MATERNAL AGE, GESTATION, AND PARTURITION AS PREDICTOR OF UTERINE INERTIA INCIDENCE

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ABSTRACT

Uterine inertia could cause complications in labor. Knowing the risk factors for uterine inertia is important to since the Maternal Death Rate in Indonesia is relatively high. This study was aimed to determine whether maternal age, gestation, and parturition could be predictors of uterine inertia. This is a cross-sectional study. Data collection was done at "C" General Hospital, West Java, with all pregnant women in their third trimester of pregnancy in January to December 2019 as samples. The statistical analysis used in this study are Independent T-test, Mann Whitney, ROC Curve test, and Pearson Chi-Square with Yates Correction to see statistical associations. Significant correlation was found between the variables of age ≤ 30 years, gestation ≤ 2 pregnancies, and parturition ≤ 2 births with uterine inertia (PR = 1.331; 1.332; 1.315 times, p-value = 0.001). Uterine inertia is affected by risk factors of age ≤ 30 years, gestation ≤ 2 pregnancies, and parturition ≤ 2 births. The results can be used to help health workers in predicting the incidence of uterine inertia so that adequate responses can be provided.

Keywords: Gestation, Maternal Age, Parturition, Predictor, Uterine Inertia

INTRODUCTION

Uterine inertia, also called uterine atony, is defined as a weak or irregular uterine contraction in labor. There are two groups of uterine inertia, primary uterine inertia (true type) and secondary uterine inertia. It is called primary when the uterus fails to contract with adequate and coordinated force, which results in prolonged labor. Secondary uterine inertia happens when the contractions are adequate initially but become more infrequent and ineffective due to fatigue. Both groups could cause obstructed labor, maternal anxiety and exhaustion, post-partum bleeding, placenta retention, increased risk of injury, and cesarean section with all the operative and anesthesia complication risks, fetal distress, and asphyxia.(Dike & Ibine, 2022; Majid Khan et al., 2014) The World Health Organization (WHO) states that the maternal mortality rate is still high, estimated at up to 287,000 in 2020, and 75% of them were caused by labor complications.(*Maternal Mortality*, n.d.) Uterine inertia is estimated to occur in every 1 of 40 deliveries in America and is the cause of 75%of post-partum hemorrhages.(Dike &

Ibine, 2022) The Maternal Death Rate (MDR) in Indonesia in 2015 was estimated at up to 305 per 100,000 live births. In 2021, 7,389 maternal deaths were recorded, where ±40% were caused by COVID-19, ±18% were caused by hemorrhage, and ±14,5% were caused by hypertension in pregnancy.(Kemenkes RI, 2022)

There are many risk factors for women to develop uterine inertia, including prolonged labor, precipitous labor (expulsion of the fetus within less than 3 hours of commencement of regular contractions), uterine distention (multi-fetal gestation, polyhydramnios, fetal macrosomia), uterine fibroids, chorioamnionitis, magnesium sulfate infusion indicated patients, prolonged use of oxytocin, and BMI above 40 (class III obesity).(Ende et al., 2021; Gill et al., 2022; KOUTRAS et al., 2021; Miller & Ansari, 2022; Suzuki, 2015) Placenta previa, placental abruption, uterine rupture, and multiple gestations are also risk factors for bleeding due to uterine inertia. Nulliparity and hypertension in pregnancy may also have a role in post-partum hemorrhage (PPH) due to uterine inertia.(Ende et al., 2021) Early recognition of the risk factors from uterine inertia can help prevent PPH because ± 80% of them are caused by uterine inertia.(A. Ratsiatosika et al., 2019; Blitz et al., 2020)

Maternal age is one of the important things in pregnancy, where if the maternal age is too young or too old have risks in both pregnancy and childbirth.(Bouzaglou et al., 2020; Cavazos-Rehg et al., 2015; Yohanna, 2016) It is not yet clear whether maternal age affects uterine inertia incidence. Several previous studies have not been able to determine whether maternal age affects uterine inertia or not.(A. Ratsiatosika et al., 2019; Ende et al., 2021; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019) The number of gestation and parturition count are also important in pregnancy. Nulliparity and excessive counts of gestations are considered to be risk factors, but some of the previous studies have yielded conflicting results.(A. Ratsiatosika et al., 2019; Blitz et al., 2020; Ende et al., 2021; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019) Based on the statements above, the authors are interested in research to find out whether maternal age, gestation, and parturition can be predictors of uterine inertia.

LITERATURE REVIEW

Uterine inertia, or uterine atony, is characterized by the uterus's failure to contract effectively during labor, resulting in postpartum hemorrhage and increased maternal morbidity and mortality. This condition can manifest as either primary or secondary, based on contraction patterns. Examining predictive factors such as maternal age, gravida, and parity is essential for enhancing maternal health outcomes. Identifying women at higher risk allows healthcare providers to implement targeted interventions and preventative measures, thereby reducing the incidence and complications of uterine inertia and improving labor and delivery management.(Purwati et al., 2022; Yulianto Sarim, 2020)

Maternal age plays a significant role in pregnancy outcomes. Advanced maternal age (35 years and older) is linked to complications such as gestational diabetes, preeclampsia, and preterm birth, while teenage pregnancies are associated with risks like low birth weight and preterm delivery. The risk of uterine inertia also increases with age; older

mothers are more prone to uterine atony due to decreased myometrial contractility and higher comorbid conditions, whereas younger mothers may face higher risks due to underdeveloped uterine muscles and physiological immaturity.(Chen & Novo, 2018; Julizar et al., 2019)

Gravida, the number of times a woman has been pregnant, impacts uterine function. Repeated pregnancies can change uterine muscle tone and elasticity. Multiple pregnancies may weaken uterine muscles, affecting their ability to contract effectively during labor, thus increasing the risk of uterine inertia.(Chen & Novo, 2018; Yulianto Sarim, 2020)

Parity, or the number of viable births, is categorized into primipara (first birth) and multipara (multiple births). Primiparas generally face a lower risk of uterine inertia compared to multiparas, as repeated childbirths can weaken uterine muscles, increasing the likelihood of uterine atony. Studies indicate that higher parity correlates with an increased incidence of uterine inertia. The combined effect of advanced maternal age, higher gravida, and parity significantly raises the risk, necessitating careful monitoring and management during labor.(Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019; Jungmann et al., 2022)

The study aims to determine whether maternal age, the number of pregnancies, and the number of childbirths can predict the occurrence of uterine inertia. This research seeks to answer the following questions: Does maternal age affect the incidence of uterine inertia? Is there a relationship between the number of pregnancies and the occurrence of uterine inertia? Does the number of childbirths influence the risk of developing uterine inertia? By investigating these factors, the study hopes to provide insights into the predictors of uterine inertia and contribute to better management and prevention strategies in maternal health care.

MATERIAL AND METHOD

The study was a cross-sectional study to determine the differences in mean age, gestations, parturitions, and abortions in pregnancy with or without uterine inertia. The research was conducted at “C” General Hospital located in West Java. The study samples include all pregnant women in the third trimester of pregnancy at “C” General Hospital from January 2019 to December 2019. The inclusion criteria for the patients were all pregnant patients who underwent childbirth or Caesarean section operations at “C” General Hospital. The minimum sample required for this study is 756 samples, based on the formula for the largest minimum sample size formula, the formula to measure the difference between 2 categorical proportions. The total sampling method was used to collect samples in this study. Tarumanagara University Human Research Ethics Council Institute of Research and Community Engagement has approved this study (Registration Number: PPZ20202076). Medical records were used to obtain anamnesis including obstetric history, physical examination, and laboratory profile. Maternal age, gestation, parturition, and abortion are the independent variables, with pregnancy with and without uterine inertia as the dependent variable in this study. The statistical analysis used in this study is the numerical-categorical test, in the form of Independent t-test and Mann Whitney. The receiver operating characteristic (ROC) Curve test is used to see how strong the model of a significant variable in numerical-

categorical statistical tests in predicting uterine inertia, as well as testing or calculating the sensitivity values, specificity, positive predictive value, and negative predictive value between the variables of age, gestation, parturition, and abortion in estimating the incidence of uterine inertia. Further testing to see statistically categorical associations was done with Pearson Chi-Square with Yates Correction.

The data's normality was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Levene test was used to see the variance between groups. For normally distributed data, Independent T-Test will be used, and Mann-Whitney as an alternative test for the abnormally distributed data. If a significant difference found in the relation between the two variables (p-value <0.05), ROC test will be used to see predictor ability in predicting the incidence of pregnancy with uterine inertia (good predictor ability if the p-value is <0.05 and the angle deviation is > 45 degrees). The accuracy value of the test is divided into 5 groups: excellent (AUC value of 0.90 - 1.00); good (0.80 - 0.90); fair (0.70 - 0.80); bad or poor (0.60 - 0.70); and fail (0.50 - 0.60). If the result are < 0.50, conversion method for the formula (1-AUC base) will be used to determine the accuracy of this variable as a predictor parameter. After determining the ROC curve, the next step is to determine which has the best predictive value in determining the incidence of uterine inertia, based on the cut-off point on the variables of maternal age, gestation, parturition, and abortion. Sensitivity, specificity, negative predictive value, and positive predictive value are determined with the cut-off point value of each independent variable in estimating the dependent variable. The last statistical test used was Pearson Chi-Square with Yates Correction to see the statistical significance (p-value) and risk magnitude (prevalence risk) between independent and dependent variables on a categorical-categorical data scale.

RESULTS

This study included 924 respondents who met the inclusion criteria with an average age of 29.62 (±7.28) years, an average of 2 (1-11) gestations, an average of 1 (0-8) parturition, and 0 (0-4) abortions. A review of the incidence of uterine inertia found 377 (40.8%) respondents without uterine inertia and 547 (59.2%) respondents with uterine inertia. In terms of length of stay, it was found that the average respondent was treated in 1 day with a range from 1 day to 5 days. All results of basic data and demographics of respondents are presented in Table 1.

Table 1.Respondent Characteristics

Variable	N (%)	Mean (SD)	Med (Min-Max)
Maternal Age			
• ≤ 30 years	530 (57.4%)	29.62 (7.28)	29 (13-49)
• > 30 years	394 (42.6%)		
Gestation			
• 1	293 (31.7%)		
• 2	219 (23.7%)	2.57 (1.57)	2 (1 – 11)
• 3-5	369 (39.9%)		
• > 5	43 (4.7%)		

Parturition			
• 0	319 (34.5%)	1.38 (1.41)	1(0 – 8)
• 1	237 (25.6%)		
• 2	184 (19.9%)		
• 3-5	172 (18.6%)		
• > 5	12 (1.2%)		
Abortion			
• 0	766 (82.9%)	0.2 (0.49)	0 (0 – 4)
• 1	135 (14.6%)		
• 2	17(1.8%)		
• > 3	1 (0.1%)		
Uterine Inertia Incidence			
• No Uterine Inertia	377 (40.8%)		
• Uterine Inertia	547 (59.2%)		
Length of Stay			
• 1 day	489 (52.9%)	1.70 (0.87)	1 (1 – 5)
• 2 days	270 (2.2%)		
• 3 days	129 (14%)		
• 4 days	32 (3.5%)		
• 5 days	4 (0.4%)		

Mann-Whitney test are used due to the distribution of data was not normal (p-value <0.05) in all variables when tested using the Kolmogorov Smirnov test. We found a significant difference in the average between the groups of pregnancies with and without uterine inertia in the variable of maternal age (p-value <0.001), gestations (p-value <0.001), and parturition (p-value <0.001). No significant mean difference found with the number of abortions (p-value=0.467). All of the data is presented in Table 2. The average distribution between the two groups is presented in graphical form in Figure 1.

Table 2. Differences in Mean Maternal Age, Partition, Gestations, and Abortion between Pregnancy Groups with and without Uterine Inertia Incidence

Parameter	Groups										*p-value*
	Normal (N: 377)					Uterine Inertia (N: 547)					
	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	
Maternal Age	31.16	7.33	31.00	16.00	49.00	28.56	7.07	27.00	13.00	49.00	< 0.001
Gestations	2.88	1.60	3.00	1.00	11.00	2.36	1.51	2.00	1.00	9.00	< 0.001
Partition	1.65	1.43	1.00	0.00	8.00	1.19	1.37	1.00	0.00	8.00	< 0.001

Abortus	0.23	0.56	0.00	0.00	4.00	0.18	0.44	0.00	0.00	3.00	0.467

From the statistical tests result, maternal age, gestation, and parturition could be used as a reference for predicting the incidence of pregnancy with uterine inertia. The ROC Curve method was used to assess the capability of each respective variables in predicting pregnancy with uterine inertia. The AUC results for the three variables obtained were maternal age (AUC = 0.606 / p-value = 0.019), gestations (AUC = 0.605 / p-value = 0.019), and parturition (AUC = 0.601 / p-value = 0.019) (Figure 1 and Table 3).

Table 3. AUC Parameter Predictor of Pregnancy with Uterine Inertia

Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Age	0.606	0.019	0.000	0.569	0.643
Gestation	0.605	0.019	0.000	0.569	0.642
Parturition	0.601	0.019	0.000	0.564	0.638
Abortion	0.509	0.019	0.634	0.471	0.547

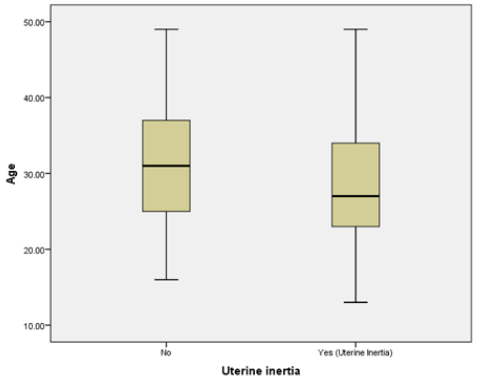
The test result variable(s): Age, Gestation, Parturition, Abortion has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

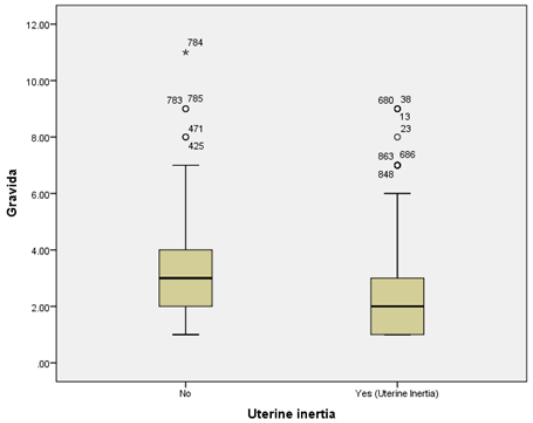
b. Null hypothesis: true area = 0.5

After the three are variables confirmed to affect uterine inertia incidence, the cut-off point will be determined from them to see which has the best predictive value in estimating the incidence of pregnancy with uterine inertia. The sensitivity and specificity values obtained from the results of the ROC curve analysis are derived and restated in a line graph to see the intersection between the two as a reference point for predicting uterine inertia events. The graphic results (Figure 2) show that the cut-off point value for maternal age is below 30 years, gestation is below 2 pregnancies, and parturition is below 2 births.

A



B



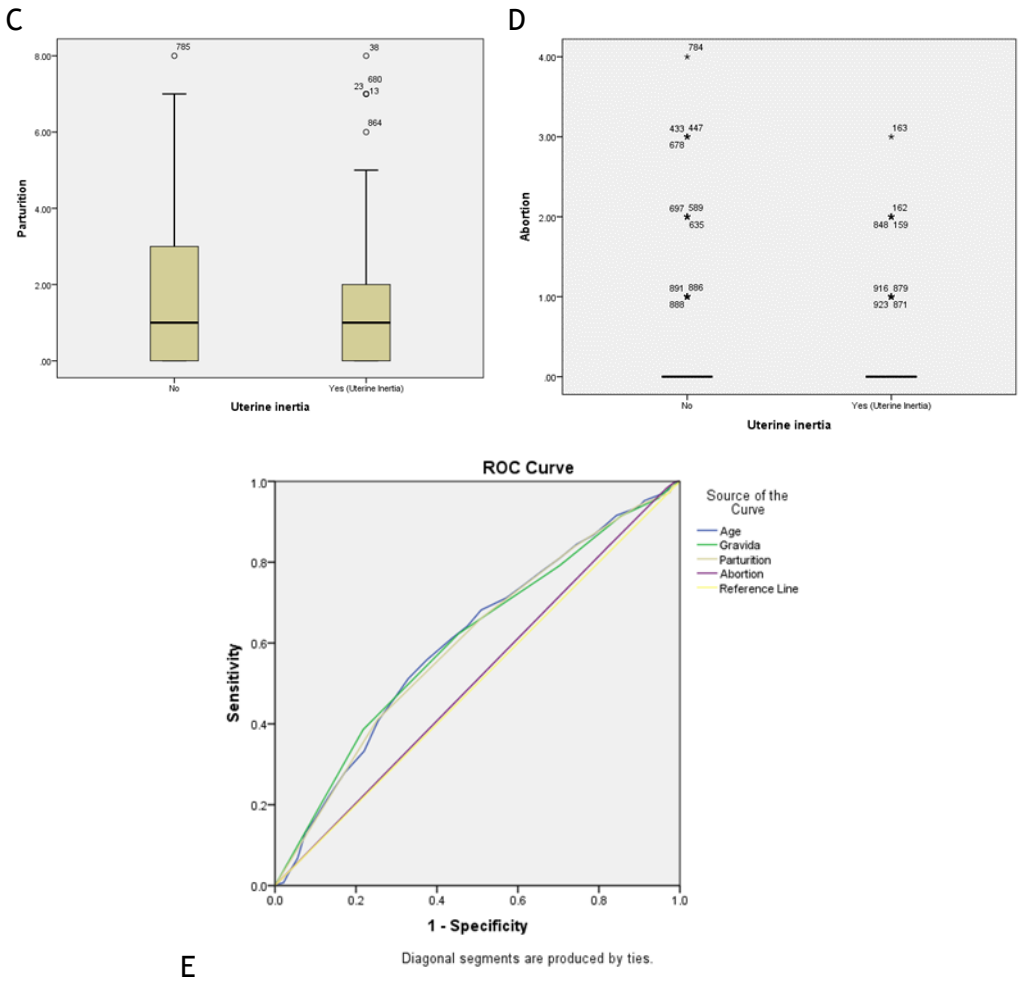
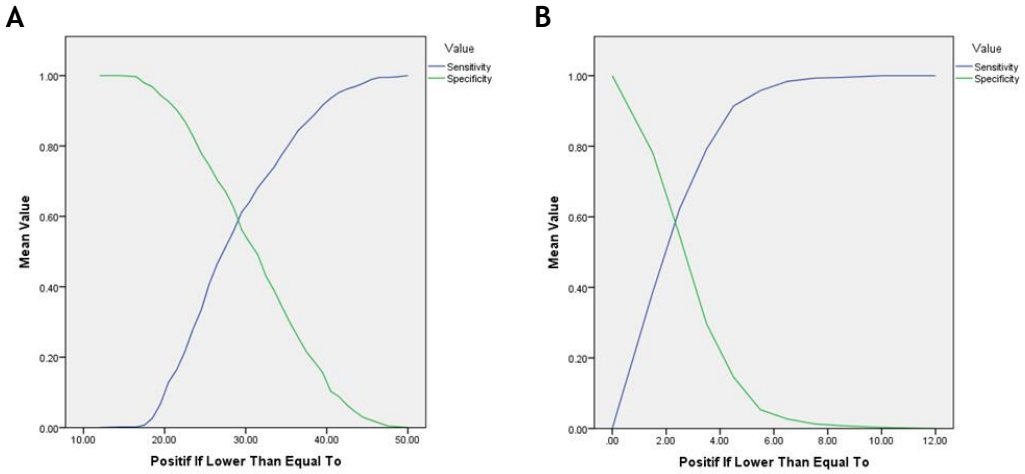


Figure 1. Differences In The Mean Of Variables Of Maternal Age (A), Gestation (B), Parturition (C), And Abortion (D) Between Groups And The ROC Curve Predictor Parameters For Uterine Inertia Incidence (E)



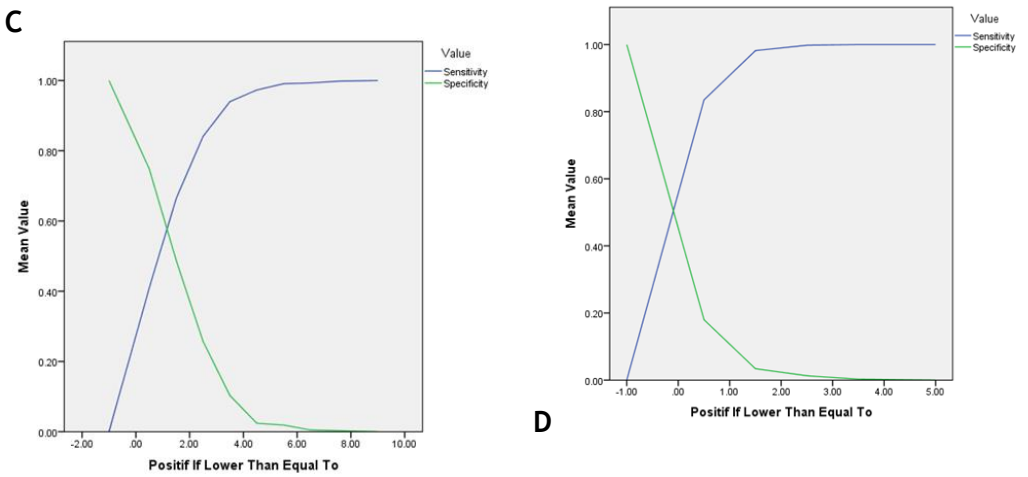


Figure 2. The cut-off point of sensitivity and specificity of maternal age (A), gestation (B), parturition (C), and abortion (D) in predicting the incidence of pregnancy with uterine inertia.

The next test is to see how much the sensitivity and specificity from each respective variables. Referring to table 4, the maternal age variable has a sensitivity value of 64.17%, a specificity of 52.52%, a positive predictive value of 66.23%, and a negative predictive value of 50.25%. The gestation variable has a sensitivity value of 62.34%, a specificity of 52.64%, a positive predictive value of 66.60%, and a negative predictive value of 50%. The parturition variable has a sensitivity value of 84.1%, a specificity of 25.73%, a positive predictive value of 62.16%, and a negative predictive value of 52.72%,

The last statistical test used was the Pearson Chi-Square test with Yates Correction to see the effect of each respective variables on the incidence of uterine inertia. A significant relationship was found between all the variables with uterine inertia (p-value = 0.001), with maternal age ≤ 30 years, gestation ≤ 2 pregnancies, and parturition ≤ 2 births have a risk magnitude for the occurrence of uterine inertia respectively, 1.331; 1.332; and 1.315 times (PR_{age} = 1.331; $PR_{gestation}$ = 1.332; $PR_{parturition}$ = 1.315 times) for uterine inertia incidence.

Table 4. The correlation magnitude between maternal age ≤ 30 years, gestation ≤ 2 pregnancies, and parturition ≤ 2 births for uterine inertia incidence

Parameter		Uterine Inertia		No Uterine Inertia		PR	95% CI		*p-value*
		N	%	N	%		Min	Max	
Maternal age	≤ 30 years	351	66,2	179	33,8	1,331	1,185	1,496	<0,001
	> 30 years	196	49,7	198	50,3				
Gestation	≤ 2 gravida	341	66,6	171	33,4	1,332	1,188	1,493	<0,001
		206	50	206	50				

	> 2 gravida								
Parturition	≤ 2 births	460	62,2	280	37,8	1,315	1,117	1,547	<0,001
	> 2 births	87	47,3	97	52,7				

Based on the study results, the maternal age, the number of gestations, and the number of parturitions are significant predictors of uterine inertia. Younger maternal age (≤ 30 years), fewer gestations (≤ 2 pregnancies), and fewer parturitions (≤ 2 births) are associated with an increased risk of uterine inertia. These factors may affect the elasticity and contractility of the uterus, leading to inadequate contractions during labor. The study underscores the importance of monitoring these variables to identify and manage the risk of uterine inertia, thereby reducing related complications such as postpartum hemorrhage and improving maternal health outcomes.

DISCUSSION

Uterine inertia, also called uterine atony, is defined as a weak or irregular uterine contraction in labor.(Dike & Ibine, 2022; Gill et al., 2022; Majid Khan et al., 2014) The definite cause of uterine inertia is still unknown, but there are several conditions associated with it. Hypocontraction from uterine overdistention and overuse (like in multifetal gestation, macrosomia, polyhydramnios, and multiparity), mechanical disruption (from myoma or gastrointestinal/urinary tract distention), fetal malposition/malpresentation, premature gestation, anemia, maternal exhaustion, and other factors has been associated with uterine inertia.(Alsammani & Ahmed, 2012; Basir et al., 2023; Chen & Novo, 2018; Dike & Ibine, 2022; Douglass, 1937; Gill et al., 2022)

Contraction of the myometrium is required to compress the blood vessels supplying the placenta to aid in hemostasis after delivery and delivery of the placenta. Inadequate contractions could cause complications in labor, especially postpartum hemorrhage.(Douglass, 1937; Ende et al., 2021; Gill et al., 2022; Wormer et al., 2022) Studies have shown that there are risk factors that can interfere with the contractions of the uterus itself, including prolonged labor, precipitous labor, uterine distention, uterine fibroids, chorioamnionitis, magnesium sulfate infusion indicated patients, prolonged use of oxytocin, and BMI above 40 (class III obesity), nulliparity and hypertension in pregnancy.(Ende et al., 2021; Gill et al., 2022; Miller & Ansari, 2022; Suzuki, 2015)

Maternal age is also one of the risk factors of uterine inertia, which can affect myometrium and muscle tone.(Basir et al., 2023; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019) This study has found that clinically, maternal age of ≤ 30 years has an increased risk for uterine inertia incidence (PR = 1.331; p-value = 0.001). This result matches with the study done by Basir et al (2023) in Dr. Mohammad Hoesin Hospital, Palembang, Indonesia,

where maternal age of < 20 years old and > 35 years old increased the risk of uterine inertia (OR = 5.829; 95% CI = 1.383-24.752; p = 0.019). Farahdiba and Taxriyanti (2019) in RSIA Sitti Khadijah 1 Makassar also found that maternal age of < 20 years old dan > 35 years old increased the risk of uterine inertia (p-value=0,000). Nkwabong et al (2019) in 2 semi-urban hospitals in Cameroon, Afrika also found that there's a significant correlation between maternal age and uterine inertia, where maternal age of ≥ 35 has an increased risk of 2.37 times more to uterine inertia incidence (OR = 2.37; 95% CI = 1.01-5.53; p-value >0.05). Herlinawati et al (2014) in Dr. Soedjono Selong Hospital in North Lombok also found significant correlation between maternal age and uterine inertia incidence (PR = 39.1, p-value = 0.000). A different result was found by Wetta et al (2013) at University Hospital, Birmingham, AL, where they found that there is no significant relation between maternal age and uterine inertia incidence (OR=1.0; 95% CI = 1.0-1.1).(Basir et al., 2023; Ende et al., 2021; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019; Herlinawati et al., 2022; Nkwabong et al., 2020; Wetta, L. A., Szychowski, J. M., Seals, S., Mancuso, M. S., Biggio, J. R., & Tita, 2013)

The definite cause of why maternal age can affect uterine is still unknown. It is said that when the maternal age is < 20 years, the reproductive organs are still immature, and the mother is still emotionally not optimal and can easily experience shock, which results in a lack of attention to health in pregnancy, such as nutritional needs being a factor causing the uterine inertia. Mothers aged >35 years are said to have a risk of complications in childbirth such as uterine inertia, dystocia, abnormalities of his, and prolonged labor. This is because the reproductive function has decreased and can endanger the health and safety of the mother.(A. Ratsiatosika et al., 2019; Basir et al., 2023; Ende et al., 2021; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019; Savitri et al., 2019)

Besides maternal age, gestation and parturition are also associated with uterine inertia incidence.(A. Ratsiatosika et al., 2019; Basir et al., 2023; Ende et al., 2021) This study has found that clinically gestation ≤ 2 pregnancies, and parturition ≤ 2 births has increased risk for uterine inertia, consecutively 1.332 and 1.315 times ($PR_{gestation}$ = 1,332; $PR_{parturition}$ = 1,315; p-value = 0.001). Farahdiba and Taxriyanti (2019) in RSIA Sitti Khadijah 1 Makassar also found that parity affects uterine inertia (p-value = 0.002). Julizar et al (2019) study in Northen Aceh District found that numbers of labors has significant correlation to uterine inertia incidence (OR = 6.69; 95% CI = 1.12-39.95; p-value = 0.037), also a significant correlation of twin pregnancy to uterine inertia (OR = 52.38; p-value < 0.001). A different result was obtained from the study done by Basir et al (2023) in Dr. Mohammad Hoesin Hospital, Palembang, Indonesia, where parturition of 1 and ≥4 doesn't affect uterine inertia incidence (OR = 1.714; 95% CI = 0.478-6.151; p-value = 0.51). Savitri et al (2017) in dr. Soebandi Jember General Hospital also found that there is no significant relation between parturition and uterine inertia incidence (p-value = 0.536). The study done by Ratsiatosika et al (2017) at Befelatanana Gynecology-Obstetrics University Hospital (CHUGOB) didn't find a significant relation between parturition and uterine inertia (p-value >0.05). Lestari et al (2019) in

Surabaya, Indonesia, found no significant correlation between parity ≥5 (with >20 weeks gestation) to uterine inertia incidence (p-value = 1.0), but found that there's a significant relation for overdistended uterine to uterine inertia incidence (OR = 4.423; 95% CI = 1.023-27.267; p-value = 0.036).(A. Ratsiatosika et al., 2019; Basir et al., 2023; Blitz et al., 2020; Dike & Ibine, 2022; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019; Gill et al., 2022; Julizar et al., 2019; Savitri et al., 2019)

Gestation and parturition are related to uterine elasticity. The elasticity decreases along with an increased number of gestation and parturition, resulting in the uterus not being able to contract optimally. Other factors like uterine overdistention and overuse occur in multifetal pregnancies and grand-multiparity, which can lead to impaired myometrial contractions after delivery and increase the risk of uterine inertia, and risk of uterine rupture as well.(Basir et al., 2023; Blitz et al., 2020; Dike & Ibine, 2022; Farahdiba & Akademi Kebidanan Pelamonia Abstrak, 2019; Gill et al., 2022; Julizar et al., 2019; KOUTRAS et al., 2021; Savitri et al., 2019)

CONCLUSION

Uterine inertia is affected by risk factors of age ≤ 30 years, gestation ≤ 2 pregnancies, and parturition ≤ 2 births. The results can be used to help health workers in predicting the incidence of uterine inertia so that adequate responses can be provided.

Future research should investigate the mechanisms linking maternal age, gestation, and parturition with uterine inertia through longitudinal studies. Exploring additional risk factors like genetics, lifestyle, and environmental influences could provide a comprehensive understanding. Studies aimed at developing targeted interventions and preventive measures for high-risk groups would be valuable. Using advanced diagnostic tools and imaging techniques could improve the accuracy of predicting uterine inertia and enhance maternal health outcomes. This approach will help devise effective strategies to manage and prevent uterine inertia, ultimately reducing its complications.

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