

**Deanship of Graduate Studies
Al-Quds University**



**The Effectiveness of Applied Therapeutic Approaches in
the Rehabilitation of Cerebral Palsy Children in
Palestine
A Multicenter Observational Study**

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**The Effectiveness of Applied Therapeutic Approaches in
the Rehabilitation of Cerebral Palsy Children in Palestine
A Multicenter Observational Study**

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**This thesis was submitted in partial fulfillment of the
requirements for the Master's degree in
Physiotherapy**

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Thesis Approval

The Effectiveness of Applied Therapeutic Approaches in the Rehabilitation of Cerebral Palsy Children in Palestine A Multicenter Observational Study

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Jerusalem- Palestine

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Dedication

I dedicate this dissertation to my dear family; my mother, my brothers Tawfeeq and Ahmed and my sisters Laila and Noor for their encouragement and supporting me, and to all my dear friends for their support during the period of my study.

To my precious father's soul, God bless his soul, who has always been supportive to me in everything and every time.

Also, I dedicate this dissertation to everyone who's been supportive to me.

Yasmeen Jomaa

Declaration

This thesis was submitted in partial fulfillment of the requirement for the Master's degree in physiotherapy.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Yasmeen Mohammad Jomaa

Signed: 

Date: 9/5/2021

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Last, I would like to thank my family and my friends for being with me and for providing support throughout this journey.

Abstract

Background: Various interventions are used in pediatric rehabilitation to treat the symptoms of Cerebral Palsy (CP) with some showing more success than others. Also, there has been a progression from traditional therapeutic intervention as focusing on muscle strength and range of motion, to treating functional elements of activity and participation. The current evidence in the CP rehabilitation discipline needs more future research to assess and improve the quality level from assessments and measurements to the therapeutic approaches.

Objectives: To examine the efficacy of the regular physiotherapy care approaches delivered to children with CP in the multi-rehabilitation centers, and to identify any potential correlation between the changes in the functional outcome measures and intervention elements as treatment frequency and total number of sessions.

Methods: Five rehabilitation centers that included PT and targeted the pediatric population were approached (the convenient centers which agreed to participate), and 71 children with CP (42 males, 29 females; mean age 3.94 ± 2.85 y) were recruited in this study. The sample involved All CP types and GMFCS levels (I-IV). The efficacy of the regular PT approaches during 3 months delivered to the children with CP was evaluated by using three outcome measures; GMFCS, GMFM-IS, and FAQ, which measure before and after 3 months of intervention. Descriptive statistics were used to characterize the centers and sample demographic and clinical characteristics (frequency, mean & SD, median, etc.). The spearman correlation tests were used to test the associations between; the change in the GMFM and Gillette FAQ values, also between outcomes changes and total number of sessions, and between frequency of sessions. A p value of < 0.05 was set to be significant.

Results: The examined and identified PT approaches were the functional approach and mix approach (mix approach included functional approach, Bobath technique and regular exercises of stretching and strengthening intervention). The children were clustered by the applied approaches. The regular PT approaches in both groups resulted in significant improvements; functional approach group (GMFM mean value at baseline (49.35 ± 19.37) and post intervention (54.55 ± 19.38) , Gillette FAQ mean value at baseline (4.10 ± 3.46) and post intervention (5.46 ± 3.23) with $(p\text{-value} = 0.000)$ for both outcome measures), the mix approach group (GMFM mean value at baseline (35.38 ± 12.71) and post intervention (43.16 ± 11.15) , Gillette FAQ mean value at baseline (2.16 ± 1.37) and post (3.35 ± 2.04) with $(p\text{-value}= 0.000)$ for both measures.

Cohen's d effect size was calculated and resulted $(d=0.65)$ for GMFM and $(d=0.68)$ for FAQ in the mix approach-based group, while the functional approach group resulted $(d=0.27)$ for GMFM and $(d=0.41)$ for FAQ which means the superiority for mix approach group at all measurements after 3 months of intervention.

Also, a spearman correlation test resulted a positive significant correlation between changes in GMFM and FAQ outcomes at baseline and post intervention with $(P\text{-value}= 0.000)$ for both. However, there are negative and weak correlations among; the sessions frequency per week, total number of sessions and GMFM & Gillette FAQ outcomes.

Conclusions: The results suggest that the PT therapeutic approaches (the functional training approach and the mixed approaches (mix included; Bobath technique, stretching and strengthening regular exercises, and functional approach)) were efficacious with superiority to mix approaches over functional approach alone for children with CP. However, there was a limitation in using standardized criteria in the rehabilitation settings from the assessment, goal setting, treatment planning, and intervention to quantifying the intervention outcomes. The results of the study will help in recommending the physiotherapists in Palestine to use a

standardized criterion in CP rehabilitation and ensure the critical need for further clinical studies on CP therapeutic approaches and their effectiveness on children's life.

Keywords: Cerebral Palsy, functional skills, pediatric rehabilitation, neurodevelopmental assessment, outcome measures.

فاعلية الأساليب العلاجية المستخدمة في إعادة تأهيل الأطفال المصابين بالشلل

الدماغي في فلسطين- دراسة تحليلية متعددة المراكز

إعداد: ياسمين محمد توفيق جمعة

إشراف الدكتورة: هديل حلاوة

ملخص الدراسة:

مقدمة: يوجد العديد من الأساليب العلاجية المتبعة في إعادة تأهيل أطفال الشلل الدماغي عالمياً ومحلياً، وتختلف هذه الأساليب في فاعليتها وتأثيرها على قدرات الأطفال وحياتهم، كما يوجد حالياً تطور وتحول كبير في هذه الأساليب من الطرق العلاجية التقليدية المعتمدة على تحسين قوة العضلات ومدى الحركة، إلى التركيز على معالجة القدرات الحركية الوظيفية والأنشطة الحياتية والمشاركة في المجتمع. ويحتاج الوضع الحالي فيما يخص إعادة تأهيل أطفال الشلل الدماغي في فلسطين إلى المزيد من الدراسات والأبحاث العملية لتقييم وتحسين مستوى الجودة للأدوات والمقاييس المستخدمة بدءاً من عملية التقييم وصولاً للنهج العلاجي والمتابعة.

الأهداف: تقييم فاعلية الأساليب التأهيلية المتبعة من خلال قياس التغيير في نتائج القدرات الحركية الوظيفية والأداء الوظيفي لدى أطفال الشلل الدماغي، وتحديد العلاقة بين إمكانيات الأطفال الحركية الوظيفية استجابة لهذه التدخلات العلاجية المختلفة وبعض العوامل الأخرى كعدد الجلسات خلال فترة الدراسة.

أساليب البحث: تمت الدراسة الحالية في خمسة مراكز تأهيلية وعلاجية في جنين ونابلس (تم تحديدهم بناءً على موافقتهم في المشاركة في الدراسة بالإضافة أنها تستهدف مختلف مشاكل الأطفال وتقدم العلاج الطبيعي بشكل جلسات منتظمة). وشملت العينة 71 طفلاً (42 من الذكور و29 من الإناث) ومتوسط

الأعمار والانحراف المعياري كان (3.95 ± 2.85) عاماً بمختلف أنواع الشلل الدماغي وكل مستويات تصنيف القدرات الحركية الوظيفية (GMFCS I-V). تمت من خلال الدراسة عملية تقييم كفاءة طرق العلاج الطبيعي المتبعة خلال ثلاثة أشهر (مدة الدراسة). تم قياس التغيير والتحسين الناتج في قدرات الأطفال الحركية الوظيفية باستخدام تصنيف القدرات الحركية الوظيفية (GMFCS E & R), ومقياس القدرات الحركية الوظيفية (GMFM-66-IS)، واستبيان الأداء الوظيفي جيليت (Gillette FAQ). تم تحليل جميع البيانات باستخدام برنامج IBM SPSS الإصدار 23.

النتائج: كانت طرق العلاج الطبيعي المتبعة خلال الدراسة هي العلاج بالنهج الحركي الوظيفي والعلاج بالنهج المختلط الذي تضمن استخدام أكثر من طريقة علاجية (هي الدمج بين تقنية بوبات والتمارين المعتمدة على تقوية العضلات ومدى حركة المفاصل بالإضافة للنهج الوظيفي). حيث صنف الأطفال لمجموعتين بناء على النهج المتبع. وأظهرت عملية تقييم الطرق العلاجية فروقات في قيم المتوسط الحسابي لكلا المقياسين. المتوسط الحسابي في مجموعة النهج الوظيفي بين متوسط قيم قياسات القدرات الحركية الوظيفية GMFM قبل (49.35 ± 19.37) وبعد الدراسة (54.55 ± 19.38) وكذلك في القيم الوسطية لقيم الأداء الوظيفي جيليت FAQ قبل (4.10 ± 3.46) وبعد الدراسة (5.46 ± 3.23) بقيمة $(p\text{-value} = 0.000)$ لكلا المقياسين. كما ظهر فرق معنوي في مجموعة النهج المختلط بين متوسط قيم قياسات القدرات الحركية الوظيفية GMFM قبل (35.38 ± 12.71) وبعد الدراسة (43.16 ± 11.15) وكذلك في القيم الوسطية لقيم الأداء الوظيفي جيليت FAQ قبل (2.16 ± 1.37) وبعد الدراسة (3.35 ± 2.04) بقيمة $(p\text{-value} = 0.000)$ لكلا المقياسين.

تم حساب حجم التأثير كوهن (د) لكلا المجموعتين لمعرفة حجم التأثير لصالح أي مجموعة حيث كان حجم التأثير أكبر لصالح مجموعة النهج المختلط بقيمة (0.65) لقيم GMFM و (0.68) لقيم FAQ بعد 3 أشهر من التدخل. ظهرت من خلال النتائج علاقة ارتباط قوية بين التغيير في متوسط قيم GMFM ومتوسط قيم FAQ قبل وبعد التدخل العلاجي لدى الأطفال وقيمة الفرق المعنوي $(p\text{-value} = 0.000)$.

كانت العلاقة بين التغيير في مقياس GMFM وتردد الجلسات الاسبوعي وعدد الجلسات الكلي عكسية وكذلك بالنسبة لأداة جيليت FAQ.

الاستنتاجات: تشير نتائج الدراسة إلى فاعلية الأساليب العلاجية المتبعة (نهج التدريب الوظيفي والنهج المدمج الذي تضمن أكثر من أسلوب علاجي) مع تفوق النهج العلاجي المختلط على النهج الوظيفي في تحسين المقاييس الحركية الوظيفية لدى الأطفال بعد فترة الدراسة. كذلك أشارت النتائج لوجود علاقة قوية بين التغيير في مقاييس القدرات الحركية الوظيفية والأداء الوظيفي للأطفال خلال فترة الدراسة. يوصى من خلال نتائج الدراسة باستخدام معايير محددة ومنهجية في عملية التأهيل بدءاً من عملية التقييم وصولاً لقياس نتائج البرامج العلاجية المختلفة, حيث كان هناك محدودية في استخدام هذه المعايير في عملية التأهيل لقياس كفاءة البرامج العلاجية , مما يؤكد الحاجة الماسة لمزيد من الدراسات والأبحاث العملية حول فاعلية الأساليب العلاجية المتبعة في تأهيل أطفال الشلل الدماغي.

الكلمات الرئيسية: الشلل الدماغي، المهارات الوظيفية، تأهيل الأطفال، تقييم النمو العصبي، مقاييس

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List of Abbreviations

ADL	Activities of daily living
CP	Cerebral palsy
CIMT	Constraint induced movement therapy
CE	Conductive education
FAQ	Gillette functional assessment questionnaire
GMFM	Gross motor function measurement
GMFCS	Gross motor function classification system
ICF	International classification of functioning, disability and health
NDT	Neurodevelopmental treatment
OT	Occupational therapy
PT	Physiotherapy
UNICEF	United nations children's fund
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

Chapter One: Introduction

1.1 Background

1.2 Problem Statement

1.3 Study Justification

1.4 Objectives of the Study

1.5 Hypotheses of the Study

1.6 Terminology

Chapter1: Introduction

1.1 Background

Cerebral palsy (CP) is the umbrella that covers a large group of neurological disorders of motor control with onset early in development and persistence throughout the lifespan, accompanied by disturbances of movement and posture cause activity limitations (Gannotti et al., 2017; Lungu, Hirtz, Damiano, Gross, & Mink, 2016; Iona Novak, 2014; B. Rosenbaum & Varvin, 2007). CP types are described based on many particular categories according to; the affected parts of the body (quadriplegia, hemiplegia, diplegia, & monoplegia), and on the motor impairment due to affected brain parts (spastic, dyskinetic, ataxic, & mixed type), or gross motor function classification system (GMFCS) from level I to level VI(Cerebral Palsy Alliance Research, 2018).

Gross motor development and functional abilities in CP children are two of the most relevant outcomes being affected with the child developing through the different life stages (P. L. Rosenbaum et al., 2002). In clinical pediatric rehabilitation, it's essential to use appropriate and accurate clinical tools to measure these relevant outcomes to examine motor development and functionality (Bier et al., 2017; Pavão, Silva, Dusing, & Rocha, 2016). The physical and functional dysfunctions (movement, coordination, muscle tone and control, reflexes, posture, and balance) are commonly accompanied by the CP disorders, these outcomes will affect the ability of a CP child to be independent in their functional mobility/skills at home and community environments (Mutlu, Akmese, Gunel, Karahan, & Livanelioglu, 2010; Mutlu, Krosschell, & Spira, 2009). So that the physiotherapy (PT) intervention plays an essential role in the rehabilitation process of CP child.(Das & Ganesh, 2019)

The PT within the rehabilitation process of a CP child depends on affecting body movements, body positions, and activity which were influenced by damage of the brain parts during pregnancy, at birth, or after birth (NINDS and NIH, 2013). This damage to or abnormalities inside the developing brain will disrupt the brain's ability to control different body functions. Moreover, this non-progressive damage that affects the motor area of the brain cortex leads to motor disorders(NINDS and NIH, 2013). The damaged parts will not recover and will not be worse, while the movements, postural control, and associated problems can be improved or get worse depending on the applied treatment and rehabilitation approaches, and how the developing brain will respond (Iona Novak et al., 2020).

Globally, CP is the most common cause of motor disability in childhood (Group, 1993; Lungu et al., 2016), with an incidence of 2 to 3 per 1,000 live births, occurring 20 to 30 times more frequently in premature or low-birth-weight infants (Oskoui, Coutinho, Dykeman, Jetté, & Pringsheim, 2013). In Palestine, the CP children with physical disorders have a high percent according to the other disorders. Up-to-date prevalence by the United Nations Children's Fund (UNICEF) report toward the childhood disability was estimated that 3-7 % of children were disabled, about 42% of those children have more than one type of disability, and 20% of disabled have a physical disability as presented in figure (1.1) (UNICEF, 2019). These statistics indicated that there is a critical need for rehabilitation services.

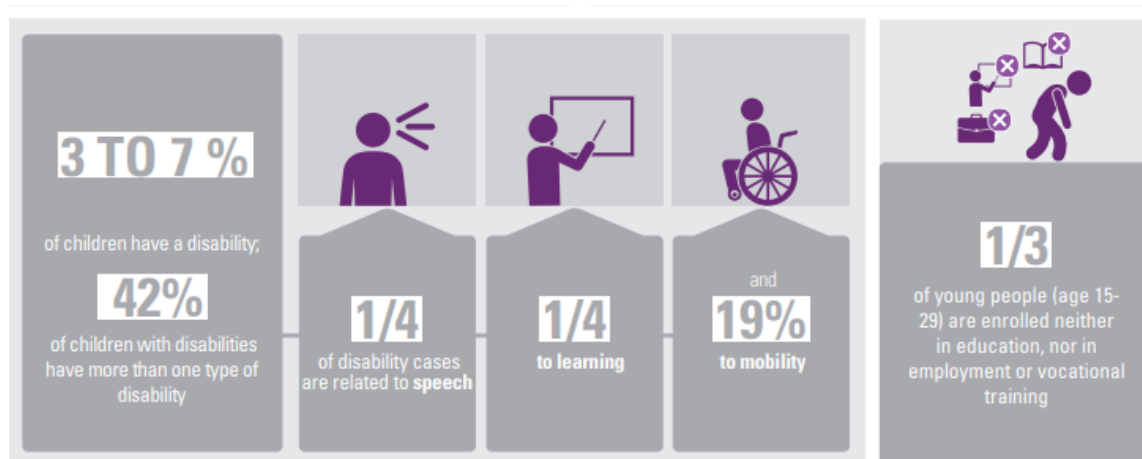


Figure 1.1: Statistics about disabled children in Palestine (UNICEF, 2019).

The Rehabilitation process involves the identification of the child and family's problems and needs, relating the problems to relevant factors of the child and the environment, setting rehabilitation goals, planning and implementing the measures and therapeutic interventions, and assessing the outcomes (WHO, 2011). In Palestine, pediatric rehabilitation in the physiotherapy field including; conventional interventions (range of motion and muscle strength exercise), neurodevelopmental treatment, functional approaches (the contextual and task-oriented approaches, the family-based approach, the goal-oriented approach, play centered approach), and conductive education.

Clients/families, researchers, and health professionals need to explore the effect of these approaches on children at different levels as; the children's gross motor development, muscle tone, functional abilities, activity, and participation levels. On other hand, there are numerous assessment tools and outcome measures that can be used to guide the professionals to assess, evaluate, set realistic goals, choose the suitable therapeutic approach from baseline to the evaluation process of intervention (Mintaze Kerem Günel, Duygu Türker, n.d.; NSW Ministry of Health, 2018; Pavão et al., 2016). Gross motor function measure (GMFM) (Harvey, 2017), and Gillette functional assessment questionnaire (FAQ)

(Himuro, Abe, Nishibu, Seino, & Mori, 2017) are examples of these clinical measures in the field.

1.2 Problem Statement

CP children with physical disorders are managed using different therapeutic approaches varying from traditional to functional oriented approaches. Moreover, various interventions are used to treat the symptoms of CP with some showing more success than others. Also, there has been a progression from traditional therapeutic intervention as focusing on muscle strength and range of motion, to treating functional elements of activity and participation, following the International Classification of Functioning, Disability, and Health framework (ICF) (Mutlu et al., 2009; Iona Novak et al., 2013). The rapid expansion of the evidence base in the applied rehabilitation approaches made it difficult for health professionals to keep updating and it is challenging for families to know the best for their child. Also, there is still emerging in the clinical efficacy of used interventions provided to children with CP (Iona Novak, 2014).

In Palestine, there are limited studies related to the effectiveness of the applied approaches being used in CP management, as well as there is a limitation in using standardized criteria in the rehabilitation settings from the assessment, goal setting, treatment planning, and intervention to quantifying the intervention outcomes. On other hand, some interventions may be applied without orienting toward the goal-oriented approach early from the beginning of the rehabilitation process. Therefore, the existing gap between the knowledge and clinical practice in the CP rehabilitation discipline needs more future research to address the quality level of the therapeutic approaches and to enable the professionals and families to quantify the effect of these approaches and their outcomes on the CP child life.

1.3 Research significance and rationale

The current study suggests using specific criteria to explore the changes and progression resulting in the children's potentials from the rehabilitation programs, which minimize the existing gap between the knowledge and clinical practice. Also, it's expected to help the professionals and clients to verify the effectiveness of therapeutic interventions, as well as supporting the clinical decision making of the appropriate treatment options and addressing the family goals which may help saving time and cost (Lungu et al., 2016; Iona Novak et al., 2013; Oskoui et al., 2013). Consequently, the current study may add to the present evidence and body of knowledge more significant implications. This may contribute to guiding the clinical practice toward the most effective approaches which maximize the children's potentials, physical and functional abilities.

1.4 Study Objectives

- To identify the applied PT approaches in the pediatric rehabilitation settings of CP children in Palestine (Nablus and Jenin).
- To examine the efficacy of the regular physiotherapy care approaches delivered to children with CP in the multi-rehabilitation centers on the following outcomes:
 - a) gross motor function
 - b) functional motor ability
- To identify any potential correlation between the changes in the functional outcome measures as:
 - The correlation between the change or progress in the children's gross motor function and the functional mobility (child performance at home and community) before and after the intervention.

- The correlation between the changes in the functional outcome measures and intervention frequency and total sessions number.

1.5 Study hypotheses

- There are different therapeutic approaches that are used for the CP children rehabilitation in clinical settings in Palestine (Jenin and Nablus).
- There is a difference between the effectiveness of these therapeutic approaches on CP children motor abilities which are:
 1. Gross motor function (using the GMFM-66-IS).
 2. Functional mobility (using Gillette FAQ).
- There is a positive correlation between the progress in gross motor development and the functional mobility.

1.6 Research questions

- 1 What are the therapeutic approaches used for CP children's rehabilitation in clinical settings in Palestine?
- 2 What is the most effective applied approach for the rehabilitation of CP children in Palestine?
- 3 Is there an association between the change in the outcomes on the CP children's gross motor function and functional abilities in the study duration?

1.7 Terminology

Ataxic CP: is the least common motor disorder which is characterized by abnormal coordination and balance.

Bobath technique (NDT): is an approach embedded into the context of normal developmental sequence to optimize function and development by passive handling techniques.

Cerebral palsy: is an umbrella that covers a large group of non-progressive but changing motor and sensory disorders.

Diplegia: this type of CP, muscle stiffness is mainly in the legs, with the arms less affected or not affected at all.

Functional ability: Performance and capability to do the underlying motor skills.

Gross motor function: the motor capacity to keep body balance and change positions via developmental motor abilities

Hemiplegia: The unilateral CP type affects one side of the body.

ICF: is a framework that was adopted the rehabilitative field to guide the physiotherapists in managing CP children from evaluation to therapy and goal attainment.

Developmental disorders: motor and sensory disorders that secondary to the lesions of the developing brain arising in the early stages of development.

Physiotherapy: is an essential part from multidisciplinary team supports the child with CP to achieve their physical capabilities to improve the quality of life for the children and their families.

Quadriplegia: The bilateral CP type affects all four limbs.

Rehabilitation: The identification of the child and family's needs, relating the problems to relevant factors of the child and the environment, setting rehabilitation goals, planning and implementing the measures and therapeutic interventions.

Spastic cerebral palsy: it is the most common motor type characterized by an excessive stiffness in the muscles.

Chapter two: literature review

2.1 Theoretical background

2.2 Similar studies

2.3 Summary

Chapter two: Literature Review

2.1 Theoretical background

2.1.1 Definition of Cerebral Palsy (CP)

Cerebral palsy CP is an umbrella that covers a large group of non-progressive but changing motor and sensory disorders that secondary to the lesions of the developing brain arising in the early stages of development (Gannotti et al., 2017; Lungu et al., 2016; Iona Novak, 2014; B. Rosenbaum & Varvin, 2007). As well as, it describes a group of developmental disorders affecting movements and postures, causing activity restriction or functional limitation (P. Rosenbaum et al., 2007). The motor disorders of CP are often accompanied by these secondary complications; disturbances of sensation, perception, cognition, communication, and behavior, epilepsy, and secondary musculoskeletal problems (NSW Ministry of Health, 2018).

CP is caused by damage to the brain which occurs before, during, or shortly after birth (Gannotti et al., 2017; Lungu et al., 2016; Iona Novak, 2014; B. Rosenbaum & Varvin, 2007). Congenital or acquired CP happens by the following possible causes; genetic problems, brain infections, lack of blood flow to brain, head injury, fever, and some cases with unknown cause (NINDS and NIH, 2013). Also the following risk factors were significant predictors of CP; Placental abnormalities, birth defects, low birth weight, meconium aspiration, cesarean delivery, birth asphyxia, neonatal seizures, Respiratory distress syndrome, hypoglycemia, and neonatal infection (McIntyre et al., 2013). These risk factors are not the cause of CP but may lead to an increase in the chance of its happening. Some CP cases may occur spontaneously or from complications associated with other medical conditions or interventions after birth (NSW Ministry of Health, 2018).

2.1.2 Types of Cerebral Palsy (CP)

The CP classifications are identified by motor types (according to brain lesion), topographical distribution, and functional motor ability (Cerebral Palsy Alliance Research, 2018). Motor types result due to the affected brain part including; spastic cerebral palsy which is the most common motor type characterized by an excessive stiffness in the muscles, the second motor type is dyskinetic CP which is characterized by dystonia and athetosis (repetitive and uncontrolled movements), the third type is Ataxic CP is the least common motor disorder which is characterized by abnormal coordination and balance, other motor types of CP are the flaccid type or hypotonia, and mixed CP which is where more than one motor type is present (Cerebral Palsy Alliance Research, 2018).

Also the CP as a diagnosis is classified according to the affected body part, it may be unilateral as monoplegia & hemiplegia or bilateral as quadriplegia & diplegia (Cerebral Palsy Alliance Research, 2018; Gannotti et al., 2017; Lungu et al., 2016; Iona Novak, 2014; B. Rosenbaum & Varvin, 2007). Besides that, a classification system is categorized into five-levels, which is called GMFCS based on the distinctions in; functional motor abilities, the use of mobility devices, and the quality of movement in gross motor function (Harvey, 2017). The GMFCS includes five-level descriptions (Level I represents the best gross motor abilities and Level V the least function) depending on the child's age (Gorter, Ketelaar, Rosenbaum, Hadders, & Palisano, 2009; Morris & Bartlett, 2004; Palisano, Cameron, Rosenbaum, Walter, & Russell, 2006).

2.1.3 Cerebral Palsy Statistics

According to statistical sources in USA and Europe, the prevalence rates in the world range from 2 to 4 per 1000 born infants develop CP, as well as the rates is expected to be higher in the countries with lower standard of medical care(ADDM & SCPE networks, 2019). Moreover, CP is one of the most common movement disorder in the world, in addition to the economic problems and heavy costs on patients, their families, the healthcare system, and society (Oskoui et al., 2013; Palestinian Central Bureau of Statistics (PCBS), 2016). Life expectancy in children with CP revealed that the life span of the child is influenced by the presence of physical, feeding, and cognitive dysfunctions, and the severity of the functional disability (Katz, 2003).

In Palestine, there is a critical need to develop a specific database or statistical registry about CP definitely, also there are limited existing data resources in the field of CP and related clinical outcomes to the therapeutic intervention and their effects on CP children's life, function, and health. In 2019 the UNICEF reported that the childhood disability was estimated by 3-7% of children were disabled, about 42% of those children have more than one type of disability, and 20% of these disabled children have motor dysfunctions (UNICEF, 2019). Moreover, CP is the most prevalent type of children diagnosed with a physical disability (Gannotti et al., 2017; Group, 1993; Lungu et al., 2016). These findings emphasize the strong link between CP and the rehabilitation process which is lifelong management focus on the motor and cognitive dysfunctions which cause inability to manage daily life activities (ADLs) and restricted possibilities for participation (Jeglinsky & Autti-Rämö, 2021).

2.1.4 Physiotherapy (PT) role in the rehabilitation process

The rehabilitation process of the CP population includes multi-dimensional disciplines; physiotherapy (PT), occupational therapy, speech therapy, and other health disciplines to manage the CP children through their life stages (Jeglinsky & Autti-Rämö, 2021). PT is an essential part of those disciplines that provide various interventions for CP children (Das & Ganesh, 2019; I Novak et al., 2013; NSW Ministry of Health, 2018). PT rehabilitation of CP primarily starts at childhood with an accurate assessment of children to select appropriate interventions that meet the child's needs (Bier et al., 2017; Jeglinsky & Autti-Rämö, 2021; NSW Ministry of Health, 2018). The gross motor development is the prime focus of PT rehabilitation with preventing the consequent deteriorations as; contractures, muscle tone problems, postural problems, muscle weakness that can lead to a loss in walking ability, difficulties with self-transferring, and general passivity. More further, those functional abilities are targeted to prevent physical deterioration and to maintain activity and participation in everyday life (Jeglinsky & Autti-Rämö, 2021).

The PT role supports the child with CP to achieve their capabilities for physical independence and activity levels, by minimizing the effect of their motor impairments, functional limitations and to improve the quality of life for the children and their families. Consequently, Gross motor skills, functional mobility, positioning, sitting, transition from sitting to standing, walking with or without assistive devices, wheelchair use and transfers, are all areas that the physiotherapist works on using a wide range of therapeutic approaches to influence functional ability of the child (Das & Ganesh, 2019).

The ICF is a framework that was adopted and used by the rehabilitation field to guide the physiotherapists in managing CP children from evaluation to therapy and goal attainment (Cerniauskaite et al., 2011; Power, Anderson, & Togher, 2011). The ICF domains (which

include body function and structure, activity, participation, contextual factors) redefined the professionals thinking way in CP disorder and its intervention options, this perspective related to the CP impacts on a person's functioning which may cause impairments, activity limitations, and participation restrictions, in addition to the personalized environment and context that contributes to determining independence level (Iona Novak et al., 2013; Power et al., 2011). Thus there are various assessments and outcome measures, besides the therapeutic approaches which are related to one or more domains of the ICF model (Jeglinsky & Autti-Rämö, 2021).

Gross motor function and functional ability can be evaluated using relevant outcome measures to investigate the therapy effectiveness and to detect any progress that happened and the resulting outcomes by the intervention. Gross motor function means the motor capacity to keep body balance and change positions via developmental motor abilities as rolling, crawling, sitting, standing, walking, running, jumping, and transferring skills. The various functional limitations were experienced by the CP condition impact on performance and capability (which mean the functional ability) to do these underlying motor skills (Kerr, McDowell, & McDonough, 2007).

Gross motor function and functional ability are important to attain ADLs. While the capacity refers to an underlying ability, “that is what a person can do in a standardized environment, however, the functional ability refer to the capability and performance in doing these abilities in daily life: capability describes what a person potentially can do in a standardized environment, whereas performance describes what a person does do in a daily environment”(Kwon, Yi, Kim, Chang, & Kwon, 2013).

The functional motor ability classification scales as GMFCS, GMFM, Gross Motor Performance Measure, Pediatric Evaluation of Disability Inventory, The Gillette FAQ, and

Functional Independence Measure for Children are used to guide assessment and intervention with all children diagnosed as a CP to facilitate and to ensure realistic goal setting and provide a baseline for therapy and evaluation of therapy programs(Duran et al., 2019; NSW Ministry of Health, 2018).

GMFCS E&R, GMFM and Gillette FAQ outcome measures:

The Gross Motor Function Classification System Expanded and Revised (GMFCS E&R) is widely applied to describe the gross motor function of children with CP. The GMFCS includes five-level descriptions (Level I represents the best gross motor abilities and Level V the least function) depending on the child age, the distinctions between levels based on the severity of functional disability and the need for mobility devices with the actual performance (quality of movements) (Gorter et al., 2009; Reid, Carlin, & Reddihough, 2011; Robert Palisano, Peter Rosenbaum, Doreen Bartlett, 2007).

GMFM is a reliable, valid and responsive measure of gross motor function for children with cerebral palsy (Brunton & Bartlett, 2011). Shortened versions of GMFM-66 have been developed more recently, the GMFM-66 Item sets (IS) use a scoring algorithm, whereby a number of decision items guide the therapist toward a predetermined set of items relevant to a child functioning at that level, and the child is then tested on that 'item set'(Harvey, 2017). Moreover, GMFM was found as a golden standard to guide and assist pediatric physical rehabilitation professionals to detect significant changes , plan treatment, monitor progress, evaluate the effectiveness of an intervention program, compare and discriminate between individuals, and provide objective information to families (Alotaibi, Long, Kennedy, & Bavishi, 2014; Brunton & Bartlett, 2011; Ferre-Fernández, Murcia-González, Espinosa, & Ríos-Díaz, 2020).

The Gillette FAQ is a 10 items valid instrument to determine level of motor function difficulty, which assesses the level of a child's functional mobility on an ordinal scale by describing various levels of mobility differing in environment, or obstacles. The scale ranges from 1 (the child cannot take any steps at all) to 10 (the child walks, runs, and climbs on level and uneven surface without difficulty) (Ammann-Reiffer, Bastiaenen, & Van Hedel, 2019; Himuro et al., 2017; Stout et al., 2009).

In PT management of CP, some approaches based on motor learning theories and other approaches may be relevant to ICF domains (Balci, 2016; Molenaers, Calders, Vanderstraeten, & Himpens, 2012; Størvold & Jahnsen, 2021). In the literature, therapeutic approaches have different names, so that the naming of therapeutic approaches in the current study will be based on the ICF model (Das & Ganesh, 2019) and evidence-based clinical guideline for CP management (NSW Ministry of Health, 2018). Commonly used approaches with CP are neurodevelopmental treatment (NDT) or Bobath technique, functional task-oriented training, conductive education, and Vojta, besides these conceptual approaches, hippo-therapy and hydrotherapy are frequently used as additional therapies for children with CP, with many different opinions regarding their effectiveness (Molenaers et al., 2012).

PT intervention

The CP management guideline identified the CP interventions as following depending on the ICF domains; body function and structure interventions including strengthening and stretch intervention, electrical stimulation, besides the adjunct approaches on the same domain as; acupuncture, hydrotherapy, hyperbaric oxygen therapy, massage, NDT, and Vojta. Also, activity and participation interventions which are upper and lower limbs specific interventions (modified constraint-induced movement therapy (mCIMT), bimanual therapy, and treadmill training), functional therapy, fitness training, home programs, and context

focused therapy, besides the adjunct animal-assisted therapy, conductive education, hippotherapy and play therapy (NSW Ministry of Health, 2018).

The previous guideline also considered the importance of additional environmental interventions as assistive devices prescription and equipment's modifications, in addition to home and environment's modifications to facilitate the participation of CP child in the different life aspects. Another recent guidance in the literature presented a systematic review categorized the interventions depending on the motor plasticity concept and ICF levels as; the active motor based intervention, passive motor-based interventions, and other adjunctive interventions as electrical stimulation, hydrotherapy, taping, trans-cranial direct current stimulation, and virtual reality which are still under research to prove their effectiveness (Iona Novak et al., 2020).

The most common applied PT approaches for CP rehabilitation in Palestine are Bobath/NDT, functional/task-specific training or functional approach, conductive education (CE), and conventional approaches as stretching and strengthening interventions. Some physiotherapists may apply mixed approaches according to the child's needs, as functional training with strengthening or stretching interventions. Also, there is little use for some of the concurrent interventions as tapping, hydrotherapy, hippotherapy, hyperbaric oxygen therapy, and treadmill gait training.

Bobath/NDT is an approach embedded into the context of normal developmental sequence to optimize function and development, which is applied by passive handling techniques that focus on the facilitation of sensorimotor components of muscle tone, reflexes, abnormal movement patterns, postural control, sensation, perception, and equilibrium responses (NSW Ministry of Health, 2018). Functional approach based on learning motor abilities which are selected according to the child priorities as sitting, gait and transfers training based

on motor function and activity performance. The activities of daily living (ADL), functional mobility skills, and community mobility are the main focus with considering the age, appropriate child or parents goal, repetitive practice, appropriate adaptations to the task or the environment, and outcomes evaluation using valid tools (NSW Ministry of Health, 2018; Susan B. O’Sullivan. Thomas J.Schmitz. George D. Fulk, 2014).

Stretch interventions are used to manage motor impairments to maintain or increase the range of motion of a specific joint. Stretch can be applied through using orthotic devices or a specific positioning with manual stretch for soft tissue elongation (NSW Ministry of Health, 2018). Strengthening and resistance training in particular for upper and lower limb which depends on muscle activation techniques by repetitive exercises & sufficient rest between exercises for recovery, also aim to increase the resistance. In clinical rehabilitation programs, it’s possible to combine other activity-based programs such as treadmill training or cycling with strengthening exercise at other aspects of function such as endurance or coordination (Molenaers et al., 2012; NSW Ministry of Health, 2018).

In the literature, the used techniques in CP rehabilitation can be generally classified to approaches with or without using equipment (Balçı, 2016; Çankaya & Seyhan, 2016; Molenaers et al., 2012):

➤ **Bobath concept :**

which is also known as neurodevelopmental treatment (NDT), the approach based the observations of how abnormal tone interfered with the child’s ability to develop functional activity. The therapists use specialized handling techniques that improve the quality of tone and movement facilitation to perform daily life tasks. Also, active participation of the child is emphasized throughout treatment with the specific aim and controlling the activity. This approach provides observation, analyzing a child’s performance and finding the child

potentials. Despite the widespread use of NDT, the evidence still reports conflicting or inconsistent findings. So, more accurate assessment tools are important for measuring the effectiveness of NDT in cerebral palsy (CP) rehabilitation (Balçı, 2016; Çankaya & Seyhan, 2016).

➤ **Goal attainment therapy**

This therapy aims to facilitate the child's participation in everyday life situations. The goals for therapy is based on the child's likings and the family's preferences, the society and environment in which the family lives, and the child's degree of disability. Today the child is given the possibility to be more of an active problem solver (instead of, as previously, a passive recipient of treatment) in the context of the day-to-day environment. Thus, it is important to integrate principles of motor learning in the treatment concept and adapt the principles to the prerequisites of each specific child. As CP is a very heterogeneous disorder, large differences exist between the children (Balçı, 2016; Çankaya & Seyhan, 2016).

The set goals should be specific, measurable, attainable, relevant, and timed (SMART). Functional training and practice of functional tasks are important parts of the rehabilitation management in CP. In literature, the goal-directed therapy in real environment showed more efficacy than approaches focusing on impairments in quality of movement and muscle performance. Effective listening and communication are strategies and fundamental components of successful interventions to establish a common goal. Treatment success was defined by Goal Attainment Scaling (GAS) which is "an individualized criterion-referenced measurement that quantifies the achievement of treatment or intervention goals for different kinds of treatment issues. Five outcome levels were identified, including expected level of performance (assigned 0), two levels of less favorable (assigned -2 or -1), and two levels of more favorable outcomes (assigned +1 or +2)" (Balçı, 2016).

➤ **Strength training programs**

In CP, muscle weakness is a primary impairment, and there is strong evidence showing that children with CP are significantly weaker than children with typical development. In the past, strength training was thought to increase muscles stiffness and result in an increase in spasticity. However, muscle strength training studies have shown that training may strengthen muscles without adverse effects in children and adolescents with CP. There is inadequate evidence to show changes in activity or participating in everyday life. However, there are strong indications that strength training programs play an important role in the rehabilitation of individuals with CP (Balçı, 2016; Çankaya & Seyhan, 2016).

The relationship between strength and function is a considerable relevance to clinical practice. Task-oriented weight-bearing strength training for children with CP was effective in increasing strength and functional performance. The functional motor performance improve with developing strength, if strengthening exercises includes more functional closed kinetic chain exercises. In these exercises, the subject is weight bearing through the feet, and the body mass is raised and lowered over the feet by concentric and eccentric action of lower limb muscles, such as sit-to-stand and walking (Balçı, 2016; Çankaya & Seyhan, 2016).

➤ **Treadmill gait training**

Over-ground gait training with assistive devices or parallel bars are typical forms of gait training. The treadmill has recently gained more attention as an instrument for evaluation and training with several advantages over conventional methods. The evidence support that treadmill training helps to improve balance and lower limbs functions, with overcome of some limitations as space constraints, reduce physical demands. Forward walking, backward walking, and partial weight bearing walking on treadmill were included in several

studies in the evidence which indicated to their benefits and improvement on gross motor function, in functional performance and greater independence in children with CP. (Balci, 2016)

➤ **Family-centered models**

A family-centered approach is based on the work with families with emphasis on the family priorities and choices, child and family strengths rather than deficits, moreover, family-therapist partnerships and good communication. In this approach, effective intervention is based on collaboration and promote the family's (including the child) self-determination, decision-making capabilities, and self-efficacy. The evidence considered this approach as one from the best approaches in the field of early intervention and pediatric rehabilitation. Successful family-therapist collaboration is characterized by good listening, sharing and learn with families what the best for the child. (Balci, 2016)

Family education and home-based treatment (family involvement)

This point indicated to the family as the center of the treatment with therapist effective collaboration. Family education plays a big role in improving outcomes for children and families as well as the family greater satisfaction emphasize the adherence to all therapeutic treatments. In addition that, the family support leading to effective application of home programs (Çankaya & Seyhan, 2016).

The home program is based on many considerations as; Parents & therapists collaboration, children and families involvement in the treatment goals and settings, evidence-based applications and changing them according to home setting, children preferences, and family life. Also it is very important to participate the family and children in the evaluation of children outcomes (Balci, 2016; Çankaya & Seyhan, 2016).

Factors affecting prognosis in CP children:

The management of factors that affect long-term outcome is critical to assist health care professionals in selecting appropriate treatment pathways and to develop, target, and evaluate interventions (Linsell, Malouf, Morris, Kurinczuk, & Marlow, 2016). The age of CP children and the severity level had effects on the prognosis for example; a two year-old child with mild CP has a 99% chance of living to the age of 20, compared with a child who has a severe level of CP (McIntyre et al., 2013). Additionally, associated problems with cerebral palsy include mental retardation, feeding difficulties, seizures, vision impairment, and hearing impairment may severely affect life span and quality of life (Katz, 2003).

In addition to these problems, it may be necessary to consider other accompanying problems such as sleep quality, global mental functions, psychosocial functions, communication skills, voluntary motion control, eating and drinking function, sensorial, and behavioral problems, and pain (Akbaş, 2016). Pain is one of the frequently observed problems in advanced ages in CP children due to several factors as contractures, hip dislocation, equines deformity, constipation, used adaptive equipment and orthosis or as a result of physiotherapy, serial casting, and surgical interventions (Akbaş, 2016; Bier et al., 2017).

2.2 Similar studies

In literature, several related studies were conducted focused on the critical need to assess the effectiveness of PT rehabilitation approaches on gross motor development and functional abilities in CP children (Brit Sorsdahl et al., 2019; Duran et al., 2019; Pavão et al., 2016) including different basic physiotherapy techniques (Franki et al., 2012; Ryan, Cassidy, Noorduyn, & O'Connell, 2017). Evidence suggests that there is a critical need of developing more advanced therapeutic approaches (Das & Ganesh, 2019; Mintaze Kerem Günel, Duygu Türker, n.d.; Molenaers et al., 2012; Mutlu et al., 2010; NSW Ministry of Health, 2018)

depending on theories such as; motor learning(Dumas, 2019), neuroplasticity, and motor control (Johnston, 2009; Kleim & Jones, 2008; Iona Novak, 2014; Power et al., 2011). The main concept of these theories considers the gross motor development evolves with the neuromaturation of the central nervous system (CNS) (Molenaers et al., 2012), besides, the recent therapeutic approaches are based on the active more than the passive view of a motor learning concept. The essence of these theories emphasize the effect of neuroplasticity induced approaches as task/functional oriented approaches that facilitate voluntary motor control, gross motor development, and functionality (Ketelaar, Vermeer, Hart, Beek, & Helders, 2001; Iona Novak, 2014; Power et al., 2011).

In the last decade, interest in functional task-oriented interventions for children with CP is rapidly increasing from the interventions based on the body structures and functions toward activity and participation-based approaches (Mattern-Baxter, n.d.; Iona Novak et al., 2013). The knowledge in the current evidence of CP field leading the professionals, researcher, and beneficiaries to change thinking in CP as a non-treatable condition toward the recent concepts of neurological rehabilitation by advancing clinical research and developing approaches based on the activity, participation, real-life tasks, and learning environment, entertainment and playing, the aquatic environment and hippo-therapy(Das & Ganesh, 2019; Iona Novak, 2014; NSW Ministry of Health, 2018).

Some researchers ensured the most common approaches and their positive effect on the gross motor development and other outcomes as the importance of the goal-oriented approach in the success of rehabilitation process (Gunel, 2009). Also, a systematic review (Molenaers et al., 2012) about the effectiveness of common approaches in physiotherapy of CP children, a number of 52 studies were included with basic approaches (NDT, conductive education, functional training, and goal-oriented therapy) as well as additional approaches (aquatic therapy and hippo-therapy). The findings of the review emphasized that NDT and functional

training were effective on gross motor function, also goal-oriented therapy and functional training were effective on the attainment of functional goals and participation (level II evidence). NDT was effective on all levels of the ICF (level IV evidence).

Another systematic review (Franki et al., 2012) contributed to developing clinical guidelines for evidence-based PT planning for CP children. The selected 83 studies were divided into categories (stretching, massage, strengthening, electrical stimulation, weight-bearing, balance, and treadmill, endurance training). The review showed the effectiveness of body function and structure interventions at the same level without significant outcome on the activity level and vice versa (strength training mainly demonstrated level II evidence for improving gait and gross motor function). There was limited evidence for specific information on intensity, duration, and frequency of training.

Additional review (Molenaers et al., 2012) appraised the applied approaches in 58 studies used the neurodevelopmental treatment (NDT), CE, Vojta therapy, sensory integration, functional training, and goal-oriented therapy, hydrotherapy, and hippo-therapy. The review presented that goal-oriented therapy and functional training were effective in the attainment of functional goals and participation as well as NDT was effective on all levels of the ICF.

Novak et.al (I Novak et al., 2013) conducted a review of systematic reviews (2009-2012) to describe the best available intervention evidence for children with cerebral palsy (CP). The selected review evaluated 64 discrete interventions in 131 included reviews with 25% CP population. Evidence supports 15 green light interventions (CIMT, bimanual training, context-focused therapy, and goal-directed/functional training are effective interventions). All yellow light interventions should be accompanied by a sensitive outcome measure to monitor progress and red light interventions should be discontinued. All effective interventions worked at only one level of the ICF.

Besides that, the literature provided other appraisal reviews and clinical guidelines on the effectiveness of various therapeutic approaches to manage CP children, such as; strengthening interventions, NDT, and additional ICF domains-focused interventions but with variety in the level of evidence (Morgan et al., 2016; NSW Ministry of Health, 2018; Porfirio, Riera, Martimbianco, & Zanon, 2015). So that, the present conflicting evidence need further research using well-conducted clinical trials to guide the professionals and beneficiaries toward the best evidence (Das & Ganesh, 2019; Lungu et al., 2016). Also the rehabilitation status needs more organized policies and systematic evaluations with updating the evidence base to optimize the clinical practice in the CP field (Gannotti et al., 2017).

In 2020, a systematic review (Alhumaidan, Tawhari, & Sulaiman, n.d.) has addressed the effects of intensive exercise-based therapy on improving gross motor function in children with CP. The Selected 10 studies between 2015 and 2019 were RCTs and experimental studies. The review found that the strengthening exercises in combination with manual resistance, functional training, quadriceps build-up training, standing activity, and walking training activity have significant effects on gross motor function measure, trunk stability, standing time, and walking distance in children with CP.

Finally, a recent article was published in 2020 (Iona Novak et al., 2020), presented a systematic overview of the current state of available evidence (2012–2019) interventions for managing cerebral palsy by appraising the conducted systematic reviews using GRADE and the Evidence Alert Traffic Light System. The main relevant findings described the best effective active motor interventions (bimanual training, CIMT, fitness training, goal-directed training, hippo-therapy, home programs, mobility training, strength training, task-specific training, treadmill training) on the child movement, function, and task performance in comparing with less effective passive motor interventions as hyperbaric oxygen and NDT.

In the last six years, many additional interventions have been researched with some of them have been emerged to be effective when combined with task-specific training as; goal-directed training for improving gross motor skills; hippo-therapy for increasing symmetry, and strength training for improving muscle strength. The authors provided guidance for health care professionals about what works and what does not and highlighted areas for more research (Iona Novak et al., 2020).

2.3 Summary

The compelling evidence for a large proportion of the interventions in use with the lack of standard care for people with CP emphasizes the critical need for more research which will increase the families and professionals confidence in the clinical efficacy of these used interventions, and so the evidence-based about CP interventions will advance and better inform the decision-making and management for CP children.

Chapter three: Methods and procedures

3.1 Study design

3.2 Study settings

3.3 Study sample

3.4 Data collection

3.5 Statistical analysis

3.6 Ethical considerations

Chapter three: Methods and procedures

3.1 Study design

A Multicenter prospective observational study with pre and post-tests was performed. Several rehabilitation settings which are convenient participated in the study, and the population of the study included all CP children with physical disorders in these rehabilitation settings. This study design enabled the researcher to examine the efficacy of the applied therapeutic approaches on the CP children outcomes through the study period. Pre and post measurements led to quantify the changes in the children outcomes.

3.2 Study settings

The study was conducted in Palestine (Jenin and Nablus) between February 2020 to April 2021. The included pediatric rehabilitation settings were five centers; Farah rehabilitation center which is intermediate level center in Nablus followed to Palestinian medical relief society including multidisciplinary team (PT, OT, speech therapy, assistive devices technician, neurologist and rehabilitation physician), Arab American University/ physiotherapy and hydrotherapy center in Jenin including PT, Spine Academy for pediatric rehabilitation in Jenin has a multidisciplinary team, and two private physiotherapy centers in Nablus which are Alayadi Albaidaa' and Adla Shalhoub physiotherapy centers which both are including PT. The selection of centers was based on the convenient sampling method (the rehabilitation centers which accepted to participate and they are targeting the pediatric population received a regular frequency of sessions).

3.3 Study sample

3.3.1 Sampling method

The researcher selected the sample based on the convenient sampling method. The researcher scanned the rehabilitation centers working with children having pediatric

conditions in Palestine. These centers were selected from the intermediate level centers, private centers, NGOs and the other centers that targeted the CP children, and having physical therapy as a part of their rehabilitation programs. The sample of children included all the eligible CP children with the following inclusion and exclusion criteria.

3.3.2 Sample size

After reviewing the numbers of convenient CP children, and scanning their case files in the 5 selected settings, eighty CP children were recruited to participate in the current study according to the inclusion and exclusion criteria for the study sample. Total of Seventy one CP children completed the entire study. Nine of children drop out due to; irregular commitment to the rehabilitation program and medical problems.

3.3.3 Inclusion criteria

Seventy one CP children were included in the study using the following inclusion criteria:

- Children aged between 1 and 14 years at the time of study.
- Children with diagnosis of CP with all GMFCS levels (all five levels).
- Children who have physical disorders and gross motor delay enrolling in pediatric rehabilitation care with receiving physiotherapy at least with regular frequency during the study.

3.3.4 Exclusion criteria

- Children with severe cognitive disorders, uncontrolled epileptic children, autistic behaviors.
- Children with medical changes during the study that may affect their motor function or their commitment to regular sessions.

3.4 Data collection

3.4.1 Tools of data collection

The data collection tools during the study included the following:

Data collection questionnaires

- A structured questionnaire for clinical settings which contained the general data about the setting as setting's name, address, target, rehabilitation services evaluation criteria and therapeutic approaches. Appendix I
- The pediatric assessment form to collect the demographic data and clinical characteristics for each child including age, address, gender, weight, height, educational level and the participant's history. Besides the other related information and variables related to CP children. Appendix II

Also, through the current study, standardized and valid diagnostic tool and outcome measures have been used by the researcher based on the ICF levels and on the evidence based practice to evaluate and follow up the CP child motor skills in the selected settings as follows:-

- **The Gross Motor Function Classification System Expanded and Revised (GMFCS E&R)** (Gorter et al., 2009; Reid et al., 2011; Robert Palisano, Peter Rosenbaum, Doreen Bartlett, 2007) is widely applied to describe the gross motor function of children with CP. The GMFCS includes five-level descriptions (Level I represents the best gross motor abilities and Level V the least function) depending on the child age, the distinctions between levels based on the severity of functional disability and the need for mobility devices with the actual performance(quality of movements). GMFCS level will presented for each children. Appendix III

- **Gross Motor Function Measure (GMFM)** (Harvey, 2017) is a reliable, valid and responsive measure of gross motor function for children with cerebral palsy. Shortened versions of GMFM-66 have been developed more recently. The GMFM-66 Items Sets (IS) use a scoring algorithm, whereby a number of decision items guide the therapist toward a predetermined set of items relevant to a child functioning at that level, and the child is then tested on that 'item set'. Appendix IV
- **Gross Motor Ability Estimator (GMAE-2) Scoring Software for the GMFM** (Keawutan, 2017; D. J. Russell, Rosenbaum, Wright, & Avery, 2002) was used to document the scoring on electronic software for professional use. GMAE was used to compute GMFM-66-IS scores, with higher values indicating less impairment. Pretest scores and post test scores for GMFM-IS were computed by GMAE-2 through the study.
- **The Gillette Functional Assessment Questionnaire scale (FAQ)** (Himuro et al., 2017) assesses the level of a child's functional mobility on an ordinal scale by describing various levels of mobility differing in environment, or obstacles. The scale ranges from 1 (the child cannot take any steps at all) to 10 (the child walks, runs, and climbs on level and uneven surface without difficulty) (Ammann-Reiffer et al., 2019). It is also a parent-report or self-report measure, also the FAQ is easy to use and require no specific assessor training. Pre and post scores for FAQ scale have been obtained from the children parents. Appendix V

3.4.2 Study procedures

The study began with the first phase; selection of the targeted settings, then selection of sample and the applied approaches. The gross motor function and functional ability of the CP children have been measured pre and post 3 months intervention. The intervention during

the study period included the PT approaches which were used in the children's rehabilitation. The study protocol was approved institutional ethics committee at Al-Quds University with approval number (107/REC/2020) before starting the study.

- **The first phase**

The study began with scanning of the settings that targeted the CP children, followed by distribution of structured questionnaires to address the applied therapeutic approaches in the clinical settings. After that, the recruitment procedure of the participants have been arranged by connection with the included settings by phone calls and initial visits. Then the researcher with assistance of physiotherapists performed the procedures of sample selection, and the applied approaches identification. The applied therapeutic approaches have been identified and discussed by the researcher and physiotherapists especially during the study period.

- **The second phase.**

In the second phase, the researcher continued to take the children profiles including the personal data, history, clinical characteristics, types of CP, frequency of sessions per week, applied PT approach and other relevant data. Pretests assessing the children's gross motor function and functional abilities using GMFCS, GMFM-66-IS, and Gillette FAQ. After that, there was a 3 months of intervention period that the children have been followed by their physiotherapists (The frequency of regular PT sessions per week was documented for the children, so on the total number of sessions can be calculated within the study period. Also the participated children have to commit in their rehabilitation program during the study to reassess them by outcome measures post intervention). Also, the participated children have to commit in their rehabilitation program during the study to reassess them by outcome measures post intervention.

The treatment approach was identified for every child from the beginning of the study by his or her physiotherapist according to ICF levels and based on the literature, therapeutic approaches have different names, so that the naming of therapeutic approaches in the current study based on the ICF model (Das & Ganesh, 2019), and evidence-based clinical guideline for CP management (NSW Ministry of Health, 2018). There are one to two physiotherapists in each center, who followed the CP children, during the study period, we ensured that the same therapist manage the participated child along the duration with the same selected approach which was applied in the rehabilitation program).

In the complementary stage of the study; all included children were reassessed by the researcher using the same outcome measures (GMFCS, GMFM-IS, and Gillette FAQ) post intervention to explore the changing happened in children' gross motor abilities after the study observation period. The researcher assessed all children pre and post intervention without any manipulation in the treatment approaches within the study period. The children were managed by their physiotherapist, so that, the assessor remained blinded concerning the treatments which participants were receiving, also the assessor has no prior interest toward specific approach over the other, this may help minimizing the researcher or assessor bias.

GMAE-2 software was used to document the GMFM scoring pretest and posttest were presented through the study.

- **Children were clustered based on the applied approaches.**

The applied therapeutic approaches have been used as a guidance to the researcher to divide the included children. The researcher identified the applied interventions for each child by asking the PT therapists, and then divided the sample according to the applied approaches. The rehabilitation settings managed the CP children using various approaches focusing on

three ICF levels; child or impairment focused (body function and structure) level, functional task focused level (activity level), learning and environmental level (participation level) (Das & Ganesh, 2019). The researcher explored these approaches and their effectiveness which have been evaluated through the current study.

The applied rehabilitation approaches were identified by asking the physiotherapists via the center's questionnaire (depending on the ICF levels) then the naming of the approaches depending on ICF levels and clinical guidance in literature. The approaches were presented in the centers included regular therapeutic exercises (regular exercises as strengthening and stretching exercises), Bobath technique, functional approach, and some of physiotherapists in selected settings mix more than one of these approaches in the intervention program according to the children need. The study sample was clustered into two groups; group of children were followed by regular training based on functional approach, and the other group were followed by mix more than one approach (regular stretching and strengthening exercises, functional training, and Bobath technique).

3.5 Statistical analysis

The data analysis was performed using the Statistical Package for Social Sciences (SPSS-software version23). Descriptive statistics were used to characterize the centers and sample demographic data in terms of age, sex, city (frequency, mean & SD, median, etc.), and clinical characteristics (history, associated problems, and diagnosis.etc).

The included children from the selected rehabilitation settings were assessed by GMFM-66-IS and Gillette FAQ outcome measures to measure the change in gross motor function and functional mobility after 3 months. The mean values were compared within the study groups (GMFM and FAQ) pre and post intervention to evaluate the change in gross motor function and functional mobility by Paired sample t-test, the effect size (Cohen's d) was calculated

for both groups to evaluate the effectiveness of the applied approaches pre and post intervention. As well as the researcher compared the results of mean values between groups post intervention by independent sample t- test and Mann-Whitney test. The spearman correlation tests were used to test the associations between; the change in the GMFM and Gillette FAQ values, also between outcomes changes and total number of sessions, and between frequency of sessions. A p value of < 0.05 was set to be significant.

3.6 Ethical considerations

The institutional ethical approval was obtained from the Research ethics committee (REC) at Al-Quds University which is in accordance with declaration of Helsinki before the study commencement (Appendix VI). All participants (parents of children) provided a written informed consent prior to participation in the study as shown in (Appendix VII). Also informed consent was received from the involved rehabilitation settings. The participants had the right to participate or reject or withdraw from the study at any time without restrictions.

Chapter Four: Results presentation, Analysis & Discussion

4.1 Results presentation and analysis

4.2 Results discussion

4.3 Study limitations

Chapter Four: Results presentation, Analysis & Discussion

4.1 Results presentation and analysis

The demographic data related to the included rehabilitation settings were illustrated in table (4.1), there are 5 clinical settings from cities of Nablus (n=3) and Jenin (n=2) participated in the entire study period. Each setting provided data related to: number of children, applied physiotherapy approaches (functional approach, conventional approaches, Bobath technique).

Additionally, as illustrated in table (4.1), the sample included two groups based on the therapeutic approaches; group 1 (40 children) were enrolled into the functional approach, and group 2 (31 children) were enrolled into mix approaches (functional approach, Bobath technique, and regular therapeutic exercises (stretching and strengthening exercises)). The homogeneity of data was tested with shapiro-wilk test which indicated to the data were not normally distributed.

The applied assessment and follow up criteria related to each center were shown in the current study, the assessment tools included general assessment forms and standardized tool which was GMFM, also the follow up tools included; non-standardized re-evaluations, recording videos, and GMFM as a follow up outcome measure. (Table 4.1)

Table 4.1: Statistical results related to rehabilitation settings.

Setting name	Setting type	Study sample n (%)	Distribution of settings	Assessment	Therapeutic approach	Follow up
Farah center for rehabilitation	NGOs	13 (18.3)	Nablus	Non Standardized, General assessment form	Functional approach	Non-standardized motor abilities re-evaluation
AAUP physiotherapy center	Therapeutic and educational center	16 (22.5)	Jenin	Standardized, GMFM	Functional approach	Standardized outcome measure GMFM
Alayadi Albaidaa' center	Private center	17 (23.9)	Nablus	Non Standardized General assessment form	Mix approaches	Non-standardized re-evaluation & recording videos
Adla Shalhoub Center	Private center	13 (18.3)	Nablus	Non Standardized General assessment form	Mix approaches	Non-standardized, recording videos.
Spine academy	Private center	12 (16.9)	Jenin	Non Standardized General assessment form	Mix approaches	Non-standardized re-evaluation with progress
	Mean SD	Min.	Max.			
Sessions frequency per week	2.27(0.88)	1	5			
Total number of sessions	27.21(10.53)	12	60			

NGOs: nongovernmental organizations, AAUP: Arab American University Palestine, SD: standard deviation, Min: minimum, Max: maximum

The figures (4.1) and (4.2) illustrated the percentages of these applied assessment and follow up tools, about 77.5% of children in the clinical settings used different general assessment forms (non-standardized), and 22.5% of children used a standardized assessment (GMFM).

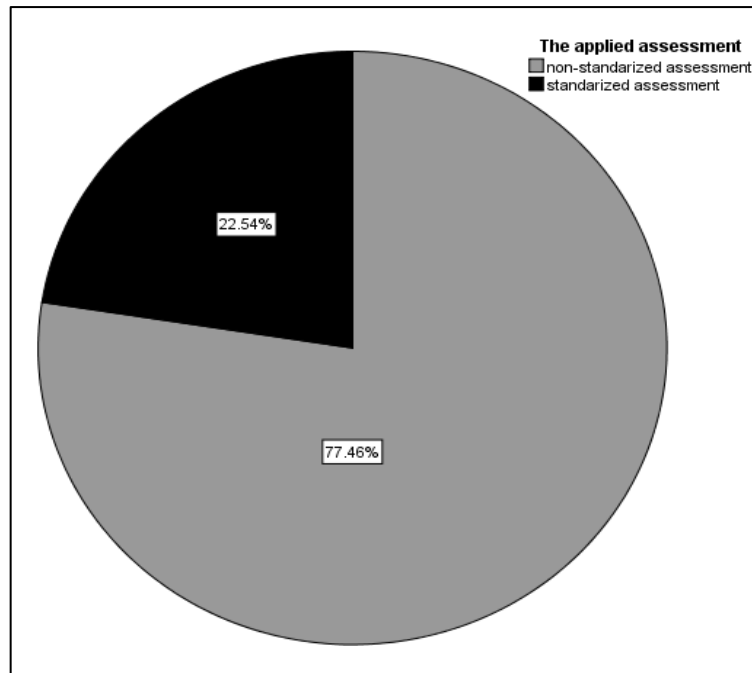


Figure 4.1: The percentages of applied assessment criteria

Also, different follow up criteria (77.5% of children were assessed by non-standardized re-evaluation form and recording follow up videos, 22.5% of children were assessed by standardized outcome measure GMFM as shown in the figure (4.2).

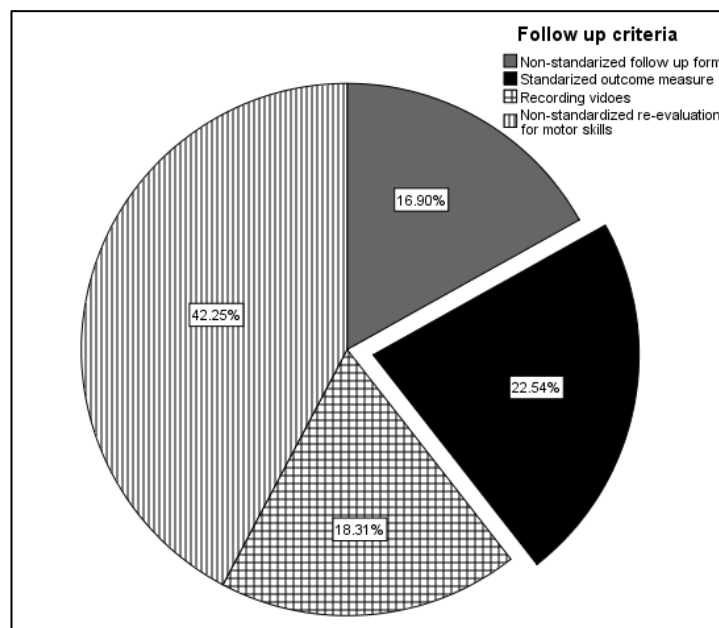


Figure 4.2: The percentages of applied follow up criteria

The results in table (4.2) show the CP children demographic as; gender, address, educational level, mean age with standard deviation. A total of 71 children (42 male and 29 female) with the mean age (3.95 ± 2.85) years completed the entire duration of study for 3 months.

Table 4.2: Demographic data related to the study sample.

Demographic data	N	Percentage		
Gender	71	100.0		
M	42	59.2		
F	29	40.8		
City				
Jenin	28	39.4		
Nablus	40	56.3		
Other areas	3	4.2		
Educational level				
under school age	44	62.0		
preschool age	9	12.7		
school age	10	14.1		
out of school	8	11.3		
	Mean (SD)	Min.	Max.	median
Age (years)	3.94 (2.85)	1.00	13.58	3.25
Rehabilitation period	2.74 (2.55)	0.33	10.00	2.00

N: number of participants, SD: standard deviation, M: male, F: female, Min: minimum, Max: maximum, M: male, F: female.

Table (4.3) shows the clinical characteristics related to the child history and CP diagnosis according to motor type (muscle tone) and affected parts distribution. The majority of CP children in the study sample were classified by motor impairments (spastic 67.6%, flaccid 19.7%, ataxic 5.6%, athetoid 7%), and by distribution (quadriplegia 71.8%, diplegic 11.3%, hemiplegic 14.1%, others 2.8%). Also, the results indicated that (50.3%) of the children using assistive devices as orthoses and mobility devices. As well as about (80.3%) children had associated problems as vision, speech impairments and learning difficulties. Also, the children focused levels in the applied intervention through the study were determined by the children's therapists according to ICF domains which were presented in (Table 4.3).

Table 4.3: Clinical characteristics related to CP children.

Clinical characteristics		N	Percentage
Past history	Prenatal causes	19	26.8
	Perinatal causes	16	22.5
	Postnatal causes	21	29.6
	genetics	6	8.5
	unknown	9	12.7
Present history	Physical dysfunction	71	100.0
	Other associated problems	57	80.3
	Cognitive and learning problems	18	25.4
	Epilepsy(controlled)	10	14.1
	Using Medication	16	22.5
	Surgeries	14	19.7
	Using assistive devices	35	50.3
	Without assistive devices	36	50.7
Diagnosis	Topographical		
	Quadriplegia	51	71.8
	Diplegia	8	11.3
	Hemiplegia	10	14.1
	others	2	2.8
	Motor impairment		
	Spastic	48	67.6
	flaccid	14	19.7
	Ataxic	4	5.6
	Athetoid	5	7.0
ICF focused level	Activity focused level	57	80.3
	Impairment and activity focused level	14	19.7

ICF: international classification of functioning, disability and health

GMFCS levels and GMFM item sets which were collected from all children were illustrated in table (4.4), which indicated to the differences in child frequencies between and within the study groups. The frequencies of children with or without assistive and mobility devices pre and post intervention with ambulation and approaches were illustrated in table (4.4), at baseline about 32 children in the sample were ambulated, however, the number of ambulated child post-intervention increased to 45 children. Moreover, it's clear from the frequencies the positive efficacy of the applied PT approaches on minimizing the child need for the assistive or mobility devices for both ambulatory and non-ambulatory children.

Table 4.4: Frequencies and percentages related to gross motor function classification system and GMFM item sets.

Variables related to GMFCS and GMFM item sets	Functional group N(40)		Mix group N(31)		Total N(71)	
	Pre N(%)	Post N(%)	pre N(%)	Post N(%)	Pre N(%)	Post N(%)
GMFCS levels						
Level I Walks without restrictions, limitations in more advanced gross motor skills. (Represent the least limitation).	11(27.5)	12(30.0)	0(0)	1(3.2)	11(15.5)	13(18.3)
Level II Walks without restrictions, limitations walking outdoors and in the community	7(17.5)	9(22.5)	4(12.9)	8(25.8)	11(15.5)	17(23.9)
Level III Walks with assistive mobility devices, limitations walking outdoors and in community	5(12.5)	8(20.0)	5(16.1)	9(29.0)	10(14.1)	17(23.9)
Level IV Self-mobility with limitations, children are transported using power mobility outdoors and in community	6(15.0)	4(10.0)	11(35.5)	6(19.4)	17(23.9)	10(14.1)
Level V Self-mobility is severely limited, even with use of assistive technology. (Represent the most limitation).	11(27.5)	7(17.5)	11(35.5)	7(22.6)	22(31.0)	14(19.7)
GMFM item sets						
Item set 1 (15 items) from lying & rolling, sitting, crawling & kneeling	12(30.0)	7(17.5)	12(38.7)	6(19.4)	24(33.8)	13(18.3)
Item set 2 (29 items) from lying & rolling, sitting, crawling & kneeling, standing and walking, running & jumping.	7 (17.5)	6(15.0)	12(38.7)	10(32.3)	19(26.8)	16(22.5)
Item set 3 (39 items) from sitting, crawling & kneeling, standing, walking, running & jumping.	8(20.0)	11(27.5)	7(22.6)	14(45.2)	15(21.1)	25(35.3)
Item set 4 (22 items) from sitting, standing, walking, running & jumping.	13(32.5)	16(40.0)	0(0)	1(3.2)	13(18.3)	17(23.9)
GMFCS (I-III)						
Ambulatory child	23(57.5)	27(67.5)	9(29.0)	18(58.1)	32(45.1)	45(63.4)
With assistive devices	9	12	3	6	12	18
Without assistive devices	14	15	6	12	20	27
GMFCS (IV - V)						
Non-ambulatory child	17(42.5)	13(32.5)	22(71.0)	13(41.9)	39(54.9)	26(36.6)
With assistive devices	12	9	11	8	23	17
without assistive devices	5	4	11	5	16	9

GMFCS: gross motor function classification system, GMFM: gross motor function measure.

There were differences between the numbers of children at GMFCS levels at all, also these differences were showed with grouping the children to ambulatory (level I-III) and non-ambulatory (level IV-V) at baseline between groups as shown in figure (4.3).

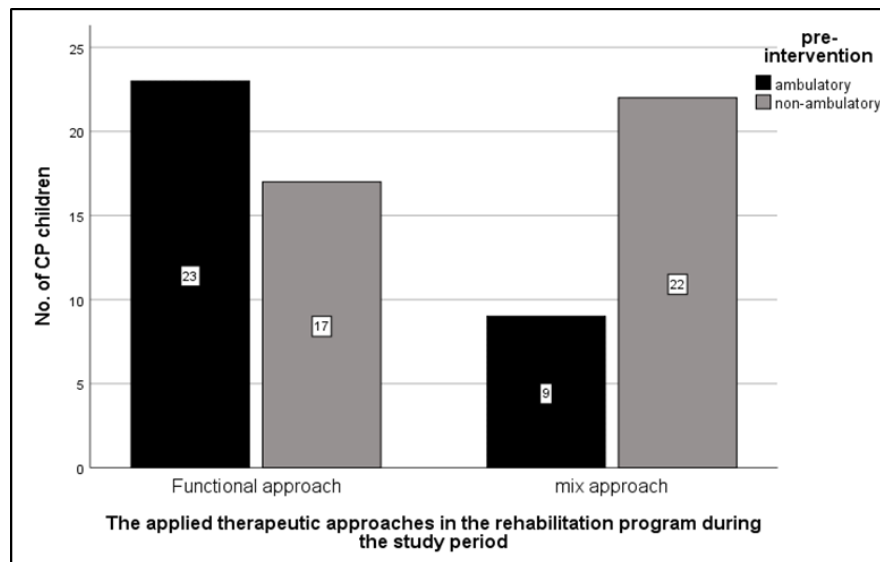


Figure 4.3: Frequencies of ambulatory and non-ambulatory child pre-intervention between groups.

As well as the figure (4.4) presented the differences between the numbers of children at GMFCS levels at all with grouping the children to ambulatory (level I-III) and non-ambulatory (level IV-V) post intervention between groups.

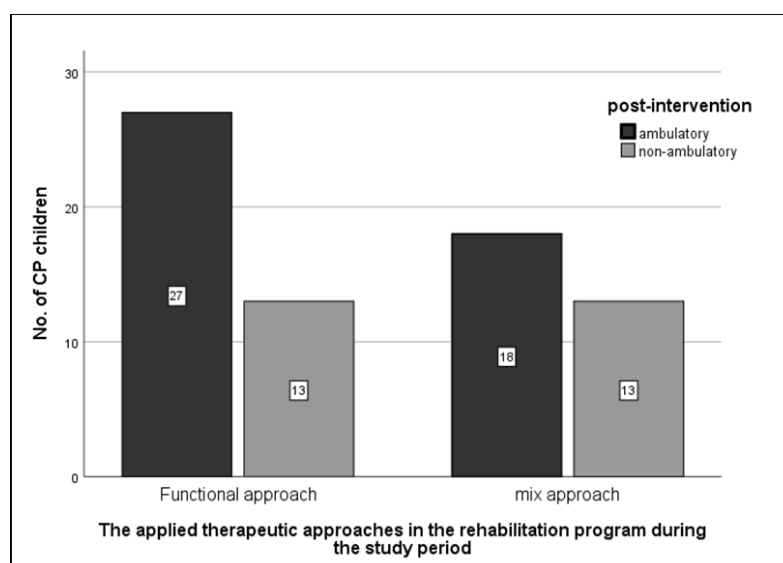


Figure 4.4: Frequencies of ambulatory and non-ambulatory child post-intervention between groups.

The results in table (4.5) presented the differences in frequencies for Gillette FAQ between groups pre and post intervention. The number of children with better functional mobility increased in both groups after the study period. These children frequencies also indicated to the improvements in the children motor abilities at home and environment.

Table 4.5: Descriptive statistics related to Gillette FAQ.

FAQ statements	Functional group N=40		Mix approaches group N=31		Total N=71	
	Pre intervention N (%)	Post Intervention N (%)	Pre intervention N (%)	Post intervention N (%)	Pre	Post
1. Cannot take any steps at all	12(30.0)	3(7.5)	13(41.9)	6(19.4)	25(71.9)	9(26.9)
2. Can do some stepping on his or her on with help	13(32.5)	6(15.0)	9(29.0)	6(19.4)	22(61.5)	12(34.4)
3. Walks for exercise in therapy or less than typical household distances	-	6(15.0)	4(12.9)	7(22.9)	4(12.9)	13(37.9)
4. Walks for household distances	-	5(12.5)	1(3.2)	5(16.1)	1(3.2)	10(28.6)
5. Walks routinely at home or school, indoor walking only	-	4(10.0)	4(12.9)	3(9.7)	4(12.9)	7(19.7)
6. Walks more than 15-50 feet outside the home but usually uses a wheelchair or stroller for community distances	-	-	-	-	-	-
7. Walks outside for community distance, but only on level surfaces	4(10.0)	-	-	2(6.5)	4(10.0)	2(6.5)
8. Walks outside for community distances and able to get round on curbs and uneven terrain but require minimal assistance for safety	3(7.5)	5(12.5)	-	2(6.5)	3(7.5)	7(19)
9. Walks outside and easily gets around on level ground, curbs, and uneven terrain but has difficulty with running, climbing stairs and keeping up with peers	6(15.0)	4(10.0)	-	-	6(15.0)	4(10.0)
10. Walks, runs, and climbs on level and uneven terrain and does stairs without difficulty or assistance. Able to keep up with peers	2(5.0)	7(17.5)	-	-	2(5.0)	7(17.5)

FAQ: functional ability questionnaire, SD: standard deviation.

The following table (4.6) indicated to the differences in GMFM and Gillette FAQ mean values according to the GMFCS levels. The findings showed the small mean differences in gross motor function measurements post intervention at level I and level V. The mean values for GMFCS I changed from 70.36 to 74.97, and in GMFCS V mean values change from 25.78 to 32.15. Level I, III, & IV didn't show significant changes. Also small changes were resulted with Gillette FAQ mean values at all levels. These findings demonstrated that the comparison between the mean values of measurements according to GMFCS levels within the study period was not statistically sensitive.

Table 4.6: The mean values for the study outcomes according to GMFCS levels

Pre	GMFM	Gillette FAQ	Post	GMFM	Gillette FAQ
GMFCS (N)	Mean(SD)	Mean(SD)	GMFCS(N)	Mean(SD)	Mean(SD)
GMFCS I (11)	70.36(5.72)	8.73(0.91)	GMFCS I (13)	74.97(8.13)	9.08(1.44)
GMFCS II (11)	56.01(9.81)	3.73(2.20)	GMFCS II (17)	55.38(6.64)	5.00(1.97)
GMFCS III (10)	47.88(5.03)	3.00(1.49)	GMFCS III (17)	46.13(5.54)	3.88(1.73)
GMFCS IV (17)	37.33(6.26)	1.82(0.95)	GMFCS IV (10)	36.90(7.93)	2.40(1.35)
GMFCS V (22)	25.78(12.59)	1.50(2.90)	GMFCS V (14)	32.15(15.38)	2.14(2.03)

GMFCS: gross motor function classification system, FAQ: functional ability questionnaire, SD: standard deviation.

Tables (4.7) and (4.8) indicated to the statistical results related to the mean differences, standard deviation (SD), minimum and maximum scores, Cohen's d calculations for clinical effect size, and p-value for the GMFM and FAQ scores pre and post-intervention for both groups. The results of functional group illustrated the significant difference in the mean values of GMFM scores between baseline and post intervention (mean difference: 5.19 ± 4.07 , Cohen's $d=0.27$) with p-value (0.000). Also the mean values for pre and post Gillette FAQ showed a significant difference (mean difference: 1.38 ± 1.25 , Cohen's $d=0.41$) with p-value (0.000).

Table 4.7: Mean differences related to GMFM-66-IS.

Therapeutic approaches Study groups (N)		GMFM-66-IS score			P- value Within group	Cohen's d effect size
		Age distribution	Pre intervention	Post intervention		
Functional approach focused group (40)	Mean(SD)	4.52(3.34)	49.35(19.37)	54.55(19.38)	0.000	0.27
	Min.		19.7	22.7		
	Max.		80.0	88.0		
Mix approaches focused group (31)	Mean(SD)	3.18(1.83)	35.38(12.71)	43.16(11.15)	0.000	0.65
	Min		13.5	23.4		
	Max		57.3	62.1		
P-value between groups		0.03	0.001	0.005		

GMFM-66-IS: gross motor function measure item set, SD: standard deviation, Min: minimum, Max: maximum

The results related to the mix approach group also indicated to significant differences in the mean values and effect size for GMFM (mean difference: 7.77 ± 0.98 , Cohen's d: 0.68) and for Gillette FAQ measurements (mean difference: 1.19 ± 5.39 , Cohen's d: 0.65) with p-value (0.000). These relevant results, especially the effect size calculations showed that the group were received the mix approaches were more significantly improved after the intervention period (3 months).

Table 4.8: Mean differences related to Gillette FAQ.

Therapeutic approaches Study groups (N)		Gillette FAQ score			P-value Within group	Cohen's d effect size
		Pre intervention	Post intervention			
Functional approach focused group (40)	Mean(SD)	4.10(3.46)	5.46(3.23)	0.000	0.41	
	Median	2.00	4.50			
	Min.	1.00	1.00			
	Max.	10.00	10.00			
Mix approaches focused group (31)	Mean	2.16(1.37)	3.35(2.04)	0.000	0.68	
	Median	2.00	3.00			
	Min	1.00	1.00			
	Max	5.00	9.00			
P-value between groups		0.07	0.006			

FAQ: functional assessment questionnaire, SD: standard deviation, Min: minimum, Max: maximum.

In comparing the GMFM and Gillette FAQ mean values between groups of the functional and mix approaches after intervention as presented in tables (4.7) and (4.8), the GMFM and FAQ measurements were demonstrated a significant differences between groups post intervention with $p\text{-value} = 0.005$ for GMFM mean values, and with small difference for Gillette FAQ mean values with $p\text{-value}=0.006$.

The correlations between the functional mobility outcome measures in the study were tested using the spearman correlation test, which indicated to that GMFM and Gillette FAQ measurements were positively correlated at the baseline with ($r=0.88$) and post intervention with ($r= 0.91$) with a $p\text{-value} (0.000)$ for both.

Figure (4.5) presented the scatterplot which illustrated the positive correlation between the measurements of the study functional mobility outcomes at baseline.

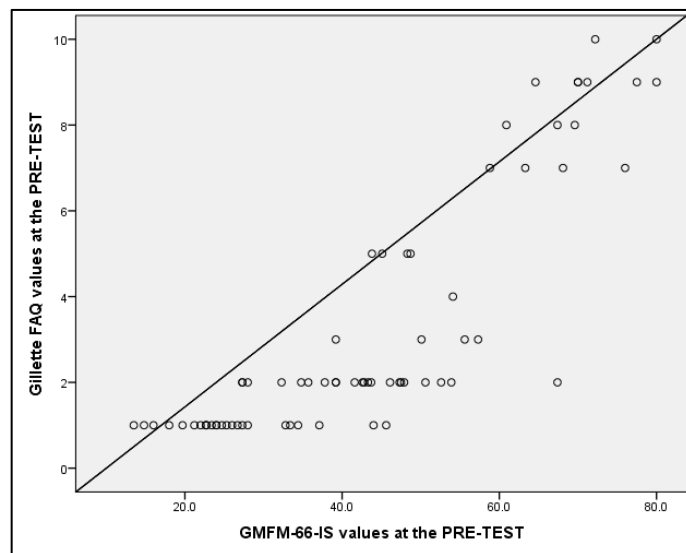


Figure 4.5: The scatterplot of spearman correlation between GMFM and Gillette FAQ values pre-intervention

Figure (4.6) presented the scatterplot which illustrated the positive correlation between the changes in measurements of the functional mobility outcomes after the 3 months duration.

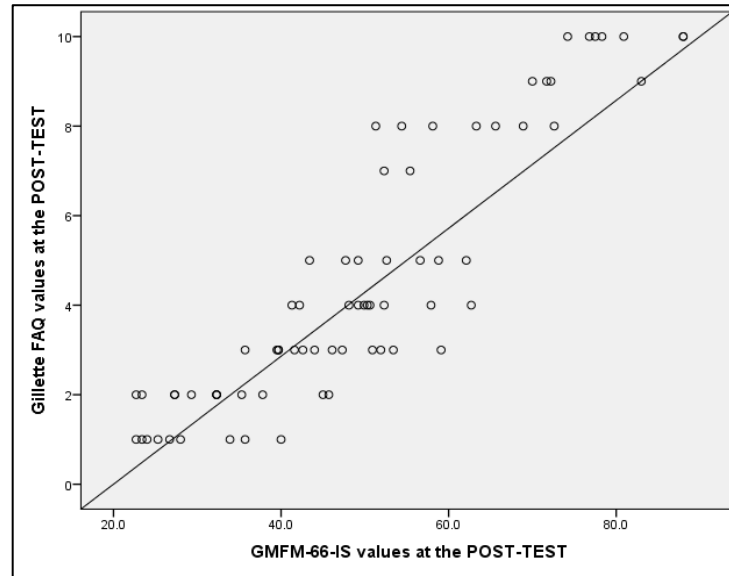


Figure 4.6: The scatterplot of spearman correlation between GMFM and Gillette FAQ values post intervention.

In addition, the correlations between the following factors; sessions frequency per week, total number of sessions, and the change in the GMFM and Gillette FAQ measurements were tested. There is a negative correlation between the session's frequency per week and the total number of sessions and the change in the GMFM and Gillette FAQ measurements which indicated to inverse associations which means when the children improved need less frequency and a smaller number of sessions. Table. (4.9) illustrated the correlation results.

Table 4.9: The correlations between the study variables and the number of treatment session

Correlation			Pre- GMFM-66- IS	Pre- Gillette FAQ	Post- GMFM-66- IS	Post- Gillette FAQ
Spearman's rho	Total No. of sessions.	Correlation	-0.24	-0.17	-0.17	- 0.18
		Sig.	0.05	0.17	0.15	0.13
	Sessions frequency per week	Correlation	-0.24	-0.17	-0.17	- 0.18
		Sig.	0.05	0.17	0.15	0.13

GMFM-66-IS: gross motor function measure-66-item sets, FAQ: functional ability questionnaire, Sig.: Significance

4.2 Results Discussion

Based on the researcher scanning of 5 rehabilitation settings with their physiotherapy interventions for CP in Palestine (Jenin and Nablus), there were several settings using different approaches in CP management, with limitation in using standardized criteria in the rehabilitation of CP children from the assessment to quantifying the intervention outcomes. The current study initially explored and presented these applied approaches including; regular exercises of stretching and strengthening intervention, Bobath technique, and functional training approach, in addition to mix these approaches. In general, there are various PT approaches used to manage the physical disorders in CP children through the rehabilitation process with different effectiveness (Molenaers et al., 2012), which is consistent with our findings in this study.

Additionally, the rapid expansion of the evidence in the applied approaches which leads to difficulty for therapists to keep updating and challenging for families to know the best for their child (Iona Novak, 2014). Some interventions are showing more success than others on the CP children outcomes (Alhumaidan et al., n.d.; Molenaers et al., 2012; Iona Novak et al., 2020; NSW Ministry of Health, 2018) as gross motor function and functional mobility (which are the outcomes for the current study) with significant differences between these interventions in many studies (I Novak et al., 2013; Iona Novak et al., 2020). Besides that, the progression from conventional interventions focusing on muscle strength and ROM alone, to treating functional elements of activity and participation, following (ICF) model (Mutlu et al., 2009; Iona Novak et al., 2013). All of these aspects either were in Palestine or worldwide emphasize the need to compare the effectiveness of applied approaches on the children motor function as in the current study.

Using valid and reliable outcome measures contribute to examine the efficacy of applied approaches on the CP children outcomes (Das & Ganesh, 2019; Ferre-Fernández et al., 2020;

Hornby et al., 2020). It is essential to address the quality level of therapeutic approaches and to enable the professionals and families to quantify the effect of these approaches and their outcomes on the CP child life (Das & Ganesh, 2019; Gannotti et al., 2017). Thus there are various outcome measures, besides the therapeutic approaches can be used to evaluate the therapy effectiveness and to detect any progress that happened and the resulting outcomes by the intervention (Jeglinsky & Autti-Rämö, 2021).

The findings of this study related to the clinical settings demonstrated limited use of standardized criteria in the assessment and reevaluation (valid and reliable outcome measures), mostly non-standardized methods were applied, about 77.5% of the CP enrolled children were previously evaluated by non-standardized methods as motor abilities re-evaluation and documenting progress in the children motor abilities by recording videos.

Worldwide, CP is the most prevalent type of children diagnosed with a physical disability (Gannotti et al., 2017; Group, 1993; Lungu et al., 2016) which emphasizes the strong link between CP and the rehabilitation process (Jeglinsky & Autti-Rämö, 2021). These findings correspond with our study results indicating that the most children are classified as quadriplegic and spastic CP (71.8% quadriplegia and 67.6% spastic) with different levels of the motor abilities limitation in the initial assessment.

Furthermore, the clinical characteristics demonstrated the importance of rehabilitation for child especially on the motor aspect due to all participants having physical problems varied from developmental delay in the initiated motor abilities to the more advanced motor functions as balance and coordination. In addition to the associated vision, speech and learning difficulties (about 80% of the sample) and other medical and health issues (surgeries and medications) that increase the challenge on the child, family, and the therapists. Our results showed that 50% of children were using assistive and mobility devices with different

types. The motor disorders of CP are often accompanied by these secondary complications; disturbances of sensation, perception, cognition, communication, and behavior, epilepsy, and secondary musculoskeletal problems (NSW Ministry of Health, 2018).

Based on this study results, there were variations in the effectiveness of applied approaches in the clinical settings on the CP children gross motor functions and functional mobility outcomes within a period of 3 months. GMFM and Gillette FAQ are both valid and reliable tools which were used by the researcher to meet the study objective, these outcome measures as GMFM enabled the researcher to explore the change and progress in the children motor abilities during a specific time (Ferre-Fernández et al., 2020), moreover self-reported FAQ enabled the family and therapists to participate in the child motor functions and performance assessment (Ammann-Reiffer et al., 2019).

Regarding ambulatory status results in this study, there were differences in children frequencies in ambulation pre and post intervention, at GMFCS levels (I-III) the number of ambulatory children was increased, while the number of non-ambulatory children decreased after intervention for both groups. Many studies emphasized that the change in the motor capacity lead to better functional mobility skills among CP children (Keawutan, Bell, Davies, & Boyd, 2014; Kwon et al., 2013; Madden & Bundy, 2019).

Based on the GMFM measurements, there was a significant difference between the mean values of GMFM scores within each group ($p < 0.001$) that indicate the progress in the gross motor function. Similarly, comparing the Gillette FAQ mean values resulted significant difference within each group between pre and post intervention with ($p < 0.001$) which means that the children functional abilities such as walking indoor and outdoor, going up and down curbs, playing outdoor and running were improved by the applied approaches. All children were improved in gross motor function and functional mobility after the intervention by

functional and mix approaches, while the effect size calculations showed the superiority for mix approaches (medium size effect) efficacy over the functional training approach (small size effect) on the children outcomes.

Findings that are supported by recent evidence illustrating that the combination between strengthening exercises and functional training have significant effects on gross motor function measure, trunk stability, standing time, and walking distance in children with CP (Alhumaidan et al., n.d.). Besides that, the literature provided other appraisal reviews and clinical guidelines to evaluate the effectiveness of other therapeutic approaches which some of them was included in the current study via the mix approaches as; strengthening and stretching interventions, Bobath technique, and additional ICF domains-focused interventions but with variety in the level of evidence (Alhumaidan et al., n.d.; Molenaers et al., 2012; Morgan et al., 2016; Iona Novak et al., 2020; NSW Ministry of Health, 2018; Porfirio et al., 2015).

The gross motor function measurements (GMFM) were compared between the study groups (the functional and mix approaches) which resulted mean difference: 5.19 with p-value 0.005, and the functional mobility measurements (Gillette FAQ) also resulted mean difference: 7.77 with p-value 0.006. These results with the current evidence provided emphasis on the variety between the efficacies of the functional approach alone or combination of functional with other approaches as Bobath and conventional interventions (as regular strengthening and stretching exercises) (Iona Novak et al., 2020; NSW Ministry of Health, 2018).

The evidence-based practice showed the functional approach as one of the most common approaches on the gross motor development (Gunel, 2009). In addition to strong evidence that the active exercise intervention (gross motor activity training) is the most common and

effective intervention (Clutterbuck, Auld, & Johnston, 2019). However, another study indicated that resistance exercises have a small improvement on gross motor functions (Ryan et al., 2017). However, in the current study the superiority was for mix approach. These findings highlight the need to further clinical research toward the approach's efficacy variations. Also, The recent evidence illustrated that the combination between therapeutic approaches as (strengthening exercises and functional training) has a significant effects on gross motor function measure, trunk stability, standing time, and walking distance in children with CP (Alhumaidan et al., n.d.).

Also, based on the study results, there was a positive correlation between the change in gross motor development and the progress in functional abilities (p-value 0.000). The literature support these findings with several studies which leading the professionals toward developing approaches based on the activity, participation, real-life tasks, and learning environment, entertainment and playing (Das & Ganesh, 2019; Iona Novak, 2014; Iona Novak et al., 2013; NSW Ministry of Health, 2018). Besides that, a systematic review (Molenaers et al., 2012) about the effectiveness of common approaches in physiotherapy of CP children, included basic approaches (neurodevelopmental treatment (NDT), conductive education, functional training, and goal-oriented therapy) emphasized that NDT and functional training were effective on gross motor function and on the attainment of functional goals and participation.

The evidence supports the current study results in terms of the positive relation between the change in gross motor abilities and the improvement in functional performance, meaning that the limitation in the underlying motor abilities experienced by CP conditions will impact on the functional motor performance in daily life activities and community participation (Iona Novak, 2014; Iona Novak et al., 2013). This finding added to the importance of

functional oriented approaches that focus more on the activity level in CP intervention from assessment to quantifying therapy effectiveness (Kerr et al., 2007; Kwon et al., 2013).

The study findings also indicated to inverse correlations between the change in the functional motor abilities after 3 months and the sessions frequency per week, as well as with the total number of sessions. These findings may provide a direction toward that the distinctions in children's functional motor abilities play important role to identify the dosage of treatment, not just the frequency, also the intensity and duration of treatment. The evidence presented several studies related to the relation between the progress in CP children outcomes and the treatment frequency, intensity and duration.

In literature, intensive task-specific training showed to be beneficial for the children, resulting in improved developmental domains for the child with CP. (D. C. Russell et al., 2018), another review presented recommendations included prescription guidelines pertaining to the exercise and physical activity prescriptions (frequency, intensity, duration and type) among people with CP, the study findings emphasized that evidence-based treatment-intervention approaches for children with CP should be applied with considering the recommendations in the evidence based clinical guidelines that prescribed treatment parameters. This paper presented the first CP-specific, evidence-based physical activity and exercise recommendations, which may be incorporated into a clinical setting. (Verschuren, Peterson, Balemans, & Hurvitz, 2016)

Recently, the evidence has many studies about the relationship between the GMFCS levels and the functional outcomes with presenting cutoff point related to GMFM and another functional measures. One study included 217 CP children emphasize that understanding of the relationship between GMFCS level and functional outcomes, especially cut-off points according to the GMFCS levels (The GMFM total score cut-off values for GMFCS levels

I–IV were 81.48, 75.98, 53.33, and 40.92, respectively) is useful for making inference of the functional outcomes of CP children in the clinical setting.(Park & Kim, 2015) The current study GMFM total score cut-off values according to GMFCS levels I–V were; 74.97, 55.38, and 46.13, 36.90, 32.15 respectively. This accurate measure is important to determine the effectiveness of intervention programs in CP children by detect changes in gross motor skill acquisition among the convenient populations (Alotaibi et al., 2014) which consistent with the current study.

Another study points out the importance of objective measures of activity performance to complement standard clinical assessments as GMFM, and no strong association between the two was concluded. However, for higher physical abilities, the GMFM discriminated well between children with CP who might or might not achieve these physical abilities in their natural environment. Furthermore, the computation of multidimensional measures and explore their association with daily life performance in CP children is a new approach and adds valuable information about CP population.(Gerber, Carcreff, Paraschiv-Ionescu, Armand, & Newman, 2020) this emphasize the critical need for similar clinical studies.

4.3 Study limitations

A potential limitation of this study is the limited number of settings due to Corona pandemic, however, the researcher was able to recruit 71 subjects to overcome this limitation. Another limitation is inability to make causal relationship between study variables due to the study design.

Also, some factors related to applied therapeutic approaches management were difficult to as treatment intensity and treatment progress due to; the variety of applied approaches, the limitation of using specific and documented prescription criteria for applied therapeutic approaches and their progress.

Chapter Five: Conclusions and Recommendations

5.1 Conclusions

5.2 Recommendations

Chapter Five: Conclusions and Recommendations

5.1 Conclusions

- There are different therapeutic approaches that were applied by physiotherapists for CP children rehabilitation in clinical settings which are:
 1. Functional training approach
 2. Mixed approaches including Bobath technique, regular exercises as resistance and ROM exercises in combination with functional training approach.
- Using valid and reliable outcome measure (GMFM) and self-reported scale (Gillette FAQ), helped to quantify changes of gross motor function and functional mobility in a specific time for CP children across all GMFCS levels in responding to the various applied physiotherapy approaches.
- The findings within each group indicated to:
 - ✓ CP children in both groups were improved in the gross motor function according to the changes in GMFM scores with P-value <0.001.
 - ✓ CP children in both groups were improved in the functional mobility according to the changes in FAQ scores with P-value <0.001.
- Based on Cohen's d results, the mix approach group who was managed by a combination of regular therapeutic approaches were improved with more efficacy on the children functional motor outcomes than the functional training-based group.
- There is a positive correlation between GMFM and FAQ measurements at baseline, similarly the gross motor function significantly correlated with the functional mobility after intervention with p-value = 0.000.

- There is improvement in the ambulation status for CP children according to GMFCS levels.
- There are inverse correlations between the change in the functional abilities' outcomes and number of sessions (frequency per week and the total number in the period of study) during the study, which means that children with better functional abilities need less number of sessions than those with least functional abilities in 3 months duration.

5.2 Recommendations

- The combination of effective therapeutic approaches as functional and Bobath technique with regular therapeutic exercise has more efficacy on the CP functional abilities outcomes than using functional approach alone.
- For both researchers and physiotherapists working with CP, using standardized criteria is fundamental in the assessment and management of CP children as valid and reliable outcome measures. This will contribute to quantify the CP children's outcomes (gross motor function and functional mobility at home, school, clinical settings and community) in response to intervention.
- For rehabilitation team including PT, OT and others, valid and reliable measures as GMFM-66 item sets promote effective planning and intervention for CP children and their families, and may contribute to save time and efforts.
- Further clinical research is recommended to enrich evidence in terms of the most appropriate approaches to promote, maintain and restore children potentials within various environments of the child including home, school, recreation, and community environments.
- In Palestine, the rehabilitation status needs more organized policies and systematic evaluations with updating the evidence- based to optimize the clinical practice in the CP field.
- Further similar studies are recommended to include further rehabilitation settings in different cities in Palestine.

References

- ADDM & SCPE networks. (2019). Cerebral Palsy Statistics || 2019 Update. Retrieved February 27, 2021, from <https://www.birthingjuryhelpcenter.org/cerebral-palsy-statistics.html>
- Akbaş, A. N. (2016). Assessments and outcome measures of cerebral palsy. *Cerebral Palsy: Current Steps. Croatia: InTech*, 23–48.
- Alhumaidan, I. A., Tawhari, F. Y. A., & Sulaiman, I. (n.d.). Effectiveness of Physiotherapy Interventions in CP Child-Systematic Review.
- Alotaibi, M., Long, T., Kennedy, E., & Bavishi, S. (2014). The efficacy of GMFM-88 and GMFM-66 to detect changes in gross motor function in children with cerebral palsy (CP): a literature review. *Disability and Rehabilitation*, 36(8), 617–627.
- Ammann-Reiffer, C., Bastiaenen, C. H. G., & Van Hedel, H. J. A. (2019). Measuring change in gait performance of children with motor disorders: assessing the Functional Mobility Scale and the Gillette Functional Assessment Questionnaire walking scale. *Developmental Medicine & Child Neurology*, 61(6), 717–724.
- Bacı, N. Ç. (2016). Current Rehabilitation Methods for Cerebral Palsy. In *Cerebral Palsy-Current Steps*. IntechOpen.
- Bier, J. D., Scholten-Peeters, W. G. M., Staal, J. B., Pool, J., van Tulder, M. W., Beekman, E., ... Verhagen, A. P. (2017). Clinical practice guideline for physical therapy assessment and treatment in patients with nonspecific neck pain. *Physical Therapy*, 98(3), 162–171.
- Brit Sorsdahl, A., Moe-Nilssen, R., Larsen, E. M., Lundal, S. H., Rieber, J., Skarstein, E., ... Strand, L. I. (2019). Long-term change of gross motor function in children with cerebral palsy; an observational study of repeated periods of intensive physiotherapy in a group setting. *European Journal of Physiotherapy*, 1–7.
- Brunton, L. K., & Bartlett, D. J. (2011). Validity and reliability of two abbreviated versions of the Gross Motor Function Measure. *Physical Therapy*, 91(4), 577–588.
- Çankaya, Ö., & Seyhan, K. (2016). ICF-CY-Based Physiotherapy Management in Children with Cerebral Palsy. *Cerebral Palsy: Current Steps*, 79.
- Cerebral Palsy Alliance Research. (2018). types of CP, cerebral palsy alliance research. Retrieved February 1, 2021, from <https://cparf.org/what-is-cerebral-palsy/types-of-cerebral-palsy/>
- Cerniauskaite, M., Quintas, R. U. I., Boldt, C., Raggi, A., Cieza, A., Bickenbach, J. E., & Leonardi, M. (2011). Systematic literature review on ICF from 2001 to 2009: its use, implementation and operationalisation. *Disability and Rehabilitation*, 33(4), 281–309.
- Clutterbuck, G., Auld, M., & Johnston, L. (2019). Active exercise interventions improve gross motor function of ambulant/semi-ambulant children with cerebral palsy: a systematic review. *Disability and Rehabilitation*, 41(10), 1131–1151.

- Das, S. P., & Ganesh, G. S. (2019). Evidence-based Approach to Physical Therapy in Cerebral Palsy. *Indian Journal of Orthopaedics*, 53(1), 20–34. https://doi.org/10.4103/ortho.IJOrtho_241_17
- Dumas, H. M. (2019). Quantifying motor learning strategies can translate to physiotherapy dose for children with cerebral palsy. *Developmental Medicine & Child Neurology*.
- Duran, I., Stark, C., Martakis, K., Hamacher, S., Semler, O., & Schoenau, E. (2019). Reference centiles for the gross motor function measure and identification of therapeutic effects in children with cerebral palsy. *Journal of Evaluation in Clinical Practice*, 25(1), 78–87. <https://doi.org/10.1111/jep.12990>
- Ferre-Fernández, M., Murcia-González, M. A., Espinosa, M. D. B., & Ríos-Díaz, J. (2020). Measures of motor and functional skills for children with cerebral palsy: A systematic review. *Pediatric Physical Therapy*, 32(1), 12–25.
- Franki, I., Desloovere, K., De Cat, J., Feys, H., Molenaers, G., Calders, P., ... Van den Broeck, C. (2012). The evidence-base for basic physical therapy techniques targeting lower limb function in children with cerebral palsy: a systematic review using the International Classification of Functioning, Disability and Health as a conceptual framework. *Journal of Rehabilitation Medicine*, 44(5), 385–395.
- Gannotti, M. E., Bailes, A., Bjornson, K., O’Neil, M., Grant-Buettler, M., & Dusing, S. (2017). Pediatric Rehabilitation Services for Children With Cerebral Palsy: What Can Existing Data Sources Tell Us? *Pediatric Physical Therapy*, 29(2). Retrieved from https://journals.lww.com/pedpt/Fulltext/2017/04000/Pediatric_Rehabilitation_Services_for_Children.19.aspx
- Gerber, C. N., Carcreff, L., Paraschiv-Ionescu, A., Armand, S., & Newman, C. J. (2020). Multidimensional Measures of Physical Activity and Their Association with Gross Motor Capacity in Children and Adolescents with Cerebral Palsy. *Sensors*, 20(20), 5861.
- Gorter, J. W., Ketelaar, M., Rosenbaum, P., Helders, P. J. M., & Palisano, R. (2009). Use of the GMFCS in infants with CP: the need for reclassification at age 2 years or older. *Developmental Medicine & Child Neurology*, 51(1), 46–52.
- Group, A. (1993). Report of the Australian Cerebral Palsy Register. *Birth Years*, 2003, 2009.
- Gunel, M. K. (2009). Rehabilitation of children with cerebral palsy from a physiotherapist’s perspective. *Acta Orthop Traumatol Turc*, 43(2), 173–180.
- Harvey, A. R. (2017). The Gross Motor Function Measure (GMFM). *Journal of Physiotherapy*. <https://doi.org/10.1016/j.jphys.2017.05.007>
- Himuro, N., Abe, H., Nishibu, H., Seino, T., & Mori, M. (2017). Easy-to-use clinical measures of walking ability in children and adolescents with cerebral palsy: a systematic review. *Disability and Rehabilitation*, 39(10), 957–968.
- Hornby, T. G., Reisman, D. S., Ward, I. G., Scheets, P. L., Miller, A., Haddad, D., ... Henderson, C. E. (2020). Clinical Practice Guideline to Improve Locomotor Function

Following Chronic Stroke, Incomplete Spinal Cord Injury, and Brain Injury. *Journal of Neurologic Physical Therapy*, 44(1), 49–100.

- Jeglinsky, I., & Autti-Rämö, I. (2021). Evidence of physiotherapeutic interventions in adults with cerebral palsy: A systematic review.
- Johnston, M. V. (2009). Plasticity in the developing brain: implications for rehabilitation. *Developmental Disabilities Research Reviews*, 15(2), 94–101.
- Katz, R. T. (2003). Life expectancy for children with cerebral palsy and mental retardation: implications for life care planning. *NeuroRehabilitation*, 18(3), 261–270.
- Keawutan, P. (2017). Relationship between habitual physical activity, gross motor function, community mobility and quality of life in 4-5 year old children with cerebral palsy.
- Keawutan, P., Bell, K., Davies, P. S. W., & Boyd, R. N. (2014). Systematic review of the relationship between habitual physical activity and motor capacity in children with cerebral palsy. *Research in Developmental Disabilities*, 35(6), 1301–1309. <https://doi.org/10.1016/J.RIDD.2014.03.028>
- Kerr, C., McDowell, B., & McDonough, S. (2007). The relationship between gross motor function and participation restriction in children with cerebral palsy: an exploratory analysis. *Child: Care, Health and Development*, 33(1), 22–27.
- Ketelaar, M., Vermeer, A., Hart, H., Beek, E., & Helders, P. (2001). Effects of a functional therapy program on motor abilities of children with CP. *Physical Therapy*, 81, 1534–1545. <https://doi.org/10.1093/ptj/81.9.1534>
- Kleim, J. A., & Jones, T. A. (2008). Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *Journal of Speech, Language, and Hearing Research*.
- Kwon, T. G., Yi, S.-H., Kim, T. W., Chang, H. J., & Kwon, J.-Y. (2013). Relationship between gross motor function and daily functional skill in children with cerebral palsy. *Annals of Rehabilitation Medicine*, 37(1), 41–49. <https://doi.org/10.5535/arm.2013.37.1.41>
- Linsell, L., Malouf, R., Morris, J., Kurinczuk, J. J., & Marlow, N. (2016). Prognostic factors for cerebral palsy and motor impairment in children born very preterm or very low birthweight: a systematic review. *Developmental Medicine & Child Neurology*, 58(6), 554–569.
- Lungu, C., Hirtz, D., Damiano, D., Gross, P., & Mink, J. W. (2016). Report of a workshop on research gaps in the treatment of cerebral palsy. *Neurology*, 87(12), 1293 LP – 1298. <https://doi.org/10.1212/WNL.0000000000003116>
- Madden, R. H., & Bundy, A. (2019). The ICF has made a difference to functioning and disability measurement and statistics. *Disability and Rehabilitation*, 41(12), 1450–1462. <https://doi.org/10.1080/09638288.2018.1431812>
- Mattern-Baxter, K. (n.d.). Effects of partial body weight supported treadmill training on

- children with cerebral palsy. *Pediatric Physical Therapy 2009 Spring*;21(1):12-22.
- McIntyre, S., Taitz, D., Keogh, J., Goldsmith, S., Badawi, N., & Blair, E. V. E. (2013). A systematic review of risk factors for cerebral palsy in children born at term in developed countries. *Developmental Medicine & Child Neurology*, 55(6), 499–508.
- Mintaze Kerem Günel, Duygu Türker, C. O. and O. K. K. (n.d.). Physical Management of Children with Cerebral Palsy. Retrieved from <https://www.intechopen.com/books/cerebral-palsy-challenges-for-the-future/physical-management-of-children-with-cerebral-palsy>
- Molenaers, G., Calders, P., Vanderstraeten, G., & Himpens, E. (2012). The evidence-base for conceptual approaches and additional therapies targeting lower limb function in children with cerebral palsy: a systematic review using the international classification of functioning, disability and health as a framework. *Journal of Rehabilitation Medicine*, 44(5), 396–405.
- Morgan, C., Darrah, J., Gordon, A. M., Harbourne, R., Spittle, A., Johnson, R., & Fetters, L. (2016). Effectiveness of motor interventions in infants with cerebral palsy: a systematic review. *Developmental Medicine & Child Neurology*, 58(9), 900–909.
- Morris, C., & Bartlett, D. (2004). Gross motor function classification system: impact and utility. *Developmental Medicine and Child Neurology*, 46(1), 60–65.
- Mutlu, A., Akmese, P. P., Gunel, M. K., Karahan, S., & Livanelioglu, A. (2010). The importance of motor functional levels from the activity limitation perspective of ICF in children with cerebral palsy. *International Journal of Rehabilitation Research*, 33(4), 319–324.
- Mutlu, A., Krosschell, K., & Spira, D. G. (2009). Treadmill training with partial body-weight support in children with cerebral palsy: a systematic review. *Developmental Medicine & Child Neurology*, 51(4), 268–275.
- NINDS and NIH. (2013). “*Cerebral Palsy: Hope Through Research*”, NINDS. NINDS and NIH. Retrieved from <https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Hope-Through-Research/Cerebral-Palsy-Hope-Through-Research#:~:text=Researchers are using imaging techniques,palsy before they are born>.
- Novak, I, McIntyre, S., Morgan, C., Campbell, L., Dark, L., Morton, N., ... Goldsmith, S. (2013). State of the evidence: systematic review of interventions for children with cerebral palsy. *Dev Med Child Neurol*, 55(10), 885–910.
- Novak, Iona. (2014). Evidence-based diagnosis, health care, and rehabilitation for children with cerebral palsy. *Journal of Child Neurology*, 29(8), 1141–1156.
- Novak, Iona, McIntyre, S., Morgan, C., Campbell, L., Dark, L., Morton, N., ... Goldsmith, S. (2013). A systematic review of interventions for children with cerebral palsy: state of the evidence. *Developmental Medicine & Child Neurology*, 55(10), 885–910.
- Novak, Iona, Morgan, C., Fahey, M., Finch-Edmondson, M., Galea, C., Hines, A., ... Popat, H. (2020). State of the evidence traffic lights 2019: systematic review of

- interventions for preventing and treating children with cerebral palsy. *Current Neurology and Neuroscience Reports*, 20(2), 1–21.
- NSW Ministry of Health. (2018). *Management Of Cerebral Palsy In Children: A Guide For Allied Health Professionals*. Retrieved from https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2018_006.pdf
- Oskoui, M., Coutinho, F., Dykeman, J., Jetté, N., & Pringsheim, T. (2013). An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. *Developmental Medicine & Child Neurology*, 55(6), 509–519.
- Palestinian Central Bureau of Statistics (PCBS). (2016). Statistics. Retrieved October 25, 2019, from <http://www.pcbs.gov.ps/post.aspx?lang=en&ItemID=1801>
- Palisano, R. J., Cameron, D., Rosenbaum, P. L., Walter, S. D., & Russell, D. (2006). Stability of the gross motor function classification system. *Developmental Medicine and Child Neurology*, 48(6), 424–428.
- Park, E.-Y., & Kim, W.-H. (2015). Relationship between the gross motor function classification system and functional outcomes in children with cerebral palsy. *Indian Journal of Science and Technology*, 8(18), 1.
- Pavão, S., Silva, F., Dusing, S., & Rocha, N. (2016). Clinical tools designed to assess motor abilities in children with cerebral palsy. *Developmental Neurorehabilitation*, 20, 1–11. <https://doi.org/10.3109/17518423.2016.1150359>
- Porfírio, G. J. M., Riera, R., Martimbianco, A. L. C., & Zanon, M. A. (2015). Neurodevelopmental treatment approaches for children with cerebral palsy. *The Cochrane Database of Systematic Reviews*, 2015(11).
- Power, E., Anderson, A., & Togher, L. (2011). Applying the WHO ICF Framework to Communication Assessment and Goal Setting in Huntington's Disease: A Case Discussion. *Journal of Communication Disorders*, 44(3), 261–275. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ925764&site=ehost-live>
- Reid, S. M., Carlin, J. B., & Reddihough, D. S. (2011). Using the Gross Motor Function Classification System to describe patterns of motor severity in cerebral palsy. *Developmental Medicine & Child Neurology*, 53(11), 1007–1012.
- Robert Palisano, Peter Rosenbaum, Doreen Bartlett, M. L. (2007). GMFCS – E & R. Retrieved March 15, 2021, from https://canchild.ca/system/tenon/assets/attachments/000/000/058/original/GMFCS-ER_English.pdf
- Rosenbaum, B., & Varvin, S. (2007). The influence of extreme traumatization on body, mind and social relations. *The International Journal of Psychoanalysis*, 88(6), 1527–1542.
- Rosenbaum, P. L., Walter, S. D., Hanna, S. E., Palisano, R. J., Russell, D. J., Raina, P., ... Galuppi, B. E. (2002). Prognosis for gross motor function in cerebral palsy: creation of motor development curves. *Jama*, 288(11), 1357–1363.

- Rosenbaum, P., Paneth, N., Leviton, A., Goldstein, M., Bax, M., Damiano, D., ... Jacobsson, B. (2007). A report: the definition and classification of cerebral palsy April 2006. *Dev Med Child Neurol Suppl*, 109(suppl 109), 8–14.
- Russell, D. C., Scholtz, C., Greyling, P., Taljaard, M., Viljoen, E., & Very, C. (2018). A pilot study on high dosage intervention of children with CP using combined therapy approaches. *South African Journal of Occupational Therapy*, 48(2), 26–33.
- Russell, D. J., Rosenbaum, P., Wright, M., & Avery, L. M. (2002). *Gross motor function measure (GMFM-66 & GMFM-88) users manual*. Mac Keith press.
- Ryan, J. M., Cassidy, E. E., Noorduyn, S. G., & O'Connell, N. E. (2017). Exercise interventions for cerebral palsy. *The Cochrane Database of Systematic Reviews*, 6(6), CD011660–CD011660. <https://doi.org/10.1002/14651858.CD011660.pub2>
- Størvold, G. V., & Jahnsen, R. B. (2021). Current Physical Therapy Practice in Norway for Children With Cerebral Palsy. *Pediatric Physical Therapy*, 33(1), 38–45.
- Stout, J., Novacheck, T., Gorton, G., Tervo, R., Bagley, A., & Tucker, C. (2009). Gillette Functional Assessment Questionnaire: Application of Rasch analysis to link classification levels to performance of functional skills in children with disabilities. *Gait & Posture*, (30), S92–S93.
- Susan B. O'Sullivan. Thomas J.Schmitz. George D. Fulk. (2014). *Physical Rehabilitation* (sixth edit).
- UNICEF. (2019). *Children in the state of palestine*. Retrieved from [https://www.unicef.org/sop/sites/unicef.org.sop/files/2018-12/Children in the State of Palestine EN.pdf](https://www.unicef.org/sop/sites/unicef.org.sop/files/2018-12/Children%20in%20the%20State%20of%20Palestine%20EN.pdf)
- Verschuren, O., Peterson, M. D., Balemans, A. C. J., & Hurvitz, E. A. (2016). Exercise and physical activity recommendations for people with cerebral palsy. *Developmental Medicine & Child Neurology*, 58(8), 798–808.
- WHO. (2011). *World report on disability 2011*. World Health Organization.

Appendices

Appendix I: Setting questionnaire

Appendix II: Children assessment form

Appendix III: GMFCS-E&R descriptors and illustrations

Appendix IV: GMFM-item sets

Appendix V: Gillette FAQ

Appendix VI: Ethical approval Letter

Appendix VII: Informed consent

Appendix I: Setting questionnaire.

الاستمارة (1) الخاصة بالمراكز التأهيلية

تتكون الاستمارة من جزأين الجزء الأول يتضمن معلومات عامة حول المركز والجزء الثاني يتضمن معلومات حول أدوات التقييم والقياس والأساليب العلاجية المستخدمة في تأهيل أطفال الشلل الدماغي

الجزء الأول: معلومات المركز

1. أسم المركز:
2. المحافظة:
3. معلومات الاتصال:
 - العنوان:
 - الهاتف:
 - البريد الإلكتروني:
4. نوع المؤسسة/ القطاع :
 - خاص
 - حكومي
 - مؤسسات أهلية
 - جمعية خيرية
 - لجان محلية
 - غير ذلك
5. الفئات المستهدفة من قبل المركز:
 - أطفال
 - بالغين
 - أكثر من فئة
6. نوع الحالات او المشاكل/التشخيصات التي يعالجها المركز
 - مشاكل حركية وحسية (شلل دماغي, تأخر نمو, متلازمة داون, تشوهات خلقية, مشاكل فتحة الظهر)
 - مشاكل متعددة (سمع, بصر, مشاكل حسية, مشاكل إدراكية, صعوبات التعلم, نطق, توحد, تأخر عقلي)
 - إصابات مختلفة أو مشاكل وتشخيصات اخرى
7. عدد الحالات المستفيدة من خدمات المركز حالياً:.....
8. عدد حالات أطفال الشلل الدماغي:
9. نوع الخدمات العلاجية المقدمة:
 - خدمات تأهيلية متعددة
 - تحويلات ومتابعة
 - رعاية صحية ووقائية
 - توعية وتثقيف
 - خدمات اخرى

10. نوع الخدمات التأهيلية المقدمة (الرجاء وضع إشارة على الخدمات المقدمة جميعها)

- علاج طبيعي
- علاج وظيفي
- علاج نطق
- تأهيل مهني
- علاج سلوكي
- تربية خاصة
- ارشاد نفسي
- الاطراف والاجهزة التعويضية

إذا كانت خدمة العلاج الطبيعي من ضمن الخدمات التأهيلية المستخدمة في المركز أرجو استكمال تعبئة الاستمارة

بما يخص الجزء الثاني من قبل المعالج الفيزيائي/ الطبيعي في المركز

الجزء الثاني: الأساليب العلاجية المستخدمة في المراكز

1. هل يستخدم المركز نهج محدد في عملية التقييم لأطفال الشلل الدماغي؟
- نعم
 - لا

2. إذا كانت الإجابة نعم أرجو ذكر اسم أدوات أو طرق التقييم المستخدمة

.....

3. هل يستخدم المركز نهج محدد أو أساليب علاجية محددة في تأهيل أطفال الشلل الدماغي
- نعم
 - لا

أرجو تحديد النهج العلاجي المستخدم في السؤال التالي،(ممكن اختيار أكثر من إجابة).

4. ما هي الاساليب العلاجية المستخدمة في تأهيل أطفال الشلل الدماغي في المركز من قبل المعالج الفيزيائي:
- النهج المعتمد على تطور ونمو الطفل الحسي الحركي (Bobath technique)
 - النهج الوظيفي (المعتمد على نشاطات الحياة اليومية، القدرات والمهارات الوظيفية)
 - أساليب علاجية أخرى : أرجو ذكر اسم أي نهج علاجي مستخدم لم يتم ذكره ضمن الخيارات
-

5. كيفية تقديم الخدمات التأهيلية من حيث عدد الجلسات او المتابعة
- جلسة أسبوعيا
 - 2-3 جلسات اسبوعيا
 - بشكل يومي
 - اخرى مع التوضيح

6. هل يوجد ادوات قياس ومتابعة لنتائج الأساليب التأهيلية و العلاجية المستخدمة؟
- نعم
 - لا

إذا كانت الإجابة نعم أرجو ذكرها:

7. إذا كان هناك أي ملاحظات أخرى من قبل المركز أرجو إضافتها

Appendix II: Children assessment form

الاستمارة (2) استمارة تقييم الطفل الأولية

A. معلومات شخصية

1. الاسم
2. العمر
3. العمر التطوري
4. الجنس
5. المستوى التعليمي
6. العنوان
7. تاريخ الاصابة date of onset
8. الفترة الزمنية التي تلقى الطفل فيها خدمات التأهيل.....

B. تاريخ العائلة

1. صلة الوالدين : هل يوجد صلة قرابة؟
 نعم
 لا
2. هل يوجد أطفال آخريين في العائلة لديهم مشاكل
 نعم
 لا
3. ما هي المشاكل في حال كانت الاجابة نعم:
3. ترتيب الطفل في الأسرة:
4. عدد الاطفال في العائلة
5. عمر الام
6. عمر الاب

C. مقاييس الجسم:

1. الوزن
2. الطول
3. محيط الرأس

D. تاريخ الحالة: (الرجاء تضليل جميع الخيارات التي لدى الطفل)

i. العوامل المسببة للشلل الدماغي سابقا لدى الطفل: past history

1. مشاكل ما قبل الولادة prenatal history
2. مشاكل خلال الولادة perinatal history
3. مشاكل ما بعد الولادة postnatal history
4. عوامل وراثية
5. أسباب أخرى مع التوضيح:

ii. وضع الطفل الحالي والمشاكل الحالية present history

1. مشاكل صحية وأمراض عضوية
- أرجو تحديد نوع او سبب المشكلة

2. مشاكل التأخر الحركي

نعم

لا

أرجو تحديدها

3. مشاكل حسية

نظر

سمع

نطق

مركبة (أكثر من خيار)

4. التشنجات (نوبات الصرع):

نعم

لا

أرجو تحديد ما اذا كانت النوبات تحت السيطرة باستخدام الأدوية والمتابعة الطبية

5. استخدام أجهزة وأدوات مساعدة

نعم

لا

أرجو ذكر اسم الأداة او الجهاز المستخدم

iii. تاريخ الحالة الطبي

1. هل أجرى الطفل أية فحوصات طبية

نعم

لا

أرجو ذكرها

2. هل أجرى الطفل أي عمليات جراحية

نعم

لا

أرجو ذكر أي تفاصيل في حال إجراء أي عمليات جراحية

1. هل يتناول الطفل أي أدوية

نعم

لا

ذكر أسم الأدوية المستخدمة ولأي غرض

E. تشخيص الطفل وتصنيفه

1. بناء على نغمة العضلات (motor impairment)

Spastic

floppy

mixed

Ataxic

Athetoid

2. بناء على الأطراف المصابة (topographic)

Quadriplegia

Diplegia

Hemiplegia

Monoplagia

3. بناء على تصنيف الوظائف الحركية GMFCS

GMFCS I

GMFCS II

GMFCS III

GMFCS IV

GMFCS V

F. الجانب العلاجي

1. ما هو المستوى المعتمد من خلال الأساليب العلاجية المتبعة في تأهيل الطفل؟

child or impairment focused level

functional task focused level

learning and environmental levels

2. الأساليب أو طرق العلاج الطبيعي المستخدمة في برنامج التأهيل خلال فترة الدراسة:

التمارين العلاجية المعتمدة على محدودية الحركة ومشاكل العضلات

النهج المعتمد على تطور ونمو الطفل الحسي الحركي (Bobath , neurodevelopmental treatment)

technique)

النهج الوظيفي (المعتمد على نشاطات الحياة اليومية , القدرات والمهارات الوظيفية)

أساليب علاجية أخرى : أرجو ذكر اسم أي نهج علاجي مستخدم لم يتم ذكره ضمن الخيارات

.....

3. عدد مرات المتابعة العلاجية/الجلسات خلال فترة البحث

مرة أسبوعيا

2-3 أسبوعيا

يوميًا

1-2 شهريا

غير ذلك

4. هل يقوم الاهل بالمتابعة البيتية خلال فترة تأهيل الطفل في المركز

نعم

لا

Appendix III: GMFCS descriptors and illustrations



GMFCS-ER_English.pdf



GMFCS-ER_Translation-Arabic.pdf

Appendix IV: GMFM-66-item sets



GMFM pediatric.pdf

Appendix V: Gillette FAQ

Gillette Functional Assessment Questionnaire (FAQ)

Please choose one statement that best describes the patient's usual or typical walking abilities (with assistive devices typically used).

This patient:

- 1. Cannot take any steps at all.
- 2. Can do some stepping on his/her own with the help of another person. Does not take full weight on feet; does not walk on routine basis.
- 3. Walks for exercise in therapy and/or less than typical household distances.
- 4. Walks for household distances, but makes slow progress. Does not use walking at home as preferred mobility (primarily walks in therapy or as exercise).
- 5. Walks for household distances routinely at home and/or school. Indoor walking only.
- 6. Walks more than 15-50 feet outside the home but usually uses a wheelchair or stroller for community distances or in congested areas.
- 7. Walks outside for community distances, but only on level surfaces (cannot perform curbs, uneven terrain, or stairs without assistance of another person).
- 8. Walks outside the home for community distances, is able to get around on curbs and uneven terrain in addition to level surfaces, but usually requires minimal assistance or supervision for safety.
- 9. Walks outside the home for community distances, easily gets around on level ground, curbs, and uneven terrain but has difficulty or requires minimal assistance or supervision with running, climbing, and/or stairs. Has some difficulty keeping up with peers.
- 10. Walks, runs, and climbs on level and uneven terrain and does stairs without difficulty or assistance. Is typically able to keep up with peers.

Appendix VI: The ethical approval letter

Al-Quds University Jerusalem Deanship of Scientific Research	<p>بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ</p> 	جامعة القدس القدس عمادة البحث العلمي
Research Ethics Committee Committee's Decision Letter		
Date: 17 February 2020 Ref No: 107/REC/2020		
Dear Dr. Hadeel Halaweh and Ms. Yasmeeen Joman		
Thank you for submitting your application for research ethics approval. After reviewing your application entitled "The effectiveness of applied therapeutic approaches in the rehabilitation of cerebral palsy children in Palestine: A Multicenter Observational Study"		
The Research Ethics Committee confirms that your application is in accordance with the research ethics guidelines at Al-Quds University.		
We would appreciate receiving a copy of your final research report/ publication. Thank you again and wish you a productive research that serves the best interests of your subjects.		
PS: This letter will be valid for two years.		
 Nuba El Sharif, PhD Research Ethics Committee Chair		
Cc. Prof. Imad Abu Kishek - President Cc. Members of the committee Cc. file		
Abu-Dies, Jerusalem P.O.Box 20002 Tel-Fax: #970-02-2791293	research@admin.alquds.edu	أبوديس، القدس ص.ب. 20002 تلفاكس: #970-02-2791293

Appendix VII: Informed consent



The effectiveness of applied therapeutic approaches in the rehabilitation of cerebral palsy children in Palestine

A Multicenter Observational Study

العنوان

فاعلية الأساليب العلاجية المستخدمة في إعادة تأهيل الأطفال المصابين بالشلل الدماغي في فلسطين

دراسة تحليلية متعددة المراكز

اسم الباحثة

ياسمين جمعة

إشراف

الدكتورة: هديل حلاوة

نموذج تعريف بالبحث

عنوان البحث: فاعلية الأساليب العلاجية المستخدمة في إعادة تأهيل الأطفال المصابين بالشلل الدماغي في فلسطين

تهديكم الباحثة في هذه الدراسة أ. ياسمين جمعة أطيّب الأمنيات وتشكر لكم استعدادكم للمشاركة بهذا البحث الذي هو جزء من دراسة الماجستير في العلاج الطبيعي/ جامعة القدس. هذا البحث يهدف الى تقييم فاعلية الأساليب العلاجية المستخدمة في إعادة تأهيل الأطفال المصابين بالشلل الدماغي في فلسطين من خلال:

- تطبيق أدوات التقييم التي سوف تستخدم في هذا البحث وهي أدوات قياس آمنه ولا يوجد منها اي ضرر على الطفل، حيث تتضمن فحص القدرات الحركية الوظيفية لأطفال الشلل الدماغي.
- سيكون هناك فحوصات قبلية في بداية البحث وفحوصات بعد 3 أشهر من تطبيق البرنامج العلاجي
- ستقوم الباحثة بإجراء البحث بالتعاون مع أهل الطفل والمعالج/ة الفيزيائي/ة.

ان اشترككم في هذا البحث هو طوعي ومرتبط بتوقعكم على نموذج موافقة بالمشاركة وتصريح بفهمكم لطبيعة البحث وأهدافه، وأدوات القياس المستخدمة فيه. وفي حال وجود أي استفسار عن البحث او أي شيء متعلق بهذه الدراسة، يرجى التواصل مباشرة مع الباحثة (ياسمين جمعة) على الرقم التالي 0599727705

شاكرين لكم حسن تعاونكم

أ. ياسمين جمعة

بكاوريوس علاج طبيعي

طالبة ماجستير علاج طبيعي

جامعة القدس

نموذج الموافقة على المشاركة في البحث

Code NO _____

عزيزي الوالد/الوالدة

توقيعك ادناه على نموذج الموافقة هذا هو بموجب موافقة مكتوبة وموقعة على مشاركة طفلك/ طفلتك في دراسة بحثية ستقوم بها الباحثة ياسمين جمعة بعنوان " فاعلية الأساليب العلاجية المستخدمة في إعادة تأهيل الأطفال المصابين بالشلل الدماغي في فلسطين ". وهو اقرار بأنه قد تم شرح أهداف البحث وطرق الفحص وتطبيق أدوات القياس للبحث وإنه قد تم شرح الحقوق المتضمنة:

- سرية المعلومات التي تصرح بها وعدم اطلاق اي شخص عليها وتخزينها في مكان آمن لا يصل اليه سوى الباحث.
- استخدام المعلومات للأغراض العلمية فقط
- حرية انسحابك في اي وقت من الدراسة ومن دون الحاجة لإبداء الاسباب ودون اية عواقب.
- حقك في الاطلاع على نتيجة الفحوصات ونتائج البحث النهائية

موافقة المشارك

لقد تم وصف الدراسة البحثية لي شفهيًا، وبما فيه المعلومات المدرجة أعلاه، ووافق على المشاركة بهذه الدراسة البحثية.

اسم الطفل الرباعي: _____

اسم والد أو والدة الطفل: _____

توقيع الوالد أو الوالدة: _____

التاريخ: _____