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Maternal and Neonatal Outcome in Pregnant Women with Chronic Energy Deficiency in Cipto Mangunkusumo General Hospital, Indonesia

Junita Indarti[1]*, Henny Sugiharto Wonodihardjo[1], Kristian Alda Sianipar[1], Mohammad Agassi Antoniman[2]

[1]Department of Obstetric and Gynecology, Faculty of Medicine University of Indonesia, Jakarta, Indonesia; [2]Faculty of Medicine University of Indonesia, Jakarta, Indonesia

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***Correspondence:** Junita Indarti, Department of Obstetrics and Gynecology, Faculty of Medicine University of Indonesia, Jl. Salemba Raya No. 6, Jakarta Pusat, Jakarta, Indonesia. E-mail: junita_indarti@yahoo.com
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Abstract

BACKGROUND: Malnutrition in pregnant women disrupts the first 1000 days of life (DOL). DOL is known as the Window of Opportunity or the Golden Period, which occurs for 1000 DOL to improve children's growth and development optimally. Disturbances that arise during this period will impact the survival of the child and child's growth and development, which is permanent. However, malnutrition in pregnant women can be prevented by the early intervention.

AIM: This study aims to describe the maternal and neonatal outcomes in pregnant women with chronic energy deficiency malnutrition.

MATERIALS AND METHODS: This research is a retrospective cohort study with a descriptive research design. Pregnant women with prepregnancy body mass index (BMI) below 18.5 kg/m^2 was included in this study. The subject characteristic, maternal, and neonatal outcomes were collected from the medical record. Variables received includes characteristics (age, education, residence, maternal occupation, paternal occupation, pregnancy frequency, pregnancy interval, comorbidities before pregnancy, body weight before and after pregnancy, height, weight increase, and BMI before pregnancy); maternal outcome (hemoglobin level, complication during pregnancy or labor); and neonatal outcome (birth weight, birth length, 1st min APGAR score, 5th min APGAR score, neonatal intensive care unit (NICU) admission, intrauterine growth restriction, and neonatal complications).

RESULTS: Eighty-one pregnant women with malnutrition who came to Cipto Mangunkusumo Hospital from 2017 to 2020 were included in the study. Some of our subjects had moderate (26%) and severe (16%) malnutrition before pregnancy. The average weight gain is 8.78 kg, lower than the recommendation. The results of this study showed a high incidence of anemia (51.9%) and perinatal maternal complications (54.4%). The neonatal outcome showed a high incidence of congenital defects and hyaline membrane disease (p = 0.031) and NICU (p = 0.001). The incidence of hyaline membrane disease and congenital defects is 15 (18.5%) and 5 (6.1%) in this study.

CONCLUSIONS: Chronic energy deficiency in pregnancy could lead to significant maternal and neonatal complications.

Introduction

Malnutrition is a condition of deficiency, or imbalance of nutritional intake and/or energy [1]. Malnutrition in pregnant women, especially chronic energy deficiency, is still a significant problem globally with social and economic impact [2], [3]. Chronic energy deficiency in pregnancy is defined as the measurement of body mass index (BMI) <18.5 kg/m^2 [2], [4]. The prevalence of malnutrition in pregnant women is still high, especially in South Asian and south-east Asian countries, as well as African countries which are classified as low- to middle-income countries [3]. Globally, 870 million people have been reported to have malnutrition which represents more than 12.5% of all population in the world. Malnutrition in pregnancy is also high in Asian countries. In India, 77% of all women in reproduction age have an abnormal BMI, with more than half having anemia [4]. Similar problems in a pregnant woman also occurred in Indonesia. According to the Indonesian National Health Survey (Riskesdas), in 2018, pregnant women with chronic energy deficiency reached 17.3% nationally [5]. Thus, the previous studies have shown the vulnerability of pregnant women to have chronic energy deficiency and could affect the pregnancy [6].

Nutrition crucially affected the first 2 years of pregnancy, known as the golden 1000 days of life. Adequate nutrition in this period could prevent the failure of growth and development that also known as stunting [7]. The previous study has shown that inadequate nutrition prior or during pregnancy could increase anemia in pregnancy, death, or neonatal complications [8], [9]. On the neonatal outcome, chronic malnutrition in pregnancy could lead to low birth weight, low birth length, premature birth, or intrauterine growth restriction (IUGR), leading to long-term complications [10]. Disorders such as gestational diabetes mellitus, preeclampsia, macrosomia, postpartum hemorrhage, and premature rupture of the membrane were also reported in pregnancy with malnutrition [11], [12].

This study aimed to describe pregnant women's maternal and neonatal outcomes with chronic energy deficiency, especially in Cipto Mangunkusumo General Hospital in Indonesia. We expect that this study could further prevent malnutrition in pregnancy and improve the treatment of the complications and outcomes of malnutrition in pregnancy.

Materials and Methods

This study was conducted in Cipto Mangunkusumo General Hospital in Indonesia from 2017 to 2020. This study is a retrospective cohort study with a descriptive design. Pregnant woman with chronic energy deficiency was included in this study which was retrospectively followed until labor. Sample size in this study was count with minimal sample size formula for descriptive category and mother with chronic energy deficiency proportion 30.3% [13]. With chronic energy, deficiency is defined as chronic malnutrition with a BMI below 18.5 kg/m^2 according to the Asian body mass classification. Pregnant women with prepregnancy BMI below 18.5 kg/m^2 were included in this study. Pregnant women with multiple pregnancies, intrauterine fetal death, and incomplete data records were excluded from the study.

Data collection was conducted after Ethical Clearance (Ethic Number: KET-1190/UN2.F1/ETIK/PPM.00.02/2020) was obtained using an electronic medical record from Cipto Mangunkusumo General Hospital. The total sampling method was obtained as there was a limited sample of chronic energy deficiency pregnancy. Variables received include characteristics (age, education, residence, maternal occupation, paternal occupation, pregnancy frequency, pregnancy interval, comorbidities before pregnancy, body weight before and after pregnancy, height, weight increase, and BMI before pregnancy), maternal outcome (hemoglobin level, complication during pregnancy or labor), and neonatal outcome (birth weight, birth length, 1st min APGAR score, 5th min APGAR score, neonatal intensive care unit (NICU) admission, IUGR, and neonatal complications). Prepregnancy BMI below 18.5 was used as the inclusion criteria. We divided the subject into three groups based on the BMI, mild, moderate, and severe malnutrition with BMI range 17–18.4, 16–16.9, and <16, respectively. The data obtained were reported descriptively; with numerical data was presented using mean and standard deviation. Categorical data were presented with frequency and percentage. The outcome of this study was to look at the characteristic, maternal, and neonatal outcomes of pregnant women with chronic energy deficiency.

Results

This study obtained 81 pregnant women with chronic energy deficiency in Cipto Mangunkusumo General Hospital in Indonesia from 2017 to 2020. The characteristic of the subject is presented in Table 1. Most of the subjects had a high school education, multigravida, and prepregnancy BMI which were mild malnutrition, live in Jakarta (Capital City), and work as housewife and their husband work as an employee.

Table 1: Subject's characteristic

Characteristics	Mean ± SD/n (%)
Age (years)	27 ± 6.39
Education	
Elementary school	22 (27.2)
Junior high school	15 (18.5)
High school	37 (45.7)
University	7 (8.6)
Gravida	2 ± 1.17
Primigravid	34 (42)
Multigravid (≥ 2)	47 (58)
Body weight before pregnancy (kg)	41.19 ± 3.78
Body weight after pregnancy (kg)	49.97 ± 5.94
Body weight increase (kg)	8.78 ± 4.63
Height (cm)	155.32 ± 5.81
Pre-pregnancy BMI (kg/m^2)	17.06 ± 1.11
< 16 (severe malnutrition)	13 (16)
16–16.9 (moderate malnutrition)	21 (26)
17–18.4 (mild malnutrition)	47 (58)
Province	
Jakarta	62 (76.5)
BoDeTaBek	13 (16.1)
Outside Jakarta Suburb	6 (7.4)
Maternal occupation	
Housewife	58 (71.6)
Employee	17 (20.9)
Student	2 (2.6)
Healthcare worker	4 (4.8)
Paternal occupation	
Employee	62 (76.5)
Business owner	6 (7.4)
Healthcare worker	1 (1.2)
Labor	4 (4.9)
Security	1 (1.2%)
Driver	2 (2.6)
Mechanic	1 (1.3)
Student	1 (1.3)
Unemployed	3 (3.6)

SD: Standard deviation, BMI: Body mass index.

Maternal outcomes of pregnant women with chronic energy deficiency are presented in Table 2.

Table 2: Clinical outcome of a pregnant woman with chronic energy deficiency

Variables	Mean ± SD/n (%)
Hb (g/dL)	10.8 ± 1.69
Anemic	42 (51.9)
Not anemic	39 (48.1)
Comorbidities before pregnancy	
None	68 (84)
Systemic lupus erythematosus	4 (4.9)
Type 2 diabetes mellitus	2 (2.5)
HIV infection	2 (2.5)
Hypertension	1 (1.2)
Valvular heart disease	1 (1.2)
History of antepartum hemorrhage	1 (1.2)
History of pulmonary tuberculosis	1 (1.2)
History of thyroid malignancy	1 (1.2)
Perinatal complications	
None	37 (45.6)
Premature rupture of membrane	19 (23.4)
Premature birth	5 (6.2)
Severe preeclampsia	5 (6.2)
Placenta previa	3 (3.7)
Low lying placenta	2 (2.5)
Intrauterine infection	2 (2.5)
Breech presentation	2 (2.5)
Fetal distress	2 (2.5)
Oligohydramnios	2 (2.5)
HELLP syndrome	1 (1.2)
Prolonged labor	1 (1.2)

SD: Standard deviation.

A significant percentage of the subjects were anemia (51.9%). However, most of the subjects do not have comorbidities before pregnancy. More than half of the subjects have maternal complications (54.4%). Chi-square analysis was conducted between the severity of chronic energy deficiency, and the incidence of anemia in pregnancy showed no significant difference (p = 0.509).

Neonatal outcomes are presented in Table 3, with most of the neonates having low birth weight (51%) and low birth length (78%). However, further analysis showed no significant difference between the severity of chronic energy deficiency and the degree of birth weight in neonates (p = 0.161). The comparison analysis of birth length between the severity of chronic energy deficiency also showed no significant difference between groups (p = 0.915). The first- and 5th-min APGAR scores showed moderate and severe asphyxia in 19% and 6% consecutively. Comparative analysis between chronic energy deficiency and APGAR scores showed no significant difference between groups in both first- (p = 0.409) and fifth- (0.344) min APGAR score. Respiratory distress syndrome caused by hyaline membrane disease is the most common complication that occurs in neonate subjects. Congenital defects were observed in this study with the incidence of congenital heart disease (2.5%), duodenal atresia (1.2%), omphalocele (1.2%), and multiple congenital abnormalities (1.2%). Association between the severity of malnutrition with congenital defects was significantly shown in this study (p = 0.031). The complication of IUGR and NICU admission showed significant prevalence in this study. The incidence of IUGR reached 30.9% of all neonates. Comparison analysis showed no significant association between the severity of chronic energy deficiency with the incidence of IUGR (p = 0.379). The prevalence of NICU admission in neonates reached 46% of all neonates, with significant association with the severity of chronic energy deficiency (p = 0.001).

Table 3: Neonatal outcome of chronic energy deficiency pregnancy

Variables	Mean ± SD/*n* (%)	p
Birth weight (g)	2265 ± 607.17	0.161
Normal birth weight	29 (35.8)	
Low birth weight	42 (51.9)	
Very low birth weight	8 (9.9)	
Extremely low birth weight	2 (2.5)	
IUGR		
Yes	25 (30.8)	0.379
No	56 (69.2)	
Birth length (cm)	44 ± 4.18	
48–52 (normal)	21 (25.9)	0.915
< 48 (low)	60 (74.1)	
First minute APGAR		
0–3 (severe asphyxia)	3 (3.7)	0.409
4–6 (moderate asphyxia)	13 (16)	
7–10 (normal/mild asphyxia)	65 (80.3)	
Fifth minutes APGAR		
0–3 (severe asphyxia)	1 (1.2)	0.344
4–6 (moderate asphyxia)	4 (5)	
7–10 (normal/mild asphyxia)	76 (93.8)	
Neonatal complications		
None	51 (63)	0.031
Hyaline membrane disease	15 (18.5)	
Early-onset neonatal sepsis	9 (11.1)	
Congenital heart disease	2 (2.5)	
Duodenal atresia	1 (1.2)	
Omphalocele	1 (1.2)	
Multiple congenital anomalies	1 (1.2)	
Meconium aspiration syndrome	1 (1.2)	
NICU		
Yes	38 (46.9)	0.001
No	43 (53.1)	

IUGR: Intrauterine growth restriction, SD: Standard deviation, NICU: Neonatal intensive care unit.

Discussion

Chronic energy deficiency is related to low body weight, low energy, and limited physical capacity caused by chronic food depletion. The state of chronic energy deficiency increased the risk of perinatal complications such as death, premature birth, IUGR, and low birth weight. This could lead to low productivity among adults and be associated with high morbidity and mortality. Factors such as age, occupation, frequency of eating, health status, marriage status, education status, address, parity, and food vulnerability cause chronic energy depletion in the normal population [14].

In this study, we included 81 pregnant women with chronic energy deficiency. In this study, we found that pregnant women aged 24–35 have the highest proportion compared to other age groups. Earlier studies showed similar results in the most common age group of 21–35 years old [15]. The results showed that the best time to have a pregnancy is older than 20 years old and younger than 34 years old with better maternal nutritional status [16]. However, there is no significant association between age group and chronic energy deficiency severity found in this study [15]. In this study, most of the subjects live in Jakarta, with 76.5% of all subjects. The previous studies have shown a significant association between the living address and chronic energy deficiency [17].

Education level showed that only 8.6% of all the subjects were university graduates. However, there is no significant difference between the level of education and the severity of chronic energy deficiency. Prior studies showed no association between education level and chronic energy deficiency [18]. Other studies showed that women with lower education levels have 2.25 times higher risks of malnutrition than normal populations [19].

Most of the subjects included in this study were primigravid, with a proportion of 42%. A previous study showed a similar result with a high prevalence of primigravid pregnancy in chronic energy deficiency patients [20]. The association of primigravid pregnancy with chronic energy deficiency could be caused by eating limitation practice, which is very common in developing countries. One of the independent factors of this eating limitation practice is primigravid pregnancy teen pregnancy, low education level, and low BMI [21]. Another study by Suzuki *et al*. showed a significant association between BMI before pregnancy with low birth weight [22]. This could be treated by the education shown by another study that proven the improvement of malnutrition with proper education [23]. Maternal comorbidities were found in 16% of all the subjects in this study, with systemic lupus erythematosus followed by diabetes mellitus as the most common comorbidities. Comparison analysis showed no association between previous maternal comorbidities with chronic energy deficiency.

This study reported the incidence of worse maternal outcomes in chronic energy deficiency pregnancy with a high prevalence of anemia and perinatal maternal complications. A high incidence of anemia in chronic energy deficient pregnancy has been reported in a previous study, with a proportion of 75% in all chronic energy deficient subjects. Chronic iron deficiency is the most common nutrient deficiency in the world and a significant common cause of anemia worldwide. It is mainly caused by inadequate dietary intake, hemorrhage, and malabsorption. Chronic energy deficiency conditions in pregnancy could, further, aggravate the iron deficiency, thus increasing anemia in pregnancy [24]. Anemia in pregnancy is associated with mortality in postpartum hemorrhage, premature birth, low birth weight, and child stunting [25].

Neonatal outcomes in this study showed a high prevalence of low birth weight and birth length. However, comparison analysis showed no significant association between chronic energy deficiency severity and the incidence of low birth weight or low birth length [26]. Patel *et al*. also reported higher risks of stillbirths, neonatal deaths, and low birth weight in the combination of malnutrition and anemia [27]. The previous study has shown that low birth weight and birth length could be affected by malnutrition in pregnancy and other complications such as premature birth or congenital defects. Another study has shown that malnutrition in pregnancy could lead to long-term neonatal complications such as low cognitive function, low academic achievement, low professionality, and lower overall income in adulthood [28]. The incidence of low birth weight is higher in the population with low body weight increase during pregnancy [29].

The previous study has reported that inadequate body weight increases in pregnancy correlated with low birth weight [30]. Prepregnancy BMI also correlated with low birth weight, as shown in a previous study [31].

Neonatal outcomes such as first and 5th min APGAR score showed normal or mild asphyxia in most subjects. Furthermore, there was no significant association between the severity of chronic energy malnutrition with neither first nor 5th min APGAR score. The association between chronic energy malnutrition with APGAR score has not been shown in the previous study.

The neonatal complication in chronic energy deficiency pregnancy has shown a significant prevalence of hyaline membrane disease and early-onset neonatal sepsis. This is also proven in a previous study with a high incidence of NICU admission in neonates with a history of chronic energy deficiency pregnancy [32]. Pregnancy with chronic energy deficiency has an increased risk of premature birth with low birth weight in 18% of the population [33]. Low birth weight infant needed to be hospitalized in the NICU for monitoring. Premature birth with low birth weight has a higher risk of having respiratory problems, infection, neurological damage, congenital heart disease, and retinopathy; thus, further needed to be in the NICU [34]. The incidence of IUGR is also correlated with malnutrition in pregnancy with other complications such as prematurity and congenital defects [35]. The mechanism of IUGR is caused by abnormal placental growth and development, deficiency in nutrition transfer in the placenta, endocrine disorders, and metabolism disorders [36].

In this study, congenital defects were also significantly higher in chronic energy deficiency in pregnancy than the normal population, with a 6.1% incidence of congenital heart disease, duodenal atresia, omphalocele, and multiple congenital abnormalities. Centers for Disease Control and Prevention reported the incidence of congenital defects of 3% in the general population, including brain/spine defects, eye defects, heart defects, mouth/face defects, intestinal defects, muscle/bone defects, and chromosomal defects [37]. Congenital defects prevalence related to malnutrition in pregnant women reached 1–10/1000 births worldwide. These congenital defects include neural tube defect, congenital heart disease, and limb or orofacial defects [38], [39]. Compared with the previous study, the incidence of congenital defects was significantly higher in chronic energy deficient pregnancy. The association between chronic energy malnutrition and congenital defects was further supported by the significant association between the severity of malnutrition and complications, including congenital defects. The most common congenital defect is neural tube defect which is associated with folic acid and B12 deficiency. The deficiency of folic acid was also associated with congenital heart disease. Periconceptional intake of thiamin, niacin, and B6 could reduce the risks of orofacial defects [39]. The prevention and management of maternal malnutrition will effectively decrease the incidence of congenital defects, thus improving the quality of future generations.

Prevention and management of chronic energy deficiency in pregnancy should be the responsibility of community leaders, health-care providers, and policymakers to provide holistic management [40]. The results of this study could provide clinical data for future research about maternal malnutrition and chronic energy deficiency in pregnancy. This study could also improve the community education and counseling to provide information about malnutrition in pregnancy. Antenatal care is recommended to obtain sufficient knowledge about adequate nutrition in pregnancy to reduce chronic energy deficiency in pregnancy. The participation of pregnant women in education and counseling programs could improve the understanding of malnutrition in pregnancy. The participation of family members, community leaders, health-care providers, and local government provides promotion, prevention, early diagnosis, and treatment of chronic energy deficiency in pregnancy. The realization of sustainable development goals, especially to reduce maternal and infant mortality, should be enforced by the ministry of health, in particular in rural areas.

The limitation of this study is the non-randomized data sampling in data collection, which is caused by the limited data available. Most of the subjects were from Jakarta, thus leading to population bias in this study. Furthermore, premature neonates were not excluded from this study and could lead to bias in the APGAR score results. The difficulty in obtaining essential variables also occurred in this study as the data were collected from the medical records. Upper limb circumference as a malnutrition indicator is one of the important variables that were not obtained from the medical records. Research with a large number of subjects, proper randomization, and complete variable, which included numbers of rural area hospitals, could improve the results reported in this study.

Conclusions

This study shows that there is a significant association between chronic energy deficiency with the incidence of neonatal complications and NICU admission. Chronic energy-deficient pregnancy showed a high prevalence of anemia and pregnancy complications of premature rupture of the membrane in the maternal outcome. Neonatal outcomes showed a high prevalence of low birth weight, high prevalence of congenital defects, hyaline membrane disease, and IUGR.

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