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Comparison of Lactational Performance of Vegetarian and Non-Vegetarian Mothers in Indonesia

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ABSTRACT

Introduction: Vegetarian mothers are known to have lower pre-pregnancy nutritional status, thereby posing an increased risk to pregnancy outcomes, including lower maternal fat stores for lactation. This study aimed at analysing the association between predominant breastfeeding on the nutritional status of lactating vegetarian mothers and growth of their breastfed infants. **Methods:** A longitudinal study was conducted on mother-infant pairs who practised breastfeeding in five cities in Indonesia, selected purposively based on the Indonesia Vegetarian Society database. A total of 42 pairs of vegetarian and 43 pairs of non-vegetarian were followed since delivery to 24 weeks infant age. Anthropometric measurements (weight of infant and mother, length of infant) were taken of each subject every 4 weeks. Finally, 15 vegetarian and 18 non-vegetarian mother-infant pairs who had successfully followed through the 24 weeks of predominant breastfeeding were analysed. **Results:** Socio-demographic characteristics did not differ between the two dietary groups except in maternal parity. Vegetarian mothers had lower pre-pregnancy BMI but higher pregnancy weight gain compared to non-vegetarian mothers. This study shows that predominant breastfeeding had no effect on infant weight and length but had significant effect on mothers' BMI and weight loss. **Conclusions:** Without adequate energy intake during lactation, the postpartum nutritional status of the vegetarian mothers declined over time. The mothers in the non-vegetarian group in this study had a significantly greater energy intake compared with the vegetarians. This is the key factor for successful lactation performance of a 6- month duration of predominant breastfeeding as it offers good nutritional outcomes for both the mother and the infant.

Key words: Lactation performance, nutritional status, non-vegetarian mothers, vegetarian mothers

INTRODUCTION

To date, vegetarian diets have shown a significant increase in popularity. This can be observed from the growing number of vegetarians in the world population (Krummel & Kris, 1996; Sabate, 2003; Conway & Cullum, 2010), as well as the increasing publication of scientific and non-scientific articles on vegetarian nutrition (Sabate, 2003). Although the current view about vegetarian diets is mostly positive, such diets are still considered problematic in terms of the adequacy of intake of animal-

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source nutrients, such as protein, vitamin B12, iron, calcium, and fatty acid (Fraser, 2003; Phillips, 2005).

Proteins derived from vegetable foods contain a lower amount and a lower quality of essential amino acids compared with proteins derived from animal sources. Protein nutritional quality is measured by the protein digestibility-corrected amino acid scoring (PDCAAS) method (Schaafsma, 2000). Egg white, chicken, and quorn pieces have an optimum score of 1.00, whereas soya protein (one of the highest-quality plant proteins) has a score of 0.94. Thus, to complement the composition of amino acids in sufficient amounts, more vegetable protein than animal protein is needed on a food plate.

A regular source of vitamin B12 is essential in pregnancy because vitamin B12 from maternal stores does not seem to cross the placenta. Thus, infants may be born with low vitamin B12 stores if the maternal intake during pregnancy is inadequate (Mangels, 2008). A study in Germany (Herrmann *et al.*, 2001) showed that vegetarians are a high-risk group for vitamin B12 deficiency.

Vegetarians are more likely to have lower iron stores, as indicated by serum ferritin levels (Hunt, 2003). The iron in vegetarian diets is in the form of non-heme iron, which is much more sensitive to factors affecting absorption compared with heme iron (Mangels, 2008). The IOM (2000) recommends a higher iron dietary allowance for pregnant vegetarians than pregnant non-vegetarians. The calcium intake of the mother during pregnancy plays an important role in the bone development of the infant. Studies have revealed that many lacto-ovo vegetarian women have calcium intakes that meet the current recommendations, but it is not so for vegan women, who tend to have lower calcium intakes.

Vegetarian diets have very low omega-3 fatty acid content. This limited intake is reflected in the blood and breast milk composition. Others have argued about vegetarian diet problems from anatomic and physiologic aspects, stating that human beings are omnivorous and should eat both animal and plant foods. Thus, a high consumption of fibre and seeds/legumes could not be optimally used due to difficult adaptation genetically and physiologically (Keith, 2009).

However, different views have come from *The American Dietetic Association* and *Dietitians of Canada*, who state that a vegetarian diet is suitable for all life cycles, including pregnancy and lactation (Fraser, 2003), and that the nutrition requirement could be fulfilled through a balanced and diverse diet. Vitamin B12 could be obtained from soy-based food, essential fatty acid from microalgae, and essential amino acids could be obtained by combining cereals and nuts (Fraser, 2003; Sabate, 2003).

Pregnancy and lactation are important periods in the human life cycle during which the foundation for optimal growth and development is established. Studies have shown the advantages of breastfeeding in both the short and long term. However, there is no clinical guidance on lactation for vegetarian mothers (Conway & Cullum, 2010). The concern arises when a vegetarian mother starts her pregnancy with a lower BMI and does not achieve the proper pregnancy weight gain as recommended; she would then have a higher risk of low birth weight outcome and low fat stores for lactation (Conway & Cullum, 2010; Fikawati, Wahyuni & Syafiq, 2012).

Data on pregnancy and lactation period among vegetarian mothers in Indonesia is scarce. Most studies have a cross-sectional design, and no study has ever been done on the nutritional status of lactating mothers and infant growth. This study aimed at analysing the association between predominant breastfeeding and the nutritional status of lactating vegetarian mothers and growth of their breastfed infant.

METHODS

A study with a prospective cohort (longitudinal) design was done over a 24-week postpartum period to compare maternal nutritional status and infant growth among vegetarian and non-vegetarian mothers who did predominant breastfeeding. In this study, predominant breastfeeding was defined in accordance to the WHO Global Strategy for Infant and Young Child Feeding (WHO, 2009), that is, the predominant source of nourishment for the infant is breast milk, but the infant may also receive liquids (water, water-based drinks, and fruit juices), ritual fluids and oral rehydration solution (ORS), drops, or syrups (vitamins, minerals, and medicines). Due to ethical considerations concerning comfort of the mother and infant, this study measured infant anthropometric indicators within one week after birth. In a previous study, Arifeen *et al.* (2000) found no difference in weight from birth to the first three days of life.

Maternal nutritional status (body weight and body mass index) was determined through height measurement (at first visit: within one week after delivery) and monthly weighing. Infant nutritional status was determined through length and weight measurements every 4 weeks since birth (measured within one week after birth) up to 24 weeks of age. In total, anthropometric assessments were done 7 times for each subject (mother-infant pair) since birth until 24 weeks after delivery. The height of the mother was measured using a standard microtoise; the infant length was measured with a locally made wooden length board to which a microtoise measuring band with 0.1 cm precision (MOH-RI, 2007) was attached. The weight of the mother and the infant were determined with the use of a calibrated weighing scale with 0.05 kg precision.

The research population consisted of vegetarian and non-vegetarian postpartum mothers in urban areas in Indonesia. Overall, there were 85 mother-infant pairs (42 vegetarian and 43 non-vegetarian pairs). A purposive sampling method was used based on the data available. The inclusion criteria included: delivery at term (gestational age >37 weeks), infant birth weight ≥2500 grams, normal birth (without defects), single birth, absence of chronic illness, intention to breastfeed exclusively for 6 months, and willingness to participate in the study for 6 months.

In the end, 33 mother-infant pairs (15 vegetarian and 18 non-vegetarian pairs) successfully implemented 24 weeks of predominant breastfeeding. Therefore, only 33 mother-infant pairs were analysed in this study. However, the repeated measurements (7 times) for each subject resulted in power of more than 80%. Data were also collected through a semi-quantitative FFQ during the first week postpartum to obtain information on consumption during pregnancy and at six months postpartum during the lactation period.

Due to the limited number of vegetarian mother-infant pairs, the research was done in five big cities in Indonesia, namely, Jakarta, Surabaya, Pontianak, Palembang, and Pekanbaru. These five cities have the biggest population of fertile-age vegetarian women in Indonesia, according to the Indonesian Vegetarian Society (IVS) database. Information gathering and research approach followed a snowball strategy from IVS Central Office down to branches in provincial level. The respondents were screened and selected based on the inclusion criteria. Non-vegetarian mothers were chosen based on similar socio-economic status to the selected vegetarian mothers; the inclusion criteria were also applied.

Independent *t*-test and chi-square analyses were used to test the differences in the socio-demographic characteristics and the infant and maternal nutritional status of respondents according to maternal diet. To test the effect of lactation on the continuous outcome variables (nutritional status of lactating mother and infant growth),

repeated measures ofANOVA (RM ANOVA) was used on the values obtained from 6-7 days after birth up to the six follow-up visits. This study was approved by the Commission of Research Experts and Ethics of the Faculty of Public Health, University of Indonesia (Approval Letter No. 9/H2.F10/PPM.00/ 2012, dated 31 January 2012). Written informed consent was obtained from all subjects.

RESULTS

Sociodemographic characteristics

The socio-demographic characteristics did not differ between the two dietary groups (Table 1) except in maternal parity (*P*=0,016), with most vegetarians being primiparous (1.3 ± 0.5) and most non-vegetarians being multiparous (2.1 ± 1.1). The majority of the mothers in both groups had similar food expenditure proportions of less than 60%, indicating that they were of similar economic status. No significant difference was found in infant sex between the two dietary groups.

Table 2 shows that the maternal pre-pregnancy BMI was significantly lower in the vegetarian mothers compared with the non-vegetarians (*P*=0.006). There was no significant difference in infant birth weight, infant birth length, and maternal postpartum BMI between the two dietary groups. However, in almost all measurements, the vegetarian mothers had lower figures than the non-vegetarians. The maternal post-partum weight was not statistically significantly different (*P*=0.067) at 0 month postpartum but was significantly lower for the vegetarian mothers at 6 months postpartum (*P*=0.026), and this caused a significantly higher IMT reduction in the vegetarian mothers compared with the non-vegetarians (*P*=0.043). One important finding was that the energy consumption of the vegetarian mothers during lactation was statistically lower compared with the non-vegetarians (*P*=0.003).

Postpartum maternal nutritional status

Table 3 shows the trend in maternal BMI during 0-6 months postpartum. The BMI of the vegetarian mothers was lower than that of the non-vegetarians at month 0 and continued to decline until the sixth month

Table 1. Socio-demographic characteristics of vegetarian and non-vegetarian postpartum mothers who successfully did 24 weeks of predominant breastfeeding

Variable	*Vegetarian (n=15)*		*Non-vegetarian (n=18)*		*P*†
	Mean	*SD*	*Mean*	*SD*	
Mother's age (years)	27.7	3.7	29.7	4.2	0.132
Parity	1.3	0.5	2.1	1.1	0.016*
Variable	N	%	N	%	*P*‡
Proportion of household expenditure					0.455
≥60%	1	6.7	0	0.0	
<60%	14	93.3	18	100.0	
Total	15	100.0	18	100.0	
Infant's sex					0.611
Girls	7	46.7	10	55.6	
Boys	8	53.3	8	44.4	
Total	15	100.0	18	100.0	

†Mann Whitney test (parity), Independent *t*-test (mother's age); ‡Chi square test; *$P<0.05$

Table 2. Maternal and infant nutritional status of vegetarian and non-vegetarian postpartum mothers who successfully did 24 weeks of predominant breastfeeding

Variable	*Vegetarian n= 15*		*Non-vegetarian n= 18*		*P†*
	Mean	*SD*	*Mean*	*SD*	
Maternal pre-pregnancy BMI	19.2	1.7	21.8	3.2	0.006*
Maternal weight gain (kg)	15.3	3.8	13.0	3.8	0.088
Infant's birth length (cm)	50.2	1.9	49.7	1.5	0.447
Maternal postpartum BMI (0 month) (kg/m²)	23.0	2.2	24.2	3.1	0.214
Maternal postpartum BMI (6 month) (kg/m²)	21.2	2.7	23.1	3.0	0.067
Maternal postpartum Weight (0 month) (kg)	55.8	6.7	60.9	8.9	0.067
Maternal postpartum Weight (6 Month) (kg)	51.4	8.1	58.2	8.5	0.026*
IMT reduction (kg/m²)	1.8	1.0	1.1	1.1	0.043*
Weight Loss (kg)	4.4	2.2	2.8	2.7	0.067
Energy consumption during lactation (kkal/hari)	1855.4	458.4	2360.7	436.7	0.003*

†Independent *t*-test

postpartum. Both groups experienced a decrease in BMI within 6 months postpartum, but the vegetarian mothers had a greater decrease in BMI (1.8 kg/m²) than the non-vegetarians (1.1 kg/m²). Overall, maternal BMI decrease did not differ between the vegetarians and the non-vegetarians at 0-6 months postpartum (P=0.053). An increment analysis showed significant differences between maternal BMIs at second and third months (P=0.017) and at fourth and fifth months postpartum (P= 0.008) (Table 3).

Further analysis indicated that at birth, vegetarian mothers had lower weight and experienced greater weight loss compared with the non-vegetarians, as shown in Table 4. In general, the maternal weight decreased significantly from 0 to 6 months postpartum (P=0.047). Vegetarian mothers had more postpartum weight loss (4.4 kg) compared with non-vegetarian mothers (2.8 kg). The most significant period of high weight loss among the vegetarian mothers compared with the non-vegetarians were from the third to the sixth months postpartum (P=0.047, 0.039, 0.022, and 0.026, respectively) (Table 4).

Infant weight growth

Infant growth was determined by using weight and length as separate measures. Table 5 shows that there was no difference in growth curves (in terms of weight) between infants of vegetarian and non-vegetarian mothers. Overall, there was no significant difference in infant weight from birth to age 6 months (P=0.504) and in the monthly increments in infant weight from birth to age 6 months (all P>0.05) (Table 5). The weight growth of the infants of both vegetarian and non-vegetarian mothers was in accordance with WHO (2006) growth standards.

Infant length growth

Table 6 presents growth in length of the infants of vegetarian and non-vegetarian mothers who predominantly breastfed for 24 weeks. As shown in the table, the length curves of the two groups coincide. The statistical test results also show that the growth in infant length did not differ between the groups. As in the case of infant weight, growth in length of the infants of

Table 3. Mean BMI of vegetarian and non-vegetarian postpartum mothers who successfully did 24 weeks of predominant breastfeeding

Maternal Diet	*Changes of BMI of Postpartum (kg/m²)†*																*P[a]*
	Birth		*1st month*		*2nd month*		*3rd month*		*4th month*		*5th month*		*6th month*		*Δ*		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Vegetarian (n=15)	23.0	2.2	22.4	2.3	22.3	2.4	21.8	2.4	21.6	2.5	21.3	2.6	21.2	2.7	1.8	1.0	0.053
Non-vegetarian (n=18)	24.2	3.1	23.5	3.3	23.2	3.3	23.1	3.2	23.0	3.2	23.0	3.2	23.1	2.9	1.1	1.1	
P[b]	0.228		0.287		0.356		0.215		0.186		0.112		0.063				
P[c]	0.864		0.187		0.017*		0.512		0.008*		0.450						

†ANOVA repeated measured analysis; ; [a] Test of within-subjects effects; [b] parameter estimates; [c] Test of within-subjects contrasts, repeated; *P <0,05

Table 4. Mean weight of vegetarian and non-vegetarian postpartum mothers who successfully did 24 weeks of predominant breastfeeding

Maternal Diet	*Changes of Weight of Postpartum Mothers (kg)†*																*P[a]*
	Birth		*1st month*		*2nd month*		*3rd month*		*4th month*		*5th month*		*6th month*		*Δ*		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Vegetarian (n=15)	55.8	6.7	54.1	7.2	53.9	7.3	52.9	7.5	52.4	7.6	51.6	7.9	51.4	8.1	4.4	2.2	0.047*
Non-vegetarian (n=18)	60.9	8.9	59.7	8.9	59.1	9.0	58.8	8.8	58.5	8.4	58.5	8.4	58.2	8.5	2.8	2.7	
P[b]	0.073		0.059		0.083		0.047*		0.039*		0.022*		0.026*				
P[c]	0.385		0.116		0.024*		0.737		0.006*		0.804						

†RM ANOVA analysis; [a] Test of within-subjects effects; [b] parameter estimates; [c] Test of within-subjects contrasts, repeated; *P<0.05

Table 5. Mean infant weight of vegetarian and non-vegetarian postpartum mothers who successfully provided 24 weeks of predominant breastfeeding

Maternal Diet	*Infant Weight (gram)*†														*P*[a]
	Birth		*1st month*		*2nd month*		*3rd month*		*4th month*		*5th month*		*6th month*		*Δ*		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Vegetarian (n=15)	3266.7	428.0	4316.3	505.6	5451.7	710.7	6360.7	952.5	6923.0	958.1	7310.0	1034.7	7746.7	1179.6	4480.0	1161.5	0.504
Non-vegetarian (n=18)	3306.7	368.0	4428.9	365.5	5405.3	460.5	6212.5	551.4	6769.2	643.0	7271.7	754.0	7545.8	868.0	4239.2	825.7	
P[b]	0.775		0.464		0.823		0.581		0.587		0.903		0.578				
P[c]	0.561		0.208		0.411		0.954		0.126		0.068						

† RM ANOVA analysis; [a] Test of within-subjects effects; [b] parameter estimates; [c] Test of within-subjects contrasts, repeated.

Table 6. Mean infant length of vegetarian and non-vegetarian postpartum mothers who successfully provided 24 weeks of predominant breastfeeding

Maternal Diet	*Infant Length (cm) (mean ±SD)*†																*P*[a]
	Birth		*1st month*		*2nd month*		*3rd month*		*4th month*		*5th month*		*6th month*		*Δ*		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Vegetarian (n=15)	50.2	1.9	54.5	1.7	57.9	2.2	60.9	2.2	63.5	2.6	65.3	2.6	67.0	2.7	16.8	2.1	0.629
Non-vegetarian (n=18)	49.7	1.5	54.6	2.2	58.3	2.2	61.4	2.6	63.8	2.4	65.3	2.2	67.0	2.1	17.3	1.9	
P[b]	0.436		0.880		0.672		0.580		0.745		0.932		0.941				
P[c]	0.171		0.671		0.748		0.630		0.444		0.972						

† RM ANOVA analysis; [a]Test of within-subjects effects; [b]parameter estimates; [c]Test of within-subjects contrasts, repeated.

both vegetarian and non-vegetarian mothers was in accordance with WHO (2006) growth standards.

DISCUSSION

Socio-demographic characteristics are fundamental factors that can affect the nutritional status of mothers (UNICEF, 2006; IOM, 2009). In this study, both groups came from the same socio-economic level; thus, the effect of diet type was not influenced by differences in socio-economic factors. The only difference found between the vegetarian and non-vegetarian mothers was in parity, with most of the vegetarian mothers being primiparous and most of the non-vegetarians being multiparous. Studies have shown that mothers with higher parity are more likely to be capable of doing 6 months of exclusive breastfeeding (Lande *et al.*, 2007; Patil *et al.*, 2009).

In terms of maternal nutritional status, the pre-pregnancy BMI of the vegetarian mothers was significantly lower than that of the non-vegetarians; however, there was no difference in BMI at 0 month postpartum (measured 6-7 days after birth) between the vegetarian and the non-vegetarian mothers. One possible reason for the lack of difference in maternal nutritional status at the time of delivery between vegetarian and non-vegetarian mothers is the higher pregnancy weight gain among vegetarians compared with non-vegetarians. This result supports a study by Fikawati, Wahyuni & Syafiq (2012), which reported that the pre-pregnancy BMI of vegetarian mothers was lower than that of non-vegetarians, but pregnancy weight gain was higher among vegetarian mothers than among non-vegetarians.

The use of maternal fat reserves for milk production is represented by the BMI and weight loss (IOM, 2009). A comparison of the BMI decline in the postpartum period among mothers who successfully did predominant breastfeeding for 24 weeks showed that the vegetarian mothers had a significantly greater decrease in BMI compared with the non-vegetarians; there was also greater weight loss among the vegetarian mothers than among the non-vegetarians. This was mainly due to a significant decrease in weight of vegetarians compared to non-vegetarians since the third month of the postpartum period.

The study observed three things that might contribute to the significant BMI decrease and weight loss among the vegetarian mothers. First, the energy consumption of the vegetarian mothers during lactation was significantly lower than that of the non-vegetarians. During pregnancy, the mother usually stores about 2-4 pounds of body fat reserves (fat stores), which are used to meet the energy needs for breastfeeding. This amount of fat reserves is able to provide about 200-300 kcal/day for 3 months of milk production. For the following 3 months (to achieve 6 months of exclusive breastfeeding), milk production must be supported by adequate energy consumption by the mother after delivery. The energy consumed prepares the mother to resume milk production in the next 3 months. Because the energy consumption of the vegetarian mothers during lactation (postpartum) was low, the energy needed to produce milk was taken from their bodies. Hence, from the third month postpartum, there was significantly greater BMI decrease and weight loss in the vegetarians compared with the non-vegetarians.

Second, several studies have revealed that mothers with lower fat reserves before pregnancy experience greater weight loss than those with larger fat reserves (Lenderman & Paxton, 1998; Kac *et al.*, 2004). In this study, the vegetarian mothers who had a significantly lower pre-pregnancy BMI compared with the non-vegetarian mothers also had a much greater BMI decrease and weight loss than the non-vegetarians. Fat mobilisation in under-weight women is higher than in normal,

overweight, and obese women (Lenderman & Paxton, 1998).

The third observation is the difference in parity, with most of the vegetarian mothers being primiparous and most of the non-vegetarians being multiparous. Parity affects the nutritional status of mothers and infants. Primiparous mothers and infants have been found to be lighter than multiparous mothers and infants (Kramer, 1987; Schauberger, Rooney & Brimer, 1992; Boardley *et al.*, 1995; Lawoyin, 2007). In this study, the vegetarian mothers who had lower parity also had lower maternal nutritional status compared with the non-vegetarians.

Further analysis was done to determine the factors that mostly influenced the maternal postpartum BMI and weight in the vegetarian and non-vegetarian mothers. The results showed that the maternal BMI at 0 month postpartum had the most influence on maternal BMI and weight at 1-6 months postpartum. The correlation was positive, meaning that mothers with a higher BMI at 0 month postpartum had a higher BMI and weight in the succeeding months compared to those with a lower BMI at 0 month postpartum. According to the IOM (2009), weight retention after birth is a pregnancy outcome that will influence the nutritional status of the mother during lactation.

In terms of infant growth, the results of this study indicate that the weight and length growth of the infants of the vegetarian and non-vegetarian mothers did not differ and could be considered good based on the WHO growth curve standard. Good infant growth was related to good postpartum maternal nutritional status. The pre-pregnancy BMI of the vegetarian mothers was significantly lower than that of the non-vegetarians, but the pregnancy weight gain of the vegetarian mothers was higher than that of the non-vegetarians, which resulted in a similar postpartum maternal BMI between the two groups.

The findings regarding the relationship between predominant breastfeeding and the nutritional outcomes for the mother and the infant, as previously explained, indicated that predominant breastfeeding by vegetarian mothers for 24 weeks had no impact on the growth in infant weight and length but resulted in greater maternal weight loss compared with non-vegetarian mothers.

Considering the duration of predominant breastfeeding and the nutritional outcomes for the mother and the infant, successful lactation performance could be categorised into three levels: (1) able to provide 6 months of predominant breastfeeding with good nutritional outcomes for both the mother and the infant; (2) able to provide 6 months of predominant breastfeeding with good nutritional outcomes only for the infant (but not for mother); and (3) able to provide 6 months of predominant breastfeeding without good nutritional outcomes for either the mother or the infant.

The first level of success was reflected in the non-vegetarian group in this study, in which 6 months of predominant breastfeeding was accompanied by good nutritional outcomes for both the mother and the infant. The key factor in this success was the energy consumption during the lactation period, with the non-vegetarian mothers having a significantly greater energy intake compared with the vegetarians.

The second level of success, that is, 6 months of predominant breastfeeding with good nutritional outcomes for the infant but not for the mother, was reflected in the vegetarian group. Without adequate energy intake during lactation, the postpartum nutritional status of the vegetarian mothers declined over time. The maternal nutritional stores were sacrificed to support normal infant growth.

The third level of success, in which predominant breastfeeding for 6 months was accompanied by good nutritional outcomes for neither the mother nor the infant, was not found in this research but has been reported in studies in developing

areas (Alam *et al.*, 2003; Soi, 2005). Alam *et al.* (2003) reported that in rural areas of Bangladesh, the infants of underweight mothers who had exclusively breastfed for 6 months experienced suboptimal catch-growing. The study supports Prentice *et al.* (1986), who stated that underweight lactating mothers did not have enough fat reserves to produce milk well. Another cohort study done by Soi (2005) in Kupang reported that the nutritional status of underweight mothers did not influence the exclusivity of breastfeeding but affected the growth of infants. Mothers who experienced chronic energy malnutrition still had the ability to breastfeed for 6 months, but infant growth was lower than the WHO curve standard.

The belief that all mothers, regardless of their nutritional status, are able to provide 6 months of exclusive breastfeeding is incorrect; if the maternal nutritional status is poor (e.g., chronic energy deficiency) and the energy intake during lactation is inadequate, the growth of the infant will falter and the chronic energy deficiency of the mother will worsen. Thus, mothers with chronic energy deficiency would be able to provide exclusive breastfeeding for 6 months but without good nutritional outcomes for either themselves or their infants.

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