ABSTRACT

Objective: The objective of this study is to examine the risk factors affecting mothers that serve as predictors of postpartum haemorrhage, with the aim of identifying key predictors to improve clinical outcomes and reduce maternal mortality, aligning with the Sustainable Development Goals (SDGs).

Theoretical Framework: In this topic, the main concepts and theories that underpin the research are presented. The framework includes understanding the pathophysiology of postpartum haemorrhage, maternal health indicators, and predictive analytics models. The Sustainable Development Goals (SDGs) for reducing Maternal Mortality Ratio (MMR) provide a solid basis for understanding the context of the investigation.

Method: The methodology adopted for this research comprises a systematic review of the literature. A comprehensive search was conducted in PubMed, SpringerLink, ScienceDirect, Neliti, and Research Gate using the keywords “risk factor as predictor for postpartum haemorrhage.” The search yielded 3587 articles, which were screened based on inclusion criteria: published between 2014 and 2024, original articles, full-text accessible, in English or Indonesian, and relevant to risk factors predicting postpartum haemorrhage. This process narrowed the selection to 805 articles. Further screening based on exclusion criteria, such as discrepancies in research titles, article inaccessibility, and duplication, resulted in six articles. These align with the PICOS framework: Population (women giving birth with or without comorbidities), Intervention (risk factors for postpartum haemorrhage), Outcome (predictors of postpartum haemorrhage), and Study (observational studies like cohorts, case controls, and cross-sectional studies).

Results and Discussion: The results obtained revealed 33 risk factors that could be used as predictors of postpartum haemorrhage. In the discussion section, these results are contextualized in light of the theoretical framework, highlighting the implications and relationships identified. Possible discrepancies and limitations of the study are also considered in this section, including variations in study design and population characteristics.

Research Implications: The practical and theoretical implications of this research are discussed, providing insights into how the results can be applied or influence practices in the field of maternal health. These implications could encompass clinical practice guidelines, development of predictive tools, and policy-making aimed at reducing MMR in line with SDGs.
Originality/Value: This study contributes to the literature by highlighting the originality of the research through the identification of multiple risk factors as clinical predictors of postpartum haemorrhage. The relevance and value of this research are evidenced by the potential to develop scoring systems, nomograms, and XGBoost classification models, which may significantly impact maternal healthcare practices and outcomes.

Keywords: Hemorrhage predictor, postpartum hemorrhage, Pregnant Women, maternal risk factor, sustainable development goals (SDGs).

1 INTRODUÇÃO

Based on the facts presented by the World Health Organization, every day eight hundred mothers die due to things that could have been prevented during pregnancy and childbirth in 2020. In fact, there is a maternal death every two minutes. Even though this figure has decreased by 34% compared to the Maternal Mortality Rate (MMR) in 2000, the most common and dangerous cause of maternal death is bleeding (World Health Organization, 2023). This must be prevented immediately considering it is one of the targets of the Sustainable Development Goals (SDG) in Indonesia is to reduce the Maternal Mortality Rate (MMR) (SDGs Indonesia, 2023). The latest data in 2023, the MMR in Indonesia is around 305 per 100,000 live births, almost double the target that should be achieved in 2024 (Sehat Negeriku Indonesian Ministry of Health, 2023). Maternal death is a result of complications that occur during pregnancy until after delivery. Supposedly, most of these complications can be prevented. The main complication that occurs most often is postpartum haemorrhage (World Health Organization, 2023). Postpartum haemorrhage is defined as blood loss accompanied by clinical signs of cardiovascular changes within 24 hours after delivery. Cardiovascular clinical signs appear as a consequence of a hypovolemic state, such as hypotension and tachycardia. These signs will appear after blood loss of 25% of the total blood volume or more than 1500 mL. The previous definition, postpartum haemorrhage was blood loss of more than 500 mL after vaginal delivery or more than 1000 mL after abdominal delivery.

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Bleeding occurs more often in mothers giving birth abdominally or by cesarean section (Borovac-Pinheiro et al., 2018; Ngwenya, 2016). Based on timing, primary postpartum bleeding occurs in the first 24 hours, while bleeding from 24 hours to 12 weeks is called secondary postpartum bleeding (Alemu et al., 2019).

The causes of postpartum haemorrhage are abbreviated as the term “4T”. First is tone, weak uterine muscle tone after delivery is the cause of bleeding in 70-80% of cases (Alemu et al., 2019; Rogers et al., 1998). Second is trauma, lacerations or ruptures in the uterus and birth canal are the cause in 20% of cases. The third is tissue, namely abnormalities in the placental detachment process in 10% of cases. And fourth is thrombin, a blood clotting factor deficiency in postpartum mothers is only less than 1%. Risk factors for the above causes include advanced maternal age, multiparity, administration of magnesium sulfate, prolonged labor, induction or augmentation of labor, multiple pregnancies, fetal macrosomia and polyhydramnios (Bienstock, Eke, & Hueppchen, 2021; Alemu et al., 2019). Problems with the placenta are also a risk factor for postpartum haemorrhage, including placenta previa, placenta accreta and placental abruption (McLintock, 2020).

As a result of heavy bleeding, the subsequent situation can cause severe anemia that requiring transfusion, disseminated intravascular coagulopathy, hysterectomy, multiorgan failure and even death (Bienstock, Eke, & Hueppchen, 2021). Long-term bleeding complications can cause infertility and psychological trauma (McLintock, 2020). To avoid this, it is necessary to recognize this risk factors for postpartum haemorrhage as the root of the problem as early as possible. This study aims to collect and analyze previous research articles that describe the risk of postpartum haemorrhage to be used as an early predictor.
2 THEORETICAL FRAMEWORK

2.1 INTRODUCTION TO POSTPARTUM HAEMORRAGE (PPH)

Postpartum haemorrhage is defined as excessive bleeding following childbirth and is a leading cause of maternal morbidity and mortality worldwide. Understanding PPH and its risk factors is vital for developing effective prevention and intervention strategies. According to the World Health Organization (WHO), PPH occurs in up to 10% of deliveries globally, with higher incidences in low-resource settings (World Health Organization, 2023). The identification of risk factors for PPH is crucial for early detection and management, potentially saving numerous lives.

2.2 THEORIES AND MODELS RELATED TO PPH

Several theoretical models and frameworks have been developed to understand the risk factors associated with PPH. One of the widely referenced models is the "Four T's" of PPH, which categorize the causes into Tone (uterine atony), Trauma (birth canal injuries), Tissue (retained placental tissue), and Thrombin (coagulopathy) (Bienstock et al., 2021). This model provides a comprehensive approach to identifying and managing the underlying causes of PPH.

2.3 PREVIOUS RESEARCH AND CONSENSUS

Previous research has consistently highlighted the significance of uterine atony as the most common cause of PPH. Studies by Bienstock et al. (2021) and Borovac-Pinheiro et al. (2018) have emphasized the importance of timely uterotonic administration and uterine massage in preventing atony-related PPH. Additionally, a consensus exists on the critical role of active management of the third stage of labor (AMTSL) in reducing the incidence of PPH (Rogers et al., 1998).
2.4 IMPORTANCE OF IDENTIFYING PREDICTORS OF PPH

Identifying reliable predictors of PPH is crucial for improving maternal outcomes. Predictive models, such as the MONITOR model for women with immune thrombocytopenia, have shown promise in identifying high-risk individuals (Huang et al., 2021). The integration of traditional statistical analysis with machine learning approaches, as explored by Mehrnoush et al. (2023), offers new avenues for enhancing the accuracy of PPH prediction.

3 METHODOLOGY

3.1 RESEARCH STUDY

This type of research uses a systematic review, by analyzing previous research that has been published regarding risk factors as predictors of postpartum haemorrhage.

3.2 RESEARCH STRATEGY

A search was carried from international and national journals, they are PubMed, SpringerLink, ScienceDirect, Neliti and Research Gate using the keywords "risk factor as predictor for postpartum haemorrhage", found 3587 articles.

The studies found were screened based on inclusion criteria, these are articles published on risk factors as predictors of postpartum haemorrhage; range 2014-2024 (10 years); original article; can be accessed full-text; articles in English and Indonesian; 805 articles were produced.

Articles that passed the inclusion criteria were screened again based on the exclusion criteria, these are the incompatibility of the article with the research title; article inaccessible; and duplicate articles. There were six articles collected that were in accordance with PICOS: Population (pregnant women with or without a history of comorbidities), Intervention (Risk factors for postpartum haemorrhage), Outcome (Predictors of postpartum...
haemorrhage) and Study (Observational study such as cohort, case control and cross sectional).

3.3 ELIGIBILITY CRITERIA

Articles that pass the inclusion and exclusion criteria are subjected to an eligibility test using the JBI Critical Appraisal critical review checklist, which can be accessed at jbi.global/critical-appraisal-tools.

The stages of searching and selecting articles are summarized in Figure 1. PRISMA diagram.

Figure 1.
PRISMA diagram

4 RESULTS AND DISCUSSIONS

4.1 RESULTS

A description of the research results of six articles that were reviewed regarding risk factors as predictors of postpartum haemorrhage is presented in Table 1.
## Results of a Systematic Review of Risk Factors as Predictors of Postpartum Haemorrhage

<table>
<thead>
<tr>
<th>No</th>
<th>Title, Author and Year of Publication</th>
<th>Design, Place and Year of Research</th>
<th>Research result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Predicting risk of postpartum haemorrhage during the intrapartum period in a general obstetric population (Gillian M, et al, 2022).</td>
<td>Cross-sectional; Ireland; 2019</td>
<td>Risk factors as the best predictors for postpartum haemorrhage include nulliparity, fetal macrosomia, vacuum delivery mode, emergency caesarean section, and caesarean section before birth, and a history of previous postpartum haemorrhage. These predictors were determined using a nomogram for individual risk assessment of postpartum haemorrhage.</td>
</tr>
<tr>
<td>2.</td>
<td>Prediction of postpartum haemorrhage using traditional statistical analysis and a machine learning approach (Vahid M, et al, 2023).</td>
<td>Retrospective cohort; Iran; 2020-2022</td>
<td>Factors associated with an increased risk of postpartum haemorrhage are living in rural areas, primiparity, anemia, abnormal placentation, fetal macrosomia, shoulder dystocia, vacuum delivery, cesarean delivery and general anesthesia during cesarean delivery. Based on machine learning analysis, the use of the XGBoost classification is the best model for predicting postpartum haemorrhage.</td>
</tr>
<tr>
<td>3.</td>
<td>Predictive score for postpartum haemorrhage in vaginal deliveries following frozen embryo transfer (Akitoshi Y, et al, 2023).</td>
<td>Retrospective cohort; Japan; 2017-2022</td>
<td>Risk factors for postpartum haemorrhage include (1) large baby; (2) maternal obesity before giving birth; (3) marginal or velamentous umbilical cord insertion, and (4) history of postpartum haemorrhage. Prediction of postpartum haemorrhage is carried out using points. One point for factors (1), (2) and (3) and two points for factor (4). A score of ≥2 points for the high risk group and a score of ≤1 point for the low risk group. This predictor score had a sensitivity of 47.8% and a specificity of 85.4%.</td>
</tr>
<tr>
<td>4.</td>
<td>Predictors of postpartum haemorrhage in vaginal deliveries: Retrospective observational study (Akhtamova, et al, 2022).</td>
<td>Retrospective cohort; Uzbekistan; 2019-2020.</td>
<td>The risks of postpartum haemorrhage in this study sample include macrosomia, incomplete placental detachment, episiotomy, multiple pregnancies and perineal suturing. On the other hand, low birth weight and multiparity are protective factors against postpartum haemorrhage. The above variables can be used by doctors as clinical predictors for bleeding prevention strategies during labor.</td>
</tr>
<tr>
<td>5.</td>
<td>Predictors of severity in primary postpartum haemorrhage (Atalay E, et al, 2015).</td>
<td>Retrospective cohort; Turkey; 2011-2014.</td>
<td>In a multivariate logistic regression analysis to identify predictors of severe postpartum haemorrhage, previous delivery by caesarean...</td>
</tr>
</tbody>
</table>
The development of a scoring system for postpartum bleeding is called MONITOR, namely (1) maternal complications with 1 point, (2) WHO bleeding score with a score of 0 then 0 points, a score of 1 then 1 point, or a score ≥2 then 3.5 points; (3) antepartum platelet transfusion with 1.5 points; (4) placental abnormalities with 3.5 points; (5) platelet count at labor admission with <20x10⁹/L 1.5 points, 20-100x10⁹/L 1 point, and >100x10⁹ with 0 points; (6) previous uterine surgery with 3 points; and (7) primiparity with 3 points. The lowest MONITOR score has a 0.3% risk of postpartum haemorrhage and the highest score has a 99.9% risk of postpartum haemorrhage.

Table 2.
List of risk factors found in each study

| Antepartum | | Retrospective cohort; China; 2008-2018
|---|---|---
| Living in rural area | (Vahid, et al, 2023) |
| Anemia | (Vahid, et al, 2023) |
| Trombocytopenia | (Qiu-Sha, et al, 2020) |
| Antepartum platelet transfusion | (Qiu-Sha, et al, 2020) |
| Leiomyoma | (Akitoshi, et al, 2023) |
| Intracytoplasmic sperm injection | (Akitoshi, et al, 2023) |
| Marginal umbilical cord insertion | (Akitoshi, et al, 2023) |
| History of postpartum haemorrhage | (Gillian, et al, 2023; Akitoshi, et al, 2023) |

<table>
<thead>
<tr>
<th>Intrapartum</th>
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</table>
Operative vaginal delivery  (Gillian, et al., 2023; Vahid, et al., 2023)
Cesarean section delivery  (Gillian, et al., 2023; Vahid, et al., 2023; Atalay, et al., 2015)
General anesthesia during cesarean section  (Vahid, et al., 2023; Atalay, et al., 2015)
Premature rupture of membranes  (Akhtamova, et al., 2022)
Epididymis  (Akhtamova, et al., 2022; Atalay, et al., 2015)
Prolonged labor  (Atalay, et al., 2015)
Shoulder dystocia  (Vahid, et al., 2023)
Retained placenta  (Akhtamova, et al., 2022)
Torn birth canal  (Akhtamova, et al., 2022)
Birth canal suturing  (Akhtamova, et al., 2022)
Large baby  (Akhtamova, et al., 2022; Atalay, et al., 2015)
Low birth weight babies  (Akhtamova, et al., 2022)

In research conducted by Gillian, et al., they explained several risk factors for postpartum haemorrhage. For several of the risk factors that have been mentioned, there are three factors that have the greatest value based on multivariate logistic regression analysis, they are a history of previous postpartum haemorrhage with OR = 8.66 (95% CI 5.94 - 12.62), followed by delivery section emergency cesarean section (OR = 5.71 95%CI 3.80 - 8.59) and prelabor cesarean delivery (OR = 4.31 95%CI 3.01 - 6.19) (Gillian, et al., 2023).

The presentation of the table of risk factors for postpartum haemorrhage in research conducted by Vahid, et al shows that the greatest risk is fetal macrosomia with OR 8.14 (95%CI 1.02 - 14.47, p value <0.001), followed by shoulder dystocia (OR = 7.88 95%CI 1.07 - 13.99 p value 0.008), general anesthesia during SC delivery (OR = 7.66 95%CI 3.11 - 9.36) and abnormal placentation (OR = 7.66 95%CI 2.81 - 17.34, p value <0.001) (Vahid, et al., 2023).

Not much different from research conducted by Akitoshi, et al which presented statistical data related to the highest risk factor, they are a history of previous postpartum haemorrhage with OR = 16.10 (95%CI 1.16 - 223.0, p value 0.04), followed by marginal umbilical cord insertion (OR = 3.33 95%CI 1.11 - 10.0, p value 0.03), large baby (OR = 2.84 95%CI 1.02 - 7.93, p value p 0.05) and obesity predelivery maternal BMI (OR = 2.53 95%CI 0.97 - 6.61, p value 0.06). Therefore, these risk factors are stated to be able to be used as predictors of postpartum haemorrhage using the point system in this study (Akitoshi, et al., 2023).
There are variations in research conducted by Akhtamova, et al which states that the risk factor for postpartum haemorrhage which has a high value is placental retention with OR = 4.31 (95%CI 1.85 - 10.04, p value <0.001), continued by multiple pregnancies (OR = 2.52 95%CI 0.59 - 10.61, p value 0.20), episiotomy (OR 2.23 95%CI 1.74 - 2.87, p value <0.001) and fetal macrosomia (OR = 2.16 95%CI 1.47 - 3.18, p value <0.001) (Akhtamova, et al, 2022).

Research by Atalay, et al shows that the risk factor for postpartum haemorrhage that has the highest value is HELLP syndrome with OR = 4.51 (95% CI 0.91 - 23.1, p value 0.096), followed by eclampsia (OR = 4.41 95%CI 0.67 - 37.4, p value 0.074) and prolonged labor (OR = 3.62 95%CI = 3.21 - 4.03, p value <0.001) (Atalay, et al, 2015).

Research by Qiu-Sha, et al shows that the risk factor with a high value for postpartum haemorrhage is abnormal placentation with OR = 14.97 (95%CI 4.7 - 47.8, p value <0.001), followed by a history of uterine surgery (OR = 10.31 95%CI 4.46 - 23.82, p value <0.001) and primiparity (OR = 7.95 95%CI 3.49 - 18.08, p value <0.001) (Qiu-Sha, et al, 2020).

In conclusion, several risk factors with the greatest value based on multivariate logistic regression analysis for postpartum haemorrhage include a history of previous postpartum haemorrhage, fetal macrosomia, placental retention, HELLP syndrome which includes hypertension in pregnancy and abnormal placentation.

5 DISCUSSION

5.1 RISK FACTORS ASSOCIATED WITH POSTPARTUM HAEMORRHAGE

There are several risk factors that are used as predictors of postpartum haemorrhage in pregnant women living in rural areas, obese mothers before giving birth, primiparity, multiple pregnancies, fetal macrosomia, shoulder dystocia, prolonged labor, oxytocin augmentation, episiotomy, perineal suturing, uterine atony, placentation abnormality, marginal or velamentous umbilical cord insertion, vacuum mode of delivery, emergency cesarean section, cesarean section before delivery, general anesthesia during cesarean

5.2 PARITY

Parity is the birth of a baby more than 20 weeks old, either live or stillborn, but not an abortion.17,18 Mothers with a high number of births will experience damage to the blood vessels of the uterine wall and a decrease in the flexibility of the uterine muscle wall which occurs repeatedly during pregnancy so they tend to causes abnormalities in the location or growth of the placenta which results in postpartum haemorrhage (Pradana & Ashhiddiq, 2021).

The uterus will be repeatedly stretched so that the uterus tends to work inefficiently at all times, in the sense of experiencing a decrease in the ability to contract to exert pressure on the open blood vessels after separation of the placenta (Husnah, 2022). This will reduce the ability to contract of the uterus immediately after the placenta is born, resulting in postpartum bleeding, this is because with each pregnancy the muscle fibers change into connective tissue in the uterus. The higher the parity, the higher the maternal mortality rate because bleeding cases increase with increasing number of parities (Sanjaya & Fara, 2021; Wang, Lee, & Clark, 2021)

5.2.1 Live in a rural area

Research conducted by Vahid M, et al explains that every mother who lives in a rural or remote area is at risk of postpartum haemorrhage due to the distance and difficulty of access to health facilities to obtain examinations related to the pregnancy or the delivery process (Gillian, at al, 2023).
5.2.2 Obese mother before giving birth

Research conducted on obese mothers with postpartum haemorrhage has significant results and shows the presence of postpartum haemorrhage in mothers who are obese, however, patients who are obese tend to have other diseases such as hypertension and diabetes mellitus so it cannot be said that obesity has a major role in the cause occurrence of postpartum haemorrhage (Vahid, et al., 2023; Wang, Lee, & Clark, 2021; Butwick, 2019)

5.2.3 Multiple pregnancy

In multiple pregnancies, namely more than one fetus, the uterus will experience overdistension which will affect the contractility of the myometrium after giving birth, as well as changes in the mother’s physiology. In multiple pregnancies the delivery process will take longer than usual so it will make the uterine muscles contract for longer and make the uterine muscles overwork which makes the muscles experience weakness during childbirth. Apart from that, having more than one baby will cause the birth canal to tear bigger. The number of placentas in multiple pregnancies increases the risk of retained tissue in the uterus (Maher et al., 2022; Akhtamova, et al., 2022; di Marco et al., 2023).

5.2.4 Macrosomia

Macrosomia is a fetus weighing ≥ 4000g so it will complicate the delivery process and cause vaginal lacerations, perineal tears and cervical lacerations. The large size of the fetus will make the mother need to exert more energy to carry out contractions during the birth process and cause the uterine muscles to experience excessive work (Akitoshi, et al., 2023; Akhtamova, et al., 2022; Atalay, et al., 2015; Dungga & Husain, 2019)
5.2.5 Shoulder dystocia

Shoulder dystocia is a condition where a baby is delivered vaginally with the head being born but the baby cannot be born because there are complications such as a narrow maternal pelvis, a large baby, an obese mother, and others. This condition forces health workers to carry out maneuvers and other actions such as carrying out an episiotomy on the mother's perineum so that suturing is required and will cause tissue damage which can cause bleeding during the birth process (Gillian, et al., 2023; Miarnasari & Prijatna, 2016; Dahlke, Bhalwal, & Chauhan, 2017).

5.2.6 Prolonged labor

Prolonged labor is marked on the partograph which crosses the alert line in the first stage of the active phase and the second stage exceeds two hours in primiparas and exceeds one hour in multiparas. This can be caused by the mother's power being inadequate, the passage being like a narrow pelvis, and the passanger being like a big baby. Prolonged labor makes the mother tired during the labor process and causes the uterine muscles to contract more so that the muscles experience more work and are at risk of releasing after delivery which risks bleeding (Akitoshi, et al., 2023; Akhtamova, et al., 2022; Baktiyani, Meirani, & Khasanah, 2012).

5.2.7 Oxytocin augmentation

Augmentation using oxytocin at a dose of ≥ 20 mU/minute is associated with an increased risk of postpartum haemorrhage, this is due to increased contractions in the uterus and prolonged contractions in the uterus, making the uterus tired of contracting which results in postpartum haemorrhage (Akhtamova, et al., 2022; Tran, Kanczuk, & Balki, 2017; Bernitz et al., 2023).
5.2.8 Uterine atony

Uterine atony is a condition where the uterine muscle fails to contract so that the process of compression of the blood vessels on the open side of the placenta after separation cannot be carried out, so that large amounts of bleeding cannot be stopped (Gillian, et al., 2023; Akhtamova, et al., 2022; Baktiyani, Meirani, & Khasanah, 2012).

5.2.9 Abnormal placenta

Abnormal placenta consists of placenta previa, placental abruption, and placental retention (Maher et al., 2022; Gillian, et al., 2023; Akhtamova, et al., 2022).

5.2.10 Placenta previa

Placenta previa is a condition where the placenta covers part or all of the cervical opening in the uterus. This condition can cause bleeding because the placenta which should be attached to the uterine wall can be located near or covering the opening of the cervix. Bleeding that occurs in placenta previa can occur due to impaired vascularization of the placenta, the placenta not attaching to the surface properly, inflammatory reactions and uterine contractions (Maher et al., 2022; Akhtamova, et al., 2022; Roni, Waluyo, & Pujojati, 2022).

5.2.11 Placental abruption

Placental abruption, is a serious condition that occurs when the placenta detaches from the uterine wall before the baby is born. This can cause significant internal bleeding and can threaten the lives of the mother and fetus (Maher et al., 2022; Akhtamova, et al., 2022; Schmidt, Skelly, & Raines, 2022).
5.2.12 Retained placenta

Placental retention occurs when the placenta has not separated within half an hour after delivery. This condition can cause significant bleeding, indicating that only part of the placenta has separated, so manual action is needed to remove the placenta immediately (Akhtamova, et al, 2022; Astuti, 2019)

5.3 UMBILICAL CORD INSERTION

5.3.1 Marginal

Marginal umbilical cord insertion, or the umbilical cord attached to the edge of the placenta, is a condition where the umbilical cord is not attached to the center of the placenta as usual, which is called central insertion. This condition can increase the possibility of bleeding during pregnancy or childbirth because contact of the umbilical cord with the edge of the placenta can cause damage to blood vessels and bleeding. Normally, the umbilical cord should be attached to the center of the placenta to ensure optimal blood flow and nutrition to the fetus (Vahid, et al, 2023; Mercier et al., 2022)

5.3.2 Vilamentous

Vilamentous insertion, refers to a condition in which the umbilical cord blood vessels attach to or infiltrate the fetal membranes before reaching the placenta. In contrast to the normal situation where the umbilical cord blood vessels are attached directly to the placenta, in vilamentous insertion, the blood vessels pass through the fetal membrane before reaching the placenta. The presence of vilamentous insertions can cause various problems, especially because the umbilical cord blood vessels that cross the fetal membranes become more vulnerable to pressure and injury during pregnancy. As the fetus grows, the pressure received by these blood vessels can increase, increasing
the risk of bleeding and disruption of blood flow to the fetus (Vahid, *et al.*, 2023; Yang *et al.*, 2020)

### 5.3.3 Anemia

Mothers with low haemoglobin conditions are at risk of experiencing postpartum haemorrhage, one of which is uterine atony, this is caused by low haemoglobin causing reduced oxygen delivered to cells, especially to muscle cells which need oxygen to produce energy for contractions, so that the muscle contraction process is disrupted and causes my muscle weakness is uterine contractions (Julizar, Effendi, & Sukandar, 2019).

### 5.3.4 The platelet count before delivery is low

Platelets are small blood cells that play an important role in the blood clotting process. During labor, especially during labor and separation of the placenta, significant blood discharge occurs and the uterine wall contracts. In thrombocytopenia, a low platelet count can inhibit the blood’s ability to form clots effectively. As a result, postpartum bleeding can become more difficult to control and last longer because the lack of platelets can cause disruption in the process of blood clot formation (van Dijk *et al.*, 2021).

### 5.3.5 Vacuum delivery

The use of a vacuum in delivery procedures can increase the risk of postpartum bleeding, although not all cases of using a vacuum will result in bleeding. The use of a vacuum may increase the risk of perineal tearing, especially if the vacuum is applied with significant force or if the procedure is not performed carefully. The vacuum extraction process can also cause trauma to the birth canal and maternal perineum, involving the potential for tearing of the perineum or other structures, which in turn can cause postpartum haemorrhage (Gillian, *et al.*, 2023; Anggraini & Riansari, 2018)
5.3.6 Previous history of postpartum haemorrhage

Mothers with a history of postpartum haemorrhage (PPH) are at risk of experiencing PPH again due to predisposing factors that can influence the regulation of hemostasis during labor. PPH is a condition that involves significant blood loss after delivery, and in individuals with a previous history of PPH, the hemostasis system may have been impaired or weakened. These factors include damage or weakness in the uterine wall, blood clotting disorders, and increased sensitivity to stimulation of uterine contractions. In addition, the presence of vascular abnormalities and hormonal changes may be additional contributors to the risk of recurrent PPH in mothers with a history of this condition (Akitoshi, et al., 2023; Vahid, et al., 2023; Lutfitasari et al, 2023)

5.3.7 Caesarean section operation

Caesarean section can cause uterine atony through pathophysiological mechanisms associated with surgical interventions that affect the uterus directly. During this procedure, manipulation and direct surgery on the uterus can cause damage to the uterine muscles and nerves that play a role in controlling contractions. This trauma can result in impaired coordination and strength of uterine contractions. The use of epidural or spinal anesthesia during caesarean section can also inhibit the body’s sensation and perception of the labor process, including uterine contractions, which can affect the uterus’ ability to respond effectively after surgery. Overall, these surgical interventions can create conditions detrimental to the regulation of postoperative uterine contractions, increasing the risk of uterine atony (Gillian, at al, 2023; Akitoshi, et al., 2023; Zuhra & Fitri, 2023)

The results and discussions of an article must be presented in a clear and organized manner, based on the data collected and the analyzes carried out during the study. Initially, the results must be presented in an objective and concise way, using tables, graphs and statistics, if applicable, to highlight the main findings. Then, in the discussion section, the results are interpreted in
light of existing literature, highlighting similarities, differences and implications for theory and practice.

Furthermore, limitations of the study and possible directions for future research are discussed. It is essential that both the results and the discussion are based on solid evidence and that they contribute significantly to the advancement of knowledge on the topic addressed.

6 CONCLUSION

Based on the results of the analysis and discussion of the six research articles that have been reviewed, it is concluded that the risk factors for postpartum haemorrhage are living in a rural area, maternal obesity before giving birth, primiparity, multiple pregnancies, fetal macrosomia, shoulder dystocia, prolonged labor, oxytocin augmentation, episiotomy, perineal suturing, uterine atony, abnormal placentation, marginal or velamentous umbilical cord insertion, vacuum mode of delivery, emergency caesarean section, prenatal caesarean section, general anesthesia during cesarean delivery, anemia, low prenatal platelet count and previous history of postpartum haemorrhage. These factors can be used as predictors of postpartum haemorrhage clinically or using a scoring system, normogram and XGBoost classification model.

This conclusion can be used as a reference to predict the occurrence of haemorrhage in mothers who are about to give birth, allowing medical personnel to prepare for this and prevent maternal mortality in accordance with the SDGs.

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REFERENCES


SDGs Knowledge Hub, Agenda 2030 untuk Pembangunan Berkelanjutan [Internet]. SDGs Indonesia. 2023. Available at: https://sdgs.bappenas.go.id/.


Wormer KC, Jamil RT, Bryant SB. Acute Postpartum Haemorrhage [Internet]. Available at: https://www.ncbi.nlm.nih.gov/books/NBK499988/.


Husnah PF. Hubungan Paritas Dan Partus Lama Dengan Kejadian Perdarahan Post Partum Corelated of Parity and Prolonged Labor With Events Maternity Mother With Post Partum Haemorrhage in the General Hospital on. SMART ANKes [Internet]. 2022;6(2):78-85. Available at: https://www.jurnalabdinusababel.ac.id/


Dahlke JD, Bhalwal A, Chauhan SP. Obstetric Emergencies: Shoulder Dystocia and Postpartum Haemorrhage. Obstet Gynecol Clin North Am [Internet].


Risk Factors in Pregnant Women as Predictors of Postpartum haemorrhage: A Systematic Review Aligned with SDG Goals

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