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PREVALENCE OF ANEMIA AND ITS ASSOCIATED FACTORS AMONG FEMALE VEGETARIANS IN KUALA LUMPUR AND SELANGOR, MALAYSIA

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By

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

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Vegetarianism has been gaining increased popularity worldwide over time due to a variety of reasons such as health, religion, and environmental impacts. However, vegetarians face the risk of nutritional disorders, such as anemia due to low dietary iron bioavailability and high phytic acid in their meal. Female vegetarians are at higher risk of anemia because of blood loss during menstruation or pregnancy. There is no published study on anemia problem among female vegetarians in Malaysia. Therefore, this cross-sectional study aimed to determine factors associated with anemia among female vegetarians in Kuala Lumpur and Selangor, Malaysia.

Chinese and Indian vegetarians were recruited from a Buddhist and a Hindu organization, respectively. Height, weight, waist circumference (WC), and body fat percentage (BF%) of the respondents were measured by trained researchers. A 3-day 24-hour dietary recall was used to measure dietary intake of the respondents. Anemia status was assessed using blood hemoglobin (Hb) level, whereby 2ml venous blood samples were collected from the respondents by a qualified nurse. A self-administered questionnaire on sociodemographic background, lifestyle factors (smoking behavior, physical activity level, sleep quality), and psychological factors (depression, anxiety, stress) were completed by the respondents.

A total of 177 female vegetarians (61.0% Chinese, 39.0% Indian) with a mean age of 48.4 years (*SD*=12.3 years) participated in this study. About half of the respondents (49.1%) were lacto-ovo-vegetarians, 27.7% were lacto-vegetarians, 18.1% were vegans, and 5.1% were ovo-vegetarians. The mean years of practicing vegetarianism among the respondents was 13.9 ± 9.9 years. Religion was the main reason for them to practice vegetarian diets (72.9%). Other reasons were health benefits (51.4%), environmental friendly (46.9%), animal welfare (39.0%), and family influences (7.9%).

Results showed that the mean Hb of the respondents was 12.5 ± 1.1 g/dL, ranging from 8.7 to 15.4 g/dL. More than one in four of the respondents (28.2%) were anemic. About one third of the respondents were overweight (26.6%) and obese (5.6%), whereas 11.3% were underweight. Nearly half of the respondents (44.0%) were having abdominal obesity and 54.8% were having unhealthy body fat percentage (too high). More than half of the respondents did not meet the recommended nutrient intake (RNI) requirement for energy (59.3%), protein (56.5%), fat (56.6%), fiber (88.1%), vitamin B_{12} (99.4%), folate (90.4%), calcium (89.3%), and zinc (52.0%). None of the respondents were current smokers. More than half of the respondents (52.0%) had low physical activity level and 57.6% had poor sleep quality. In terms of psychological factors, 16.4% of the respondents were depressed, 37.3% were anxious, and 17.5% were stressed.

Chi-square analysis results showed that age (χ^2=11.793, p=0.008), marital status (χ^2=6.281, p=0.012), the percentage of energy derived from protein (χ^2=8.370, p=0.015), and vitamin C intake (χ^2=4.268, p=0.039) were significantly associated with anemia. Furthermore, logistic regression analysis results showed that respondents with age below 50 years (*AOR*=2.53, 95% *CI*=1.24–5.19), who were married (*AOR*=2.79, 95% *CI*=1.31–5.95), and who had inadequate intake of percentage of energy derived from protein (*AOR*=5.32, 95% *CI*=1.35–20.93) were found to be significantly associated with increased risk of anemia among female vegetarians in this study, in which they explained 16.4% of the variation in anemia status.

In conclusion, the present study suggested that anemia is a public health problem among female vegetarians. Age, marital status, and percentage of energy derived from protein were significant factors associated with anemia. Future interventions may consider the strategies of increasing energy intake derived from protein among female vegetarians, especially in those who are married and aged below 50 years in order to increase the effectiveness of anemia prevention programs. More research need to be conducted to confirm these findings.

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

PREVALENS ANEMIA DAN FAKTOR YANG BERKAITAN DENGANNYA DALAM KALANGAN VEGETARIAN WANITA DI KUALA LUMPUR DAN SELANGOR, MALAYSIA

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Vegetarianisme semakin mendapat popularity di seluruh dunia dari masa ke masa disebabkan oleh pelbagai sebab seperti kesihatan, agama, and impak persekitaran. Walau bagaimanapun, vegetarian menghadapi risiko gangguan pemakanan seperti anemia akibat bioavailabiliti zat besi yang rendah dan kandungan asid fitik yang tinggi dalam makanan mereka. Vegetarian wanita menghidapi risiko anemia yang lebih tinggi disebabkan oleh kehilangan darah semasa haid atau kehamilan. Tiada kajian mengenai masalah anemia dalam kalangan vegetarian wanita di Malaysia. Justeru itu, kajian keratan rentas ini bertujuan untuk menentukan faktor yang berkaitan dengan anemia dalam kalangan vegetarian wanita di Kuala Lumpur and Selangor, Malaysia.

Vegetarian Cina dan India dari sebuah organisasi Buddha dan Hindu mengambil bahagian dalam kajian ini. Ketinggian, berat badan, lilitan pinggang, dan peratusan lemak badan responden diukur oleh penyelidik. Kaedah 3-hari ingatan diet 24-jam digunakan untuk mencatat pengambilan makanan responden. Status anemia dinilai dengan menggunakan paras hemoglobin (Hb), di mana 2ml sampel darah dikumpulkan dari responden oleh seorang jururawat berkelayakan. Soal selidik mengenai latar belakang sosiodemografi, faktor gaya hidup (tingkah laku merokok, tahap aktiviti fizikal, kualiti tidur), and faktor psikologi (kemurungan, kebimbangan, tekanan) dilengkapkan oleh responden.

Seramai 177 vegetarian wanita (61.0% Cina, 39.0% India) dengan min umur 48.4 tahun (*SD*=12.3 tahun) mengambil bahagian dalam kajian ini. Lebih kurang separuh daripada responden (49.1%) merupakan lakto-ovo-vegetarian, 27.7% adalah lakto-vegetarian, 18.1% adalah vegan, dan 5.1% adalah ovo-vegetarian. Min tahun mengamalkan vegetarianisme dalam kalangan responden adalah sebanyak 13.9 ± 9.9 tahun. Agama merupakan sebab utama mereka mengamalkan diet vegetarian (72.9%). Sebab lain

adalah manfaat kesihatan (51.4%), mesra persekitaran (46.9%), kebajikan haiwan (39.0%), dan pengaruh keluarga (7.9%).

Hasil kajian ini menunjukkan bahawa purata Hb responden ialah 12.5 ± 1.1 g/dL, dari 8.7 hingga 15.4 g/dL. Lebih daripada satu perempat responden (28.2%) mengalami masalah anemia. Kira-kira satu pertiga responden mempunyai berat badan yang berlebihan (26.6%) dan obes (5.6%), manakala 11.3% adalah kekurangan berat badan. Hampir separuh responden (44.0%) mengalami masalah obesiti abdomen dan 54.8% mempunyai peratusan lemak badan yang tinggi dan tidak sihat. Lebih daripada separuh responden tidak memenuhi Saranan Pengambilan Nutrien (RNI) untuk tenaga (59.3%), protein (56.5%), lemak (56.6%), fiber (88.1%), vitamin B_{12} (99.4%), folik (90.4%), kalsium (89.3%), dan zink (52.0%). Tiada responden ialah perokok semasa. Lebih daripada separuh responden (52.0%) mempunyai tahap aktiviti fizikal yang rendah manakala 57.6% mempunyai kualiti tidur yang kurang baik. Dari segi faktor psikologi, 16.4% responden mengalami kemurungan, 37.4% mengalami kebimbangan, dan 17.5% mengalami tekanan.

Hasil analisis khi-kuasa dua menunjukkan bahawa umur (χ^2=11.793, p=0.008), status perkahwinan (χ^2=6.281, p=0.012), peratusan tenaga yang diperolehi dari protein (χ^2=8.370, p=0.015), dan pengambilan vitamin C (χ^2=4.268, p=0.039) adalah berkaitan dengan anemia. Tambahan pula, analisis regrasi logistik menunjukkan bahawa responden yang berumur 50 tahun ke bawah (*AOR*=2.53, 95% *CI*=1.24–5.19), yang telah berkahwin (*AOR*=2.79, 95% *CI*=1.31–5.95), dan yang memiliki kekurangan peratusan pengambilan tenaga yang diperolehi dari protein (*AOR*=5.32, 95% *CI*=1.35–20.93) didapati berkait rapat dengan peningkatan risiko anemia dalam kalangan vegetarian wanita dalam kajian ini, di mana mereka menjelaskan 16.4% daripada variasi dalam status anemia.

Kesimpulannya, kajian ini menunjukkan bahawa anemia merupakan masalah kesihatan awam dalam kalangan vegetarian wanita. Umur, status perkahwinan, dan peratusan tenaga dari protein merupakan faktor signifikan yang berkaitan dengan anemia. Intervensi pada masa depan mungkin boleh mempertimbangkan strategi penambahan peratusan tenaga yang diperolehi dari protein dalam pencegahan anemia dalam kalangan vegetarian wanita, terutamanya dalam kalangan yang berkahwin dan berumur 50 tahun ke bawah supaya dapat meningkatkan keberkesanan program pencegahan anemia. Lebih banyak penyelidikan perlu dijalankan untuk mengesahkan hasil kajian ini.

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

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LIST OF ABBREVIATIONS

ACP	Acute phase protein
AHS	Adventist Health Study
ALSPAC	Avon Longitudinal Study of Parents and Children
AOR	Adjusted odds ratio
BMR	Basal metabolic rate
BCNS	British Columbia Nutrition Survey
BF%	Body fat percentage
BMI	Body mass index
BRINDA	Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia
CDC	Centers for Disease Control and Prevention
CES-D	Center for Epidemiological Studies Depression Scale
CIDI	Composite International Diagnostic Instrument
CRP	C-reactive protein
CV	Coefficient of variation
CVD	Cardiovascular disease
DASS	Depression Anxiety Stress Scale
DMT1	Divalent metal-iron transporter 1
EDHS	Ethiopia Demographic Health Survey
EPA	Eicosapentaenoic acid
EPIC	European Prospective Investigation into Cancer and Nutrition
EPO	Erythropoietin
ESRD	End-stage renal disease
FFQ	Food frequency questionnaire
GATS	Global Adult Tobacco Surveys

GBD	Global Burden of Diseases, Injuries and Risk Factors
GHS-MHS	German Health interview and Examination Survey and its Mental Health Supplement
GPAQ	Global Physical Activity Questionnaire
G6PD	Glucose 6-phosphate dehydrogenase
Hb	Hemoglobin
HIF-2α	Hypoxia-inducible factor-2 alpha
HQ	Headquarter
HRS	Health and Retirement Study
ID	Iron deficiency
IDA	Iron deficiency anemia
IHD	Ischemic heart disease
IL-6	Interleukin-6
InCHIANTI	Invecchiare in Chianti
INCRA	Italian National Research Council of Aging
IPC	Investigations Préventives et Cliniques'
IPH	Institute for Public Health
JKEUPM	*Jawatankuasa Etika Universiti Penyelidikan Melibatkan Manusia*
KL	Kuala Lumpur
MA/WIC	Massachusetts Special Supplemental Nutrition Program for Women, Infants, and Children
METs	Metabolic Equivalents
MOH	Ministry of Health
NESDA	Netherlands Study of Depression and Anxiety
NFHM	National Family Health Survey
NGO	Non-governmental organization

NHMS	National Health and Morbidity Survey
NLCS	Netherlands Cohort Study
NSHAP	National Social Life, Health, and Aging Project
PAL	Physical activity level
PSQI	Pittsburgh Sleep Quality Index
QD2A	Questionnaire of Depression 2nd version, Abridged
RNI	Recommended Nutrient Intake
RS	Rio Grande do Sul
SES	Socioeconomic status
SD	Standard deviation
T2DM	Type-2 diabetes mellitus
UK	United Kingdom
US	United States
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

With the constantly and rapidly evolving environment, some recent studies have recognized the impact of a multi-nutrient dietary approach on lipid profiles, blood pressure, metabolic parameters, and cardiovascular diseases and impose attention on certain models of diet, for example the vegetarian diet (Sofi, Dinu, Pagliai, Cesari, Marcucci, & Casini, 2016). Vegetarianism is no more restricted to strictly religious as people become more health conscious. Ethical, environmental, and health reasons motivate many believers and hence increase the popularity in vegetarianism (Hoffman, Stallings, Bessinger, & Brooks, 2013). There are increasing numbers of individuals in the world adopting vegetarian diets, especially females (Key, Appleby, & Rosell, 2006).

Vegetarians are defined as people who do not eat any meat and meat products, poultry and seafood (Key et al., 2006). Generally, vegetarians can be sub-classified into several groups, including lacto-vegetarians, ovo-vegetarians, lacto-ovo-vegetarians, and vegans (Agnoli et al., 2017). Lacto-vegetarians consume dairy products but exclude eggs. Ovo-vegetarians consume eggs but no dairy products in their diet. Lacto-ovo-vegetarians consume dairy products and eggs but no fish, poultry or meat. Vegans do not eat any animal products including dairy products and/or eggs, and may exclude honey (Melina, Craig, & Levin, 2016).

Worldwide, there is limited statistic showing the exact number of vegetarian population. It is estimated that 5.0% of the United States (US) population are vegetarians (Le & Sabaté, 2014). India is considered as the world's largest vegetarian population (Edelstein, 2013), in which the proportion of vegetarians in India is at almost 30% (Agrawal, Millett, Dhillon, Subramanian, & Ebrahim, 2014). In Malaysia, there is no published national data on the proprotion of vegetarians (Gan, Boo, Seik, & Khoo, 2018). With the urgent demands for reducing average worldwide usage of animal products, long-term health outcomes of vegetarianism becomes a matter of considerable interest (Appleby, Crowe, Bradbury, Travis, & Key, 2016).

Regardless of the types of vegetarianism, vegetarian diets provide large amounts of whole-grain cereals, fruits, nuts, and vegetables. Numerous studies have been carried out to examine the benefits of vegetarian diet towards health (Barnard, Levin, & Yokoyama, 2015; Kwok, Umar, Myint, Mamas, & Loke, 2014; Pawlak, 2015; Yeh & Glick-Bauer, 2016). For example, a systematic review with meta-analysis of observational studies showed that a vegetarian dietary pattern helped in reducing the risk of ischemic heart disease (IHD) and cancers (Dinu et al., 2017).

Poor bioavailability of iron from plant sources will increase the risk of iron deficiency and eventually anemia, which is a disorder generally defined by a lack of hemoglobin (Hb) in the blood, as iron is very important in the production of Hb (Rodak, Fritsma, & Doig, 2007). Anemia is affecting almost 30.0% population worldwide and putting it as the most common global nutritional deficiency disorder (McLean, Cogswell, Egli, Wojydyla, & de Benoist, 2009). Serum Hb is the most sensitive and widely used indicator for anemia (Cavalcanti, Vasconcelos, Muniz, Santos, & Osório, 2014). It is defined using the World Health Organization (WHO) definition of Hb concentration of <13g/dL in men and <12g/dL in women (WHO, 2011). The consequences of anemia are major and significant as it jeopardizes human well-being and socioeconomic development. Even borderline mild anemia is associated with impaired health and decreased work productivity (Haas & Brownlie, 2001).

Cumulated evidence suggests that poorly planned vegetarian diets may possibly predispose vegetarians to develop anemia (Lilare & Sahoo, 2017; Toheed et al., 2015; Hermanto & Rahayuningsih, 2012; Lee & Krawinkel, 2011). In developed countries such as US, anemia is still posing as a major health issue and yet growing due to the nearly doubled increased prevalence of anemia (4.0% to 7.1%) and moderate-severe anemia (1.0% to 1.9%) from 2003–2004 to 2011–2012 (Le, 2016). In China, the overall prevalence of anemia is 13.4%, with more than 180 million China citizens are anemic, which is deemed to be a large-scale health problem (Li, Luo, Sylvia, Medina, & Rozelle, 2015). In India, the 2005–2006 National Family Health Survey (NFHS-3) reported 70.0% anemia prevalence in children (6–59 months) and 55.0% in females (15–49 years) (Bhat et al., 2007). In Malaysia, the recent National Health and Morbidity Survey (NHMS) 2015 indicated that the prevalence of anemia among Malaysians was 24.6% (Institute for Public Health; IPH, 2015). Hence, anemia is still deemed as a national issue of moderate public health significance (WHO, 2011) that warrants more researches.

Vegetarian studies on anemia were only available in other countries and these studies were mainly conducted among females. The prevalence of anemia among female vegetarians was 64.4% in Mumbai, India (Lilare & Sahoo, 2017), 22.2% in Korea (Lee & Krawinkel, 2011), 20.9% in Semarang and Bandung, Indonesia (Hermanto & Rahayuningsih, 2012), and 20.8% in Lahore, Pakistan (Toheed, Ayun, Ali, Mumtaz, & Haneef, 2015). These findings indicate that not only general population such as children and women but vegetarians are also at risk of anemia. Therefore, research determining the factors associated with anemia among female vegetarians is important to be conducted.

1.2 Problem Statement

In Malaysia, Buddhists and Hindus are the two major groups practicing vegetarianism (Gan et al., 2018). Religion has been listed as the major reason behind vegetarianism in previous studies (Akthet et al., 2016; Hod et al., 2016; Wong et al., 2013). Therefore, Buddhist and Hindu vegetarians were recruited in the current study. Besides religion reason, it is believed that there is a trend of vegetarianism in Malaysia in view of the

expansion of vegetarian food market (Wong et al., 2013) and mock-meat products (Joshi & Kumar, 2015), despite a lack of available data or statistics supporting it.

Vegetarian diet is beneficial in improving health status. However, there are some concerns regarding nutrient adequacy of a vegetarian diet. The nutrients of concern in the diet of vegetarians include vitamin B_{12}, vitamin D, calcium, zinc, iron, and long chain n-3 fatty acids (Tonstad et al., 2013). Specifically, anemia status of vegetarians is of interest in this study as vegetarians would not be able to have any intake of heme iron for those who do not consume meats, poultry or fish. Non-heme iron from plant-based diet has been known for poor absorption in human body (Hailu & Addis, 2016). The bioavailability of dietary iron can be reduced considerably by the phytic acid and possibly other constituents of some plant foods (Posen, 2013). Therefore, the risk of iron deficiency exists among vegetarians. Iron deficiency has been accounted for the most common reason of anemia (>50%) (McLean, Cogswell, Egli, Wojydyla, & de Benoist, 2009).

No published study has been conducted to determine the level of serum Hb level, which is commonly assessed to diagnose anemia among vegetarians in Malaysia. Most of the local studies on anemia were conducted on children (Al-Mekhlafi et al., 2008; Hamid Jan, Mitra, Rohani, & Norimah, 2010; Ngui, Lim, Kin, Chuen, & Jaffar, 2012) and pregnant women (Haniff et al., 2007; Nik Rosmawati, Mohd Nazri, & Mohd Ismail, 2012; Milman, 2015; Soh et al., 2015). The recent NHMS 2015 found that the prevalence of anemia in Malaysia was 24.6%, in which the prevalence of anemia was significantly higher among females (35.5%) than males (14.3%) (IPH, 2015). Women were 2.84 times more likely to be anemic compared to men in Malaysia (IPH, 2015). A systematic review of global anemia burden from 1990 to 2010 also showed that females had the highest prevalence of anemia (Kassebaum et al., 2014). However, the prevalence of anemia among female vegetarians in the local context is not known.

Several studies found that vegetarian population consists of higher number of females compared to males (Bedford & Barr, 2005; Larsson, Klock, Nordrehaug Åstrøm, Haugejorden, & Johansson, 2002; Mihrshahi et al., 2017; Perry, Mcguire, Neumark-Sztainer, & Story, 2001). This phenomenon could be possibly due to higher level of health-consicousness and adherence to less risky behaviours and social life among females (Olson, Hummer, & Harris, 2017; Simon, 2010). Females appear to be the major risk group for anemia instead of males mainly due to their physiological menstrual loss and increased iron demand during pregnancy, which both do not occur in males (Camaschella, 2015). Adolescent females have to face regular subsequent iron losses after their first menstruations; iron demand for pregnant women is even higher to support the need of the growing baby (Milman, 2011). Besides, hormone testosterone in males is claimed to be responsible for increased Hb values as stimulating erythropoietin (EPO) boosts red blood cell counts in adult men (Bachman et al., 2013). These could explain why females are tend to be more susceptible to anemia than males.

A few studies demonstrated a high prevalence of anemia among female vegetarians (Kumar, 2015; Mahajani & Bhatnagar, 2015; Rammohan, Awoteso, & Robitaille, 2011). For instance, the prevalence of anemia among vegetarians was 55.0% among

women of reproductive age in Distt Mandi Himachal Pradesh, India (Kumar, 2015). In Udaipur City, Rajasthan, India, 40.0% of the vegetarian women were anemic (Mahajani & Bhatnagar, 2015). Furthermore, by comparing Hb level between vegetarians and non-vegetarians, it was found that Hb level was statistically higher in non-vegetarians (Mahajani & Bhatnagar, 2015; Sharma, Kaur, Kaur, Kaur, & Kaur, 2009). Nonetheless, there are contradicting studies showing that there was no significant difference in Hb level between vegetarians and non-vegetarians (Harvey et al., 2005; Obeid, Geisel, Schorr, Hübner, & Herrmann, 2002).

In general, anemia status has been largely explored in general Malaysian population and well-established as a significant public health concern (IPH, 2015). While anemia problem among female vegetarians has been addressed for a long time, the prevalence of anemia among vegetarians in the local context is still not known. Vegetarian findings from other countries are difficult to be applied in Malaysia because the types of common plant food consumed could be vastly different between countries. Therefore, more research is warranted to determine the prevalence of anemia in Malaysian female vegetarians and its associated factors.

Anemia is associated with multiple risk factors, including sociodemographic factors and lifestyle factors (Goetz & Valeggia, 2017; Murat et al., 2015; Seth & Khan 2015; Zaytoun & Khan, 2016; Zeng et al., 2016). However, most studies on factors associated with anemia refer to general populations (Camaschella, 2015; Corona, Duarte, & Lebrao, 2014; Vulser et al., 2016) but not specifically on vegetarians. Furthermore, studies on anemia in vegetarians are mainly focused on a single factor with anemia, such as sociodemographic factor (Allès et al., 2017; Rammohan et al., 2012). Therefore, by investigating multiple factors associated with Hb level of vegetarians will help to expand the body of evidence linked to vegetarians.

In summary, there is limited local study on female vegetarians and the published local vegetarian studies focused mostly on nutrient intake and body composition (Gan et al., 2018; Wong et al., 2013). To the best of our knowledge, there is no local published study determining factors associated with anemia among female vegetarians. Owing to the fact that anemia and vegetarianism prevalence rates are both seemingly high in females, more attention should be paid in connecting anemia to vegerianism in females. Hence, this study was conducted to determine the factors associated with anemia among female vegetarians in Kuala Lumpur and Selangor. This study addressed the following research questions:

a) What is the prevalence of anemia among female vegetarians?
b) Are there any associations between sociodemographic, nutritional, lifestyle, and psychological factors with anemia among female vegetarians?

1.3 Significance of the Study

Despite the popularity of vegetarianism worldwide, the significant health outcomes of female vegetarian group remain largely unexplored, especially anemia status. To the best of our knowledge, this is the first study determining anemia status among female

vegetarians in Malaysia. More information is needed to understand the situation of anemia in order to reduce its risk among vegetarians. Hence, it is important to explore the prevalence of anemia in this group of population.

Research on factors associated with anemia among female vegetarians is not known in Malaysia. By combining sociodemographic, nutritional, lifestyle, and psychological factors, the present study will further enhance the understanding of these factors with anemia status among female vegetarians. In addition, the findings of this study could serve as baseline data for future studies. The findings are also vital for policy makers, researchers, nutritionists, and health promotion planners to plan appropriate and effective health promotion programs in the management and prevention of anemia among female vegetarians in order to improve their nutritional and health status. Furthermore, understanding anemia status in vegetarians could help nutritionists to develop appropriate dietary guidelines for vegetarians.

1.4 Objectives

1.4.1 General objective

To detemine the factors associated with anemia among female vegetarians in Kuala Lumpur and Selangor.

1.4.2 Specific objectives

a) To examine the sociodemographic factors (age, ethnicity, marital status, education level, household members, and monthly household income), nutritional factors (nutrient intake, body mass index, waist circumference, and body fat percentage), lifestyle factors (smoking behaviour, physical activity level, and sleep quality), and psychological factors (depression, anxiety, and stress) among female vegetarians.
b) To determine the prevalence of anemia among female vegetarians.
c) To determine associations between sociodemographic factors, nutritional factors, lifestyle factors, and psychological factors with anemia among female vegetarians.

1.5 Null Hypothesis

There were no significant associations between sociodemographic factors, nutritional factors, lifestyle factors, and psychological factors with anemia among female vegetarians.

1.6 Conceptual Framework

The conceptual framework of this study is shown in Figure 1.1. The dependent variable in this study was anemia, in which it was measured using Hb level of the respondents. The independent variables in this study were sociodemographic factors, nutritional factors, lifestyle factors, and psychological factors.

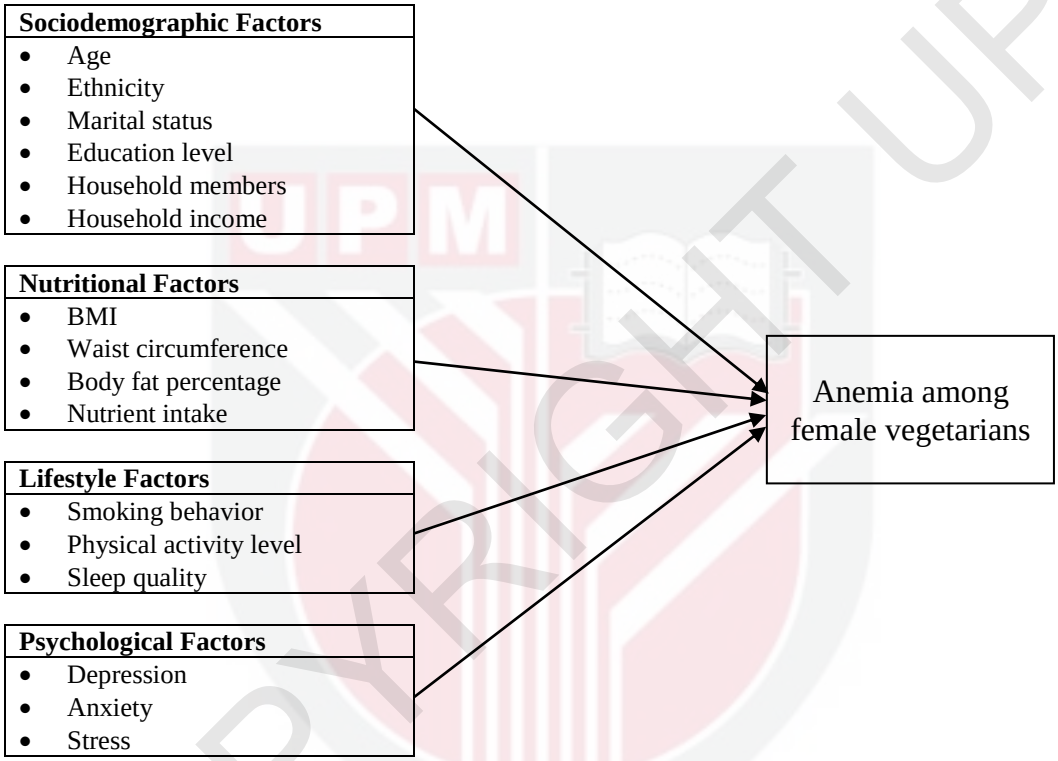

Figure 1.1: Conceptual framework of this study

Vegetarianism is more common among females possibly due to their different opinions on animal welfare and health matters (Larsson et al., 2002). A few studies observed a significant relationship between age and anemia (Alvarex-Uria et al.,2014; Zaytoun & Khan, 2016). Indian was found to have a higher prevalence of anemia as compared to other ethnic groups (IPH, 2015; Loh & Khor, 2010). On the other hand, those with lower educational level were found to have higher levels of anemia (Chaparro & Lutter, 2008).

Vegetarians tend to consume significantly lesser calcium, iron, and Vitamin B_{12} (Farmer, Larson, Fulgoni, Rainville, & Liepa, 2011; McEvoy, Temple, & Woodside, 2012; Rizzo, Jaceldo-Sielg, Sabate, & Fraser, 2013). Energy intake of vegetarian diets

showed a significantly lower amount comparing to other patterns of diet (Clarys et al., 2014). Hb level was significantly associated with body weight statusin adults (Bhattacherjee et al., 2010). Anemia was inversely associated with overweight, obesity, and abdominal obesity among Chinese women from Jiangsu Province, China (Qin et al., 2013). Similarly, Hb concentration was negatively associated with BMI in Iran (Saxena, Shrivastava, & Saxena, 2011). This is however in contrast with studies elsewhere. No significant association between anemia and BMI status was found in Nigerian adults from Ebonyi State (Ugwuja, Ogbonnaya, Obuna, Awelegbe, & Uro-Chukwu, 2015) and females in Saudi Arabia (Hanafi, Adballah, & Zaky, 2013).

In terms of lifestyle factors, some studies revealed a significant relationship between physical activity and anemia, in which lower physical activity level induced anemia (Calbet et al., 2006; Choudhary et al., 2012). Smoker studies were also unable to provide unanimous results because some findings have shown that smokers had low Hb concentration (Leifert, 2008; Zeng et al., 2016) and Shah et al. (2013) found that non-smokers performed better in Hb profile. In the context of sleep quality, Murat et al. (2015) reported that non-anemic persons slept better.

In term of psychological factors, Noorazar et al. (2015) inferred that there was a significant association between depression and anemia. Onder et al. (2005) also supported that anemic individuals had more depressive symptoms. Milligen et al. (2014) had yielded contradictory results, suggesting that association between depression and anemia status did not exist. Studies on the associations between anxiety and stress with anemia are limited.

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LIST OF PUBLICATIONS

Chai Z. F., Gan W. Y., Chin, Y. S., Ching Y. K., & Appukutty, M. (2019). Factors associated with anemia among female adult vegetarians in Malaysia. *Nutrition Research and Practice*, *13*(1), 23–31. http://doi.org/10.4162/nrp.2019.13.1.23

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