UNIVERSITI PUTRA MALAYSIA

NUTRITIONAL STATUS OF MOTHER-CHILD PAIRS AND FACTORS ASSOCIATED WITH DOUBLE BURDEN OF MALNUTRITION AMONG ORANG ASLI (TEMUAN) HOUSEHOLDS IN SELANGOR, MALAYSIA

ROZALINA BT ISMAIL

FPSK(m) 2021 27

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By

ROZALINA BT ISMAIL

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

December 2020

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DEDICATION

This thesis is dedicated to

My lovely husband and children:

With love, respect and a bunch of memories
Indeed, we belong to Allah and indeed to Him we will return.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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December 2020

Chairman : Professor Zalilah Mohd Shariff, PhD
Faculty : Medicine and Health Sciences

Poverty, urbanization, and nutrition transition are identified as factors associated with double burden of malnutrition (DBM). However, there are other underlying factors associated with DBM at the household level. This cross-sectional study aimed to determine the nutritional status of mother-child pairs and factors associated with DBM among *Orang Asli* (*Temuan*) households in Selangor. Non-probability sampling was used in this study. A total of 451 mother (20 – 49 years) and child (6 – 59.9 months old) pairs participated in this study. Information on demographic and socio-economic status and dietary intake of mothers and children were obtained using a pre-tested questionnaire while food security status was assessed using Radimer Cornell/ Hunger and Food Security Instrument. Anthropometric measurements of mothers and children were taken using standard procedures. DBM household was defined as the coexistence of an overweight/obese mother and an underweight/stunted child (OWOBM/ UWSTC) within the same household.

Majority (79.2%) of the households were living below the poverty line for Peninsular Malaysia of RM 240.00. Mean age of mothers and children were 29.51 ± 6.59 years and 27.67 ± 15.40 months, respectively. About 90% of the households experienced some forms of food insecurity, namely household food insecure (29.9%), individual food insecure (21.1%) and child hunger (38.8%). Overweight and obesity among the OA mothers were 28.2% and 35.0%, respectively. About 23% of the OA children were underweight, and 35.7% were stunted. About 29% of the households were DBM, while 23.3% of mother-child pairs were in the Normal households.

The average daily energy intake of mothers was 1,510 kcal. Although 54.1% of mothers met the RNI (2017) for energy intake, RNI attainment was poor for micronutrients such as vitamin A, thiamine, riboflavin, vitamin C, calcium, iron, and

folate. Mothers also had inadequate serving intakes for most of food groups, except grains and cereals. Majority of children had inadequate intake of energy, micronutrients (vitamin A, calcium and folate) and number of servings for fruits, vegetables, legumes, meat, fish, and milk and dairy products.

This study revealed that food insecure (AOR: 3.64; 95% CI: 1.08–12.29), children aged ≥ 24 months (AOR: 4.44; 95% CI: 2.38–8.29), mothers with height < 150 cm (AOR: 2.21; 95% CI: 1.22–3.98), mothers who had energy intake ≥ RNI (AOR: 3.85; 95% CI: 1.38 – 10.81), and children who did not meet the recommended serving intake for vegetables (AOR: 6.82; 95% CI: 1.22 – 38.25) were significantly associated with DBM at the household level. Also, increased percentage of RNI for vitamin C among mothers was significantly less likely to be associated with DBM.

DBM at the household level is a public health concern among OA households. Household, mother, and child factors were associated with DBM. Therefore, the strategies for DBM prevention in this vulnerable population should consider food or financial aid, promotion of healthy lifestyle, and appropriate infant and young child feeding practices.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

STATUS PEMAKANAN PASANGAN IBU-ANAK DAN FAKTOR BERKAITAN *DOUBLE BURDEN OF MALNUTRITION* DALAM KALANGAN ISI RUMAH ORANG ASLI (TEMUAN) DI SELANGOR, MALAYSIA

Oleh

ROZALINA BT ISMAIL

Disember 2020

Pengerusi : Profesor Zalilah Mohd Shariff, PhD
Fakulti : Perubatan dan Sains Kesihatan

Kemiskinan, urbanisasi, dan peralihan pemakanan dikenalpasti sebagai faktor yang berkaitan dengan *double burden of malnutrition* (DBM). Walau bagaimanapun, terdapat faktor lain yang berkaitan dengan DBM di peringkat isi rumah. Kajian keratan rentas ini bertujuan untuk mengenal pasti status pemakanan pasangan ibu-anak dan faktor-faktor yang berkaitan dengan DBM di kalangan isi rumah Orang Asli (Temuan) di Selangor. Persampelan bukan kebarangkalian digunakan dalam kajian ini. Sebanyak 451 pasangan ibu (20 - 49 tahun) dan anak (6 - 59.9 bulan) telah mengambil bahagian dalam kajian ini. Maklumat mengenai status demografi dan sosio-ekonomi, dan pengambilan makanan ibu dan anak telah diukur dengan menggunakan borang soal-selidik yang telah diuji manakala status sekuriti makanan dibuat dengan Radimer Cornell/ Hunger dan Instrumen Keselamatan Makanan. Pengukuran antropometri ibu dan anak diambil dengan menggunakan prosedur piawai. DBM ditakrifkan sebagai kewujudan satu pasangan ibu yang berlebihan berat badan/ obes dan anak yang kurang berat badan/ terbantut dalam isi rumah yang sama.

Majoriti (79.2%) isi rumah hidup dengan pendapatan di bawah garis kemiskinan (RM 240.00) di Semenanjung Malaysia. Min umur ibu dan anak masing-masing adalah 29.51 ± 6.59 tahun dan 27.67 ± 15.40 bulan. Kira-kira 90% isi rumah mengalami beberapa bentuk ketiadaan sekuriti makanan, iaitu ketiadaan sekuriti makanan isi rumah (29.9%), ketiadaan sekuriti makanan individu (21.1%) dan kelaparan anak (38.8%). Berat badan berlebihan dan obesiti di kalangan ibu OA masing-masing adalah 28.2% dan 35.0%. Kira-kira 23% kanak-kanak OA mengalami kurang berat badan, dan 35.7% mengalami kebantutan. Kira-kira 29% isi rumah adalah DBM, sementara 23.3% pasangan ibu-anak berada di isi rumah normal.

Pengambilan tenaga harian ibu secara purata ialah 1,510 kcal. Walaupun terdapat 54.1% ibu memenuhi RNI (2017) untuk pengambilan tenaga, pencapaian RNI adalah kurang baik untuk mikronutrien seperti vitamin A, tiamin, riboflavin, vitamin C, kalsium, zat besi, dan folat. Ibu juga mempunyai pengambilan makanan yang tidak mencukupi untuk kebanyakan kumpulan makanan, kecuali biji-bijian dan bijirin. Sebilangan besar kanak-kanak mempunyai pengambilan tenaga, mikronutrien (vitamin A, kalsium dan folat) dan jumlah sajian yang tidak mencukupi untuk buah-buahan, sayur-sayuran, kekacang, daging, ikan, dan susu dan produk tenusu.

Kajian ini mendapati bahawa ketiadaan sekuriti makanan (AOR: 3.64; 95% CI: 1.08 - 12.29), kanak-kanak berumur ≥ 24 bulan (AOR: 4.44; 95% CI: 2.38 - 8.29), ibu dengan ketinggian < 150 cm (AOR: 2.21; 95% CI: 1.22 - 3.98), ibu yang mempunyai pengambilan tenaga ≥ RNI (AOR: 3.85; 95% CI: 1.38 - 10.81), dan anak yang tidak mencapai jumlah sajian sayur-sayuran yang disaran (AOR: 6.82; 95 % CI: 1.22 - 38.25) adalah faktor yang berkaitan dengan DBM di peringkat isi rumah. Selain itu, peningkatan peratusan RNI untuk vitamin C dalam kalangan ibu adalah kurang cenderung berkaitan dengan DBM.

DBM di peringkat isi rumah adalah masalah kesihatan awam dalam kalangan OA. Faktor isi rumah, ibu, dan anak adalah dikaitkan dengan DBM. Oleh itu, strategi pencegahan DBM pada populasi yang rentan ini harus mempertimbangkan bantuan makanan atau kewangan, promosi gaya hidup sihat, dan amalan pemberian makanan yang baik dan bersesuaian kepada ibu dan anak.

ACKNOWLEDGEMENTS

With the name of Allah the Most Compassionate and Most Merciful

All praise and thanks to the Almighty Allah, with His blessing in giving me the strength and passion, to finish the research and have this manuscript completed and compiled.

First and foremost, I would like to express my sincere gratitude to my supervisor, Prof. Dr. Zalilah Mohd Shariff for the continuous support of my Master study. Her patience, encouragement, experience-sharing and guidance had offered me the impetus to complete my study. I also appreciate her contribution of time and immense knowledge to make my study experience productive and stimulating. Second, my heartfelt thanks to my co-supervisor, Dr. Nurul Husna Mohd for their encouragement and insightful comments to improve my research.

I would like to extend my acknowledgement to Universiti Putra Malaysia (GP-IPS/2018/9616300) that provided the financial support to complete my research. Additionally, I am grateful to the Jabatan Kemajuan Orang Asli (JAKOA), *Tok Batin* and local resource individuals from all *Orang Asli* villages in this study who have willingly assisted and supported me throughout the data collection. I would like to thank to all the participants who gave me full support to succeed my research.

Sincere appreciation to all my fellow colleagues (Nur Dayana, Wong Chee Yen, Sulhariza, and Nur Liyana) and friends for their knowledge, assistance and moral support during my study. Finally, I would like to express my utmost appreciation to thank my beloved husband and children, family members who helped, supported and strengthen me throughout my study and my life in general. Your support, contributions and sacrifices during this time are never forgotten.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Zalilah Mohd Shariff, PhD
Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman)

Nurul Husna Mohd Shukri, PhD
Senior Lecturer
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 06 May 2021

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Name and Matric No: Rozalina bt Ismail, GS46796

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Signature: _____

Name of Chairman of Supervisory Committee: Professor Dr. Zalilah Mohd Shariff

Signature: _____

Name of Member of Supervisory Committee: Dr. Nurul Husna Mohd Shukri

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LIST OF ABBREVIATIONS

BAZ	Body mass index-for-age
BMI	Body mass index
BMR	Basal metabolic rate
DBM	Double burden of Malnutrition
DDS	Dietary diversity score
NHMS	National Health and Morbidity Survey
OA	*Orang Asli*
WAZ	Weight-for-age
L/ HAZ	Length/ height-for-age
LMICs	Low- and middle-income countries
TEE	Total energy expenditure
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Malnutrition manifests itself in many ways, such as under-nutrition (underweight, stunting, and wasting) and over-nutrition (overweight and obesity). It is a major public health problem, and the leading cause of morbidity and mortality, predominantly among women and young children. The coexistence of under-nutrition and over-nutrition at the same time, at the population, household and individual levels are defined as double burden of malnutrition (DBM). Globally, approximately 22.2% (150.8 million) and 7.5% (50 million) of children under five years old are reported to be stunted and wasted, respectively (WHO & UNICEF, 2017). Meanwhile, about 38.9% of adults were overweight and obese, with higher rates of obesity among women (39.2%) than men (38.5%) (WHO, 2018).

By regions, Asia and Africa showed the highest prevalence of under-nutrition among children. In the year 2017, more than half of the stunted (55.0%) and wasted (69.0%) children under five years lived in Asia, while 39.0% and 27.0% of the stunted and wasted child lived in Africa, respectively. Northern America has the lowest prevalence of stunting (2.3%) and wasting (0.5%), with a total number of 0.5 million and 0.1 million children, respectively. However, among adults, the prevalence of BMI $\geq$ 30.0 kg/m^2 was found to be the highest in the United Arab Emirates (74.0%) and the United States of America (USA) (67.3%) (WHO, 2018).

The phenomenon of stunted child coexisting with overweight/ obese mother at the population level is occurring in South East Asian countries, such as Indonesia, the Philippines and the Solomon Islands. The prevalence were reported as 36% and 26%, 32% and 29%, 33% and 71%, respectively (Haddad, Cameron & Barnett, 2015). In Malaysia, from the year 2005 to 2016, there is increasing prevalence of adult overweight (16.4% to 17.6%) and child stunting (17.2% to 20.7%) (NHMS, 2015).

DBM at the household level is commonly defined as the coexistence of an overweight/ obese mother and an undernourished child (Mahmudino et al., 2018; Aitsi-Selmi, 2015; Wong et al., 2015). Studies in developing countries such as Indonesia, Guatemala and Gaza Strip of Palestine reported that the prevalence of DBM at the household level were 24.7%, 17.0% and 15.7%, respectively (Doak et al., 2016). National surveys of six low to middle income countries reported that 3.7% – 15.5% of households were consisted of underweight and overweight members (Doak et al., 2016), while national surveys of 42 developing countries reported that there were 0.9% – 16.0% of households with a stunted child and an overweight or obese mother found in Africa, Asia and Latin America (FAO, 2006).

There are many underlying causes of DBM that include socioeconomic, biological, environmental, and behavioural factors (WHO, 2016). Maternal age, marital and employment status (Malik & Puri, 2018; Mahmudiono, 2016; Wong et al., 2015), child age, sex and birth order (Rahman, 2016; Oddo et al., 2012), large household size and high number of children are among factors associated with DBM at the household level (Gubert et al., 2017; Zeba et al., 2012). While under-nourished children are more likely to have cognitive and physical development deficit, psychosocial and behavioural problems, and poorer general health (Jimoh et al., 2018; Onstad, Schmandt & Lu, 2016; WHO, 2016; Lanka, 2015), obese adults are more likely to be at increased risk of non-communicable diseases, low economic productivity, and mortality. Indigenous peoples are without exception, and they would be even worse than the non-indigenous population (Hendriks et al., 2018; Norhayati M; Aniza I, 2018; Oteng-ntim et al., 2013; Sutradhar & Hasan, 2017; Tomayko et al., 2017).

Indigenous peoples constitute approximately 4.5% (~300 million) of the global population. They can be found in every region of the world. About 70% of the indigenous peoples reside in Asian countries, with nearly 30% in China. Indigenous peoples are globally identified as the worlds' poorest population, with lower socioeconomics, quality of life and health status compared to the general population. They suffer from lower life expectancy, high morbidity and mortality among infants, children and mothers, high burden of malnutrition, infectious and non-communicable diseases, substance abuse, and depression (Valeggia & Snodgrass, 2015; King et al., 2009). Moreover, death rates of adults in this population are more than twice of those in the general population [International Work Group for Indigenous Affairs (IWGIA), 2017]. The WHO (2010) reported that life expectancy of indigenous peoples of Australia (Aboriginal and Torres Strait Islander people) was estimated to be 17 years lesser than their non-Indigenous counterparts (Thomson et al., 2013). Anderson et al. (2016) also reported that the life expectancy of indigenous peoples from lower middle-income countries such as Camerron, Kenya, India and Nigeria was lower than 65 years. However, indigenous populations of upper middle-income and high-income countries have life expectancy of > 70 years, with the exception of the Inuit in Canada (68.5 years). In addition, the average infant mortality rate (IMR) among indigenous infants is almost tripled that of the national average in some countries [United Nations Inter-Agency Support Group (IASG), 2014; Thomson et al., 2013; WHO, 2007; MOH, 2006].

Studies have shown that indigenous peoples experience under-nutrition. For example, Laxmaiah et al. (2007) and Schmid et al. (2006) reported that more than half of the indigenous adult women were categorized as chronic energy deficiency (CED) in districts of Khamman and Andra Pradesh, South India. On the other hand, about 5.6% and 14.7% of under five indigenous children in Xavante of Central Brazil are underweight and stunted, respectively (Ferreira et al., 2012). Findings from the first National Survey of Indigenous People's Health and Nutrition in Brazil reported that nearly 30.0% of the under five years old children were identified as under-nourished (Horta et al., 2013).

However, the phenomenon of undernutrition has gradually changed over time to overweight and obesity among adults, with under-nutrition remains persistent among children. This situation could be associated with nutrition transition and modernisation that brought undesirable changes in dietary patterns and physical activity (Anderson et al., 2016; Sauer, 2016; United Nations General Assembly, 2007; Montenegro & Stephens, 2006; Kuhnlein et al., 2004). In the first national study of Indigenous peoples of Brazil, approximately one third (30.3%) of the indigenous non-pregnant women were overweight and obese, despite nearly one third (25.7%) of the children being stunted (Cardoso et al., 2013). In Guatemala, the National Maternal and Child Health Survey (2014 – 2015), reported that about 60.1% of indigenous children < 5 years old were stunted, while 49.4% of the adult women (20 – 49 years) were overweight (Mazariegos et al., 2019). Thus, indigenous peoples are not spared from the coexistence of under- and over-nutrition.

1.2 Problem Statement

The Indigenous peoples of Peninsular Malaysia are known as *Orang Asli* (OA), which represents 0.84% (205,000) of Malaysia's total population (The International Work Group for Indigenous Affairs, 2015). The OA comprises three main sub-tribes, namely the *Senoi*, *Negrito*, and *Proto-Malay*. Each sub-tribe has its own culture and language (JAKOA, 2014). The poverty rate among OA is much higher than the national poverty rate and among other groups. For example, in the year 2014, while the national figure for poverty was 0.4%, the incidence of poverty in OA was 34.0% (Khazanah Research Institute, 2014). Current data showed that one in three OA has an income of less than RM1,000 per month compared to about one in ten of the general population (Khazanah Research Institute, 2018). The lack of income among OA might be due to the majority of them being engaged in low wage occupations related to agriculture, forestry, hunting and fishing.

Due to poverty and low socioeconomic status, the majority of OA experience food insecurity that could adversely impact their health and nutrition. Previous studies among the OA children showed that under-nutrition and inadequate energy and nutrient intakes are still prevalent (Phua, 2015; Norhasmah et al., 2012; Zalilah, 2002; Lim & Chee, 1998). According to Zalilah et al. (2002), majority of OA *(Temuan)* (82.8%) households in Hulu Langat, Selangor reported experiencing food insecurity, with 45.0% and 52.0% of under-five children were significantly underweight and stunted, respectively. Chua et al. (2012) reported that more than half of the OA (*Jah Hut, Che Wong* and *Temuan*) children in Krau Wildlife Reserve, Pahang were underweight (50.9%) and stunted (61.6%). In addition, several recent studies indicated that more than one-third (35.6% – 64.0%) of under-five OA children were stunted (Mohd Adzim Khalili et al., 2018; Siti Fatihah et al., 2018; Wong et al., 2015). For dietary intakes, the mean calorie, calcium, and iron intakes were less than two-third of recommended intakes (Tham & Zalilah, 2002). A study among OA in Sepang reported that the dietary diversity score (DDS) of the children was in the lowest (56.0%) and middle (36.1%) tertiles (Nurfaizah et al., 2009).

Despite the pervasive undernutrition in OA children, studies have shown that the prevalence of overweight and obesity has been increasing among the OA adults. Azhanie & Zalilah (2010) reported that the prevalence of overweight and obesity among OA (*Che Wong* tribe) adults in Krau Wildlife Reserve was 21.1%. Among seven sub-tribes of OA in Peninsular Malaysia, approximately, 16.8% of them were classified as obese (Phipps et al., 2015). A recent study found that 51.0% of OA *(Temiar)* adults in Kuala Betis, Kelantan were overweight and obese (Mohd Adzim Khalili et al., 2018). Ashari et al. (2016) reported that metabolic syndrome (MetS) among OA was in the range of 16.4% – 63.0%, depending on the sub-tribes. In two different studies among OA adults in Perak and Selangor, 33.3% were diagnosed with hypertension and high blood glucose level, while 51.4% had at least one chronic disease, respectively (Othman et al., 2017; Cheng et al., 2014). The increasing prevalence of overweight and obesity among adults and the persistence of undernutrition in children, support the existence of DBM among OA population. Consequently, this condition could further increase the risk of morbidity and mortality among the OA population.

Overweight or obesity is a health hazard, as it is associated with poorer overall health outcomes, including mental illness and reduced quality of life. Worldwide, obesity is shown to be associated with the leading causes of death, including hypertension, diabetes, heart disease, and some types of cancer. Obesity also imposes a large economic burden on the individual, and on families and nations (WHO, 2016).

DBM at the household level among the OA was reported in the range of 12.5% – 25.8% (Norfaizah et al., 2009; Wong et al., 2015) which was lower or almost similar to the prevalence reported among the general population in Malaysia (25.8% – 29.6%) (Ali et al., 2014; Khor & Zalilah, 2003). To date, there are only few studies reporting factors associated with DBM at the household level among the OA or general population (Wong et al., 2015; Ali et al., 2012; Nurfaizah et al., 2009; Khor & Zalilah, 2003). The OAs (*Temuan*), particularly in the state of Selangor are more likely to have NCDs as they are living in urban and peri-urban areas as compared to the other indigenous tribes. Their settlements are characterised by proximity to urbanisation and modernisation, and are rapidly exposed to nutrition transition changes. The nutrition transition is shifting the traditional diet to a more westernised diet, as well as the changes in the role of occupation or lifestyle. Furthermore, urban-rural interactions have led to changes in the environment, including the influence of alcohol consumption and smoking habits. Therefore, this study was conducted to assess the prevalence of DBM (overweight/ obese mother and underweight and/or stunted children) and its associated factors among OA households in Selangor. The research questions were:

1. How prevalent is the DBM among OA *(Temuan)* households in Selangor?
2. What are the factors associated with the DBM among OA *(Temuan)* households in Selangor?

1.3 Objectives of study

1.3.1 General objective

To determine the nutritional status of mothers and children, and factors associated with DBM among OA (*Temuan*) households (mother-child pairs) in Selangor.

1.3.2 Specific objectives

1. To assess the demographic and socioeconomic characteristics, and food security status of OA *(Temuan)* mothers and children.

2. To assess the nutritional status of OA *(Temuan)* mothers and children

   i. Mothers
      a. Weight (kg)
      b. Height (cm)
      c. Body mass index (kg/m^2)
      d. Waist circumferences (cm)

   ii. Children
      a. Weight- for-age (WAZ)
      b. Length/ height-for-age (L/ HAZ)
      c. Weight-for-length/ height (WL/ HZ)

3. To identify household categories.
   a. Double burden of malnutrition (DBM) households: Overweight/ obese mother and underweight and/ or stunted child (OWOBM/ UWSTC);
   b. Normal households: Normal weight mother/ normal children;
   c. Others households (OT): Households who are not complied with the DBM and Normal households (i.e. underweight/ normal weight mother and overweight/ obese/ normal weight children).

4. To assess the dietary intakes of OA (Temuan) mothers and children, including energy and nutrients, number of food group serving, and dietary diversity.

5. To determine factors associated with DBM at household level:
   a. Household factors (household size, number of children, number of schooling children, income, income per capita, and food security status).
   b. Maternal factors (age, marital status, education level, employment status, income, and dietary intakes).
   c. Child factors (gender, age, birth order, birth weight, and dietary intakes).

1.4 Hypothesis of the study

DBM is significantly associated with household factors (household size, number of children, number of schooling children, income, income per capita, and food security status); maternal factors (age, marital status, education level, employment status, income, and dietary intakes); and child factors (gender, age, birth order, birth weight, and dietary intakes) among OA *(Temuan)* households in Selangor.

1.5 Research Framework

The research framework is presented in Figure 1.1. The independent variables are categorised as household factors (household size, number of children, number of schooling children, income, income per capita, and household food security status, maternal factors (age, marital status, education level, employment status, income, height, and dietary intakes); and child factors (gender, age, birth order, birth weight, and dietary intakes). The dependent variable in this study was double burden of malnutrition (DBM), where DBM was defined as households with overweight/ obese mother and underweight and/ or stunted child (OWOBM/ UWSTC) (Wong et al., 2015).

At the household level, household, maternal and child factors have been identified as underlying factors of DBM (Mahmudiono, 2016; Sarmiento et al., 2014; Oddo et al., 2012). Households with low income, large household size and a high number of children or many schooling children were more likely to have undernourished children and overweight/ obese mother (Wong et al., 2015; Wulung & Gindo, 2015).

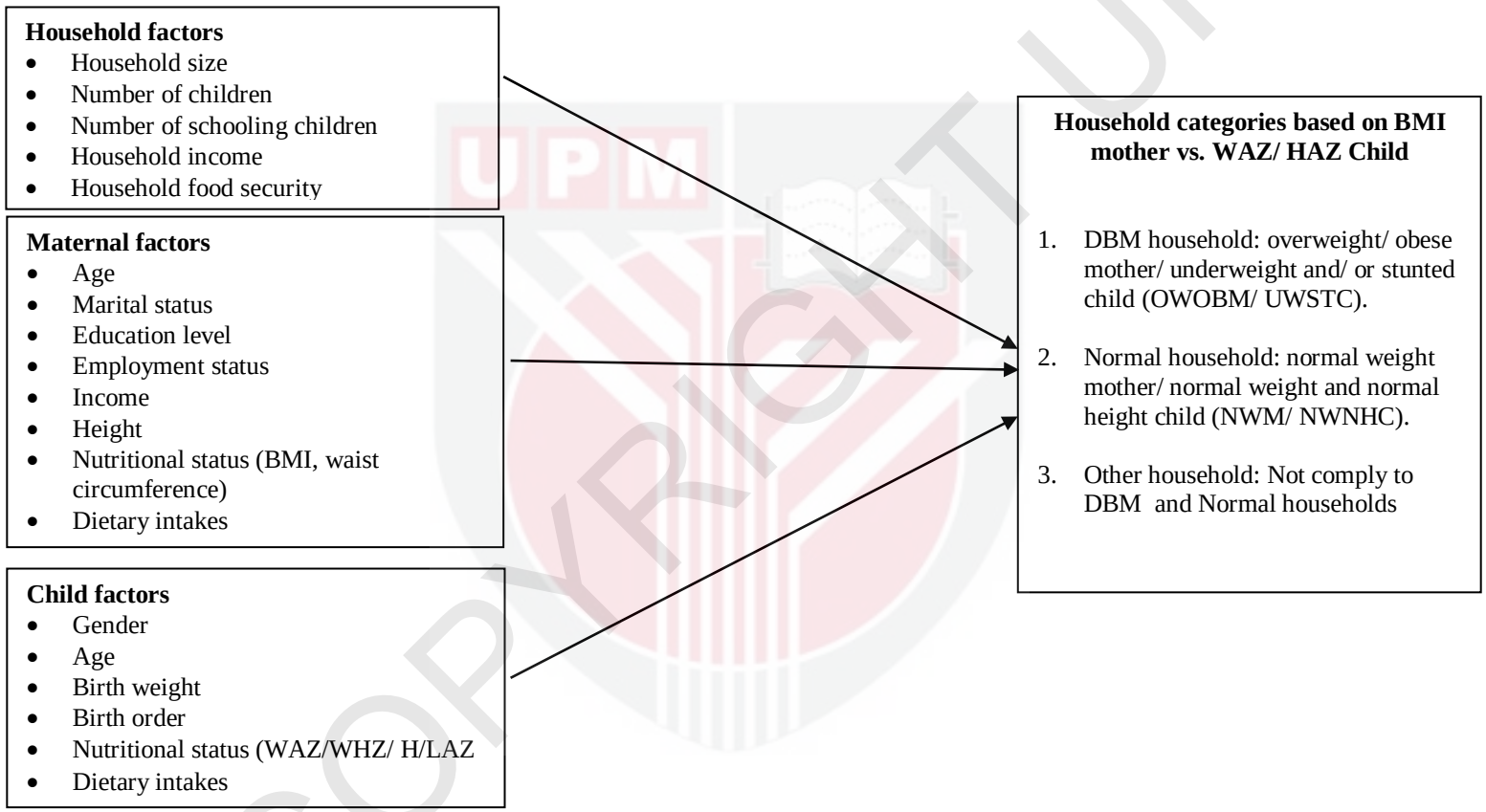

Figure 1.1 : Research framework

Women with advanced maternal age, low education level, unmarried, widowed or separated from their husbands, unemployed and have low food variety score but higher intakes of energy-dense foods were associated with the DBM (Rima et al., 2016; Ali et al., 2013; Barquera et al., 2007). Children who were female, with lower birth weight, born with higher birth order and older age, were found more likely to be undernourished which puts the household at a higher risk of DBM (Bassete et al., 2014; Oddo et al., 2012).

1.6 Significance of the Study

The present study aimed to provide baseline data for double burden of malnutrition (DBM) at the household level, food insecurity status, anthropometry, and dietary intakes of OA *(Temuan)* households (mother-child pairs) in Selangor. In addition, the study could provide insights on factors associated with DBM in the *Temuan* population. These findings could add to the limited studies on DBM in OA population Additionally, the findings of this study could support and reject previous literature on DBM and its associated factors. Such information on prevalence and associated factors of DBM can be used to guide and facilitate the development of policies, strategies, guidelines and intervention programmes to address this form of malnutrition. For example, DBM households not only have limited access to healthy foods, but do also lacked the necessary knowledge for choosing healthy foods, leading to poor dietary diversity and nutritional status. Thus, interventions to promote healthy eating and responsive feeding could be beneficial to the OA population.

In the previous years, strategies to prevent DBM have been discussed at the various international and national platforms. For example, the Action Plan to Reduce the Double Burden of Malnutrition in the Western Pacific Region (2015 – 2020) was developed as a guideline to achieve eight nutrition target. One of them is to reduce under-nutrition and to halt the rise of overweight, obesity and NCDs (WHO, 2015). Likewise, in Malaysia, various government strategies and action plans have been formulated and implemented to combat any form of malnutrition. Currently, the third National Plan of Action for Nutrition of Malaysia (NPANM III, 2016 – 2025), has been implemented by adopting a multi-sectoral and multi-stakeholder approach for strategies to prevent DBM. Hence, identifying the factors associated with DBM is crucial in order to facilitate health professionals as well as policy makers to plan effective and specific intervention programs for preventing and controlling malnutrition in all its forms. At present, there is no specific programme that addresses DBM at the household level (mother–child pairs). For the OA population, existing programs such as Community Feeding and *Program Pemulihan Susu Tepung Penuh Krim* are focused on individual children and mothers who are undernourished. However, women and children in this populations are still among the most marginalized groups with poor nutritional and health status. Therefore, the findings of this study would be useful to strengthen the existing national nutrition programs and interventions, that aim to improve health and nutrition of this population.

In a population, the nutritional status of women and children are vital indicators of health of the population. The current study is therefore, aimed at fulfilling the Sustainable Development Goals (SDGs), which undertakes to leave no one behind and provides additional impetus for tackling the situation of OA women and children. In addition, the findings of this study may portray the nature, demographic and socio-economic background of the OA population, which can be used to update information on the population for various stakeholders, such as the Orang Asli Development Department (JAKOA), Ministry of Health and non-governmental organizations to improve the implementation of existing policies and intervention programmes.

Finally, the findings of this study could also increase the awareness of researchers and academicians on the need to include this vulnerable group in future studies related to malnutrition and DBM. Studies on various aspects of socio-economic and health of OA population should be a priority area in the Nutrition Research Priority (NRP) of Malaysia. This is to ensure that current findings can be used as a basis for improvement of the health and nutrition of the OA population in Malaysia.

1.7 Operational Definition

1.7.1 Double burden of malnutrition households (OWOBM/ UWSTC)

The double burden of malnutrition (DBM) is characterized by the coexistence of undernutrition along with overweight, obesity or diet-related NCDs, within individuals, households and populations, and across the life-course. This study defined DBM households with coexistence of an overweight/ obese mother and an underweight/ stunted child (OWOBM/ UWSTC) (Wong et al., 2015)

1.7.2 Dietary diversity

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals. Dietary Diversity Score (DDS) was calculated by summing the number of unique food groups consumed during last 24 hour. DDS of infant and children (6 – 59.9 months old) is based on seven food groups (grains, root, and tubers; legumes and nuts; dairy products (milk, yoghurt, cheese); meat, fish, poultry and liver/ organ meats; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables). A cut - off point of ≥ 4 indicates adequate dietary diversity. DDS of mothers (20 – 49 years old) is based on ten food groups (grains, white roots and tuber, and plantains; pulses (beans, peas and lentils; nuts and seeds; dairy; meat, poultry and fish; eggs; dark green leafy vegetables; other vitamin-A rich fruits and vegetables; other vegetables; other fruits). A cut-off point of ≥ 5 indicates adequate dietary diversity.

1.7.3 Food security

A condition when all people, at all times have physical and social and economic access to sufficient, nutritious and safe foods that meet their dietary needs and food preferences for an active and healthy lifestyle. Food security status was measured using the Radimer Cornell and Hunger Instrument, and categorised into four levels namely i) food security; ii) household food insecurity; iii) Individual food insecurity; iv) child hunger.

1.7.4 Nutritional status

Nutritional status: is the physiological state of an individual, which results from the relationship between nutrient intake and requirements and from the body's ability to digest, absorb and use these nutrients.

Stunting: Children with low length/ height-for-age (< -2SD) based on the WHO Growth Chart (2006).

Underweight: Children with low weight for age (< -2SD) based on the WHO Growth Chart (2006).

Overweight: Mothers (20 – 49 years old) with body mass index (BMI) ≥ 25.0 – 29.99 kg/m^2 based on WHO (1995).

Obese: Mothers (20 – 49 years old) with body mass index (BMI) ≥ 30.0 kg/m^2 based on WHO (1995).

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BIODATA OF STUDENT

Rozalina Ismail was born in Felda Keratong 4, Rompin, Pahang on 8th June 1981. She had education at Sekolah Rendah Kebangsaan Felda Keratong Empat. She obtained her secondary education at Sekolah Menengah Kebangsaan Felda Keratong and Maktab Rendah Sains Mara (MRSM), Kuantan, Pahang. In 2003, she graduated with Bachelor Science (Nutrition and Community Health) at Universiti Putra Malaysia.

In 2004 – Mac 2005, she joined Health Farm Sdn. Bhd, which is a health food and supplement company that promote products and provide consultancy services on health. In early April 2005, she was offered a position as a Food Nutrition Science Officer at Ministry of Health. Her first posting was placed at Selangor State Health Department. She has served at the State Health Department for approximately 6 years. Then she got promotion in 2011 and currently working at Nutrition Division, Ministry of Health. She has worked on national nutrition training under National Coordinating Committee on Food and Nutrition (NCCFN).

On September 2016, she pursues her Master degree, under the supervision of Prof. Dr. Zalilah Mohd Shariff. Her research interest is on food security, maternal and child health and nutrition.

In 2019, she continued her work at Ministry of Health. She is currently working under National Plan of Action for Nutrition of Malaysia (NPANM). She takes responsibility in coordinating food and nutrition security under Nutrition Division, Ministry of Health. She has a great experience in planning and coordinating national programs and projects, direct involvement of community-based services, and development of nutrition related training modules and national guidelines.

PUBLICATION

Journals

Rozalina, I. Zalilah, MS.Nurul Husna, MS. (2021). Double Burden of Malnutrition and its Associated Factors among Indigenous Peoples (Orang Asli) Living in an Urbanized State of Peninsular Malaysia. Ethnicity & Health

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