



Faculty of Medicine and Health Sciences

**Double Burden of Malnutrition and Its Associated Factors at Household
Level among Indigenous Communities in Sarawak**

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Double Burden of Malnutrition and Its Associated Factors at Household Level
among Indigenous Communities in Sarawak

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



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ABSTRACT

The increasing trend obesity in adults and persisting stunting in children remains a public health concern in Malaysia. However, information on the coexistence of this contrasting form of malnutrition called the double burden of malnutrition (DBM) among the indigenous communities in Sarawak is scarce. To not neglect the health of indigenous people, this cross-sectional study aims to determine the household-level DBM and its associated factors among the indigenous communities in Sarawak. Total of 286 mother-child pairs were recruited via multistage random sampling from six divisions in Sarawak. Using interviewer-administered questionnaires, demographic, socioeconomic, and food security status were collected. Two days 24-hour dietary recall for both mother and child were obtained to determine dietary intake, and to compute for Malaysian Healthy Eating Index (M-HEI) to assess dietary quality. Height and weight were measured following standard guidelines. Household with an overweight or obese mother with an undernourished child, who is either underweight, stunting or wasting is classified as DBM. Simple and multiple binary logistic regression analysis were performed to determine associated factors to DBM. In this study, 25.2% of the households had DBM, of which 12.9% were overweight/obese mother with a stunting child, 11.9% were overweight/obese mother with a wasting child, and 9.4% were overweight/obese mother with an underweight child. Younger maternal age, larger household size and higher household income per capita were associated with higher odds of DBM. In contrast, higher monthly non-food expenses and higher child M-HEI fish and seafood score were associated with lower odds of DBM. Further research is warranted to better understand the determinants associated with DBM among the indigenous communities in Sarawak.

Keywords: Double burden of malnutrition, obesity, stunting, indigenous, Sarawak

Beban Berganda Malpemakanan dan Faktor-faktor yang Berkaitan di Peringkat Isi Rumah dalam kalangan Komuniti Asli di Sarawak

ABSTRAK

Trend peningkatan obesiti dalam kalangan dewasa dan masalah bantut dalam kalangan kanak-kanak kekal sebagai masalah kesihatan awam di Malaysia. Walau bagaimanapun, maklumat tentang kewujudan bentuk malnutrisi yang bertentangan ini yang dipanggil "beban berganda malpemakanan" (DBM) dalam kalangan komuniti asli di Sarawak adalah terhad. Bagi tidak mengabaikan kesihatan penduduk asli, kajian rentas-susunan ini bertujuan untuk menentukan DBM di peringkat isi rumah dan faktor-faktor yang berkaitan dengannya dalam kalangan komuniti asli di Sarawak. Sejumlah 286 pasangan ibu-anak telah dipilih melalui persampelan rawak pelbagai peringkat dari enam bahagian di Sarawak. Menggunakan soal selidik yang dijalankan oleh pemeriksa, maklumat demografi, sosioekonomi, dan status jaminan kedapatan makanan telah dikumpulkan. Maklumat pengambilan makanan untuk ibu dan anak telah diperoleh melalui ingatan pengambilan makanan selama 24 jam selama dua hari untuk menentukan pengambilan makanan, dan untuk mengira Indeks Makanan Sihat Malaysia (M-HEI) bagi menilai kualiti pemakanan. Ketinggian dan berat badan diukur mengikut garis panduan. Isi rumah dengan ibu yang berat badan berlebihan atau obes bersama anak yang kurang nutrisi, sama ada kurang berat badan, terbantut atau susut, diklasifikasikan sebagai DBM. Analisis regresi logistik binari tunggal dan berganda dilakukan untuk menentukan faktor-faktor yang berkaitan dengan DBM. Dalam kajian ini, 25.2% isi rumah mempunyai DBM, di mana 12.9% adalah ibu yang berat badan berlebihan/obes bersama anak terbantut, 11.9% adalah ibu yang berat badan berlebihan/obes bersama anak yang mengalami susut, dan 9.4% adalah ibu yang berat badan berlebihan/obes bersama anak yang kurang berat badan. Usia ibu yang lebih muda,

saiz isi rumah yang lebih besar dan pendapatan isi rumah yang lebih tinggi setiap kapita berkaitan dengan kemungkinan DBM yang lebih tinggi. Sebaliknya, perbelanjaan bukan makanan bulanan yang lebih tinggi dan skor ikan dan hidangan laut M-HEI kanak-kanak berkaitan dengan kemungkinan DBM yang lebih rendah. Kajian lanjut diperlukan untuk lebih memahami faktor-faktor penentu yang berkaitan dengan DBM dalam kalangan komuniti asli di Sarawak.

Kata kunci: *Beban berganda malpemakanan, obes, bantut, asli, Sarawak*

TABLE OF CONTENTS

	Page
DECLARATION	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
ABSTRAK	iv
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
CHAPTER 1 INTRODUCTION	1
1.1 Study background	1
1.2 Problem statement	4
1.3 Significance of study	6
1.4 Research questions	7
1.5 Research objectives	8
1.6 Research hypothesis	8
1.7 Operational definition	8
CHAPTER 2 LITERATURE REVIEW	12

2.1	Overview of double burden of malnutrition	12
2.1.1	Levels of double burden of malnutrition	13
2.1.2	Operational definition of double burden of malnutrition	13
2.2	Overview of prevalence of double burden of malnutrition	14
2.2.1	Prevalence at household level	16
2.2.2	Prevalence among Malaysian indigenous communities	17
2.3	Factors associated with double burden of malnutrition	19
2.3.1	Demographic and socioeconomic characteristics	19
2.3.2	Food security status	23
2.3.3	Dietary intake and quality	25
2.4	Conceptual framework	28
2.4.1	UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020	28
2.4.2	Conceptual framework of study	30
2.5	Literature review summary	31
	CHAPTER 3 METHODOLOGY	32
3.1	Research design	32
3.2	Study location	33
3.3	Study population	33
3.4	Sample size of study	34

3.5	Sampling procedure	35
3.6	Data collection instruments	36
3.7	Classification of household nutritional status	41
3.8	Data collection procedure	42
3.9	Data management and quality control – pilot study	43
3.10	Data entry and validation	44
3.11	Data analysis	44
3.12	Ethical approval	46
3.13	Duration of study	47
	CHAPTER 4 RESULTS	49
4.1	Response rate	49
4.2	Nutritional status of mother and child	50
4.2.1	Prevalence of double burden of malnutrition at household level	51
4.3	Demographic and socioeconomic characteristics	54
4.4	Food security status of participants	57
4.5	Dietary intake of mother and child	59
4.6	Dietary quality of mother and child	65
4.7	Factors associated with double burden of malnutrition	67
	CHAPTER 5 DISCUSSION	71
5.1	Findings	71

5.1.1	Prevalence of household-level DBM	72
5.1.2	Factors associated with the occurrence of double burden of malnutrition at household level	74
5.2	Strength and limitations of study	86
5.3	Implications of study	87
CHAPTER 6 CONCLUSION AND RECOMMENDATION		89
6.1	Conclusion	89
6.2	Recommendations	90
REFERENCES		92
APPENDICES		115

LIST OF TABLES

	Page
Table 3.1: Growth indicators for children aged 2-12 years (adapted from WHO Growth Reference 2006)	41
Table 3.2: Nutritional status classifications for mother-child pairs within the same household	43
Table 4.1: Nutritional status of mother and child (n=286)	51
Table 4.2: Nutritional status classification of mother-child pairs (n=286)	53
Table 4.3: Demographic and socioeconomic characteristics of participants (n=286)	55
Table 4.4: Distribution of responses to items in Radimer/Cornell Hunger and Food Insecurity Instrument (n=286)	58
Table 4.5: Food security status of participants (n=286)	59
Table 4.6: Caloric and macronutrients intake of mothers by the DBM status (n=286)	61
Table 4.7: Caloric intake of children by age, sex and DBM status (n=286)	63
Table 4.8: Macronutrients intake of children by DBM status (n=286)	64
Table 4.9: M-HEI component scores of mothers and child by DBM status (n=286)	66
Table 4.10: Factors associated with DBM households	69
Table 4.11: Summary of significant factors associated with double burden of malnutrition at household level	70

LIST OF FIGURES

	Page
Figure 2.1: UNICEF’s Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020 (UNICEF, 2021)	30
Figure 2.2: Conceptual framework of present study	31
Figure 3.1: Map of divisions in Sarawak (EPU & Department of the Premier of Sarawak, 2022)	33
Figure 3.2: Multistage random sampling procedure of the study	36

LIST OF ABBREVIATIONS

BAZ	BMI-for-age z-score
BMI	Body mass index
DBM	Double burden of malnutrition
DOSM	Department of Statistics Malaysia
ECLAC	Economic Commission for Latin America and the Caribbean
EPU	Economic Planning Unit
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
HAZ	Height-for-age z-score
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IPH	Institute for Public Health
LMIC	Low and middle income country
MASCO	Malaysia Standard of Classification of Occupation
M-HEI	Malaysian-Healthy Eating Index
MOH	Ministry of Health Malaysia
MOHR	Ministry of Human Resources
NCCFN	National Coordinating Committee for Food and Nutrition
NCD	Non-communicable disease
NIH	National Institutes of Health
NHMS	National Health and Morbidity Survey
RNI	Recommended Nutrient Intake

UNICEF	United Nations Children's Fund
WAZ	Weight-for-age z-score
WFP	World Food Programme
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Study background

Nutrition transition over the years which is perpetuated by evolving diet and activity patterns, is giving rise to the double burden of malnutrition (DBM) (Popkin et al., 2020). The World Health Organization (WHO) characterised double burden malnutrition as “the coexistence of undernutrition along with overweight, obesity or diet-related non-communicable diseases (NCDs), within individuals, households and populations, and across the life-course” (WHO, 2017). In 2016, approximately 1.9 billion adults were overweight, in which over 650 million were identified as obese globally. Additionally, among children and adolescents, more than 340 million were either overweight or obese (WHO, 2021). On the other hand, undernourishment was affecting approximately 586 million people in 2016 (FAO et al., 2023). Increase in the trend can be observed for overweight which was more than 2.6 billion for people aged above five, of which 988 million were obese in 2020 (World Obesity Federation, 2023). The COVID-19 pandemic led to a sharp increase in the number of undernourished people in 2020, with estimates ranging from 691 to 783 million by 2022. (FAO et al., 2023). In the same year, it was estimated that 148.1 million were stunted and 45 million were wasted while 37 million were overweight among children under five worldwide (FAO et al., 2023). This shed a light on the current nutrition reality, that various form of malnutrition can exist concurrently in different ways and in different places (Fanzo et al., 2019).

Various operational definitions for DBM were used in previous studies (Davis et al., 2020). At the household level, frequently used definition referred to the mother-child pair, a

condition where simultaneous existence of an undernourished (underweight, stunting, wasting) child and an overweight or obese member within the same household (Davis et al., 2020; Tzioumis & Adair, 2014). About 16% were overweight mother/stunted child pairs from the analysis of 42 Demographic and Health Surveys. This phenomenon was found to be linked to economic factors and the ongoing nutritional transition (Garrett & Ruel, 2005). A more recent study reported 10%, 7% and 7% of overweight/obese mother with a stunted child, overweight/obese mother with a wasted child, and overweight/obese mother with an underweight child respectively, with 12% overall prevalence of any of the DBM from eight South and Southeast Asian countries (Biswas et al., 2021). Popkin and colleagues (2020) found that the prevalence of household-level DBM varied between 3% and 35% worldwide. Notably, a substantial proportion of DBM cases involved pairs consisting of overweight mothers and stunted children, ranging from 1% to 24%. Additionally, the prevalence was 0.3% to 10% for pairs comprising overweight mothers and wasted children. Interestingly, 22 countries with at least two surveys with gap of 15 years apart showed DBM reductions in five countries while 15 countries revealed increases in their DBM (Popkin et al., 2020). Therefore, it is evident that the increasing DBM trend is not only occurring at the population level, but also at the household level.

Indigenous people are among the population most vulnerable to DBM. Latest results from the 2019 National Health and Morbidity Survey (NHMS) in Malaysia reported national prevalence of overweight was 30.4% and obesity 19.7% among adult while stunting, underweight, wasting and overweight were 21.2%, 15.3%, 11.0% and 6.0% respectively among children under five (Institute of Public Health [IPH] et al., 2020). Notably, compared to the national prevalence, overweight and obesity among the indigenous Sarawak (Bumiputera Sarawak) were higher at 34.4% and 20.8% respectively, while indigenous

Sabah (Bumiputera Sabah) had highest prevalence of overweight at 35.3%. Among children under five years old, children of Bumiputera Sarawak had higher prevalence of 41.5% for stunting compared to the national prevalence. At the household level, Wong et al. (2015) reported overall DBM of overweight or obese mother with a stunted or underweight child pair was 20%, of which 19.4% was overweight or obese mother with a stunted child pair, and 12.5% was overweight or obese mother with an underweight child pair among indigenous (Orang Asli) in Peninsula Malaysia. In fact, Khor & Shariff (2019) have emphasised on the importance highlighting the health and nutritional deprivations experienced by the indigenous peoples in Malaysia.

The DBM phenomenon brings about a range of negative outcomes throughout life course including mortality, impair cognitive development, disrupts physical and mental health, poor school performance and lower likelihood to finish school among undernourished children (ECLAC & WFP, 2017). Later in life, increased risk of obesity and NCDs, along with poor social and economic productivity can be observed among adults (ECLAC & WFP, 2017). With the emergence of DBM being more apparent in recent decade, it is of utmost importance to identify the common underlying drivers of the concurrent existence of undernutrition and overnutrition. Predictors of household-level DBM include maternal age, household size, income, education level, employment, urbanisation, food security, dietary intake, water quality, sanitation and proper toilet facilities (Bose et al., 2022; Guevara-Romero et al., 2022; Kosaka & Umezaki, 2017). Among the indigenous population, DBM occurrence at any level (population, household, individual, across life course) can be largely attributed to nutrition transition, acceptance of the Westernised lifestyle and the gradual decline in traditional food system and practices over the years (Khor & Shariff, 2019). Increasing dependence on food obtained via cash economy may have influenced the rise in

intake of energy-dense but nutritionally poor, often processed and ultra-processed food among the indigenous population (Khor & Shariff, 2019). Linked to dependence on cash economy food, they are more likely to be susceptible to experiencing food insecurity, affecting their accessibility and availability of adequate nutrition intake, and therefore, the overall dietary quality. To add on, exposure to the digital era has led to more sedentary lifestyles, with more time spent on screen rather than being physically active. Interconnection between these factors might have been key contributors to the DBM occurrence among the indigenous communities.

In line with Sustainable Development Goal 2 (SDG2) to end hunger, achieve food security and improved nutrition, the latest National Plan of Action for Nutrition of Malaysia (NPANM III) (2016-2025) emphasised on strengthening food and nutrition security by promoting healthy eating, greater food purchasing power and decreasing unhealthy eating behaviours (NCCFN & MOH, 2016). The Sustainable Development Report in 2023 showed that Malaysia ranked 78th out of 166 countries in terms of overall SDG performance and is still facing major challenges in SDG2 with stagnating progress (Sachs et al., 2023). Considering almost half (excluding Malays) of the population in Sarawak are indigenous people, it is crucial to identify the drivers of malnutrition among this community in an effort to achieve SDG2. Therefore, this study aims to determine the prevalence of DBM and its associated factors among the indigenous communities in Sarawak.

1.2 Problem statement

Undernutrition along with overweight and obesity has previously been approached as separate public health issue. Reality however, showed that undernutrition and overnutrition are interconnected, and that DBM is a complicated issue. The Rome

Declaration on Nutrition 2014 was the outcome from the 2nd International Conference on Nutrition (ICN2), acknowledging malnutrition in all its forms and has substantial adverse effects. The declaration acknowledges that the root causes and factors contributing to malnutrition are complex and multidimensional (FAO & WHO, 2014). While the nature of Framework for Action (another outcome from ICN2) is voluntary, Malaysia's commitment to fulfilling the Rome Declaration on Nutrition can be observed via the revision of NPANM II, 2006-2015 and the formulation of NPANM III, 2016-2025 (NCCFN & MOH, 2016). The current NPANM III, 2016-2025 focuses on food and nutrition security which included the four pillars – availability, accessibility, affordability and utilisation of food. To highlight, one key objective is to enhance nutritional status to reach the target of achieving optimal nutritional well-being of Malaysians. However, the trend of overweight and obesity among adults, and undernutrition along with obesity among children have shown increases over the years and is presumed to have worsen following COVID-19 pandemic (IPH et al., 2020).

Additionally, the prevalences of undernutrition and overnutrition among the indigenous communities in Malaysia are higher compared to the national prevalence (IPH et al., 2020). At the household level, four DBM studies were previously conducted in Peninsular Malaysia. Two of the studies were conducted among Orang Asli communities, while the other two were conducted among rural Malay communities. Surrounding the Krau Wildlife Reserve in Pahang, coexistence of overweight/obese mother with a stunted or an underweight child was observed in 20% of the Orang Asli households (Wong et al., 2015). In Sepang District and Carey Island in Selangor, 25.8% of the Orang Asli households had an overweight mother with an underweight child (Saibul et al., 2009). In rural district of Bachok, Kelantan and Sabak Bernam, Selangor, households with coexistence of overweight mother with an underweight child was 29.6% and 26% respectively (Ihab et al., 2013; Khor

& Sharif, 2003). These studies showed evidence that household-level DBM existed among the indigenous in Peninsula Malaysia.

However, lesser is known about the DBM status among indigenous communities in Sarawak, of which almost half the population is indigenous people (DOSM, 2022). DBM is associated with an elevated risk of NCDs. Factors such as low birth weight, childhood stunting, and wasting reduce components of metabolic capacity, while being overweight and exposure to unhealthy environments contribute to an increased metabolic load (Popkin et al., 2020). The risk of adults developing NCDs can be attributed to poor early growth and increased BMI in later life in relation to nutrition transition (Popkin et al., 2020). Indeed, the Malaysian economy had suffered up to RM8.91 billion due to loss of productivity attributed by three selected NCDs, cardiovascular, diabetes and cancer based on 2017 data (MOH & WHO, 2020). This is equivalent to approximately 0.65% of Malaysia's gross domestic product (GDP) while the burden of disease costed about 7.35% of Malaysia's GDP, approximately RM100.79 billion. Values are expected to increase with elevated NCDs observed in Malaysia's 2019 NHMS report. Therefore, to prevent further descend in terms social and economic productivity, it is crucial to identify the factors contributing to DBM to not only reduce risk of NCDs, but also to take the appropriate plan of action to tackle DBM.

1.3 Significance of study

This research unravels the household-level DBM status and its associated factors among the indigenous communities in Sarawak. DBM studies conducted at household level, in particular the mother-child pair were previously conducted in Peninsula Malaysia and information on Sarawak's indigenous communities remained scarce. While there are quite a number of literatures on household-level DBM globally, studies involving the indigenous

communities were limited and mostly focused on the sociodemographic factors. More research focusing beyond the sociodemographic factors is needed to understand the household-level DBM and their contributing factors. Therefore, the expectation from this current study will be intended to identify various drivers of household-level DBM, particularly among the Sarawak indigenous communities to spotlight the extent of nutritional deprivation impacting one of the largest indigenous populations in Malaysia.

1.4 Research questions

To determine the prevalence of household-level DBM and its associated factors among the indigenous communities in Sarawak, this study plans to answer the following research questions:

- i. What is the prevalence of DBM at household level among the indigenous communities in Sarawak?
- ii. What are the demographic and socioeconomic characteristics of the indigenous communities in Sarawak?
- iii. What is the food security status of the indigenous communities in Sarawak?
- iv. What is the dietary intake (calorie and macronutrients) of the mother and child among indigenous communities in Sarawak?
- v. What is the dietary quality of the mother and child among indigenous communities in Sarawak?
- vi. What are the factors associated with household-level DBM among the indigenous communities in Sarawak?

1.5 Research objectives

The general objective of this study is to determine the prevalence of household-level DBM and its associated factors among the indigenous communities in Sarawak. Specific objectives include:

- i. To determine the prevalence of mother-child DBM at household level among the indigenous communities in Sarawak.
- ii. To describe the demographic and socioeconomic characteristics, and food security status of the indigenous communities in Sarawak.
- iii. To describe the caloric and macronutrients intake, and dietary quality of mother and child among the indigenous communities in Sarawak.
- iv. To determine the factors associated with DBM at the household level among the indigenous communities in Sarawak.

1.6 Research hypothesis

There will be a relationship between household-level DBM with demographic and socioeconomic characteristics, food security status, dietary intake (calorie and macronutrients) and dietary quality among the indigenous communities in Sarawak.

1.7 Operational definition

- 1 Child : Child is defined as “*a person who is under the age of 18 years*” in Section 2 of the Child Act 2001 in Malaysia (Child Act 2001 (ACT 611), 2001). For this study, only children aged 2-12 years old were included.

- 2 Double burden of malnutrition : According to WHO, the double burden of malnutrition is characterised by *“the coexistence of undernutrition along with overweight, obesity or diet-related non-communicable diseases (NCDs), within individuals, households and populations, and across the life-course”*. For this study, double burden of malnutrition is defined as the coexistence of an overweight or obese mother and an undernourished child (either underweight, stunting or wasting) within the same household.
- 3 Food security : The 1996 World Food Summit defined food security as *“when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”* (FAO, 1996). In this study, food security status is assessed using Radimer/Cornell Hunger and Food Insecurity Instrument where participants were categorised as food secure or food insecure (household food insecure, individual food insecure, child hunger).
- 4 Indigenous : *“Races which are now considered to be indigenous to Sarawak and accordingly natives include Bidayhs or Land Dayaks, Bukitans, Bisayahs, Dusuns, Ibans or Sea Dayaks, Kadayans, Kelabits, Kayans, Kenyahs*

(including Sabups and Sipengs), Kajangs (including Sekapans, Kejamans, Lahanans, Punans, Tanjongs and Kanowits), Lugats, Lisums, Malays, Melanaus, Muruts or Lun Bawang, Penans, Sians, Tagals, Tabuns, Ukits and any admixture of these races with each other” according to Sarawak Interpretation Ordinance 2005 (Interpretation Ordinance (CAP. 61), 2005). For this study, Malays were excluded.

- 5 Overweight and obesity : Overweight and obesity are defined as “*abnormal or excessive fat accumulation*”. Adults with a BMI greater than or equals to 25 kg/m² is considered overweight, whereas a BMI greater than or equals to 30 kg/m² is considered obese (WHO, 2021). For children aged 5-19 years, overweight is BMI-for-age z-score (BAZ) greater than 1 standard deviation (SD) above the WHO Growth Reference median, and obesity is BAZ greater than 2 SD above the WHO Growth Reference median (de Onis, 2007). For children under five years old in this study, overweight is BAZ greater than 2 SD above the WHO Growth Reference median, and obesity is BAZ greater than 3 SD above the WHO Growth Reference median (WHO, 2006).

- 6 Stunting : Stunting, is defined as height-for-age z-score (HAZ) more than 2 SD below the WHO Growth Reference median (WHO, 2006).
- 7 Underweight : Underweight refers to low weight for age, when children can be either thin or short for their age. Adults with a BMI lower than 18.5 kg/m² is considered underweight. For children aged 10 years and under, underweight is defined as weight-for-age z-score (WAZ) more than 2 SD below the WHO Growth Reference median (WHO, 2006).
- 8 Wasting : Child wasting refers to children being too thin for their height. For children under five years, wasting is defined as weight-for-height z-score (WHZ) or BAZ more than 2 SD below the WHO Growth Reference median (WHO, 2006). For children aged 5-19 years, thinness is defined as BAZ more than 2 SD below the WHO Growth Reference median (de Onis, 2007). For this study, children who are thin will be labelled similarly as the children under five, that is wasting.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the relevant literature regarding DBM in general, followed by literature focusing on DBM at the household level and the contributing factors to DBM.

2.1 Overview of double burden of malnutrition

Before the Rome Declaration on Nutrition in 2014, there were the World Declaration on Nutrition in 1992 pledge to reduce all forms of malnutrition (WHO, 1995). Entering the new century, the Commission on the Nutrition Challenges of the 21st Century suggested a novel paradigm of DBM (James et al., 2000). In 2012, WHO endorsed the Comprehensive Implementation Plan for Maternal, Infant, and Young Child Nutrition, which outlined six global nutrition targets (WHO, 2012). These targets encompassed areas such as stunting, wasting, overweight in children under 5 years, breastfeeding, low birthweight, and anemia in women of reproductive age. In 2013, WHO saw the adoption of the first Global Action Plan for the Prevention and Control of NCDs (WHO, 2013). At this point of time, strategies to address undernutrition, overweight and obesity, and NCDs still took separate path. It was only in 2014, that the term malnutrition in all its forms was introduced in Rome Declaration on Nutrition (FAO & WHO, 2014). Targets from the Maternal, Infant and Young Child Nutrition and NCD Monitoring Framework were brought together in the Global Nutrition Report in 2015 (IFPRI, 2015). In SDG, ending malnutrition in all its form became target 2.2 of SDG2 Zero Hunger.

2.1.1 Levels of double burden of malnutrition

DBM can occur at three levels, namely individual, household and population level. At individual level, DBM manifests through concurrent development of two forms of malnutrition or across the lifespan and is temporally separated (WHO, 2016). Household level DBM is indicated by two or more family members who developed contrasting forms of malnutrition simultaneously. Both undernutrition and overweight, obesity or NCDs existing in the same community, region or nation is described as population level of DBM. A few earlier studies have investigated DBM of the mother-child pairs at household level (Doak et al., 2000, 2004; Garrett & Ruel, 2005). Subsequently over the years, more studies have measured DBM prevalence at various levels, including population, household and individual level by including anthropometric and biochemical outcomes.

2.1.2 Operational definition of double burden of malnutrition

With the transition in globalisation and urbanisation, populations worldwide are experiencing malnutrition in all forms due to the rapidly changing contexts. Unlike food security, there is no global consensus on the definition of double burden malnutrition. According to WHO (2017), DBM is “characterised by coexistence of undernutrition along with overweight, obesity or diet-related NCDs, which can occur at individual, household and population, and across the life course”. This broad definition does not provide specific guidance on the operationalisation of DBM measurement which is crucial in determining the prevalence and developing effective intervention or strategies to tackle the issue.

Research by Varela-Silva et al. (2012) has shown that the indicators used to classify the nutritional dual-burden at individual, household and population levels have significant implications on the estimate of DBM prevalence. A systematic review of the operational

definitions of DBM showed that by form of malnutrition assessment, overweight/obesity paired with thinness/wasting/underweight was most frequently used with 77% (n=185) existing articles utilising this characterisation of DBM followed by overweight/obesity paired with stunting 43% (n=103) articles, overweight/obesity paired with anaemia 14% (n=34) articles, and overweight/obesity paired with more than one micronutrient deficiencies 7% (n=23) articles respectively (Davis et al., 2020). By level of assessment, population level DBM was predominantly studied at 90% (n=214), followed by individual level at 15% (n=35), dyad level, referring to comparisons among or across mother-child or caregiver-child pairs at 9% (n=22) and household level, referring to comparisons among or across households of all or some specified household members at 7% (n=17). While there is still no systematic examination of DBM operational definitions, it is extremely crucial to address DBM as urged in the UN Decade of Action on Nutrition (2016-2025) objective to eradicate hunger and prevent all forms of malnutrition worldwide.

2.2 Overview of prevalence of double burden of malnutrition

DBM is considered a global challenge that affects all regions worldwide, with exacerbation in LMICs. Global prevalence of undernutrition in children has decreased from 40% in 1990 to 26% in 2011 and contrastingly, maternal overweight has been rising from 20% in 1990 to 30% in 2008, while an increase from 5% in 1990 to 10% in 2008 is observed for maternal obesity (Black et al., 2013). Approximately 38% (2.6 billion) people (excluding children under five years) were overweight or obese in 2020, of which 14% (988 million) were obese (World Obesity Federation, 2023). Latest malnutrition data in 2022 for children under five years showed 22.3% (148.1 million) were stunting, 6.8% (45 million) were wasting while 5.6% (37 million) were overweight (FAO et al., 2023). While stunting and wasting had declined since 2000, the current progress is still far from the 2030 targets.

Overweight on the other hand, has a non-significant increase since 2000 and require a reversal in trajectory to be able to achieve the 2030 target.

Regional-wise, Asia and Africa had the most children under five impacted with malnutrition. For stunting, number of children affected in Asia decreased from 106.8 million to 76.6 million in 2012 to 2022 whereas Africa had an increase from 61.3 million to 63.1 million. These rates are much higher when compared to Latin America and the Caribbean, Europe and Oceania (excluding Australia and New Zealand). For wasting, the sub-region Southern Asia has the highest prevalence of 14.3%, which is estimated to 25.1 million children under five years. There was no change for number of children under five years affected by overweight from 2012 to 2022, but Australia and New Zealand had the highest percentages of children who were overweight 19.4% (0.4 million).

Popkin et al. (2020) prominent article in the Lancet's Double Burden of Malnutrition Series highlighted the current DBM shift towards LMICs. Using the country-level DBM definition as "high prevalence of both undernutrition and overweight and obesity in at least one population group", 82 LMICs faced DBM based on data from 1990s, of which 45 (37%), 22 (18%) and 15 (12%) countries had DBM based on 20%, 30% and 40% overweight prevalence cutoff respectively. Number of LMICs facing DBM based on data from 2010s increased to a total of 93 countries, of which 48 (38%), 35 (28%) and 10 (8%) countries were based on overweight prevalence cutoff of 20%, 30% and 40% respectively. Prior to the Joint Child Malnutrition Estimates 2023 edition which highlighted Asia and Africa had the most children with malnutrition, Popkin et al. (2020) revealed that sub-Saharan Africa, south Asia, and east Asia and the Pacific were more prevalent to facing DBM, where DBM increases were observed in Asia after adjusting for increases and decreases for both time

periods. Notably, increases in DBM from 1990s to 2010s were more prevalent within countries with the lowest income quartile based on GDP per capita.

2.2.1 Prevalence at household level

Household-level DBM varied depending on the form of malnutrition and which household member was recruited for the study. The most frequent combinations for DBM occurring within the same household was maternal overweight-child stunting in contrast to maternal thinness-child overweight which was least frequent from national health surveys in 22 countries with at least two surveys of more than 15 years gap (Popkin et al., 2020). DBM households with maternal overweight-child stunting ranged from 1.08% in Vietnam to 24.34% in Guatemala using latest survey years. Maternal overweight-child wasting ranged from 0.27% in Kazakhstan to 10.21% in Egypt while maternal thinness-child overweight ranged from 0.0% in Egypt to 3.99% in China.

Garrett & Ruel (2005) secondary analysis of the Demographic and Health Surveys (DHS) in 42 countries revealed overweight mother-stunted child pair ranged from 0.9% to 12.4% in Africa, 1.0% to 5.5% in Asia, and 2.2% to 16% in Latin America. The prevalences were generally below 10% for the DBM pairs except for three countries, Egypt (12.4%), Bolivia (11.5%) and Guatemala (16.0%). Notably, DBM of overweight mother-stunted child tends to rise with economic development to a certain extent, and that this form of DBM is most commonly observed in countries undergoing nutrition transition. Secondary analysis of DHS in eight Asian countries which included 798,961 households revealed DBM of overweight/obese mother-stunted child was 10%, overweight/obese mother-wasted child was 7% and overweight/obese mother-underweight child was 7% with overall prevalence of DBM was 12% (Biswas et al., 2021). A systematic review of household-level DBM by

(Kosaka & Umezaki (2017) reported varied national prevalence of 0.0% to 26.8% by country and year, whereby overweight/obese mother-stunted child pairs ranged from 0.9% in Nepal to 20% in Guatemala. Compared to lower income countries, middle income countries tended to have higher prevalence DBM of overweight/obese mother-stunted child, and this DBM pairs were more prevalent in African countries compared to Asian countries.

2.2.2 Prevalence among Malaysian indigenous communities

Indigenous peoples is one of the vulnerable populations to DBM at population, household, or individual level. Delving into the indigenous peoples (Orang Asli) in Peninsula Malaysia, an estimate of 10-35% of adults was overweight and obese (Yusof et al., 2007). Contrastingly, underweight (50.9%) and stunting (61.6%) can be found in more than half of the Orang Asli children aged 1-6 years while 27.8% and 7.4% of the mothers were overweight and obese respectively (Chua et al., 2012). Chua et al. (2019) follow-up study among the Orang Asli adults in Krau Wildlife Reserve showed 35.5% had weight gain of more than 5.0% when observing the increase from 18.8% and 7.4% to 26.1% and 9.5% for overweight and obesity prevalence in 2011-2012 to 2015-2016, with increase in weight gain being more prominent in women. These findings of undernutrition in children and, overweight and obesity in adults were similar to the indigenous peoples in other countries such as Australia, Brazil, Canada, Guatemala and India (Batal & Decelles, 2019; Burns & Thomson, 2008; Coimbra et al., 2013; Das et al., 2023; Lee et al., 2017).

Though there have been numerous studies among the Orang Asli in Peninsula Malaysia, malnutrition study among the indigenous peoples of Sarawak has been scarce. A study conducted in Serian District, Sarawak illustrated that prevalence of underweight among the indigenous children under five was 20.9%, stunting was 11.9% and wasting was

10.2% (Eunice et al., 2014). Bong et al. (2018) study among 0-23 months old Penan infants and young children showed underweight, stunting and wasting prevalence were 29.8%, 43.0% and 5.8% respectively. A more recent study involving 304 children under five years from Samarahan Division, Sarawak reported almost a quarter (21.7%) were stunted and 11.5% wasted (Gahamat et al., 2022). Within the same child, concurrent stunting and wasting was 3.9% while concurrent stunting and overweight was 3.6%. However, majority of the children in this study were Malay (91.8%) and the remaining 8.2% were Iban, Bidayuh, Chinese and Hindus. Findings from the 2008 National IDD Survey among children aged 8-10 years revealed prevalence of moderate underweight was highest among indigenous in Peninsula Malaysia (Orang Asli), followed by indigenous Sarawak (Bumiputera Sarawak) and indigenous Sabah (Bumiputera Sabah) at 31.8%, 21.1% and 20.4% respectively (Zainuddin et al., 2013).

Specifically DBM at household level, there were four studies investigating the DBM involving mother-child pairs in Malaysia, of which two were conducted among Orang Asli communities and two were conducted in rural communities (Ihab et al., 2013; Khor & Sharif, 2003; Saibul et al., 2009; Wong et al., 2015). Wong et al. (2015) reported 20% Orang Asli households had coexistence of overweight or obese mother with an underweight or stunted child aged 6-59 months while Saibul et al. (2009) observed 25.8% DBM which had overweight mother with an underweight child aged 2-9 years. In the rural district Bachok, Kelantan, proportion of overweight mother with an underweight child was 29.6% (Ihab et al., 2013) whereas 26% of the Malay households had overweight mother with an underweight child aged 1-6 years in rural Sabak Bernam, Selangor (Khor & Sharif, 2003). These findings indicate that as overweight and obesity continue to rise especially in the

indigenous women, stunting and underweight still persist among the indigenous children in Malaysia.

2.3 Factors associated with double burden of malnutrition

Nutrition transition, demographic transition and epidemiological transition of countries have been observed to influence DBM phenomenon worldwide. Four drivers linked to DBM were biological, environmental, social and behavioural factors (WHO, 2017). Identification of these may be useful indicators to target specific groups which are at risk of malnutrition. Previous articles by Kosaka & Umezaki (2017) on systematic review of DBM predictors within households, Bose et al. (2022) review of household-level DBM in LMICs and Guevara-Romero et al. (2022) scoping review of DBM associated factors at household level will be the basis for the following sections.

2.3.1 Demographic and socioeconomic characteristics

Maternal age was one of the factors associated with household-level DBM. With increase in age, overweight or obese mothers were observed to have higher likelihood of having a child with malnutrition or nutritional deficiencies (Guevara-Romero et al., 2022). In a comparative study among four countries, mothers in the age range 35-49 years were 2.64 (1.27-5.52), 2.03 (1.04-4.11) and 2.01 (1.06-3.81) times more likely to have DBM for Pakistan, Myanmar and Bangladesh respectively compared to the reference group age 15-24 years (Anik et al., 2019). This finding is supported by (Biswas et al. (2021) study in eight countries from South and Southeast Asia which reported compared to below 20 years mothers, mothers in the age group 40-49 years had 3.6 times higher odds of being DBM household consisting overweight or obese mother with an undernourished (underweight, stunting or wasting) child. Wong et al. (2015) revealed 1.2 times higher odds of DBM of

overweight or obese mother-stunting child pair as maternal age increases among the indigenous (Orang Asli) in Peninsula Malaysia. While increased maternal age was associated with higher odds of DBM (mother and child aged below three years old dyads) from analysis of the fifth National Family and Health Survey (NFHS-5) conducted in 2019-2021 in India, this determinant's contribution to DBM was pretty low at 2.4% (Singh et al., 2023). These studies showed that mothers aged above 35 years have higher likelihood to experience DBM.

Studies on DHS data from Latin American countries reported that poorer countries had a higher rate of stunting whereas countries with developing economies had greater overweight prevalence (Tzioumis & Adair, 2014). DBM studies in India and Nepal both showed mother-child pairs from rich wealth quintiles were more likely to face DBM compared to poor wealth quintiles. In a multilevel study on DBM in Indonesia, households with high economic status are more likely to experience household DBM (Vaezghasemi et al., 2014). Although earlier estimates predicted that DBM is more prevalent among the rich population, transition in all aspects and lifestyle changes occurring in a country might have caused a shift towards the poorer population group (Roemling & Qaim, 2013). DBM studies among indigenous communities revealed that low- and middle-income households faced greater likelihood of DBM. Increased risk of stunted child and maternal overweight pair was reported in Orang Asli (indigenous people in Peninsula Malaysia) households with income per capita less than USD 29.01 (Wong et al., 2015). In a study of association between socioeconomic disparities and DBM (overweight mother-stunted child pair) in some indigenous and non-indigenous Guatemalan households, low and middle socioeconomic households were more prevalent to have DBM. Interestingly, households from the middle consumption per capita quintile were 1.7 times more likely to have DBM as compared to

households from the first quintile (Lee et al., 2012). To highlight, in the same study, child stunting was more prevalent among the poor households whereas maternal overweight was less prevalent. This may explain why households with coexistence of both extreme of the malnutrition were more likely to occur in the middle income households instead of the poor or the rich households.

Other determinants associated with DBM include level of education, particularly maternal education. Some studies have shown that higher education level is associated with higher odds of DBM. Sunuwar et al. (2020) reported that mothers with at least secondary level of education had higher odds (AOR = 2.05, 95% CI: 1.03–4.07) of DBM as compared to mothers with no education. Compared to normal BMI mother-normal height child, DBM of overweight mother-stunted child were 3.23 times more likely among mothers with higher education in the Republic of the Marshall Islands (Blankenship et al., 2020). In rural Bangladesh, higher maternal education predicted DBM of overweight mother-stunted child but was protective against this type of DBM in rural Indonesia (Oddo et al., 2012). Fookan & Vo (2021a) examined the association of macroeconomic and socioeconomic determinants of DBM (overweight mother-stunted child) using DHS data from 11 Asian LMICs with mothers aged 15-49 years and have at least one child aged 36-59 months. One interesting finding is that DBM was most prevalent among mothers with primary or secondary education in contrast to mother with no education or highest education level. This might suggest that maternal's higher education level may not always translate into good nutritional outcomes for themselves and their children as some studies reported that maternal education level was not linked to occurrence of DBM (Ihab et al., 2013; Khor & Sharif, 2003).

Presence of DBM at household level is influenced by mother's employment status. Oddo et al. (2018) conducted a qualitative study in Nuevo San Carlos, Guatemala which has a large indigenous population to explore the pathways of association between maternal employment and nutritional status of mother and child within the same household. The mothers who were interviewed had varying perceptions on the influence of employment on bodyweight status. Employed mothers described being able to purchase more food and increase food variety for their household which in turn, improve the household well-being. However, employment may have influenced the mother's time allocation in food preparation where employed mothers were perceived to be more exposed to take-away or street food due to time constraints. While the maternal employment may positively change food purchasing with the additional income, they were more inclined to purchasing high-energy "tastier" food and purchasing food requested by their children, often being junk food. Notably, both employed and unemployed mothers described concern for their children's health, where they perceived being employed indicate lesser time spent with taking care of the household and their children, which in turn, influenced the mother's health or weight when they worry about their children. On the other hand, there were significantly higher proportions of housewives or unemployed mothers among the DBM (overweight mother-underweight child) Orang Asli households in Peninsula Malaysia, where being housewives were associated with 3.18 times higher likelihood of DBM (Saibul et al., 2009). One possible explanation is that housewives are less engaged in physical activities, increasing their risk of overweight or obesity. At the same time, they were considered to have lower purchasing power, thus, were less likely to provide sufficient and quality food for their children, which may have contributed to the underweight among their children.

Furthermore, household size is associated with occurrence of DBM at household level. Several articles have shown higher odds of DBM with the increase in number of household members. In Bangladesh, family which had four or more children were 4.72 times more likely to experience DBM of overweight or obese mother with a stunted, wasted or an underweight child (Das et al., 2019). Having more children in the same household might compromise the food sources availability for children as some members will be prioritised above the others. It may be more challenging to provide adequate nutrition to all family members, potentially leading to imbalanced diet and malnutrition. However, both household size and number of children were not linked to DBM in a study involving 223 mother-child pairs in rural Bachok, Kelantan in Malaysia (Ihab et al., 2013). Interconnected with household size and DBM, food security status may potentially impact the household's food accessibility and availability, which might change the nutritional outcomes among the family members which will be discussed in the next subsection.

2.3.2 Food security status

Taking a closer look at household level DBM, there are several determinants which put certain groups at higher risk of DBM. Food security which influences diet quality and quantity have significant implications on nutritional outcomes, especially in women and children depending on the severity of the household food insecurity experienced by them (Pei et al., 2018). Mahmudiono et al. (2018) revealed significant correlation between child stunting and stunted child-overweight/obese mother pair with household food insecurity, notably greatest odds of stunted child-overweight/obese mother pair in mildly food insecure households in Indonesia. Sansón-Rosas et al. (2021) reported similar finding in which only moderate food insecurity was significantly associated with DBM of overweight or obese mother-stunting child in the secondary analysis of 2350 mother-child pairs living in rural

Colombian household from the 2015 Colombian National Nutritional Survey (ENSIN). On the other hand, Gubert et al. (2017) shown that household with severe food insecurity were 2.65 times more likely to experience DBM of overweight or obese mother with a stunted child in the secondary analysis of 4299 mother-child pairs from the 2006 Brazilian National Demographic and Health Survey. Therefore, from the studies reviewed above, it is evident that being food insecure may be linked to higher likelihood of being a DBM household.

Indigenous (Mah Meri) women in Malaysia who experienced food insecurity had poorer diet quality (Chong et al., 2019). Compared to food secure group after adjusting for age, lower mean Malaysian Healthy Eating Index (M-HEI) score was significantly related to individual food insecure and child hunger (severe) food insecure among the Mah Meri women. Furthermore, scores for grain and cereal, and meat, poultry and eggs components were significantly lower in individual food insecure and child hunger when compared to food secure and household food insecure women, indicating poor intake of these food groups (Pei et al., 2018). Notably, women from the household food insecure had significantly higher BMI compared to individual food insecure and child hunger group. Higher intake of fat might have contributed to the higher BMI observed in the household food insecure women (Pei et al., 2018). This might be attributed to buying cheaper food as a coping strategy during food shortages, in which food insecure households might opt for more affordable prices of processed foods, often comprising relatively high energy and fat content (Law et al., 2018). Although this study did not determine the association between food security status and DBM, it highlights the influence of food insecurity status on the food intake, particularly which food groups were less consumed. The association between food insecurity and DBM may be attributed to how being food insecure is dictated by inaccessibility and unavailability of adequate and nutritious food for consumption, and thus, affecting the inadequate nutrient

intake among children but excess calorie among women. Transitioning from the specific context of food insecurity and DBM, it is essential to understand the broader determinants of DBM, particularly dietary intake and quality.

2.3.3 Dietary intake and quality

Interconnected with food security, dietary intake is one of the key determinants of DBM. Undernutrition and overweight or obesity conditions are predominantly related to dietary intake and habits. Undernutrition may be attributable to inadequate nutrient intake while overweight and obesity may be influenced by intake of food with high energy content but poor nutritional values. To illustrate, two dietary patterns were observed among Samoan children aged 24-59 months old (Choy et al., 2018). The modern pattern, characterised by Westernised food including red meat, condiments and snacks while neo-traditional pattern consisted of vegetables, local starches, coconuts, fish and poultry. Notably, children in the highest quintile of the modern dietary pattern had lower protein and fibre intake but higher total fat and sugar intake. In contrast, children in the top quintile of the neo-traditional dietary pattern had reduced carbohydrate, monounsaturated fat, sugar and calcium intake but greater protein, polyunsaturated fat and fibre intake. This indicates that modern dietary pattern tends to contribute to greater fat and energy intake, but poor protein as compared to neo-traditional which provided higher protein.

Further illustrating the influence of dietary patterns on macronutrient intake, a study conducted in Bandung district of Indonesia identified two dietary patterns namely, modern, characterised by elevated consumption of flesh and convenient snack foods whereas high-animal product dietary pattern was characterised by increased intake of animal products (Sekiyama et al., 2015). Among 242 mother-child pairs included in the study, lower risk of

DBM (overweight mother-stunting child) was observed among children in the highest quintile of high-animal products dietary pattern. Additionally, a strong correlation was observed between higher animal product dietary pattern consumption and a lower risk of child stunting, suggesting that adequate animal product intake may help to improve child stunting. Conversely, mothers in the mid to the highest consumer of the modern dietary pattern had increased overweight risk by two-fold. This further supports Choy et al. (2018) findings that the modern dietary pattern contributes to high fat but low essential micronutrients.

High animal product dietary pattern intake tends to be protective against DBM, while high modern dietary pattern is associated higher risk of overweight. Among Kuwaitis, nutrition transition was illustrated via increase in energy and macronutrients intake but decline in fibre and micronutrients, resulting in rising prevalence of overweight and obesity (Zaghloul et al., 2013). From (Choy et al. (2018) and Sekiyama et al. (2015), one similarity is the modern dietary pattern which consisted of unhealthy food such as snacks, further providing evidence that nutrition is transitioning towards a more Westernised diet. This diet often comprises processed or ultra-processed food with market integration being more prominent and gradually replacing traditional food. While these modern foods provide high energy, they are unfortunately prone to be nutrient-poor, often containing high fat, sugar and salt content as highly processed foods are linked to lower dietary quality (Bleiweiss-Sande et al., 2020).

Poor quality diet has been linked to poor nutritional outcomes. Diet quality is usually assessed using Healthy Eating Index (HEI), Dietary Diversity Score (DDS) and Food Variety Score (FVS) in nutrition studies. Ramadas et al. (2021) scoping review on Malaysian's diet

quality detected poor diet quality, reflected by poor vegetables, fruits, dairy and overall variety of food among rural children, with high proportions from individual food insecure and child hunger food insecure households. While there is no significant association between a child's vegetable intake and DBM (overweight mother-stunting child dyads), children's vegetable consumption of four days or lesser per week were 2.21 times more likely to be stunted when compared to vegetable intake greater than four days per week (Géa-Horta et al., 2016). Insufficient consumption of good sources of essential micronutrients such as vegetables, legumes, and fruits may lead to stunted growth, reduced body weight, and increased vulnerability to infectious illnesses in children. Children with higher FVS score had lower odds of experiencing DBM (overweight mother-underweight child) (Saibul et al., 2009). These findings emphasise the importance of adequate intake from each food group to achieve the recommended nutrient intake (RNI) and maintain a balanced diet. Failure to achieve the balanced and healthy diet might exacerbate the risk of undernutrition among children.

Low HEI scores, which indicate poor quality diet, have been linked to risks of overweight, visceral obesity and hypertension in adults. In Malaysia, a low healthy eating index of 45.3 was reported among Orang Asli women (Chong et al., 2019). Indigenous (Mah Mari) women in Peninsula Malaysia had poor intake for vegetables, fruits, meat, poultry and eggs, legumes, and dairy product components but decent consumption for grains and cereal, and fish and seafood components (Chong et al., 2019). This finding is consistent with the high rice, anchovies and fresh marine fish consumption observed among women from rural Malay households in Sabak Bernam, Malaysia (Khor & Sharif, 2003). This indicates sufficient consumption of the grain and cereal food group component but inadequate intake

of other food group components including vegetables, meat, poultry and eggs, fruits, legumes and dairy might have influenced the nutritional imbalance in women.

Interestingly, Saibul et al. (2009) revealed that mothers who had higher food variety score (FVS) were more likely to experience DBM (overweight mother-underweight child) in contrast to children with higher FVS score who had lower odds of being in a DBM household. One possible explanation is that dietary diversity has a limited beneficial association with dietary adequacy because, once nutrient requirements are fulfilled, increasing food variety is generally accompanied by surplus calories with no further health advantages among adults. In the case of children, they are presumed to consume lesser food than adults, thus higher FVS will supply them with the essential nutrients within the recommended intake but are less likely to be excessive. This section underscores the impact of dietary patterns on DBM, highlighting how modern diets contribute to obesity while traditional diets support better nutrition and the importance of balanced, diverse diets in reducing malnutrition risks.

2.4 Conceptual framework

The UNICEF's Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020 was drawn as the framework to inform the potential determinants of household-level DBM among the indigenous communities in Sarawak.

2.4.1 UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020

Adaptation and modification of UNICEF's 1990 Conceptual Framework on the Causes of Child Malnutrition has presented the latest UNICEF's Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020 (UNICEF, 2021) as shown in Figure

2.1. The use of positive narratives in the framework provides clarity on the determinants contributing to good nutrition in children and women and were deliberately chosen to maximise relevant stakeholders' engagement in addressing malnutrition (Hapsari, 2020).

Enabling determinants that support good nutrition for children and women include good governance, sufficient resources and positive norms pertaining to gender, cultural and social aspects. The modification of the word 'basic' to 'enabling' in the 2020 framework highlights the importance of social and political commitments to nutrition intervention, and maintaining the efforts (Hapsari, 2020). Relevant policy environments such as policies, coordination and nutrition action that inhibits stunting were more apparent in countries with high stunting prevalence as compared to low stunting prevalence (WHO, 2018).

Sufficient food and nutrition services and healthy practices are categorised into food, feeding and environments which are recognised as the underlying determinants to enable good nutrition. Household food security plays a key role in ensuring food adequacy including nutrient-rich food appropriate for the age groups. Food insecure households have been discovered to consume energy-dense but nutrient-poor food due to its cheaper price, leading to poor diet quality (Ranjit et al., 2020). Interconnected with the food underlying determinant, poor dietary practices under the feeding determinant can also negatively impact the diet quality of children and women (Ranjit et al., 2020).

The proximate determinants include a healthy diet facilitated by sufficient food and proper feeding, as well as effective care. These are supported by adequate services and appropriate practices. Failure to achieve both will result in short-term and long-term adverse nutrition outcomes for maternal and child. Undernutrition in childhood and adolescence have been linked to disrupt cognitive development, health and physical growth, and poor school

performance (ECLAC & WFP, 2017). Later in adulthood, long-term effects of undernutrition can be observed as lower productivity and wages, employability, and negative health outcomes such as overweight, obesity and NCDs such as CVD, type 2 diabetes mellitus and cancer (ECLAC & WFP, 2017).

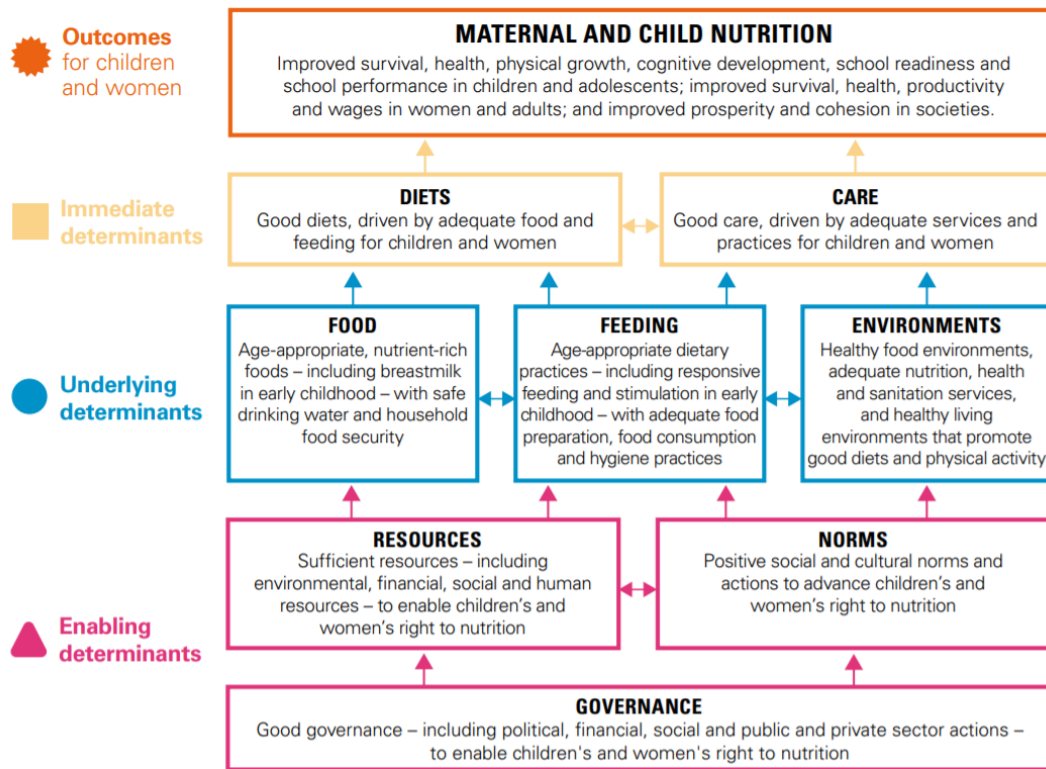


Figure 2.1: UNICEF's Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020 (UNICEF, 2021)

2.4.2 Conceptual framework of study

The UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020 was employed but not all determinants were investigated. Due to practical constraints, only several determinants that are likely to have the greatest impact on DBM were included as the independent variables in this study. The present study consists of independent variables including demographic and socioeconomic characteristics, food

security status, dietary intake and dietary quality while the dependent variable is occurrence of mother-child DBM at household level as shown in Figure 2.2.

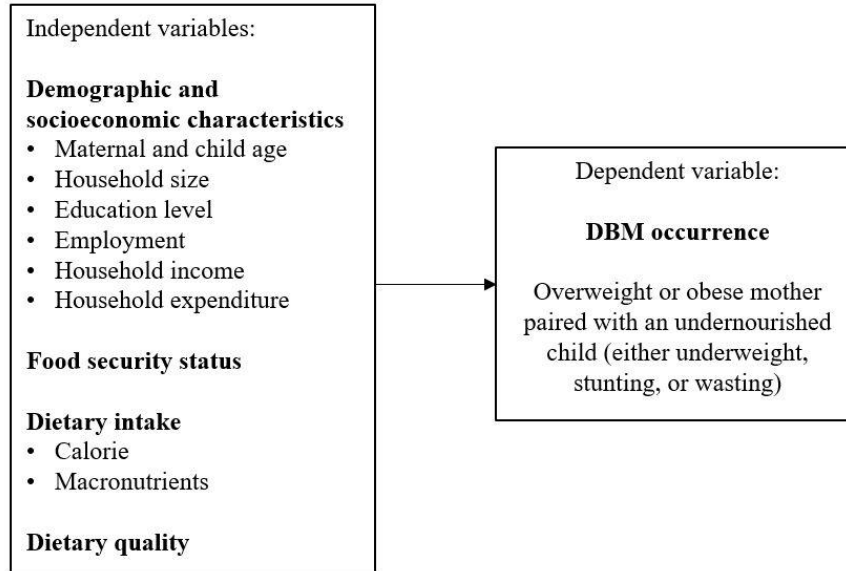


Figure 2.2: Conceptual framework of present study

2.5 Literature review summary

Household-level DBM shows varying patterns based on malnutrition forms and the family members involved. Most commonly, DBM manifests as an overweight mother with a stunted child. Studies reveal that DBM, particularly overweight mother-stunted child pairs, is more prevalent in middle-income countries and those undergoing nutritional transition. Among Malaysian indigenous communities, undernutrition is common in children, while adults increasingly face overweight and obesity, paralleling trends in indigenous populations globally. Various factors, including maternal age, socioeconomic status, education level, employment, household size, food security, and dietary intake and quality, are identified as drivers of DBM, emphasizing the need for comprehensive approaches to address both undernutrition and obesity within households.

CHAPTER 3

METHODOLOGY

This study aims to determine the household-level double burden of malnutrition (DBM) and its associated factors among the indigenous communities in Sarawak. Therefore, this chapter presents the outline of the research design. Subsequently, the methods and materials used will be explained in detail in this chapter.

3.1 Research design

Specific direction for procedures in a research design is informed via strategies of inquiry. This present study utilised the cross-sectional study design which is observational in nature. The aim of this study is to determine the prevalence of household-level DBM and its associated factors. This is an analytical cross-sectional study because the outcome variable, namely the presence or absence of DBM is assessed for potential associations with predictors which will be further explained in following section.

The rationale for adopting the cross-sectional study design is that it provides the snapshot of households among the indigenous population in Sarawak with the mother-child DBM at a given time. Additionally, associations of multiple exposure and outcomes can be examined. Considering the UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020, several predictors can be assessed in relation to their association with the presence of DBM. One of the limitations in research using cross-sectional design is its inability to establish causal inference. However, in view of this study's research questions, cross-sectional design best suits the objectives and available resources in this study.

3.2 Study location

The indigenous population in Sarawak is 1,186,965, which represents 48% of the total 2,453,677 population in Sarawak based on the Malaysian Census 2020 (DOSM, 2022). The largest state in Malaysia, Sarawak comprise of 12 divisions and 40 districts (currently 45 districts after the upgrade of five sub-districts to districts effective 31 March 2022) (EPU & Department of the Premier of Sarawak, 2022). The map of divisions in Sarawak is shown in Figure 3.1.

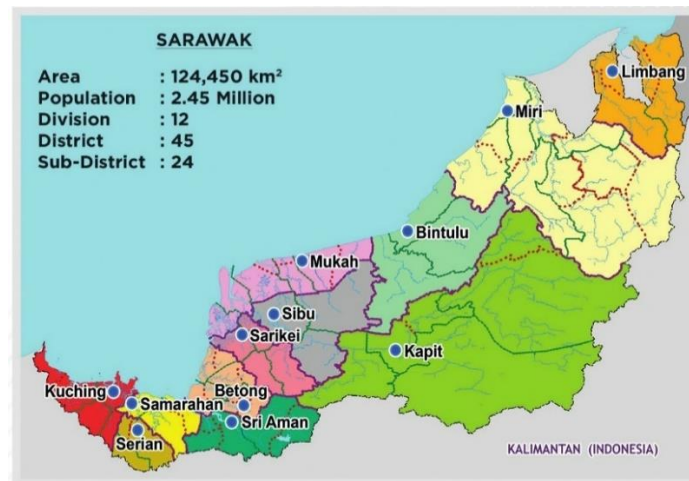


Figure 3.1: Map of divisions in Sarawak (EPU & Department of the Premier of Sarawak, 2022)

3.3 Study population

The study population focused on the indigenous communities in Sarawak. While the Malays were listed as indigenous to Sarawak according to the Schedule (Section 3) of the Sarawak Interpretation Ordinance 2005 (Interpretation Ordinance (CAP. 61), 2005), this study have excluded the Malays due to their distinct cultural practices and ethnic identities. Participants were recruited from the villages and longhouses which were selected via multistage random sampling. Divisions and districts randomly selected were scattered across

Sarawak, which may help to improve the demographic representation of the indigenous population in Sarawak. The inclusion criteria were indigenous women (aged 20-49 years) who had at least one child with ages ranging from 2 to 12 years old. Physically or mentally disabled women, pregnant or lactating were excluded from the study. Women who disagreed to participate were also excluded from the study. Women were selected as they are presumed to be more involved in food preparation and food sources availability in the household. They were also believed to be more aware of their child's growth and development. Hence, will be able to provide succinct information on their child's dietary intake and habits. If the household has more than one child aged 2-12 years old, only one was selected randomly to participate in this study.

3.4 Sample size of study

In this cross-sectional study, the aim was to estimate the prevalence of DBM at household level among the indigenous communities in Sarawak. Daniel (2012) formula will be used to calculate sample size as follow:

$$n = (Z^2(p)(1 - p))/d^2, \text{ whereby}$$

n = estimated sample size

Z = standard value at Confidence Level of 95% = 1.96

p = estimated prevalence of DBM in households with overweight/obese mother and underweight/stunted child among Indigenous People (Orang Asli) = 20.0 % (Wong et al., 2015)

d = margin error set at 5% = 0.05

$$\text{Thus, } n = (1.96^2(0.20)(1 - 0.20))/0.05^2 = 246$$

During pilot testing, non-response rate was approximately 10.0% but following the rise in COVID-19 cases throughout Sarawak, non-response rate is estimated to be higher at 20.0%. With consideration to non-response rate of 20.0%, the estimated final sample size is 296.

3.5 Sampling procedure

Villages and longhouses with predominantly indigenous communities in six divisions, namely Kuching, Samarahan, Serian, Sibuan, Sarikei and Miri were selected through multistage random sampling as shown in Figure 3.2. After random selection of division, districts within the selected divisions were then randomly selected. The districts were Bau, Simunjan, Serian, Sibuan, Julau and Miri. List of villages and longhouses were obtained from respective local district offices. Identification numbers were assigned to each division and district as Appendix C, and an online random number generator was used in the random selection. Similar to selection at the division and district stage, villages and longhouses were also randomly selected using the random number generator. Households that met the inclusion criteria in the selected villages and longhouses were invited to participate in the study. Local enumerators who were trained in the study's objectives and procedures, approached these households. They provided detailed information about the study, answered any questions, and obtained written informed consent from those who agreed to participate. Households that consented were then asked to complete interviewer-administered questionnaires.

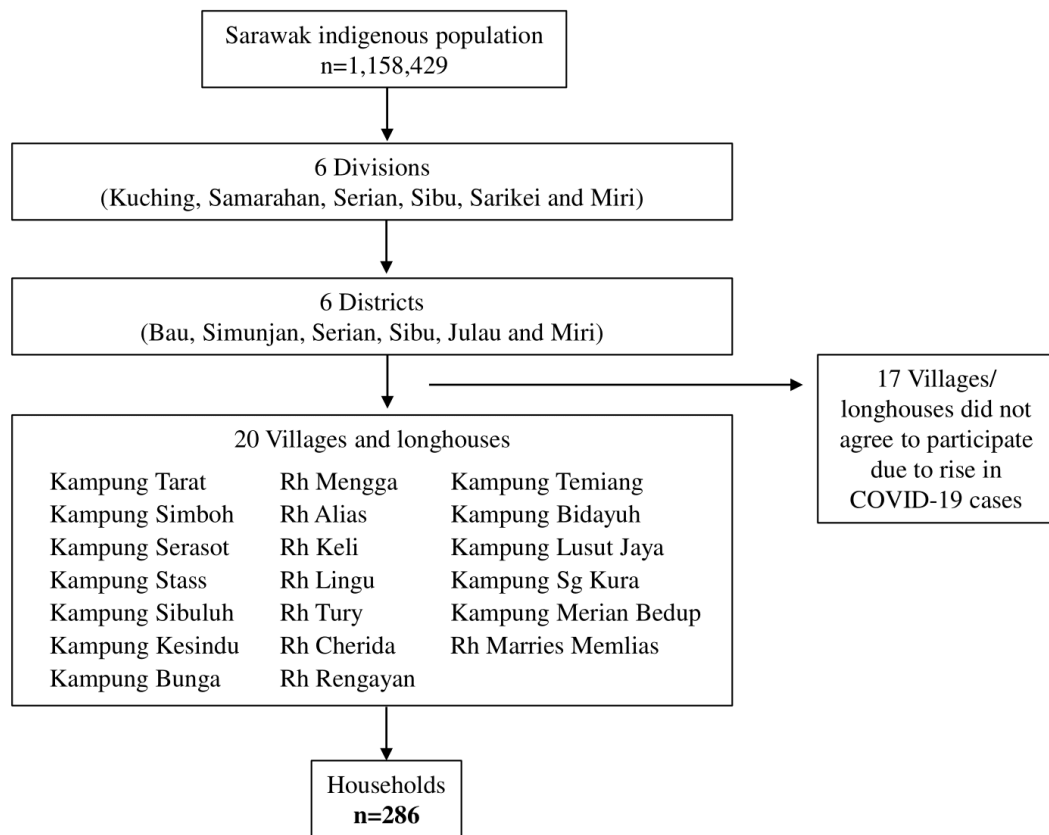


Figure 3.2: Multistage random sampling procedure of the study

3.6 Data collection instruments

The following sections outlined the instruments used to collect relevant data for this study. UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition, 2020 were the basis for the selection of instruments (UNICEF, 2021). This included 1) demographic and socioeconomic characteristics; 2) food security status; 3) dietary intake, 4) dietary quality, and 5) nutritional status which were interviewer-administered as Appendix F with the assistance of local enumerators.

Part A: Demographic and socioeconomic characteristics

This demographic and socioeconomic questionnaire was used to gather information comprising age, household size, level and year of education (participants and spouses), occupation (participants and spouses), number of children, household income, household income per capita, monthly household expenses, house or transport ownership, having savings and access to healthcare service. Based on the Poverty Line Income (PLI) of Sarawak, monthly household income <RM2,131 were considered absolute poor while hardcore poor were households with monthly income <RM1,096 (DOSM, 2020). The Malaysia Standard of Classification of Occupation (MASCO) which comprises ten different types of occupations was used as a guideline to classify the occupation category (MOHR, 2020). Additionally, conditions such as retired and housewife were included to accurately capture the characteristics of participants. The children's information on age, sex and birthweight were also collected.

Part B: Food security status

Radimer/Cornell Hunger and Food Insecurity Instrument is a validated instrument developed by Radimer et al. (1992) to determine the severity of household food insecurity. The Malay language version which was also validated was used as majority of the local communities understands Malay (Sharif & Ang, 2001). The instrument is applicable in the study given that it was instigated from the perspectives of rural women who experienced hunger in the upstate of New York (Radimer et al., 1992). In Malaysia, this instrument has been used to assess the food security status in several studies among the indigenous (Orang Asli) in Peninsula Malaysia, low-income households, university students, and the elderly population (Sulaiman et al., 2021). The instrument is justified for use in measuring food

insecurity in this study due to its validation in local language, comprehensive scope, established use in diverse Malaysian populations. Consisting of ten items and response categories of “not true”, “sometimes true” and “often true”, the severity of food insecurity is depicted through four levels:

- *Food secure* - Respondents provided negative responses to all questions related to hunger and food insecurity items.
- *Household food insecure* - Respondents gave positive responses to one or more items (1-4) but did not acknowledge issues at the adult or child level.
- *Individual or adult food insecure* - Respondents affirmed one or more items (5-7) but did not report problems with items (8-10).
- *Child hunger* - Respondents acknowledged issues by providing a positive response to one or more items (8-10).

Part C: Dietary intake of mother and child

Data on dietary intake of all the mother and randomly selected child were collected using two days of 24-hour recall. Dietary recalls were taken from one weekday and one weekend. Any information on food and drink consumption throughout the 24-hour including method of cooking, brand names and portion sizes were gathered. To give a more precise estimate, the quantity consumed were recorded by referring to the standard local household utensils including cup, glass, spoon, plate and bowl. This was presented visually to participants via pictures of each utensil. Any additional dietary supplement taken were also recorded. The nutrient adequacy was examined by comparing the calories and macronutrients intake of the mother and child in this study to the RNI for Malaysia (NCCFN & MOH, 2017).

Part D: Dietary quality of mother and child

The Malaysian Healthy Eating Index (HEI), developed by Lee et al. (2011) and validated by Goh & Norimah (2012) is a tool consisting of seven food groups and two nutrient groups. It is employed to evaluate the overall dietary quality of study participants. Each food group's score is determined by the formula: (actual serving consumed based on the respondent's dietary recall/recommended serving size according to the Malaysian Dietary Guidelines (MDG)) $\times$ 10. Conversely, nutrient scores are calculated proportionally for responses falling between whole numbers within the 0-10 range. The scoring of components is based on serving size and nutrient intake recommendations outlined in the MDG. The composite score, expressed as a percentage, is computed using the formula: (total score obtained from 9 components/maximum score of 90) $\times$ 100%. Total scores of less than 51%, 51 to 80%, and more than 80% indicated poor diet, diet in need of improvement and good diet respectively (Pei et al., 2018).

Part E: Nutritional status of mother and child

Height and weight measurements of mother and child were collected according to standard procedures recommended by WHO (WHO, 2006). Height was measured using SECA Stadiometer 217 to the nearest 0.1 cm with no shoes while standing straight. Participant's weight measurement was collected using TANITA Digital Weighing Scale HD-382 with accuracy to nearest 0.1 kg, wearing light clothing. Both height and weight measurement were taken twice to ensure precision. Body mass index (BMI) of the mothers was determined using the formula $\text{weight (kg)}/\text{height}^2(\text{m}^2)$. Mothers were classified as underweight, overweight or obese according to the WHO's cut off for BMI (WHO, 2021).

Underweight is indicated by BMI $<18.5 \text{ kg/m}^2$, normal BMI at $18.5 - 24.9 \text{ kg/m}^2$, overweight is BMI at $25.0 - 29.9 \text{ kg/m}^2$, and obese at BMI $\geq 30.0 \text{ kg/m}^2$ (WHO, 2021)

Using WHO AnthroPlus software (version 1.0.4, 2009), z-scores for weight-for-age (WAZ), height-for-age (HAZ) and BMI-for-age (BAZ) of children were computed based on their age and sex. Growth indicators for the children aged 2-12 years in this study was adapted from WHO Growth Reference 2006 (WHO, 2006) as shown in Table 3.1. Although children with BAZ $<-2\text{SD}$ were considered thin for children aged five and above, this present study classified them similarly to children under five years with BAZ $<-2\text{SD}$, which is wasting. This is to avoid confusion when classifying the household nutritional status which consisted of multiple possible pairings for the mother and child's nutritional status.

Table 3.1: Growth indicators for children aged 2-12 years (adapted from WHO Growth Reference 2006)

Nutritional status of children	z-scores
Weight-for-age (WAZ) [†]	
Underweight	$WAZ < -2SD$
Normal	$-2SD \leq WAZ \leq +2SD$
Overweight*	$WAZ > +2SD$
Height-for-age (HAZ)	
Stunting	$HAZ < -2SD$
Normal	$-2SD \leq HAZ \leq +2SD$
BMI-for-age (BAZ) for under five	
Wasting	$BAZ < -2SD$
Normal	$-2SD \leq BAZ \leq +2SD$
Overweight	$+2SD < BAZ \leq +3SD$
Obese	$BAZ > +3SD$
BMI-for-age (BAZ) for five and above	
Thinness	$BAZ < -2SD$
Normal	$-2SD \leq BAZ \leq +1SD$
Overweight	$+1SD < BAZ \leq +2SD$
Obese	$BAZ > +2SD$

[†]Weight-for-age applicable to children aged 2-10 years only;

*WAZ>+2SD indicate overweight for children aged 5-10 years whereas growth problem in children under five; SD = Standard deviation

3.7 Classification of household nutritional status

The nutritional status of household is determined from the nutritional status of the mother and child pair living within the same household. This study defined DBM as the coexistence of an overweight/obese mother with an undernourished (underweight/stunting/wasting) child within the same household. Therefore, households with the combination of mother with overnutrition and undernourished child were identified as DBM

households while other households with combinations aside from overnutrition mother-undernourished child were identified as non-DBM households. Table 3.2 showed the household nutritional status based on the mother's BMI and the three growth indicators for child (WAZ, HAZ and BAZ).

3.8 Data collection procedure

Data collection was commenced once approved by the Ethics Committee of Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak (UNIMAS). Approval and lists of villages and longhouses were obtained from the respective local district offices. Data collection was conducted from October 2021 to September 2022 via interviewer-administered questionnaires. Approval to conduct the research was obtained from village and longhouse heads (known as *Ketua Kampung* in villages and *Tuai Rumah* in longhouses). If verbal approval was granted, they were informed prior to commencement of the study for a more convenient entry to the villages and longhouses since they often have considerable influence within their communities. The researcher briefed and trained several local enumerators from respective villages and longhouses to assist with the data collection. Briefing included purpose of the study, inclusion and exclusion criteria for recruiting participants, obtaining informed consent, administering the questionnaires and measuring height and weight using standard procedures as Appendix E. Local enumerators were utilised due to their familiarity with the residential area and their ability to communicate in local languages to minimise language barriers. The completed questionnaires were sent back to the researcher via postage for the districts in central (Sibu and Julau) and north area (Miri). For the districts in south area (Bau, Serian and Simunjan), the researcher collected the completed questionnaires herself.

Table 3.2: Nutritional status classifications for mother-child pairs within the same household

No.	Household nutritional status	BMI _m /WAZ _c	BMI _m /HAZ _c	BMI _m /BAZ _c
DBM household				
1.	Mother overweight or obese /child undernutrition	OM/UC	OM/SC	OM/WC
Non-DBM household				
2.	Mother normal/child normal	NM/NWC	NM/NHC	OM/NWHC
3.	Mother normal/child undernutrition	NM/UC	NM/SC	NM/WC
4.	Mother overweight or obese/child normal	OM/NWC	OM/NHC	OM/NWHC
5.	Mother underweight/child normal	UM/NWC	UM/NHC	UM/NWHC
6.	Mother underweight/child undernutrition	UM/UC	UM/SC	UM/WC
7.	Mother overweight or obese/child overweight or obese	OM/OC	-	OM/OC
8.	Mother normal/child overweight or obese	NM/OC	-	NM/OC

DBM = double burden of malnutrition; BMI_m = body mass index of mother; WAZ_c = weight-for-age of child; HAZ_c = height-for-age of child; BAZ_c = BMI-for-age of child; OM = overweight or obese mother; NM = normal weight mother; UM = underweight mother; UC = underweight child; SC = stunted child; WC = wasted child; NWC = normal weight child; NHC = normal height child; NWHC = normal BMI child; OC = overweight or obese child

3.9 Data management and quality control – pilot study

Pilot study was conducted before commencement of the actual study. Pilot testing of the survey was conducted in several villages in Serian and Samarahan districts. A total of 108 participants answered the questionnaires to test for the reliability of the instrument at

local setting. The participants in this pilot testing were not included in the main study. Local enumerators were asked to enquire the participant whether they understood the wordings used in the questionnaire. The internal consistency reliability of the Radimer/Cornell Hunger and Food Insecurity Instrument using the Cronbach's coefficient alpha was 0.898 in the pilot study, indicating good reliability. The Malay version of the questionnaire was used for the study since majority of the participants were more familiar with the language. No changes were made to the 10 items in the Malay version. Regarding the validity and reliability of the M-HEI, these measures are not directly applicable as it is not a psychometric scale. The primary relevant aspect of validity would be criterion validity, which is beyond the scope of the current study. However, previous studies have found the validity of the M-HEI to be acceptable (Goh & Norimah, 2012; T. T. Lee et al., 2011; Rezali et al., 2015).

3.10 Data entry and validation

Data entry started immediately after the data collection was completed. Demographic and socioeconomic characteristics, food security status, height and weight information of the mothers and their children were entered in Statistical Package for Social Sciences (SPSS) Window Software Program version 25 (SPSS INC., Chicago, IL, USA). As for the 24-hour dietary recalls, data were entered into Nutritionist Pro version 2.4.1 first. The diet record nutrition summaries were then extracted and entered into SPSS for further analysis. Missing values, normality, outliers and errors were checked and corrected.

3.11 Data analysis

Data analysis was performed using SPSS Window Software Program version 25 (SPSS INC., Chicago, IL, USA). Descriptive statistics were utilised to summarise demographic and socioeconomic characteristics, household food insecurity, dietary intake

and dietary quality. Dietary intake referred to the calories and macronutrients intake of mother and child while the dietary quality was assessed using M-HEI for both mother and child. Normality checks were conducted using graphs (histogram and boxplot) and descriptive statistics using skewness and kurtosis. When normally distributed, continuous data were presented as mean and SD. Median and interquartile range (IQR) were used to present continuous data which were not normally distributed. Categorical data were presented as count and percentage. Internal consistency reliability was assessed using Cronbach's alpha coefficient for the Radimer/Cornell Hunger and Food Insecurity instrument.

Subsequently, inferential statistical analysis was performed to test the hypothesis. Initially, the household nutritional status was identified first before performing the inferential statistical analysis. As presented in Table 3.2 previously, the dichotomous outcome variables were whether DBM household or non-DBM household based on the mother and child pair nutritional status within the same household. Considering the binary outcome, simple and multiple binary logistic regression analysis were performed via the enter method to assess the association between the independent variables with DBM. Simple binary logistic regression was performed to determine the association between the independent variables (demographic and socioeconomic characteristics, food security status, caloric and macronutrients intake of mother and child, M-HEI component scores of mother and child) with the binary dependent variable (DBM household/Non-DBM household). Independent variables with associations $p < 0.20$ were further analysed in the multiple binary logistic regression analysis to adjust for confounding effects. The findings were reported as crude odds ratio (COR) and adjusted odds ratio (AOR), accompanied by a 95% confidence interval (CI). Independent variables with $p < 0.05$ were considered statistically significant in

their association with DBM. Multicollinearity among the predictor variables was examined using variance inflation factor (VIF) with cut-off below 10 to prevent statistical bias in the multiple binary logistic regression model (Mansfield & Helms, 1982).

Model fit assessment was performed using the model summary table, Hosmer-Lemeshow test, classification table of the output from the multiple binary logistic regression analysis in SPSS. The approximate variation in outcomes was reported using Nagelkerke R Square and Cox & Snell R Square from the model summary table. The value shown in Nagelkerke R Square showed how much the variation in the occurrence of DBM can be accounted to the predictor variables in the model (Nagelkerke, 1991). Hosmer-Lemeshow test with $p > 0.05$ indicated that the model adequately fits the data (Park, 2013). The overall accuracy of the model of >70% correctly classified is expected for a good model fit based on the classification table of the model.

3.12 Ethical approval

Approval from the Ethics Committee of the Faculty of Medicine and Health Sciences at Universiti Malaysia Sarawak (UNIMAS) was obtained to ensure the study's ethical compliance as Appendix A. Approval to conduct the study was also obtained from district offices as Appendix B. Verbal consent was obtained from the respective heads of villages (*Ketua Kampung*) and longhouses (*Tuai Rumah*) involved prior to commencement of the study. Informed consent forms were collected during the survey as Appendix C and D. The participants were briefed on the following:

- a. The objective and overview of the study;
- b. Benefits of the study for participants and contribution to the community;

- c. Participant's responsibility when participating in the study;
- d. Absolute confidentiality of the participants, with only the researcher and her supervisor having access to the data;
- e. The right to withdraw from the study without their current situation being affected by withdrawal in any way.

3.13 Duration of study

Total duration of present study was two and a half years. Throughout the period, the phases of the study are as follow:

Phase 1: Proposal preparation and proposal defence, and application for approval to conduct study from relevant authorities were conducted in this phase between March till August 2021. Literature search was conducted to search for research gap regarding the study topic. Proposal defence was in July 2021 and subsequent approval allowed the progression to the next phase. Approval from local district offices and ethics committee were obtained.

Phase 2: Preparation of instruments and pilot testing for validation of questionnaires in this phase was conducted between August till September 2021. Pilot study was conducted in several villages in Samarahan district with approval from respective head villages. Outcome of pilot study was analysed and deemed appropriate to proceed to next phase with the questionnaires.

Phase 3: Data collection, data entry and data analysis was conducted between October 2021 to January 2023. Data collection and data entry were performed concurrently throughout this phase. With the completion of both, data analysis was then performed.

Phase 4: Dissertation write-up was conducted between January 2022 to October 2023. Draft of each chapter was reviewed and revised accordingly with guidance from supervisor. Completed thesis was submitted for review in November 2023.

CHAPTER 4

RESULTS

The general objective of this cross-sectional study was to determine the household-level double burden of malnutrition (DBM) and its associated factors among the indigenous communities in Sarawak. Specifically, to determine the factors contributing to the occurrence of DBM among indigenous households in Sarawak. Firstly, the response rate of this study will be presented followed by sections which provide statistical analysis to address the four specific research objectives and test their corresponding hypotheses.

Data on demographic and socioeconomic characteristics, food security status, dietary intake and dietary quality were presented using descriptive information such as mean, SD, median, IQR, percentage and count. Nutritional status of mother and child were identified to enable assessment of DBM and non-DBM households. For the purpose of determining the association between potential predictors (independent variables) and the dependent variable (households with DBM), simple binary logistic regression was performed. Subsequently, multiple binary logistic regression was conducted to identify the significant predictors of DBM households.

4.1 Response rate

Out of the 340 mother-child pairs approached by the local enumerators, only 286 mother-child pairs agreed to participate in this study. The response rate was 84.12%. While all the mother-child pairs fitted the inclusion criteria, some participants rejected participating in this study due to fear of the movement restriction orders (during COVID-19 pandemic) imposed by the Sarawak government during the data collection. Although the estimated final

sample size with 20.0% non-response rate was 296 mother-child pairs in the research methodology, local enumerators were requested to approach up to 340 participants due to high rejection rate during the data collection.

Based on the four specific objectives of this study, the findings will be presented as the following: (1) nutritional status of mother and child; (2) prevalence of double burden of malnutrition at household level; (3) demographic and socioeconomic characteristics; (4) food security status; (5) dietary intake of mother and child; (6) dietary quality of mother and child; and (7) Associated factors with double burden of malnutrition.

4.2 Nutritional status of mother and child

The nutritional status of mother and child is shown in Table 4.1. Eight in ten (78.7%) of the mothers were overweight or obese. Only 19.6% were in the normal BMI range and only a minority of 1.7% were underweight. Mean BMI was 29.56 ± 6.18 kg/m² which is in the overweight BMI category.

For weight-for-age z-score (WAZ), 12.3% of children aged 2-10 years were underweight (WAZ<-2.0SD) whereas 11.5% were overweight (WAZ>+2.0SD). As for the height-for-age z-score (HAZ), 16.8% of the 2-12 years old children were stunted (HAZ<-2.0SD). Children aged below five years were considered as wasted while children aged 5-12 years were considered as thin for the BMI-for-age z-score (BAZ<-2.0SD). In order to avoid confusion, children aged 5-12 years who are thin will be labelled similarly to the below five years children, which is wasted; in this study. For BAZ, 16.4% of the children were wasted. Notably, the percentage of overweight (12.9%) and obese (17.1%) children were considerably quite high; with the obesity percentage being slightly higher than the wasting percentage.

Table 4.1: Nutritional status of mother and child (n=286)

Characteristics	n	%	Mean ± SD
Mothers	286		
Weight (kg)			69.20 ± 15.20
Height (cm)			152.95 ± 5.43
BMI (kg/m ²)			29.56 ± 6.18
Underweight (<18.50)	5	1.7	
Normal (18.50-24.99)	56	19.6	
Overweight (25.00-29.99)	111	38.8	
Obese (≥30.00)	114	39.9	
Children 2-12 years			
Weight (kg)			25.35 ± 11.97
Height (cm)			119.25 ± 22.00
Weight-for-age (WAZ) ^a	235		-0.15 ± 1.67
Underweight (<-2.0 SD)	29	12.3	
Normal (-2.0 to 2.0 SD)	179	76.2	
Overweight (>2.0 SD)	27	11.5	
Height-for-age (HAZ)	286		-0.44 ± 1.86
Stunting (<-2.0 SD)	48	16.8	
Normal (-2.0 to 2.0 SD)	238	83.2	
BMI-for-age (BAZ)	286		0.10 ± 2.09
Wasted (<-2.0 SD)	47	16.4	
Normal (-2.0 to 1.0 SD)	153	53.5	
Overweight (>1.0 SD)*	37	12.9	
Obese (>2.0 SD)*	49	17.1	

^aWeight-for-age (WAZ) only for children aged 2-10 years, n=235;

*Overweight (BAZ>2.0 SD) and obese (BAZ>3.0 SD) for children below five years

4.2.1 Prevalence of double burden of malnutrition at household level

The nutritional status classification of the mother-child pairs is presented in Table 4.2. In general, one in four of the households were DBM households (25.2%) consisting of an overweight or obese mother paired with an undernourished child (either underweight,

stunting or wasting) in this study. The other mother-child nutritional status combinations were considered as non-DBM households according to the operational definition used in this study, which was 74.8% of the households.

For the mother's BMI with WAZ child pairings, 9.4% were DBM households which had an overweight or obese mother paired with an underweight child. The highest percentage of 60.4% can be observed in non-DBM households with an overweight or obese mother paired with a normal WAZ child. As for the mother's BMI with HAZ child pairings, 12.9% were DBM households which had an overweight or obese mother paired with a stunted child. The highest percentage of 65.7% is observed in non-DBM households which had an overweight or obese mother paired with a normal HAZ child. In the mother's BMI with BAZ child pairings, there were 11.9% DBM households which had an overweight or obese mother paired with a wasted child. Interestingly, almost a quarter (24.8%) of the non-DBM households had an overweight or obese mother paired with an overweight or obese child in the BMI mother-BAZ child category.

Table 4.2: Nutritional status classification of mother-child pairs (n=286)

Nutritional status classification	n	%
BMI mother - WAZ child	235	
mNormal/cNormal	34	14.5
mOver/cUnder	22	9.4
mOver/cNormal	142	60.4
mUnder/cUnder	2	0.9
mUnder/cNormal	3	1.3
mNormal/cUnder	5	2.1
mOver/cOver	23	9.8
mNormal/cOver	4	1.7
 BMI mother - HAZ child	 286	
mNormal/cNormal	46	16.1
mOver/cStunt	37	12.9
mOver/cNormal	188	65.7
mUnder/cStunt	1	0.3
mUnder/cNormal	4	1.4
mNormal/cStunt	10	3.5
 BMI mother - BAZ child	 286	
mNormal/cNormal	30	10.5
mOver/cWasted	34	11.9
mOver/cNormal	120	42
mUnder/cWasted	2	0.7
mUnder/cNormal	3	1
mNormal/cWasted	11	3.8
mOver/cOver	71	24.8
mNormal/cOver	15	5.2
 Household double burden malnutrition status	 286	
Non-DBM	214	74.8
DBM	72	25.2

WAZ: weight-for-age; HAZ: height-for-age; BAZ: BMI-for-age

mNormal: Mother with normal BMI; mOver: Mother with overweight/obese BMI; mUnder: Mother with underweight BMI; cNormal: Child with normal BAZ, HAZ or BAZ; cUnder: Child with WAZ<-2.0 SD; cStunted: Child with HAZ<-2.0 SD, cWasted: Child with BAZ<-2.0 SD, cOver: Under 5 years child with BAZ>2.0 SD and child aged ≥5 years with BAZ>1.0 SD

4.3 Demographic and socioeconomic characteristics

The demographic and socioeconomic characteristics of participants is presented in Table 4.3. The age of mothers ranged from 20 to 49 years old. Mean age of mothers was 34.65 ± 6.78 years with the highest percentage of 49.7% in the 30-39 years age group followed by 25.9% in 40-49 years and 24.5% in the 20-29 years. Majority of the mothers were Bidayuh (52.8%), followed by Iban (36.4%) Kayan (7.0%) and others (3.8%). The most predominant religion was Christian (95.5%). Most of the mothers were married (92.3%) followed by widowed (4.5%) and divorced or separated (3.1%). More than half of the participants had household size greater than four persons (63.6%) while 36.4% had at most four persons. Mean household size was 5 ± 1 persons.

Three quarters of the mothers had secondary school education (75.5%) followed by tertiary education (13.6%), primary education (7.0%) and no formal education (3.8%). Mean duration of the mothers' education was 10.50 ± 3.13 years. Almost three quarters of the spouse had secondary education (68.5%) followed by tertiary education (11.9%), primary education (10.5%), passed away or divorced (7.7%) and no formal education (1.4%). Mean duration of the spouses' education was 9.65 ± 3.74 years. Predominantly, 71.3% of the participants were housewives while the highest percentage for spouse occupation was elementary occupations (26.2%).

Based on the Poverty Line Income (PLI) of Sarawak, more than half (52.1%) of the participants were absolute poor (<RM2,131), 29.0% was normal and 18.9% were hardcore poor (<RM1,096). The median for monthly household income was RM1,550 which ranged from RM500 to RM14,000. Meanwhile, based on household income per capita, 43.4% were poor (<RM586), 36.7% were hardcore poor (<RM286) and 19.9% were normal. Median

household income per capita was RM333.33 which ranged from RM55.60 to RM4,400.00. Percentage of food and beverages expenses; and non-food items expenses were 53.33% and 40.00% respectively.

For the children's characteristics, the majority of the children were aged five years and above (67.8%) while 32.2% aged below five years old. Percentage of boys and girls were almost similar, which were 50.3% and 49.7% respectively. Overall mean birth weight was 2.86 ± 0.45 kg while the boys' mean birth weight was 2.91 ± 0.48 kg and girls was 2.81 ± 0.42 kg.

Table 4.3: Demographic and socioeconomic characteristics of participants (n=286)

Variables	n (%)	Mean $\pm$ SD	Min, max
Mothers' characteristics			
Age (years)		34.65 $\pm$ 6.78	
20-29	70 (24.5)		
30-39	142 (49.7)		
40-49	74 (25.9)		
Ethnicity			
Iban	104 (36.4)		
Bidayuh	151 (52.8)		
Kayan	20 (7.0)		
Others ^a	11 (3.8)		
Religion			
Christian	273 (95.5)		
Muslim	10 (3.5)		
Atheist	3 (1.0)		
Marital status			
Married	264 (92.3)		
Divorced or separated	9 (3.1)		
Widowed	13 (4.5)		
Household size ^b		5 $\pm$ 1	2, 13
≤ 4	104 (36.4)		
> 4	182 (63.6)		
Education of mother (years)		10.50 $\pm$ 3.13	0, 23
No formal education	11 (3.8)		
Primary school	20 (7.0)		
Secondary school	216 (75.5)		
Tertiary education	39 (13.6)		

Variables	n (%)	Mean ± SD	Min, max
Education of spouse (years)		9.65 ± 3.74	0, 20
No formal education	4 (1.4)		
Primary school	30 (10.5)		
Secondary school	196 (68.5)		
Tertiary education	34 (11.9)		
Passed away or divorced	22 (7.7)		
Occupation of mother*			
Professionals	15 (5.2)		
Technicians and Associate Professionals	14 (4.9)		
Clerical Support Workers	11 (3.8)		
Service and Sales Workers	19 (6.6)		
Skilled Agricultural, Forestry, Livestock and Fishery Workers	5 (1.7)		
Craft and Related Trades Workers	9 (3.1)		
Elementary Occupations	6 (2.1)		
Armed forces	3 (1.0)		
Housewife**	204 (71.3)		
Occupation of spouse ^c			
Managers	3 (1.0)		
Professionals	14 (4.9)		
Technicians and Associate Professionals	35 (12.2)		
Clerical Support Workers	12 (4.2)		
Service and Sales Workers	23 (8.0)		
Skilled Agricultural, Forestry, Livestock and Fishery Workers	59 (20.6)		
Craft and Related Trades Workers	12 (4.2)		
Plant and Machine Operators and Assemblers	17 (5.9)		
Elementary Occupations	75 (26.2)		
Armed forces	5 (1.7)		
Others (retired/passed away/divorced/unemployed)	31 (10.8)		
Monthly household income (MYR) [†]			
Hardcore poor (<1096)	54 (18.9)		
Absolute poor (<2131)	149 (52.1)		
Normal (≥2131)	83 (29.0)		
Median (range)		1550	500.00-14000.00
Household income per capita (MYR) [†]			
Hardcore poor (<286)	105 (36.7)		
Poor (<568)	124 (43.4)		
Normal (≥568)	57 (19.9)		
Median (range)		333.33	55.60-4400.00

Variables	n (%)	n (%)	Min, max
Expenses on food and beverages (MYR)			
Median (range)		900	200.00-2000.00
Percentage of food and beverages expenses based on household income (%)		53.33	10.83-80.00
Expenses on non-food items (MYR)			
Median (range)		604.50	2000.00-6000.00
Percentage of expenses on non-food items based on household income (%)		40.00	12.90-75.00
Children's characteristics			
Age (years)		7.20 ± 3.10	2-12
<5	92 (3.2)		
≥5	194 (67.8)		
Sex			
Male	144 (50.3)		
Female	142 (49.7)		
Birthweight (kg)		2.86 ± 0.45	
Male		2.91 ± 0.48	
Female		2.81 ± 0.42	

^aOthers include Kenyah, Melanau, Kedayan and Sebob; ^bAverage household size was four persons based on the Household Income and Basic Amenities Survey Report by State and Administrative District: Sarawak 2019 (DOSM, 2020);

^cOccupation classification based on MASCO 2020 (MOHR, 2020); ^{**}Housewife was added to classification due to high frequency; [†]Income category based on the Poverty Line Income (PLI) in Sarawak (DOSM, 2020); MYR: Ringgit Malaysia; USD 1 = MYR 4.55 as of 26 July 2023

4.4 Food security status of participants

Participants answered a total of 10 items from the Radimer/Cornell Hunger and Food Insecurity Instrument. Response categories were “Not true”, “Sometimes true” and “Often true”. “Not true” was considered as a negative answer whereas “Sometimes true” and “Often true” were considered positive answers. The highest percentage for positive responses “Sometimes true” or “Often true” was observed in “I worry whether my food will run out before I get money to buy more” (Item-1) followed by “The food that I bought just did not

last, and I did not have money to get more” (Item-2) with 45.5% and 34.6% respectively. The lowest percentage for positive responses was 11.5% which was observed in child level for both statements; “My child(ren) is/are not eating enough because I just cannot afford enough food” (Item-9) and “I know my child(ren) is/are hungry sometimes but I just cannot afford more food” (Item-10). On the other hand, the negative response was highest in individual level statement; “I am often hungry but I do not eat because I cannot afford enough food” (Item-6) as shown in Table 4.4. Cronbach’s alpha for the Radimer/Cornell Hunger and Food Insecurity Instrument in this study was 0.91.

Table 4.4: Distribution of responses to items in Radimer/Cornell Hunger and Food Insecurity Instrument (n=286)

Item	Statements	Food security status, n (%)	
		Not true	Sometimes true/Often true
	Household level		
1	I worry whether my food will run out before I get money to buy more.	156 (54.5)	130 (45.5)
2	The food that I bought just did not last, and I did not have money to get more.	187 (65.4)	99 (34.6)
3	I do not have enough food or raw materials to cook or prepare a family meal and I did not have money to get more food.	202 (70.6)	84 (29.4)
4	We eat the same thing for several days in a row because we only have a few different kinds of food at hand and do not have money to buy more.	203 (71.0)	83 (29.0)
	Individual level		
5	I cannot afford to eat properly.	214 (74.8)	72 (25.2)
6	I am often hungry but I do not eat because I can't afford enough food.	254 (88.8)	32 (11.2)
7	I eat less than I think I should because I do not have enough money for food.	244 (85.3)	42 (14.7)
	Child level		
8	I cannot give my child(ren) a balanced meal because I cannot afford that.	248 (86.7)	38 (13.3)
9	My child(ren) is/are not eating enough because I just cannot afford enough food.	253 (88.5)	33 (11.5)
10	I know my child(ren) is/are hungry sometimes but I just cannot afford more food.	253 (88.5)	33 (11.5)

Half of the participants were food insecure (50.7%) whereas 49.3% were food secure. Among those who were food insecure, 22.0% were household insecure, 14.7% were individual insecure and 14.0% were child hunger as shown in Table 4.5.

Table 4.5: Food security status of participants (n=286)

Food security status	n	%
Food secure	141	49.3
Food insecure	145	50.7
Household insecure	63	22.0
Individual insecure	42	14.7
Child hunger	40	14.0

4.5 Dietary intake of mother and child

The distribution of caloric and macronutrients intake of mothers by the DBM status is shown in Table 4.6. The nutrient reference values were based on the recommended nutrient intakes for Malaysian women (NCCFN, 2017). In general, the mothers mean caloric intake was 1748 ± 309 Kcal. For mothers aged below 30 years, the mean caloric intake of mothers in DBM households was higher with 1823 ± 265 Kcal as compared to non-DBM households with 1708 ± 348 Kcal. More than half of the mothers (64.3%) aged below 30 years had caloric intake lower than the RNI of 1840 Kcal. As for mothers aged 30 years and above, almost three quarters (67.1%) did not achieve the caloric RNI of 1900 Kcal. Both the mothers in DBM and non-DBM households had almost similar mean caloric intake, which were 1749 ± 317 Kcal and 1749 ± 301 Kcal respectively.

The mean carbohydrate intake of mothers was 196.98 ± 40.51 g/d in DBM households and 193.40 ± 38.91 g/d in non-DBM households. In DBM households, 79.2% had a percentage of energy from carbohydrate lower than 50% as compared to 76.6% in non-DBM households. Regardless of the DBM status, slightly more than three quarters (77.3%)

of the mothers had percentage energy from carbohydrate lower than 50%, which is lower than the recommended 50-65% carbohydrate contribution to the total energy intake.

For protein, the majority of the mothers (82.5%) had 10-20% energy from protein as per the recommendation. Both the DBM and non-DBM households had 81.3% mothers who had 10-20% protein contribution to total energy intake. Overall, the mean protein intake was 78.12 ± 18.89 g/d, of which the DBM households had slightly lower mean protein of 77.85 ± 17.54 g/d as compared to non-DBM households mean protein of 78.21 ± 19.36 g/d. Nevertheless, the mothers in this study had adequate protein considering that the RNI for women's protein intake is 55 g/d.

Almost all of the mothers (89.2%) had more than 30% energy from fat, which is higher than the recommended 25-30% fat contribution to total energy intake. In the non-DBM households, 89.3% mothers had greater than 30% of fat contribution to energy intake, which is just slightly higher than the 88.9% mothers in DBM households. The mean fat intake was 75.18 ± 19.55 g/d for mothers in DBM households as compared to 73.16 ± 20.34 g/d for mothers in non-DBM households.

Table 4.6: Caloric and macronutrients intake of mothers by the DBM status (n=286)

Macronutrients	n (%)			Mean $\pm$ SD		
	Normal	DBM	Total	Normal	DBM	Total
Calories (Kcal)				1740 $\pm$ 312	1773 $\pm$ 301.43	1748 $\pm$ 309
<30 years old (Kcal)				1708 $\pm$ 348	1823 $\pm$ 265	1746 $\pm$ 326
RNI ^a				1840	1840	1840
%RNI				92.83	99.08	94.89
<RNI	33 (70.2)	12 (52.2)	45 (64.3)			
$\geq$ RNI	14 (29.8)	11 (47.8)	25 (35.7)			
$\geq$30 years old (Kcal)				1749 $\pm$ 301	1749 $\pm$ 317	1749 $\pm$ 304
RNI ^a				1900	1900	1900
%RNI				92.05	92.05	92.05
<RNI	109 (65.3)	36 (73.5)	145 (67.1)			
$\geq$ RNI	58 (34.7)	13 (26.5)	71 (32.9)			
Carbohydrate (g/d)				193.40 $\pm$ 38.91	196.98 $\pm$ 40.51	194.30 $\pm$ 39.28
% energy from carbohydrate				44.64 $\pm$ 6.40	44.61 $\pm$ 6.69	44.63 $\pm$ 6.47
<50%	164 (76.6)	57 (79.2)	221 (77.3)			
50-65%*	50 (23.4)	15 (20.8)	65 (22.7)			
Protein (g/d)				78.21 $\pm$ 19.36	77.85 $\pm$ 17.54	78.12 $\pm$ 18.89
% energy from protein				18.01 $\pm$ 3.48	17.62 $\pm$ 3.29	17.91 $\pm$ 3.43
10-20%*	174 (81.3)	174 (81.3)	236 (82.5)			
>20%	40 (18.7)	40 (18.7)	50 (17.5)			
Fat (g/d)				73.16 $\pm$ 20.34	75.18 $\pm$ 19.55	73.67 $\pm$ 20.13
% energy from fat				37.36 $\pm$ 5.70	37.78 $\pm$ 5.78	37.47 $\pm$ 5.71
<25%	3 (1.4)	1 (1.4)	4 (1.4)			
25-30%*	20 (9.3)	7 (9.7)	27 (9.4)			
>30%	191 (89.3)	64 (88.9)	255 (89.2)			

^aRNI=Recommended Nutrient Intake (NCCFN & MOH, 2017); *Recommended macronutrient contribution to total energy intake for Malaysian adults (NCCFN & MOH, 2017)

The distribution of caloric intake in children by age group, sex and DBM status is shown in Table 4.7 whereas the distribution of macronutrients by DBM status is shown in Table 4.8. Overall, the children in DBM households had lower mean caloric intake of 1319 ± 318 Kcal as compared to 1400 ± 335 Kcal of children in non-DBM households. Regardless of the DBM status, more than half of the children had caloric intake lower than the RNI, which was 63.1% in non-DBM households and 56.9% in DBM households. Notably, the highest percentage of children that did not achieve the calorie RNI was the age group 10-12 years old children, which was 87.5% and 80.0% in DBM and non-DBM households respectively. This was followed by the age group of 7-9 years, 69.6% of children in DBM and 77.6% of children in non-DBM households had inadequate calorie intake.

Almost three quarters of the children (74.8%) had a percentage of energy from carbohydrate lower than the recommended 50-65% energy from carbohydrate. The children in DBM households had a slightly higher mean percent energy from carbohydrate of $46.94 \pm 7.75\%$ than the $44.55 \pm 7.49\%$ in non-DBM children. However, the mean carbohydrate intakes were almost similar for the children in DBM and non-DBM households, which was 152.08 ± 34.51 g/d and 152.90 ± 33.41 g/d respectively. For protein, most of the children (75.9%) had adequate 10-20% protein contribution to total energy intake. However, mean protein intake 56.33 ± 17.25 g/d was lower for children in DBM than 62.85 ± 18.48 g/d mean protein in non-DBM households. As for fat intake, 63.6% children had a fat contribution to total energy of greater than 35% and followed by 33.6% children who had a percentage of energy from fat within the recommended 15-35% range. In DBM households, the children had slightly lower mean fat of 54.19 ± 19.15 g/d as compared to the 59.86 ± 21.26 g/d in non-DBM households.

Table 4.7: Caloric intake of children by age, sex and DBM status (n=286)

Variable	Normal, Mean $\pm$ SD		DBM, Mean $\pm$ SD		Overall, Mean $\pm$ SD	
	Boys	Girls	Boys	Girls	Normal	DBM
Calories (Kcal)	1423 $\pm$ 326	1377 $\pm$ 344	1315 $\pm$ 299	1323 $\pm$ 339	1400 $\pm$ 335	1319 $\pm$ 318
<RNI, n (%)	77 (70.6)	58 (55.2)	22 (62.9)	19 (51.4)	135 (63.1)	41 (56.9)
$\geq$ RNI, n (%)	32 (29.4)	47 (44.8)	13 (37.1)	18 (48.6)	79 (36.9)	31 (43.1)
2-3 years old (Kcal)^a	999 $\pm$ 205	970 $\pm$ 238	1274 $\pm$ 336	1253 $\pm$ 301	984 $\pm$ 219	1265 $\pm$ 312
RNI	980	900	980	900		
%RNI	101.94	107.78	130.00	139.22		
<RNI, n (%)	7 (50.0)	6 (40.0)	2 (20.0)	1 (12.5)	13 (44.8)	3 (16.7)
$\geq$ RNI, n (%)	7 (50.0)	9 (60.0)	8 (80.0)	7 (87.5)	16 (55.2)	15 (83.3)
4-6 years old (Kcal)^a	1325 $\pm$ 273	1356 $\pm$ 275	1288 $\pm$ 298	1074 $\pm$ 328	1341 $\pm$ 272	1204 $\pm$ 321
RNI	1300	1210	1300	1210		
%RNI	101.92	112.07	99.08	88.76		
<RNI, n (%)	12 (44.4)	9 (30.0)	9 (64.3)	6 (66.7)	21 (36.8)	15 (65.2)
$\geq$ RNI, n (%)	15 (55.6)	21 (70.0)	5 (35.7)	3 (33.3)	36 (63.2)	8 (34.8)
7-9 years old (Kcal)^b	1489 $\pm$ 270	1418 $\pm$ 289	1347 $\pm$ 317	1462 $\pm$ 305	1459 $\pm$ 278	1427 $\pm$ 306
RNI	1750	1610	1750	1610		
%RNI	85.09	880.7	76.97	90.81		
<RNI, n (%)	27 (81.8)	18 (72.0)	7 (100.0)	9 (56.3)	45 (77.6)	16 (69.6)
$\geq$ RNI, n (%)	6 (18.2)	7 (28.0)	0 (0)	7 (43.8)	13 (22.4)	7 (30.4)
10-12 years old (Kcal)^b	1605 $\pm$ 276	1540 $\pm$ 336	1454 $\pm$ 224	1464 $\pm$ 291	1573 $\pm$ 307	1459 $\pm$ 241
RNI	1930	1710	1930	1710		
%RNI	83.16	90.06	75.34	85.61		
<RNI, n (%)	31 (88.6)	25 (71.4)	4 (100.0)	3 (75.0)	56 (80.0)	7 (87.5)
$\geq$ RNI, n (%)	4 (11.4)	10 (28.6)	0 (0)	1 (25.0)	14 (20.0)	1 (12.5)

^aEnergy requirements based on PAL 1.4; ^bEnergy requirements based on PAL 1.6; RNI=Recommended Nutrient Intake (NCCFN & MOH, 2017)

Table 4.8: Macronutrients intake of children by DBM status (n=286)

Macronutrients	n (%)			Mean $\pm$ SD		
	Normal	DBM	Total	Normal	DBM	Total
Carbohydrate (g/d)				152.90 $\pm$ 33.41	152.08 $\pm$ 34.51	152.70 $\pm$ 33.63
% Energy from carbohydrate				44.55 $\pm$ 7.49	46.94 $\pm$ 7.75	45.15 $\pm$ 7.61
<50%	169 (79.0)	45 (62.5)	214 (74.8)			
50-65%*	47 (20.1)	26 (36.1)	69 (24.1)			
>65%	2 (0.9)	1 (1.4)	3 (1.0)			
Protein (g/d)				62.85 $\pm$ 18.48	56.33 $\pm$ 17.25	61.21 $\pm$ 18.37
% Energy from protein				17.89 $\pm$ 3.38	16.92 $\pm$ 3.03	17.65 $\pm$ 3.32
<10%	3 (1.4)	1 (1.4)	4 (1.4)			
10-20%*	155 (72.4)	62 (86.1)	217 (75.9)			
>20%	56 (26.2)	9 (12.5)	65 (22.7)			
Fat (g/d)				59.86 $\pm$ 21.26	54.19 $\pm$ 19.15	58.44 $\pm$ 20.86
% Energy from fat				37.56 $\pm$ 6.54	36.12 $\pm$ 6.13	37.20 $\pm$ 6.46
<25%	6 (2.8)	2 (2.8)	8 (2.8)			
25-35%*	67 (31.3)	29 (40.3)	96 (33.6)			
>35%	141 (65.9)	41 (56.9)	182 (63.6)			

*Recommended macronutrient contribution to total energy intake for Malaysian children (NCCFN & MOH, 2017)

4.6 Dietary quality of mother and child

Dietary quality of the mothers and children was assessed using the Malaysian-Healthy Eating Index (M-HEI). The M-HEI food groups and nutrients component scores of the mother and child by DBM status is presented in Table 4.9. Notably, both the mothers and children had poor diet quality with composite M-HEI scores of $48.4 \pm 7.8\%$ and $36.3 \pm 9.6\%$ respectively. More than half (64.0%) of the mothers had poor diet quality while 36.0% had a diet requiring improvement. For the children, almost all (94.8%) had poor diet quality whereas 5.2% had a diet requiring improvement. Conspicuously, none of the mothers and children had good diet quality.

Mothers scored the lowest medians of 0(0) for the fruits; and legumes food group components; and 0(2.0) for percentage of fat contribution to total energy for the nutrient component. This was followed by a median score of 1.0(0.5) for the milk and milk products food group component. Food groups vegetables 10.0(0); meat, poultry and eggs 10.0(0); and fish and seafood 10.0(5.0) were the highest median scores achieved by the mothers. Grains and cereals also had a good median score of 8.0(3.1).

Similar to the mothers, the children also scored the lowest medians of 0(1.3), 0(0) and 0(0) for fruits; and legumes for the food group component; and percentage of fat contribution to total energy intake for the nutrient component respectively. Additionally, children also scored 0(7.0) for sodium of the nutrient component. For the food group fish and seafood, children in DBM households had a lower median score of 0(5.0) as compared to 2.5(7.5) in non-DBM households. On the other hand, children in DBM households had slightly higher median scores of 8.2(4.0) than the 6.5(4.2) scored by children in non-DBM households for the grains and cereals food group. They also scored slightly higher for the

milk and milk products food group, which was 2.5(4.5) as compared to the 1.0(3.4) median score by the non-DBM households. In general, children only scored 10.0(0) for the meat, poultry and eggs food group.

Table 4.9: M-HEI component scores of mothers and child by DBM status (n=286)

M-HEI components scores	Median (IQR)/Mean $\pm$ SD		
	Non-DBM	DBM	Overall
Mother			
Food groups			
Grains and cereals	8.0 (2.9)	8.4 (3.2)	8.0 (3.1)
Vegetables	10.0 (0)	10.0 (0)	10.0 (0)
Fruits	0 (3.8)	0 (2.5)	0 (0)
Meat, poultry and eggs	10.0 (0)	10.0 (0)	10.0 (0)
Fish and seafood	10.0 (5.0)	10.0 (7.4)	10.0 (5.0)
Legumes	0 (0)	0 (0)	0 (0)
Milk and milk products	1.0 (0.5)	1.0 (0.5)	1.0 (0.5)
Nutrients			
Total fat (% from total energy intake)	0 (2.0)	0 (1.8)	0 (2.0)
Sodium (mg)	5.0 (5.3)	5.0 (6.8)	5.0 (6.0)
Mother HEI composite score (%)	48.7 $\pm$ 7.2	47.5 $\pm$ 9.3	48.4 $\pm$ 7.8
Poor diet (<51), n (%)	134 (62.6)	49 (68.1)	183 (64.0)
Diet require improvement (51-80), n (%)	80 (37.4)	23 (31.9)	103 (36.0)
Children			
Food groups			
Grains and cereals	6.5 (4.2)	8.2 (4.0)	6.8 (4.7)
Vegetables	5.0 (7.7)	4.5 (7.0)	5.0 (6.7)
Fruits	0 (1.3)	0 (0.9)	0 (1.25)
Meat, poultry and eggs	10.0 (0)	10.0 (0)	10.0 (0)
Fish and seafood	2.5 (7.5)	0 (5.0)	2.5 (7.1)
Legumes	0 (0)	0 (0)	0 (0)
Milk and milk products	1.0 (3.4)	2.5 (4.5)	1.5 (4.5)
Nutrients			
Total fat (% from total energy intake)	0 (0)	0 (0)	0 (0)
Sodium (mg)	0 (5.0)	0 (10.0)	0 (7.0)
Children HEI composite score (%)	36.2 $\pm$ 9.6	36.7 $\pm$ 9.6	36.3 $\pm$ 9.6
Poor diet (<51), n (%)	202 (94.4)	69 (95.8)	271 (94.8)
Diet require improvement (51-80), n (%)	12 (5.6)	3 (4.2)	15 (5.2)

M-HEI = Malaysian Healthy Eating Index; IQR = Interquartile range

4.7 Factors associated with double burden of malnutrition

The households were coded dichotomously as DBM and non-DBM households. DBM households consisted of an overweight or obese mother paired with an undernourished child (either underweight, stunting or wasting). The other combination pairs which did not fit the DBM definition in this study are coded as non-DBM. Initially, independent variables (demographic and socioeconomic characteristics, food security status, energy and macronutrients intake, dietary quality) associated with a binary dependent variable (non-DBM or DBM) were analysed using simple binary logistic regression. The independent variables which were found to be significant with $p < 0.20$ in the simple binary logistic regression were further analysed in the multiple binary logistic regression using the enter method.

Initial simple binary logistic regression analysis revealed that mother's age, child's age, spouse education level, occupation of spouse, monthly non-food expenditure, food security status, child's protein intake, child's grain and cereal; and fish and seafood food groups; and sodium components of M-HEI appeared as significant influencing factors of DBM ($p < 0.05$). However, only five (5) independent variables were identified as significant associated factors in the multiple binary logistic regression ($p < 0.05$) as shown in Table 4.10.

The multiple binary logistic regression model explained 18.3% (Cox and Snell R square) and 24.1% (Nagelkerke R squared) of the variance in the presence of DBM. It was able to correctly classify 75.2% of the cases. The goodness of fit (Hosmer and Lemeshow test) was not statistically significant ($p > 0.05$) which indicated that the model adequately fits the data. Multicollinearity was examined with variance inflation factor (VIF) < 5 .

Factors that are significantly associated with DBM households include mother's age, household size, household income per capita, non-food expenses and children's M-HEI score for fish and seafood. Mothers aged 20-29 years (AOR = 3.118, 95% CI [1.079, 9.007], $p < 0.05$), household size greater than four persons (AOR = 2.391, 95% CI [1.102, 5.187], $p < 0.05$) and greater household income per capita (AOR = 1.002, 95% CI [1.000, 1.003], $p < 0.05$) were significantly associated with higher odds of DBM households. Contrastingly, higher children's fish and seafood M-HEI score (AOR = 0.892, 95% CI [0.812, 0.980], $p < 0.05$) and greater non-food expenditure (AOR = 0.999, 95% CI [0.998, 1.000], $p < 0.05$) were significantly associated with lower odds of DBM. Table 4.11 will present the summary of associated factors with DBM.

Table 4.10: Factors associated with DBM households

Independent variables	Adjusted b (SE)	Wald (df)	Adjusted OR (95% CI)
Age of mother (years)		4.653 (2)	
20-29	1.137 (0.541)	4.414 (1)	3.118 (1.079, 9.007)*
30-39	0.876 (0.464)	3.561 (1)	2.402 (0.967, 5.969)
40-49			Ref (1.00)
Household size			
≤4			Ref (1.00)
>4	0.872 (0.395)	4.867 (1)	2.391 (1.102, 5.187)*
Household income per capita (MYR)	0.002 (0.001)	4.771 (1)	1.002 (1.000, 1.003)*
Monthly non-food expenses (MYR)	-0.001 (0)	6.303 (1)	0.999 (0.998, 1.000)*
Child fish & seafood M-HEI score	-0.115 (0.048)	5.691 (1)	0.892 (0.812, 0.980)*
Constant	-1.089 (0.136)	63.927 (1)	0.336**
Model chi square (df)			51.958** (21)
n			286
Cox & Snell R Square			0.183
Nagelkerke R Square			0.241
Hosmer and Lemeshow Test			X ² (df) = 5.697 (8); p=0.681

*p<0.05; **p<0.001; Ref (1.00) = Reference category; Binary dependent variable = Non-DBM (coded 0) vs DBM (coded 1); SE = Standard Error; DBM = Double burden of malnutrition

Table 4.11: Summary of significant factors associated with double burden of malnutrition at household level

Independent variables	Predictors	Statistical significance	Inferential
Demographic and socioeconomic characteristics	Age of mother	AOR=3.118,	Younger aged mothers were three times more likely to have DBM
	• 20-29 years old	95% CI: 1.079, 9.007	
	Household size	AOR=2.391,	Households with more than four persons were two times more likely to have DBM
	• >4 persons	95% CI: 1.102, 5.187	
	Household income per capita	AOR=1.002,	Households with higher income per capita were more likely to have DBM
		95% CI: 1.000, 1.003	
	Monthly non-food expenses	AOR=0.999,	Households which had higher non-food expenses were less likely to have DBM
		95% CI: 0.998, 1.000	
Dietary intake	Child M-HEI fish and seafood score	AOR=0.892,	Children with greater fish and seafood M-HEI scores were less likely to have DBM
		95% CI: 0.812, 0.980	

M-HEI = Malaysian Healthy Eating Index; AOR = Adjusted Odd Ratio; CI = Confidence Interval

CHAPTER 5

DISCUSSION

This chapter 5 presents the discussion part of this study. Main findings explanation from the cross-sectional study revealed several insights that supports and extend existing literature. This will be followed by the strengths and limitations, and implications of the study.

5.1 Findings

This chapter presented the discussions of key findings from the study of household-level double burden of malnutrition (DBM) and its associated factors among the indigenous communities in Sarawak. Main focus of this findings is the determination of the prevalence of the DBM at household level and the factors associated with the occurrence of DBM based on the multiple binary logistic regression analysis. Two sub-research questions were investigated to address the aim of this study; which was to determine the household-level DBM and its associated factors among the indigenous communities in Sarawak:

- a. What is the prevalence of DBM at household level among the indigenous communities in Sarawak?
- b. What are the factors associated with the occurrence of DBM at the household level among the indigenous communities in Sarawak?

Therefore, this chapter consisted of the prevalence of household level DBM, followed by the discussion of associated factors with the occurrence of DBM among indigenous communities in Sarawak to address the research questions and capture the comprehensive picture of the research problems.

5.1.1 Prevalence of household-level DBM

In this study, the overall prevalence of DBM at household level was 25.2% which consisted of overweight or obese mother with an undernourished (underweight/stunting/wasting) child. Prevalence of households with an overweight or obese mother with a stunting child was 12.9%, with a wasted child was 11.9%, and with an underweight child was 9.4% respectively. There were four previous study which examined the DBM at household level in Peninsula Malaysia, two which were conducted among Orang Asli and the other two among rural households. Wong et al. (2015) reported 20% Orang Asli households had coexistence of overweight or obese mother with an underweight or stunted child aged 6-59 months while Saibul et al. (2009) observed 25.8% DBM which had overweight mother with an underweight child aged 2-9 years. In the rural district Bachok, Kelantan, prevalence of overweight mother with an underweight child was 29.6% (Ihab et al., 2013) whereas 26% of the Malay households had overweight mother with an underweight child aged 1-6 years in rural Sabak Bernam, Selangor (Khor & Sharif, 2003). The current study further supports the existence of DBM at household level among the indigenous populations in Malaysia.

Aside from Malaysia, the indigenous peoples in other parts of the world also experienced household-level DBM. Previous research indicates that there are disparities in the prevalence of the DBM among various racial groups. A secondary analysis from the Mexican Nutrition Survey 1999 revealed that mother with central adiposity (Waist-to-hip ratio ≥ 0.85) coexisting with stunting child within the same household was more prevalent in indigenous households (23.9%) compared to non-indigenous households (4.2%) (Barquera et al., 2007). Multivariable logistic regression showed that households with an overweight mother and a stunted child pair were almost two times more likely to have indigenous mother as compared to non-indigenous mother in a secondary analysis of the Living Standards

Measurement Study (LSMS) 2000 conducted in Guatemala. Using the same data set, prevalence of overweight mother with a stunted child was significantly higher in indigenous households (22.2%) as compared to non-indigenous households (15.9%) (Lee et al., 2017).

Similar to previous studies involving indigenous populations, proportions of overweight and obesity among the indigenous mothers in this study are considerably high (Chua et al., 2019; Coimbra et al., 2021; Law et al., 2020; Pei et al., 2018; Saibul et al., 2009). While the proportions of underweight, stunting and wasting are not as alarming when compared to the indigenous children in Peninsula Malaysia (Yen et al., 2018), the presence of these undernutrition among the indigenous children in Sarawak needs to be addressed. Interestingly, proportions of overweight and obesity among children in current study are considerably high.

The higher prevalence of DBM observed among indigenous population might be linked to environmental and genetic predisposition. The unique socio-cultural, economic, and environmental contexts in which these populations live often contribute to their increased vulnerability to malnutrition. For example, limited access to nutritious food, inadequate healthcare, and environmental factors such as pollution or lack of clean water can all contribute to the development of malnutrition (Joseph & Turner, 2020). The increasing influence of modernisation and globalisation has led to a shift away from traditional diets towards processed and unhealthy Western-style foods (Popkin et al., 2020). The erosion of indigenous food systems has had profound implications for the nutritional health of these populations (Joseph & Turner, 2020). With the decline of traditional food sources, indigenous communities are forced to rely on imported and often nutrient-poor

foods as compared to their traditional foods rich in essential nutrients (Joseph & Turner, 2020; Popkin et al., 2020).

5.1.2 Factors associated with the occurrence of double burden of malnutrition at household level

One of the main purposes of this study was to determine the associated factors with DBM at household level among the indigenous communities in Sarawak. The multiple binary logistic regression analysis revealed maternal age, household size, household income per capita, monthly non-food expenses and child's fish and seafood intake to be significantly associated with the occurrence of DBM. The following sections discuss the significant variables and insignificant variables in this study.

5.1.2.1 Maternal age

This present study showed that the maternal age is linked to the occurrence of DBM. In particular, DBM was three times more likely to be present in households with younger aged mothers. Falster et al. (2018) reported heightened risk of developmental vulnerability in children born to younger aged mothers, especially those with disadvantaged socioeconomic status whereas lowest risk was among mothers in their late twenties to mid-thirties. Although developmental vulnerabilities declined with maternal ages between 15-49 years, Hanly et al. (2020) revealed decline in risk was notably more pronounced in non-indigenous children compared to indigenous children. Biologically, young mothers are in the midst of their own physical and emotional growth. Their bodies might not be fully prepared for pregnancy and childbirth, which can potentially affect the development of the child (Lee et al., 1998). In contrast to the current study, older maternal age was significantly associated with increased likelihood of overweight mother and an undernourished child (stunting or underweight) in a multinomial logistic regression consisting of survey data sets

from 18 LMIC (Jehn & Brewis, 2009). Oddo et al. (2012) and Wong et al. (2015) both reported older maternal age association with overweight or obese mother with a stunting child. Physiological changes that occur with age, such as reduced nutrient absorption and increased risk of chronic diseases may have contributed to the presence of DBM. It is also possibly likely that the mother was already overweight or obese before pregnancy. Albeit, while maternal age might influence DBM presence physiologically, other factors should be considered.

Therefore, another possible explanation for DBM association with younger aged mothers might be due to their lack of experience and knowledge necessary for their children's optimal growth. The complex web of responsibilities regarding child health predominantly falls on mothers, making them pivotal figures in child caring. Maternal knowledge, however, can pose a potential obstacle when it comes to implementing effective parenting strategies. In a study in Nepal, older mothers (aged 35 years and above at pregnancy) were 2.5 times more likely to provide their children with food that meets the minimum dietary diversity as compared to mothers aged 15-19 years at pregnancy (Khanal et al., 2013). In a qualitative study conducted among 40 Bangladesh mothers aged below 19 years, most of the adolescent mothers lack the knowledge in regards to nutrition and child nutrition (Faiza & Tanvir, 2023). While the mothers know the appropriate timing for complementary feeding, most were more likely to have limited knowledge on what is appropriate to feed their children. A study from the Health Nutrition Survey (ENSANUT-2006) in Mexico showed that the indigenous mothers introduced animal food later at 11 months for their infants, with 50% were introduced at 8 months, as compared to non-indigenous that had early introduction at 3 months (González de Cossío et al., 2013). Although the current study did not examine the infant and young children feeding (IYCF)

practices, the association of younger aged mothers with DBM might suggest the lack of experience and knowledge when it comes to appropriately feeding their children.

5.1.2.2 Household size

This present study showed that household size is significantly associated with DBM. Similar to previous studies, the current study presented that larger household size was associated with DBM. A study in rural Indonesia showed that large family size had increased odds of experiencing DBM (Oddo et al., 2012). While this present study showed no significant association between food insecurity and DBM after adjusting for confounding factors, it is important to note that household size is a key determinant for food insecurity, suggesting the interconnection with DBM since food insecurity is also a risk factor for DBM (Gubert et al., 2017; Sansón-Rosas et al., 2021). With larger family size, food sources are more likely to be limited as with food insecurity, accessibility and availability of food is compromised. (Ali Naser et al. (2014) reported statistically significant mean difference between household size in food secure (mean 5.92) and food insecure (6.87) households. In food insecure households, children were almost 2.5 times and 3 times more likely to be underweight and stunting respectively compared to children in food secure households. Having to share might have led to unequal food distribution among the family members. Wibowo et al. (2015) study on the association between intra-household food distribution with DBM reported lower calorie, carbohydrate, protein and fat intake in the children whereas greater carbohydrate intake was observed in the mothers when compared to other family members. This pattern of food distribution might have contributed to DBM, where mothers who ate more macronutrients and children who ate less macronutrients were more inclined to DBM occurrence (Wibowo et al., 2015).

Notably, the extremely large household size observed in this study is attributed to the fact that some indigenous households practise joint-family living, meaning multiple generations living together within the same household. Gaupholm et al. (2023) analysis of the 2013 Philippines National Nutrition Survey revealed that various household size was significantly associated with DBM. Extremely large household size (≥ 11) was almost five times more likely to have DBM, followed by 2.5 times in 7-10 household size, and 1.5 times in 4-6 household size when compared to 2-3 household members respectively (Gaupholm et al., 2023). Economically productive household members, which is traditionally the men, are favoured when it comes to food allocation because they are perceived to require more energy as they assume the role of being the main income provider (Chattopadhyay et al., 2022). In food insecure households, adults, in particular the women, may act as a buffer during food shortages to prevent their child from going hungry. Qualitative study among indigenous (Orang Asli) in Peninsula Malaysia described dietary change (eating plain rice with soy sauce or salt) and rationing strategies (skipping meals, reducing portion size, more food for children, drinking fluid when hungry, going hungry) were few of the coping strategies practised during food insecurity (Law et al., 2018). This may have potentially underscored the inadequate nutrient intake among the mothers and children as a result of the hypothetical link between food insecurity and inequity in food allocation in larger household size (Harris-Fry et al., 2017).

5.1.2.3 Household income per capita

Although higher household income per capita was significantly associated with DBM in the current study, it is important to note that the association was weak. Contrary to the current study, Nakphong & Beltrán-Sánchez (2021) reported that overweight mothers in the poorest household quintiles had at least 2.5 times the risk of having a stunted child as

compared to households from the richest quintiles, both in the 2000-2005 and 2010-2014 periods in Cambodia. However, several studies supported the DBM association with higher household income in this current study. The association is consistent with study by Oddo et al. (2012) which reported almost 2 times higher odds of DBM in Bangladesh households with higher socioeconomic status, as indicated by higher weekly per capita household expenditure. In a comparative study, DBM was more prevalent among households with higher wealth-index in Bangladesh (richest, richer and middle-income households) and in Pakistan (richest and richer households) when compared to poorest households (Anik et al., 2019). This finding is consistent with Biswas et al. (2021) study assessing household-level DBM and its determinants in South and Southeast Asia which showed positive association with the richest household quintile. Higher likelihood of DBM in wealthier households can be attributed to obesity being more prevalent in affluent families compared to those with lower incomes (Ahirwar & Mondal, 2019; Pengpid & Peltzer, 2019).

Higher monthly household income per capita is an indicator of better overall socioeconomic status within a household. This would indirectly imply that they have greater access to cash economy foods, such as processed and ultra-processed foods rather than depending mostly on foods that were obtained via traditional food seeking methods (Ellena & Nongkynrih, 2017). Foods purchased from stores typically provided the highest share of dietary energy in the diets of indigenous populations and their consumption is linked to an elevated risk of NCDs as compared to traditional foods (Luongo et al., 2020). Furthermore, foods obtained via cash economy provide convenience in a way that not much physical exertion is involved when conducting the activity. Along with more sedentary lifestyle and increase in market food consumption, these might be the key factors to the DBM observed in indigenous population. Subsequently, the indigenous communities' nutrition seems to be

transitioning towards a more Westernised diet, consisting of high energy intake but unfortunately, lacklustre nutritional profile. Anjos et al. (2011), Gomes et al. (2021) and Rodrigues et al. (2023) suggested that the Brazilian indigenous population lifestyle has changed, following their poor metabolic syndrome findings. Market integration influenced general negative impact on dietary quality, diversity and food security among indigenous Amazonian populations (Godoy et al., 2005; Roche et al., 2008), leading to negative physical growth outcomes and nutritional status among their children (Benefice et al., 2006). Dietary intake lacking essential nutritional value might have been a key factor in the overweight and obesity in mothers and undernutrition in children.

5.1.2.4 Household non-food expenditure

Aside from household income, household expense is another indicator for socioeconomic status, in which household income and expenditure are interconnected to one another. As opposed to the discussion in the previous paragraph which showed higher socioeconomic status as a predictor of DBM, this next paragraph highlights a more stable socioeconomic status as protective against DBM. Note that both the socioeconomic indicators, household income per capita and monthly non-food expenditure showed weak associations with DBM, hinting a complex relationship with DBM.

This current study reported lower likelihood for DBM to occur in households with higher monthly non-food expenses. Referring to Engel's law, the proportion of income spent on food declines with increase in income as households dedicate greater share on non-food budgets to improve overall livelihood (Timmer et al., 1983; Zhu et al., 2022). On the other hand, Bennett's law stated that "starchy staple ratio declines as household income increases", indicating that as income increases, people tend to consume smaller proportion of calories from basic starchy staples and are more prone to diversify their food choices to include more

expensive calories sources (Timmer et al., 1983, p. 23). Increased household spending on non-grain foods, particularly animal-source foods was linked to lower likelihood of child stunting in the 0–59 months age group from an analysis of the Nutrition and Health Surveillance System conducted from 1999 to 2003 in Indonesia (Sari et al., 2010). Analysis of data from Young Live cohort comprising 5-, 8- and 12-years children from Ethiopia, India, Peru and Vietnam revealed lowest expenditure for food group meat and fish in households with the lowest food expenses (lowest quartile) whereas highest in household with greatest food expenditure (highest quartile) (Humphries et al., 2017). In all four countries, the total food expenditure was positively associated with HAZ and BAZ among the children. This can indicate that these households with higher food expenditure and depending on how expenses were allocated across food groups might influence nutritious food intake, resulting in better overall nutritional status for the adults and children within the household.

Linking back to food security, households which spent more on non-food items give an indication that accessibility and availability of their food supply are not restricted by financial constraints (Ren et al., 2018). Thus, allowing sufficient food quantity and adequate nutrients that meet their dietary needs. Nonetheless, higher non-food expenditure may not always equate to better nutrition considering that mother's knowledge and children's food preference play a part in impacting the DBM status of the household.

5.1.2.5 Child fish and seafood intake

Moving on to the dietary aspect that contributed to DBM, households with children who had greater fish and seafood intake were less likely to experience DBM in this current study. In terms of protein intake, meat, poultry, fish and eggs are known to be important sources of high quality protein. While the children in this study had a good score for meat,

poultry and eggs intake, their fish and seafood intake were shown to be poor. Martínez-Martínez et al. (2020) reported similar low fish and seafood intake frequencies among children as compared to adolescents. Examining the nutritional content of fish, it is found to be the major source of long chain (LC) n-3 PUFA eicosapentaenoic acid (EPA, C20:5 n-3) and docosahexaenoic acid (DHA, C22:6 n-3), in contrast to meat which contain lesser of these fatty acids. To highlight the difference in the fatty acids content, non-fish eaters had at least 5 times lower EPA and DHA intake as compared to fish eaters (De Smet, 2012). Emphasis on the significant values of EPA and DHA in fish is to give prominence to the beneficial effects that they provide in children. Studies involving malnourished children reported that LC n-3 supplementation has aided the improvement in learning and cognitive performance (Dalton et al., 2009; Portillo-Reyes et al., 2014). In a randomised control trial among the Australian indigenous children with limited literacy skills, EPA and DHA can promote cognitive development (tested by drawing a person) with strongest effect in 7-12 years old (Parletta et al., 2013).

Additionally, low fish and seafood intake in children might suggest that DBM households potentially have infrequent fish meals. However, the mothers in this current study scored well for their fish and seafood intake, contrary to the poor scores observed among the children, and particularly lower score among children from DBM households. One possible explanation is that the children might be picky eaters, often excluding certain food groups from their dietary consumption. The UK Avon Longitudinal Study of Parents and Children (ALSPAC) highlighted the causes and short- and long-term consequences of picky eating by detailing the long-term diet differences starting from age 3 years to age 13 years (Taylor & Emmett, 2019). Reportedly, at both 3.5 and 7.5 years, meat, fish, fruit and vegetables intake were lower among picky eaters compared to non-picky eaters. This was

evident in reduced consumption levels of iron, zinc, carotene, and dietary fibre, with a significant proportion of iron, zinc and dietary fibre not meeting the RNI. Among children aged 6-23 months in Zambia, a greater proportion who consumed fish had normal HAZ when compared to children who did not consume fish, with significant difference in HAZ (Marinda et al., 2018). Children in this age group were less likely to be stunted with greater fish consumption. Another longitudinal study following children from birth to age 15 years in Czech reported that compared to non-picky eaters, picky eaters were 2.3 kg lighter and 0.8 cm shorter at 15 years (Grulichova et al., 2022).

Linking back to late introduction of complementary feeding to children observed among indigenous mothers noted in section 5.1.2.1 of this study, late introduction has been associated to a higher likelihood of experiencing picky eating habits later on in life (Shim et al., 2011). Consuming fish is generally considered safe, and it shows the most significant reduction in the risk of various health outcomes (CHD mortality, CVD mortality, all-cause mortality, stroke, myocardial infarction, metabolic syndrome) when individuals consume two to four servings per week (Li et al., 2020). However, the fish consumption among indigenous DBM households might not meet the minimal requirement as they conformed to cooking food that their children can and prefer to consume. Thus, potentially contributing to the malnutrition in the household.

5.1.2.6 Other associated factors of double burden of malnutrition at household level

Several predictors such as maternal education, maternal employment, food insecurity and dietary intake were statistically insignificant with DBM occurrence in this present study. However, previous studies have shown significant associations between the variables and DBM. Type of urbanisation was not examined in this study.

Maternal education level produced mixed results in relation to association with DBM. Some studies identified higher maternal education to have lower likelihood of DBM (Anik et al., 2019; Biswas et al., 2021; Blankenship et al., 2020; Das et al., 2019; El Kishawi et al., 2016; Hong, 2021; Patel et al., 2020; Wong et al., 2015) while others revealed lower education as risk factor of DBM (Fookien & Vo, 2021b; Ghattas et al., 2020; Mahmudiono et al., 2018; Sunuwar et al., 2020). Mothers who had attended higher education level were perceived to have more knowledge on children's health and are more aware of dietary implications on nutritional outcomes. On the contrary, mothers who had lower education were more likely to lack good financial management and lack of knowledge on healthy dietary practices. Food quality purchased for household intake tend to be compromised as a response to increased household economic stress. Coping strategies during food shortages may include purchasing cheaper food items, typically processed and ultra-processed market food which are energy-dense but nutrient-poor. However, similar to the study conducted in mother-child dyad in rural Bachok, Kelantan, the current study showed that maternal education is not significantly associated with DBM (Ihab et al., 2013). This finding suggests that maternal education may not always translate to good nutritional status due to complex dimension of DBM.

Another insignificant variable with DBM was maternal employment in this study. Notably, 71.3% (204/286) of the mothers in this study were housewives. Saibul et al. (2009) study among indigenous (Orang Asli) in Selangor reported housewives were 3.18 times more likely to be associated with household with an overweight mother and an underweight child compared to employed mothers. In-depth interviews were conducted among 20 Guatemalan mothers from Nuevo San Carlos, a rural community with large indigenous population to better understand the impact of maternal employment on the mothers and their children

weight status (Oddo et al., 2018). Mothers who were employed described being able to purchase more food and enhance food variety, particularly meat and dairy, but have higher tendency to purchase food requested by their children such as junk food with the additional income. On the contrary, employed mothers were perceived to have less time to prepare meal or grocery shop, and limited time to supervise children's food consumption, or skipped eating due to time constraint. The mixed positive and negative influences of maternal employment on presence of DBM might explain the non-significant association observed. Therefore, it might help to conduct qualitative study among the Sarawakian indigenous mothers in this study to better understand how their employment status may influence DBM presence in their household.

Apart from the two variables above, food insecurity was significantly associated with DBM in previous studies but not in the current study. Simple binary logistic regression showed household experiencing child hunger (severe food insecurity) were 2.27 times more likely to have DBM. However, after adjusting for confounding factors, child hunger became a non-significant predictor of DBM in this study. Conversely, only food insecurity status remained a significant predictor of DBM comprising overweight or obese mother with a stunting child in Mahmudiono et al. (2018) study among 685 households in Surabaya, Indonesia. Interestingly, households with mild food insecurity had highest odds of DBM, followed by moderate, then severe food insecurity when compared to food secure households respectively. Gubert et al. (2017) secondary data analysis of the 2006 Brazilian National Demographic and Health Survey revealed the opposite, in which only severe food insecure household was significantly associated with 3.33 times higher likelihood of DBM comprising overweight or obese mother with a stunted child. Note that all three studies used different instruments to measure food insecurity status, which might explain the varying

findings. Mahmudiono et al., (2018) utilised Household Food Insecurity Access Scale (HFIAS) whereas Gubert et al. (2017) used Brazilian Household Food Insecurity Measurement Scale (EBIA) while this current study uses Radimer/Cornell Hunger and Food Insecurity Instrument. Food insecurity has been linked to both undernutrition and overnutrition. With food security as indicator of a household's accessibility and availability to adequate food, it is possible that food insecure DBM households have poor dietary quality and lack food variety considering that food insecurity and DBM share some similar determinants.

This present study showed dietary intake, particularly energy and macronutrients intake of mother and child were not significantly associated with DBM. Khor & Sharif (2003) showed that total energy, fat and riboflavin intake of children from households with normal weight mother/child were significantly higher than households with DBM (overweight mother and underweight child). For mothers, adequacy for total energy and most nutrients intake was higher among households with normal weight mother/child than the DBM households but were not significantly different. Similar with the findings from Khor & Sharif (2003), current study revealed that mothers from DBM and non-DBM households have more similarities than differences in relation to energy and macronutrients intake. The energy and macronutrients intake among the mothers might not differ much due to the overweight or obese mother paired with any child nutritional status (except underweight, stunting or wasting) were included in non-DBM households in this study.

Additionally, high proportion of overweight and obese mothers, 78.7% (225/286) might have influenced the mostly similar dietary intake observed among the mothers. However, the obesity proportion did not reflect the calorie intake. One possible explanation

is underreporting during the 24-hour dietary recall among the mothers. Interestingly, the proportions of overweight or obese children were considerably high, 30% (86/286) and proportion of overweight or obese mother and child pairing in the non-DBM household was 24.8%. The dietary pattern among the indigenous Sarawakian might have possibly shifted away from traditional food to a more Westernised diet, leading to increased consumption of processed foods containing high fat, sugar and salt content, which may have been influenced by the food environment with rapid market integration (Popkin et al., 2020).

5.2 Strength and limitations of study

This is the first study of prevalence of DBM and its associated factors among indigenous communities in Sarawak. Therefore, it provides valuable insights to relevant stakeholders on what aspects to look into when planning effective strategies to combat DBM, especially among this indigenous communities in Sarawak. Moreover, the study included sample from various divisions across Sarawak, encompassing the south, central and north areas to ensure the indigenous population were adequately represented. Aside from the sociodemographic factors typically examined in DBM studies, this present study has included food insecurity and dietary aspect association with DBM, particularly the calorie and macronutrients intake, and dietary quality of both the mother and child. This study adaptation of the UNICEF Conceptual Framework on Maternal and Child Nutrition, 2020 provides a solid theoretical foundation for understanding DBM. Thus, may be a stepping stone for future research on what should be examined further to better capture the associated factors more comprehensively in relation to DBM among Sarawak indigenous communities.

There were several limitations identified in this study. Due to the definition of DBM used in this study, there was less highlight on overweight and obesity in children which

showed to be quite prevalent among the indigenous children. As with any cross-sectional study design, the cause and effect relationship for the associated factors with DBM could not be determined. In addition to that, the use of 24-hour dietary recall to capture the nutrient intake of participants depended on the memory and cooperation from the mothers, and how well they know what their children consumed. The study focus on indigenous people in Sarawak limits the generalisability to other populations or regions. Another limitation is that the villages and longhouses recruited in this study were all accessible via private transport, and therefore, the exclusion of indigenous communities in the rural areas were lamentable considering their likelihood of increased vulnerability to DBM.

5.3 Implications of study

While DBM has been extensively studied in various populations in other countries, there is limited research available specifically on the DBM among indigenous communities in Sarawak. This study showed the existence of DBM at household level among the indigenous communities in Sarawak. Applying the UNICEF Conceptual Framework on Maternal and Child Nutrition, 2020 as a guidance, several predictors of DBM were identified after the multiple binary logistic regression analysis. To decrease the prevalence of DBM at household level, policymakers and relevant stakeholders should consider planning strategies or programs addressing the issue via the socioeconomic and dietary intake of both mother and child but without forgoing the cultural aspect, especially their traditional foodways.

The findings suggest that mothers, who are primarily responsible for childcaring and food preparation within a household should be educated on what constitute a good nutrition for the family, especially for their children. Complex interplay between food security, income and expenditure suggests that strategies to tackle the DBM phenomenon should be

targeted at the enabling determinants in the UNICEF Conceptual Framework on Maternal and Child Nutrition, 2020, encompassing improving the financial, social and environmental conditions that facilitate good nutrition for children and women.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

This chapter concludes and concisely summarise the research outcomes and offer a comprehensive overview of the entire study. Subsequently, recommendations of study will be outlined.

6.1 Conclusion

The DBM phenomenon is an important issue to be studied as the current malnutrition reality often show the concurrent existence of undernutrition alongside overweight and obesity, or micronutrient deficiencies which became more apparent in recent years, and more evident in vulnerable indigenous populations. Contributing factors to DBM are complex and interwoven with the biological, socioeconomic and environmental aspects. Therefore, applying the UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition 2020 helped enhance understanding on how the determinants may influence the DBM occurrence.

Achieving the research objectives, this study gained some insights into the DBM status and the factors contributing to the occurrence of DBM at household level, particularly the mother-child pair among the indigenous communities in Sarawak. DBM presence among the Sarawak indigenous communities is confirmed in this study, with proportion of maternal overweight and obesity being alarmingly high whereas underweight, stunting and wasting among the children are not negligible. Albeit not the focus of current study due to definition of DBM used, the children's overweight and obesity were considerably high.

Findings from this study highlighted the demographic, socioeconomic and dietary intake as associated factors of DBM at household level among the indigenous communities in Sarawak. To be more specific, maternal age, household size, household income per capita, household non-food expenditure and children's fish and seafood intake significantly influence the DBM occurrence. Therefore, future initiatives or programs should include collaborative effort between various stakeholder including government, healthcare provider and school to address the DBM issue holistically.

6.2 Recommendations

Several recommendations on intervention strategies may be relevant based on this study's findings. Considering how the in-utero and first 1000 days of life essentially influence the nutritional status in early childhood and later on in adulthood, it is of utmost importance for mothers to be provided with the necessary information on healthy, balanced nutrition before, during and after pregnancy. The healthcare provider, in particular, the maternal and child health clinic might be a suitable platform to give the comprehensive nutrition education especially in relation to young child feeding practices for the children's optimal growth and development. Notably, the NPANM III, 2016-2025 have included providing nutrition education session to mothers and care givers based on the Infant and Young Child Feeding module at the clinic level. With the nutrition education, the main focus is to equip mothers with vital nutrition knowledge and good child feeding practices regardless of their age.

Aside from the maternal and child health clinic, nutritionists can play their role in educating healthy and varied food consumption to children and adolescents via schools, and the community via local engagements with villages and longhouses. Considering majority

of the mothers and children in this study had poor quality diet, it is crucial to make them be informed of what constitutes good quality diet and how to achieve them practically and affordably. Not neglecting their traditional food, nutritionists can suggest how to modify or substitute certain ingredients in their cooking to improve the nutritional value of the dishes.

In an effort to reduce consumption of unhealthy food, the government-imposed tax on certain unhealthy food and beverages such as sweetened creamer, sugar-sweetened beverages (SSBs) and processed foods). To further increase efficacy of the tax levied on unhealthy food, the prices of unprocessed and minimally processed food such as meat, poultry, egg and fish which are good protein sources should remain stable and affordable. In other words, improving efficiency and increasing productivity of the food industry should be another priority for the government to ensure sufficient food supply, and thus, mitigating inflation rate.

While several recommendations were stated above, it is important to conduct further research on the factors contributing to DBM. Future study can investigate the infant and young child feeding practices, physical activity level and the food environmental aspects considering the UNICEF Conceptual Framework of Determinants of Maternal and Child Nutrition 2020. Additionally, future study investigating the concurrent existence of micronutrient deficiency such as anaemia with undernutrition or overweight and obesity is essential since it is also a form of malnutrition and potentially impacted by nutritional intake. The various aspects suggested is to better understand the DBM predictors more comprehensively.

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APPENDICES

Appendix A: Ethical approval from UNIMAS Medical Ethic Committee

Fakulti Perubatan dan Sains Kesihatan
Faculty of Medicine and Health Sciences



www.unimas.my

UNIMAS/NC-21.02/03-02 Jld.5 (24)

16 Februari 2021

Dr. Law Leh Shii
Fakulti Perubatan dan Sains Kesihatan
Universiti Malaysia Sarawak
94300 Kota Samarahan
Sarawak

Dr.,

Kelulusan Etika Untuk Penyelidikan:

- An Analytical Framework for Household Food Insecurity among Indigenous Communities in Sarawak, Malaysia

NO. RUJUKAN ETIKA: FME/21/13

Dengan segala hormatnya perkara di atas dirujuk.

Sukacita dimaklumkan bahawa etika untuk penyelidikan seperti di atas telah **DILULUSKAN**. Penyelidik-penyelidik yang terlibat adalah seperti dibawah:

1. Dr. Law Leh Shii (Penyelidik Utama)
Universiti Malaysia Sarawak
2. Prof. Madya Dr. Cheah Whye Lian
Universiti Malaysia Sarawak
3. Prof. Madya Dr. Jeffery anak Stephen
Universiti Malaysia Sarawak
4. Yolanda Salleh
Universiti Malaysia Sarawak
5. Teoh Wan Jool
Universiti Malaysia Sarawak

Segala rekod dan data subjek adalah SULIT dan hanya digunakan untuk tujuan penyelidikan dan semua isu serta prosedur mengenai kerahsiaan data mesti dipatuhi. Kebenaran daripada Ketua Pusat Tanggungjawab di mana kawasan kajian yang terlibat mesti diperolehi terlebih dahulu sebelum penyelidikan dimulakan.

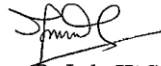


94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 | Fax + 60 82 665 152

Untuk makluman, kelulusan ini adalah sah untuk tempoh bermula dari **Februari 2021** sehingga **Disember 2023** sahaja. Sebarang urusan surat-menyurat berkaitan dengan penyelidikan ini haruslah dinyatakan nombor rujukan kelulusan etika bagi melancarkan proses yang berkaitan.

Sekian, terima kasih.

Yang benar,



Profesor Dr Lela Hj Su'ut
Pengerusi
Jawatankuasa Etika Perubatan
Fakulti Perubatan dan Sains Kesihatan

Ethicsapproval_022020/42

Note: This study was conducted as part of the Research Project – An Analytical Framework for Household Food Insecurity among Indigenous Communities in Sarawak.

Appendix B: Sample approval from District Office



PEJABAT DAERAH SIBU
Aras 4, Kompleks Islam Sarawak Sibu,
Jalan Awang Ramli Amit,
96000 Sibu, SARAWAK.
Tel : +6084-319687 Faks : +6084-337022
Laman Web: www.sibu.sarawak.gov.my

Ruj. Kami: DOS/200-4/P25Vol.2(11)

Tarikh: 8 Oktober 2021

Dekan
Fakulti Perubatan dan Sains Kesihatan
UNIMAS
94300 Kota Samarahan, Sarawak.

Puan,

**PERMOHONAN UNTUK MENJALANKAN PENGUMPULAN DATA DI
BAWAH GERAN FRGS F05/FRGS/2008/2020: AN ANALYTICAL
FRAMEWORK FOR HOUSEHOLD FOOD INSECURITY AMONG
INDIGENOUS COMMUNITIES IN SARAWAK**

Dengan hormatnya saya merujuk kepada perkara yang tersebut di atas.

2. Pejabat ini tiada halangan ke atas permohonan UNIMAS untuk menjalankan pengumpulan data di bawah Geran FRGS F05/FRGS/2008/2020: *An Analytical Framework for Household Food Insecurity Among Indigenous Communities in Sarawak* yang melibatkan kampung/rumah panjang di Daerah Sibu.

3. Pehatian daripada puan amatlah dihargai.

Sekian, terima kasih.

"BERSATU BERUSAHA BERBAKTI"
"AN HONOUR TO SERVE"

(SUHAILI BIN MOHAMED)
Pegawai Daerah Sibu

Appendix C: Participant information sheet

Risalah Maklumat Peserta

ID:



Risalah Maklumat Peserta dan Borang Persetujuan/Keizinan Peserta

1. **Tajuk kajian:** Kerangka analitis untuk tiada jaminan kedapatan makanan isi rumah dalam kalangan komuniti-komuniti asli di Sarawak, Malaysia
2. **Nama penyelidik:** AP Dr Cheah Whye Lian, Ap Dr Jeffery Anak Stephen, Dr Teoh Wan Jool, Yolanda Anak Salleh
3. **Ketua penyelidik:** Dr Law Leh Shii
4. **Institusi:** Jabatan Perubatan Komuniti dan Kesihatan Awam, Fakulti Perubatan dan Sains Kesihatan, 94300 Kota Samarahan, Sarawak
5. **Nama penaja:** Geran FRGS
6. **Pengenalan:**

Berbeza dengan Semenanjung Malaysia, kemiskinan dan deprivasi kapasiti, dan masalah pemakanan tidak seimbang kekal sebagai satu cabaran di Sarawak. Cabaran tersebut membekalkan bukti tentang kebarangkalian tinggi dalam kewujudan masalah tiada jaminan kedapatan makanan. Kajian ini bertujuan untuk meningkatkan pemahaman tentang faktor-faktor penyumbang, strategi daya tindak, dan kesan daripada tiada jaminan kedapatan makanan terhadap dalam kalangan komuniti-komuniti asli melalui kaedah kuantitatif (bahagian A) dan kualitatif (bahagian B). Dalam bahagian A, seramai 450 orang ibu daripada komuniti-komuniti asli yang berada dalam lingkungan umur boleh beranak dari enam daerah akan dipilih secara rawak (Bau, Simunjan, Serian, Julau, Kanowit, dan Miri) dan dijemput untuk menyertai kajian keratan rentas ini. Latar belakang sosiodemografi, status tiada jaminan kedapatan makanan, faktor-faktor persekitaran, pengambilan makanan, dan kesihatan umum akan dikumpul melalui temuramah bersemuka, dengan menggunakan instrumen yang peka dan sah. Hemoglobin (Hb), feritin serum, ferum serum, dan transferrin akan dianalisis. Berat and tinggi badan akan diukur. Regresi logistic berganda dan ANCOVA akan digunakan semasa analisis data. Untuk bahagian B, ibu-ibu yang mempunyai anak-anak berdaftar sebagai mempunyai pemakanan tidak seimbang di Bau, Simunjan, Serian, Julau, Kanowit, dan Miri akan terlibat dalam kajian kes ini. Temuramah bersemuka akan digunakan untuk mengumpul maklumat berkaitan dengan tiada jaminan kedapatan makanan, dengan bantuan daripada protokol temuramah. Analisis tema akan dijalankan. Adalah dijangkakan latar belakang sosiodemografi, faktor-faktor persekitaran, dan cabaran dalam aktiviti-aktiviti pencarian makanan tradisional akan dikenalpasti sebagai faktor-faktor penyumbang kepada tiada jaminan kedapatan makanan. Pada masa yang sama, tiada jaminan kedapatan makanan dijangkakan mempunyai perkaitan signifikan dengan pengambilan makanan, ukuran antropometri, biopenanda, dan kesihatan. Penemuan kajian ini akan penting untuk penggubal dasar, pengamal perubatan, pakar pemakanan, dan penyelidik kerana maklumat tersebut adalah penting dalam proses penggubalan dasar, pelaksanaan projek promosi kesihatan, dan perancangan program intervensi untuk menambatkan keadaan pemakanan untuk isi rumah komuniti-komuniti asli tersebut pada masa hadapan.

Penyertaan anda dalam penyelidikan ini adalah secara sukarela. Anda tidak perlu menyertai penyelidikan ini sekiranya tidak mahu turut serta. Anda juga mempunyai hak untuk tidak menjawab mana-mana soalan yang diajukan. Anda juga boleh menarik diri daripada penyelidikan ini pada bila-bila masa sahaja. Sekiranya anda menarik diri, segala maklumat yang telah diperolehi sebelum anda menarik diri tetap akan digunakan dalam penyelidikan ini. Jika anda tidak mahu menyertai ataupun menarik diri dari penyelidikan ini, tindakan anda ini tidak akan menjejaskan segala hak dan keistimewaan perubatan kesihatan. Penyelidikan ini telah mendapat kelulusan daripada Fakulti Perubatan dan Sains Kesihatan, UNIMAS.

7. **Apakah tujuan penyelidikan ini dilakukan?**

Membentuk satu kerangka menerangkan tiada jaminan kedapatan makanan dalam kalangan komuniti-komuniti asli (faktor-faktor penyumbang, strategi daya tindak, dan kesan-kesan) di Bahagian Kuching (Daerah Bau), Bahagian Samarahan (Daerah Simunjan), Bahagian Serian (Daerah Serian), Bahagian Sarikei (Daerah Julau), Bahagian Sibuan (Daerah Kanowit), dan Bahagian Miri (Daerah Miri) di Sarawak melalui kaedah kuantitatif dan kualitatif. Penyelidikan ini akan berlangsung selama 3 tahun (1/1/2020 until 31/10/2023). Anggaran peserta seramai 450 orang akan melibatkan diri dalam penyelidikan ini.

8. Apakah tanggungjawab saya sewaktu menyertai penyelidikan ini?

Amatlah penting untuk anda menjawab kesemua soalan yang dikemukakan oleh kakitangan penyelidikan dengan jujur dan lengkap di mana ia hanya akan memakan masa sekitar 1.5 jam. Untuk kajian yang melibatkan soal selidik/temu bual, kakitangan penyelidikan akan menemu bual anda sepanjang proses aktiviti pengumpulan data. Borang ini mengandungi lima belas (15) bahagian yang akan menilai jaminan kedapatan makanan, daya tindak strategi, pengambilan makanan, faktor persekitaran, halangan dalam pertanian, halangan dalam pencarian makanan secara tradisional, depresi, kebimbangan, keyakinan diri, kualiti kehidupan, dan akhir sekali, maklumat sosio-demografi anda.

Pada masa yang sama, kakitangan penyelidikan akan mengukur berat dan tinggi badan anda untuk menentukan jisim berat badan (BMI) dan status berat badan anda. Sampel darah (6 -7 mL) turut akan diambil untuk menentukan tahap hemoglobin, feritin serum, ferum serum, dan transferrin agar status anemia anda dapat dikenalpasti. Jika anda terpilih untuk bahagian kualitatif (Bahagian B), anda akan ditemu bual (mengambil masa 30-45 minit) mengenai pengalaman tiada jaminan kedapatan makanan dan seluruh proses temubual akan dirakam untuk tujuan penyelidikan sahaja.

9. Apakah risiko dan kesan-kesan sampingan menyertai penyelidikan ini?

Kajian ini tidak akan mendatangkan apa-apa risiko sama ada secara fizikal dan mental terhadap anda. Anda berhak untuk tidak menjawab atau tidak mengambil bahagian jika rasa tidak selesa dengan mana-mana aktiviti kajian.

10. Apakah manfaatnya saya menyertai kajian ini?

Kajian ini mungkin tidak mendatangkan manfaat secara langsung kepada anda. Namun, dengan mengambil bahagian dalam kajian ini, segala maklumat yang diperolehi daripada anda akan membantu dalam meningkatkan pemahaman mengenai keadaan jaminan kedapatan makanan isi rumah seperti berkenaan dengan faktor penyumbang berserta strategi daya tindak di kalangan masyarakat pribumi di Sarawak. Penemuan daripada kajian tersebut dapat dijadikan maklumat penting bagi program intervensi masa depan yang bertujuan untuk menambahbaikan keadaan jaminan kedapatan makanan isi rumah di kalangan masyarakat pribumi Sarawak. Sebagai tanda penghargaan, hadiah akan diberi kepada semua responden. Pada masa yang sama, sekiranya anda didapati mempunyai masalah anemia (kekurangan darah), anda akan dihubungi dan dirujuk ke klinik berdekatan untuk tindakan selanjutnya.

11. Siapakah yang membiayai penyelidikan ini?

Kajian ini adalah dibawah tajaan geran FRGS. Anda tidak akan dibayar untuk menyertai kajian ini.

12. Adakah maklumat saya akan dirahsiakan?

Segala maklumat peribadi yang diperolehi dalam penyelidikan ini akan disimpan dan diuruskan secara sulit, bersesuaian dengan peraturan-peraturan dan/ atau undang-undang yang berkenaan. Sekiranya hasil penyelidikan ini diterbitkan atau diusulkan kepada orang ramai, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Individu yang terlibat dalam kajian ini, pemantau yang berkecuali, juruaudit, dan pihak berkuasa kerajaan atau pengawal selia boleh memeriksa data kajian, jika sesuai dan perlu.

13. Siapakah yang perlu saya hubungi sekiranya saya mempunyai sebarang pertanyaan?

Anda boleh menghubungi penyelidik Dr Teoh Wan Jool [+6016-8265362]/ Yolanda Anak Salleh [+6016-3782492] sekiranya anda mempunyai sebarang pertanyaan atau memerlukan maklumat lebih lanjut mengenai kajian ini. Adalah dimaklumkan bahawa maklum balas hasil kajian ini tidak akan disediakan. Jika anda setuju untuk mengambil bahagian dalam kajian ini, sila tandatangan boring persetujuan di bawah dan kembali kepada penyelidik. Terima kasih kerana mengambil bahagian dalam kajian ini.

Appendix D: Informed consent form

Borang Persetujuan/ Keizinan Peserta



Borang Persetujuan/ Keizinan Peserta

Tajuk kajian: Kerangka analitis untuk tiada jaminan kedapatan makanan isi rumah dalam kalangan komuniti-komuniti asli di Sarawak, Malaysia

Dengan menandatangani di bawah, saya mengesahkan bahawa:

- Saya telah diberi maklumat mengenai penyelidikan yang disebutkan di atas secara lisan dan bertulis, dan juga saya telah membaca dan memahami semua maklumat yang diberikandalam manual ini.
- Saya mempunyai masa yang mencukupi untuk mempertimbangkan keputusan samada ingin mengambil bahagian dalam penyelidikan ini dan turut berpeluang mengemukakan soalan di mana kesemuanya telah dijawab secara terperinci.
- Saya faham bahawa penyertaan saya ini adalah secara sukarela dan pada bila-bila masa juga saya bebas untuk menarik diri daripada penyelidikan ini tanpa perlu memberi sebarang alasan dan ia sama sekali tidak akan menjejaskan segala hak dan keistimewaan perubatan kesihatan. Saya tidak mengambil bahagian dalam mana-mana penyelidikan lain pada masa ini. Saya juga memahami tentang risiko dan manfaat penyelidikan ini dan saya secara sukarela memberi persetujuan untuk menyertai penyelidikan ini di bawah syarat-syarat yang telah dinyatakan di atas. Saya faham bahawa saya harus mematuhi nasihat dan arahan yang berkaitan dengan penyertaan saya dalam penyelidikan ini daripada kakitangan penyelidikan.
- Kajian ini boleh diusulkan di persidangan dan kajian ini juga boleh diterbitkan di jurnal. Maklumat peribadi diri saya tidak akan didedahkan. Maklumat tersebut akan terus disimpan secara sulit.
- Saya faham bahawa penyelidik, pemantau dan juruaudit terlatih, pihak penaja atau gabungannya, dan pihak berkuasa kerajaan atau undang-undang, mempunyai akses langsung dan boleh menyemak laporan saya bagi memastikan penyelidikan ini dijalankan dengan betul dan data direkodkan dengan betul. Segala maklumat dan data peribadi akan dianggap sebagai SULIT.

Nama Peserta

Nombor IC

Tandatangan Peserta

Tarikh

Nama Saksi

Nombor IC

Tandatangan Saksi

Tarikh

Nama Penyelidik

Nombor IC

Tandatangan Penyelidik

Tarikh

Appendix E: Guide for enumerator

Nota Ringkas untuk Pembantu Kajian

Tajuk kajian: Kerangka analitis untuk tiada kejamindapatan makanan isi rumah dalam kalangan komuniti Bumiputera di Sarawak, Malaysia

No	Topik	Info	Nota
1	Objektif kajian	Jelaskan kajian secara ringkas kepada responden (<i>food security</i>)	Ringkasan kajian: ❖ Untuk menentu tahap kejamindapatan makanan isi rumah, faktor-faktor penyumbang, dan kesan-kesan. ❖ Maklumat yang diperolehi akan membantu meningkatkan pemahaman mengenai keadaan kejamindapatan makanan isi rumah di kalangan masyarakat Bumiputera di Sarawak.
2	Responden (sasaran)	1) Warganegara 2) Bumiputera Sarawak (kecuali Melayu) 3) Ibu (20-49 tahun) - Tidak mengandung - Tidak menyusu 4) Anak (2-18 tahun)	**Sekiranya terdapat beberapa orang anak (2-18 tahun), pilih anak yang berumur 2-12 tahun. ** Sekiranya terdapat beberapa orang anak (2-12 tahun), pilih satu anak sahaja secara rawak.
3	Risalah Maklumat Peserta & Borang Persetujuan	1) RA menjelaskan tanggungjawab peserta, risiko dan manfaat menyertai kajian. 2) RA perlu mendapatkan persetujuan responden dengan mengisi borang persetujuan.	1. Tanggungjawab peserta: a. Menjawab 15 bahagian soalan (<i>interviewed/ guided by research assistants</i>). b. Pengukuran berat (kg) & ketinggian (m)- Bahagian N) c. Sampel darah (6 -7 mL) status kekurangan darah (anemia) (Pengambilan darah akan dijalankan oleh ahli makmal perubatan. Tarikh dan masa akan dimaklumkan kemudian). ❖ Token akan diberi kepada responden sebagai tanda penghargaan. ❖ Risiko: Kajian ini tidak akan mendatangkan apa-apa risiko sama ada secara fizikal dan mental terhadap anda. ❖ Segala maklumat responden yang diperolehi dalam kajian ini akan disimpan dan dikendalikan secara sulit, bersesuaian dengan undang-undang yang berkenaan. 2. Borang Persetujuan Peserta a. Peserta: Isi Nama peserta, no. IC, tandatangan, Tarikh. b. Pembantu penyelidik: Isi Nama saksi, no. IC, tandatangan, Tarikh
4	Data yang diperlukan	RA cuma kumpul (1) & (2). 1) Soal selidik - 15 bahagian (237 soalan) 2) Berat & tinggi peserta	1. Soal selidik: ** Ibu (20-49 tahun) & anak (2-12 tahun) : Jawab kesemua bahagian 2. Berat (kg) & tinggi (cm) : ** Ibu ** Anak (untuk anak 2-12 tahun sahaja

Appendix F: Questionnaire

ID:

SOAL SELIDIK

Jabatan Perubatan Komuniti dan Kesihatan Awam,
Fakulti Perubatan dan Sains Kesihatan
Universiti Malaysia Sarawak

Soal Selidik

Bahagian A: Ciri-ciri sosio-demografi dan ekonomi

Arahan: Bahagian soal selidik ini akan mengenal pasti tentang status sosio-demografi dan ekonomi anda.

No.	Pemboleh Ubah	Maklum Balas	Catatan
1	Nombor telefon responden (bagi tujuan makluman keputusan darah kemudian)		
2	Tarikh temubual (hari/bulan/tahun)		
3	Tarikh lahir (hari/bulan/tahun)		
4	Umur (tahun)		
5	Jantina	a. Lelaki b. Perempuan	
6	Etnik	a. Iban b. Bidayuh c. Melanau d. Kayan e. Kenyah f. Lun Bawang/Murut g. Penan h. Kajak i. Kelabit j. Punan k. Lain-lain: _____	
7	Agama	a. Islam b. Kristian c. Lain-lain: _____	
8	Status perkahwinan	a. Bujang (tidak pernah berkahwin) b. Berkahwin c. Berceraai (berpisah) d. Janda	
9	Bilangan anak (orang)	a. Bilangan anak yang < 7 tahun: _____ b. Bilangan anak yang bersekolah (termasuk anak yang menuntut di IPTA/IPTS): _____	
10	Bilangan isi rumah (termasuk responden)		
11	Bilangan ahli keluarga yang menghidapi penyakit kronik/kecacatan	a. Bilangan: b. Jika ada, sila nyatakan nama penyakit kronik /kecacatan: _____	
12	Kelayakan pendidikan (Responden)	a. Tiada pendidikan formal b. Pendidikan sekolah rendah c. Pendidikan sekolah menengah d. Pendidikan pra-universiti e. Pendidikan university f. Pendidikan pascasiswazah	

No.	Pemboleh Ubah	Maklum Balas	Catatan
13	Tempoh responden menerima pendidikan (tahun)		
14	Kelayakan pendidikan (pasangan)	a. Tiada pendidikan formal b. Pendidikan sekolah rendah c. Pendidikan sekolah menengah d. Pendidikan pra-universiti e. Pendidikan universiti f. Pendidikan pascasiswazah	
15	Tempoh menerima pendidikan untuk pasangan (tahun)		
16.	Pendapatan		
16a	Pekerjaan utama responden	a. Sila nyatakan: b. Pendapatan sebulan:	
16b	Pekerjaan sampingan responden	a. Sila nyatakan: b. Pendapatan sebulan:	
16c	Pekerjaan utama (pasangan)	a. Sila nyatakan: b. Pendapatan sebulan:	
16d	Pekerjaan sampingan (pasangan)	a. Sila nyatakan: b. Pendapatan sebulan:	
16e	Menerima bantuan kewangan dari agensi kerajaan atau bukan kerajaan	a) Ya b) Tidak c) Jika ya, sila nyatakan nama agensi tersebut: d) Jumlah sebulan/setahun: _____	
16f	Sumbangan kewangan dari anak-anak	a. Ya b. Tidak c. Jumlah sebulan/setahun: _____	
16g	Sumbangan dari kawan atau saudara mara	a. Ya b. Tidak c. Jumlah sebulan/setahun: _____	
16h	Pencen bulanan	a. Ya b. Tidak c. Jumlah sebulan: _____	
16i	Dividen/bonus saham	a. Ya b. Tidak c. Jumlah sebulan/setahun: _____	
16j	Hartanah sewaan	a. Ya b. Tidak c. Jumlah sebulan/setahun: _____	
16k	Lain-Lain	a. Ya b. Tidak c. Jumlah sebulan/setahun: _____	
16l	Pendapatan isi rumah (sebulan)		

No.	Pemboleh Ubah	Maklum Balas	Catatan
17. Pemilikan harta			
17a	Pemilikan kenderaan	a. Ya; sila nyatakan: _____ b. Tidak	
17b	Pemilikan rumah	a. Ya; sila nyatakan(dari): _____ b. Tidak	
17c	Simpanan wang	a. Ya b. Tidak	
18. Perbelanjaan			
18a	Perbelanjaan isi rumah untuk makanan (makanan basah & makanan kering) dan minuman (RM) [sebulan]		
18b	Perbelanjaan isi rumah untuk benda bukan makanan (RM) [sebulan]		
18c	Jumlah perbelanjaan (RM) [sebulan]		
19. Lain-lain			
19a	Adakah anda akan berjumpa doktor sekiranya memerlukan perkhidmatan perubatan?	a. Ya b. Tidak; Sila nyatakan sebab: _____	
19b	Adakah anda menjerang air sebelum minum?	a. Ya b. Tidak; Sila nyatakan sebab: _____	
20. Anak (merujuk kepada yang menjadi responden kajian ini)			
20a	Umur		
20b	Jantina	a. Lelaki b. Perempuan	
20c	Etnik	a. Iban b. Bidayuh c. Melanau d. Kayan e. Kenyah f. Lun Bawang/Murut g. Penan h. Kajak i. Kelabit j. Punan k. Lain-lain: _____	
20d	Berat lahir (kg)		

Bahagian B: Sekuriti makanan

Arahan: Bahagian soal-selidik ini akan mengenal pasti tentang keadaan makanan di rumah anda. Sila tandakan [✓] untuk jawapan yang paling sesuai bagi setiap kenyataan. Semua maklumat yang diberikan adalah sulit.

No.	Kenyataan	Skala		
		Tidak betul	Kadang-kadang betul	Selalunya betul
Tahap isi rumah				
1	Saya bimbang makanan saya akan habis sebelum saya mendapat wang untuk membeli lebih banyak makanan.			
2	Makanan yang saya beli tidak dapat tahan lama, dan saya tidak mempunyai wang untuk mendapatkan lebih banyak makanan.			
3	Saya tidak mempunyai makanan atau bahan mentah yang mencukupi untuk tujuan memasak atau menyediakan makanan bagi keluarga kerana saya tidak mempunyai wang untuk mendapatkan lebih banyak makanan.			
4.	Kami makan makanan yang sama selama beberapa hari berturut-turut kerana kami hanya mempunyai beberapa jenis makanan sahaja dan tidak mempunyai wang untuk membeli lebih banyak jenis makanan.			
Tahap individu (dewasa)				
5	Saya tidak mampu (dari segi kewangan) untuk mengambil makanan seimbang.			
6	Saya sering merasa lapar tetapi saya tidak makan kerana saya tidak mampu mendapat makanan yang mencukupi.			
7	Saya makan kurang daripada apa yang sepatutnya saya makan kerana saya tidak mempunyai wang yang mencukupi untuk membeli makanan.			
Tahap kanak-kanak				
8	Saya tidak dapat memberi makanan yang seimbang kepada anak (anak-anak) kerana saya tidak mampu.			
9	Anak (anak-anak) saya tidak mengambil makanan yang mencukupi kerana saya tidak mampu (dari segi kewangan).			
10	Saya tahu anak (anak-anak) saya kadang-kadang merasa lapar tetapi saya tidak mampu mendapatkan makanan yang lebih banyak.			

Bahagian C: Ukuran Antropometri

Ukuran Ibu

Variable <i>Pembolehubah</i>	First Reading <i>Bacaan Pertama</i>	Second Reading <i>Bacaan Kedua</i>	Mean <i>Purata</i>
Height (cm) <i>Tinggi</i>			
Weight (kg) <i>Berat</i>			
		BMI	

Ukuran anak (umur 2-12 tahun)

Variable <i>Pembolehubah</i>	First Reading <i>Bacaan Pertama</i>	Second Reading <i>Bacaan Kedua</i>	Mean <i>Purata</i>
Height (cm) <i>Tinggi</i>			
Weight (kg) <i>Berat</i>			
		BMI	

Bahagian D: Pengambilan Makanan

Ingatan Diet 24 Jam HARI 1 Ibu								
Tarikh								
Hari (Sila bulatkan)		Isnin	Selasa	Rabu	Khamis	Jumaat	Sabtu	Ahad
Masa Pengambilan	Jenis Makanan	Saiz Hidangan			Cara penyediaan atau jenama			

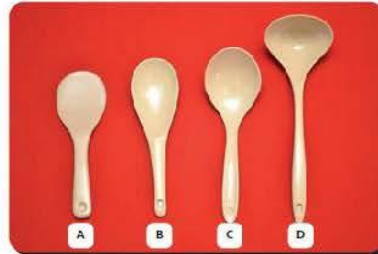
Ingatan Diet 24 Jam HARI 1 Anak								
Tarikh								
Hari (Sila bulatkan)		Isnin	Selasa	Rabu	Khamis	Jumaat	Sabtu	Ahad
Masa Pengambilan	Jenis Makanan		Saiz Hidangan		Cara penyediaan atau jenama			

Ingatan Diet 24 Jam HARI 2 Ibu								
Tarikh								
Hari (Sila bulatkan)		Isnin	Selasa	Rabu	Khamis	Jumaat	Sabtu	Ahad
Masa Pengambilan	Jenis Makanan		Saiz Hidangan		Cara penyediaan atau jenama			

Ingatan Diet 24 Jam HARI 2 Anak								
Tarikh								
Hari (Sila bulatkan)		Isnin	Selasa	Rabu	Khamis	Jumaat	Sabtu	Ahad
Masa Pengambilan	Jenis Makanan		Saiz Hidangan		Cara penyediaan atau jenama			

Contoh Sukatan Isi Rumah

1.1 Senduk



A	Senduk nasi plastik	25 ml
B	Senduk nasi plastik	40 ml
C	Senduk nasi sederhana plastik	50 ml
D	Senduk sederhana plastik	30 ml

1.2 Sudu



A	Sudu teh	5 ml
B	Sudu cina	20 ml
C	Sudu makan	10 ml
D	Sudu sup	15 ml

1.3 Gelas



A	Gelas plastik	200 ml
B	Gelas	250 ml
C	Gelas	250 ml
D	Gelas	300 ml
E	Gelas	400 ml

1.4 Cawan



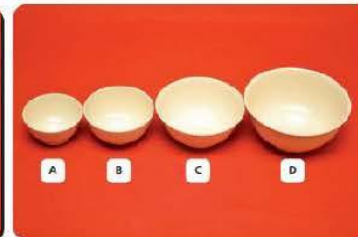
A	Cawan	200 ml
B	Cawan	300 ml
C	Cawan	350 ml
D	Cawan	300 ml
E	Cawan	250 ml
F	Cawan	200 ml

1.5 Piringan



A	Piringan makan	10 inci (diameter)
B	Piringan makan	9 inci (diameter)
C	Piringan makan	8 inci (diameter)
D	Piring kecil	7 inci (diameter)

1.6 Mangkuk



A	Mangkuk sup (A)	9.0 cm (diameter)
B	Mangkuk cina (B)	11.0 cm (diameter)
C	Mangkuk sederhana (C)	13.5 cm (diameter)
D	Mangkuk besar (D)	16.0 cm (diameter)

Appendix G: Oral presentation



Nutrition Update 1



Factors associated with double burden of malnutrition (DBM) among Dayak communities in Sarawak
by
Ms Yolanda Anak Salleh
Universiti Malaysia Sarawak