

**MALNUTRITION AMONG CHILDREN WITH
CEREBRAL PALSY IN HOSPITAL RAJA
PEREMPUAN ZAINAB II AND HOSPITAL
UNIVERSITI SAINS MALAYSIA**

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**DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR THE DEGREE OF MASTER OF
MEDICINE
(PAEDIATRICS)**



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CHAPTER I:

PRELIMINARIES

DECLARATION

I hereby declare that the effort of this dissertation is of my personal except for citations and summaries that have been properly acknowledged.

30th November 2017

DR NOR DIYANA BINTI ISMAIL

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CERTIFICATION

I hereby certify that to the best of my knowledge, this research project is the original work of the candidate, Dr Nor Diyana binti Ismail (P-UM 0174/14).

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The capacity to learn is a gift, the ability to learn is a skill and

the willingness to learn is a choice.

- Brian Herbert

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But above all, *Alhamdulillah*, praise be to Allah for giving me this life, the strength, the courage and determination to complete this phase of my journey in this world. May this writing be blessed for a good cause and a better future.

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LIST OF ABBREVIATIONS AND NOMENCLATURE

ADL	: Activity of daily living
BMI	: Body mass index
CDC	; Centre for Disease Control
CP	: Cerebral palsy
GERD	: Gastro-oesophageal reflux disease
GI	: Gastro-intestinal
GMFCS	: Gross motor function classification system
HRPZ II	: Hospital Raja Perempuan Zainab II
HUSM	: Hospital Universiti Sains Malaysia
KKM	: Kementerian Kesihatan Malaysia
MREC	: Medical Research and Ethics Committee
NCHS	: National Centre for Health and Statistics
SD	: Standard deviation
SPSS	: Statistical Package for Social Sciences
WHO	: World Health Organization

ABSTRAK

Pengenalan: Kekurangan nutrisi sering dilaporkan sebagai masalah di kalangan kanak-kanak palsy serebral. Mereka lebih terdedah dengan masalah ini berbanding kanak-kanak normal kerana kecacatan fizikal dan kekurangan kapasiti untuk mencapai fungsi yang normal maka mereka memerlukan keperluan nutrisi yang lebih tinggi untuk mencapai tumbesaran dan perkembangan yang optimum.

Objektif: Tujuan kajian ini adalah untuk mendapatkan prevalensm malnutrisi di kalangan kanak-kanak palsy serebral di HRPZ II dan HUSM dan untuk menyiasat faktor-faktor yang berkaitan dengan malnutrisi.

Kaedah: Satu kajian keratan rentas dijalankan di kalangan kanak-kanak palsy serebral berumur 2 hingga 18 tahun yang menerima rawatan susulan di klinik neurologi dan rehabilitasi di Hospital USM dan Hospital Raja Perempuan Zainab II daripada Jun hingga November 2017. Temubual dijalankan dan rekod perubatan diselidik untuk mendapatkan prevalens malnutrisi, ciri-ciri demografik, masalah perubatan, cara pemakanan dan tahap klinikal untuk menentukan faktor yang berkaitan dengan malnutrisi. Analisa regresi mudah dan berbilang digunakan untuk mengenalpasti faktor yang berkaitan dengan malnutrisi di kalangan kanak-kanak palsy serebral.

Keputusan: Sejumlah 141 kanak-kanak palsy serebral telah dikaji dan 62.4% kanak-kanak (lelaki = 84, perempuan = 57) telah didapati mengalami malnutrisi paling teruk dengan kategori yang paling kerap adalah tumbesaran terbantut, diikuti dengan kekurangan berat badan dan indeks jisim badan rendah. Malnutrisi adalah lebih tinggi di kalangan kanak-kanak palsy serebral yang mempunyai masalah fungsi pergerakan kasar, masalah pemakanan dan penyakit-penyakit yang berkait. Faktor utama berkait bebas

dengan malnutrisi adalah pesakit spastik kuadriplegik yang mempunyai 5 hingga 20 kali lebih tinggi risiko untuk mendapat malnutrisi paling teruk berbanding jenis spastik yang lain samada yang mengalami masalah pemakanan atau tidak.

Kesimpulan: Prevalens malnutrisi di kalangan kanak-kanak palsy serebral adalah tinggi terutama bagi kanak-kanak spastik kuadriplegik, maka ini menunjukkan bahawa penambahbaikan dalam intervensi merawat masalah kekurangan nutrisi amatlah diperlukan.

Kata kunci: palsy serebral, spastik kuadriplegik, malnutritisi, kekurangan nutrisi, pengukuran berat badan dan tinggi, masalah pemakanan, fungsi motor kasar

ABSTRACT

Introduction: Poor nutrition is often reported as a problem among children with cerebral palsy. They are more vulnerable than any other normal children because of their physical disabilities, impairments and inadequate capacity to achieve normal function therefore needing higher nutritional requirements for optimum growth and development.

Objectives: This study aimed to provide data on prevalence of malnutrition among children with cerebral palsy in HRPZ II and HUSM and to determine the associated factors of malnutrition.

Methods: A cross sectional study is performed among children with cerebral palsy aged 2 to 18 years old attending the paediatric neurology and rehabilitation clinics in Hospital USM and Hospital Raja Perempuan Zainab II (HRPZ II) from June to November 2017. Interviews were done and case notes were reviewed to determine the demographic characteristics, medical problems, feeding behaviour and clinical assessments. Simple and multiple logistic regression analysis were used to identify the factors associated with malnutrition.

Results: A total of 141 patients were enrolled and 62.4% (male = 84, female = 57) of children with cerebral palsy were severely malnourished, with stunting being the most common category, followed by underweight and thinness. Severe malnutrition is more prevalent in patients with severe motor impairments, having feeding difficulties and co-morbidities. The main factor for severe malnutrition is spastic quadriplegia having 5 to 20 times the odds of being severely malnourished compared to other types of CP with or without having feeding difficulties.

Conclusion: Prevalence of severe malnutrition is high in children with CP especially among children with spastic quadriplegia, thus showing the need for improvement in appropriate nutritional intervention for this group of patients.

Keywords: cerebral palsy, spastic quadriplegia, malnutrition, anthropometric measurement, feeding difficulties, gross motor function

CHAPTER II: THE TEXT

Section A: Introduction

1. INTRODUCTION

Cerebral palsy is a well-recognized childhood disability that affects mainly the motor functions, hence leads to impaired general functions essentially caused by oro-motor dysfunction. Severity of impairments determines their difficulty in feeding risking them to malnutrition and thus negatively affects their quality of life.¹

There are limited studies from developing countries describing growth and nutritional status of children with cerebral palsy. Challenges in assessing their growth and nutrition are associated with contractures, involuntary muscle spasm and cognitive impairments causing limited patient cooperation.²

Malnutrition is defined as a state of poor nutrition characterised by insufficient, excessive or imbalanced consumption of nutrients. Although it is rarely the direct cause of death, child malnutrition was associated with 54% of child death (10.8 million children) in developing countries in 2001.³ The WHO Global Database on Child Growth and Malnutrition uses a Z-score cut-off point of <-2 SD to classify low weight-for-age, low height-for-age, low weight-for-height as moderate and severe undernutrition.^{4,5}

In Malaysia, Kelantan is one of the states in the east coast with the highest number of children below 5 years of age with moderate to severe malnutrition.⁶ According to the National Health and Morbidity Survey 2015, Kelantan is the highest state with children reported to be stunting with prevalence of 18.2% and one of the top four states with underweight children with the prevalence of 15.8%.⁷ Unfortunately, there were limited data on nutritional status for children with disabilities.

Children with cerebral palsy has been known to be undernourished due to multiple interrelated factors causing disturbance in feeding ability due to abnormal motor and movement disorders. It has been hypothesized that hypertonicity and spasticity of children with CP causes an increase in their metabolic needs and increase in energy expenditure. This does not explain why some children with adequate calorie intake are also found to be malnourished. This suggest there are other factors besides the quantitative amount of feeding such as the other health problems and other non-related diseases contributing to malnutrition. ⁸

The study was aimed to provide the local data of nutritional status of children with cerebral palsy in HRPZ II and HUSM. We would also like to determine the associated factors of malnutrition in children with CP based on their sociodemographic factors, feeding behaviour and their medical problems and clinical severity. This is to identify those at high risk of severe malnutrition, thus an early intervention could be provided.

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Section B:

Study Protocol

**B (I): Documents
submitted for ethical
approval**

**MALNUTRITION AMONG CHILDREN WITH
CEREBRAL PALSY IN HOSPITAL RAJA PEREMPUAN
ZAINAB II (HRPZ II) AND HOSPITAL UNIVERSITI
SAINS MALAYSIA (HUSM) AND ITS ASSOCIATED
FACTORS**

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RESEARCH PROPOSAL



UNIVERSITI SAINS MALAYSIA

2017

1. Research Title:

Malnutrition among children with Cerebral Palsy attending Hospital Raja Perempuan Zainab II (HRPZ II) and Hospital Universiti Sains Malaysia (HUSM)

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5. Introduction

Cerebral palsy is a well-recognized childhood disability that affects mainly the sensory and motor functions, hence leads to impaired general functions essentially caused by oro-motor dysfunction. Severity of impairments determines their difficulty in feeding risking them to malnutrition and thus negatively affects their quality of life. ¹

There are limited studies from developing countries describing growth and nutritional status of children with cerebral palsy. Challenges in assessing their growth and nutrition are associated with contractures, involuntary muscle spasm and cognitive impairments causing limited patient cooperation.²

Malnutrition is defined as a state of poor nutrition characterised by insufficient, excessive or imbalanced consumption of nutrients. Although it is rarely the direct cause of death, child malnutrition was associated with 54% of child death (10.8 million children) in developing countries in 2001.³ The WHO Global Database on Child Growth and Malnutrition uses a Z-score cut-off point of <-2 SD to classify low weight-for-age, low height-for-age, low weight-for-height as moderate and severe undernutrition.^{4,5}

In Malaysia, Kelantan is one of the states in the east coast with the highest number of children below 5 years of age with moderate to severe malnutrition.⁶ According to the National Health and Morbidity Survey 2015, Kelantan is the highest state with children reported to be stunting with prevalence of 18.2% and one of the top four countries with underweight children with the prevalence of 15.8%.⁷ Unfortunately, there were limited data on nutritional status for children with disabilities.

Children with cerebral palsy has been known to be undernourished due to multiple interrelated factors causing disturbance in feeding ability due to abnormal motor and movement disorders. It has been hypothesized that hypertonicity and spasticity of children with CP causes an increase in their metabolic needs and increase in energy expenditure. This does not explain why some children with adequate calorie intake are also found to be malnourished. This suggest there are other factors besides the quantitate amount of feeding such as the other health status and other non-related diseases contributing to malnutrition.⁸

6. Problem Statement & Study Rationale

Malnutrition on its own itself has been seen to lead premature death and significant morbidities (UNICEF 2013).⁹ It is well known that children with cerebral palsy are almost always been undernourished due to a wide range of factors ranging from the biological, environmental and behavioural aspects. Other health issues associated with cerebral palsy such as epilepsy, gastro-intestinal disorders, recurrent infections and cognitive impairment have also been identified as an influence to attribute to the cause of malnutrition. Essential information gathered from this study will facilitate the attainment of better necessities required for the wellbeing of the unfortunate children especially in this part of the country.

7. Literature review

Children with cerebral palsy are more vulnerable than any other normal children because of their physical disabilities, impairments and inadequate capacity to achieve a normal function therefore needing higher nutritional requirements for optimum growth and development. Deterioration of their health status and an uncontrolled medical problems could easily affect their nutritional status and growth. Hence it is important to identify the associated factors and other co-morbidities to justify the needs of a better nutritional outcome. Below is the table of the journals reviewed and their outcome.

Study	Participant	Outcome
Kakooza-Mwesige et al, 2015 Acta Paediatrica 104, pp. 1259-1268	Children with cerebral palsy recruited from children visiting the CP clinic in Uganda's national referral hospital. (n=135)	52% of CP children were malnourished and rates were higher in those who were 5 years or more or had experience neonatal complications.
Win Lai May et al, 2014, The Myanmar Health Sciences Research Journal, Vol 26, No 1, 2014	Cross sectional descriptive study conducted at CP Clinic, Yangon Childrens Hospital from May 2010 to June 2011 (n=173)	Malnutrition and feeding problems prevalent in children with CP at YCH is associated with older age, feeding mainly solid food and higher dependence on caregivers for feeding.
WL Cheah et al, Rural and Remote Health 10: 1248. (Online), 2010	Cross-sectional study examining causal relationships among the biological, behavioural and environmental factors related to malnutrition in children in rural Kelantan	The results demonstrated that an environmental construct (with factors that included total household income, total expenditure, number of rooms in the house and socioeconomic status had a significant effect on malnutrition. Neither the biological nor behavioural constructs had significant effects.

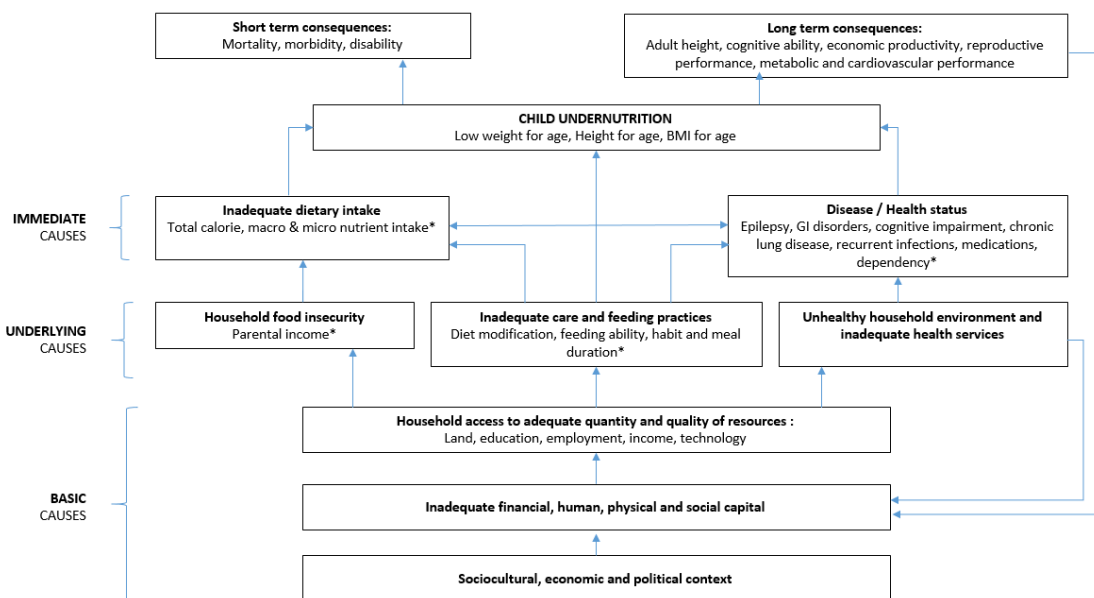
Study	Participant	Outcome
Sjakti et al, Paediatr Indones 2008;48:224-9	Cross-sectional study in an outpatient paediatric clinic in Indonesia. (n=55)	Malnutrition in CP patients tends to be related with inadequate calorie intake due to feeding difficulties that is found in 78% subjects especially those with spastic quadriplegic CP.
Hung et al, Chang Gung Med J 2003;26:425-32	Seventy-five spastic CP children, (ages, 5 months to 10 years) in a rehabilitation clinic in a hospital in Taiwan were analyzed to estimate the influences of various factors on the nutritional status of the spastic CP children.	From the study, undernutrition was significantly associated with girls more feeding problems, shorter duration per meal and poor communication ability. Periodic anthropometric assessments of CP children are indicated for the early identification of nutritional risk.
Zainah SH et al. Determinants of linear growth in Malaysian Children with cerebral palsy. J. Paediatr. Child Health (2001) 37, 367-381	Cross sectional study of CP children attending Neurology clinic IPHKL and Rehab department in Cheras, Selangor. (n=101)	Poor linear growth in children with CP are not associated with medical factors such as type of CP, impaired cognitive function, presence of epilepsy, medications taken daily and history of hospitalizations.

Study	Participant	Outcome
<p>Wang F et al, <i>Pediatr Neurol.</i> 2016 May; 58:90-7.doi: 10.1016/j.pediatrneurol.2016.01.002. Epub 2016 Jan 7.</p>	<p>Cross-sectional survey of children registered as having cerebral palsy in the China Disabled Persons' Federation branch in Chengdu, West China. (n=377)</p>	<p>Malnutrition were significantly more prevalent in patients with severe motor impairments. A significant negative correlation was found between nutritional status and age, GMFCS and MACS levels.</p>
<p>Socrates C et al, <i>Int J Rehabil Res.</i> 2000 Sep;23(3):177-84.</p>	<p>In Palawan, Philippines, the nutritional status of 31 children with CP was compared to that of their siblings (n = 20) and a control group of neighbourhood children (n = 64), matched for age and sex</p>	<p>The children with CP had extremely poor nutritional status, and had significantly smaller weights for height, heights for age and weights for age than siblings or controls.</p> <p>Haemoglobin levels were not significantly different between the children with CP and their siblings. The nutritional status of children with quadriplegic CP was much poorer than that of similar children in the USA.</p>

Study	Participant	Outcome
<p>Sullivan, P.B. et al. Prevalence and severity of feeding and nutritional problems in children with neurological impairment: Oxford Feeding Study. <i>Dev. Med. Child Neurol.</i> 2000, 42, 674–680.</p>	<p>Children with cerebral palsy age range 4.2–13.1 years (n = 271)</p> <p>Questionnaire regarding gastrointestinal and feeding problems</p>	<p>Feeding problems were prevalent: 89% needed help with feeding and 56% choked with food; 20% described feeding as stressful and unenjoyable. Prolonged feeding time was reported by 28%.</p>
<p>Lopes, P.A.C et al. Food pattern and nutritional status of children with cerebral palsy. <i>Rev. Paul. Pediatr.</i> 2013, 31, 344–349</p>	<p>Children with CP (n = 90, age range 2–12.8 years). Parental interview for feeding difficulties. A 24-h recall and food frequency questionnaire.</p>	<p>Prevalence of chewing and swallowing problems in children with spastic quadriplegia 41% and 12.8% respectively. Dietary pattern with low in carbohydrates (52%), adequate in protein (53%), and high in lipids (43%). Average energy intake below recommendations in children aged 9–13 years.</p>

8. Conceptual Framework

Diagrammatic illustration of the study framework based on literature review with some text to explain the diagram.



The conceptual framework of this study is adapted from United Nations Children’s Fund’s (UNICEF) framework for the determinants of child nutritional status. However, it has been improvised by adding other imperative details to specifically look into the issues with children with cerebral palsy. In general, the economic background, social, behavioural and biological aspects of a child are the foundation of their general wellbeing which signifies their health and nutritional status.

9. Target Research Question(s)

9.1 What is the nutritional status of patients with cerebral palsy?

9.2 What feeding issues correlate significantly to malnutrition in cerebral palsy patients?

9.3 What are the associated factors of malnutrition in cerebral palsy patients?

10. Objectives

10.1 General Objective

To determine the circumstances surrounding malnutrition in children with cerebral palsy in HRPZ II and HUSM

10.2 Specific Objectives

10.2.1 To determine the prevalence of malnutrition among children with cerebral palsy in HRPZ II and HUSM

10.2.2 To describe the demographic data and clinical characteristic of children with CP in HRPZ II and HUSM

10.2.3 To identify associated factors of malnutrition in children with CP in HRPZ II and HUSM, based on;

- Sociodemographic factors – Age, race and gender of child, gestational age at birth, age of parents, parental or caregiver’s educational status, occupation, marital status and household income
- Feeding problems – feeding ability, type of feeding, feeding time, feeding difficulties
- Medical problems and clinical severity – aetiology and type of CP, severity of gross motor function, presence of cognitive impairment, other comorbidities and physical findings

11. Study Hypothesis

11.1 Malnutrition is significantly related to children with cerebral palsy.

11.2 There will be significant relationship between associated factors (sociodemographic, physical disability, other medical problems and feeding problems) and malnutrition among children with cerebral palsy in HRPZ II and HUSM.

12. Operational Definition

12.1 Cerebral Palsy

Patients who are diagnosed with cerebral palsy who met the CP diagnosis criteria according to the definition by Rosenbaum et al.

“Cerebral palsy(CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing foetal or infant brain.¹⁰“

Cerebral palsy patients included in this study would have abnormal gross and fine motor functioning which includes difficulties with walking, feeding and swallowing, coordinated eye movements, articulation of speech and secondary problems with behaviour, musculoskeletal function, and participation in society.

The aetiology could be attributed to or caused by an inciting event or discrete series of events which are no longer active at the time of diagnosis, such as hypoxic-ischaemic encephalopathy, post meningitis complications, bilirubin neurotoxicity, paediatric stroke

or periventricular leukomalacia (PVL). These patients may or may not be supported by neuroimaging and exclusion of metabolic causes of neurodevelopmental disabilities.

12.2 Malnutrition

Based on WHO standard deviation scores (Z-scores), any children with a Z-score of -2.0 or lower in any of the nutritional indicators were defined as having malnutrition. The nutritional indicators used in this study is based on the Malaysian National Health and Morbidity survey 2015 adapted from the WHO Child Growth Standards. Description of different types of malnutrition is shown below. :-

Classification of Malnutrition		
Z-score	Nutritional Indicators	Definition
<-2 SD	Low weight for age	Underweight
	Low height for age	Stunting
	Low weight for height	Wasting
	BMI	Thinness
>+2 SD	Weight for age	Overweight
	BMI, 0-5 years old	Overweight
	BMI, 5-19 years old	Obesity

For this study, malnutrition is defined as having a Z-score of -2.0 or lower in any of the nutritional indicators mention in the table above.

13. Research Design

Cross sectional, descriptive study over a six-month period.

14. Study Area

Data will be collected in Hospital Raja Perempuan Zainab II (HRPZ II) and Hospital Universiti Sains Malaysia (HUSM) which are the tertiary referral centres in Kelantan with specialized Paediatric Neurology and Rehabilitation services. Both centres has its own paediatric neurology clinic, general paediatric wards and rehabilitation clinic.

15. Study Population

Reference population – Children with cerebral palsy in Kelantan.

Source population – Children with cerebral palsy attending HUSM and HRPZ II.

Target population – Children with cerebral palsy admitted to general paediatric wards or attending paediatric neurology and rehabilitation clinic in HUSM and HRPZ II.

Sampling frame – Attendance list for paediatric neurology and rehab clinic follow up.

16. Subject Criteria

16.1 Inclusion Criteria

- Patients with definitive diagnosis of cerebral palsy documented in the files and attending neurology and rehabilitation clinic and general paediatric ward

- Age 2 to less than 18 years old
- Granted with parental consent or consent from guardians or other legally acceptable representative

16.2 Exclusion Criteria

- Patients admitted to general paediatric wards complicated with other severe concomitant disease or very ill and required emergency management in intensive care setting
- Genetic syndromes or confirmed chromosomal abnormalities

17. Sample Size Estimation

Sample size was calculated based on the specific objectives. For objective 1, 1 proportion formula was used. Using 11% prevalence of malnutrition among patients with cerebral palsy from previous study (Sjakti et al. 2008), at least 150 patients are required.

$$n = \left\{ \frac{Z_{\alpha}}{d} \right\}^2 \times P(1 - P)$$

$P = 0.11$, the population proportion from Sjakti et al, 2008

$d = 0.05$ precision

$Z_{\alpha} = 1.96$ for $\alpha = 0.05$, (level of significance at 5%; 95% CI).

For objective 3 which is to identify the associated factors of malnutrition in children with cerebral palsy, the sample size for comparing two proportions using the Power and Sample size calculation was used for categorical variables.

Associated factors	Study	P1	P0	n	n + 20%
Types of CP	Caselli et al, 2017 (Brazil)	0.22	0.05	62	74
Gross motor function (GMFCS IV and V)	F. Wang et al, 2016 (West China)	0.70	0.90	62	74
Cognitive impairment	Kakooza-Mwesige et al, 2015 (Uganda)	0.58	0.36	80	96
Feeding ability (Dependant)	Kakooza-Mwesige et al, 2015 (Uganda)	0.10	0.33	49	59

Po = proportion of corresponding variable among malnourished group based on previous study

P1 = proportion of corresponding variable among normal group based on previous study

Sample size calculation for comparing 2 proportions by PS software

Alpha α = 0.05, Power = 0.8, m = 1

Thus, anticipating 10% incomplete data, this study will recruit 165 children with Cerebral Palsy.

18. Sampling Method and Subject Recruitment

All patients with cerebral palsy who attended the Paediatric Neurology and Rehabilitation Clinic within the period of the study who fulfil the inclusion and exclusion criteria will be recruited in this study after obtaining parental consent. If parents are not around, the consent will be obtained from guardians or legally acceptable representatives. There will be no randomisation.

Consent from parents or guardians or other legally acceptable representative will be obtained for children with cerebral palsy. Permission from the parents or guardians or other legally representative is sufficient for the involvement of patients from 7 to less than 18 years old with physical disabilities or incapable of comprehending the research process or unable to make a decision or has a limited mental capacity (such as severe mental retardation). Assent will be obtained from children age 7 to less than 18 years old who have a good understanding of the research processes, informed about what they are expected to do and has obtained permission from their parents or guardians.

19. Research Tool

There are 2 research tools used in this study.

19.1 Case Report Form (Appendix 1)

This will include information on the sociodemographic data, dietary history and feeding problems which will be retrieved from the patients or the parents or guardian or legally acceptable representatives.

19.2 Data Collection Form (Appendix 2 and 3)

This form includes information on the medical history, physical disabilities, physical examination findings and anthropometric measurements that will be retrieved from the case notes during the clinic follow up. Latest blood investigations results available within 1 year from the study date will be recorded.

20. Data Collection Method

The data collection will be taken on the same day of clinic visit. The researcher or attending neurologist will identify cases of cerebral palsy. After the attending medical officer or neurologist has reviewed the patients' general condition, completed the physical examination, addressed the patients issues or problems and given appropriate treatment, consent will be obtained by the researchers in the same clinic room before the patients leaves the clinic visit. Once the patient or the parent has consented to join the study, data will be collected by filling up the case report form (Appendix 1) and data collection form (Appendix 2 and 3).

The study task involve data collection on information from the parent or caregiver which will be obtained using a structured interview based on previous studies done in Malaysia (Zainah et al, 2001). The questions included factors that can potentially be associated with malnutrition based on previous studies that explored predictors of poor nutrition and growth in children with cerebral palsy as well as their dependencies of daily activities. (Cheah et al 2009, Win et al 2014).

Information on clinical assessment of types of cerebral palsy and the physical impairment (gross and fine motor), classification of the severity of impairment either mild, moderate

or severe will be recorded according to GMFCS scoring system that will be retrieved from the patients' case notes. Documentation on other physical signs of malnutrition will also be recorded.

Anthropometric measurements including the patients' weight, height or recumbent length and body mass index (BMI) will be retrieved from the case notes. These measurements are taken routinely at each clinic visit or ward admission. The weight are measured using a digital measuring scale. For children who are unable to stand, the weight are calculated as the difference between the weight of the caregiver holding the child and the weight of the caregiver alone. Height or length of patients able to stand are measured using a stadiometer. Children who are unable to stand, they are measured lying down. The length of children with contractures are measured in segments using a flexible tape measure to measure the tibial length and estimated height will be calculated using the formula by Stevenson 1995. All measurements are recorded to the nearest 0.1 cm and 0.1 kg.

Results of routine blood investigations consisting of full blood count (FBC), liver function test (LFT), renal profile (RP) and serum iron level taken within 1 year of the study period will be retrieved from the case notes.

Follow ups will be continued by the managing neurologist. Patients will only participate once in this study. If patients are seen again within the study period, they would not be included in the study. If the patients are noted to be malnourished from the examination in the clinic or ward admission, patients will be referred to dietician for further management. Collected data will be keyed in and analysed at the end of the study period.