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Nutrient Intake of Pregnant Women in Indonesia: A Review

Yayuk Hartriyanti*, Perdana ST Suyoto, Harry FL Muhammad & Ika R Palupi

School of Nutrition and Health, Medical Faculty, Gadjah Mada University, Yogyakarta, Indonesia

ABSTRACT

Introduction: Pregnant women are encouraged to comply with dietary recommendations to meet their own nutritional needs as well as their child. Deficiency of certain nutrients may lead to morbidity of both the mother and child. In this review, information on nutrients intake of pregnant women from studies conducted in Indonesia will be analysed. **Methods:** A literature search of all possible sources of information was conducted. These included (i) electronic databases of PubMed, Elsevier, Science Direct, EBSCO, and Google Scholar; (ii) archives and records of the Ministry of Health; (iii) library collection in institutions such as health polytechnics, local health offices, non-government organisations and universities in Yogyakarta, Central Java, East Java Province; and (iv) articles on pregnant women's nutrient intake conducted in Indonesia in 2000 – 2010. The results were analysed descriptively by comparing them with the Estimated Average Requirements (EAR) value. **Results:** Two of four studies showed mean energy intake below EAR. Protein intake was lower than EAR only in two studies, while four are in contrary to the EAR. No study showed low fat and carbohydrate intake. A large number of studies reported low average intake of calcium and iron. **Conclusion:** The reviewed studies suggest that intake of several nutrients by pregnant women in Indonesia is below the EAR.

Keywords: Indonesia, pregnant women, nutrient intake

INTRODUCTION

Maternal mortality and perinatal mortality rates in developing countries are higher than in developed countries. Ninety-nine percent of the estimated 529,000 maternal deaths each year occur in developing countries. Ninety-eight percent of the estimated 5.7 million perinatal deaths also occur in developing countries. In some developing counties, a woman could have a 140 times higher risk of dying from a pregnancy related cause compared with a woman in a developed country (WHO, 2006). In Indonesia, the maternal mortality rate was 228 per 100,000 live births in 2008. Looking at the Millennium Development Goals (MDGs) of reducing the maternal mortality to 100 per 100,000 live births in 2015, it is apparent that we are still not in the right tract (Ministry of Health, 2010).

Maternal nutritional status is important for the health and quality of life of a woman and her child. Various recommendations about pregnancy weight gain have been made as both maternal pre-pregnancy nutritional status and pregnancy weight gain affect the survival and health of the newborn. In Indonesia, the study by Winkvist *et al.* (2002) in Purworejo district,

* Correspondence author: Yayuk Hartriyanti; Email: *uke_yh@yahoo.com*

Central Java province showed that a large proportion of women are undernourished in the first trimester of the pregnancy. They also reported that 79% of the women do not gain sufficient weight during pregnancy. According to their study, socio-economic and education related factors are associated with weight gain.

Pregnant women in developing countries experience several health problems, including chronic energy malnutrition, iodine deficiency, and anemia which have been given special attention. The worldwide prevalence of anemia, according to WHO, is 41.8% (McLean *et al*., 2009), while the prevalence of anemia in Indonesia is 40% (Ministry of Health, 2006). Anemia in pregnant women is related to several negative pregnancy outcomes such as Small for Gestational Age (SDA) babies (Kozuki, Lee & Katz, 2011) and prematurity (Banhidy *et al*., 2011). In the long term, anemia leads to several risks. In developing countries, chronic anemia in pregnancy may increase morbidity and mortality rates in malaria and tuberculosis. Mother and child HIV transmission risk is also increased in anemic pregnant women. Children born from mothers suffering anemia in pregnancy were found to have impaired cognitive ability and poor growth and development (Gangopadhyay, Karoshi & Keith, 2011).

Many low-income countries have set goals on ensuring optimal nutritional status and health of the pregnant woman, both to ensure the health of the mother and the newborn. One factor of great importance in achieving this is adequate dietary intake during pregnancy (Persson *et al.*, 2002). A study conducted in Purworejo district showed that the food intake of pregnant women was inadequate. The high carbohydrate intake is characteristic of Indonesian people in general because rice is a staple food and it is not supplemented by adequate consumption of protein and fat. Hartini *et al.* (2003) has documented that Indonesian pregnant women are vulnerable to vitamin and mineral deficiency because of inadequate food consumption.

The studies described above constitute part of a bigger picture on food consumption during pregnancy. However, there has been an absence of a review to bring together all the studies which have been carried out and provide a more complete picture of the evidence on food consumption during pregnancy, in Indonesia. This study aims to review studies on food consumption among pregnant women conducted by institutions and researchers in Indonesia.

METHODS

We first searched literature through electronic databases (PubMed, Elsevier, Science Direct, EBSCO, and Google Scholar). The keywords used are listed in Table 1. We limited the search to articles published within the last ten years (2000-2010). Only papers published in Bahasa Indonesia or English were included. This was followed by a search on the archives of the Ministry of Health (Directorate of Nutrition and National Institute of Health Research and Development). We included all relevant reports compiled between 2000 – 2010.

To complement the searches done through electronic databases and national archives listed above, we visited institutions to identify research publications including thesis, dissertations, reports, or articles in local journals. Our target institutions were universities, health polytechnics, local health offices, non-government organisations particularly in seven districts in Central Java, Yogyakarta and East Java province (Yogyakarta, Semarang, Surabaya, Jember, Malang, Surakarta, Purwokerto). These locations were selected because they had institutions which are active in the field of nutrition and maternal and child health. Moreover, as these institutions were in the vicinity of the researchers' home institutions (Gadjah Mada University), they were more accessible, given the limited resources of the

Table 1. Keywords used in literature search

Pregnancy	*Intake*	*Macronutrients*	*Micronutrients*
Pregnant	Intake	Macronutrient	Micronutrient
Pregnancy	Ingestion	Energy	Vitamin
Gestation		Calorie	Mineral
Gravid		Protein	Beta carotene
		Fat	Folate
		Carbohydrate	Folic acid
			Riboflavin
			Pantotenic acid
			Piridoxin
			Piridoxal
			Cyanocobalamine
			Iron
			Calcium
			Zinc

study. The institutional visits were carried out between March – May, 2010.

We established several inclusion criteria in the literature search: the study must be conducted in Indonesia with the study population being pregnant women of all gestational ages. The minimum sample size had to be 80. Although survey studies were preferred, experimental and observational studies were also included with several conditions. Essentially, our intention was to include dietary assessment results from study participants who reflected normal or a healthy condition. Therefore, we only included the control group (in experimental / case-control group) and non-exposed group (in cohort studies) based on the assumption that the control group reflected the normal or healthy population. Exceptions were made, however, if the dietary assessment was conducted prior to treatment (particularly in experimental studies).

Estimation of Estimated Average Requirements (EAR) value

Our intention was to compare the results from dietary assessment in several studies included in this review with the estimated average requirements (EAR) value. According to Gibson (2005), the EAR is more appropriate for evaluating adequacy in a population compared to the recommended dietary allowance (RDA) which yields over-estimation of the calculation. In Indonesia, RDA is known as *Angka Kecukupan Gizi* (AKG), which is issued by Widyakarya Nasional Pangan dan Gizi (2004). The EAR value is not available in Indonesia, but it can be estimated from dietary recommendation (in this case, AKG) in several ways. The US Institute of Medicine published the conversion factor for calculating estimated average requirements from dietary recommendations (Food and Nutrition Board, 2003). The conversion factor in this publication is only available for micronutrients. We used it only to evaluate the average intake of vitamin A, vitamin C, calcium, iron, and zinc. We used EAR value from the US Institute of Medicine for carbohydrates. Since the EAR of fat, protein, and energy is not available in that source, we derived EAR from 77% of AKG, as explained by Gibson (2005).

The data were analysed using descriptive statistics. The average intake of

Table 2. Summary of studies included in the analysis

First author, year	*Study characteristics*	*Subjects criteria*	*Source*	*Dietary assessment methods*	*Validity of dietary assessment*	*Explanation*
Prianto, 2005	Cohort Prospective, simple random sampling, Sample Size: 140 Location : Gunung Kidul Regency, Daerah Istimewa Yogyakarta Province [Rural]	Pregnant women with gestational age 13-25 weeks. Excluded subjects with chronic diseases or preeclampsia.	Thesis: Medical Faculty, Gadjah MadaUniversity, Indonesia	7 non-consecutive days, multiple 24-hour food recall	Replicate at least two non-consecutive days or at least three consecutive days 24 h food recall: **Yes**	
Wijanti, 2004	Randomised Controlled Trial, Sample size: 91 Location: Kediri City, East Java Province [Urban]	Pregnant women attending antenatal care in 33 Primary Health Care Centers in Kediri City with gestational age of 13-24 weeks. Excluded: obesity, multiple pregnancy, and chronic diseases.	Thesis: Medical Faculty, Gadjah Mada University, Indonesia	Single 24 hours food recall	Replicate at least two non-consecutive days or at least three consecutive days 24 -h food recall: **No**	Treatment: Control: daily calcium 500 mg treatment: daily calcium 2000 mg. Only baseline data is included
Widagdo, 2004	Cross-sectional, purposive sampling, Sample size: 337 Location: Srumbung and Salam District, Magelang Regency, Central Java Province [Rural]	Pregnant women residing in endemic area of iodine deficiency disorders (IDD) of more than 2 years.Did not suffer from chronic diseases	Journal: *Nutrisia*. 2004. 5(2): 65-70	Semi-quantitative Food Frequency Questionnaire	-	

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First author, year	*Study characteristics*	*Subjects criteria*	*Source*	*Dietary assessment methods*	*Validity of dietary assessment*	*Explanation*
Joko Susilo & Hamam Hadi, 2002	Cross-sectional, purposive sampling, Sample size: 244, Location: Bantul Regency, Daerah Istimewa Yogyakarta Province (Rural)	Pregnant women with gestational age of 20-28 weeks	Journal: *Berita Kedokteran Masyarakat*. 2002. 18(1): 1-10	Semi-quantitative Food Frequency Questionnaire	-	
Hartini *et al*.	Surveillance, Purposive sampling, Sample size: 450 (only 235 included in analysis) Location: Purworejo District, Central Java Province (Rural)	Pregnant women under marital status only (exclusion due to cultural reason)	Journal: *European Journal of Clinical Nutrition* (2003) 57, 654–666	6 non- consecutive days, multiple 24-h food recall	Replicate at least two non-consecutive days or at least three consecutive days, 24-h food recall: **Yes**	The study was a part of experimental study with vitamin A and zinc 2003 supplementation, therefore, vitamin A analysis is not included
Ngardita, 2004	Cross-sectional, purposive sampling, Sample size: 95 Location: Jayapura city, Papua (Urban)	Pregnant women suffering from malaria	Thesis: Medical Faculty, Gadjah Mada University, Indonesia	5 non- consecutive days, multiple 24-h food recall	Replicate at least two non-consecutive days or at least three consecutive days 24-h food recall: **Yes**	One 24-hour food recall carried out before malaria treatment, the rest carried out at the 4th day after treatment
Zakiyah & Kusmiyati, 2007	Cross-sectional, concecutive sampling, Sample size: 96 Location: Garut District, West java (Rural)	Pregnant women Excluded: infection and bleeding	Thesis: Medical Faculty, Diponegoro University, Indonesia	Semi-quantitative Food Frequency Questionnaire	-	

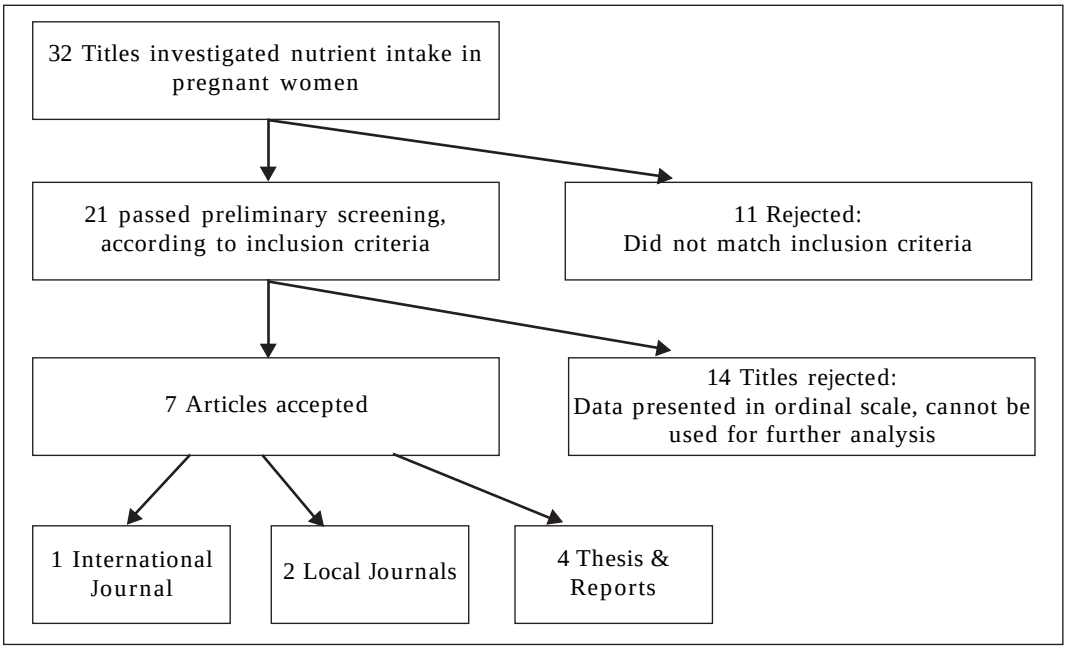

Figure 1. The literature flow

nutrients is presented and compared to the EAR.

RESULTS

We identified 32 potential papers investigating nutrients intake in pregnant women in Indonesia. During the selection process, 11 articles were excluded for not meeting defined inclusion criteria. Of the 21 articles, 14 presented the data in categorical variables. Only 7 articles presented the nutrients intake data in average values which were therefore available for analysis (Figure 1).

Energy and macronutrients intake

The average intake of energy and micronutrients of pregnant women are presented in Table 3. Two out of four studies showed that the average energy intakes are below EAR at 99% and 94% respectively (Prianto, 2005; Wijanti, 2004). Only two studies showed an average protein intake that was above EAR (Widagdo, 2004; Susilo & Hadi, 2002), while the other four showed values below the EAR (Prianto, 2005; Wijanti, 2004; Hartini *et al.*, 2003; Ngardita, 2004). For fat and carbohydrate, no average intake values below EAR were observed (Wijanti, 2004; Hartini *et al*., 2003).

Micronutrient intake

Based on all three studies analysed, the mean intakes of calcium by pregnant women were 68%, 78%, and 45% repectively below EAR (Susilo & Hadi, 2002; Wijanti, 2004; Hartini *et al*., 2003). Other than the study by Zakiyah & Kusmiyati (2007), four studies showed low mean iron intake of 44%, 65%, 65% and 64% below EAR (Widagdo, 2004; Susilo & Hadi, 2002; Hartini *et al*., 2003; Ngardita, 2004). Average intake of vitamin A, on the other hand, was higher than EAR according to Ngardita (2004) and Zakiyah & Kusmiyati (2007). Only one study showed the average intake of Vitamin C being lower than the EAR (Widagdo, 2004), while the other three studies showed otherwise (Susilo & Hadi, 2002; Wijanti, 2004; Ngardita, 2004).

Table 3. The Indonesian Dietary Recommendation (AKG – *Angka Kecukupan Gizi*) and Estimated Average Requirements (EAR) in pregnant women[a]

Nutrients	*AKG*	*EAR*
Energy (kcal)	2200	1694 [c]
Protein (g)	67	51.6[c]
Fat (g) 30 [b]	23.1 [c]	
Carbohydrate (g)	175 [b]	135[d]
Vitamin A (RE)	900	642.9 [e]
Vitamin C (mg)	85	70.8 [e]
Iron (mg)	26	21.7 [e]
Calcium (mg)	950	791.7 [e]
Zinc (mg)	11	9.2 [e]
Sodium [b]	-	-
Potassium [b]	-	-

a. For 19 to 29-year-old pregnant women

b. Not available in AKG; Recommended Dietary Allowance from the Institute of Medicine, US is used instead

c. EAR is estimated by 77% value of AKG (or RDA) (according to Gibson, 2005)

d. No conversion factor available for the respective nutrient; EAR from the Institute of Medicine, US is used instead

e. Derived from AKG using conversion factor provided by FAO/WHO (Food and Nutrition Board, 2003)

Table 4. The average intake of energy and macronutrients intake and percentage of EAR of respective nutrients in reported studies.

Nutrients intake	*Author, year*	*Mean (SD) Result*	*% EAR*
Energy intake (kcal/day)	Prianto, 2005	1670.1 (365.5)	99
	Widagdo, 2004	2239.0 (77.8)	132
	Susilo & Hadi, 2002	1825.0 (688)	108
	Wijanti, 2004	1591.3 (561.8)	94
Protein intake (g/day)	Prianto, 2005	42.5 (12.3)	82
	Widagdo, 2004	58.8 (0.9)	114
	Susilo & Hadi, 2002	58.5 (24.2)	113
	Wijanti, 2004	45.9 (21.3)	89
	Hartini *et al*., 2003	46 (14)	89
	Ngardita, 2004	51.31 (13.5)	99
Fat intake (g/day)	Wijanti, 2004	46.1 (71.2)	200
	Hartini *et al*., 2003	44 (17)	190
Carbohydrate intake (g/day)	Wijanti, 2004	248.5 (85.6)	184
	Hartini *et al*., 2003	327 (95)	242

Table 5. The average intake of micronutrients and percentage of EAR of respective nutrients in reported studies.

Nutrients intake	*Author, year*	*Mean (SD) Result*	*% EAR*
Vitamin A	Ngardita, 2004	1673.3 (580.51)	260
	Zakiyah & Kusmiyati, 2007	992.5 (337.9)	154
Vitamin C intake (mg/day)	Widagdo, 2004	68.1 (17.9)	96
	Susilo & Hadi, 2002	145.9 (97.2)	206
	Wijanti, 2004	131.1 (139.1)	185
	Ngardita, 2004	149.5 (48.2)	211
Calcium intake (mg/day)	Susilo & Hadi, 2002	536.2 (345.1)	68
	Wijanti, 2004	614.4 (269.4)	78
	Hartini *et al*., 2003	360 (140)	45
Iron intake (mg/day)	Widagdo, 2004	9.6 (1.0)	44
	Susilo & Hadi, 2002	14.1 (6.1)	65
	Hartini *et al*., 2003	14 (5)	65
	Ngardita, 2004	13.9 (5.7)	64
	Zakiyah & Kusmiyati, 2007	30.4 (6.3)	140
Zinc intake (mg/day)	Zakiyah & Kusmiyati, 2007	12.9 (4.2)	140
Sodium intake (mg/day)	Wijanti, 2004	2356.2 (261.9)	-
Potassium intake (mg/day)	Wijanti, 2004	1910.6 (787.7)	-

Average zinc intake reported by Zakiyah *et al.* (2007) showed a higher value compared to EAR (Table 4).

DISCUSSION

Pregnant mothers exhibit incremental nutrients needs, especially on the last half of gestation. During this time, metabolic cost of foetal tissue synthesis is the greatest, thus increasing the basal metabolic rate about 60%. During the 10th week of gestation, the maternal fat store is gained before fetal energy demands reach their peak (King, 2000). It is consistent with dietary recommendation for pregnant women to increase their intake during pregnancy, mainly during the last two trimesters (Widya Karya Pangan & Gizi, 2004). In our study, two of four publications (Widagdo, 2004; Susilo & Hadi, 2002) showed average intake higher than EAR value. The studies which show low energy intake values are about 1 to 6 % below the EAR value (Prianto, 2005; Wijanti, 2004).

In this review, several studies showed a low average protein intake that was below EAR. Low protein intake in pregnancy is associated with poor pregnancy outcomes. In an experimental animal study, low protein intake in pregnancy led to several abnormalities, including reduced bone mass (Ashton *et al.*, 2007) and metabolic consequences, for instance impairment of glucose homeostasis through reduced insulin secretion and therefore being prone to gestational diabetes (Souza Dde *et al.*, 2011). Offspring of rats given low protein exhibited low birth weight. Furthermore, the rat offspring also had a lower number of nephron, indicating intrauterine growth retardation (Zimanyi *et al*., 2000).

In order to improve pregnancy outcomes, adequate protein intake is essential. Kramer & Kakuma (2010) published a systematic review about energy

and protein in pregnancy. They reported that pregnant women will benefit from balanced energy / protein supplementation (protein content <25% total calorie supplements). This supplementation is associated with an increase in mean birth weight and a reduction in incidence of small for gestational age (SGA) babies (Kramer & Kakuma, 2010). In another review, Imdad, Yakoob & Bhutta (2011) reported that balanced energy / protein supplementation also reduced incidence of stillbirth. In contrast, when protein is given in isolation as a supplement (isocaloric protein supplement), there is a significant increase in SGA risk (Kramer & Kakuma, 2010). These publications suggest that giving protein in isolation without energy supplement leads to detrimental effects on the infant and thus any recommendation to increase nutrient intake should be cautiously given.

Looking at the average intake of fat in several studies in this review which was above EAR value, we suggest that fat intake, quantitatively, is not an issue of deficiency. Based on consensus recommendation from the European Commission research projects Perinatal Lipid Metabolism (PeriLip) and Early Nutrition Programming (EARNEST), dietary fat intake recommendation (energy%) for pregnant women is the same as that recommended for the general population (Koletzko *et al.*, 2007).

Fat intake concerns in relation to pregnant mothers should be focused on essential fatty acids. However, since we could not find data on fatty acids intake of pregnant women, only data on fat intake was analysed. Essential fatty acids play an important role in pregnancy. It is essential for growth and function of nerve tissue (Innis, 2007). The foetus needs fatty acids for fluidity, permeability, and conformation of membrane; it is the precursor of prostacyclins, prostaglandin, thromboxanes, and leukotrienes and of course as a source of energy (Haggarty, 2002). Fatty acids, particularly long chained-polyunsaturated fatty acids (LC-PUFA) is associated with development of visual and cognitive ability (Koletzko *et al*., 2008). Docosahexaenoic acid (DHA)—an omega 3 fatty acid—is the predominant structural fatty acid in the central nervous system. Therefore, its availability is vital for brain development of the infant. Seventy percent of human brain growth is achieved at birth, another 15% completed during infancy, and the rest during preschool years (Singh, 2005). Thus, during pregnancy compared to other life stages, DHA is most essential.

Carbohydrate serves as the main source of energy. In our review, we found no study with an average intake of carbohydrate below EAR. Carbohydrate contributes 70% of total calorie consumed in Indonesia (Hartini *et al.*, 2003). The high proportion of carbohydrate in the diet is probably due to the eating pattern of most of the Indonesians where rice is the staple food (Ministry of Health, 2000). Pregnant women must be aware of carbohydrates as a food choice as it can affect pregnancy outcomes. For instance, eating a primarily high glycemic index carbohydrate leads to heavier birth weight (Moses *et al.*, 2006), and excessive maternal weight gain (Clapp III, 2002). Benefits may be obtained if pregnant women choose to eat low glycemic index carbohydrates. A study observed that this carbohydrate leads to normal weight gain during pregnancy (Clapp III, 2002).

Among the micronutrients analysed in this study, calcium and iron are probably the nutrients that require more attention. These average intake of micronutrients in almost all these studies are lower than the EAR value. Iron deficiency anemia is prevalent in developing countries, including Indonesia (Ministry of Health, 2006). This problem probably was caused, in part, by low dietary iron intake. Anemia in pregnancy poses poor pregnancy outcome risks, including foetal loss and neonatal mortality (Black, 2001).

Most of the studies concerning vitamin A, vitamin C, and zinc intake showed that the average nutrients intake in pregnant

women in Indonesia is above EAR value. Vitamin A is important for many physiological functions, including vision, growth, reproduction, and cell differentiation. Until recently, poor maternal vitamin A status has received attention primarily for its effects on foetal development and child health, for example, increased risk of preterm birth, reduced intrauterine growth, decreased birth weight and reduced vitamin A content in breast milk (Persson *et al.*, 2002). Excessive vitamin A intake, however, is not recommended for pregnant women. Studies on impact of excessive vitamin A intake in human beings is limited as clinical trials in this area are ethically impossible. In animal studies, the high dose of vitamin A clearly showed teratogenic effects (Azaïs-Braesco and Pascal, 2000). Vitamin C cannot be synthesised or stored in the human body, so a daily supply is required. Vitamin C is necessary for collagen synthesis and increasing non-haem iron absorption. In maternal blood, vitamin C levels decrease during pregnancy while in foetal blood at delivery, the levels are 2-4 times higher than in maternal blood (WHO, 2001). Zinc is necessary for the normal growth and development of foetus and placenta. Data suggests that Zn deficiency may cause intrauterine growth retardation in foetus (WHO, 2001).

Even with collection and compilation of data from several studies, it seems still difficult to depict nutrient intake in pregnant women in Indonesia. It is very difficult to access research articles in Indonesia because a large number of the study reports and journals are often not available online. We have to conduct the literature search physically in several institutions in Indonesia. Due to financial constraints, the search was only carried out in Java Island. Although the island contributes only 7% of land area in Indonesia, 58% of Indonesian citizens live in Java island (Indonesian Bureau of Statistics, 2010). Institutional visits yielded limited studies concerning nutritional intake in pregnant women with several flaws in methodology and sample size. In our review of electronic journals, only a limited number of studies were found reporting nutrient intake in pregnant women in Indonesia.

In this review, we obtained raw descriptions on nutrients intake of pregnant women in Indonesia. Based on our review, we conclude that the average intake of several nutrients by pregnant women in Indonesia is below the EAR.

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