

UNIVERSITI PUTRA MALAYSIA

FACTORS ASSOCIATED WITH COGNITIVE PERFORMANCE AMONG ORANG ASLI'S CHILDREN AGED 2 TO 6 YEARS OLD IN NEGERI SEMBILAN, MALAYSIA

SITI FATIHAH BINTI MURTAZA

FPSK(M) 2018 47



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By

SITI FATIHAH BINTI MURTAZA

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

April 2017

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

FACTORS ASSOCIATED WITH COGNITIVE PERFORMANCE AMONG ORANG ASLI'S CHILDREN AGED 2 TO 6 IN NEGERI SEMBILAN, MALAYSIA

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April 2017

Chair : Gan Wan Ying, PhD Faculty : Medicine and Health Sciences

Young children aged 2 to 6 years old are in crucial period of growth development. Attainment of specific cognition related to concentration and attention is important for them to be prepared to perform well in school later in life. Various factors could influence cognition of the children in multidirectional ways during this crucial period. There is limited study determining cognitive performance of underprivileged children who are living in poverty, especially Orang Asli children. Therefore, this cross-sectional study aimed to determine the factors associated with cognitive performance among Orang Asli children aged 2 to 6 years old in Negeri Sembilan, Malaysia.

A total of 269 children (50.9% boys and 49.1% girls) aged 2 to 6 years old (M=4.04, SD=1.21 years) and their mothers from 14 Orang Asli villages in Negeri Sembilan participated in this study. A face-to-face interview was administered on mothers to obtain information on demographic and socioeconomic background, home environment, sanitation and hygiene. A 2-day 24-hour dietary recall and dietary diversity scores were used to measure current nutrient intake of the children. Anthropometric measurements of both children (height and weight) and their mothers (height, weight, and waist circumference) were recorded. Cognitive performance [working memory index (WMI), processing speed index (PSI), cognitive proficiency index (CPI)] was measured using the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) IV instrument including picture memory, zoo location, bug search and cancellation tests. Blood samples of the children were collected by a pediatrician to assess hemoglobin, serum iron, serum ferritin and transferrin of the children. Meanwhile, mother's hemoglobin level was determined using the HemoCue technique. Stool samples of the children were taken to screen for parasitic infections.

Nearly one third of the children were underweight (27.2%) and had stunted growth (35.6%). Majority of the mothers were overweight (29.5%) and obese (32.2%). Two in five (38.3%) of the mothers and one in five (21.7%) of the children were anemic. One third of the children had parasitic infections (35.0%). Almost all of the Orang Asli

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households (96.3%) experienced varying levels of household food insecurity. Meanwhile, about two in five (43.7%) of the children had a low CPI (\leq 89 points). One in three (31.6%) had low WMI (\leq 89 points) and half (50.0%) of the children had low PSI (\leq 89 points).

Multiple linear regression results in this study showed that higher number of years of child's education (β =0.236, p=0.015), father's years of education (β =0.234, p=0.016), higher father's income (β =0.274, p=0.003), lower weight-for-age (β =-0.262, p=0.002), higher height-for-age (β =0.336, p=0.025), absence of parasitic infections (β =-0.329, p=0.001), higher energy ($\beta=0.212$, p=0.004) and fat ($\beta=0.319$, p=0.029) intakes were predictors for better WMI. These factors predicted 52.4% of variance in WMI. Higher number of father's years of education (β =0.306, p=0.005), higher child's hemoglobin level (β =0.209, p=0.044), more learning materials available at home (β =0.299, p=0.007). and more parental responsivity to the child (β =0.247, p=0.009) predicted better PSI, in which 38.5% of variance in PSI were explained by these factors. In term of CPI, higher number of years of father's (β =0.236, p=0.026) and child's education (β =0.217, p=0.035), higher father's income ($\beta=0.250$, p=0.003), increase in birth weight ($\beta=0.215$, p=0.043, higher intakes of energy ($\beta=0.408$, p=0.006), fat ($\beta=0.474$, p=0.011), iron $(\beta=0.598, p=0.001)$, and calcium $(\beta=0.390, p=0.012)$, absence of parasite infections $(\beta=0.598, p=0.001)$ 0.325, p=0.004), and more parental responsivity to the child (β =0.280, p=0.008) predicted better CPI. These factors predicted 56.2% of variance in CPI.

In conclusion, half of the Orang Asli children in this study had low cognitive performance as well as one third of them had poor nutritional and health status. Their cognitive performance (WMI, PSI, CPI) can be enhanced by improving parental education and income level, providing optimal nutrition specifically with iron, educating parents to provide intellectual environment at home specifically increasing learning materials and parenting skills with periodically deworming parents, communities and government agencies should be established in order to improve cognitive performance of these disadvantaged children. Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

FAKTOR BERKAITAN DENGAN PRESTASI KOGNITIF DALAM KALANGAN KANAK-KANAK ORANG ASLI BERUMUR 2 HINGGA 6 TAHUN DI NEGERI SEMBILAN, MALAYSIA

Oleh

SITI FATIHAH BINTI MURTAZA

April 2017

Pengerusi : Gan Wan Ying, PhD Fakulti : Perubatan dan Sains Kesihatan

Kanak-kanak yang berumur 2 hingga 6 tahun merupakan lingkungan umur yang sangat penting dalam proses pertumbuhan manusia. Pencapaian kebolehan kognitif yang tertentu yang berkaitan dengan tumpuan dan perhatian adalah sangat penting sebagai persediaan untuk mencapai prestasi yang baik di sekolah pada masa akan datang. Pelbagai faktor boleh mempengaruhi prestasi kognitif kanak-kanak dalam tempoh yang penting ini. Terdapat kajian yang terhad bagi menentukan prestasi kognitif kanak-kanak kurang bernasib baik yang hidup dalam kemiskinan, terutamanya kanak-kanak Orang Asli. Justeru itu, kajian keratan rentas ini bertujuan untuk menentukan faktor yang berkaitan dengan prestasi kognitif dalam kalangan kanak-kanak Orang Asli yang berumur 2 hingga 6 tahun di Negeri Sembilan, Malaysia.

Seramai 269 kanak-kanak (50.9% lelaki dan 49.1% perempuan) yang berumur 2 hingga 6 tahun (M=4.04, SD=1.21 tahun) serta ibu mereka daripada 14 perkampungan Orang Asli di Negeri Sembilan telah mengambil bahagian dalam kajian ini. Ibu ditemuduga untuk mendapatkan maklumat mengenai latar belakang demografi dan sosio-ekonomi, persekitaran rumah, sanitasi dan kebersihan kanak-kanak. Kaedah dua hari Ingatan Diet 24 jam yang lepas dan skor kepelbagaian makanan telah digunakan untuk mengukur pengambilan nutrien kanak-kanak. Ukuran antropometri dijalankan ke atas kanak-kanak (ketinggian dan berat) dan ibu mereka (ketinggian, berat, dan lilitan pinggang). Prestasi kognitif [indeks memori kerja (WMI), indeks kelajuan pemprosesan (PSI) dan indeks kecekapan kognitif (CPI)] diukur oleh penyelidik dengan menggunakan instrumen Wechsler Preschool and Primary Scale of Intelligence (WPPSI) IV termasuk ujian memori gambar, lokasi zoo, carian serangga dan pembatalan. Sampel darah kanak-kanak diambil oleh seorang Pakar Pediatrik untuk menilai status hemoglobin (Hb), serum zat besi, feritin dan transferin kanak-kanak. Sementara itu, hemoglobin ibu diukur dengan menggunakan teknik HemoCue. Sampel najis kanak-kanak diambil untuk menjalankan saringan jangkitan cacing parasit.

Hampir satu pertiga orang kanak-kanak mengalami kekurangan berat badan (27.2%) dan terbantut (35.6%). Kebanyakan ibu mempunyai masalah berat badan berlebihan (29.5%) dan obesiti (32.2%). Dua daripada lima orang (38.3%) ibu dan satu daripada lima orang (21.7%) kanak-kanak mengalami masalah anemia. Satu pertiga orang kanak-kanak mempunyai jangkitan cacing parasit (35.0%). Sebanyak 96.3% isi rumah Orang Asli mengalami pelbagai tahap ketidakjaminan kedapatan makanan. Dua daripada lima orang (43.7%) kanak-kanak mempunyai CPI yang rendah (\leq 89 markah). Satu daripada tiga orang (31.6%) mempunyai WMI yang rendah (skor \leq 89) dan separuh (50.0%) kanak-kanak mempunyai PSI yang rendah (skor \leq 89).

Keputusan analisis regrasi pelbagai linear dalam kajian ini menunjukkan bahawa pendidikan anak (β =0.236, p=0.015) dan bapa (β =0.234, p=0.016) yang lebih tinggi, bapa yang berpendapatan tinggi (β =0,274, p=0.003), berat-untuk-umur yang lebih rendah $(\beta = -0.262, p = 0.002)$, ketinggian-untuk-umur yang lebih tinggi $(\beta = 0.336, p = 0.025)$, tiada sebarang jangkitan cacing parasit (β =-0.329, p=0.001), pengambilan tenaga (β =0.212, p=0.004) dan lemak ($\beta=0.319$, p=0.029) yang tinggi berkaitan dengan WMI. Faktorfaktor ini meramalkan 52.4% varians dalam WMI. Pendidikan bapa yang lebih tinggi $(\beta=0.306, p=0.005)$, tahap hemoglobin anak yang lebih tinggi $(\beta=0.209, p=0.044)$, mempunyai bahan pembelajaran di rumah (β =0.299, p=0.007), dan ibu bapa yang memberi tindak balas kepada kanak-kanak (β =0.247, p=0.009) meramalkan PSI yang lebih baik, di mana 38.5% daripada varians dalam PSI diterangkan oleh faktor-faktor ini. Dari segi CPI, pendidikan bapa (β =0.236, p=0.026) dan anak yang lebih tinggi (β =0.217, p=0.035), pendapatan bapa yang lebih tinggi ($\beta=0.250$, p=0.003), peningkatan dalam berat lahir (β =0.215, p=0.043), pengambilan tenaga (β =0.408, p=0.006), lemak $(\beta=0.474, p=0.011)$, zat besi $(\beta=0.598, p=0.001)$, dan kalsium $(\beta=0.390, p=0.012)$ yang lebih tinggi, tiada jangkitan cacing parasit (β =-0.325, p=0.004), dan ibu bapa yang memberi tindak balas kepada kanak-kanak (β =0.280, p=0.008) berkaitan dengan CPI. Faktor-faktor ini meramalkan 56.2% daripada varians dalam CPI.

Kesimpulannya, hampir separuh daripada kanak-kanak Orang Asli dalam kajian ini mempunyai prestasi kognitif yang rendah, serta satu pertiga mempunyai status pemakanan dan kesihatan yang lemah. Prestasi kognitif (WMI, PSI, CPI) kanak-kanak ini boleh dipertingkatkan dengan memperbaiki pendidikan dan pendapatan ibu bapa, menyediakan makanan yang bernutrisi tinggi khususnya makanan yang tinggi zat besi, mendidik ibu bapa untuk menyediakan persekitaran yang intelektual di rumah khususnya meningkatkan bahan pembelajaran untuk anak di rumah dan meningkatkan kemahiran keibubapaan bersama dengan membasmi cacing parasit secara berkala dan pendedahan awal kepada pendidikan prasekolah kepada kanak-kanak. Pendekatan holistik yang melibatkan ibu bapa, komuniti, dan agensi kerajaan perlu diwujudkan dalam usaha untuk meningkatkan prestasi kognitif kanak-kanak yang kurang bernasib baik ini.



ACKNOWLEDGEMENTS

Alhamdulillah, I would like to thank Allah, the almighty upon the completion of my master's thesis project. Firstly, I would like to express my sincerest gratitude to my supervisor, Dr. Gan Wan Ying, who has continuously supported and guided me throughout the process of completing my thesis. This thesis would not have been possible without her supervision, advice, enthusiasm, brilliance and patience, which I am very thankful of. My gratitude also goes to the members of the supervisory committee, Professor Dr. Zalilah Mohd Shariff, Associate Professor Dr. Norhasmah Sulaiman, and Dr. Siti Irma Fadhilah Ismail for their thoughtful comments and suggestions to improve my research project.

I am grateful to obtain the scholarship provided by the MyBrain15 scheme from Ministry of Higher Education (MOHE) Malaysia and also the Graduate Research Fellowship (GRF) from Universiti Putra Malaysia (UPM). Without this I will not be able to further my study at this top university. Besides that, I would also like to thank the Fundamental Research Grant Scheme (FRGS) by MOHE Malaysia for funding this study (Grant No. 04-02-14-1547FR). Furthermore, I would like to thank the Department of Orang Asli Development Malaysia (JAKOA) for allowing me to conduct this project in the Orang Asli villages. I am hugely indebted to Tok Batin (chief of village) and all participants involved in making this project into a reality.

I would like to thank my colleagues, Nur Syazwani Razali, Nur Fahilin Tahir, and Siti Farhana Mesbah for helping me in data collection, continuous support and encouragement throughout the whole process of research. Thank you very much for being with me through my ups and downs throughout this process. I am also very grateful to have such a great parent and husband who constantly support, encourage and understand me patiently throughout the entire period of my study. Last but not least, to those who have contributed to this study directly or indirectly, I would like to thank you very much.

I certify that a Thesis Examination Committee has met on 14 April 2017 to conduct the final examination of Siti Fatihah Binti Murtaza on her thesis entitled Factors associated with cognitive performance among Orang Asli children aged 2 to 6 years old in Negeri Sembilan, Malaysia in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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LIST OF ABBREVIATIONS

BAZ	BMI-for-age z score
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CPI	Cognitive proficiency index
DDS	Dietary diversity scores
EI	Energy intake
FAO	Food and Agriculture Organization
HAZ	Height-for-age z score
HFA	Height-for-age
Hb	Hemoglobin
НОМЕ	Home Observation for Measurement of the Environment (HOME) Inventory
IDA	Iron deficiency anemia
IQ	Intellectual Quotient
NCCFN	National Coordinating Committee on Food and Nutrition
PSI	Processing speed index
RNI	Recommended Nutrient Intake
WAZ	Weight-for-age z score
WC	Waist circumference
WFA	Weight-for-age
WHO	World Health Organization
WMI	Working memory index
WPPSI IV	Weschler Preschool and Primary Scale of Intelligence – Fourth Edition

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GLOSSARY OF TERMS

Working memory index	Encompasses concentration, attention, and mental control. It measures specific aspects of working memory such as visual-spatial working memory, visual working memory, and competency to withstand disturbance from earlier memorized items (Raiford & Coalson, 2014).
Processing speed index	Measures the competency of the children to quickly and correctly scan or discriminate simple visual information within specified time (Raiford & Coalson, 2014).
Cognitive proficiency index	Encompasses information in the service of learning, problem solving, and higher-order reasoning (Raiford & Coalson, 2014).
Low cognitive performance	Less than 89 composite index scores (Weschler & Scales, 2012).
Anemia	Children under age of 5 years with Hb concentration < 11g/dL (WHO, 2011). Children 5 years and above with Hb concentration < 11.5 g/dL (WHO, 2011).
Iron deficiency without anemia	Hb level is in normal value and iron deficiency is defined as either one of the resulting indicators are existing with abnormal value: serum ferritin, transferrin, and serum iron (De la Cruz-Góngora et al., 2012; UNICEF/UNU/WHO, 2001).
Iron deficiency anemia	Abnormal value of anemia and iron deficiency (De la Cruz-Góngora et al., 2012; UNICEF/UNU/WHO, 2001).

C

CHAPTER 1

INTRODUCTION

1.1 Background

Cognition refers to the psychological process of memory, attention, learning, language, reasoning, and coordination of motor outputs (Swaminathan, Edward, & Kurpad, 2013). There are various factors known to influence cognition. Poverty, low socioeconomic status, poor health status, malnutrition, intestinal parasitic infections, poor home environment, low education of parents, and micronutrient deficiencies are among the various factors that may contribute to low cognitive performance among children (Al-Mekhlafi et al., 2011; Christensen, Schieve, Devine, & Drews-Botsch, 2014; Crookston, Forste, Mcclellan, Georgiadis, & Heaton, 2014; Perignon et al., 2014; Santos et al., 2008).

Early childhood development encompasses holistic aspects of children's development, including physical, social-emotional, and language-cognitive domains (Wise, 2013). It is important for parents from before birth to the age of 8 years to ensure all children have an equal chance to thrive and grow (Wise, 2013). There is a significant cognitive gap between indigenous and non-indigenous children due to the higher rate of poor nutritional and health status among indigenous children compared to non-indigenous children (Arteaga & Glewwe, 2014; Wise, 2013).

An estimated of more than 370 million people worldwide are classified as Indigenous or Aboriginal (Gracey & King, 2009; King, Smith, & Gracey, 2009). Indigenous people are also called as Aboriginal, tribal, or minority groups or people (Stephens et al., 2005). Asia-Pacific region hosts the largest number of indigenous people, accounting for 70% of the global indigenous population that were from the Australian Aboriginal, African Pygymy or known as Bayaka, Inuit (arctic Canada, United States, Greenland, Russia), Orang Asli (Peninsular Malaysia), and Yanomami (Amazon rainforest; Brazil and Venezuela) (Hotez, 2014). These indigenous people usually live in poor conditions with inadequate intake of energy, and are exposed to high rates of infections such as acute and chronic ear diseases, parasitic infections, trachoma, dental caries, diarrheal diseases, urinary tract infections, upper and lower respiratory tract infections, viral and bacterial infections affecting the nervous system (Carville et al., 2007). Infections are the most common cause of hospitalization among Australian Aboriginal children with 34% of admission as compared to non-aboriginal children (Carville et al., 2007).

Besides of hunger and general inadequacy of food and energy, specific deficiencies of nutrients included iron deficiencies, iodine deficiencies, and poor vitamin intake (vitamin A and D; folic acid) were common among indigenous people (Gracey & King, 2009). A study done on indigenous children and adolescents of the Peruvian Amazon found that 51% of them had anemia, 50% were stunted, and 20% were underweight (Anticona &

San Sebastian, 2014). Since indigenous children usually live in impoverished conditions, they tend to have poor health status that eventually impairs their cognitive development.

In 2015, the indigenous people of Malaysia were estimated to account for approximately 13.9% of the 31 million population in Malaysia (IWGIA, 2016). Orang Asli people has distinctive language, cultures and beliefs. They often have a lot in common with other neglected societies, such as lack of socioeconomic status and poverty, healthcare awareness, poor sanitation and of essential needs such as appropriate clothing and nutritious food for the whole family (Masron, Masami, & Ismail, 2013). In Peninsular Malaysia, Orang Asli consists of 18 ethnic subgroups and it is divided into three major tribal groups, including Semang (Negrito), Senoi and Proto Malay (Aboriginal Malay), in which they are estimated to account for 205,000 or 0.84% of the population in Peninsular Malaysia (IWGIA, 2016; Masron et al., 2013). About 61% of Orang Asli are located in rural areas. Orang Asli are among the poorest populations in Malaysia. More than three-quarters (76.9%) of the Orang Asli population live below the poverty line (monthly household income of less than and equal to RM940), with 35.2% classified as living in hard-core poverty (monthly household income of less than and equal to RM580), compared to 1.4% nationally (Department of Statistics Malaysia, 2001). In 2014, overall poverty among Malaysians had reduced from 3.8% in 2009 to 0.6%, but poverty rates among Orang Asli population (34%) was still high (Economic Planning Unit, 2016).

Children living in poverty usually experience fewer cognitive encouragement and enrichment in comparison to wealthier children. This is because children from low household income families frequently lack stimulation and social skills necessary to get them ready for school (Ferguson, Bovaird, & Mueller, 2007). For example, low income parents interact less with their children and involve minimaly in their education due to unmanageable stress in their daily lives (Gratz, Nation, Schools, & Kurth-Schai, 2006).

Besides poor socioeconomic status, Orang Asli children in Malaysia have persistent problems of malnutrition, low birth weight, and poor iron status (Al-Mekhlafi et al., 2008; Khor & Misra, 2012; Wong et al., 2015). About 49% of Orang Asli children were underweight and 64% were stunted (Wong et al., 2015). Another study among Orang Asli school children in remote areas, Pos Betau, Pahang found that 48.5% were anemic and 34% had iron deficiency anemia (Al-Mekhlafi et al., 2008). The concern for these entire health problems among Orang Asli children can lead to retardation in cognitive development and academic achievement in school.

1.2 Problem Statement

Over the years, the Malaysian government have implemented programs that are primarily aimed at improving the quality of life and general welfare of Orang Asli. Examples of the programs include resettling them, increasing income through cash-cropping and commercial activities as well as providing physical support such as electricity, water supply, roads, and houses (Khor & Zalilah, 2008). However, little success has been achieved as they are still facing poverty, poor nutritional and health status, especially in

young children (Chua, Zalilah, Chin, & Norhasmah, 2012; Khor & Zalilah, 2008; Shashikala, Kandiah, Zalilah, & Khor, 2005) as compared with other ethnic groups in Malaysia. The problems of poor socioeconomic status, malnutrition, parasitic infections, poor sanitation practices, and iron status are still persistent among Orang Asli (Al-Delaimy et al., 2014; Al-Mekhlafi et al., 2008; Santos et al., 2008), which in turn may affect their cognitive performance and educational performance later in school.

In Malaysia, limited studies have been reported on the biochemical data (especially micronutrient status) and cognitive performance of Orang Asli children (Ahmed et al., 2012; Al-Mekhlafi et al., 2008). There are several small scale studies among Orang Asli children in selected areas and age groups. However, the results cannot be generalized to the total population of Orang Asli children in Malaysia. These studies mainly focus on body weight status, dietary intake, parasitic infections, and food security status (Al-Delaimy et al., 2014; Chua et al., 2012; Haslinah, 2009; Ngui, Lim, Liam, Chow, & Shukri, 2012; Shashikala et al., 2005; Zalilah & Tham, 2002).

Furthermore, limited studies have been carried out to examine cognitive performance among Orang Asli young children aged 2 to 6 years old. A study on cognitive performance of Orang Asli children aged 2 to 9 years old (Haslinah, 2009) found that 78.1% of the children had low (extremely low, very low, and low) cognitive ability. However, this study did not measure iron status, sanitation condition, parasitic infections and it was mainly focused on socioeconomic factors. Al-Mekhlafi et al. (2011) reported that among Orang Asli school children aged 7 to 12 years old in Pos Betau, Kuala Lipis, Pahang, 99.8% had low (extremely low, very low, and low) cognitive performance with almost none had above average scores. However, this study did not measure home environment factors and cognitive performance of children below 7 years old where many young children are more susceptible to poor health conditions, in which this can affect their growth and cognitive development. It is important for children to have optimal cognitive development to get them ready to school. Nevertheless, the percentages of low cognitive performance among Orang Asli children were very high. Hence, study determining factors contributed to cognitive performance of Orang Asli children is needed in order to improve their cognitive performance.

Poor cognitive performance in children is not associated with only one risk factor, rather it is likely to result from a range of interacting factors. Many factors have been found to be associated with poor cognitive performance, including poor iron status, low birth weight, poor parental schooling, poverty, poor growth status, parasitic infection, poor psychosocial stimulation at home, and poor sanitation practices (Al-Mekhlafi et al., 2011; Berkman, Lescano, Gilman, Lopez, & Black, 2002; Perignon et al., 2014; Santos et al., 2008).

Childhood anemia can be one of the factors that lead to serious consequences on cognitive performance, including growth retardation, lower resistance to infections and increased morbidity and mortality (Ayoya et al., 2013; Khor & Zalilah, 2008; Mclean et al., 2009). For example, a study in Korea found that iron deficiency had significant association with cognitive deficit among children aged 5 years old (Jeong et al., 2014). Another study found that improved growth status would improve their cognition

(Crookston et al., 2014). Iron deficiency impairs cognitive development of children from early childhood through adolescence, where it damages immune mechanisms, and is associated with increased morbidity rates (WHO, 2001).

Malnutrition is one of the factors that could impair cognitive performance among Orang Asli children. It is well known that malnutrition occurs as a result of inadequate food intake rich in macro and micronutrients such as calcium, niacin, vitamin A, zinc, and iron (Khor & Misra, 2012). Multiple studies have shown that children with low birth weight, came from poor household factors, food insecurity, and poor hygiene and sanitation that also contributed to the malnutrition problem (Wong, Moy, & Sulochana, 2014; Zalilah & Tham, 2002). Parasitic infections are common among Orang Asli people, which is also likely to be a contributing factor to malnutrition and anemia among them (Al-Delaimy et al., 2014; Ezeamama et al., 2008; Ngui et al., 2012; Yang et al., 2012). As Orang Asli children are vulnerable to infection and malnutrition, it is not unlikely that it would affect their health status and prevent them from achieving optimum cognitive capabilities.

In summary, growth failure and micronutrient deficiencies can lead to developmental delays throughout childhood and adolescence and consequently reducing the productivity in adulthood (UNICEF, 2006). Although previous studies have found several factors that are associated with cognitive performance among children, their contributions have yet to be examined among Orang Asli children. This is an important area that should be further explored in order to provide better understanding of factors that may be associated with cognitive performance among Orang Asli children. Therefore, this study aims to answer the research questions below:

- a) What are the associations between demographic and socioeconomic factors, nutritional factors, and environmental factors with cognitive performance among Orang Asli children aged 2 to 6 years old?
- b) What are the contributing factors of cognitive performance among Orang Asli children aged 2 to 6 years old?

1.3 Significance of the Study

Studies on factors contributing to cognitive performance among Orang Asli children aged 2 to 6 years old in Malaysia are still scarce. This study provides information on iron status, nutritional status, sanitation and hygiene, home environment and intestinal parasitic infection among Orang Asli children, which is helpful in identifying levels of cognitive performance among Orang Asli children.

Additionally, this study can enhance the understanding of factors associated with cognitive performance. Identifying factors associated with cognitive performance are very important in order to improve health status, encounter dropouts from schools and improve education level of Orang Asli children. Furthermore, the Department of Orang Asli Development (JAKOA) under Ministry of Rural and Regional Department can

utilize the findings of this study as a basic guideline to construct suitable programs for Orang Asli children. For example, program supplying nutrient-rich food to young children as early as 2 years old can be conducted to address anemia problems, which in turn can improve cognitive performance of Orang Asli children. This is important in order to improve their school academic performance and attendance in school. Besides that, this study can help to develop appropriate nutritional interventions in Orang Asli community to improve their cognitive performance.

The results of this study can also be used by other researchers, health care practitioners, nutritionists, dietitians, as well as health promotion program planners to understand the situation of cognitive performance, malnutrition, iron status and parasitic infection among Orang Asli children. Furthermore, it will also allow them to take initiative to create awareness among parents on the importance of healthy eating behaviors by providing sufficient nutrient intake, especially iron-rich food to improve their children's iron and growth status as well as cognitive performance. Health care practitioners can also use the findings of this study to develop proper sanitation practices to improve the hygiene status of the Orang Asli. Additionally, the findings can be used as reference for future studies on factors associated with cognitive performance among children aged 2 to 6 years old.

1.4 Research Objectives

1.4.1 General objective

To determine factors associated with cognitive performance among Orang Asli children aged 2 to 6 years old in Negeri Sembilan.

1.4.2 Specific objectives

- a) To examine demographic and socioeconomic factors (child's age, birth order, household size, parent's education level, child education level, parent's occupation status, parent's monthly income, monthly total household income and food security status), nutritional factors of mothers (body weight status, height status, and hemoglobin level) and children (birth weight, body weight status, dietary intake, and iron status), and environmental factors (parasitic infections, home environment, sanitation and hygiene) among Orang Asli children.
- b) To assess cognitive performance among Orang Asli children.
- c) To determine the associations between demographic and socioeconomic factors, nutritional factors, and environmental factors with cognitive performance among Orang Asli children.
- d) To determine the contributions of demographic and socioeconomic factors, nutritional factors, and environmental factors towards cognitive performance among Orang Asli children.

1.5 Research Hypotheses

- a) There are significant associations between demographic and socioeconomic factors, nutritional factors, and environmental factors with cognitive performance among Orang Asli children.
- b) There are significant contributions of demographic and socioeconomic factors, nutritional factors, and environmental factors toward cognitive performance among Orang Asli children.

1.6 Conceptual Framework

Figure 1.1 shows that demographic and socioeconomic factors, nutritional factors, and environmental factors act as independent variables in this study that may predict cognitive performance among Orang Asli children aged 2 to 6 years old. Demographic and socioeconomic factors consisted of child's age, child's birth order, household size, parents' education level, child's education level, parent's occupation status, monthly income, monthly household income, and food security status. Several studies found that age of children, small family size and birth order were associated with cognitive performance among children (Kanazawa, 2012; Keller, Troesch, & Grob, 2015; Zyrianova, Chertkova, & Pankratova, 2013).

Older age children committed fewer errors and corrected their errors more frequently than younger children (Macdonald, Beauchamp, Crigan, & Anderson, 2014). Parents tend to react contrarily to elder children than younger children, for example, parents teach and expect the elder to become more independent than the younger children (Saroglou & Fiasse, 2003). Few studies found that parents' education level and income level were associated with cognitive performance among children (Al-Mekhlafi et al., 2011; Crookston et al., 2014; Santos et al., 2008). Highly educated parents tend to provide a better home environment for their children (Biedinger, 2011). These parents will expose their children to early preschool education and get engaged with their children to learn, such as helping them finish their homework as well get in touch with their teachers to update their child's development (Biedinger, 2011; Smith, 2006). Meanwhile, parents with high income tend to buy more education learning materials for their children at home as these learning stimulations can improve cognitive performance of their children (Khanam & Nghiem, 2016).

Mother's nutritional status comprised of body height status, body weight status, and hemoglobin status might affect child's nutritional factors. Previous studies have been reported that mother's weight status and hemoglobin level were associated with child's nutritional status (Balarajan, Ramakrishnan, Ozaltin, Shankar, & Subramanian, 2011; Felisbino-Mendes, Villamor, & Velasquez-Melendez, 2014; Habte et al., 2013; Subramanian, Ackerson, Davey Smith, & John, 2009).



On the other hand, child's nutritional factors comprised child's birth weight, body weight status, dietary intake, and iron status. Previous studies have been reported that low birth weight children, stunting, underweight, lack of micro and macronutrient intake, and poor serum iron status were significantly associated with cognitive performance among children (Benton, 2010; Ewusie, Ahiadeke, Beyene, & Hamid, 2014; Santos et al., 2008; Skalicky et al., 2006; Zhang, Mckeown, Muldoon, & Tang, 2006).

Environmental factors consisted of parasitic infections, home environment, sanitation and hygiene. Parasitic infections tend to influence poor scores in cognitive ability test in children (Eppig, Fincher, & Thornhill, 2010). Infected children are vulnerable to illness and nutrient deficiencies that would make them absent in school and lose concentration in learning process (Perignon et al., 2014). Besides that, in other studies, lack of home environment and poor sanitation at home showed significant association with low cognitive performance among children (Biedinger, 2011; Santos et al., 2008; Smith, 2006). A poor home environment which means lack of mother to child interactions in the first 3 years of life at home among children could have impact on their cognitive performance (Februhartanty et al., 2007). Besides, poor sanitation and hygiene can expose the child to variety of infections and diseases which may in turn impair their cognitive performance (Brown, Cairncross, & Ensink, 2013). Children with good quality of home environment and good sanitation and hygiene practices were expected to have better cognitive performance (Brown et al., 2013; Santos et al., 2008).

On the other hand, there are other factors such as child's breastfeeding history, parent's cognitive assessment, iron status of mothers, Hb status of mothers during pregnancy, body weight status before pregnancy, and mother's nutrition knowledge might have associations with cognitive performance among children but were not been studied in this study. This is because Orang Asli has difficulty to recall the history of child's breastfeeding, weight status before pregnancy as well as Hb status during pregnancy due to poor memory. Also, due to lack of resources, iron status of mothers and parent's cognitive assessment could not be studied in this study. Future studies should include these factors to have a more comprehensive picture on the factors associated with cognitive performance among Orang Asli children.

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