CP cases have a similar life expectancy to the general population, especially in countries with advanced health and rehabilitation services (Hutton, 2006). However, CP condition is associated with some negative health consequences, such as pressure ulcers, which could be caused by inappropriate wheelchairs, vertebral complications with a reduction in respiratory volume, high rate of hip dislocation, and

severe chronic pain as a result of muscular spasticity, bone deformities and other complications (Alkhateeb et al., 2019; Ekiz et al., 2017; Schmidt et al., 2020). According to previous quality of life assessments, both families and patients living with CP rated the pain as the main negative consequence of CP that deteriorates the quality of life significantly (Blackman et al., 2018). Health economic studies revealed that each case of CP costs around a million dollars in health care and rehabilitation services in addition to the cost of lost productivity from CP cases and their caregivers (Korzeniewski et al., 2018).

1.8 Wheelchair Specifications

Child's Pushchair a child or small person who is unable to independently propel may benefit from a one-piece seat mounted into a folding chassis with tilting capability. This will allow the parent to reposition the child during the day for various activities. The seat unit can be easily removed by a quick-release mechanism and the chassis folded for transportation in a vehicle. The World Health Organization (WHO, 2007)

Active Wheelchair If the patient (child or adult) has good upper limb dexterity, a light-weight wheelchair that is easily propelled may be beneficial. It can encourage independence and be configured so that it is safe but easily pushed by the user. This dynamic balance can be altered as they progress through their rehabilitation. Suitable for patients with spinal cord issues - either through genetic or physical damage. Most likely to have a separate seat and backrest configuration. The World Health Organization (WHO, 2007)

General Issue Wheelchair A folding wheelchair can form a good base for seating, where the user is able to maintain a fixed position for a set period. These chairs come

in many sizes/ configurations, so can be selected to meet the aims of the user or the family. The seating will either be seat cushion with separate backrest or a one piece seat unit. Either system will be removable via the quick-release interface. The World Health Organization (WHO, 2007)

Tilt-In-Space Wheelchair Where the patient has compromised independence and remains seated for long periods of time, Tilt-In-Space allows them to be re-positioned regularly to reduce sitting pressure or aid functional activities. Generally, can only be transported as a complete unit in an adapted vehicle. Suitable for patients having suffered TBI, stroke or high level spinal injury. The World Health Organization (WHO, 2007)

Electrically Powered Wheelchairs An electrically powered wheelchair will provide a client who has the mental (but not the physical) capacity, to be independent. The base can be prescribed to meet the needs of the user and varies from a light-weight unit (mainly for indoor use) through to a heavy-duty model for outdoor mobility. Any seating can be attached to the base through the correct interface system - either quick-releasing or permanently attached. Powered seat positioning can be prescribed to aid the user's daily activities and increase their time in the seat. Additional/specialist controls allow the most restricted physical movements of the user to drive the wheelchair safely and can be configured to integrate with external technology - phone, tablet, TV etc. The use of a quick-release interface allows the seating to be swapped between several wheelbases where there are different requirements on different sites. The World Health Organization (WHO, 2007)

1.9 Problem Statement

Saudi Arabia, especially in peripheral areas, lacks accessible rehabilitation centres for people living with disabilities (Mohamed Madi et al., 2019). Furthermore, previous studies showed that there is a high stigma level towards families of children with CP and a high prevalence of malnutrition among Saudi CP children (Almuneef et al., 2019; Soliman et al., 2019). A 2012 published article revealed that mothers of CP cases reported high denial levels of their children diagnosed with CP and this could impact their level of care and the quality of life (Madi et al., 2012).

Cerebral palsy, a persistent, non-progressive disorder of movement and posture, remains a common global cause of paediatric morbidity despite the technological advances in neonatal intensive care and improved maternal care over the last two decades (Arpino et al., 1999). According to Abulsalam's study, cerebral palsy is a common cause of disability in Saudi children (Abulsalam, 1997).

Based on a recent report by Saudi Arabia's General Authority for Statistics (GAS), the prevalence rate of disability among the Saudi population is 33 per 1,000 (The General Authority for Statistics, 2010). CP incidence in Saudi Arabia is 0.41%. This is somehow considered as a high incidence rate when compared with other countries (Al-Asmari et al., 2006). Consanguineous marriage and early motherhood (< 18 years old mothers) are still common practices in Saudi Arabia and they could explain the high incidence rate of CP between live births (al-Rajeh et al., 1991; Norell et al., 1987). CP cases are sometimes treated in centres that provide care according to traditional or out of date methods. These centres also provide special equipment and chairs for better positions. However, CP children are not typically provided with appropriate wheelchairs, which do not suit their condition. Therefore, CP children do

not receive proper sittings and positions care according to their clinical conditions. Thus, the typical traditional treatment could deteriorate the child's health condition. According to Zaky et al., better CP treatment results were achieved when CP cases were provided with standardized treatment methods rather than treatment by traditional CP centres (Zaky et al., 2019).

Sultan Bin Abdulaziz Humanitarian City (SBAHC) in Riyadh, Saudi Arabia, is one of the care centers for CP patients. It provides CP children with rehabilitation and health care services according to proper evidence-based medicine and in accordance with scientific protocols. Service duration for CP cases depends on the clinical condition of each case. Saudi nationality is the most common one among paediatric patients, making 96.8% of the total population. Around one-quarter of the cases were referred from Riyadh and three quarters from outside Riyadh. The average length of stay in the Paediatric Specialty Program is approximately one month (SBAHC, 2020).

Table 1.1 SBAHC Indicators and Statistics

Admission									
Program	Surgical	Paediatric	Spinal cord injury	Stroke	Brain injury	Amputee	Medical	Adult Others	Total
2018	2202	1677	562	546	370	75	13	641	6220

Paediatric Admission				
Paediatrics	Female	Males	Total	ALOS* (Days)
Number	694	983	1677	31
Percentage (%)	41.4 %	58.6%	100%	

Readmission			
Admission	6220	Paediatrics admission	1677
Readmission	2606	Paediatrics Readmission	308
Percentage	42.0 %	Percentage	37.1%

* ALOS is Average length of stay Source: (SBAHC, 2018)

Saudi nationality is the most common nationality among paediatric patients making 96.8% of total population in 2018. In 2018, 26.9% of the cases were referred from Riyadh and 70.2% from outside Riyadh. The average length of stay in the Paediatric Specialty Program increased by 8% from 28.9 days in the year 2017 to be 31.2 days in 2018 (1680 cases). Total number of admissions was 6220, out of which 2606 patients (42%) were readmitted, which is double the target (20%). The highest share of readmissions within 6 months was in the paediatric program 308 cases (37.1% of readmissions within 6 months in 2018) (SBAHC, 2018).

Spastic cerebral palsy is associated with several motor and respiratory dysfunctions that could be managed with postural management using proper wheelchairs (Vekerdy, 2007). The effect of postural management using proper wheelchairs on paediatric cases with cerebral palsy was not investigated before in Saudi Arabia or the Middle East region. The current study measured the effect of postural management using proper wheelchairs in children with spasticity cerebral palsy.

1.10 Research questions

The current study aims to answer the following questions:

- What is the effect of postural management with proper wheelchair on spasticity in children with cerebral palsy?
- What is the effect of postural management with proper wheelchair on gross motor function in children with spasticity cerebral palsy?
- What is the effect of postural management with proper wheelchair on quality of life in children with spasticity cerebral palsy?

1.11 Research Objectives

The objectives of the current study are

1. To measure the effect of postural management using proper wheelchair selection on spasticity of children with spastic cerebral palsy,
2. To investigate the effect postural management using proper wheelchair selection on gross motor function of children with spastic cerebral palsy and
3. To determine the effect of postural management using proper wheelchair selection on the quality of life of children with spastic cerebral palsy.

1.12 Research Hypothesis

Proper selection of wheelchairs in postural management of cerebral palsy will reduce spasticity, improve gross motor function, and improve quality of life of children with spastic cerebral palsy.

1.13 Operational Definitions

1.13.1 Cerebral Palsy

Cerebral Palsy is a group of permanent disorders of the development of posture and movement, causing activity limitations that are attributed to non-progressive disturbances that occurred in the developing infant or fetal brain (te Velde et al., 2019).

1.13.2 Spasticity

Spasticity is established by an increased stretch reflex that is strengthened with movement velocity. Spasticity in cerebral palsy, also sometimes called as a pyramidal motor disorder, is described by pathological reflex activation or/and hypertonia (Bar-On et al., 2015).

1.13.3 Cerebral Palsy Quality of Life

Quality of life is the overall general well-being that comprises objective descriptions and subjective evaluations of social, material, physical, and emotional well-being together with the extent of purposeful activity and personal development, all examined by a personal set of values (Karimi & Brazier, 2016). Cerebral palsy quality of life is the well-being across several broad areas; it has become the main treatment objective between cerebral palsy cases (Aran, 2010).

1.13.4 Modified Ashworth Scale for Spasticity (MAS)

MAS is an ordinal measurement scale used for grading the muscle resistance encountered during passive muscle movement, ranging from zero score (indicating normal muscle tone) up to four scores (indicating limb rigidity in extension or flexion) (Germanotta et al., 2020).

1.13.5 Postural Management

Postural management is a planned clinical management approach, including all treatment interventions and activities that impact a person’s function and posture (Gough, 2009).

1.13.6 Proper Wheelchair

Proper wheelchair is a wheelchair that meets a person's needs and environmental situation, provides adequate postural support and fit, is available in the country, durable and safe, can be obtained and maintained and support services sustained in the country at a tolerable price range (Khasnabis et al., 2013).

1.14 Significance of the Study

All paediatric cerebral palsy interventions aim to improve the quality of life of patients and their families, improve their daily functions, and reduce the risk for comorbidities and complications (Gulati & Sondhi, 2018). Postural management by using a proper wheelchair in spastic cerebral palsy cases is a curtail part of physiotherapist interventions. Despite that, to the best of our knowledge, the effect of this postural management was not examined before. Surgical and pharmaceutical interventions sometimes do not yield better outcomes for cerebral palsy cases. Therefore, it is of utmost essential to evaluate the effect of any pediatric cerebral palsy intervention (Holmes et al., 2003). Identifying the effects of postural management by using a proper wheelchair in spastic cerebral palsy cases would provide health care workers and parents with proper evidence to proceed or avoid this type of rehabilitation intervention. Health care workers, caregivers and even patients are actively seeking evidence-based interventions that could benefit cerebral palsy cases, especially those living with severe disability (Colver et al., 2014; McDonald & Surtees, 2007). This study aims to provide evidence-based recommendations for physiotherapists regarding postural management by selecting a proper wheelchair in spastic pediatric cerebral palsy cases.

CHAPTER 2

LITERATURE REVIEW

2.1 Cerebral Palsy

Cerebral Palsy is a term that describes a heterogeneous group of motor and cognitive disabilities that is not progressive in nature, but the disability and its associated comorbidities could become progressive with age (Korzeniewski et al., 2018; Oskoui et al., 2013). The scientific literature is full of articles and studies that describe surgical, physiotherapy and medication interventions aiming to improve the quality of life of people living with cerebral palsy (Michael-Asalu et al., 2019). Postural management has become one of the keystones of intervention that could lead to better health outcomes for children living with cerebral palsy (Pérez-de la Cruz, 2017). In the end, the ultimate goal of all clinical interventions is to improve the quality of life of children living with cerebral palsy and their families' quality of life, as well as increase their societal productivity (Novak et al., 2013). Before considering the implementation of the current postural management protocol, a compressive literature review was conducted regarding postural management of cerebral palsy with the aim to build on currently known interventions and enhance the outcome, especially in the Middle Eastern context. The main goal of this literature review is to summarise the current literature regarding paediatric cerebral palsy postural interventions and to identify gaps in the scientific literature.

2.2 Spastic Cerebral Palsy

Recently in 2018, IAB-Interdisciplinary Working Group for Movement Disorders defined spasticity in a broader sense as “involuntary muscle hyperactivity in the presence of central paresis”. In this definition, the ‘involuntary muscle hyperactivity’ has been described as a spectrum consisting of ‘Spasticity Sensu Strictu’ triggered by rapid passive joint movements, ‘rigidity’ triggered by slow passive joint movements, ‘dystonia’ when the involuntary muscle hyperactivity is spontaneous and ‘spasms’ triggered by sensory or acoustic stimuli. The group has also proposed axis-based approach to spasticity—clinical description (axis 1), etiology (axis 2), localization (axis 3) and additional central nervous system deficits (axis 4). Severity of the muscle hyperactivity can be described by the Modified Ashworth Scale, Tardieu Scale and Frequency of Spasms Score.

Spasticity can be classified as ‘phasic’ and ‘tonic’ based on the predominant involvement of either the phasic (dynamic) or tonic (static) components of muscle stretch reflexes. After spinal injury, ‘phasic’ spasticity with brisk stretch reflexes and clonus develops in patients who are ambulatory. However, ‘tonic’ spasticity develops in non-ambulatory patients, demonstrated by passive stretch at ankle and vibratory tonic reflex testing.

Tone is maintained by complex interplay of spinal and supraspinal mechanisms, disruptions of which lead to spasticity and rigidity. Altered tone can, however, be seen in dystonia and paratonia, disorders resulting due to network dysfunction, abnormal sensorimotor integration, and disinhibition in the brain and spinal cord. In a clinical scenario of hypertonia, differentiating these four disorders is of the utmost importance from pathophysiological and therapeutic perspectives.

Spasticity in children can result from any disease process that affects the upper motor neuron within the central nervous system. Injury to the upper motor neuron decreases cortical input to the descending reticulospinal and corticospinal tracts, which causes weakness, loss of motor control, and reduction in the number of voluntarily active motor units.

2.3 Postural Management

Postural management is a vital intervention in the care plan of paediatric CP cases with spasticity and in CP cases at risk for vertebral defects or at risk for hip displacement (Vekerdy, 2007). The main objective of postural management is to reduce the disability of CP cases and improve their functions (Vekerdy, 2007). Many CP cases are not provided with proper wheelchairs or the patients and caregivers were not appropriately and sufficiently trained on the optimal use for the wheelchair. Therefore, there is a high rate of wheelchair abandonment among cases with severe CP disabilities (Toro et al., 2015). The World Health Organization (WHO) created a detailed guide for wheelchair assessment and training that facilitates the process of selecting appropriate wheelchairs for CP cases and it is adapted to the needs of countries with limited resources (Khasnabis et al., 2013). There is a clear need for proper postural management of CP cases using proper wheelchairs because wheelchairs could provide the patients with the needed support to the vertebra, trunk and neck. Moreover, proper wheelchairs could facilitate the movement process of CP cases (Alkhateeb et al., 2019; Rodby-Bousquet & Hägglund, 2010).

The definition of Cerebral Palsy (CP) can be described as motor impairment, global physical and mental dysfunction. It affects a person’s capability to move, maintain balance and posture. The United Cerebral Palsy Foundation estimated, in 2001, that

764,000 children and adults in the USA were diagnosed with cerebral palsy. Additionally, it was estimated that 8,000 newborns and toddlers, as well as around 1,300 preschool-age children, are diagnosed with CP yearly in the US (Taylor, 2005). Worldwide, the prevalence of CP is 2-3 cases for every 1,000 births (Wimalasundera & Stevenson, 2016).

"Cerebral Palsy" was defined by a clinical description in a time when there was a lack of full understanding in relation to aetiology and pathology. Mutch and his co-workers published a description in 1990 and several registers have since embraced it. To better define the intricacy of CP, Rosenbaum et al., in 2007, further described CP by the repeatedly associated impairments (Mutch et al., 1992).

CP is a neurologic disorder that is caused by a brain injury, which occurs afore cerebral development completion. As the brain remains in development through the first two years of life, CP can be the outcome of a brain injury that happens during the prenatal, perinatal, or postnatal periods (Bass, 1999). Neonatal CP risk factors include low birth weight, premature birth (less than 32 gestational weeks), trauma and intracranial haemorrhage.

In about 10-20% of patients, CP occurs postpartum due to brain damage caused by hyperbilirubinemia, viral encephalitis, bacterial meningitis and falls, among others (Taylor, 2005).

Measuring reflexes in children is very important. In children who do not have CP, the Moro reflex is seldom existent after 6 months and hand preference rarely develops earlier than 12 months of age. However, it may happen if spastic hemiplegia is present. Progressive hereditary neurologic or metabolic disorders need to be eradicated as the cause of observed abnormalities (Taylor, 2005).

Since CP is defined by clinical description, a more extended period of time helps confirm that the condition satisfies the criteria for CP and in describing precisely the type and topography of the motor damage. As the clinical description changes, spastic and dyskinesia characters become evident with time (Smithers-Sheedy et al., 2014).

CP is categorized into three types: spastic, ataxic and dyskinetic. The most ordinary motor disability in CP is spasticity. Patients with muscle spasticity in CP cases could improve with age, stay the same or worsen (Mohammed et al., 2016). Spasticity is usually associated with muscular hypotonia in infants with CP (Bar-On et al., 2015). There are treatments for spasticity in CP cases that may improve life quality, impede complications (or delay them) and improve muscular movement (Multani et al., 2019).

The Ashworth scale is utilized to measure spasticity and muscle tone, and it is the most commonly used to measure muscle spasticity. Developed in the 60s and improved in the 80s, the scale measures muscle tone in clinical settings with no need for other equipment (Meseguer-Henarejos et al., 2018). The score ranges from 0-4, 0 representing no increase in muscle tones and 4 indicating full rigidity. It could be useful for cases with upper motor neuron lesions, as well as CP cases. Depending on the Ashworth scale score, the efficiency of interventions may be assessed and observed (Meseguer-Henarejos et al., 2018).

CP could negatively impact the quality of life for both paediatric cases and their caregivers through numerous factors that are linked to wellbeing, such as the level of disability, the occurrence of complications and socioeconomic factors, among others (Mohammed et al., 2016).

Quality of life is the individual's awareness of their own wellbeing, which involves the perception of relationships, health and materialistic possessions, as well as

personal fulfillment, exchanges with others in work, family and the general community. It can be measured by self-reporting questionnaires (Mohammed et al., 2016). One of the main issues that could affect the quality of life of CP patients is postural management (Gough, 2009).

2.4 Cerebral Palsy Quality of Life

The quality of life of paediatric CP cases and their parents has become the main focus of several research studies in the last decade (Gilson et al., 2014; Power et al., 2018). Recent studies reported quality of life of children living with CP similar or comparable to their general population peers. This could indicate the effect of CP on children's perception of the quality of life is not that much affected by their CP condition. On the other hand, the QoL of the parents is lower than the general population. The pain of CP children was one of the main factors that were associated with significantly lower quality of life of caregivers of cerebral palsy patients (Glinac et al., 2017; Michael-Asalu et al., 2019). On the other hand, Gilson et al. (2014) reported that the severity of CP disability was not significantly associated with quality of life.

2.5 Risk Factors of Improper Wheelchair Use

Improper wheelchair use in CP cases is associated with pressure ulcer risk, hip pain risk and falling down risk (Hodgkinson et al., 2001; Newman et al., 2010). For example, Newman and researchers. reported a high prevalence of skin injuries among wheelchair dependant CP cases (Newman et al., 2010). Similarly, Alkhateeb et al. (2019) associated prolonged seating in the wheelchair with pain in cerebral palsy cases.

2.6 Postural Management of Cerebral Palsy Cases

A postural management program is a comprehensive, designed intervention involving all activities that affect the individual's posture and function. These programs are personalized particularly for each child and could incorporate special seating techniques, standing supports, exercising, surgical interventions and individual therapy sessions (Gericke, 2006).

Postural management through the use of wheelchairs aids to avoid joint contractures and developing asymmetrical deformity in other body parts. For instance, spinal scoliosis, which could affect respiratory and cardiac function, may require postural management for the trunk to help control the spinal rotation of the knee and ankle contractures, which changes the ability to transfer weight.

In 2006, Gericke et al. devised a guideline for postural management, aiming to prevent these complications (Gericke, 2006). Postural management programs designed specifically for each case. These programs, which aim to increase the children's comfort, are effective for cases with bilateral CP in facilitating communication, aiding their functional skills and enhancing social participation. The nature of the postural intervention, while reliant on the individual's conditions, can be guided by a child's level of function, according to the Gross Motor Function Classification System (GMFCS). Children in GMFCS groups IV-V are encouraged to start postural management programs. Paediatric cases with a motor disorder at GMFCS level III need postural management programs that emphasize postural activity from an early age. Close surveillance should be maintained to develop postural or positional deformity to soft tissues and bony structures. It is recommended that all children who cannot walk more than ten steps by the age of thirty months should have a hip X-ray

to measure the migration percentage of each hip, and this investigation should be done again every six to twelve months until the age of seven years, or when the additional deformity is less likely to occur. Spine X-rays should be considered for all children in GMFCS groups V and IV who are unable to stand by the age of five years, at five, and ten years as a minimum. Intervention to prevent deformity is provided as an integrated approach between postural management activity, equipment, and surgery. Decisions regarding which intervention is chosen should be based on a child's clinical and functional activities, pain levels, sleep assessment, hip migration percentage, long-term prognosis, and the implications of the interventions in social and emotional terms.

Postural care and guidance are necessary to achieve the active understanding and participation of all individuals involved with the child, parents, professionals, wheelchair services and caregivers. Selecting a suitable wheelchair, appropriate training, maintenance and follow up are all needed and efficient postural management (Khasnabis et al., 2013).

A prior study has revealed that 80% of CP cases did not use suitable wheelchairs for their conditions (Ekiz et al., 2017). The World Health Organization (WHO) developed wheelchair criteria and training programs that could show improvement and be incorporated in postural management. The table in (APPENDIX D) includes a summary of WHO wheelchair selection criteria for proper paediatric wheelchairs.

The complex ankle and foot anatomy contribute directly to observed deformities. Four groups of muscles (invertors, evertors, dorsiflexors, and plantarflexors) act on the ankle–foot complex. Any isolated ankle movement is a net result of the combined activation of a group of target muscles, e.g., inversion occurs when dorsiflexors

(primarily the tibialis anterior muscle) and plantarflexors (primarily the tibialis posterior muscle) co-activate. In the presence of spasticity, stroke survivors have less control and isolated activation; activation is more diffuse and divergent. Therefore, a variety of ankle–foot deformities could be observed, depending on the severity of spasticity and weakness of individual muscles.

2.7 Gaps in the Literature

Based on this literature review, several gaps could be identified in the current literature. For example, most cerebral palsy postural management studies were observational ones with very small sample size (Martins et al., 2016). Also, studies on this subject are scarce in the Middle Eastern region and developing countries. In addition, cerebral palsy postural management studies focused more on the physical aspect of postural management more than the effect on the quality of life of CP patients and their families (Liu et al., 2014; Rodby-Bousquet & Hägglund, 2010). The effect of selecting a proper wheelchair according to WHO criteria on muscle spasticity of paediatric CP cases was not investigated before.

2.8 Conceptual Framework

The conceptual framework of the current interventional study is that providing paediatric CP cases with postural management using proper wheelchair selection, distribution and training would lead to better muscular spasticity and would enhance the quality of life of those patients. In addition, it was hypothesized that postural management using a proper wheelchair would lead to better gross motor outcome function during the study period (Figure 2.1).

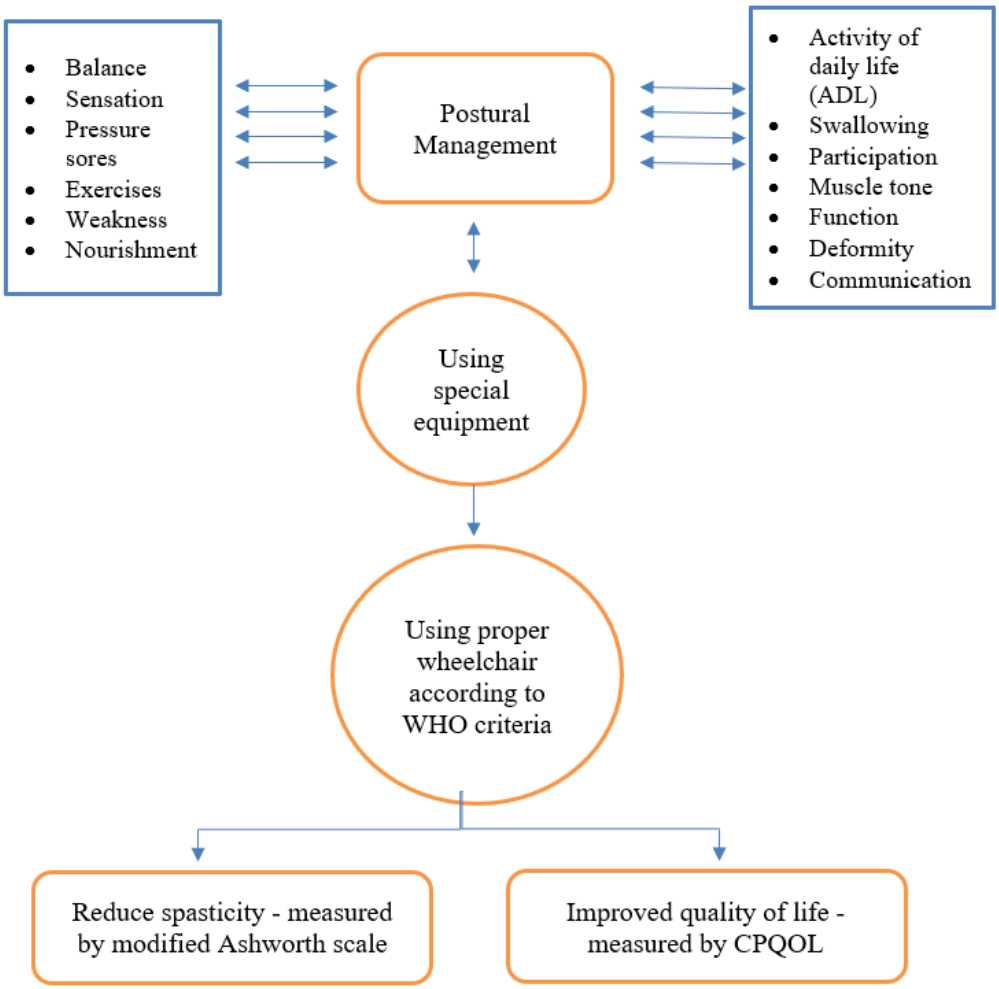

Figure 2.1 Conceptual Framework

2.9 Summary of Literature Review

Postural management in cerebral palsy has become a cornerstone in any physical therapy intervention (Graham et al., 2016). In addition to the risk of wheelchair abandonment, CP cases with permanent use of a wheelchair are at higher risk for pressure ulcers, pain and risk of falling down when the wheelchair is improperly used (Toro et al., 2015). Most of the previous postural management studies were

observational studies and there is a gap in the literature about the efficacy of proper selection of the wheelchair according to the WHO criteria on muscular spasticity and the quality of life of paediatric spastic CP cases (Hatta et al., 2007). The theoretical concept of the current study is that a statistically significant positive effect of postural management will be detected after applying the study protocol on patients with spastic CP.

There are many challenges facing people with disabilities in their communities, where they remain largely marginalized and often face basic and complex problems, such as poverty, unemployment, and their inability to resolve health issues that result in higher mortality levels, this group is largely dismissed from development projects in their communities, both civil and political (MOH, 2022).

This segment of society has comprehensive rights, and the state has provided the means to support them in achieving their rights, as well as ensure a decent living and the ability to integrate into all aspects of society through rehabilitation and healthcare. Also, it provided them with all the means needed to live with their families, taking into account their needs and prioritizing them in all government sectors (MOH, 2022).

People with disabilities are often denied employment, study, and full participation in society, which adversely affects their ability to meet their full potential and well-being. The Convention on the Rights of Persons with Disabilities is a key convention in this regard, due to the fact that it provides a tool for ensuring that this category enjoys the same rights and opportunities as all other groups, with nearly a billion people with disabilities worldwide (MOH, 2022).

This is an international human rights treaty designed by representatives of the international community, including persons with disabilities, government officials,

and nongovernmental groups. People with disabilities should be treated differently in their communities by changing how they perceive and perceive them (MOH, 2022).

Disability is viewed as a human rights issue, rather than a medical issue, or a charity or dependency problem, according to the Convention. Access to buildings, the use of roads and transportation, and access to information through written and electronic communication are all examples of areas where obstacles can arise. It also aims to reduce the forms of discrimination that often prevent people with disabilities from accessing education, employment, health and other services (MOH, 2022).

For the first time, there is now an international legally binding instrument to ensure that States that have ratified the treaty promote and protect the rights of persons with disabilities, as well as seeking to develop their own national civil rights legislation to improve the lives of persons with disabilities (MOH, 2022).

The cooperation and participation of persons with disabilities in their communities has the greatest impact on the physical and psychological health and progress of persons with disabilities, and the provision of an active, participatory and more independent community member, rather than relying on others (MOH, 2022).

Provide material and moral support for the equal participation of persons with disabilities. Countries should ensure development and support services, including assistive devices and technologies, to help persons with disabilities increase their level of independence in their daily lives.Training employees: Trainers and training opportunities should be created for staff, at all levels, in addition to involvement in planning and providing programs and services for persons with disabilities (MOH, 2022).

CHAPTER 3

METHODOLOGY

This chapter describes the details of methods used to examine the effects of postural management using wheelchairs in children with spastic cerebral palsy in Saudi Arabia. It starts with describing the study design and settings including a full description of the targeted population with this intervention and its effects on their quality of life. After that, a complete description of measurement tools is described including the definitions of study variables. Lastly, this chapter demonstrates the ethical consideration in the current study and data analysis details.

3.1 Research Design

The design of the current study is quasi-experimental research for inpatient spastic CP. Usually, in clinical quasi-experimental studies, the association between dependent and independent variables is examined by standardized measurement tools in order to identify the effect of treatment intervention on the study subjects under controlled conditions (Waddington et al., 2017). The spasticity and quality of life were measured before, during and after the postural management protocol using a proper wheelchair. To achieve the objectives of the current study, a quantitative interventional study design was selected and all measurements were conducted according to the study protocol.

3.2 Study Location

The current study was conducted at the Seating and position clinic in the Rehabilitation Services and program at Sultan Bin Abdulaziz Humanitarian City (SBAHC). SBAHC is one of the care centres for CP patients. It provides CP children with rehabilitation and health care services according to proper evidence-based medicine and in accordance with scientific protocols (Al-Owesie et al., 2012; F. M. Ibrahim, 2018; SBAHC, 2020). SBAHC is located in Riyadh the capital and principal city in the Kingdom of Saudi Arabia with a population estimate of eight million inhabitants (Alanazi et al., 2020). On average, 1,600 paediatric cases are admitted to SBAHC annually. Paediatric cases are almost equally distributed between the two genders and three-quarters of admitted cases are Riyadh city residents. In the last two years, the mean length of stay of admitted cases was 31 days.

3.3 Sample Size and Sample Technique

A previous interventional study regarding wheelchair and children with CP included 72 participants (Lampe & Mitternacht, 2010). However, several other interventional studies on children with CP included 20 to 30 participants (Ekiz et al., 2017; Liu et al., 2014). The sample size of the current study was calculated using G Power software (version 3.1.3). The following variables were used to calculate the minimum sample size:

Effect size f = 0.25

α err prob = 0.05

Power (1-β err prob) = 0.80

Number of groups = 1

Number of measurements = 3

Corr among rep measures = 0.5

Nonsphericity correction ε = 1

Outputs of sample size calculation were

Noncentrality parameter λ = 10.5

Critical F = 3.17

Numerator df = 2.0

Denominator df = 54.0

Total sample size = 28

Actual power = 0.81

Considering a 20% drop out

28/0.8=35 participants

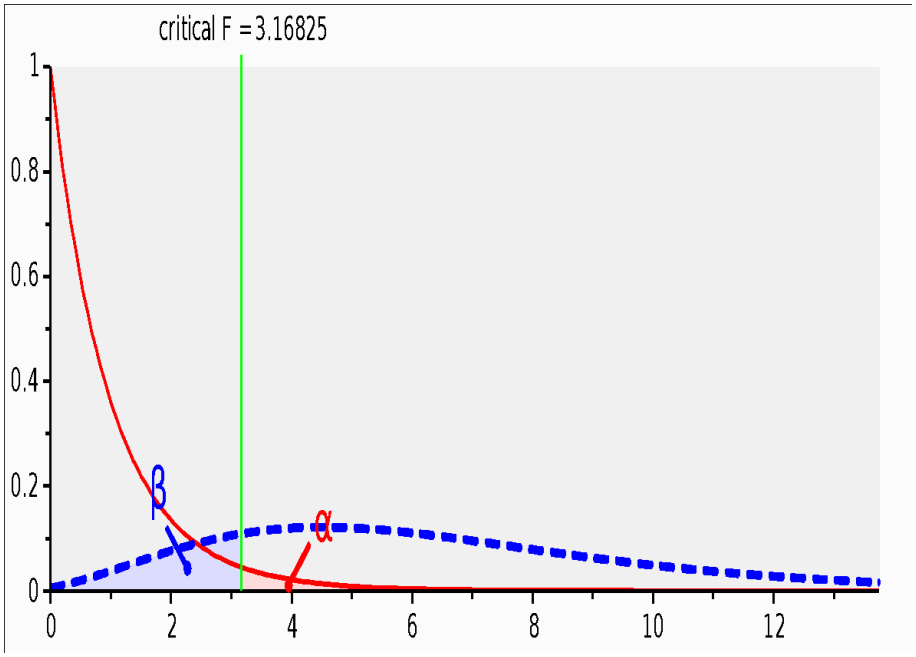

Figure 3.1 Sample size Calculation using G power

3.3.1 Sampling Population and Sample Selection

Spasticity CP cases, aged between 4 and 12 years, from both genders were eligible to be included in this study if they were admitted as an inpatient to Sultan Bin Abdulaziz Humanitarian City. A non-random and non-blinding consecutive quasi-randomized sampling protocol was used based on workflow in the seating and position clinic. All CP subjects who fulfilled the inclusion criteria were asked to participate in the postural management using a proper wheelchair at their physiotherapy sessions in the seating and position clinic.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

- Spastic cerebral palsy;
- Age between four and twelve years were included in the current study;
- The gross motor functional measurement score (GMFMCS) of three to five;
- Admission or readmission to SBAHC with a stable medical condition.

3.4.2 Exclusion Criteria

- Nonspastic cerebral plastic cases;
- cases younger than 4 years or older than 12 years;
- Any case with fixed or already fully established deformity;

- Moreover, any cases with a GMFM score less than three;
- Cases that were medically unstable at the time of data collection such as cases with uncontrolled seizures, cases with uncontrolled cardiac disorders or cases with any other uncontrolled chronic illness;
- In addition, ambulatory status and established Attention Deficit Hyperactivity Disorder (ADHD);
- Finally, children whose parents did not sign the consent form or did not answer the questionnaire.

3.5 Details of the Study Methods

In order to understand the patient's needs and the muscular skeletal forces that are acting within their body, a FULL investigation must be carried out. It is likely to last several hours and must look at: How they sit or interact with any current equipment The range of movement of all major joints, body parts, their ability to maintain or alter their posture. Their weight and pressure distribution whilst sitting and lying. Based on the analysis of the results - an optimum posture can be proposed and then tested to ensure the equilibrium of the bio-mechanical & musculoskeletal forces. It must ensure maximum contact with support surfaces and optimise weight bearing capabilities. All corrective forces required to reduce asymmetry should be identified and be tolerated by the patient. They should feel secure, have less pain and be comfortable in this suggested position. The selection of the equipment and the rationale behind the process will be written up to support the clinical process and allow outcomes to be measured.

During the patient admission process to the inpatient rehabilitation department, the parents will be invited to participate in the current study. A detailed face-to-face explanation was given to the parents of all eligible cases. All included cerebral palsy cases were recruited by a non-random consecutive sampling protocol and they were evaluated by repeated measures during their visits to the seating and position clinic. Each included case was tested and assessed at three measurement intervals: on day one, after two weeks and after four weeks from the initial postural management intervention using proper wheelchair according to the World Health Organization (WHO) protocol (Khasnabis et al., 2013) (Figure 3.1).

Study Flowchart

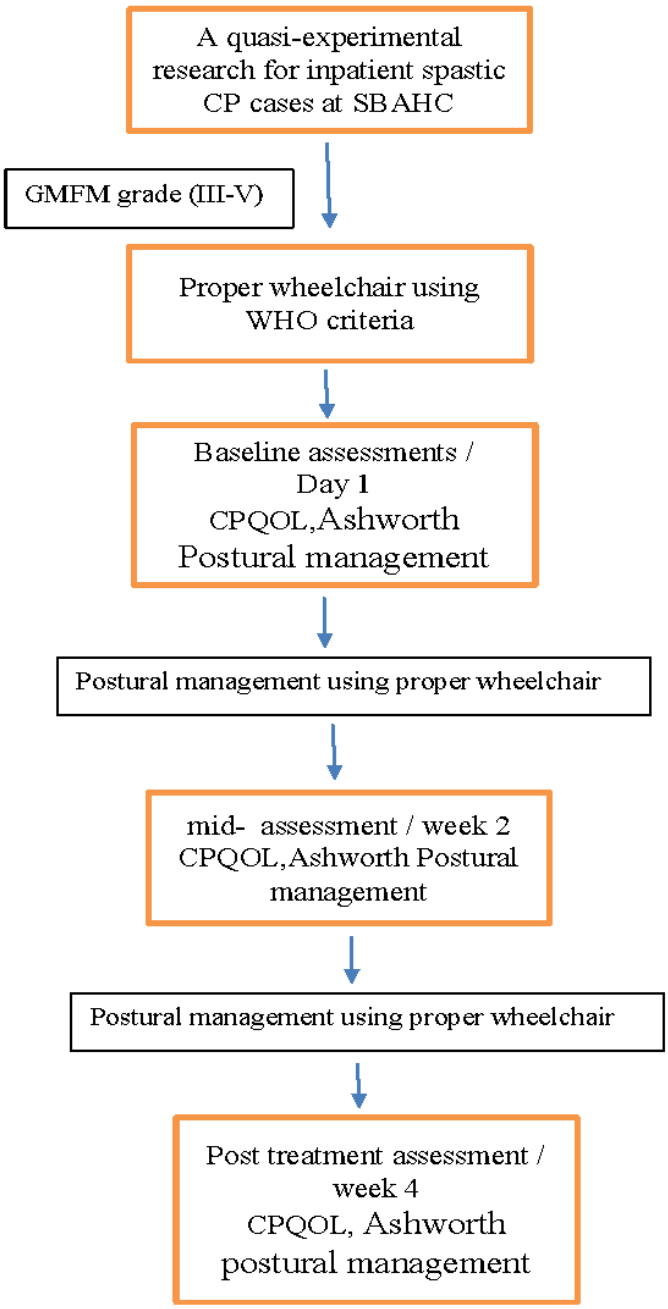

Figure 3.2 Data Collection Flowchart

3.5.1 Postural Management Intervention

Upon patient selection, demographic data and Gross Motor Function Classification System (GMFCS) were collected. Then, a comprehensive physiotherapy assessment was performed for each case to reach a diagnosis and select the appropriate wheelchair according to WHO criteria (Appendix D). After that, the parents or caregivers were educated about the proper positioning, safety transfer, methods to prevent pressure ulcers, adjustability of the wheelchair, and proper way of using the wheelchair (Table 3.1 and Figures). The caregivers were requested to attend 30 minutes of educational sessions for five days per week. Each educational session was divided into 10 minutes of theoretical education and demonstration, 10 minutes of practical proper sitting training and 10 minutes of practical proper transfer training.

Table 3.1 Covered topics at caregiver's postural management training

Topic	Included details
Proper positioning	The child needs to be positioned in the wheelchair as the function of the patient, the knees need to be bent a little more than neutral, the feet need to be in contact with the footplate, and the headrest should be put at the base of the head.
Safety transfer	Keeping the wheelchair as close as possible to where the caregiver is moving the child. Transfer on the trunk of the child first. Always keeping the wheelchair locked during the transfer and keeping the foot pedals out of the way
Prevention of pressure ulcers	Shifting the child weight in the wheelchair every 15 to 20 minutes and hygiene measures for the child skin
The adjustability of the wheelchair	Adjusting the width, depth, length, back height, arms and footrest measures to fit the child current and future needs taking in consideration the growth needs
The proper way of using the wheelchair	Getting familiar with the wheelchair, using the breaks, movement of the wheelchair, and maintaining it

Source: (United Nation World Tourism Organization, 2016)

Figure 3.3 Proper Positioning

Figure Safety Transfer 3.4

Figure 3.5 Prevention of Pressure Ulcers

Figure 3.6 The Adjustability Of the Wheelchair

Figure 3.7 The Proper Way Of Using The Wheelchair

3.5.2 Data collection tools

At the baseline, after two weeks and after four weeks of postural management, a Modified Ashworth scale (MAS) physical assessment, a Cerebral Palsy Quality of Life (CPQOL) assessment, and Gross Motor Function Classification Scale (GMFC) assessment were performed for each included patient.

3.5.2.1 Cerebral Palsy Quality of Life (CPQOL)

The Cerebral Palsy Quality of Life (CPQOL) Questionnaire is a standardized measurement tool for the quality of life of children 4 – 12 years old with cerebral palsy that was developed by a multidisciplinary team of researchers across four countries: Australia, Scotland, Germany and the USA. The development phase of this tool involved children, caretakers, health providers and other stakeholders. The Australasian Academy of Cerebral Palsy and Developmental Medicine (AusACPDM) has made this measurement tool publicly and freely available for researchers all over the world. The AusACPDM restrictions were on amending, changing or translating this standardized questionnaire (Waters et al., 2013).

The CPQOL for primary caregivers of children (4 – 12 years) is composed of 65 questions distributed on seven domains. For each question, there are nine possible answers ranging from 1 (Very unhappy) to 9 (Very happy). The domains that were covered by this standardized questionnaire are feelings about functioning, participation and physical health, emotional wellbeing, social wellbeing, pain and impact of child's disability, access to several types of services and family health (Appendix A).

The Arabic version of this questionnaire was administered in face-to-face interviews after a brief explanation about the purpose of the questionnaire and its methodology.

After the interviews, the results were entered into a Microsoft Excel spread sheet. CPQOL scores were transferred into 100 points measurement scores in the following method: if the answer was 1 then the score becomes 0, for 2 it becomes 12.5, for 3 it becomes 25, for 4 it becomes 37.5, for 5 it becomes 50, for 6 it becomes 62.5, for 7 it becomes 75, for 8 it becomes 87.5, and for 9 it becomes 100 score (Waters et al., 2013).

Finally, the mean CPQOL score (ranging from 0 to 100) was calculated for each participant and it was compared between day 1, after 2 weeks, and after 4 weeks from providing them with the appropriate wheelchair and postural management.

A 2017 published study concluded that the Arabic translated version of the CPQOL questionnaire was valid and reliable to use on an Egyptian population (El-Weshahi et al., 2017). The intraclass correlation for this translated measurement tool ranges from 0.88 to 0.97 and Cronbach's alpha was higher than 0.7 for most of the domains (El-Weshahi et al., 2017).

3.5.2.2 Modified Ashworth scale (MAS)

The Modified Ashworth Scale (MAS) is one of the most common measurement tools to assess muscular spasticity among researchers. It is considered the gold standard tool (Ghotbi et al., 2009). It was developed in the sixties and modified in the eighties by Bohannon and Smith to have more accurate and reliable muscular resistance measurements. It is an ordinal scale used for grading the muscle resistance encountered during passive muscle movement, ranging from zero scores (indicating

normal muscle tone) up to four scores (indicating limb rigid in extension or flexion). The modified scale included +1 to measure the minor increase in muscle tone, displayed by a catch, followed by the lowest resistance level throughout the remaining range of movement (Germanotta et al., 2020) (Appendix B).

In MAS spasticity is scored in the following manner: 0 scores is indicated when there is no increase in muscle tone, 1 score is indicated when there is a slight rise in muscle tone, revealed by a catch and release or by a minimal level of resistance at the end of the ROM (range of movement) when the examined part is moved in flexion or extension, 1+ score is indicated when there is a slight increase in muscle tone, shown by a catch, followed by minimal resistance all over the remainder (less than half) of the ROM, 2 scores is indicated when there is a more noticeable intensification in muscle tone through most of the ROM, but affected part(s) easily moved, 3 scores are indicated when there is a considerable increase in muscle tone – passive movement difficult, and 4 scores is indicated when the affected part(s) is rigid in flexion or extension (Abolhasani et al., 2012). It is applicable for children 6 to 12 years old and adults 18 to 64 years old (Abilitylab, 2016).

The validity of the Modified Ashworth Scale was assessed in several published studies across several countries and it revealed a high validity of this scale (Meseguer-Henarejos et al., 2018). A systematic review of 33 articles concluded that it has higher inter and intra reliability for upper limb tests than in lower limb tests. However, the reliability of this test is still high for both extremities. The reported intraclass correlation was 0.686 and 0.781 for the lower and upper limbs, respectively. In addition, reported kappa coefficients were 0.360 and 0.593 for lower and upper limb, respectively (Meseguer-Henarejos et al., 2018).

3.5.2.3 Gross Motor Function Classification System (GMFCS)

The Gross Motor Function Classification System (GMFCS) was established and validated in the nineties to measure and classify children with cerebral palsy according to their motor abilities. It applies to all children with cerebral palsy despite the type or severity of their disability (Birth Injury Guide, 2015). It is a standardized tool that is used to communicate child ambulation severity between care providers and researchers. It ranges from 1 to 5 where five indicates more severity (Palisano et al., 1997) Appendix C.

After the age of six years, it is unlikely for a child with cerebral palsy to have a change in the GMFCS classification. Therefore, this tool could help with planning the mobility assistance that the child will require for a lifelong duration (Cerebral Palsy Alliance Research Foundation, 2018). In GMFCS, motor ability assessment differs according to the child's age. There are four age groups to assess motor abilities: 1 to 2, 2 to 4, 4 to 6, and 6 to 12 years. Based on motor function assessment for children aged 6 to 12 years old, classification 1 means that the child is able to walk indoors and outdoors, and climb stairs without limitations, classification 2 means that the child walk indoors and outdoors, and climb stairs holding onto a rail, but facing some limitations walking on uneven planes and inclines, and walking in crowds or confined spaces, classification 3 means that the child can walk indoors or outdoors on a level surface with an assistive mobility device. Children may climb stairs holding onto a rail, classification 4 means than the child may maintain levels of function achieved before the age of 6 years or rely more on wheeled mobility at home, school, and in the community, and classification 5 means that physical disability limits voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas

of motor function are limited (Wood & Rosenbaum, 2000). A 2015 Jordanian study examined the validity and reliability of the Gross motor functional measurement assessment tool. The Arabic Gross Motor Classification measurement tool has high kappa coefficients between physiotherapists (0.080) (Almasri & Saleh, 2015).

3.6 Ethical Considerations

Written ethical approval was obtained from the UniSZA Human Research Ethics Committee (UHREC) Number UniSZA.C/2/UHREC/828-2HID2/81 and the SBAHC Ethics Committee Number 09-2019-IRP. A hard copy of a written, informed consent was collected from all caregivers of the included subjects in this study at the time of the data collection (Appendix D). It was mentioned in the consent form that the voluntary participation in the study or refusal to participate will not affect the management plan. The data collected in this study were anonymous and the filled out electronic questionnaires were stored securely and only the primary investigator had access to the data. The data will be safely deleted after three years of completion of the study.

3.7 Data Analysis

The anonymous data were numerically coded and cleaned in an Excel sheet (Microsoft Corp., Redmond, WA, USA). Then, Statistical Product and Service Solutions (SPSS) Statistics, Chicago, Illinois, USA) version 25 software was used for data analysis. The data normality of the data set was checked using Kolmogorov-Smirnov normality test. The study variables were compared using t-test and ANOVA test to analyze these continuous variables. Data were interpreted as statistically significant when p-value < 0.05. Mean CP QOL and Modified Ashworth scores were

calculated for study participants to identify significant differences in mean scoresData collected and analyzed using SPSS version 22.0. The data checked for normality using Kolmogorov Simonov/shapiro wilk test.Descriptive statistics formulated and tabulated as mean and SD. Repeated measures of ANOVA used to analyse the time effect for all the variables analyzed once the assumptions are met

3.8 Safety Protocol COVID-19

As our study was done during COVID 10 we followed the Saudi ministry of health protocol and SBAHC protocol. As an employee in Sultan Bin Abdulaziz Humanitarian City and in line with the directives of the relevant authorities toward coexistence with covid-19 pandemic by applying social distancing and other precautionary measures inside and outside the City

We are following the all infection prevention measures, Personal & Workplace Hygiene, Continuous hand hygiene (soap and water / alcohol based hand rub) especially after touching any surface, papers, tools, etc, Not to use other people's personal belongings, such as mobile phones, laptops, pens, etc, Ensure the cleanliness of my workplace using surface disinfection wipes. (Phone, keyboard, table, etc) Social Distancing/Workplace Safety, Wearing face mask in all public areas inside or outside the City and when sharing the same room with another person, Wearing a surgical mask and all assigned PPEs when interacting with patients and while doing supervisory rounds, Not to visit other departments, sections, and offices that I am not supposed to visit as per my job duties, Not to attend face to face meetings and to attend virtually instead. (for example, using Microsoft teams), Keep distance of 1.5M to 2M between myself and any other person whether inside or outside the City, Not to join any gathering in any private or public areas whether inside or outside the City,

Not to use elevators unless it is necessary, and to ensure not to share the elevator with more than three persons, Applying social distancing outside the City and not to attend private (family/friends) or public events and gatherings, as exposing myself to infection will put patients and colleagues at risk.

For our patient we are following all infection prevention measures, Universal masking of all healthcare workers, patients and visitors, Correct and consistent use of available PPE and appropriate hand hygiene, Perform hand hygiene after contact with respiratory secretions, Personal protective equipment (PPE) effectiveness depends on adequate and regular supplies and proper selection, use of Personal protective equipment (PPE), Ensure that environmental cleaning and disinfection procedures are followed consistently and correctly. Thorough cleaning of environmental surfaces with water and detergent and applying commonly used hospital level disinfectants (such as sodium hypochlorite) is an effective and sufficient procedure.

CHAPTER 4

RESULTS

This chapter describes postural management results using wheelchairs in children with spastic cerebral palsy in Saudi Arabia. It starts with describing the results of descriptive analysis. After that, a complete description of the results of correlation is demonstrated. Thirty-five children participated in this study and the results of their scores pre-intervention, during and post are described in this chapter.

4.1 Descriptive Analysis

The mean age of the subjects was 8.0 ± 2.7 years, ranging between 4 and 12 years, almost equally divided between the two genders, 51.4% and 48.6% male and females, respectively. All data represent a normal distribution value of Sig. higher than 0.05 using Shapiro-Wilk test in Tables 4.1, 4.2 and 4.3. Around half of the study subjects were provided with WHO standard wheelchair type after proper assessment of their postural management needs, 34.3% of them were provided with WHO active wheelchair type and 20.0% were provided with WHO pushchairs type. Sociodemographic characteristics of study subjects and the wheelchair type that was given to them are shown in Table 4.1.

Table 4.1 Shapiro-Wilk test Normality Data the Modified Ashworth Scale n=35

	Baseline	MAS after 2 weeks	MAS after 4 weeks
	Statistic and Sig.	Statistic and Sig.	Statistic and Sig.
Right Shoulder	0.983 & 0.842	0.911 & 0.058	0.979 & 0.725*
Left Shoulder	0.980 & 0.759	0.962 & 0.255	0.930 & 0.628
Right Elbow	0.971 & 0.474	0.993 & 0.997	0.976 & 0.641
Left Elbow	0.975 & 0.602	0.964 & 0.308	0.987 & 0.937
Right Wrist	0.995 & 1.000	0.938 & 0.058	0.955 & 0.064
Left Wrist	0.972 & 0.502	0.968 & 0.388	0.915 & 0.060
Right Hip	0.978 & 0.709	0.955 & 0.160	0.954 & 0.151
Left Hip	0.970 & 0.447	0.978 & 0.688	0.977 & 0.657
Right Knee	0.948 & 0.095	0.968 & 0.624	0.969 & 0.429
Left Knee	0.951 & 0.126	0.955 & 0.167	0.983 & 0.852
Right Ankle	0.964 & 0.306	0.957 & 0.191	0.993 & 0.998
Left Ankle	0.964 & 0.309	0.968 & 0.391	0.976 & 0.360

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4.2 Shapiro-Wilk test Normality Data the Gross Motor Function Classification System (GMFCS) Score n=35

	Baseline	MAS after 2 weeks	MAS after 4 weeks
	Statistic and Sig.	Statistic and Sig.	Statistic and Sig.
GMFCS	0.969 & 0.419	0.931 & 0.060	0.980 & 0.749*

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4.3 Shapiro-Wilk test Normality Data. The Cerebral Palsy Quality of Life (CPQOL) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35

Domain	Baseline Statistic and Sig.	MAS after 2 weeks Statistic and Sig.	MAS after 4 weeks Statistic and Sig.
Social Wellbeing and Acceptance	0.945 & 0.082	0.993 & 0.997	0.984 & 0.889
Feelings About Functioning	0.973 & 0.545	0.986 & 0.932	0.971 & 0.468
Participation and Physical Health	0.978 & 0.683	0.978 & 0.681	0.945 & 0.078
Emotional Wellbeing and Self Esteem	0.983 & 0.851	0.979 & 0.730	0.967 & 0.366
Access to Services	0.971 & 0.465	0.969 & 0.404	0.981 & 0.792
Pain and Impact of Disability	0.936 & 0.053	0.958 & 0.197	0.976 & 0.625
Family Health	0.977 & 0.644	0.966 & 0.348	0.958 & 0.194

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table Socio :4.4-Demographic Characteristics (n=35)

Variable	Number	Percent
Age (mean (years)± SD = 8.0 ± 2.7)		
4 – 6 year	12	34.3
7 – 9 year	12	34.3
10+ year	11	31.4
Gender		
Male	18	51.4
Female	17	48.6
Type of wheelchair that was provided to the child		
Standard wheelchair	16	45.7
Active wheelchair	12	34.3
Push wheelchair	7	20

Socio-Demographic Characteristics

Postural management using a proper wheelchair in children with cerebral palsy was associated with a statistically significant bilateral reduction in MAS score between the baseline and after 4 weeks of following up in the shoulder, elbow, wrist and hip joints (p-value <0.001). Meanwhile, the MAS score did not change significantly in knee and ankle joints. Changes in MAS scores of study subjects are shown in Table 4.5 and Figure 4.1.

Table 4.5 Mean Score of the Muscle tone using The Modified Ashworth Scale (MAS) Score (n=35)

Joint	MAS		
	Baseline	2 weeks	4 weeks
Right Shoulder	2.5 (1.3)	2.8 (1.1)	1.7 (1.5)
Left Shoulder	2.5 (1.3)	2.8 (1.1)	1.7 (1.5)
Right Elbow	3.1 (1.0)	2.9 (1.25)	2.0 (1.4)
Left Elbow	2.7 (1.0)	2.9 (1.4)	2.0 (1.4)
Right Wrist	2.7 (1.3)	2.9 (1.4)	1.8 (1.2)
Left Wrist	2.8 (1.2)	2.7 (1.2)	2.0 (1.3)
Right Hip	2.7 (1.1)	2.5 (1.3)	2.0 (1.0)
Left Hip	2.8 (1.3)	2.7 (0.9)	2.0 (1.3)
Right Knee	2.6(1.6)	2.9 (1.1)	2.6 (1.4)
Left Knee	2.9 (1.3	3.0 (1.2)	2.9 (1.2)
Right Ankle	2.7 (1.2)	2.6 (1.3)	2.4 (1.4)
Left Ankle	3.8 (1.3)	3.4 (1.5)	3.9 (1.5)

Mean (SD)

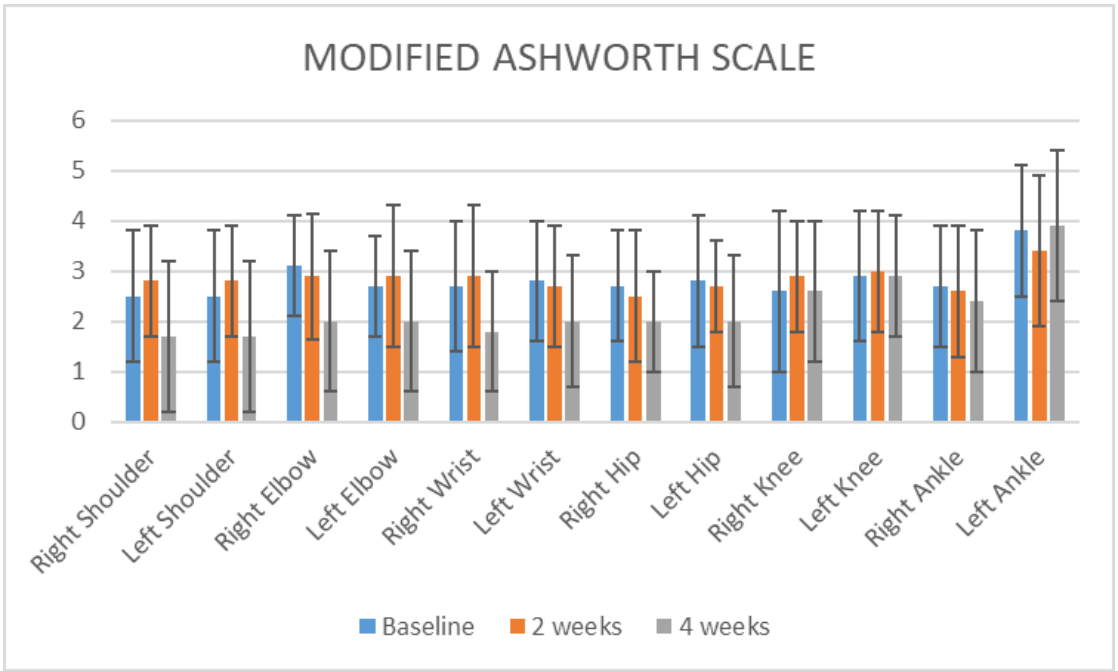

Figure 4.1 The Modified Ashworth Scale (MAS) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35)

Analysis of MAS Right shoulder

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 6.92 p = 0.030. A Greenhouse-Geisser correction was applied [F (1.679, 57.097) = 10.039, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for right shoulder spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean muscle tone of the right shoulder differed statistically significantly between time points [F(1.679,57.097)= 10.039, p< 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of shoulder statistically significantly decreased from baseline to 4 weeks (0.75 (95% CI, 0.23 to 0.27) , p < 0.05), and from 2 weeks to 4 weeks (1.034 (95% CI, 0.48 to 1.584) , p <0.05), but not from baseline to 2 weeks (-0.29 (95% CI, -0.64 to 0.09) , p = .129).

Table 4.6 Comparison within Time Muscle Tone- Right Shoulder

Joint	Time		Mean Difference (SE)	P value	95% CI
Right Shoulder	Baseline	2 Weeks	-.281(.180)	.129	(-.647,.086)
	Baseline	4 Weeks	.753(.255)*	.006	(.235, 1.27)
	2 Weeks	4 Weeks	1.034(.271)*	.001	(.484,1.58)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left shoulder

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi 2$ (2) = 1.226 p = 0.542. The sphericity assumed value was taken [F (2,68) = 2.393, p =0.099]. The pairwise comparisons for left shoulder spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed determined that mean muscle tone of the left shoulder differed between time points [F (2, 68) = 2.393, p =0.099]. Post hoc analysis with a Bonferroni adjustment revealed that there was no statistical significant difference in muscle tone of the left shoulder across measurements.

Table 4.7 Comparison Within Time Muscle Tone-Left Shoulder

Joint	Time		Mean Difference (SE)	P value	95% CI
Left shoulder	Baseline	2 Weeks	-.016(.255)	.951	(-.5350.503)
	Baseline	4 Weeks	.493(.288)*	.006	(-.093,1.08)
	2 Weeks	4 Weeks	.509(.248)*	.008	(.005,1.013)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Right elbow

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 5.857 p = 0.053 A Greenhouse-Geisser correction was applied [F (1.720, 58.489) = 10.427, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for right elbow

spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean muscle tone of the right elbow differed statistically significantly between time points [F (1.720, 58.489) = 10.427, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of right elbow statistically significantly decreased from baseline to 4 weeks (1.07 (95% CI, 630 to 1.512) , p <0 .05), and from 2 weeks to 4 weeks (.832 (95% CI, .239 to 1.425) , p <0.05), but not from baseline to 2 weeks (.239 (95% CI,-.214 to 693)) , p = .291).

Table 4.8 Comparison within Time Muscle Tone-Right Elbow

Joint	Time		Mean Difference (SE)	P value	95% CI
Right Elbow	Baseline	2 Weeks	.239(.223)	.291	(-.214,.693)
	Baseline	4 Weeks	1.07(.217)*	.000	(.630,1.512)
	2 Weeks	4 Weeks	.832(.292)*	.007	(.239,1.425)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left elbow

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi 2$ (2) = 3.587 p = 0.167. Hence sphericity assumed value was taken [F (2, 68) = 9.789, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points.The pairwise comparisons for left elbow spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the left elbow differed statistically significantly between

time points [F (2, 68) = 9.789, p<0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of left elbow statistically significantly decreased from baseline to 4 weeks (.964 (95% CI, .246 to 1.075) , p < 0.05), and from 2 weeks to 4 weeks (.873 (95% CI, .399 to 1.347) , p <0.05), but not from baseline to 2 weeks (.212 (95% CI,-.570 to .145)) , p = .236).

Table 4.9 Comparison Within Time Muscle Tone-Left Elbow

Joint	Time		Mean Difference (SE)	P Value	95% CI
Left Elbow	Baseline	2 Weeks	-.212(.176)	.236	(-.570,.145)
	Baseline	4 Weeks	.964(.204)*	.003	(.246,1.075)
	2 Weeks	4 Weeks	.873(.233)*	.001	(.399,1.347)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Right wrist

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi 2$ (2) = .264 p = 0.876. Hence sphericity assumed value was taken [F (2, 68) = 11.887, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points.The pairwise comparisons for right wrist spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the right wrist differed statistically significantly between time points [F (2, 68) = 11.887, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of right wrist statistically significantly decreased from baseline to 4

weeks (.964 (95% CI, .462 to 1467) , p <0.05), and from 2 weeks to 4 weeks (.1.139 (95% CI, .605 to 1.672) , p <0.05), but not from baseline to 2 weeks (-.174 (95% CI,-.570 to .145)) , p = .481).

Table 4.10 Comparison within Time Muscle Tone-Right Wrist

Joint	Time		Mean Difference (SE)	P Value	95% CI
Right Wrist	Baseline	2 Weeks	-.174(.245)	.481	(-.672,.323)
	Baseline	4 Weeks	.964(.247)*	.000	(.462,1.467)
	2 Weeks	4 Weeks	1.13(.262)*	.000	(.605,1.672)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left wrist

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 6.618 p = 0.037. A Greenhouse-Geisser correction was applied [F (1.692, 57.543) = 6.624, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for left wrist spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean muscle tone of the left wrist differed statistically significantly between time points [F (1.692, 57.543) = 6.624, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of left wrist

statistically significantly decreased from baseline to 4 weeks (0.827 (95% CI, 0.243 to 1.411) , $p < 0.05$), and from 2 weeks to 4 weeks (.666 (95% CI, .244 to 1.089) , $p < 0.05$), but not from baseline to 2 weeks (.161(95% CI, -.286 to .608) , $p = 0.470$).

Table 4.11 Comparison Within Time Muscle Tone-Left wrist

Joint	Time		Mean Difference (SE)	P Value	95% CI
Left Wrist	Baseline	2 Weeks	.161 (.220)	.470	(-.286,.608)
	Baseline	4 Weeks	.827(.28)*	.007	(.243,1.411)
	2 Weeks	4 Weeks	.666(.208)*	.003	(.244,1.089)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Right hip

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi 2$ (2) = 3.470 $p = 0.176$. Hence sphericity assumed value was taken [F (2, 68) = 5.288, $p < 0.05$]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for right hip spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the right hip differed statistically significantly between time points [F (2, 68) = 5.288, $p < 0.05$]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of right hip statistically significantly decreased from

baseline to 4 weeks (0.742 (95% CI, 0.339 to 1.145) , $p < 0.05$), and from 2 weeks to 4 weeks (.558 (95% CI, .056 to 1.060) , $p < 0.05$), but not from baseline to 2 weeks (.184(95% CI, -.351 to .719) , $p = 0.489$).

Table 4.12 Comparison within Time Muscle Tone-Right Hip

Joint	Time		Mean Difference (SE)	P Value	95% CI
Right Hip	Baseline	2 Weeks	.184(.263)	.489	(-.351,.719)
	Baseline	4 Weeks	.742(.198)*	.001	(.339, 1.14)
	2 Weeks	4 Weeks	.558(.247)*	.030	(.056,1.060)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left hip

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 2.432 $p = 0.296$. Hence sphericity assumed value was taken [F (2, 68) = 7.158, $p < 0.05$]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for left hip spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the left hip differed statistically significantly between time points [F (2, 68) = 7.158, $p < 0.05$]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of left hip statistically significantly decreased from baseline

to 4 weeks (0.732 (95% CI, 0.278 to 1.186) , p < 0.05), and from 2 weeks to 4 weeks (.626 (95% CI, .175 to 1.076) , p <0.05), but not from baseline to 2 weeks (.107(95% CI, -.257 to .471) , p = 0.555).

Table 4.13 Comparison Within Time Muscle Tone-Left Hip

Joint	Time		Mean Difference (SE)	P Value	95% CI
Left Hip	Baseline	2 Weeks	.107(.179)	.555	(-.257,.471)
	Baseline	4 Weeks	.732(.223)*	.002	(.278, 1.18)
	2 Weeks	4 Weeks	.626(.222)*	.008	(.175,1.076)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Right knee

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 0.032 p = 0.984. Hence sphericity assumed value was taken [F (2, 68) = .632 p=0.535]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for right knee spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the right knee was not statistically significantly between time points [F (2, 68) = .632, p = 0.535].

Table 4.14 Comparison within Time Muscle Tone-Right Knee

Joint	Time		Mean Difference (SE)	P Value	95% CI
Right Knee	Baseline	2 Weeks	-.284(.280)	.316	(-.853,.284)
	Baseline	4 Weeks	-.029(.28)	.920	(-.601, .544)
	2 Weeks	4 Weeks	.256(.274)	.358	(-.302,.813)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left knee

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 0.793 p = 0.673. Hence sphericity assumed value was taken [F (2, 68) = .123, p=0.885]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for left knee spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the left knee was not statistically significantly between time points [F (2, 68) = .123, p = 0.885].

Table 4.15 Comparison within Time Muscle Tone -Left Knee

Joint	Time		Mean Difference (SE)	P Value	95% CI
Left Knee	Baseline	2 Weeks	-.100(.205)	.628	(-.518,.317)
	Baseline	4 Weeks	-.010(.23)*	.966	(-.485, .465)
	2 Weeks	4 Weeks	.090(.229)*	.696	(-.376,.556)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Right ankle

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 1.031 p = 0.597. Hence sphericity assumed value was taken [F (2, 68) = .677, p=0.512]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for right ankle spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean muscle tone of the right ankle was not statistically significantly between time points [F (2, 68) = .677, p = 0.512].

Table 4.16 Comparison within Time Muscle Tone-Right Ankle

Joint	Time		Mean Difference (SE)	P Value	95% CI
Right Ankle	Baseline	2 Weeks	0.67(.234)	.776	(-.409,.543)
	Baseline	4 Weeks	.256(.241)	.296	(-.234, .746)
	2 Weeks	4 Weeks	.189(.208)	.370	(-.610,.233)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Analysis of MAS Left ankle

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 1.582 p = 0.453. Hence sphericity assumed value was taken [F (2, 68) = 3.586, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for left ankle spasticity measured with MAS that reduced form baseline, 2 weeks and 4 weeks using proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined

that mean muscle tone of the left ankle differed statistically significantly between time points [F (2, 68) = 3.586, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that muscle tone of left ankle statistically significantly decreased from baseline to 2 weeks (.425(95% CI, .017 to .834) , p <0.05), but it increased from 2 weeks to 4 weeks (-.558 (95% CI, -1.044 to -.071) , p <0.05), but from baseline to 4 weeks (-.132 (95% CI, -.560 to 0.295) , p=.534) there was no significant difference in tone.

Table 4.17 Comparison Within Time Muscle Tone-Left Ankle

Joint	Time		Mean Difference (SE)	P Value	95% CI
Left Ankle	Baseline	2 Weeks	0.425(.201)	.042	(.017,.834)
	Baseline	4 Weeks	-.132(.210)	.534	(-.560, .295)
	2 Weeks	4 Weeks	-.558(.240)	.026	(-1.044,-.071)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Gross Motor Function Classification System (GMFCS) Score

Similar to the MAS score, the GMFCS scores decreased between the baseline and after four weeks of postural management using proper wheelchairs (p-value <0.001). The mean GMFCS score of study subjects was 1.6540 (.96385) at the baseline and it decreased to 1.5053 (1.21700) after two weeks of postural management and it reached a mean score of 1.5187 (1.14477) after four weeks of postural management and follow-up. Changes in GMFCS scores before and after postural management of study subjects are demonstrated in table 4.37 and figures 4.2, 4.3 and 4.4.

Table 4.18 Descriptive Statistics the Gross Motor Function Classification System (GMFCS) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35)

	Mean score (SD)		
	Baseline	2 weeks	4 weeks
GMFCS	4.5 (0.9)*	3.5 (0.8)*	3.4 (0.8)*

*. This is a lower bound of the true significance.

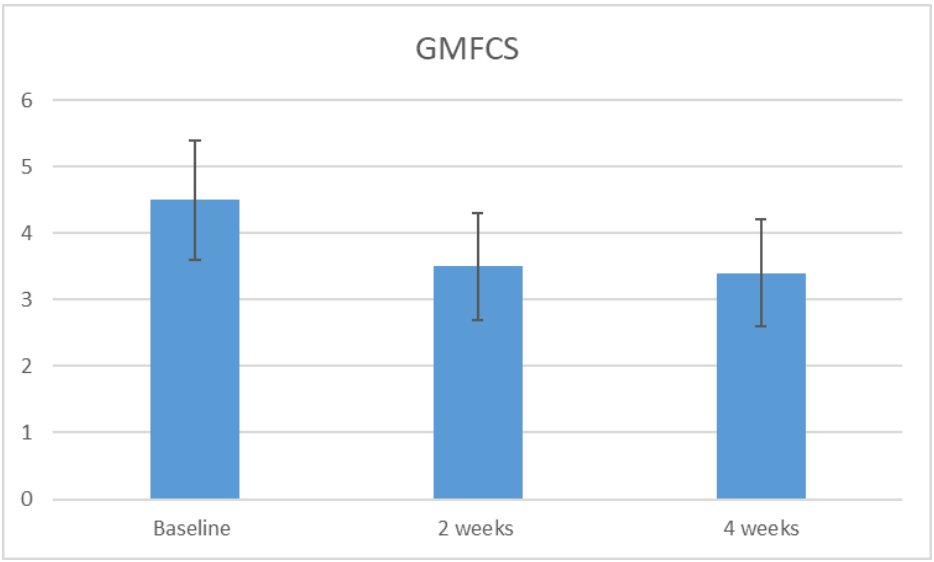

Figure 4.2 Gross Motor Function Classification System (MAS) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35)

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 4.154 p = 0.125 Hence sphericity assumed value was taken [F (2, 68) = .289, p = 0.750]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for GFMCS reduced from baseline, 2 weeks and 4 weeks using a proper wheelchair. A repeated measures ANOVA with sphericity assumed value determined that mean GFMCS was not statistically significantly between time points [F (2, 68) = .289, p = 0.750].

Table 4.19 Comparison within Time-GMFCS

	Time		Mean Difference (SE)	P Value	95% CI
GMFCS	Baseline	2 Weeks	1.0 (.164)*	1.9	(.587,1.41)
	Baseline	4 Weeks	1.086(.17)*	8.9	(.655,1.516)
	2 Weeks	4 Weeks	.086(.048)*	.249	(-.035, .206)

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Cerebral Palsy Quality of Life (CPQOL) Score

On the other hand, CPQOL scores showed a similar improvement pattern after postural management but the improvement was statistically significant in five out of seven quality of life domains. The mean CPQOL score in the social wellbeing and acceptance domain increased from 556.4 ±91.9 on the baseline to 642.8 ±99.5 after four weeks of postural management and this improvement was statistically significant (p-value <0.001). Also, the mean score of the 'Feelings about Functioning' domain increased from 597.8 ±92.3 to 670.7 ±97.3 and this increase was statistically significant (p-value 0.003). In addition, the mean score of 'participation and physical health' improved significantly after postural management (p-value 0.001), the mean score was 508.2 ±120.2 and 611.4 ±128.1, at the baseline and after 4 weeks of follow-up, respectively. In the same way, the mean score of the 'Emotional wellbeing and self-esteem' domain increased from 276.7 ±69.6 at the baseline to 310.3 ±70.9 after two weeks of postural management and reached 319.2 ±90.6 after four weeks of postural management using a proper wheelchair. Also, the mean score of the 'Access to Services' domain improved significantly from 563.9 ±119.9 before the treatment to

672.5 ±121.3 after a month of postural management (p-value 0.001). Contrary to that, the mean score of 'Pain and Impact of Disability' and 'Family Health' domains did not improve significantly after postural management, p-value 0.184 and 0.301, respectively. The details of postural management effects of the CPQOL score are described in table 4.20.

Table 4.20 The Cerebral Palsy Quality of Life (CPQOL) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35)

Domain	Mean score(SD)		
	Baseline CPQOL	CPQOL after 2 weeks	CPQOL after 4 weeks
Social Wellbeing and Acceptance	556.4 (91.9)	615 (101)	642.8 (99.5)
Feelings About Functioning	597.8 (92.3)	616 (113.7)	670.7 (97.3)
Participation and Physical Health	508.2 (120.2)	595 (116.6)	611.4 (128.1)
Emotional Wellbeing and Self Esteem	276.7 (69.6)	310.3 (70.9)	319.2 (90.6)
Access to Services	563.9 (119.9)	619.6 (114.5)	672.5 (121.3)
Pain and Impact of Disability	386.4 (82.80	403.5(93.70	411.7 (81.2)
Family Health	194.2 (47.6)	195.7 (58.70	210 (68.8)
Total score	3083.9 (206.60	3355.4 (98.3)	3538.6 (186.9)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

And CPQOL scores showed a similar improvement pattern after postural management as the result in each domain using Mauchly's Test of Sphericity and Tests of within-Subjects Effects.

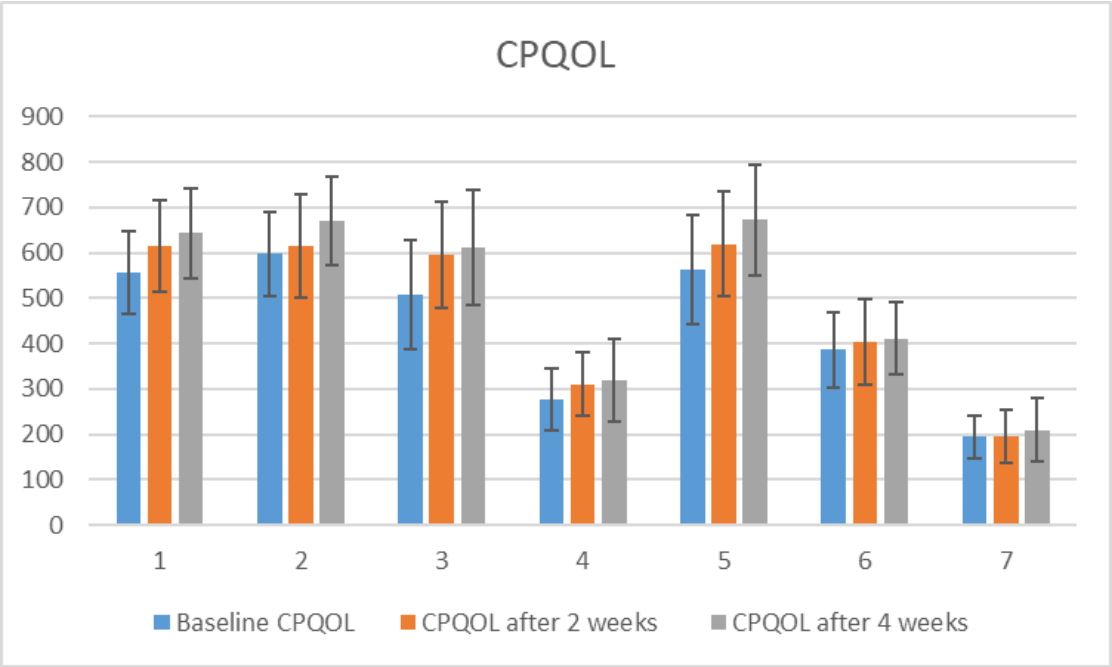

Figure 4.3 The Cerebral Palsy Quality of Life (CPQOL) Score of Study Subjects pre, during, and post postural management using a proper wheelchair (n=35)

Social Wellbeing and Acceptance

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 2.888 p = 0.236. Hence sphericity assumed value was taken [F (2, 68) = 7.061, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for social wellbeing and acceptance showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the social acceptance and well-being differed statistically significantly between time points [F (2, 68) = 7.061, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that the score statistically significantly increased from baseline to 2 weeks (-58.571 (95% CI, -103.180 to -13.963), p <0.05) and from baseline to 4

weeks (-86.429 (95% CI, -130.086 to -42.771), p<0.05) but there was no significant difference in score from 2 weeks to 4 weeks (-27.857(95% CI, -82.0222 to 26.308), p=.303).

Table 4.21 Comparison within Time-Social Wellbeing and Acceptance - CPQOL

Subscale	Time		Mean Difference (SE)	P Value	95% CI
Social Wellbeing And Acceptance	baseline	2 weeks	-58.5(21)*	.012	(-103,-13.9)
	baseline	4 weeks	-86.4(21)*	.000	(-130,-42.7)
	2 weeks	4 weeks	-27.8(26)*	.303	(-82.4,26.2)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Feelings About Functioning

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 0.366 p = 0.833. Hence sphericity assumed value was taken [F (2, 68) = 5.060, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for feelings about functioning showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the social acceptance and well-being differed statistically significantly between time points [F (2, 68) = 5.060, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that the score statistically significantly increased from baseline to 4 weeks (-72.857 (95% CI, -119.969 to -25.745), p <0.05) and from 2 weeks to 4 weeks (-54.643 (95% CI, -101.842 to -7.443), p<0.05) but there was no significant difference in score from baseline to 2 weeks (-18.214(95% CI, -69.141 to 32.713), p=.472).

Table 4.22 Comparison within Time-Feelings about Functioning- CPQOL

Subscale	Time		Mean Difference (SE)	P Value	95% CI
Feelings About Functioning	baseline	2 weeks	-18.2(25.0)*	.472	(-69.1,32.7)
	baseline	4 weeks	-72.8(23.1)*	.003	(-119.9,-25)
	2 weeks	4 weeks	-54.6(23.2)*	.025	(-101.8,-7.4)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Participation and Physical

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 2.022 p = 0.364. Hence sphericity assumed value was taken [F (2, 68) = 8.826, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for participation and physical subscale showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the participation and physical subscale differed statistically significantly between time points [F (2, 68) = 8.826, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that the score statistically significantly increased from baseline to 4 weeks (-103.214 (95% CI, -150.463 to -55.966) , p <0.05) and from baseline to 2 weeks (-86.786 (95% CI, -141.229 to -32.343) , p<0.05) but there was no significant difference in score from 2 weeks to 4 weeks (-16.429 (95% CI, -75.071 to 42.214) , p=.573)

Table 4.23 Comparison within Time-Participation and Physical- CPQOL

Subscale	Time		Mean Difference (E)	P Value	95% CI
Participation And Physical	baseline	2 weeks	-86.7(26.7)*	.003	(-141,-32.3)
	baseline	4 weeks	-103(23.2)*	.000	(-150,-55.9)
	2 weeks	4 weeks	-16.4(28.1)*	.573	(-75,42.2)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Emotional Wellbeing and Self Esteem

Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated, $\chi 2$ (2) = 8.647 p = 0.013. A Greenhouse-Geisser correction was applied [F (1.625, 55.261) = 3.091, p<0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for emotional well-being and self-esteem showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with Greenhouse-Geisser correction determined that the emotional well-being and self-esteem differed statistically significantly between time points [F (1.625, 55.261) = 3.091, p<0.05]. Post hoc analysis with a Bonferroni adjustment revealed that the score statistically significantly increased from baseline to 4 weeks (-42.500 (95% CI, -81.428 to -3.572), p <0.05) and from baseline to 2 weeks (-33.571 (95% CI, -60.362 to -6.781), p<0.05) but there was no significant difference in score from 2 weeks to 4 weeks (-8.929 (95% CI, -33.407 to 51.264), p=.671).

Table 4.24 Comparison within Time-Emotional Well Being and Self Esteem-CPQOL

Subscale	Time		Mean Difference (SE)	P Value	95% CI
Emotional Well Being And Self Esteem	baseline	2 weeks	-33.5(13.1)*	.016	(-60.3,-6.7)
	baseline	4 weeks	-42.5(19.1)*	.033	(-81.4,-3.5)
	2 weeks	4 weeks	-8.9(20.8)*	.671	(-51.2,33.4)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Access to Services

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 0.329 p = 0.848. Hence sphericity assumed value was taken [F (2, 68) = 7.660, p < 0.05]. As the main ANOVA is significant, there is a difference between at least two time points. The pairwise comparisons for access to services subscale showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the access to services subscale differed statistically significantly between time points [F (2, 68) = 7.660, p < 0.05]. Post hoc analysis with a Bonferroni adjustment revealed that the score statistically significantly increased from baseline to 4 weeks (-108.571 (95% CI, -167.683 to -49.460), p <0.05) and from baseline to 2 weeks (-55.714 (95% CI, -110.499 to -.930), p<0.05) but there was no significant difference in score from 2 weeks to 4 weeks (-52.857 (95% CI, -107.994 to 2.280), p=.060).

Table 4.25 Comparison within Time-Access to services- CPQOL

Subscale	Time		Mean Difference (SE)	P Value	95% CI
Access to services	baseline	2 weeks	-55.7(26.9)*	.046	(-110,-.930)
	baseline	4 weeks	-108.5(29)*	.001	(-167,-49.4)
	2 weeks	4 weeks	-52.8(27.1)*	.060	(-(107.9,2.2)

Based on estimated marginal means

*. This is a lower bound of the true significance.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pain and Impact of Disability

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 1.450 p = 0.484. Hence sphericity assumed value was taken [F (2, 68) = .758, p=.472]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for pain and impact of disability subscale showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the pain and impact of disability subscale did not differ statistically significantly between time points [F (2, 68) = .758, p = .472].

Table 4.26 Comparison within Time-Pain and Impact of Disability - CPQOL

Scale	Time		Mean Difference (SE)	P Value	95% CI
Pain and Impact of Disability	Baseline	2 Weeks	-17.143(22.024)	.442	(-61.901,27.615
	Baseline	4 Weeks	-25.357(18.706)	.184	(-63.372,12.658)
	2 Weeks	4 Weeks	-8.214(22.118)	.713	(-53.164,36.735)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Family Health

Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, $\chi 2$ (2) = 3.359 p = 0.187. Hence sphericity assumed value was taken [F (2, 68) = .669, p=.501]. As the main ANOVA is not significant, there is no difference between at least two time points. The pairwise comparisons for family health subscale showed improvement from baseline, 2 weeks and 4 weeks after intervention. A repeated measures ANOVA with sphericity assumed value determined that the family health subscale did not differ statistically significantly between time points [F (2, 68) = .669, p = .501].

Table 4.27 Comparison within time- Family Health - CPQOL

Subscale	Time		Mean Difference (SE)	P Value	95% CI
Family Health	Baseline	2 Weeks	-1.429(12.424)	.909	(-26.677,23.820)
	Baseline	4 Weeks	-15.714(14.970)	.301	(-46.136,14.708)
	2 Weeks	4 Weeks	-14.286(16.432)	.391	(-47.679,19.102)

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

CHAPTER 5

DISCUSSIONS

This chapter discusses postural management results using wheelchairs in children with spastic cerebral palsy in Saudi Arabia in light of other studies that examined similar effects of postural management. It starts with result discussion for cerebral palsy cases who received postural management using a proper wheelchair showed a significant improvement in MAS, GMFCS and CPQOL scores after four weeks of follow-up at the postural clinic in Sultan Bin Abdul-Aziz Humanitarian City, discussing the results of postural management with other studies in developed and developing countries. After that, a complete description of strengths and limitations are demonstrated.

5.1 Result of Proper Wheelchair on Spasticity

In children with cerebral palsy, postural management using a suitable wheelchair was linked to a statistically significant reduction in MAS score in the shoulder, elbow, wrist, and hip joints between baseline and after 4 weeks of follow-up (p-value 0.001) . The spasticity was decreased 32% in the right and left shoulder between baseline and after 4 weeks, the right elbow the spasticity was decreased 36% and left elbow was decreased 26%, the right wrist was decreased 34% and the left wrist was decreased 29%, and the spasticity in right hip was decreased between baseline and 4 weeks 26%, the spasticity in left hip was decreased between baseline and 4 weeks 28%, and no significant decreased in the spasticity between baseline and 4 weeks in the knee joints and the right ankle was decreased 11% the spasticity between baseline and 4 weeks was increased the spasticity in the left ankle 2% .Meanwhile, Spasticity is defined as increased speed-dependent resistance to passive muscle extension, or inadequate

involuntary muscle activity associated with upper motor neuron paralysis. Spasticity can cause functional problems with activities of daily living (ADL) such as walking, eating, and washing, going to the bathroom, and changing clothes. Over time, spasticity can also cause problems such as subluxation, dislocation, and loss of functional independence. Contracture occurs when a joint loses movement due to structural changes in the muscles, ligaments, and tendons that surround the joint. The shortening and stiffness of the soft tissue makes it difficult for the joints to stretch and interferes with normal movement. However, spasticity is beneficial for children with cerebral palsy.

The ROM using proper wheelchair that reduce spasticity with Biofeedback combined with functional movement reduction in spasticity And postural management promote optimal recovery by modulating muscle tone, providing appropriate sensory information, increasing spatial awareness with Normalise Tone or Decrease Abnormal influence on the Body

The MAS score in knee and ankle joints did not significantly affect the complex knee and ankle anatomy directly contributing to the observed deformity. With spasticity, paediatric patients have less control and isolation of activation. The activation is more diffuse and divergent. Therefore, different ankle and foot deformities may be observed, depending on the severity of the spasticity and the weakness of the individual muscles. And in our study, wheelchairs did not directly intervene in the knee and ankle joints as physical therapy may be involved in maintaining the range of motion of the ankle joint, and in the control of ankle muscle tone in children with spastic CP.

Proper wheelchair and orthoses are all devices that are designed to keep the body in a certain position. These devices are used to prevent or correct deformities in the spastic limb and/or to help children with cerebral palsy overcome activity limitations, such as difficulties with standing and walking and wheelchair can improve the range of movement in a joint that is already spasticity. Proper wheelchair is an intervention practice that is becoming more commonly used in occupational therapy practice, in addition to other treatment modalities/protocols for children with cerebral palsy to manage spasticity.

Providing a prolonged stretch offers biomechanical benefits and inhibits spasticity using proper wheelchairs with orthosis are typically designed to limit unwanted ankle movements, specifically ankle plantar flexion (foot pointed toward the ground).

It is well known that muscle tone and ROM of the knee and ankle joints are important for the maintenance of standing posture and ambulatory function. The effects of the wheelchair on spasticity are not significant. Our findings that need more than 30 days reducing spasticity in Knee and ankle joints may significantly affect the flexibility or muscle tone and ROM of the spastic knee and ankle joints. In addition, during the study as the patients' readmission no direct physical therapy intervention. For this reason, it is noted that regular PT to prevent ankle contracture and control hypertonicity is an important component of the care continuum for children with spastic CP. The current study is the city of Riyadh's first interventional study on postural management for CP children, and it included a gold-standard evaluation tool to analyze the effects of postural management utilizing a correct wheelchair selection. The full assessment spasticity features of this intervention would aid in the development of primary evidence concerning its benefits and potentials. Furthermore, the full examination of this element and its precise implications on CP scores added

novel physiotherapy research views to the current study findings. Despite the modest sample size, it is greater than numerous other interventional postural management studies on CP children, which will aid in the development of future larger-scale investigations.

The use of an appropriate wheelchair for posture management resulted in a statistically significant improvement in the spasticity score. The findings of this interventional study can be utilized to emphasize the importance of correct wheelchair selection for this very vulnerable population. They can also be utilized to raise awareness about posture management and pediatric rehabilitation services, as well as boost the visibility of the potential benefits of physiotherapy and occupational therapy. These evidence-based findings could be used to argue for better posture care for spastic CP patients in order to improve their health.

Management of spasticity is a major challenge to the treatment team. Various forms of therapy are available to people living with cerebral palsy as well as caregivers and parents caring for someone with this disability. They can all be useful at all stages of this disability and are vital in a CP person's ability to function and live more effectively.

There is no standardized approach to spasticity management of cerebral palsy. But adequate assessment of the specific impairments causing disability is necessary for appropriate interventions to be instituted. The treatment strategy depends on the degree of functional failure caused by the spasticity and its location. In general, treatment options for management of spasticity in children with cerebral palsy include oral medications, physical and occupational therapy, splinting and casting, chemo

denervation with botulinum toxin or phenol, selective dorsal rhizotomy, intrathecal baclofen, and orthopaedic surgery.

5.2 Result of Proper Wheelchair on The Quality Of Life

CPQOL scores, on the other hand, improved in a similar pattern after postural treatment, but in five of the seven quality of life domains, the change was statistically significant. After four weeks of postural treatment, the mean CPQOL score in the social wellbeing and acceptability category improved from 556.491.9 to 642.899.5, which was statistically significant (p-value 0.001). In addition, the mean score for the 'Feelings about Functioning' domain increased from 597.8 92.3 to 670.7 97.3, a statistically significant increase (p-value 0.003). Furthermore, after posture management, the mean score for 'participation and physical health' improved significantly (p-value 0.001), with mean scores of 508.2 120.2 and 611.4 128.1 at baseline and after 4 weeks of follow-up, respectively. Similarly, after two weeks of postural management, the mean score in the 'Emotional wellness and self-esteem' category climbed from 276.7 69.6 to 310.3 70.9, and after four weeks of postural management using a suitable wheelchair, it reached 319.2 90.6. In addition, after a month of postural management, the mean score in the 'Access to Services' domain improved dramatically from 563.9 119.9 before the therapy to 672.5 121.3 after the treatment (p-value 0.001).

CPQOL was increased in total score between baseline and 4 weeks 15% and this is was significant improvement and if we will go in domains details will started with Social Wellbeing and Acceptance that was increased between baseline and 4 weeks

16% as start the family and patient be more independent when using proper wheelchair, Feelings About Functioning was increased between baseline and 4 weeks 12% and its significant improvement as the patients was more independent in function, Participation and Physical Health was increased 20% as the patents more participating using proper wheelchair and this is significant improvement, Emotional Wellbeing and Self Esteem was increased 15% between baseline and 4 weeks, Access to Services was increased 20% as the patients have access to services using proper equipment and this is was significant improvement, Pain and Impact of Disability was increased 6% between baseline and 4 weeks, and Family Health increased 8% between baseline and 4 weeks

The mean score of the 'Pain and Impact of Disability' and 'Family Health' domains, on the other hand, did not change substantially after postural treatment, with p-values of 0.184 and 0.301, respectively. In summary, postural management enhanced the overall quality of life of spastic CP children, with the social wellbeing, feelings about functioning, physical health, emotional wellbeing, and access to services domains showing the greatest improvement.

5.3 Result of Wheelchair Selection on Gross Motor Function

GMFCS values fell considerably between baseline and four weeks of posture control utilizing correct wheelchairs, as no significant improvement in the P value The study subjects' mean GMFCS score was 4.5 (0.9) at the start, 3.5 (0.8) after two weeks of postural management, and 3.4 (0.8) after four weeks of postural management and follow-up.

GMFC was decreased between baseline and 4 weeks 25% significant improvement cross the all our patient

5.4 Comparing Study Results with Other Studies in Developed and Developing countries

The objectives of this study are to measure the effect of proper wheelchair selection on the spasticity of children with spastic cerebral palsy, to determine the effect of proper wheelchair selection on the QOL of these children, and to investigate the effect of wheelchair selection on their gross motor function. The literature review revealed several previous postural specific studies for cases living with CP. However, most previous studies were observational and cross-sectional and there is an apparent scarcity in interventional studies. For example, Alkhateeb et al. conducted an interventional postural study on nine CP cases in Jeddah, Saudi Arabia and concluded that the adjustment of head and neck support in the wheelchair would result in better body part positions and therefore benefit the patients (Alkhateeb et al., 2019). Alkhateeb et al. findings are in line with the current study finding that the postural management with proper wheelchair selection yielded with better MAS score and better gross motor function. However, the scope of the current study was on wheelchair selection rather than wheelchair adjustment.

There is a high need for a proper wheelchair selection, especially in developing countries where rehabilitation services might not cover all CP population in need of these proper services (Toro et al., 2015). For example, a recent cross-sectional Turkish study revealed that 8 out of 10 CP children were not using an appropriate wheelchair for their clinical and functional needs (Ekiz et al., 2017). In addition, another Japanese study showed that around half of CP cases were not receiving appropriate postural

support while they were using wheelchairs and this poor postural support would negatively affect their health and functional status (Hatta et al., 2007). Rodby-Bousquet and Hägglund reported that early intervention during the childhood and early development years by proper wheelchair selection would improve CP cases' mobility outcomes and potentially increase their independence (Rodby-Bousquet & Hägglund, 2010).

One of the most extensive interventional studies regarding wheelchair selection for CP cases was performed in Indonesia and it involved more than 300 adult and children CP cases. This large-scale study showed that proper wheelchair selection according to WHO criteria improved the quality of life of the involved cases, especially for female cases (Toro et al., 2015). This is in line with the current study finding where our included cases had significant improvement in total CPQOL scores after four weeks of postural management, with a proper wheelchair selection.

Moreover, a retrospective study in the United Kingdom showed that proper wheelchair selection for more than 100 CP patients improved their function and significantly decreased the spasticity (Frank & De Souza, 2017). The current study results showed a similar trend of spasticity and functional scores improvement after postural management in spastic Saudi CP children.

Meanwhile, another small-scale interventional study involving only three patients in Japan showed promising objective results for the CP cases when postural and foot support was applied in the wheelchairs (Shirogane et al., 2017). Similarly, another interventional study involving 20 CP cases in Taiwan revealed that using wheelchairs technology that provides proper support would improve body parts alignment and benefit CP cases (Liu et al., 2014). Also, McDonald and Surtees conducted an

interventional study involving 23 British CP cases who were managed by postural intervention on the knee level. McDonald and Surtees intervention failed to significantly improve CP cases (McDonald & Surtees, 2007). Our study results contradict McDonald and Surtees findings, but this could be explained by the differences in postural management intervention and by differences in the study methodology.

Furthermore, Vekerdy conducted a postural interventional study on 47 CP children in Hungary. The results of this study also included an objective measurable improvement in the posture of involved CP cases (Vekerdy, 2007). Although objective measurement of CP children's posture status was outside the scope of the current study, the improvement in joint spasticity and the functional scores are showing the same trend of improvement after postural management interventions for CP children.

Finally, a series of four interventional and observational studies in Sweden showed a significant quality of life improvement in CP cases, but the postural intervention was done by using standing devices (Nordström, 2014). This improvement in the quality of life results after a postural intervention is in line with the current study results keeping in mind that the postural intervention was not a totally different intervention.

5.5 Study Limitation

Similar to other quasi interventional studies, measuring the causality between intervention and results is limited (Waddington et al., 2017). Also, the small sample size and non-random selection of study participants limit the generalization of study findings.

In addition, rehabilitation services at Sultan Bin Abdulaziz Humanitarian City are known to be high standard services all over the Saudi Arabia Kingdom. This fact would increase the expectations of study participants and possibly improve their compliance with postural management. Therefore, the generalization of the current study findings to other centres with possibly less standardized rehabilitation services would be limited. However, the primary researcher tried his best to include CP children from the capital city Riyadh and from surrounding areas as well.

5.6 Study Strength

The current study is the first interventional study on postural management for CP children in the city of Riyadh and it included a variety of assessment tools to examine the effects of postural management using a proper selection of wheelchairs. The comprehensive assessment of the quality of life effects in addition to assessing the functional and spasticity aspects of this intervention would help in building primary evidence about the benefits and potentials of this crucial intervention. Moreover, the comprehensive assessment of these aspects and their detailed effects on CP scores enriched the current study findings with unique physiotherapy research perspectives. Although the sample size was small, it is larger than several other interventional postural management studies on CP children and this would help with building future larger-scale studies.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

This chapter demonstrates the main conclusions of the current study regarding the effects of postural management using proper wheelchairs in children with spastic cerebral palsy, with a special focus on the overall benefits for the children, their families and healthcare providers. It also explains the core recommendations for future research and essential recommendations for additional postural management interventions for this vulnerable group of patients living with severe functional and physical disabilities.

6.1 Conclusions

The current study is one of a handful of interventional studies that examined the effects of postural management in spastic cerebral palsy children. Postural management using a proper wheelchair has led to statistically significant improvement in the spasticity score (MAS score) and in the motor functional score (GMFCS score). In addition, this postural management significantly improved the total score of quality of life of spastic CP children and this improvement was more prominent in the social wellbeing, feelings about functioning, physical health, emotional wellbeing and access to services domains of quality of life.

The results of this interventional study can be used to highlight the benefits of proper selection of wheelchairs for this extremely vulnerable group. They can be used to increase awareness regarding the postural management and pediatric rehabilitation services, as well as increasing the visibility of physiotherapy and occupational therapy

potential benefits. These evidence-based results could be used to advocate for providing spastic CP cases with better postural management so they can achieve better functional status and the coming generations could have a better quality of life.

6.2 Recommendations for Future Research

Based on the current study results, it is recommended to have further future large-scale studies to examine the subjective and objective effects of postural management using proper wheelchairs. However, in order to have a better generalization of future study results, it is recommended to plan the coming interventional studies on blinded randomized methodology.

In addition, the follow-up duration of the current study was only four weeks. Therefore, there is a need for future long-term and longitudinal research in order to identify the sustainability of postural management effects on spastic CP cases. Furthermore, the postural management assessments in the current study were done by the primary researcher who is an employee at the postural clinic so the interviewer bias cannot be eliminated. It is recommended for future research to have an independent assessor for the effects of proper wheelchair selection.

Lastly, the current study was a single-centre interventional study, and the generalization of single-centre study results is limited. Thus, it is recommended to have multi-center or even better, multi-country interventional postural studies on spastic CP children so the evidence will become more robust and conclusions could be generalized.

6.3 Recommendations for Future Postural Management Using Proper Wheelchair

It is recommended to continue and expand postural management using a proper wheelchair for spastic CP cases because it yielded promising results regarding functional and quality of life scores. However, it is recommended to develop and implement postural management intervention based on a multidisciplinary approach that involves patients, families and health care providers from clinical, nursing, social and rehabilitation departments.

Health authorities are encouraged to allocate sufficient resources and funds for the postural management interventions in order to avoid or delay potential adverse health and psychological consequences of spastic CP.

Allocating funds, personnel and efforts in the development and implementation of a nation-wide postural intervention using a proper selection of wheelchair to spastic CP children could eventually lead to cost-effective results in terms of better children and families' quality of life and less functional burden.

It is favored to have a screening program for those who could benefit from postural management using a proper wheelchair, such as spastic CP children probably living in underprivileged or out of reach areas for early detection and prevention of negative health and functional consequences among those children.

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APPENDICES

Appendix A Quality of Life Questionnaire for Children (CP QOL-CHILD)

Primary Caregiver Questionnaire (4-12 years)

We want to ask you some questions about how you think your child FEELS about aspects of their life such as family, friends, health and school. Each question begins with "How do you think your child FEELS about…..?"
It is important for you to report how you believe your child feels. Sometimes it is difficult to know how your child is feeling. Please just try and answer as best as you can.
For each question we want you to circle the best number that shows how you think your child FEELS. You can circle any number from 1 (Very unhappy) to 9 (Very happy).
This questionnaire is measuring how your child feels, not what they can do.
Here is an example:
How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
their ability to play games with other children	1	2	3	4	5	6	7	8	9

Family & Friends

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
the way they get along with people generally?	1	2	3	4	5	6	7	8	9
the way they get along with you?	1	2	3	4	5	6	7	8	9
the way they get along with their brothers & sisters? OR ☐ my child doesn't have any brothers or sisters	1	2	3	4	5	6	7	8	9
the way they get along with other children at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time). OR ☐ my child does not attend preschool or school	1	2	3	4	5	6	7	8	9
the way they get along with other children outside preschool or school?	1	2	3	4	5	6	7	8	9
the way they get along with adults?	1	2	3	4	5	6	7	8	9
the way they get along with their teachers and/or carers?	1	2	3	4	5	6	7	8	9
their ability to play on their own?	1	2	3	4	5	6	7	8	9
their ability to play with friends?	1	2	3	4	5	6	7	8	9
going out on trips with families?	1	2	3	4	5	6	7	8	9
how they are accepted by their family?	1	2	3	4	5	6	7	8	9
how they are accepted by other children at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time). OR ☐ my child does not attend preschool or school	1	2	3	4	5	6	7	8	9
how they are accepted by other children outside of preschool or school?	1	2	3	4	5	6	7	8	9
how they are accepted by adults?	1	2	3	4	5	6	7	8	9
how they are accepted by people in general?	1	2	3	4	5	6	7	8	9
being able to do things they want to do?	1	2	3	4	5	6	7	8	9

Participation

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
their ability to participate at preschool or school? (If your child attends more than one school, please think about the school where your child spends the most time). OR ☐ my child does not attend preschool or school	1	2	3	4	5	6	7	8	9
their ability to participate in recreational activities?	1	2	3	4	5	6	7	8	9
their ability to participate in sporting activities? (This question is asking how your child feels about their ability to participate in sport, not whether they can participate).	1	2	3	4	5	6	7	8	9
their ability to participate in social events outside of preschool or school?	1	2	3	4	5	6	7	8	9
their ability to participate in their community?	1	2	3	4	5	6	7	8	9

Communication

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
the way they communicate with people they know well (using any means of communication)?	1	2	3	4	5	6	7	8	9
they way they communicate with people they don't know well (using any means of communication)?	1	2	3	4	5	6	7	8	9
they way other people communicate with them?	1	2	3	4	5	6	7	8	9

Health

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
their physical health?	1	2	3	4	5	6	7	8	9
the way they get around?	1	2	3	4	5	6	7	8	9
how they sleep?	1	2	3	4	5	6	7	8	9
the way they look?	1	2	3	4	5	6	7	8	9
their ability to keep up academically with their peers?	1	2	3	4	5	6	7	8	9
their ability to keep up physically with their peers?	1	2	3	4	5	6	7	8	9
their life in general?	1	2	3	4	5	6	7	8	9
themselves?	1	2	3	4	5	6	7	8	9
their future?	1	2	3	4	5	6	7	8	9
their opportunities in life?	1	2	3	4	5	6	7	8	9

The next 3 questions are asking how your child feels about using parts of their body, not whether your child can use part of their body.

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
the way they use their arms?	1	2	3	4	5	6	7	8	9
the way they use their legs?	1	2	3	4	5	6	7	8	9
the way they use their hands?	1	2	3	4	5	6	7	8	9

The next 3 questions are asking how your child feels about their ability to complete daily activities, not whether your child can complete the activities.

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
their ability to dress themselves?	1	2	3	4	5	6	7	8	9
their ability to drink independently?	1	2	3	4	5	6	7	8	9
their ability to use the toilet by themselves?	1	2	3	4	5	6	7	8	9

Special Equipment

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
the special equipment they have at home (e.g. special seating, standing frames, wheelchairs, walkers)? OR ☐ my child does not have any special equipment at home	1	2	3	4	5	6	7	8	9
the special equipment they have at their school? (e.g. special seating, standing frames, wheelchairs, walkers)? OR ☐ my child does not have any special equipment at home	1	2	3	4	5	6	7	8	9
the special equipment that is available in the community (ramps, escalators, wheelchair access)? OR ☐ my child does not have any special equipment at home	1	2	3	4	5	6	7	8	9

Pain and Bother

How do you think your child feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
Is your child bothered by hospital visits?	1	2	3	4	5	6	7	8	9
Is your child bothered when they miss school for health reasons?	1	2	3	4	5	6	7	8	9
Is your child bothered by being handled by other people?	1	2	3	4	5	6	7	8	9

	Never	Rarely	Sometimes	Often	Always
Does your child worry about who will take care of them in the future?	1	2	3	4	5

Some final questions about your child

How do you think your child feels about…

	Not concerned at all								Very concerned
Is your child concerned about having cerebral palsy?	1	2	3	4	5	6	7	8	9
	No pain at all								A lot of pain
How much pain does your child have?	1	2	3	4	5	6	7	8	9
	Not upset at all								Very upset
How does your child feel about the amount of pain they have?	1	2	3	4	5	6	7	8	9
	No discomfort at all								A lot of discomfort
How much discomfort does your child experience?	1	2	3	4	5	6	7	8	9
	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
How happy is your child?	1	2	3	4	5	6	7	8	9

Access to Services

The next set of questions are about YOU and how you feel about your access to services

How do you feels about…

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
your child's access to treatment?	1	2	3	4	5	6	7	8	9
your child's access to therapy (for example, physiotherapy, speech therapy, occupational therapy)?	1	2	3	4	5	6	7	8	9
your child's access to specialised medical or surgical care?	1	2	3	4	5	6	7	8	9
your ability to get advice from a paediatrician?	1	2	3	4	5	6	7	8	9
your access to respite care?	1	2	3	4	5	6	7	8	9
OR ☐ I have never tried to access respite care (Please skip the next two questions on respite)									
the amount of respite care you receive?	1	2	3	4	5	6	7	8	9
how easy it is to get respite?	1	2	3	4	5	6	7	8	9
your child's access to community services and facilities (e.g. kindergarden, childcare, after-school programs, holiday programs, community based groups such as cubs and brownies)?	1	2	3	4	5	6	7	8	9
your child's access to extra help with learning at preschool or school?	1	2	3	4	5	6	7	8	9

Your Health

	Very unhappy		Unhappy		Neither happy nor unhappy		Happy		Very Happy
your physical health?	1	2	3	4	5	6	7	8	9
your work situation?	1	2	3	4	5	6	7	8	9
your family's financial situation?	1	2	3	4	5	6	7	8	9
How happy are you?	1	2	3	4	5	6	7	8	9
	Not at all confident								Very confident
How confident are you that you can report how your child feels?	1	2	3	4	5	6	7	8	9

Thank you for helping us with our questions.

إستبيان نوعية الحياة لألطفال المصابين بالشلل الدماغي

إستبيان مقدمي الرعاية ألولية لألطفال في سن ٤ – ١٢ عام

خلال هذا الإستبيان نود أن نطرح عليك بعض الأسئلة بخصوص ما تظن أن طفلك يشعر به تجاه بعض جوانب حياته/حياتها مثل الأسرة والأصدقاء والصحة والمدرسة ويبدأ كل سؤال كالتالي: "من وجهة نظرك، ما هو شعور طفلك تجاه ...؟" ومن المهم هنا أن تعبر عن إعتقادك بشأن شعور طفلك. وأحياناً يكون من الصعب أن تعرف شعور طفلك. من فضلك، ليس عليك سوى محاولة الإجابة بما يعبر عن مشاعر طفلك قدر المستطاع

وكل ما هو مطلوب وضع دائرة حول الرقم الذي يعبر أفضل عما تعتقد بخصوص شعور طفلك في مقابل كل سؤال. ويمكنك وضع الدائرة حول أي رقم من ١ (غير سعيد مطلقاً) إلى ٩ (سعيد جداً)

وتذكر أن هذا الإستبيان مهمته هي معرفة شعور طفلك، وليس ما يستطيع القيام به

وإليك المثال التوضيحي التالي:

س. من وجهة نظرك ما هو شعور طفلك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
قدرته على ممارسة الألعاب مع غيره من الأطفال	١	٢	٣	٤	٥	٦	٧	٨	٩

الأسرة والأصدقاء

س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
طريقة تعايشه مع الناس بشكل عام؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة تعايشه معك أنت؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة تعايشه مع أخوانه وأخواته؟	١	٢	٣	٤	٥	٦	٧	٨	٩

أو ( ) طفلي ليس لديه أخوة أو أخوات

طريقة تعايشه مع غيره من الأطفال في الحضانة أو المدرسة؟ (إذا كان طفلك يذهب إلى أكثر من مدرسة واحدة فاجعل إجابتك بخصوص المدرسة التي يقضي فيها معظم الوقت)	١	٢	٣	٤	٥	٦	٧	٨	٩

أو ( ) طفلي لا يذهب إلى أي حضانة أو مدرسة

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
طريقة تعايشه مع غيره من الأطفال خارج الحضانة أو المدرسة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة تعايشه مع البالغين؟	١	٢	٣	٤	٥	٦	٧	٨	٩

س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
طريقة تعايشه مع المعلمين أو من يقومون برعايته؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على اللعب بمفرده؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على اللعب مع أصدقائه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
الذهاب في رحلة مع العائلة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى تقبل أسرته له؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى تقبل غيره من الأطفال له في الحضانة أو المدرسة؟ (إذا كان طفلك يذهب إلى أكثر من مدرسة واحدة فاجعل إجابتك بخصوص المدرسة التي يقضي فيها معظم الوقت) أو ( ) طفلي لا يذهب إلى أي حضانة أو مدرسة	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى تقبل الأطفال الآخرين له من خارج الحضانة أو المدرسة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى تقبل البالغين له؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى تقبل الناس له بشكل عام؟	١	٢	٣	٤	٥	٦	٧	٨	٩
القدرة على فعل الأشياء التي يريد فعلها؟	١	٢	٣	٤	٥	٦	٧	٨	٩

المشاركـــة

س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

غير سعيد أبدا	غير سعيد	متوسط	سعيد	سعيد جدا

قدرته على المشاركة في الحضانة أو المدرسة؟ مثل التفاعل مع المعلمين والأطفال والمشاركة في الأنشطة التعليمية (إذا كان طفلك يذهب إلى أكثر من مدرسة واحدة فاجعل إجابتك بخصوص المدرسة التي يقضي فيها معظم الوقت)

١	٢	٣	٤	٥	٦	٧	٨	٩

أو ( ) طفلي لا يذهب إلى أي حضانة أو مدرسة

قدرته على المشاركة في الأنشطة الترفيهية؟

١	٢	٣	٤	٥	٦	٧	٨	٩

قدرته على المشاركة في الأنشطة الرياضية؟ (ويدور هذا السؤال حول مشاعر طفلك نحو قدرته على المشاركة في الرياضة وليس حول ما إذا كان يستطيع المشاركة أم لا).

١	٢	٣	٤	٥	٦	٧	٨	٩

قدرته على المشاركة في الأحداث الإجتماعية خارج نطاق الحضانة أو المدرسة؟ مثل تجمعات أفراد الأسرة – الإحتفالات الأسرية مثل أعياد الميلاد – خروجات الأسرة للتنزة والترفيه ودخول السينما

١	٢	٣	٤	٥	٦	٧	٨	٩

قدرته على المشاركة في مجتمعه؟ مثل مشاهدة مباريات الكرة والأفلام السينمائية وبرامج التليفزيون والقراءات والمناسبات الدينية مثل صلاة الأعياد

١	٢	٣	٤	٥	٦	٧	٨	٩

الإتصـال

س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

غير سعيد أبدا	غير سعيد	متوسط	سعيد	سعيد جدا

طريقة إتصاله بالأشخاص الذين يعرفهم جيداً؟ (بإستخدام أي من وسائل الإتصال). مثل إستخدام اللغة بمكوناتها لفظية وغير لفظية

١	٢	٣	٤	٥	٦	٧	٨	٩

طريقة إتصاله بالأشخاص الذين لا يعرفهم جيداً؟ (بإستخدام أي من وسائل الإتصال). مثل إستخدام اللغة بمكوناتها لفظية وغير لفظية

١	٢	٣	٤	٥	٦	٧	٨	٩

طريقة إتصال الآخرين به؟ مثل إستخدام اللغة بمكوناتها

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
طريقة إتصاله بالأشخاص الذين يعرفهم جيداً؟ (بإستخدام لفظية وغير لفظية	١	٢	٣	٤	٥	٦	٧	٨	٩

الصحــة

س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
صحته البدنية؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة نومه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة تحركاته بشكل عام؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مظهره وكيف يبدو؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على مواكبة أقرانه في الناحية الأكاديمية؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على مواكبة أقرانه في الناحية البدنية؟	١	٢	٣	٤	٥	٦	٧	٨	٩
حياته بشكل عام؟	١	٢	٣	٤	٥	٦	٧	٨	٩
نفسه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مستقبله؟	١	٢	٣	٤	٥	٦	٧	٨	٩
فرصته في الحياة؟	١	٢	٣	٤	٥	٦	٧	٨	٩

تدور الأسئلة الثلاثة التالية حول شعور طفلك نحو إستعمال جزء من جسمه ، وليس ما إذا كان يستطيع إستعماله أم لا.

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
طريقة إستعماله لذراعيه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة إستعماله لرجليه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
طريقة إستعماله ليديه؟	١	٢	٣	٤	٥	٦	٧	٨	٩

تدور الأسئلة الثلاثة التالية حول شعور طفلك نحو قدرته على إتمام الأنشطة اليومية وليس ما إذا كان يستطيع إتمامها

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
قدرته على إرتداء ملابسه؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على الشرب بدون مساعدة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرته على إستخدام المرحاض بمفرده؟	١	٢	٣	٤	٥	٦	٧	٨	٩

الأجهزة المساعدة والتعويضية

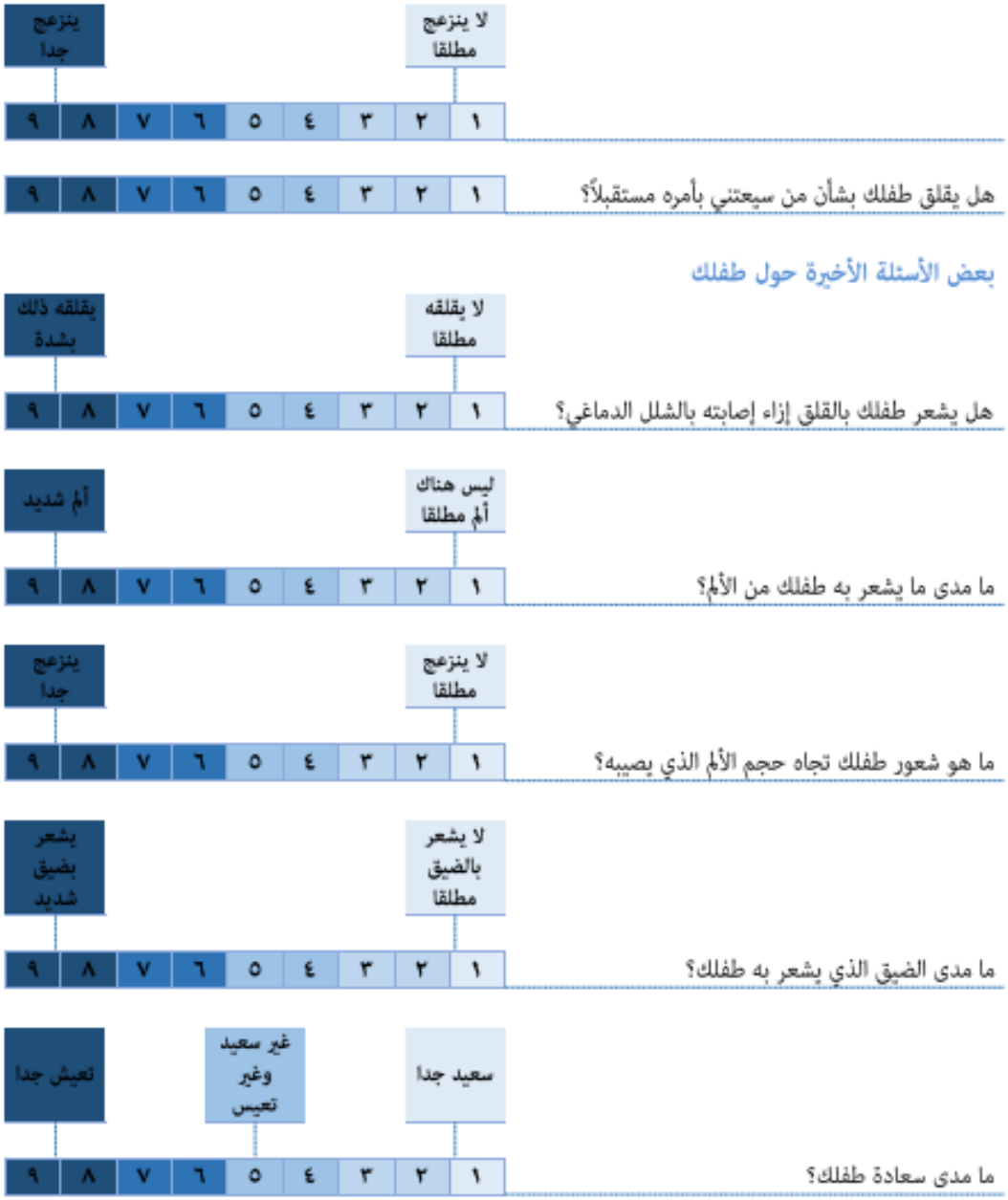
س. من وجهة نظرك، ما هو شعور طفلك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
الأجهزة المساعدة والتعويضية التي لديه في المنزل؟ (مثل: كرسي ذوي الإحتياجات الخاصة، جهاز الوقوف، الكرسي ذو العجلات، الممشاة)	١	٢	٣	٤	٥	٦	٧	٨	٩
أو ( ) طفلي ليست لديه أجهزة من هذا النوع في المنزل									
الأجهزة المساعدة والتعويضية في المدرسة؟ (مثل: كرسي ذوي الإحتياجات الخاصة، جهاز الوقوف، الكرسي ذو العجلات، الممشاة)	١	٢	٣	٤	٥	٦	٧	٨	٩
أو ( ) طفلي ليست لديه أجهزة من هذا النوع في المدرسة									
المعدات والمساعدات الخاصة المتوفرة في المجتمع عموماً؟ (الطرق الخاصة الممهدة للكراسي المتحركة، السلم المتحرك، أماكن مخصصة لدخول أصحاب الكراسي المتحركة).	١	٢	٣	٤	٥	٦	٧	٨	٩

الألم والإزعاج

تدور الأسئلة القليلة التالية حول الأشياء التي يمكن أن تزعج طفلك

	لا ينزعج مطلقا								ينزعج جدا
هل ينزعج طفلك من زيارات المستشفى؟	١	٢	٣	٤	٥	٦	٧	٨	٩
هل ينزعج طفلك عندما يتغيب عن المدرسة لأسباب صحية؟	١	٢	٣	٤	٥	٦	٧	٨	٩
هل ينزعج طفلك عندما يقوده الآخرين في حركته؟									


ينزعج جدا
لا ينزعج مطلقا
٩ ٨ ٧ ٦ ٥ ٤ ٣ ٢ ١
هل يقلق طفلك بشأن من سيعتني بأمره مستقبلاً؟
بعض الأسئلة الأخيرة حول طفلك
يقلقه ذلك بشدة
لا يقلقه مطلقا
هل يشعر طفلك بالقلق إزاء إصابته بالشلل الدماغي؟
ألم شديد
ليس هناك ألم مطلقا
ما مدى ما يشعر به طفلك من الألم؟
ينزعج جدا
لا ينزعج مطلقا
ما هو شعور طفلك تجاه حجم الألم الذي يصيبه؟
يشعر بضيق شديد
لا يشعر بالضيق مطلقا
ما مدى الضيق الذي يشعر به طفلك؟
تعيش جدا
غير سعيد وغير تعيس
سعيد جدا
ما مدى سعادة طفلك؟

الحصول على الخدمات

تدور مجموعة الأسئلة التالية حولك أنت وما تشعر به تجاه حصولك على الخدمات

س. ما هو شعورك تجاه ...

	غير سعيد أبدا		غير سعيد		متوسط		سعيد		سعيد جدا
حصول طفلك على العلاج؟	١	٢	٣	٤	٥	٦	٧	٨	٩
حصول طفلك على أنواع العلاجات المختلفة؟ (مثل: العلاج الطبيعي، علاج النطق، العلاج المهني).	١	٢	٣	٤	٥	٦	٧	٨	٩
حصول طفلك على الرعاية الطبية أو الجراحية المتخصصة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
قدرتك على تحصيل النصيحة من طبيب أطفال؟	١	٢	٣	٤	٥	٦	٧	٨	٩
حصولك على الرعاية المؤقتة؟ مثل ترك طفلك لدي أقارب أو مؤسسة لبعض الوقت لإنشغالك عنه	١	٢	٣	٤	٥	٦	٧	٨	٩

أو ( ) لم أحاول قط الحصول على الرعاية المؤقتة

(في هذه الحالة من فضلك تخطى الإجابة عن السؤالين التاليين)

حجم الرعاية المؤقتة التي تلقيتها؟	١	٢	٣	٤	٥	٦	٧	٨	٩
مدى سهولة الحصول على الرعاية المؤقتة؟	١	٢	٣	٤	٥	٦	٧	٨	٩
حصول طفلك على الخدمات والتسهيلات المجتمعية (مثل: روضة الأطفال، رعاية الأطفال، برامج ما بعد المدرسة، برامج الإجازات، برامج التأهيل المرتكز على المجتمع")؟	١	٢	٣	٤	٥	٦	٧	٨	٩
حصول طفلك على مساعدة إضافية في الحضانة أو المدرسة؟	١	٢	٣	٤	٥	٦	٧	٨	٩

صحتك

نتقدم لكم بخالص الشكر على مساعدتكم بالإجابة عن أسئلتنا

Appendix B Ashworth Scale and Modified Ashworth Scale

Score	Ashworth Scale (1964)	Modified Ashworth Scale Bohannon & Smith (1987)
0 (0)	No increase in tone	No increase in muscle tone
1 (1)	A slight increase in tone giving a catch when the limb was moved in flexion or extension	A slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
1+ (2)		Slightly increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM (range of movement)
2 (3)	A more marked increase in tone but limb easily flexed	A more marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3 (4)	Considerable increase in tone – passive movement difficult	Considerable increase in muscle tone – passive movement difficult
4 (5)	Limb rigid in flexion or extension	Affected part(s) rigid in flexion or extension

Appendix C Gross Motor Function Classification System (Gmfcs)

GMFCS E & R between 6th and 12th birthday: Descriptors and illustrations

GMFCS Level I

Children walk at home, school, outdoors and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance and coordination are limited.

GMFCS Level II

Children walk in most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a hand-held mobility device or used wheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.

GMFCS Level III

Children walk using a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may self-propel for shorter distances.

GMFCS Level IV

Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and in the community children are transported in a manual wheelchair or use powered mobility.

GMFCS Level V

Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements.

GMFCS descriptors: Palisano et al. (1997) Dev Med Child Neurol 39:214-23
CanChild: www.canchild.ca

Appendix D Wheelchairs Selection Criteria for Paediatrics

Type	Criteria
Standard wheelchair	Unsafe ambulation A patient can propel standard weight wheelchair (15, 20 kg), Self-propelling, for short distances only No postural issues, spasticity, obesity, or behaviors that will stress the chair frame
Lightweight chair/Transit chair	Unsafe ambulation The patient cannot functionally propel a standard weight wheelchair (15-20 kg) A caregiver is frail/ small Pediatric patients as they cannot often push a heavy chair
Recliner Wheelchair	The patient hip angle is fixed at more than 90 degrees Comfort and rest post-surgical patients
Full support wheelchair (Tilt in space)	Totally Dependent require head/trunk support At risk for pressure ulcers Rests in the chair during day time Correctible or partially correctible scoliosis, kyphosis or lordosis Severe spasticity 50 degrees tilt may be necessary for bladder or pressure sore management
Active Chairs	Unsafe ambulation Active lifestyle (Attends school, work, etc.) Has adequate strength/AROM required Good sitting balance required
Powerchairs	The patient has a permanent /progressive condition is unable is propel for more than 10 feet severe weakness/pain of the upper extremities Demonstrated cognitive ability to operate it

	Caregiver able to do maintenance of the wheelchair Needs power chair in outdoor/ indoor activity such as school, work, or daily practice The patient has an appropriate vehicle
Pushchairs	Transportation for the cognitively impaired person Transportation of disabled child when a therapeutic seat is used in the home Age-appropriate can be used for pediatrics and adolescents

Source: (Gericke, 2006; Khasnabis et al., 2013)

Appendix E Consent Form to Participate in a Research

UniSZA-PTPIP-42-GP 001-BR 008(01)

Jawatankuasa Etika Penyelidikan Manusia UniSZA I UniSZA Human Research Ethics Committee (UHREC)

INFORMED CONSENT FORM

Research Title: The Effect of Postural Management Using Proper Wheelchairs in Children with Spastic Cerebral Palsy In Saudi Arabia
Name of Principal Investigator/ (MMC No.)*: Majdaldeen M I Ashqar
Name of co-Researcher(s)/ (MMC No.)*: *Dr.* Naresh Bhaskar Raj

**To be included if applicable*

To become a participant of this research, you or your legal representative (parent/ guardian) must sign this form.

By signing this page, I am confirming the following:

- I have read the Research Information Sheet (UniSZA-PTPIP-42-GP 001-BR 006(01) and this Informed Consent Form, or it has been read to me.
- I understand the nature and scope of research being undertaken including any information regarding the risk in this research and I have had time to think about it.
- All my questions relating to this research and my participation therein have been answered to my satisfaction.
- I voluntarily agree to take part in this research, to follow the study procedures and to provide all necessary information to the investigators as requested.
- I may at any time choose to withdraw from this research without giving any reasons.
- Except for damages resulting from negligent or malicious conduct of the researcher(s), I hereby release and discharge Universiti Sultan Zainal Abidin and all the participating researchers from all liability associated with, arising out of, or related to my participation and agree to hold them harmless from any harm or loss that may be incurred by me due to my participation in the research.
- I have received a copy of the Research Information Sheet (UniSZA-PTPIP-42-GP 001-BR 006(01).

Participant Name:	**Participant I.C No/ Passport No.**
Signature/ Thumb Print of Participant/ Legal Representative:	**Date:**

Name of Individual Conducting Consent Discussion:	**Role:** *Researcher/ Research Assistant/ Enumerator/ Field Assistant/ Others (please specify)*
Signature of Individual Conducting Consent Discussion:	**Date:**

Note: All participants who are involved in this study will not be covered by insurance.

Secretariat of UniSZA Human Research Ethics Committee (UHREC), Medical Campus, UniSZA, Jalan Sultan Mahmud, 20400 Kuala Terengganu, Terengganu Darul Iman, Malaysia
tel: +609-668 8763/7981 email : uhrec@unisza.edu.my

الموافقة المستنيرة للمعلومات الطبية والدراسات السريرية

موافقة المريض على الدراسة

معلومات عن الدراسة

عنوان الدراسة:	تأثير تعديل الوضعيات مع الاطفال شلل الدماغي في المملكة العربية السعودية
رقم البروتوكول/ كود الدراسة:	
الباحث الرئيس:	مجد الدين محمد اشقر
عنوان الباحث الرئيس:	الرياض /المملكة العربية السعودية
الهاتف:	00966552006824
البريد الإلكتروني:	mashqar@sbahc.org.sa
الراعي/التمويل غير التجاري/لا ينطبق: نعم	

الموافقة
المشارك المحترم:

أنا أوافق طواعيةً على المشاركة في هذه الدراسة البحثية، واتباع إجراءات الدراسة، وعلى تقديم المعلومات التي يطلبها مني طبيب الدراسة، الممرضات أو أعضاء آخرون من الطاقم.

أوافق على أنه في حال قررت الانسحاب وترك الدراسة، فإن المعلومات والبيانات التي تُجمع عنّي حتى نقطة انسحابي قد تبقى قيد الاستخدام.

أنه إذا لم يكن طبيبي في الدراسة طبيب العائلة الخاص بي، فإنني أوافق على جواز إبلاغ طبيب العائلة الخاص بي عن أمر مشاركتي في هذه الدراسة وطلب معلومات طبية منه.

أنا أوافق على أن يتم أخذ عيناتي واستخدامها كما هو موضح في ورقة المعلومات هذه

أنا أُعطي إذناً بأن يتم جمع معلوماتي الشخصية واستخدامها كجزء من هذه الدراسة الإكلينيكية وأن:

- يتم التعريف بها فقط بواسطة رقم بطاقة تعريف المشارك الخاصة بي ؛
- تُراجع، وتُعالج، ويُفصح عنها من قِبل وإلى الراعي وممثليه المخولين ومراقبي الدراسة للأغراض الموصوفة في بروتوكول الدراسة؛

- مراجعتها أو تدقيقها من قِبل منظمات مخولة بصورة مناسبة؛
- نشرها وإرسالها إلى السلطات التنظيمية أو لجان الأخلاقيات في دولتي أو الدول الأخرى، ونقلها إذا دعت الحاجة إلى أي دولة، حيث يمكن أن تكون القوانين التي تحمي معلوماتي الشخصية أقل صرامة.

أنا أفهم أنه من الممكن أيضًا أن يتم الاتصال بي في تاريخ (تواريخ) لاحق (لاحقة) للحصول على إذني فيما يتعلق بهذه الدراسة أو أي دراسة فرعية ذات صلة.

سوف أتسلم نسخة من نموذج الموافقة هذا.

توقيع المشارك:	
التاريخ:	
الوقت: (صباحًا ☐ / مساءً ☐)	

الشخص الذي يحصل على الموافقة:

لقد شرحت طبيعة الدراسة والغرض منها والمخاطر التي تنطوي عليها. لقد أجبت وسوف أجيب على الأسئلة بأفضل ما أستطيع. سأقدم نسخة موقعة من نموذج الموافقة للمشارك.

توقيع الشخص الذي يحصل على الموافقة:	
التاريخ:	
الوقت: (صباحًا ☐ / مساءً ☐)	
الباحث الرئيس:	
اسم الباحث الرئيسي:	
التاريخ:	
الوقت: (صباحًا ☐ / مساءً ☐)	

توقف! لا تستخدم خطوط التوقيع التالية ما لم يتم طلب موافقة طرف ثالث.
(بالنسبة للمشاركين الغير قادرين على منح الموافقة).

بالنسبة للمشاركين الغير قادرين على منح الموافقة:

الممثل القانوني المعتمد:	
التاريخ:	
الشخص الذي يحصل على الموافقة:	
التاريخ:	

للأطفال الذين لا يستطيعون الموافقة:

الشخص الذي يؤخذ في الاعتبار لهذه الدراسة غير قادر على الموافقة بنفسه/ نفسها كونه/ كونها قاصرًا. بالتوقيع أدناه، فإنك تمنح إذنك لضم طفلك إلى هذه الدراسة.

الوالد أو الوصي القانوني:	
التاريخ:	

الشاهد المحايد: في حالة عدم قدرة الشخص على قراءة و/أو فهم نص نموذج الموافقة المستنيرة والدراسة وطبيعتهما، يلزم وجود شاهد.

اسم الشاهد:	
الصلة بالمشارك، إن وجدت:	
التوقيع:	
التاريخ:	
الشخص الذي يحصل على الموافقة:	
التاريخ:	

الباحث الرئيس:	
التوقيع	
التاريخ:	
الوقت (صباحًا ☐ مساءً ☐)	

Appendix F Research Information Sheet

UniSZA-PTPIP-42-GP 001-BR 006(01)

Jawatankuasa Etika Penyelidikan Manusia UniSZA I UniSZA Human Research Ethics Committee (UHREC)

RESEARCH INFORMATION SHEET

Research Title: The Effect of Postural Management Using Proper Wheelchairs in Children with Spastic Cerebral Palsy in Saudi Arabia
Name of Principal Investigator/ (MMC No.)*: Majdaldeen M I Ashqar
Name of co-Researcher(s)/ (MMC No.)*: ***Dr.*** **Naresh Bhaskar Raj**

**To be included if applicable*

INTRODUCTION

You are invited to take part voluntarily in a research project. This research is about of postural management using proper wheelchairs in children with spastic cerebral palsy

It is important that you read and understand this research information before agreeing to participate in this study. If you agree to participate, you will receive a copy of this form to keep for your records.
Your participation in this study is expected to last for 4 weeks of study. This study is estimated to include up to 21 participants.

PURPOSE OF THE STUDY

To provide children with CP with Postural Management in both during the care period inside the care centres in KSA and outside after the child return to home. The aim is to show that only Postural Management during certain periods inside the centre care will not provide complete solution and growth for the child.

TYPE OF RESEARCH

This research will involve assessment of the effectiveness of postural management using proper wheelchair and quality of live for cerebral palsy children

The CP children will be tested and assessed at three measurement intervals (Day one, 2nd week, and 4th week).

PARTICIPANTS CRITERIA

Participant inclusion criteria:

1. Spasticity cerebral palsy
2. 4-12 years age
3. The gross motor functional measurement assessment tools GMFM grade (II-V).
4. Admitted patients
5. Medical stable
6. Readmission patients

Secretariat of UniSZA Human Research Ethics Committee (UHREC), Medical Campus, UniSZA, Jalan Sultan Mahmud, 20400 Kuala Terengganu, Terengganu Darul Iman, Malaysia
tel: +609-668 8763/7981 email : uhrec@unisza.edu.my

Participant exclusion criteria:

1. Another type of cerebral palsy.
2. Patients who have fixed deformity
3. The gross motor functional measurement assessment tools GMFM grade (I-II)
4. ADHD patient,
5. Ambulatory patient,
6. Medical unstable (uncontrolled seizure, cardiac problem, and chronic disease)

VOLUNTARY PARTICIPATION

Your participation in this study is entirely voluntary.

You may refuse to participate in the study or you may stop your participation in the study at anytime, without any penalty or loss of benefits to which you are otherwise entitled.

Your participation may also be stopped by the research team at any time without your consent if it is found that you have violated the study eligibility criteria. The research team member will discuss with you if this matter.

STUDY PROCEDURES

During patient admission for rehabilitation and after referring to the seating clinic they will be asked if they are looking to participate in the study, face to face explanation in the clinic will be given and the consent form will be introduced for each participant. After signing the consent form the patient will start the assessment and given the proper wheelchairs as WHO criteria.
Day one, after 2 weeks and after 4 weeks.

RISKS

No risk related to study for the participants.

POSSIBLE BENEFITS [Benefit to Individual, Community, University]

By participating in this research, your child will receive a proper wheelchair and we will share the improvement achieved by your child. Your participation will help us to solve the research question. It can also help the rehabilitation center to modify the rehabilitation procedure.

REIMBURSEMENTS

You will not receive any compensation or gifts for this study..

CONFIDENTIALITY

Your information will be kept confidential by the researchers and will not be made publicly available unless disclosure is required by law.

Data obtained from this study that does not identify you individually will be published for knowledge purposes.

Your original records may be reviewed by the researcher, the Ethical Review Board for this study, and regulatory authorities for the purpose of verifying the study procedures and/or data. Your information may be held and processed on a computer. Only research team members are authorized to access your information

ENQUIRES

f you have any question about this study or your rights, please contact;

MAJDELDDIN ASHQAR
Universiti Sultan Zainal Abidin
Faculty of Health Science
Tel. No. : +966552006824
Email : majdashqar@yahoo.com

If you have any questions regarding the Ethical Approval or any issue / problem related to this study, please contact;

Secretariat,
UniSZA Human Research Ethics Committee (UHREC)
Faculty of Medicine
Medical Campus
Universiti Sultan Zainal Abidin
Tel. No. : 09-6687981 / 09-6688763
Email : uhrec@unisza.edu.my

DECLARATION

To be entered into the study, you or a legal representative must sign the Informed Consent Form (UniSZA-PTPIP-42-GP 001-BR 008(01)

By signing the informed consent form, you authorize the record review, information storage and data process as described above.

الموافقة المستنيرة للمعلومات الطبية والدراسات السريرية
نموذج مجلس المراجعة المؤسسي لمدينة سلطان بن عبد العزيز للخدمات الإنسانية A-005

القسم أ:

معلومات عن الدراسة

عنوان الدراسة:	تأثير تعديل الوضعيات مع الاطفال شلل الدماغي في المملكة العربية السعودية
رقم البروتوكول/ كود الدراسة:	
الباحث الرئيس:	مجد الدين محمد اشقر
عنوان الباحث الرئيس:	الرياض /المملكة العربية السعودية
الهاتف:	00966552006824
البريد الإلكتروني:	mashqar@sbahc.org.sa
الراعي/التمويل غير التجاري/لا ينطبق: نعم	

مقدمة

المشارك المحترم،

أنت مدعو للمشاركة في دراسة بحثية سريرية. لمساعدتك على اتخاذ القرار، ينبغي عليك فهم الدراسة وما ستشتمل عليه بالنسبة لك. لاتخاذ قرار مستنير بالمشاركة، ينبغي عليك أن تعرف الغرض من الدراسة، وإجراءاتها وفوائدها ومخاطرها، فضلاً عن الإزعاجات والاحتياطات المتخذة. تسمى هذه العملية "موافقة مستنيرة". يُرجى تخصيص وقت لقراءة المعلومات التالية بعناية ومناقشتها مع الأخرين. يُرجى سؤال طبيب الدراسة في حالة غموض أي أمر، أو رغبتك في الحصول على معلومات إضافية.

يُمكِنك ترك الدراسة في أي وقت بدون إبداء سبب إن لم يكن لديك الرغبة في التبرير. ولن يؤثر ذلك على الرعاية الطبية العادية التي تتلقاها. قبل التأكيد على مشاركتك في الدراسة، عليك إكمال الاختبارات الأولية لطبيب الدراسة.

لا نعدك بأن الدراسة ستساعدك، ولكن في المستقبل قد تساعِد المعلومات المستمدة من هذه الدراسة في تحسين العلاج المستقبلي للأشخاص المصابين بذات الحالة.

حالما تكون قد قررت أنَّك تريد المشاركة، سيُطلَب مِنك (أو من ممثلك المقبول قانونًا) التوقيع على نموذج الموافقة المستنيرة. ستُعطى نسخة من النموذج الموقَّع للاحتفاظ بها، وتبقى النسخة الأصلية في مركز الدراسة.

القسم ب:

1. ما هو الغرض من الدراسة؟
رؤية مدى التاثير الاجهزه المساعده والوضعيات الصحيه على الاطفال ذوي الشلل الدماغي

2. كم عدد الأشخاص الذين سيشاركون في الدراسة؟
40 (نكرزانثى)

3. موقع الدراسة؟
مدينة سشلطان بن عبد العزيز للخدمات الانسانيه

4. ماذا سيحدث إذا شاركت في هذه الدراسة؟
المساعده في رؤية مدى التاثير الاجهزه المساعده والوضعيات الصحيه على الاطفال ذوي الشلل الدماغي

5. ما هو المتوقع مني خلال الدراسة؟
الالتزام واتباع التعليمات طول فترة البحث

6. ما الفترة التي سأمضيها في الدراسة؟
4 اسابيع
7. ما هي مسؤولياتي؟
الالتزام واتباع التعلميات طول فترة البحث
8. هل يمكنني التوقف عن المشاركة في الدراسة؟
نعم
9. هل هناك مخاطر إذا توقفت عن المشاركة في الدراسة؟
لا
10. ما هي الآثار الجانبية أو المخاطر التي يمكن أن أتوقعها من المشاركة في الدراسة؟
لا يوجد اي مخاطر

11. هل توجد فوائد للمشاركة في الدراسة؟
نعم, المساعده في رؤية مدى التاثير الاجهزه المساعده والوضعيات الصحيه على الاطفال ذوي الشلل الدماغي
12. ماذا لو سافرت خارج المملكة أو بالخارج أثناء المشاركة في الدراسة؟
الدراسه تشمل الاطفال المنومين في المستشفى
13. ماذا يحدث إذا أصبتُ بالضرر بسبب وجودي في هذه الدراسة؟

لا يوجد اي اضرار

14. ما هي تكاليف المشاركة في الدراسة؟
مجانا
15. هل سأتلقى مقابلاً نظير مشاركتي في هذه الدراسة؟
لا
16. هل سيتم الحفاظ على خصوصية معلوماتي الطبية؟

نعم بكل تاكيد

القسم ج:

ملاحظة: أكمل هذا القسم في حالة كانت العينات الحيوية للمشارك مطلوبة كجزء من الدراسة

17. يُطلب مني تقديم عينة (عينات) حيوية على النحو المذكور في إجراء (إجراءات) الدراسة).

18. طلبت مني العينات الحيوية المدرجة في الشرط (الشروط) المذكورة.
19. لماذا يطلب مني تقديم عينات حيوية؟

20. سيتم إرسال عيناتي الحيوية إلى مختبر محلي.

21. أوافق بموجبه على تقديم بياناتي السريرية المطلوبة مع العينات الحيوية. ☐ نعم/ ☐ لا

22. لن يتم استخدام عيناتي الحيوية للاختبار الوراثي. ☐ نعم/ ☐ لا

القسم د:

23. ما هي حقوقي إذا شاركت في هذه الدراسة؟
سرية المعلومات في الدراسة ويمكنك الانسحاب اي وقت
24. ما هي العيوب أو المخاطر المحتملة للمشاركة؟
لا يوجد
25. ماذا يحدث حين تتوقف هذه الدراسة البحثية؟

26. ما العلاجات البديلة المتاحة؟
لا يوجد
27. بمَن يجب عليّ الاتصال إذا كانت لدي أسئلة أو مشكلات؟
الباحث الرئيسي في اي وقت
28. ماذا إذا توفرت معلومات جديدة حول عقار الدراسة؟

لا يوجد

29. ماذا سيحدث إذا لم ترغب في الاستمرار في الدراسة؟

لا شيئ ابدا

30. لماذا يتم جمع بياناتي وتحليلها؟

رؤية مدى التاثير الاجهزه المساعده والوضعيات الصحيه على الاطفال ذوي الشلل الدماغي

القسم هـ:

الموافقة
المشارك:

أنا أوافق طواعيةً على المشاركة في هذه الدراسة البحثية، واتباع إجراءات الدراسة، وعلى تقديم المعلومات التي يطلبها مني طبيب الدراسة، الممرضات أو أعضاء آخرون من الطاقم.

أوافق على أنه في حال قررت الانسحاب وترك الدراسة، فإن المعلومات والبيانات التي تُجمع عنّي حتى نقطة انسحابي قد تبقى قيد الاستخدام.

أنه إذا لم يكن طبيبي في الدراسة طبيب العائلة الخاص بي، فإنني أوافق على جواز إبلاغ طبيب العائلة الخاص بي عن أمر مشاركتي في هذه الدراسة وطلب معلومات طبية منه.

أنا أوافق على أن يتم أخذ عيناتي واستخدامها كما هو موضح في ورقة المعلومات هذه

أنا أُعطي إذناً بأن يتم جمع معلوماتي الشخصية واستخدامها كجزء من هذه الدراسة الإكلينيكية وأن:

- يتم التعريف بها فقط بواسطة رقم بطاقة تعريف المشارك الخاصة بي ؛
- تُراجع، وتُعالج، ويُفصح عنها من قِبل وإلى الراعي وممثليه المخولين ومراقبي الدراسة للأغراض الموصوفة في بروتوكول الدراسة؛
- مراجعتها أو تدقيقها من قِبل منظمات مخولة بصورة مناسبة؛
- نشرها وإرسالها إلى السلطات التنظيمية أو لجان الأخلاقيات في دولتي أو الدول الأخرى، ونقلها إذا دعت الحاجة إلى أي دولة، حيث يمكن أن تكون القوانين التي تحمي معلوماتي الشخصية أقل صرامة.

أنا أفهم أنه من الممكن أيضًا أن يتم الاتصال بي في تاريخ (تواريخ) لاحق (لاحقة) للحصول على إذني فيما يتعلق بهذه الدراسة أو أي دراسة فرعية ذات صلة.

سوف أتسلم نسخة من نموذج الموافقة هذا.

توقيع المشارك:	
التاريخ:	
الوقت: (صباحًا / مساءً)	

الشخص الذي يحصل على الموافقة:

لقد شرحت طبيعة الدراسة والغرض منها والمخاطر التي تنطوي عليها. لقد أجبت وسوف أجيب على الأسئلة بأفضل ما أستطيع. سأقدم نسخة موقعة من نموذج الموافقة للمشارك.

توقيع الشخص الذي يحصل على الموافقة:	
التاريخ:	
الوقت: (صباحًا / مساءً)	
الباحث الرئيس:	
اسم الباحث الرئيسي:	
التاريخ:	
الوقت: (صباحًا / مساءً)	

القسم و:

توقف! لا تستخدم خطوط التوقيع التالية ما لم يتم طلب موافقة طرف ثالث.
(بالنسبة للمشاركين الغير قادرين على منح الموافقة).

بالنسبة للمشاركين الغير قادرين على منح الموافقة:

الممثل القانوني المعتمد:	
التاريخ:	
الشخص الذي يحصل على الموافقة:	
التاريخ:	

للأطفال الذين لا يستطيعون الموافقة:

الشخص الذي يؤخذ في الاعتبار لهذه الدراسة غير قادر على الموافقة بنفسه/ نفسها كونه/ كونها قاصرًا. بالتوقيع أدناه، فإنك تمنح إذنك لضم طفلك إلى هذه الدراسة.

الوالد أو الوصي القانوني:	
التاريخ:	

الشاهد المحايد: في حالة عدم قدرة الشخص على قراءة و/أو فهم نص نموذج الموافقة المستنيرة والدراسة وطبيعتهما، يلزم وجود شاهد.

اسم الشاهد:	
الصلة بالمشارك، إن وجدت:	
التوقيع:	
التاريخ:	
الشخص الذي يحصل على الموافقة:	
التاريخ:	

الباحث الرئيس:	
التوقيع	
التاريخ:	
الوقت (صباحًا مساءً)	

Appendix G Ethical approval

Jawatankuasa Etika Penyelidikan Manusia UniSZA | UniSZA Human Research Ethics Committee (UHREC)

Our Ref : UniSZA.C/2/UHREC/628-2 Jld 2 (81)

Date : 27th July 2020

Mr. Majdaldeen M I Ashqar
Postgraduate Candidate
Faculty of Health Sciences
UniSZA, Gong Badak Campus

Dear Mr. Majdaldeen M I Ashqar,

THE APPROVAL OF HUMAN RESEARCH ETHICS

It is my pleasure to inform you that your study protocol has been reviewed and is hereby granted an ethics approval by Universiti Sultan Zainal Abidin Human Research Ethics Committee (UHREC). This study has been assigned with a study protocol code (UniSZA/UHREC/2020/177) which should be used for all communications with UHREC related to this study.

Title	The Effect of Postural Management Using Proper Wheelchairs In Children with Spastic Cerebral Palsy in Saudi Arabia		
Protocol No.	-	**Principle Investigator**	Majdaldeen M I Ashqar
UHREC Code	UniSZA/UHREC/2020/177		
Date of Approval • Protocol received • Reviewed by Committee	 14th June 2020 15th June 2020	**Co-Investigator (s)**	Dr. Naresh Bhaskar Raj (Supervisor)
Study Site	Seating and position clinic, Rehabilitation services and programs, Sultan bin Abdel Aziz Humanitarian City, Riyadh, Kingdom of Saudi Arabia	**Duration of Study**	12 months
Financial Support	-	**Validity of Ethical Clearance**	30th June 2021

The following items (√) were received and reviewed in the process of approval.

(√) Research proposal
(√) Research information sheet (English)
(√) Informed consent form (English)
(√) Approval letter from faculty/ Institute research committee
(√) Curriculum Vitae (CV) of researchers
(√) Research tool (Data collection forms)

Investigator(s) are required to :-

a) follow instructions, guidelines and requirements of the UniSZA Human Research Ethics Committee (UHREC)
b) report any protocol deviations/amendments to UniSZA Human Research Ethics Committee (UHREC)
c) comply with International Conference on Harmonization – Guidelines for Good Clinical Practice (ICH-GCP)
d) note that UniSZA Human Research Ethics Committee (UHREC) may audit the approved study

Thank you.

Yours truly,

PROF. DR. NYI NYI NAING @ SYED HATIM NOOR
Chairperson
UniSZA Human Research Ethics Committee

Secretariat of UniSZA Human Research Ethics Committee (UHREC), Blok R, Aras 1, UniSZA Kampus Gong Badak, 21300 Kuala Nerus, Terengganu Darul Iman, Malaysia
tel: +609-668 8763 email : uhrec@unisza.edu.my

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY

Date: 15/12/2019
IRB No.: 09-2019-IRB

To: Mr. Majd Ashqar M I Ashqar
Ms. Sadia Misbach
PI: "The Effect of 24Hr Postural Management on Children with Cerebral Palsy [a case study of Saudi Arabia]"
Sultan Bin Abdulaziz Humanitarian City
Supervisor's E-mail: smisbach@sbahc.org.sa
PI's E-mail: mashqar@sbahc.org.sa

Subject:	Approval for Research Project No. 07/MSc/2019
Study Title:	The Effect of 24Hr Postural Management on Children with Cerebral Palsy
Study Code:	07/MSc/2019
Date of Approval:	12/12/2019
Date of Expiry:	30/07/2020
Board approval:	All members except the absentees (Dr. Mohammed Zaben, Ms. Manar Sweis, Ms. Samaher AbuSamra, Mr. Mosaab AlManaa, Dr. Saeed AlGhamdi)

Dear Ms. Sadia and Mr. Majd,

Your Project has been approved and you have the permission to conduct this study following your submitted documents as follow:

1. Curriculum Vitae for the PI researcher
2. Letter from researcher's affiliating Organization/College
3. Letter from the researcher requesting SBAHC participation in the clinical study
4. Letter from the researcher's supervisor requesting supervision in the clinical study
5. Research proposal according to SBAHC IRB Guidelines
6. SBAHC Informed Consent Template (English and Arabic)
7. Research Obligatory Agreement. Available upon the completion of the other requirements

You are required to obey by the rules and regulations of the Government of Saudi Arabia, the SBAHC IRB Policies and procedures and the ICH-GCP guidelines. You have to note that this approval mandate responding to IRB's periodic request and surveillance result. Drawing your attention to the following:

- Amendment of the project with the required modification to providing Periodical report for this project specially when study extension is required or expiry before study completion
- All unforeseen events that might affect continued ethical acceptability of the project should be reported to the IRB as soon as possible
- Any serious unexpected adverse events should be reported within 48 hours (2 days)
- Personal identifying data should only be collected when necessary for research.
- Secondary disclosure of personal identifiable data is not allowed.
- Monitoring: projects may be subject to an audit by the IRB at any time.

LIST OF PUBLICATIONS

1. Majdaldeen M. I. Ashqar, Dr. Naresh Bhaskar Raj, Sadia Misbach, Dr. Akram Amro, Dr. Wan Arfah Nadiah (2021). Reduction in Spasticity Following Postural Management Using Proper Wheelchairs in Children with Spastic Cerebral Palsy in Saudi Arabia. *Annals of the Romanian Society for Cell Biology*, 4316-4326.

2. Majdaldeen M. I. Ashqar, Dr. Naresh Bhaskar Raj, Sadia Misbach, Dr. Akram Amro, Dr. Wan Arfah Nadiah (2021). Postural Management And Quality Of Life In Children With Spastic Cerebral Palsy, *Turkish Journal of Physiotherapy and Rehabilitation*, 2651-4451 e-ISSN 2651-446X.

CANDIDATE BIODATA

Majdaldeen M I Ashqar was born July 4th, 1988 in Nablus, Palestinian. He received his early education at Saida Education School. Then between 2006 and 2010 he continued his education at the University of Jordan. He holds a bachelor's degree in Occupational Therapy. He is a licensed health specialist in Saudi Arabia and holds an Eligibility Letter for Dubai Health Authority (DHA). Also, he is a member of The Jordanian Society for Occupational Therapy. Starting from January 2012, he works as a senior occupational therapist at Sultan Bin Abdulazeez Humanitarian City (SBAHC). He is a seating and positioning specialist. In 2019, he started his Master studies at Universiti Sultan Zainal Abidin in the field of Health Sciences under the supervision of Dr. Naresh Bhaskar Raj. His research interest is on cerebral palsy; rehabilitation science; occupational therapy; and quality of life