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RISK FACTORS ASSOCIATED WITH SPONTANEOUS ABORTION AT DR. SOETOMO HOSPITAL IN 2019–2023

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Abstract

Background: Spontaneous abortion or miscarriage is one of the pregnancy complications which can cause vaginal bleeding, as well as a significant impact on women's psychology. The occurrence of spontaneous abortion is caused by several risk factors that need to be considered. This research is aimed to analyze risk factors related to spontaneous abortion in pregnant women at Dr. Soetomo Hospital. **Method:** The study used a cross-sectional approach. The population was women who checked their pregnancy at Dr. Soetomo Hospital who experienced spontaneous abortion and did not experience spontaneous abortion. The number of samples was 55 for the case group and 55 for the control group. Data were obtained from medical records at Dr. Soetomo Hospital Surabaya. Bivariate chi-square statistical analysis and multivariate logistic regression were performed using SPSS software. **Results:** The risk factors found to be significant for the occurrence of spontaneous abortion were maternal age (p = 0.003), pregnancy interval (p = 0.005), and hemoglobin levels (p = 0.005). Meanwhile, the insignificant risk factors for the occurrence of spontaneous abortion were parity (p = 0.070) and body mass index (p = 0.525). The most dominant risk factor associated with the occurrence of spontaneous abortion was maternal age <20 or >35 years (OR = 6,769). **Conclusion:** maternal age, pregnancy interval, and hemoglobin level have been shown to be the significant risk factors for spontaneous abortion in pregnant women.

Keywords: body mass index, hemoglobin level, maternal age, parity, pregnancy interval, spontaneous abortion.

INTRODUCTION

According to the WHO (2023), nearly 800 women worldwide died every day in 2020 due to pregnancy and childbirth-related causes that could have been prevented. Based on the Indonesian Health Profile, the number of maternal deaths due to hemorrhage in 2021 reached 1,320 from a total of 7,389 maternal deaths (Kemenkes, 2021). Hemorrhage in pregnancies under 20 weeks is generally caused by spontaneous abortion, and about 10-12% of pregnancies end in spontaneous abortion (Prawirohardjo, 2018). In Indonesia, the percentage of spontaneous abortions reaches 10-15% from 6 million pregnancies each year (Tuzzahro, *et al*. 2021). The

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number of maternal deaths in East Java in 2022 was the lowest in the last seven years. However, more motivation is still needed for preventative efforts because Indonesia's Maternal Mortality Ratio (MMR) is declining at a relatively slow rate (only 1.8% annually), making it almost impossible to meet the Sustainable Development Goals (SDGs) objective by 2030 (Dinas Kominfo Jatim, 2023).

Abortion or miscarriage is a termination of pregnancy when the fetus is less than 20 weeks old or weighs less than 500 grams making it incapable to live outside the womb. Spontaneous abortion is an abortion that is unintentional and occurs naturally, in contrast to an induced abortion which is intentional with a certain purpose (Purwaningrum and Fibriana, 2017). Theoretically, there are multiple potential causes that could lead to spontaneous abortion, such as chromosomal abnormalities, immunological factors, infectious diseases, and maternal risk factors (Jackson and Watkins, 2021). Despite causing physical complications such as vaginal bleeding and pain, spontaneous abortion has a significant impact on women's psychology such as depression and emotional disorders (Maulana, H., et al., 2023). It can also be an early sign of future health risks in women, including maternal death (Wang, et al., 2021).

To ensure a healthy and safe pregnancy among women, it is important to have early detection and control of risk factors for spontaneous abortion. There are many maternal risk factors that are proved could increase the occurrence of spontaneous abortion. Based on a meta-analysis from Akbar (2019), the main risk factors of spontaneous abortion in Indonesia in 2010-2019 were maternal age and parity. This statement is in line with research from Purwaningrum & Fibriana (2017) which found that mothers aged <20 or >35 years are at 3 times greater risk of experiencing spontaneous abortion than mothers aged 20-30 years. The research conducted by Kartina & Trisna (2014) discovered that primiparous parity has a 4.3 times higher chance of experiencing spontaneous abortion than multiparous parity.

There are a few more risk factors that play quite a significant role in spontaneous abortion, including pregnancy interval, nutritional status, and hemoglobin level. Supported by ACOG (2018), pregnancy interval of less than 18 months and greater than 5–10 years are associated with increased risk of adverse outcomes. According to Rahmah (2016), pregnant women with normal nutritional status must experience weight gain in order to meet the nutritional needs of the

mother and fetus, which can be measured from the mother's body mass index. Pregnant women who lack food for a long period will experience health problems (Madumurti, et al., 2020). Overweight women have reproductive weaknesses in achieving pregnancy, such as early miscarriage, recurrent miscarriage, and so on (Cunningham, 2022). Pregnant women with anemia (Hb <11g/dL) have an increased risk of maternal and infant morbidity and mortality. Maternal Hb levels of more than 13 g/L during the second and third trimester were associated with an increased risk of poor pregnancy outcomes (Wu L, et al. 2022).

As a referral hospital in the Eastern Indonesia Region, internationally accredited by the Joint Commission International (JCI), with a variety of health cases, and professional medical personnel in their fields, Dr. Soetomo Hospital is the right location to conduct this research. Above all, this study strives to educate pregnant women, women desire to become pregnant, and other related communities about the risk factors for spontaneous abortion so that they can always carry out early prevention and control the risk factors.

METHOD

This study was a descriptive analytical study using a retrospective method from secondary data, particularly medical records obtained from Dr. Soetomo Hospital, Surabaya. The population in this study were all pregnant women who checked their pregnancies at Dr. Soetomo Hospital, who had experienced spontaneous abortion and had not experienced spontaneous abortion in medical records from 2019 to 2023. The inclusion criteria were having complete medical records regarding patient diagnosis, gestational age, maternal age, parity history, pregnancy interval, body mass index, and Hb levels. Whereas exclusion criteria were having incomplete medical records at Dr. Soetomo Hospital from 2019 to 2023 according to the required data.

Lemeshow formula was used to calculate the sample size with 0.15 for value of case proportion (*p*) derived from the prevalence of spontaneous abortion in Indonesia (Tuzzahro, *et al*., 2021). The number of samples was 55 for the case group and 55 for the control group. A total sampling technique was used for case samples, which were all pregnant women experiencing spontaneous abortion. The control

samples used systematic random sampling to collect samples of pregnant women who had a complete assessment in the medical records and did not experience spontaneous abortion, each year randomly from 2019 to 2023 to represent the population of each year. Collected case samples had a gestational age of <20 weeks, while the gestational age of control samples was >20 weeks when the results of conception were removed from the mother's body in order to be excluded from the criteria for spontaneous abortion.

The data analysis used bivariate analysis with the Chi-square test and multivariate analysis with logistic regression. Confidence Interval (CI) was set at 95% and the degree of significance $\alpha = 0.05$. SPSS software version 25 was utilized to perform the statistical analysis. Independent variables consisted of maternal age, parity, pregnancy interval, body mass index (BMI), and hemoglobin (Hb) level. This study analyzed the significance of the association among these risk factors and the incidence of spontaneous abortion at Dr. Soetomo Hospital in 2019–2023 as the dependent variable. Ethical approval for this study was acquired from the Research Ethics Board of the Dr. Soetomo General Hospital Surabaya which ensured that all protocols adhered with the hospital's ethical guidelines.

RESULT AND DISCUSSION

Table 1 Distribution of subjects by demographic characteristics

Characteristics	Case	Control	Total	
	n	n	n	%
Year				
2019	4	4	8	7.3
2020	1	1	2	1.8
2021	2	2	4	3.6
2022	32	32	64	58.2
2023	16	16	32	29.1
City of origin				
Surabaya	39	19	58	52.7
Outside Surabaya	16	36	52	47.3
Maternal age (years)				
20–35 years	36	50	86	78.2
<20 or >35 years	19	5	24	21.8

Among the 110 pregnant women who were the subject of the study, the majority—64 individuals (58.2%)—were patients in 2022. Most participants, totaling 58 (52.7%), were from Surabaya. The average age of the participants was 28.7 years, with 86 women (78.2%) falling within the 20 to 35 age range, while those under 20 or over 35 accounted for 24 individuals (21.8%). Regarding parity, most patients (75 individuals, 68.2%) had a history of parity either below 2 or above 4, while 35 individuals (31.8%) had a parity of 2–4. For pregnancy intervals, 71 participants (64.5%) had intervals of less than 2 years or more than 5 years, while 39 participants (35.5%) had intervals of 2–5 years. In terms of body mass index (BMI), the largest group was classified as obese (≥25 g/dL), comprising 53 individuals (48.2%). This was followed by 28 participants (25.5%) with normal BMI (18.5–22.9 g/dL), 17 participants (15.5%) categorized as overweight (23.0–24.9 g/dL), and 12 participants (10.9%) who were underweight (<18.5 g/dL). For hemoglobin (Hb) levels, the highest percentage (65 individuals, 59.1%) had levels of 11–13 g/dL, while 45 individuals (40.9%) had Hb levels below 11 or above 13 g/dL.

Table 2 Bivariate analysis with chi-square statistical test

Variables	Case		Control		Total		*p*
	n	%	n	%	n	%	
Maternal age (years)							
20–35 years	36	41.9	50	58.1	86	100	0.003
<20 or >35 years	19	79.2	5	20.8	24	100	
Parity							
2–4	12	34.3	23	65.7	35	100	0.041
<2 or >4	43	57.3	32	42.7	75	100	
Pregnancy interval (years)							
2–5	10	25.6	29	74.4	39	100	<0.00
<2 or >5	45	63.4	26	36.6	71	100	1
Body Mass Index (BMI) (kg/m²)							
<18,5	8	66.7	4	33.3	12	100	
18,5–22.9	14	50	14	50	28	100	0.223
23.0–24.9	11	64.7	6	35.3	17	100	
≥25	22	41.5	31	58.5	53	100	
Hb level (g/dL)							
11–13	24	36.9	41	63.1	65	100	0.002

<11 or >13	31	68.9	14	31.1	45	100

Bivariate analysis was conducted to understand the relationship between independent and dependent variables and to determine which variables would be included in the multivariate analysis. The relationship between risk factors and spontaneous abortion incidence is indicated by a p value <0.05 at 95% Confidence Interval (CI). The bivariate analysis test revealed that the independent variables with p-value below 0.05 were maternal age (p = 0.003), parity (p = 0.041), pregnancy interval (p <0.001), and Hb level (p = 0.002), which can be interpreted that there was a significant relationship between maternal age, parity, pregnancy interval, and Hb level with spontaneous abortion.

The independent variable with a p-value above 0.05 was BMI (p = 0.223), which means there was no significant relationship between BMI and spontaneous abortion. The results of this study are in line with a case-control study conducted by Zakira and Hardianto (2021) on 120 samples, consisting of 40 people as cases and 80 people as controls. This might have occurred because the BMI used in the study by Zakira and Hardianto (2021) was only from BMI after pregnancy, while this study only used BMI during pregnancy, without considering weight before pregnancy. In addition, the different gestational ages of respondents can affect the results of weight measurements by health workers. The results of this study are contrary to the findings of a case-control study conducted by Hadi, R. *et al.* (2020) on 113 pregnant women who experienced abortion and 113 pregnant women who did not have spontaneous abortion as controls at Hasan Sadikin Hospital in the 2017-2018 period. According to Sitilonga, *et al.* (2017), increased BMI to obesity can cause leptin resistance; mothers with a history of recurrent abortions tend to have low serum leptin levels (Purwaningrum & Fibriana, 2017). Leptin plays a role in regulating the balance between food intake and energy expenditure in the body (Dornbush and Aeddula, 2023). Being overweight is also associated with various pregnancy complications such as hypertension, preeclampsia, gestational diabetes, and other complications. Conversely, severe malnutrition can increase the risk of abortion. Mothers with low BMI also have low leptin levels (Purwaningrum & Fibriana, 2017). Nutritional and health problems in pregnant women affect the quality of the baby

born. Pregnant women with chronic energy deficiency can cause chromosomal abnormalities (Madumurti, *et al*., 2020).

Table 3 Summary results of the multivariate model of risk factors associated with spontaneous abortion events at Dr. Soetomo General Hospital 2019–2023

Step	Variable enter	Nagelkerke R Square
1	Maternal age (years) Parity Pregnancy interval (years)	0.402
2	Body Mass Index (BMI) (kg/m²) Hb level (g/dL)	0.382

Regression analysis showed that maternal age, parity, pregnancy interval, body mass index, and Hb levels simultaneously influenced the occurrence of spontaneous abortion in pregnant women. The Nagelkerke R Square value was 0.382, which means that those five risk factors altogether were risk factors for spontaneous abortion simultaneously and had a significance of 38.2% for spontaneous abortion. Meanwhile, the remaining percentage was explained by other factors not examined in this study. The next analysis removes variables with p values >0.05 from the model gradually starting from the variable with the largest p value. The removal starts from the BMI variable (p = 0.525) which is then processed again in the same way and if the result still has a p value of more than 0.05 then it is removed from the modeling and so on, until all of the remaining variables had a <0.05 p value on the last analysis test.

Table 4 Results of multivariate modeling of risk factors associated with spontaneous abortion events at Dr. Soetomo General Hospital 2019–2023

Variables	*p* Wald	OR	95% CI
Maternal age (years)	0.003	6.769	1.882 - 24.349
Parity	0.070	2.742	0.922 - 8.152
Pregnancy interval (years)	0.005	4.157	1.551 - 11.144
Hb level (g/dL)	0.005	3.796	1.508 - 9.555

The maternal age variable has a p value = 0.003 and OR = 6.769 with 95% CI 1.882 - 24.349, which means that maternal age is significantly related to the incidence of spontaneous abortion and mothers aged <20 or >35 years have a 6.769 times risk of experiencing spontaneous abortion. The results of this study are

supported by a case-control study conducted by Purwaningrum & Fibriana (2017), but contradict the findings of a case-control study conducted by Asniar, *et al*. (2022) which is thought to be due to the lack of samples studied. Pregnancy in adolescence causes various complex problems, including physical changes during pregnancy, psychological changes, anxiety about childbirth and the future, and economic factors such as family financial capacity which also increase the risk of pregnancy. At the age of under 20 years shows that the reproductive organs are not yet fully functioning properly and are not ready to accept conception. In addition, the perineum muscles and abdominal muscles are not yet working optimally (Purwaningrum & Fibriana, 2017).

Pregnancy at the age of ≥35 years causes a decrease in physiological body function. Changes during pregnancy present challenges to aging organ systems, which may be able to function well when not pregnant, but are compounded by the increased blood volume, cardiac output, and insulin resistance that occur during pregnancy (Sauer, *et al*., 2015). Older maternal age is also associated with inadequate progesterone production, so that the corpus luteum is unable to produce enough progesterone to maintain implantation (Purwaningrum & Fibriana, 2017). At age over 35 years, the risk of chromosomal abnormalities increases (Sitilonga, *et al*., 2017). Most miscarriages are caused by abnormalities in the meiotic spindle that occur in older oocytes, resulting in chromosome nondisjunction and abnormal embryos that fail to implant or experience spontaneous abortion (Sauer, *et al*., 2015).

Parity variable has a p value = 0.070 and OR 2.742, which explains that there is no significant relationship between the number of parities and the incidence of spontaneous abortion. The results of this study are in line with the case-control study conducted by Yanti (2018), but not in line with the findings from the research by Asniar, *et al*. (2022). Difference in results may occur because the study by Asniar, *et al.* (2022) calculated both babies born alive and dead, while this study did not count stillbirths, but only the number of viable babies born who could live in the outside world according to the definition of parity from BKKBN (2021). Pregnant women with safe parity still have a risk of abortion which is caused by other factors that have not been studied, such as abnormalities in fetal growth, infection, hypertension, abnormalities in the reproductive tract, problems with the placenta,

diseases experienced by the mother, endocrine disorders, malnutrition, use of drugs, and environmental factors such as alcohol consumption, caffeine, tobacco, and radiation exposure (Asniar, *et al*., 2022). According to Purwaningrum & Fibriana (2017) Pregnancy history is associated with subsequent pregnancies, where the endometrium in the uterine corpus experiences decreased function and reduced blood supply. This makes the area less fertile and not ready to receive the results of conception leading to nonoptimal implantation, which can cause death or some or all of the results of conception are released. Mothers with parity of more than four children are at risk of fetal growth disorders and bleeding during pregnancy due to the increasingly weak condition of the uterus. Parity 2-3 is considered the safest from the risk of maternal death. Meanwhile, the first parity and high parity (more than three) have higher maternal mortality rates.

The pregnancy interval variable has a p value = 0.005 and OR = 4.157 with 95% CI 1.551 - 11.144, which means that the pregnancy interval is significantly related to the incidence of spontaneous abortion and mothers with a pregnancy interval of <2 or >5 years have a 4.157 times risk of experiencing spontaneous abortion. The results of this study are supported by a case-control study conducted by Sitilonga, *et al.* (2017), but are not in line with the results of a meta-analysis study by Akbar (2019) which found that pregnancy interval was not the most significant risk factor for spontaneous abortion, but was one of the factors associated with spontaneous abortion from 43 articles published throughout 2010 to 2019 in Indonesia.

The WHO recommendation for a 24-month interval is based on the higher risks to maternal, infant, and perinatal health associated with birth intervals shorter than 24 months. The selection of a 24-month interval also takes into account other factors, such as its compliance with WHO and UNICEF recommendations on a minimum breastfeeding duration of two years, as well as its ease of program implementation, compared to a gap of 18 or 27 months (Hassen, *et al*. 2024). Pregnancies that are too close to a previous pregnancy can have a negative impact because the reproductive organs have not fully recovered in terms of form and function (Purwaningrum & Fibriana, 2017). The uterus is not ready for implantation and fetal growth, increasing the risk of abortion (Sitilonga, *et al*., 2017). Pregnancy that is

too far apart can cause a decline in reproductive organ function due to the mother's increasing age (Purwaningrum & Fibriana, 2017). Degenerative processes occur, which affect pregnancy and childbirth due to weakening of the uterine and pelvic muscles (Sitilonga, *et al*., 2017). Public health and clinical recommendations suggest a minimum interpregnancy interval of 18 months, with some suggesting a range of 18 to 60 months (Schummers, *et al*., 2018). These intervals are based on recommendations from the WHO Technical Consultation Report on Pregnancy Spacing which stated that the lowest risk for miscarriage, induced abortion, and stillbirth was in the birth-to-pregnancy (BTP) interval group of 18–36 months, and the highest risk was in the very short (<6 months) and very long (>71 months) interval groups. Although this study did not examine how many women from the 2-5 years pregnancy interval group who actually knew about the pregnancy interval recommended by WHO or other studies to implement, it is clearly important for every woman to know the ideal pregnancy interval to avoid the risk of spontaneous abortion and other adverse outcomes of pregnancy.

The Hb level variable has a p value = 0.005 and OR = 3.796 with 95% CI 1.646 - 13,681.508 - 9.555, which means that Hb levels are significantly related to the incidence of spontaneous abortion and mothers with Hb levels <11 or > 13 g/dL have a 3.796 times risk of experiencing spontaneous abortion. The results of this study are supported by research conducted by Kartina & Trisna (2014), especially in patients with Hb levels <11gr% (anemia) who are at higher risk of spontaneous abortion than patients with Hb ≥11gr%. In contrast to the case control conducted by Asniar, *et al*. (2022) which found no significant relationship between Hb levels and the incidence of spontaneous abortion.

Iron deficiency during pregnancy can inhibit fetal growth, including the development of body and brain cells, which can potentially cause miscarriage. Iron deficiency occurs gradually, starting with a decrease in iron stores. Serum ferritin levels drop to less than 30 mg/l, while Total Iron Binding Capacity (TIBC) increases. When iron stores are depleted, red blood cell production continues, but serum iron levels drop to below 30 mg/dl, and transferrin saturation drops below 15%. In the later stages MCV will decrease, accompanied by microcytic hypochromic cells, anisocytosis, and poikilocytosis. Therefore, meeting iron needs

is very important for pregnant women to prevent unwanted complications (Kartina & Trisna, 2014). During pregnancy, the total number of erythrocytes and plasma volume increase, but hemoglobin (Hb) levels decrease due to a greater increase in plasma volume. This condition reduces blood viscosity and increases blood flow to the placenta. On the other hand, excessively high Hb levels during pregnancy can cause placental infarction due to increased blood viscosity. This can lead to complications such as gestational hypertension, fetal growth retardation, and perinatal death (Çakmak, *et al*. 2018).

Table 6 Results of logistic regression analysis of risk factors associated with spontaneous abortion at Dr. Soetomo General Hospital 2019–2023

Variables	Coefficient Value	*p* Value
MA	1.912	0.003
PI	1.425	0.005
HL	1.334	0.005
Constant	-2.579	<0.001

MA: maternal age; PI: pregnancy interval; HL: Hb level

The independent variables that have a significant relationship reanalyzed in this model are maternal age (MA), pregnancy interval (PI), and Hb levels (HL) on the dependent variable of spontaneous abortion (SA) at Dr. Soetomo Hospital. The results of the logistic regression analysis can be formulated into the following logistic regression equation: SA= -2.579 + 1.912MA + 1.425PI + 1.334HL + e. Based on the logistic regression equation above, the relationship between the independent variables and the dependent variable can be analyzed. The constant value (α) is -2.579, meaning that if the independent variable is constant, then the spontaneous abortion value (SA) is -2.579. Coefficient values for each of the significant independent variables are 1.912 for maternal age (MA), 1.425 for pregnancy interval (PI), and 1.334 for Hb levels (HL). Each one-unit increase in MA, PI, or HL assuming the value of other variables remains constant will increase the spontaneous abortion (SA) value according to the size of their respective coefficient values.

CONCLUSION AND SUGGESTION

Based on the results, it can be concluded that the risk factors that have a significant relationship with the occurrence of spontaneous abortion consist of maternal age, pregnancy interval, and Hb levels, while those that do not have a significant relationship include parity and body mass index (BMI). However, the risk factors of maternal age, number of parities, pregnancy spacing, body mass index, and Hb levels altogether are associated with the occurrence of spontaneous abortion with a significance of 38.2%. Mothers, expected parents, families, and the general public are expected to always avoid things that are risk factors for spontaneous abortion by planning a healthy pregnancy. Pregnant women who have risk factors are advised to routinely check their pregnancy such as in Antenatal Care (ANC) and more intensive supervision by medical personnel. Further researchers are expected to examine other variables that are suspected to be risk factors for spontaneous abortion and use a larger number of samples.

DECLARATION

Conflict of Interest

Regarding the publishing of this study, the authors declare there is no conflict of interest.

Authors' Contribution

Each author made a substantial contribution to the article's writing, analysis, and research. The study's design, data collection supervision, statistical analysis, data interpretation, and paper preparation were all done by the authors. The final version was examined and approved by all authors.

Ethical Approval

This research has been approved by the Research Ethics Board of the Dr. Soetomo General Hospital Surabaya with the Letter of Exemption referral number 1617/LOE/301.4.2/III/2024.

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Data Availability

Subject to participant confidentiality limitations, the corresponding authors can provide the data supporting the study's conclusions upon reasonable request.

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