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The impact of nutritional status and maternal behavior on infant growth

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ABSTRAK

Latar Belakang: *Perilaku ibu selama kehamilan erat kaitannya dengan kondisi janin. Kekurangan gizi pada ibu hamil dapat menyebabkan Bayi Berat Lahir Rendah (BBLR) dan juga penurunan tingkat kecerdasan. Prevalensi stunting pada tahun 2021 mengalami penurunan sebesar 1,6 dari tahun 2019, yaitu dari 27,7% menjadi 24,4%.*
Tujuan: *Untuk mengetahui pengaruh status gizi dan perilaku ibu terhadap tumbuh kembang bayi di Jakarta Barat.*
Metode: *Penelitian ini merupakan penelitian cross-sectional, dimulai pada bulan Juli 2017 hingga Januari 2018. Sebanyak 66 subjek ibu hamil usia 18-35 tahun dipilih untuk mengikuti penelitian sejak usia kehamilan 37 minggu hingga persalinan. Minum alkohol, jamu tradisional, obat-obatan, dan merokok merupakan indikator perilaku ibu. Konsentrasi IGF-1 ibu, berat badan, panjang badan, dan denyut jantung bayi merupakan indikator pertumbuhan bayi. Uji Chi-Square dan Independent T-Test digunakan untuk analisis statistik*
Hasil: *Subjek menunjukkan rerata usia 26,0±4,8 tahun, tinggi badan 154,0±4,9 cm, berat badan pada kehamilan ketiga 66,4±11,3 kg, IMT 22,6±3,7 kg/m2, LILA (lingkar lengan atas) 27,2±3,3 cm, dan suhu tubuh. 36,2±1,3°C. Perilaku ibu dan status gizi tidak berpengaruh nyata terhadap tumbuh kembang bayi (p≥0,05). Namun, LILA merupakan faktor yang mempengaruhi denyut jantung pada bayi (p<0,05).*
Kesimpulan: *Status gizi merupakan salah satu indikator yang mempengaruhi tumbuh kembang bayi; Oleh karena itu, ibu hamil perlu lebih memperhatikan status gizi, asupan gizi dan perilaku hidup sehat selama kehamilannya.*

KATA KUNCI*: pertumbuhan bayi; perilaku ibu; riwayat kesehatan; status gizi; ibu hamil*

ABSTRACT

Background: *Maternal behaviour during pregnancy is closely related to the condition of the fetus. Malnutrition in pregnant women can cause Low Birth Weight Babies (LBW) and a decrease in intelligence level. The prevalence of stunting in 2021 decreased by 1.6 from 2019, from 27.7% to 24.4%.*
Objectives: *This study aims to determine the impact of nutritional status and maternal behaviour on infant growth in West Jakarta.*
Methods: *This study was cross-sectional, from July 2017 until January 2018. A total of 66 subjects of pregnant women aged 18-35 were chosen to participate in the study from their 37th weeks of pregnancy to delivery. Drinking alcohol, traditional herbs, medicines, and smoking were indicators of maternal behaviour. Maternal IGF-1 concentrations, body weight, body length, and infant heart rate were indicators of infant growth. Chi-Square test and Independent T-Test were used for the statistical analysis.*
Results: *The subjects showed a mean of 26.0±4.8 years old, body height of 154.0±4.9 cm, body weight in third pregnancy of 66.4±11.3 kg, BMI of 22.6±3.7 kg/m^2, MUAC of 27.2±3.3 cm, and body temperature of 36.2±1.3°C. Maternal behaviour and nutritional status did not significantly affect infant growth (p≥0.05). However, MUAC was a factor that affected heart rate in infants (p<0.05).*
Conclusions: *Nutritional status is one indicator that affects infant growth; therefore, pregnant women*

need more attention to keep their nutritional status, nutritional intake and healthy living behaviour during pregnancy.

KEYWORDS*: infant growth; maternal behavior; medical history; nutritional status; pregnant women*

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INTRODUCTION

One of the maternal health problems is infant growth. In Indonesia, this problem has still become a serious problem. Because the infant mortality rate (IMR) was still high about 24 per 1000 births. [1] Furthermore, RISKESDAS 2018 showed the prevalence of stunting in Indonesia about 30.8% of toddlers due to chronic malnutrition. [2] The prevalence of stunting in 2021 decreased by 1.6 from 2019, from 27.7% to 24.4%. [3] Therefore, a strategy is needed to improve infant growth in Indonesia. In this regard, research is important to determine the factors influencing infant growth.

In the literature, several researchers have attempted to investigate the factors that influence infant growth. Maternal nutritional status and behavior are indicators of optimum growth and development of fetus, especially for the predictor of offspring cognitive function. [1-2] Maternal nutritional status, maternal body composition (fats and fluids), metabolism, and placental function are the main factors determining fetal development, such as adverse pregnancy outcomes and expression of fetal genetic potential. [4-6]

In addition to health status, nutrient intake contributes significantly to maternal nutritional status. Many studies found the relationship between diet and unfavorable obstetric outcomes as seen from the level of nutrient intake, foods, or dietary patterns. [7-8] The contribution of maternal nutrition and pregnancy outcome is a complex problem influenced by biological, socio-economic, demographic, populations, morbidity, healthcare costs and services. [9-11] Maternal behavior is one factor that contributes to a mother's health status. Commonly, maternal behavior is related to dietary patterns and lifestyle, such as activity, smoking, medication and traditional herbs, drinking alcohol. [12-14] Many studies found an association between dietary patterns in pre and pregnancy to maternal mental health disorders and their impact on pregnancy outcomes. [15-17] Maternal healthy dietary pattern consists of higher intakes of vegetables, fruits, and animal protein (fish during pre-pregnancy and pregnancy) that protect against anxiety symptoms. [18-19] Maternal behavior in pregnancy is related to fetus development. Studies found that mothers who consume alcohol during pregnancy affect neurodevelopment in a fetus. [20-21] Another study stated that smoking behavior is related to neurodevelopment and weight gain in pregnancy. [22-23]

In Indonesia, 14.8% of undernourished mothers have a high risk of pregnancy complications. [24] Undernutrition mothers will have an increased risk of delivering a baby with low birth weight and height. Many factors contributing to undernutrition in mothers include socioeconomic, demographics, education, and morbidity (health history). [25-27] We conducted the cohort study to prove the hypothesis and understand the relationship of some factors. Therefore, this study aims to understand the impact of nutritional status and maternal behavior on infant growth. This study was conducted from the second trimester, while observation was in the third trimester until the mother delivered the baby.

MATERIALS AND METHODS

This was a cross-sectional study on the impact of maternal nutritional status and behavior on infant growth. The study was conducted in the Kebon Jeruk, West Jakarta, Indonesia, from July 2017 until January 2018. The study sites consist of

seven healthcare centers with the highest number of pregnancy examinations. Ethical approval was granted by the Ethics Committee of the Faculty of Medicine, University of Indonesia (No.869/UN2.F1/ETHICS/2016).

The total samples of this study were 66 pregnant women who visited a health care center in Kebon Jeruk. The inclusion criteria were as follows; 1) doing pregnancy examination at the study site, 2) in the second and third trimester, 3) in normal health (no secondary infection) based on the medical record, 4) never having low-birth-weight or stunted (<48 cm), 5) aged between 18-35 years, 6) the height between 150–165 cm, 7) having BMI (body mass index) of 18.5–25.0, 8) having experienced urinary tract infection, 9) having experienced vomiting, nausea, and diarrhea in the first trimester, 10) having planning to delivery in the study site, 11) signing the informed consent, 12) being willing to comply with the study procedures, and 13) never doing caesarean delivery. Meanwhile, the schema of collecting subjects was as follows: The data collected were characteristics of subjects (mothers) such as mother's age, body weight, body height, BMI, weight gain, MUAC (mid-upper arm circumference), heart rate, body temperature, and blood pressure. Midwife and trained enumerators measured the anthropometric data. In addition, the midwife measured the infant's growth data such as birth weight, length, and heart rate. Blood biomarkers, such as IGF-1 (insulin growth factor-1) level, were taken by the midwife from the placentae shortly after birth and were analyzed at the Accredited Laboratory.

Weight was measured by a weighing scale and rounded to the nearest 0.1 kg; height was measured using a microtoise stature meter and rounded to the nearest 0.1 cm; upper arm circumference was measured by a meter line and rounded to the nearest 0.1 cm. The data on maternal behavior and health history were administered using trained enumerators with a background in nutrition. The IGF-1 level was analyzed using the sandwich ELISA (enzyme-linked immunosorbent assay) method.

The variable maternal behavior consisting of drugs, drinking traditional herbal medicine, and smoking was used for analyses. First, we categorized them into two; "Yes and No." Then, for maternal health history, we divided it into two; "Frequent and Rare." Frequent category means that mothers feel more than two diseases and symptoms every month. On the contrary, the rare category means that women feel less than two diseases and symptoms every month (from the first to the third trimester). Next, we used BMI and MUAC indicators of nutritional status according to WHO standards. Afterwards, we categorized them into two; "Abnormal and Normal." The abnormal category means that BMI and MUAC are lower and higher than normal. In addition, we used two categories for the weight gain variable: "Abnormal and Normal."

Data analysis was conducted to understand the relationship between maternal nutritional status and maternal behavior on infant growth (IGF-1, birth weight, birth length, and heart rate). The independent t-test was used to analyze the impact of maternal nutritional status and maternal behavior on infant growth. An easy way to comply with the journal paper formatting requirements is to use this document as a template and type your text into it. The process of collecting subjects is illustrated in Figure 1.

RESULTS AND DISCUSSIONS

Table 1 shows that most of the subjects were in a normal range. The subjects showed a mean of 26.0±4.8 years old, body height of 154.0±4.9 cm, body weight in third pregnancy of 66.4±11.3 kg, BMI of 22.6±3.7 kg/m^2, MUAC of 27.2±3.3 cm, and body temperature of 36.2±1.3°C.

Another study found that increasing mother's age has a lower risk of developmental for babies born from mothers aged 15-30 years. On the contrary, the mother aged 35 years or older tended to have increasing vulnerability (high risk in pregnancy). [28-29] The ideal mother's age to get pregnant is around the early twenties, which is relevant to the international context of later childbearing. [30-31]

This study shows body weight, height, BMI, and MUAC in a normal standard range. Maternal undernutrition is critical for maternal health, neonatal, and pregnancy outcomes. Many studies

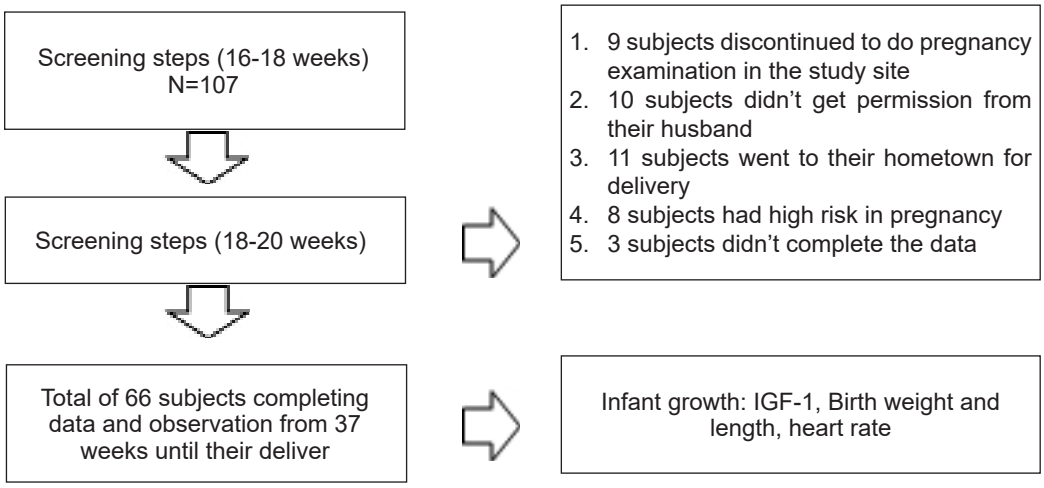

Figure 1. The process of collecting subject

Table 1. Characteristics of subjects

Variables	Mean ± SD
Mother's age (y)	26.0±4.8
Body height (cm)	154.0±4.9
Body weight before pregnancy (kg)	54.5±9.3
Body weight in the third trimester (kg)	66.4±11.3
BMI (*kg*/m^2)	22.6±3.7
Weight gain (kg)	11.9±4.0
MUAC (cm)	27.2±3.3
Heart rate (bpm)	89.0±18.3
Body temperature (^{0}C)	36.2±1.3
Blood pressure:	
Systole (mmHg)	108.6±9.0
Diastole (mmHg)	68.6±6.5

stated that mothers who are undernutrition status affected morbidity events and dietary patterns, and nutrient intake. [32] Maternal nutrition is one of the determinant factors of nutritional status. Maternal undernutrition is critical for maternal health, neonatal, and pregnancy outcomes. Therefore, maternal nutrition refers to the nutritional needs of pregnant women during antenatal and postnatal periods and in the conceptual period. [33]

Table 2 shows that most subjects said "No" to some indicators of maternal behaviors (drinking alcoholic, drugs, taking traditional herbs, and smoking). However, a few of them said "Yes" for some indicators of maternal behaviors such as drugs, taking traditional herbs, and smoking.

Meanwhile, for indicators of maternal health history, it shows the proportion of subjects who said "No" for some indicators such as nausea and vomiting; hypertension; swollen feet, hands, and face; convulsions; fever; pain full urination; eyes/ yellow skin, urine colour like tea; dizziness, pale; tiredness; and diabetes mellitus were higher than subjects who said "Yes." Nevertheless, this was still a problem during the pregnancy period. At least, reducing the symptoms and diseases during pregnancy will help reduce the risks arising during pregnancy until delivery.

Many studies stated that mothers who consume alcohol and drugs tend to get fetal physical and neurological impairment since it would affect their dietary pattern and maternal nutrition. [34] Prenatal nutrition interventions and strategic therapy must reverse directing to normal development.

Another study found that mothers who experience certain symptoms and diseases during pregnancy, in a healthy state and with adequate nutritional intake have a low risk of pregnancy disorders and intrauterine growth restriction (IUGR). [35]

Table 3 shows no difference between infant growth (IGF-1 level, birth weight, birth height, heart rate) based on maternal behavior, maternal health history, BMI, and weight gain. However, we found a different heart rate between the chronic deficiency energy group and the normal based on the MUAC category (P <0.05).

This study also describes a tendency of IGF-1 levels based on maternal behaviors (drugs,

Table 2. Maternal behavior and health history description in pregnancy period

Variables	Yes N[%]	No N[%]
Maternal behaviors:		
Drinking alcohol	0 (0.0)	66 (100.0)
Drugs	9 (13.6)	57 (86.4)
Drinking traditional herbs	4 (6.1)	62 (93.9)
Smoking	2 (3.0)	64 (97.0)
Maternal health history:		
Nausea and Vomiting	13 (19.7)	53 (80.3)
Hypertension	16 (24.2)	50 (75.8)
Swollen feet, hands, and face	26 (39.4)	40 (60.6)
Convulsions	13 (19.7)	53 (80.3)
Fever	21 (31.8)	45 (68.2)
Painful urination, frequent, and less	25 (37.9)	41 (62.1)
Eyes/yellow skin, urine color like a tea	14 (21.2)	52 (78.8)
Dizziness, pale	16 (24.2)	50 (75.8)
Tiredness, Breathlessness, or shortness of breath	15 (22.7)	51 (77.3)
Diabetes Mellitus	4 (6.1)	63 (93.9)

Table 3. The factors affecting infant growth

Variables	Infant's growth			
	IGF-1 [ng/ml]	Birth weight [kg]	Birth length [cm]	Heart rate [bpm]
Maternal behavior				
Drugs				
Yes	40.5±10.7	3.05±0.25	48.3±0.8	142.0±2.8
No	46.5±12.2	3.08±0.48	48.2±1.4	141.0±2.3
Taking traditional herbs				
Yes	40.5±14.5	3.29±0.71	48.5±1.2	141.7±2.0
No	46.0±11.9	3.06±0.43	48.2±1.3	141.0±2.4
Smoking				
Yes	36.0±9.80	2.73±0.99	47.5±0.7	141.3±2.8
No	45.9±12.0	3.09±0.45	48.2±1.3	141.0±2.4
Maternal health history				
High (often)	44.9±11.1	3.05±0.47	47.9±1.5	141.5±3.1
Low (rare)	46.2±12.9	3.10±0.44	48.3±1.1	140.6±1.6
Nutritional status				
Abnormal	43.3±16.6	3.21±0.44	48.5±1.4	140.7±1.3
Normal	45.0±11.7	3.08±0.45	48.0±1.3	140.9±2.7
MUAC (cm)				
Chronic deficiency energy	47.0±16.6	2.93±0.74	47.5±2.9	142.7±5.0*
Normal	45.9±11.5	3.10±0.39	48.3±0.9	140.8±1.8
Weight gain in pregnancy period:				
Abnormal	44.8±11.9	3.06±0.46	48.0±1.3	141.1±2.6
Normal	51.7±11.9	3.20±0.36	48.8±0.8	140.1±1.1

Data presented in mean±SD, *P<0.05

traditional herbs, and smoking). Mothers who said "No" for consuming drugs, traditional herbs, and smoking showed IGF-1 levels higher than the ones who said "Yes." Based on maternal health history, mothers who said "rare" or in "low" group had IGF-1 levels higher than the ones who said "frequent" or in "high" group. In line with the nutritional status and weight gain variable, mothers in the normal group had IGF-1 levels higher than the abnormal group.

Another study stated that maternal behavior such as food patterns, drugs consumption, drinking alcohol, taking traditional herbs, and smoking correlates to fetal development. [36-37] Also, historical maternal status is related to childbirth.

[38-39] Mothers with a history of easy to get sick or often feeling sick will have susceptible fetus and fetus growth restriction. [40-41]

Another study found many factors related to IGF-1 level as one indicator of fetal growth such as environment, genetics, maternal food pattern, maternal health status, and maternal behavior. IGF-1 system is the regulator of fetal growth. Through the interaction of two growth factors (IGF-I and IGF-II), the actions are influenced by up to six other binding proteins (IGFBP) related to fetal growth. However, IGF-1 dominates in later gestation, while IGF-II is the primary growth factor in the embryonic period. [42-46]

Nevertheless, another study showed many factors have contributed to infant growth, such as placental structure and function, neonatal morbidities, gestational weight gain, pre-pregnancy weights, maternal behaviors, dietary pattern, maternal sanitations, socio-economic and demographics. [47-52] Pregnant women should monitor their nutritional status (weight gain), nutritional intake and healthy living behavior during pregnancy.

CONCLUSIONS AND RECOMMENDATIONS

This study found no differences in infant growth (IGF-1, birth weight, birth length, heart rate) based on maternal behavior variables (drugs, smoking, and taking traditional herbs). In addition, maternal health history had no association with infant growth (IGF-1, birth weight, birth length, heart rate). However, this study proved there were differences in heart rate as one indicator of infant growth between mothers in chronic deficiency energy and the normal group. Nutritional status is one indicator that affects infant growth. Therefore, pregnant women need to pay more attention to keeping their nutritional status, nutritional intake and healthy living behavior during pregnancy.

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