STUNTING AND ITS ASSOCIATED FACTORS AMONG CHILDREN BELOW FIVE YEARS OLD IN THE EAST COAST OF PENINSULAR MALAYSIA: FINDINGS FROM THE NATIONAL HEALTH AND MORBIDITY SURVEY 2016

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2020

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By

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Research project submitted in partial fulfilment of the requirement for the degree of Master of Public Health

JUNE 2020

ACKNOWLEDGEMENT

In the name of Allah, the Most Compassionate, the Most Merciful. Salutation is upon His Messenger Muhammad S.A.W., his family and his companions. I would like to express my deepest gratitude and thanks to the following individuals who have helped and guided me during the preparation of this research project report.

1. Assoc. Prof Dr Rohana Abdul Jalil, Main supervisor and Lecturer from Department of Community Medicine, USM
2. Dr Noor Aman A. Hamid, Co-supervisor and Lecturer from Department of Community Medicine, USM
3. Dr Mohd Azahadi Omar, Co-supervisor (field) and Head of Biostatistics & Data Repository Sector at Institute of Public Health
4. Dr Noor Hashimah Abdullah, Co-supervisor (field) and Principal Assistant Director of Epidemiology (Non-Communicable), Kelantan Health State Department
5. All my lecturers from Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia who have given guidance for the research project report and the course
6. My family especially my parents Haji Haron Abdul Rahman and Hajjah Saodah Saibon for the endless prayers throughout this journey, my beloved wife Dr Nawal Nabilah and our little Muhammad Rizqi for all the sacrifices and supports, and my parents-in-law for the continuous encouragement
7. My fellow colleagues of Master of Public Health 2019/2020

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LIST OF SYMBOLS

%	Percent
=	Equal to
≥	More than and equal to
≤	Less than and equal to
>	More than
<	Less than

LIST OF ABBREVIATIONS

AdjOR	Adjusted Odds Ratio
ASEAN	Association of South East Asian Nations
BMI	Body mass index
CI	confidence interval
IFLS	Indonesian Family Life Survey
HAZ	height-for-age Z-score
IQR	interquartile range
kg	kilogram
MOH	Ministry of Health
NHMS	National Health and Morbidity Survey
OR	odds ratio
ROC	Receiving Operating Curve
SD	standard deviation
SGA	Small for Gestational Age
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

ABSTRAK

KEBANTUTAN DAN FAKTOR-FAKTOR YANG BERKAITAN DENGANNYA DALAM KALANGAN KANAK-KANAK BAWAH UMUR LIMA TAHUN DI PANTAI TIMUR SEMENANJUNG MALAYSIA: PENEMUAN DARI TINJAUAN KESIHATAN DAN MORBIDITI KEBANGSAAN TAHUN 2016

Kebantutan adalah ketidakupayaan kanak-kanak untuk mencapai potensi ketinggian sejajar dengan usia mereka. Bantut merupakan satu bentuk malpemakanan yang tergolong dalam kumpulan kekurangan zat makanan. Kanak-kanak didefinisikan sebagai terbantut jika nilai tinggi-untuk-umur mereka kurang daripada dua sisihan piawai median berdasarkan Piawaian Pertumbuhan Kanak-kanak Pertubuhan Kesihatan Sedunia. Tujuan kajian ini adalah untuk mengenalpasti peratusan kebantutan serta faktor-faktor berkaitan dalam kalangan kanak-kanak di bawah umur lima tahun di pantai timur Semenanjung Malaysia. Kajian ini menggunakan data dari Tinjauan Kesihatan dan Morbiditi Kebangsaan (NHMS) tahun 2016. Tinjauan Kesihatan dan Morbiditi Kebangsaan (NHMS) adalah survei berasaskan populasi juga merupakan data tambahan rutin terhadap isu-isu kesihatan di Malaysia. Regresi logistik berganda telah digunakan untuk membandingkan antara kumpulan bukan terbantut dan kumpulan terbantut. Peratusan kebantutan dalam kalangan kanak-kanak bawah umur lima tahun di kawasan pantai timur ini adalah 26.2%. Apabila dipecahkan mengikut negeri, Kelantan menunjukkan jumlah anak terbantut tertinggi di wilayah ini, yakni sebanyak 28.8% diikuti oleh Pahang dan Terengganu, masing-

masing 26.2% dan 23.4%. Faktor-faktor yang berkaitan dengan kebantutan dalam kajian ini ialah kanak-kanak yang berada dalam kategori umur 24-59 bulan (AdjOR; 1.52, 95% CI: 1.26, 1,83), kanak-kanak lelaki (AdjOR; 1.47, 95% CI: 1.23, 1.76), kanak-kanak Orang Asli (AdjOR; 2.84, 95% CI: 1.86, 4.32), kanak-kanak yang kurang berat lahir 1500-2499 gram (AdjOR; 1.86, 95% CI: 1.36, 2.55), dan isi rumah yang mengamalkan pembuangan sisa yang tidak bersih (AdjOR; 1.42, 95% CI: 1.16, 1.74). Kesimpulannya, peratusan kebantutan dalam kalangan kanak-kanak bawah umur lima tahun di pantai timur Semenanjung Malaysia masih tinggi dan program-program intervensi yang mensasarkan faktor-faktor berkaitan adalah perlu bagi menurunkan peratusan kanak-kanak terbantut di wilayah ini.

Kata kunci: malpemakanan, kebantutan, kanak-kanak, faktor-faktor berkaitan

ABSTRACT

STUNTING AND ITS ASSOCIATED FACTORS AMONG CHILDREN BELOW FIVE YEARS OLD IN THE EAST COAST OF PENINSULAR MALAYSIA: FINDINGS FROM THE NATIONAL HEALTH AND MORBIDITY SURVEY 2016

Stunting is the incapability of the children to achieve their potential height for their age. Stunting is a form of malnutrition belong to the undernutrition group. Children are defined as stunted if their height-for-age value is less than two standard deviations of the World Health Organization Child Growth Standards median. This study was aimed to determine the proportion of stunting among children below five years old and its associated factors in the east coast of Peninsular Malaysia. This study utilised data from the National Health and Morbidity Survey (NHMS) 2016. NHMS is the population-based survey which supplement routinely available data on trends of issues in health, health needs and expenditure in the Malaysian nation. Multiple logistic regression was used to compare between non-stunting and stunting group. The proportion of stunting among children below five years old in this east coast region was 26.2%. When divided by state, the highest proportion of stunting was in Kelantan, which was 28.8% , 26.2% and 23.4% for Pahang and Terengganu, respectively. Factors associated with stunting in this study were children in the age group of 24-59 months (AdjOR; 1.52, 95% CI: 1.26, 1.83), boys (AdjOR; 1.47, 95% CI: 1.23, 1.76), being *Orang Asli* children (AdjOR, 2.84; 95% CI: 1.86, 4,32), children with low birth weight from 1500 to 2499 grams (AdjOR, 1.86; 95% CI: 1:36, 2:55), and households

that practice unsanitary waste disposal (AdjOR; 1.42, 95% CI: 1.16, 1.74). In conclusion, the proportion of stunting among children under the age of five on the east coast of Peninsular Malaysia is high and intervention programs should be intensive and focussed public health program should target these factors to reduce the stunting prevalence in this region.

Keyword: malnutrition, stunting, children, factors associated

CHAPTER 1

INTRODUCTION

1.1 Study background

Malnutrition has accounted for nearly half of the world's five-year-olds death (UNICEF, 2020). It puts children more susceptible to common infections, increases their severity, delays recovery and is at greater risk of dying from these diseases (UNICEF, 2020). Malnutrition is divided into two categories, undernutrition and overnutrition. Undernutrition includes stunting, underweight, wasting, and micronutrient deficiencies while overnutrition includes overweight, obesity, and diet-related noncommunicable diseases such as diabetes, heart disease, stroke, and cancer (WHO, 2016).

Malnutrition relates to the first two goals from the Sustainable Development Goals (SDGs) comprised of 17 goals, where the primary two goals have highlighted on malnutrition and hunger issues; which are #1 No Poverty and #2 Zero Hunger. Both goals are considered as the main pillars of SDGs which play a significant role to achieve prior to the other goals. Eradication poverty in all forms to prevent hunger is the first aim of the SDG, whereas zero hunger defines as end hunger, achieve food security through nutrition, and promote agriculture to prevent malnutrition, especially wasting and stunting in children by 2030 (United Nations Development Programme, 2019). In terms of child stunting, The Global Action for Nutrition 2025 target is 40% reduction of stunting prevalence worldwide (WHO, 2014).

Children who are stunting will have a higher likelihood of obesity and metabolic complications as they grow older due to decreased energy expenditure in their body (Uauy *et al.*, 2011). Stunting during early life - especially in the first 1000 days of conception until they are two years old - any disrupted growth has adverse effects on children (WHO, 2019b). A theory related to stunting named Foetal programming or Barker Theory formulated by Dr. David Barker postulated that stunting children will lead to chronic diseases during adulthood (Kwon and Kim, 2017).

There is one study done by Dewey and Huffman (2009) which states that the cumulative difference in the height of Malawian children with WHO growth standard median at three years old is 10 cm. Of these, 20% were present at birth, 20% increased during the first six months, 50% occurred at 6–24 months and the remaining 10% during the third year. Since children are introduced to other foods besides breast milk at the age of 6 months and above, this period is a critical period for the growth and development of the children. Also, during this time, children are mobile and less dependent on their parents. These environmental factors also affect their growth.

The WHO conceptual framework on Childhood Stunting classifies the immediate causes of child stunting under these comprehensive elements (and sub elements): household and family factors (maternal factors and home environment), inadequate complementary feeding (poor quality foods, inadequate practices, and food and water safety), breastfeeding (inadequate practices), and infection (clinical and subclinical infection). It categorises corresponding contextual factors under the broad element, community and societal factors, with the following sub-elements: political economy; health and health care; education; society, and culture; agriculture and food systems; and water, sanitation, and environment (Figure 1.1).

In Malaysia, as a developing country; however, stunting is still a major problem in public health (Wong Jyh Eiin, 2019). Stunting is the most prevalent form of malnutrition among children in Malaysia compared to underweight and wasting (de Onis and Branca, 2016) (Institute for Public Health, 2016b). One in five children in Malaysia is estimated to be stunted. The stunting prevalence among under five children in Malaysia is 20.7%, which is comparable to the global prevalence at 21.3% (UNICEF, 2020). Within ten years' time, the prevalence of stunting in Malaysia has increased from 17.2% in 2006 to 20.7% in 2016 (Institute for Public Health, 2016b). Hence, urgent action is needed from the policy development level to the implementation level to tackle this issue.

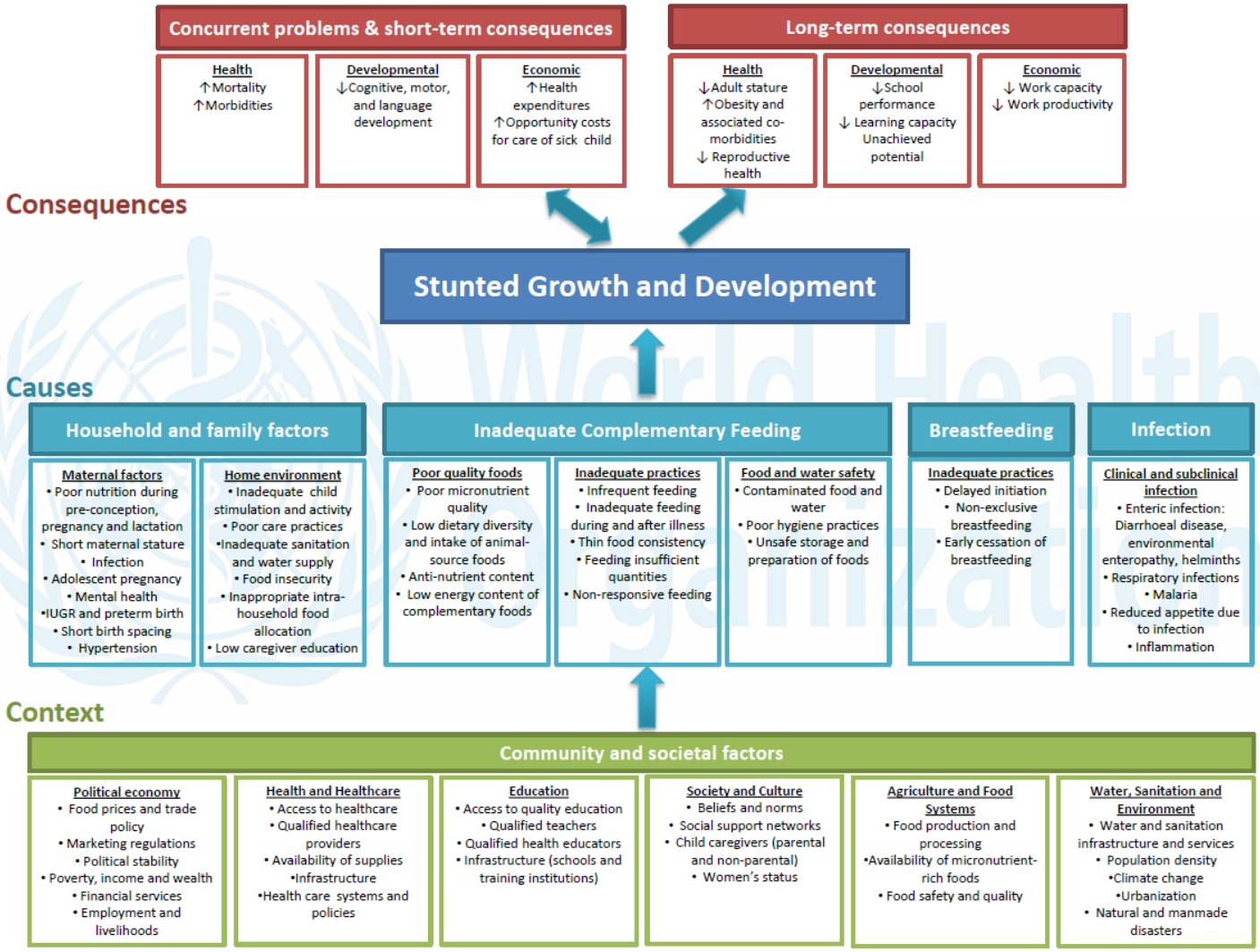


Figure 1.1: WHO conceptual framework on Childhood Stunting: Context, Causes, and Consequences (Stewart *et al.*, 2013)

1.2 Problem statement

The global prevalence of stunting is 21.3% (UNICEF, 2020). While the national prevalence for stunting is 20.7%, three states in the East Coast region of Peninsular Malaysia recorded the highest prevalence: Kelantan 34.0%, Terengganu 26.1%, and Pahang 25.7% (Institute for Public Health, 2016b).

In 2019 it was estimated that approximately 144 million children under five are affected with stunting worldwide (UNICEF, 2020). In Malaysia, about one in five children below five years old is affected with stunting (Institute for Public Health, 2016b). Due to the increased prevalence within ten years' time from 17.2% (2006) to 20.7% (2016), it shows that stunting is one of the major problems in public health in Malaysia (Institute for Public Health, 2016b). It was the highest prevalence form of undernutrition if compared to underweight and wasting which is 13.7% and 11.5%, respectively. And most recently, the Ministry of Health released their National Health and Morbidity Survey report last year, again showing that the prevalence of stunting has not decreased but has risen up to 21.8% (Institute for Public Health, 2020).

Stunting differs from underweight and wasting, and even more important. It's not just about height. It's beyond the height. Stunting can reflect chronic nutritional deficiencies and causes one million child deaths every year (Stephen Adkisson, 2014). For those who survive, they have to deal with irreversible short term and long term effects. Their cognitive, motor, and language development will decline. In schools, their learning and academic achievement will be affected. As they grow up, their productivity at work has also been negatively impacting the economy of a country. They are prone to chronic illnesses that cost a lot to treat and cause mortality to increase (de Onis and Branca, 2016; Hoddinott *et al.*, 2013; Stewart *et al.*, 2013).

Majority of the studies in Malaysia have looked into child malnutrition rather than focussing on stunting alone. For example, a study in preschool children aged between one and six years in Baling, Kuala Kangsar, Kuala Terengganu and Machang found chronic undernutrition, with 22.5% of the children stunted and 9.7% wasted (Wan Manan Wan Muda *et al.*, 2019). In addition, they were conducted at a small scale study in a rural area but not a nationwide study (Khambalia *et al.*, 2012).

1.3 Rationale of the study

Currently little is known about stunting in Malaysia and there is almost no literature showing the evidence on stunting in the east coast of Malaysia, where the prevalence is above the national average. Therefore, there is an urgent need to conduct studies looking into the determinants of stunting in this region. As the prevention is better than cure, hopefully, the findings of these nationwide findings will inform the policy makers in managing stunting and food assistance program to improve nutritional status of children under five in Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 Malnutrition

Malnutrition, in all its types, comprises undernutrition (stunting, underweight, wasting), insufficient minerals or vitamins, obesity, overweight, and subsequent diet-related noncommunicable diseases (WHO, 2018). The term malnutrition discusses three wide groups of situations. Firstly undernutrition, which includes stunting (low height-for-age), underweight (low weight-for-age) and wasting (low weight-for-height). Second, micronutrient-related malnutrition, which includes micronutrient insufficiencies (a deficiency of vital minerals and vitamins) or micronutrient excess. Third, obesity, overweight, and diet-related noncommunicable diseases (such as stroke, heart disease, diabetes, and some cancers) (WHO, 2018).

Globally, about 45% of deaths among under five children are related to malnutrition (WHO, 2018). This mostly occurs in low- and middle-income countries. At the same time, overweight and obesity have also increased in these countries. (Akombi *et al.*, 2019). This phenomenon of nutrition transition is called the double burden of malnutrition. The double burden of malnutrition is presence of undernutrition (stunting, wasting, underweight) and overnutrition (overweight, obesity) in the same individual, community, population, nation or region level (WHO, 2019a). The double burden of malnutrition is very challenging because to reduce the prevalence of undernutrition at the lowest level and at the same time, keeping

overweight and obesity at par with no exception among ASEAN countries (Rachmi *et al.*, 2018).

2.2 Stunting

As stated earlier, stunting is a form of malnutrition belong to undernutrition group. Stunting is the incapability of the children to achieve their potential height for their age. Children are defined as stunted if their height-for-age value is less than two standard deviations of the World Health Organization Child Growth Standards median (WHO, 2006). But stunting is not just about height, it is the most common measurement for chronic child malnutrition (Derek Kok, 2019). Childhood stunting is an accurate reflection of social inequalities and the world's best indicator of children's well-being (de Onis and Branca, 2016).

Stunting is the undeniable major result of malnutrition and recurrent infections during the first 1000 days of a child's life (UNICEF, 2020). It means that serious attention is needed to maternal nutritional status, new born and child under 2 years old. Thus, there has been an increased commitment by countries to emphasis on active interventions during the opportune window to prevent malnutrition during the “first 1,000 days,” from pregnancy through the first 2 years of life (Eka *et al.*, 2018; Wan Manan Wan Muda *et al.*, 2019). Therefore, WHO has put child stunting reduction is the first of six goals in the Global Nutrition Targets for 2025 (WHO, 2014).

2.3 Prevalence stunting worldwide

In 2019, the global prevalence of stunting, wasting, and overweight among children less than five years old was 21.3% (144 million), 6.9% (47 million), and 5.6% (38 million) respectively (UNICEF, 2020). Global stunting prevalence was observed to decline from 32.4% to 21.3% between 2000 and 2019, and the number of affected children has dropped from 199.5 million to 144.0 million (UNICEF, 2020). In a simple word, stunting prevalence has dropped from one in three to just over one in five children between 2000 and 2019 (UNICEF, 2020). The prevalence of stunting showed a significant difference between the region with Eastern and Southern, West and Central Africa both at 32.7%, North Africa and Middle East at 14.3%, the Pacific and East Asia at 11.0%, Caribbean and Latin America at 9.0%, Central Asia and Eastern Europe at 7.7%, and North America at 2.6% (Sarma *et al.*, 2017; UNICEF, 2020)

Although the global prevalence of stunting is reducing in trend for the past two decades, it is still high in sub-Saharan Africa and South Asia. South Asia leads the prevalence of stunted children worldwide, 33.2%. It was estimated that nearly two out of five children in this region were stunted. Besides stunting, the wasting prevalence in South Asia is high, 15.2% or more than half of all wasted children lived in South Asia while 3.1% of children are overweight (UNICEF, 2020).

For South-East Asian countries, the prevalence of stunting in Indonesia is 37.2%, higher than Philippines 33.6% and Vietnam 22.7% (Beal *et al.*, 2018; Eka *et al.,* 2018). In Brunei, the stunting prevalence was 24%. However, the study was limited among children aged 0-24 months (Boylan *et al.*, 2017). A higher stunting prevalence was estimated in Bangladesh, by which 41% of under five children were

found to be stunted (Sarma *et al.*, 2017). This study also analysed that stunting was more affected in rural setting (43%) rather than urban areas (36%). In West Africa, for example, a study conducted in Burkina-Faso involving 6337 children under five showed stunting prevalence was 34.8%. This analysis was a population-based cross sectional study (Poda *et al.*, 2017)

Moving to the African region, most of the countries were using their Demographic and Health Survey (DHS) for their analysis. For example in Ghana, stunting prevalence among their under five children was 28% (Mzumara *et al.*, 2018). A more significant sample size analysis involving 24, 529 children below five years old in Nigeria found that the prevalence of stunting was 36.7% (Akombi *et al.*, 2017). The prevalence of stunting among 12, 328 children aged 0-59 months in Zambia was 40% (Mzumara *et al.*, 2018). Rakotomanana *et al.* (2017) found that the stunting prevalence among under five children in Madagascar was 48.5%. A higher prevalence of stunting has been reported in rural northwest of Ethiopia. Among children between the ages of 6-59 months, the overall prevalence of stunting reached 64.5% of which 37.7% and 26.8% were moderately and severely stunted, respectively (Tariku *et al.*, 2017). This high prevalence may be due to the study area located in the rural areas, most of whom are farmers and from low socioeconomic groups.

2.4 Prevalence of stunting in Malaysia

Malaysia, as a developing country, has also not been exempt from global trends. Malnutrition remains an enormous challenge in the Malaysian population. In this food secure country, all people should be able to have sufficient and healthy food,

not living in fear of sudden loss to food access, economically or physically. Food is available and affordable in Malaysia.

The prevalence of child stunting in Malaysia has remained high over the past decade. The threshold of a country that was classified as experiencing stunting is when the stunting prevalence among under five children is ≥ 20% (Global Nutrition Report, 2018). Based on the National Health and Morbidity Survey (NHMS), the prevalence of stunting was increasing from 17.2% in 2006, 17.7% in 2015, 20.7% in 2016, and recently published for 2019 was 21.8% (Institute for Public Health, 2016b; Institute for Public Health, 2020; Wan Manan Wan Muda *et al.*, 2019). In the same survey in year 2016, it was documented that the prevalence of underweight, wasting, and overweight was 13.7%, 11.5%, and 1.6% respectively (Institute for Public Health, 2016b). Earlier in 2010 and 2011, The South East Asian Nutrition Surveys (SEANUTS) conducted a cross-sectional nutritional study among 3542 children ages six months to 12 years old in Malaysia discovered that the prevalence of stunting was 8.4% (Poh *et al.*, 2013).

Other than nationally presented data, there are some studies conducted at the local level. For example, a study done among under five children in Tumpat, Kelantan revealed that the stunting prevalence among them was 69% (Cheah *et al.*, 2012). Another study done in Bachok, a district in Northeastern of Peninsular Malaysia, found that the stunting prevalence among children aged 2-12 years old was 65.2% (Ali Naser *et al.*, 2014). This study was done among the low-income households who were receiving financial assistance. This may explain why the stunting prevalence slightly higher than the previous research as well as national prevalence (Ali Naser *et al.*, 2014; Cheah *et al.*, 2012).

2.5 Implications of stunting

The implications of stunting can be divided into short term and long term. Stunting is not only the children who fail to reach their linear growth potential, yet they suffer permanent physical and cognitive impairment (de Onis and Branca, 2016). Generally, the most important consequence is stunting will increase the morbidity and mortality risk of the child (Stewart *et al.*, 2013). Impaired behavioural development in initial life, performing poorly in school or late bloomer, tend to score lower marks and have lower cognitive capability are among consequences that have been observed in stunted children (Dewey and Begum, 2011; Hoddinott *et al.*, 2013; Prendergast and Humphrey, 2014). Other than that, they suffer from delayed motor skills development such as crawling and walking, being emotionless and show reduced exploratory behaviour (Brown and Pollitt, 1996). Brain development is very important in the first two years of life. Pathologically, in malnutrition children, the apical dendrite from the brain cortex appears to be shortened, reducing the number of spines and presence of abnormal forms which is known as the dysplastic spine (Benítez-Bribiesca *et al.*, 1999; Cordero *et al.*, 1993).

Several studies have been conducted to show the long-term effects or chronic diseases among stunted children in their adult life. A research done by Whincup *et al.* (2008) shows that a low birth weight among newborn has demonstrated to have high blood pressure, kidney disease, and altered glucose metabolism during adulthood. All those findings are consistent with another study (Victora *et al.*, 2008). From an economic perspective, there is an association between short stature adult and labour products such as lesser incomes & more reduced efficiency (Dewey and Begum, 2011; Hoddinott *et al.*, 2013). Last but not least, stunted children are at risk to be obese during adult life (Adair *et al.*, 2013; Stettler, 2007; Wilson *et al.*, 2012).

2.6 Determinants of stunting

There are many factors that contributed to stunting. Many studies have been conducted at the local, national, to the international level to study the determinants of stunting and strategies to prevent it. Stunting not only occur after a baby or child was born. It often starts in utero and persist for at least the first two years in the post-natal period. The critical window in which failure to grow as part of an active process of becoming stunted is a period of conception up to two years old (the first 1000days) (Victora *et al.*, 2010). Thus, the preventive measure starts during antenatal care of the mother to ensure wellbeing of the offspring. This is in line with fetal programming or Barker Theory. Dr David Barker postulates that the environment surrounding of fetal life during intrapartum will influence the outcome or chronic diseases during adulthood (Kwon and Kim, 2017).

As for sociodemographic factor, previous studies show the age of children affected with malnutrition is around 24 months or two years old. A research was done to determine factors associated with malnutrition in Tumpat, a district in Kelantan state shows the average age of children studied was 24.8 ± 17.77 months (Cheah *et al.*, 2012). This coincides with other studies done in Brunei and Bangladesh, which age affected with stunting range from 12-24 months and 12-23 months respectively (Boylan *et al.*, 2017; Sarma *et al.*, 2017). A large-scale study involving 72 countries found similar findings (Bommer *et al.*, 2019). However, some studies discovered that the age affected a little bit younger (20.6 months) and older (27.5 months) (Mas-Harithulfadhli-Agus *et al.*, 2018; Wong *et al.*, 2014).

The sex of the children affected by malnutrition varies. Some studies found boys are more affected if compared to girls (Bork and Diallo, 2017). For example, a

study done in Brunei found that male children are two times likely to be stunted if compared with female children (Boylan *et al.*, 2017). In a systematic review of malnutrition in Malaysia, Khambalia *et al.* (2012) observe boys have a higher prevalence for both underweight and overweight than girls.. On the contrary, two other studies analysed that a higher percentage of malnutrition occurrence among girls if compared to boys (Mas-Harithulfadhli-Agus *et al.*, 2018; Wong *et al.*, 2014).

Low birth weight is the most common factor associated with malnutrition. Many kinds of research have proved this. In Bangladesh, a study found that child with low or very low birth weight was more likely to be stunted compared to normal weight (Sarma *et al.*, 2017). The same finding was observed during studies conducted to identify factors associated with malnutrition among children below five in Indonesia and Myanmar (Khaing *et al.*, 2019; Rachmi *et al.*, 2016). As an addition, this is found elsewhere in our country (Cheah *et al.*, 2012; Wong *et al.*, 2014).

Apart from the low birth weight of the baby, the mother's weight shows another factor for child malnutrition. In Terengganu, a case control study was done to identify the risk factors of malnutrition among under-five children noted that a higher number of cases mothers were underweight (Wong *et al.*, 2014). This is consistent with Rachmi *et al.* (2016) and (Khaing *et al.*) findings in their study. Besides, maternal height also gives a significant factor related to malnutrition. A cross sectional study among two to five years old children in Gaza-Strip Palestine found that mother's height had a considerable influence on the odds of stunting (El Kishawi *et al.*, 2017). Rachmi *et al.* (2016) say factors associated with the higher possibility of being underweight and stunted were having a mother or father who had short stature.

Low parents' educational level, especially the mother's education, was strongly associated with stunting in numerous studies. Generally, the lower the educational level, the higher probability to get stunted or malnutrition. In 2014, a study was done in in Kelantan to determine the association between household food insecurity and nutritional status found that there was a significant association between mothers' education level and household food insecurity (Ali Naser *et al.*, 2014). Similarly, this finding was observed in other Asian countries such as in Indonesia, Brunei and Bangladesh (Boylan *et al.*, 2017; Rachmi *et al.*, 2016; Sarma *et al.*, 2017). As an addition, there were two studies found that mothers of unemployed or housewives are associated with childhood malnutrition or stunting (Boylan *et al.*, 2017; Wong *et al.*, 2014).

Household income or household numbers always have been linked to poor nutrition outcomes in children. Locally, Cheah *et al.* (2012) found that low household income was associated with child stunting. The average income of the family was RM 655.34 ± 414.73. In another economic perspective, the mothers of malnutrition children did not have any personal asset showing the low household income of the family (Wong *et al.*, 2014). Families living in the poorest households were 2.17 times more likely to be stunted, a study did by Sarma *et al.* (2017) in Bangladesh. All of these households under the poverty line will have a higher proportion of food insecurity that later will lead to child malnutrition (Ali Naser *et al.*, 2014). Other than household income, household numbers also may be associated with child stunting as 36.6% of the family household of stunting offspring consisted of 10 or more people (Boylan *et al.*, 2017).

One of the components of feeding practices is breastfeeding. Breastfeeding duration was found to have an essential effect on stunting, underweight, and wasting

in children (Cheah *et al.*, 2012). A recent analysis by (Rachmi *et al.*, 2016) showed that children who were weaned before six months had a higher probability of stunting. The same study also noted that prolonged breastfeeding related to the increasing stunting prevalence among children. Still, there is a lack of evidence in this cross-sectional study to determine causal relationships. Both studies from Cheah *et al.* (2012) and Wong *et al.* (2014) found that all children are reported to not meet the recommended Nutrition (RNI) calorie requirements.

One of the most critical factors to stunting specifically or malnutrition in general and not to left behind is food insecurity. Previous studies show the importance of it that will impair the nutritional status of the child. Two studies from our countries found that children who were food insecure were 3.04 times more likely to be stunted and more than half (62%) of the malnutrition families reported that they experienced some kind of food insecurity (Ali Naser *et al.*, 2014; Wong *et al.*, 2014). This is in parallel with another study that shows families that reported to have food insecurity were likely to have stunted offspring (Sarma *et al.*, 2017).

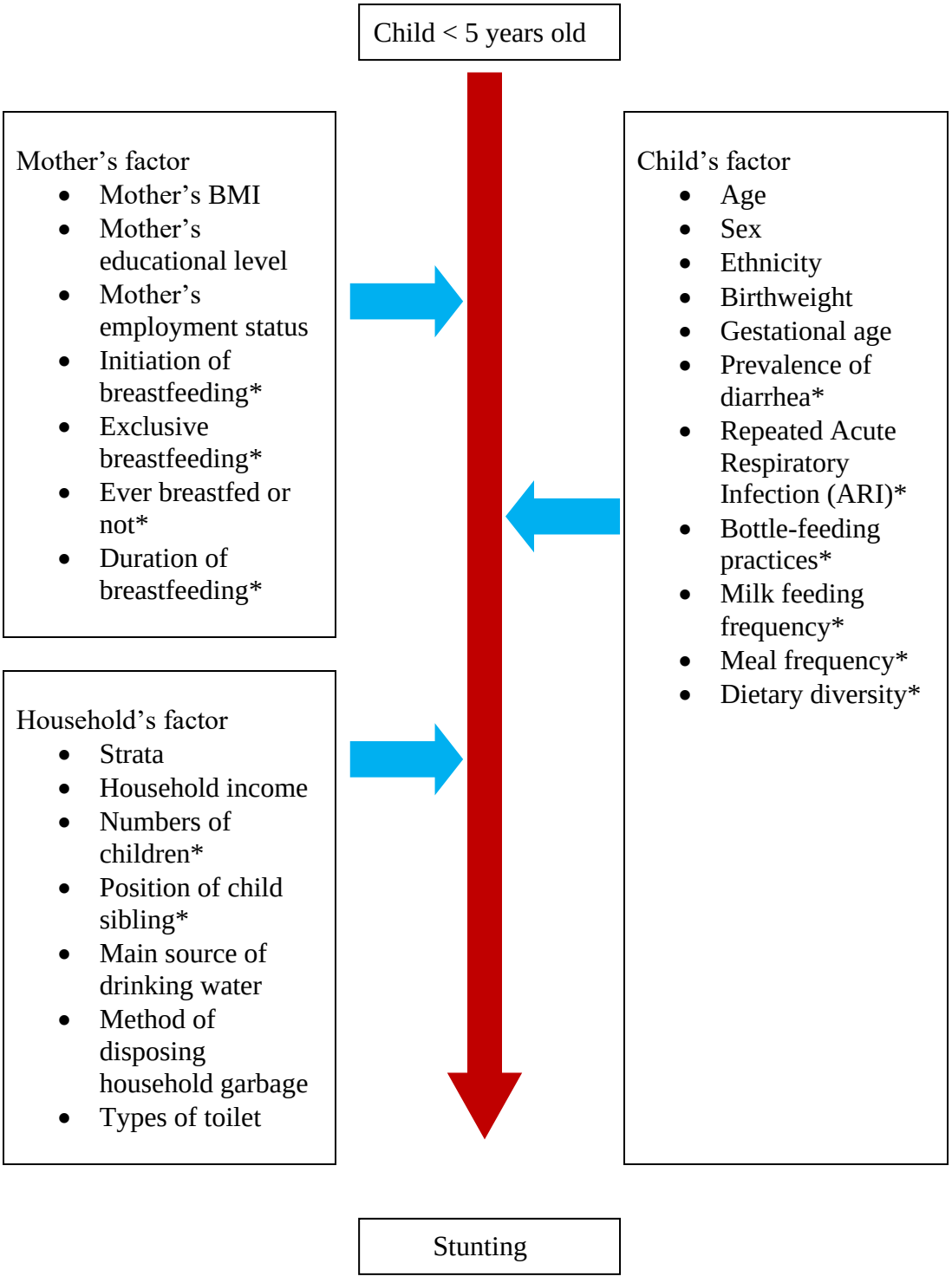
Environment factor plays a major role in public health issue including nutritional aspect. Irregular waste management can result in repeated faecal cross-contamination. This cross-contamination can lead to an illness called environmental enteropathy. This disease causes malnutrition and stunting by increasing intestinal permeability to bacteria and lowering the rate of nutrient absorption in the gastro-intestinal tract (GIT) system (Lulu'ul Badriyah and Ahmad Syafiq, 2017). According to the study done in five districts in Terengganu state in Malaysia, it was demonstrated that a majority of malnutrition cases had a pour or pit toilet. However, they used piped water located inside their houses (Wong *et al.*, 2014). In Indonesia, it is found that

children aged less than 24 months living in households using untreated drinking water and unsanitary latrines have a higher chance of stunting. (Torlesse *et al.*, 2016).

2.7 Conceptual framework

Based on literature reviews, there were several factors associated with stunting among children below five. The identified factors were divided into child's factors including age, sex, ethnicity, birth weight, gestational age, prevalence of diarrhoea, repeated Acute Respiratory Infection (ARI), bottle-feeding practices, milk feeding frequency, meal frequency, and dietary diversity; mother's factors including mother's BMI, mother's education level, mother's employment status, breastfeeding practices, duration of breastfeeding, and practice of exclusive breastfeeding; household's factors including strata, household incomes, source of water, types of latrine, and types of waste disposal.

However, due to limitation of secondary data that were used in this study, numbers of children and position of child sibling were excluded as those data were not available.



*Factors not included in the study

Figure 2.1: Conceptual framework of the study

CHAPTER 3

RESEARCH QUESTIONS, OBJECTIVES AND HYPOTHESIS

3.1 Research Question

What is the proportion of stunting and its associated factors among children below five years old in the East Coast of Peninsular Malaysia?

3.2 Objectives

3.2.1 General Objective

To determine the proportion of stunting and its associated factors among children below 5 years old in the East Coast of Peninsular Malaysia

3.2.2 Specific Objectives

1. To determine the proportion of stunting among children below five years old in the East Coast of Peninsular Malaysia
2. To determine the factors associated with stunting among children below five years old in the East Coast of Peninsular Malaysia

3.3 Hypothesis

The proportion of stunting among children below five years old in the east coast of Peninsular Malaysia are associated with low birth weight, mothers' BMI, parents' educational level and occupation, household income and environmental factors.

CHAPTER 4

METHODOLOGY

4.1 Study Design

This is a cross-sectional study

4.2 Study area

The study area was the east coast of Peninsular Malaysia which consisted of three states (Kelantan, Terengganu & Pahang) (Figure 4.1)

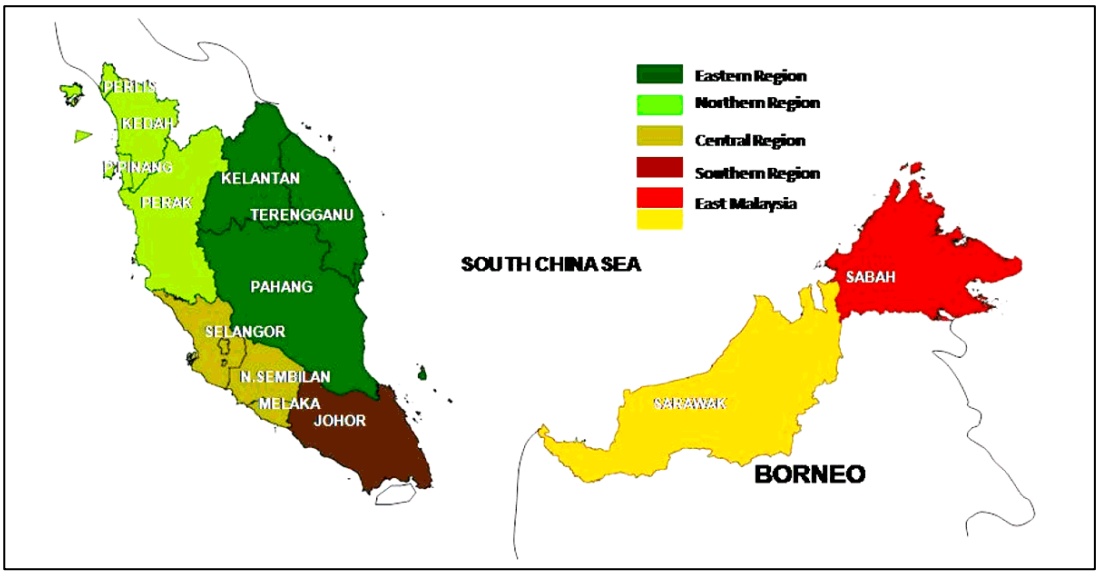


Figure 4.1: Map of East Coast of Peninsular Malaysia

4.3 Study Duration

This study was carried out from October 2019 to June 2020

4.4 Reference population

All children below five years old residing in the East Coast of Peninsular Malaysia

4.5 Source population

All children below five years old residing in the East Coast of Peninsular Malaysia who participated in the National Health and Morbidity Survey (NHMS) in year 2016

4.6 Sampling frame

All children below five years old in the East Coast of Peninsular Malaysia who participated in NHMS in the year 2016 and fulfilled the study criteria

4.7 Inclusion and exclusion criteria

1. Inclusion criteria
    i. All children below five years old
2. Exclusion criteria
    i. Respondent with incomplete data of more than 20% in National & Health Morbidity Survey (NHMS) 2016

4.8 Sample size calculation

a. Sample size for objective 1

For objective 1, to determine the proportion of stunting among children below five years old in the East Coast of Peninsular Malaysia, the sample size calculation was done by using estimation for a single proportion formula by PS Software. Type 1 error, α was set at 0.05 and precision of estimation, Δ was set at 0.025. Prevalence of stunting, P was obtained from the literature search. An additional 10% in sample size calculation was done due to the possibility of missing or incomplete data as shown in Table 4.1.

Table 4.1: Calculation of sample size to calculate proportion

α	Δ	**P**	**n**	**n+10%**	**Source**
0.05	0.025	0.21	1052	1169	(UNICEF, 2020)
0.05	0.025	0.20	1009	1222	(Institute for Public Health, 2016b)
0.05	0.025	0.19	969	1077	(El Kishawi *et al.*, 2017)
0.05	0.025	0.37	1433	1593	(Beal *et al.*, 2018)

α = 0.05, Δ = 0.025, P = population proportion, n = calculated sample size

b. Sample size for objective 2

For objective 2, to determine the factors associated with stunting among children below five years old in the East Coast of Peninsular Malaysia, the sample size calculation was done by using estimation for two independent proportion formula by PS Software as shown in Table 4.2.

Table 4.2: Calculation of sample size to calculate factors associated

Associated factors	P_0	P_1	m	α	Power	n	2n+10%	Source
Strata:								
Rural	0.37	0.43	1	0.05	80%	1043	2318	(Sarma *et al.*, 2017)
Sex:								
Boy	0.46	0.53	1	0.05	80%	797	1772	(El Kishawi *et al.*, 2017)
Birth weight:								
Low birth weight	0.46	0.51	1	0.05	80%	1565	3478	(Nshimyiryo *et al.*, 2019)
Household income:								
Poor household	0.55	0.59	1	0.05	80%	1059	2354	(Aheto *et al.*, 2015)
Source of drinking water:								
Unimproved	0.56	0.62	1	0.05	80%	769	1710	(Akombi *et al.*, 2017)

$\alpha = 0.05$, $\beta = 0.8$
P_0 = proportion of exposure among the control group based on literature review
P_1 = estimated proportion of exposure among cases
m = ratio between cases group and control group

Therefore, the final total sample size required for the study is **3478**.

4.9 Sampling method and subject recruitment

Although the total sample size required for this study was 3478 for both stunted and non-stunted children (below 5 years) in the East Coast of Peninsular Malaysia based on NHMS 2016, however, after considering the inclusion and exclusion criteria for the sample required, the total sample for analysis in this study was 2829 children. Therefore, all samples (n=2829) were included in the study.

4.10 Research tool

This study was utilised data from the National Health and Morbidity Survey (NHMS) in the year 2016. NHMS is a nationally representative health survey of population that covered all districts in 16 states in Malaysia. It is a population-based health survey designed to obtain information on the health status of Malaysians. It is routinely conducted by the team of researchers from the Institute for Public Health (IPH) and the report is readily available at their website. In NHMS 2016, all mothers aged 15–49 with last childbirth less than two years before the survey and their children under five years of age in the Selected Living (LQ) were the target population. The National Registration Department has provided birth registration from June 2014 to January 2015 to obtain a sampling frame.

4.11 Data collection

This study uses existing national research data. Permission for data access was obtained from the Director-General, Ministry of Health and the Director of Institute of Public Health. All cases were identified by a code number. The data was provided and anonymised in SPSS format and was analysed SPSS version 24 software. The variables needed from the data are shown as in the table below: