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The Relationship Between First-Trimester Body Mass Index and the Occurrence of Miscarriage in Pregnant Women

Yanfa Oktazhahira Putra Pratama Tjikman[1], Fransisca Chondro[2]*

[1]Medical Program, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia
[2]Department of Physiology, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia
*E-mail : Fransisca_chondro@trisakti.ac.id

Abstract

The nutrition in the early stages of pregnancy can affect implantation, development of placenta and continuation of the pregnancy. Measurement of body mass index in the first trimester is an important parameter for evaluation of risk of miscarriage. To assess the relationship between body mass index and miscarriage This is an observational analytical study with a retrospective cross-sectional medical-record study. Data used in this study is a secondary data obtained from the medical records of pregnant women who visit Koja Regional General Hospital between January 2024 to December 2025. A total of 688 first-trimester pregnant women who met the inclusion and exclusion criteria were recruited through non-random consecutive sampling. The patients' body mass index was categorized into underweight, normal, overweight, class I obesity, and class II obesity. To evaluate the link between variables, a Chi-square test was performed, applying a statistical significance threshold of $p<0.05$. Among 688 participants, 146 women (21.2%) experienced miscarriage. Normal body mass index was the most common category (29.4%), followed by class I obesity (29.0%), overweight (24.1%), class II obesity (9.2%), and underweight (8.3%). Body mass index measured in the first trimester was showed a significant association with miscarriage ($p<0.001$). Pregnant women classified as underweight presented 24.05 times higher odds of experiencing a miscarriage compared to those with a normal body mass index. First-trimester body mass index was significantly associated with miscarriage. Therefore, early assessment of the nutritional status of pregnant women is essential, particularly during the first trimester of pregnancy.

Keywords: Body Mass Index, Miscarriage, First Trimester, Nutritional Status, Pregnant Women

1. Introduction

Miscarriage is still an important reproductive health problem as it may contribute to maternal morbidity and mortality. In Indonesia, recent studies have highlighted pregnancy loss as an important maternal health concern. A nationwide cross-sectional study involving 18,882 women of reproductive age identified several factors associated with pregnancy loss, including advanced maternal age, grand multiparity, and smoking.[1] Furthermore, a systematic review of maternal mortality in Indonesia reported that pregnancy with abortive outcomes accounted for approximately 2% (236 cases) of maternal deaths, highlighting its contribution to adverse maternal outcomes.[2] A recent case-control study in South Kalimantan also demonstrated significant associations between miscarriage and maternal nutritional status, parity, educational level, and employment status.[3] Modifiable and non-modifiable factors influencing miscarriage are many, including maternal age, parity, reproductive history, maternal disease, and nutritional status.[4] Body mass index can be used to assess maternal nutritional status. The first trimester is of special interest because this is the time of implantation, early embryonic development, and placental formation, and the body mass index at this time is of special interest. Poor or excessive nutritional status may interfere with hormonal balance, metabolic regulation, inflammatory responses, endometrial receptivity, and embryo implantation and increase the risk of miscarriage.[5] Earlier research has shown mixed results concerning

the link between a mother's body mass index and the likelihood of miscarriage. Silitonga et al. did not observe a meaningful correlation between body mass index and spontaneous miscarriage at Dr. Mohammad Hoesin General Hospital, Palembang.[6] Compared to this, Fitri and Herdiman found a strong correlation between maternal body mass index and miscarriage rate, with underweight pregnant women being more prevalent among miscarriage cases.[7] The variations in the results could be attributed to differences in the population under study, profile of respondents, clinical setting, and time of measurement of body mass index. There are limited data on the association between body mass index specifically calculated at the first trimester and miscarriage, especially among hospital-based pregnant women in Jakarta. Nutritional status measured in the first trimester may more closely reflect maternal body composition before large gestational weight gains. Therefore, the present study was conducted to determine the association of BMI in the first trimester of pregnancy with the risk of miscarriage in pregnant women attending Koja Regional General Hospital.

2. Method

This study used a retrospective cohort design based on medical records of pregnant women who attended their first antenatal care (ANC) visit at Koja Regional General Hospital, North Jakarta, Indonesia, between January 2024 to December 2025. BMI was calculated based on body weight and height recorded at the first ANC visit, while the occurrence of miscarriage was identified from pregnancy outcomes documented in the medical records.

Participants were recruited using consecutive non-random sampling. During this study, medical records of pregnant women were reviewed to check eligibility according to the inclusion and exclusion criteria. Participants were included if their medical records documented a first-trimester pregnancy at the time of their initial antenatal care (ANC) visit. Records were excluded if incomplete, or there were conditions such as fetal congenital abnormalities, diabetes mellitus, cancer, or autoimmune diseases. After the screening process, 688 pregnant women were included in the final analysis.

The main independent variable was maternal BMI during the first trimester, while miscarriage was the dependent variable. BMI was calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2). Based on the Indonesian Ministry of Health guidelines, BMI was classified into five categories: underweight (<18.5 kg/m^2), normal weight (18.5-22.9 kg/m^2), overweight (23.0-24.9 kg/m^2), class I obesity (25.0-29.9 kg/m^2), and class II obesity (≥30.0 kg/m^2).[8] Miscarriage was identified based on the diagnosis documented by an obstetrician and gynaecologist in the medical records. Maternal age, gravidity, parity, and previous miscarriage history were also recorded as additional maternal characteristics.

Before analysis, the data were checked, coded, entered, and cleaned. Statistical analysis was performed using SPSS version 29.0. Categorical variables were presented as frequencies and percentages. The Chi-square test was used to examine the association between BMI, maternal age, gravidity, parity, previous miscarriage history, and miscarriage. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to assess the strength of the associations. A p-value of <0.05 was considered statistically significant.

3. Result

The data of 688 pregnant women who matched the criteria were analyzed using SPSS. Among the participants, 78.8% of women did not experience miscarriage.

Table 1. Characteristics of The Study Participants

Characteristic	n	%
First-trimester body mass index		
Underweight	57	8.3
Normal weight	202	29.4
Overweight	166	24.1
Class I obesity	200	29.0
Class II obesity	63	9.2
Miscarriage		
Yes	146	21.2
No	542	78.8
Maternal age		
Risk age (<20 or >35 years)	225	32.7
Non-risk age (20-35 years)	463	67.3
Gravidity		
Primigravida	143	20.8
Multigravida	463	67.3
Grande multigravida	82	11.9
Parity		
Nullipara	187	27.2
Primipara	243	35.3
Multipara	239	34.7
Grand multipara	19	2.8
Previous miscarriage		
Yes	192	27.9
No	496	72.1

Table 2. Association between study variables and miscarriage

Variable	Miscarriage n (%)		p-value
	Yes	No	
First-trimester body mass index			
Underweight	49 (7.12)	8 (1.16)	<0.001
Normal weight	41 (5.96)	161 (23.40)	
Overweight	29 (4.22)	137 (19.91)	
Class I obesity	16 (2.33)	184 (26.74)	
Class II obesity	11 (1.60)	52 (7.56)	
Maternal age			
Risk age	92 (13.37)	133 (19.33)	<0.001
Non-risk age	54 (7.85)	409 (59.45)	
Gravidity			
Primigravida	23 (3.34)	120 (17.4)	<0.001
Multigravida	82 (11.92)	381 (55.38)	
Grande multigravida	41 (5.96)	41 (5.96)	
Parity			
Nullipara	25 (3.63)	162 (23.55)	0.018
Primipara	55 (7.99)	188 (27.33)	
Multipara	61 (8.87)	178 (25.87)	
Grand multipara	5 (0.73)	14 (2.03)	
Previous miscarriage			
Yes	63 (9.16)	129 (18.75)	<0.001
No	83 (12.06)	413 (60.03)	

The most common first-trimester body mass index category was normal weight, comprising 202 participants (29.4%), followed by class I obesity in 200 participants (29.0%), overweight in 166 participants (24.1%), class II obesity in 63 participants (9.2%), and underweight in 57 participants (8.3%). Most participants were aged 20-35 years (67.3%), were multigravida (67.3%), and had no previous history of miscarriage (72.1%). Primipara was the largest parity group, accounting for 243 participants (35.3%). First-trimester body mass index demonstrated a significant correlation with miscarriage occurrence ($p<0.001$).

The highest proportion of miscarriage was observed among underweight participants, with 49 of 57 women (86.0%) experiencing miscarriage. Compared with participants with normal BMI, those who were underweight had 24.05 times higher unadjusted odds of miscarriage (OR = 24.05; 95% CI: 10.57-54.73). Maternal age, gravidity, parity, and a history of previous miscarriage were also associated with the occurrence of miscarriage in the unadjusted analysis. Higher proportions of miscarriage were found among women in the maternal age risk group, with a history of grand multigravidity, a history of grand multiparity, and a previous history of miscarriage.

4. Discussion

The proportion of miscarriage was highest in underweight women. This finding may indicate a relationship between low maternal BMI and miscarriage, although it does not imply a causal link. A low BMI may be related to several underlying factors, such as insufficient energy intake, long-term nutritional inadequacy, pre-existing health conditions, and micronutrient deficiencies alone. The first trimester is particularly important for pregnancy development because this is where implantation, early placental formation, and embryonic growth take place. Although maternal nutritional status may be associated with pregnancy outcomes during this period, other factors, such as maternal age, underlying medical conditions, genetic abnormalities, and socioeconomic circumstances, may also contribute to the observed association.[5,8,9] Low BMI may be associated with hormonal disturbances that affect normal reproductive function. In women, inadequate energy availability and reduced body fat may disrupt the hypothalamic-pituitary-gonadal axis, potentially affecting ovulation and reproductive hormone regulation.[10, 11]

These results are in line with the research conducted by Fitri and Herdiman that there is a strong correlation between maternal body mass index and the incidence of miscarriage, especially that underweight pregnant women are more likely to experience miscarriage.[7] Balsells et al. reported similar findings, suggesting that women who were underweight before pregnancy had a higher likelihood of miscarriage.[10] This may indicate that inadequate maternal nutritional status is associated with less favourable pregnancy outcomes. On the other hand, overweight and obesity may influence pregnancy through different metabolic mechanisms. Excess body fat has been associated with insulin resistance, chronic inflammation, oxidative stress, hormonal disturbances, and impaired endometrial function, which may affect embryo implantation and placental development. However, our findings showed a different pattern, with a lower proportion of miscarriage among women with class I obesity than among those with normal BMI (8.0% vs. 20.3%). This difference should be interpreted with caution, as it may be influenced by other maternal characteristics, potential confounding factors, or selection bias. It is also possible that the relationship between

BMI and miscarriage is not linear. Therefore, further studies with adequate adjustment for potential confounders are needed to better understand this relationship.[12-14]

Conversely, the present findings differ from the study of Silitonga et al., which reported no significant association between maternal body mass index and spontaneous miscarriage.[6] This difference might be explained by the difference in study design, sample size, characteristics of participants, research setting, and the time of body mass index measurement. Gestational weight gain may affect body mass index at different gestational ages and may not be a reliable measure of maternal nutritional status in early pregnancy.

Maternal age was also significantly associated with miscarriage. Female patients under the age of 20 or over the age of 35 exhibited a greater miscarriage rate compared to those aged 20-35 years. At a younger age, maternal reproductive and physiological readiness may not yet be optimal, whereas advanced maternal age is associated with declining oocyte quality, increased chromosomal abnormalities, and reduced reproductive function.[6,15-17] Gravidity was significantly associated with miscarriage, with the highest proportion occurring among grande multigravida women. Repeated pregnancies may be associated with changes in uterine and endometrial conditions that affect implantation and pregnancy maintenance. In addition, high gravidity is often accompanied by increasing maternal age, which may further contribute to adverse pregnancy outcomes.[17,18] The proportion of miscarriage in the present study increased across parity categories and was highest among grand multiparous women. This finding is consistent with Cohain et al., who reported an increase in first-trimester spontaneous miscarriage with increasing parity.[19] However, this association should be interpreted cautiously, as maternal age and other reproductive factors may also contribute to the observed pattern. Although repeated pregnancies may be accompanied by structural and physiological changes in the uterus, their direct contribution to miscarriage remains unclear.[19] A previous history of miscarriage was significantly associated with miscarriage in the current pregnancy. Previous miscarriage may indicate persistent maternal risk factors, including uterine anatomical abnormalities, hormonal disorders, immunological factors, genetic abnormalities, or impaired endometrial function.[15,20] Women with a previous miscarriage may therefore require more comprehensive assessment and closer monitoring during subsequent pregnancies.

Overall, miscarriage was related to maternal BMI in the first trimester, maternal age, gravidity, parity, and a history of previous miscarriage. These findings show the importance of assessing a woman's nutritional status and pregnancy history during early antenatal care. This information may help healthcare providers identify women who need closer monitoring during pregnancy. However, some limitations of this study should also be considered. It was based on retrospective medical records from a single hospital, and some information may have been incompletely documented. Other factors, such as smoking, socioeconomic status, and underlying medical conditions, were also not available for analysis. In addition, it is difficult to know whether the recorded BMI truly reflected the mother's nutritional status before the miscarriage occurred. It is also possible that the miscarriage itself may have influenced the recorded BMI. Finally, the findings may not reflect the experiences of all pregnant women, as the study involved a specific group of participants. Since the analysis did not account for other factors that might influence

miscarriage, the results cannot confirm a direct cause-and-effect relationship. Therefore, these findings should not be taken to mean that early antenatal assessment can prevent miscarriage.[3, 5, 21]

5. Conclusion

At Koja Regional General Hospital, maternal BMI in the first trimester was found to be associated with miscarriage, with the highest proportion seen among underweight women. Maternal age, gravidity, parity, and a previous history of miscarriage were also related to miscarriage. The results suggest that maternal nutritional status and pregnancy history are important to consider during early antenatal care. However, they do not prove that these factors directly cause miscarriage or can be used to predict an individual woman's risk. Further studies that consider other influencing factors are needed to better understand the relationship between maternal BMI and miscarriage.

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