

Meta-analysis: Factors associated with the occurrence of postpartum hemorrhage

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Abstract

WHO states that there are 140,000 maternal deaths every year or 1 woman every 4 minutes, 25% of maternal deaths are caused by postpartum hemorrhage and it has been calculated that there are 100,000 maternal deaths every year. Many factors are related and influence the incidence of postpartum hemorrhage. This study aims to analyze the relationship between parity and delivery distance with the incidence of postpartum hemorrhage. This study used a meta-analysis method with a cross-sectional, case-control, and retrospective cohort design in Google Scholar and PubMed databases. The results of the identification after going through the selection stage on relevant studies according to the inclusion criteria reviewed were 10 articles entered into the meta-analysis. Parity was not significantly associated with the incidence of postpartum hemorrhage with p value > 0.33 and pOR value 1.31 (95% CI 0.76-2.24). Furthermore, the delivery distance variable was significantly related to the incidence of postpartum hemorrhage with $p < 0.0001$ and pOR 2.85 (95% CI 1.78-4.55). Maternal parity did not have a relationship with the incidence of postpartum hemorrhage. Meanwhile, birth spacing was significantly associated with the incidence of postpartum hemorrhage.

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I. INTRODUCTION

Postpartum hemorrhage (PPH) is defined as the loss of more than 500 cc of blood within 24 hours after childbirth.¹ Maternal mortality can be caused by two factors: direct and indirect causes. Among these, direct causes of maternal death include postpartum hemorrhage, sepsis, and hypertension, accounting for 37.1% of cases.² According to the World Health Organization (WHO), maternal deaths reach approximately 140,000 annually, equivalent to one woman every four minutes. Postpartum hemorrhage accounts for 25% of maternal deaths, with an estimated 100,000 maternal deaths occurring each year due to this condition.³ The WHO also reports that approximately 14 million women, or 11.4% of all women worldwide, experience postpartum hemorrhage.⁴ The highest rates occur in developing countries, with 480,000 cases (32%), compared to only 1,200 cases (8%) in developed countries.⁵ In Indonesia, the percentage of bleeding during and after childbirth over

three consecutive years was 31% in 2015, 29.2% in 2016, and 27.1% in 2017. Although there has been a yearly decline, bleeding complications remain one of the top three causes of maternal death.⁶ According to data from the Ministry of Health, maternal deaths increased in 2020 to 4,627 cases, up from 4,221 in 2019, with the majority caused by hemorrhage—totaling 1,330 cases [1]. Several studies have indicated a significant relationship between parity and the incidence of postpartum hemorrhage [2, 3]. Parity greater than three is associated with a three-fold increased risk of experiencing postpartum hemorrhage [4]. However, some researchers argue that grand multiparity is not significantly related to postpartum hemorrhage [5]. As parity increases, the strength of the uterine (myometrial) muscles may decline due to a reduction in collagen fibers, thus increasing the likelihood of PPH [6]. Another maternal characteristic related to hemorrhage incidence is birth spacing. Birth spacing refers to the interval,

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measured in months or years, between the birth of one child and the next [6]. It is recommended to allow sufficient time between pregnancies so that the mother's body can properly recover and prepare for the next pregnancy and delivery. A spacing of 2–5 years is considered optimal for both reproductive health and psychological well-being, enabling mothers to manage pregnancy and childbirth more effectively [7].

Based on this background, the researcher is interested in mapping study results using a meta-analysis method to examine the relationship between parity and birth spacing with the incidence of postpartum hemorrhage.

II. METHOD

This study uses a meta-analysis approach. Meta-analysis is a systematic review that employs statistical techniques to combine two or more research results, resulting in new, quantitatively based data. Meta-analysis is used to analyze empirical studies that have been conducted by previous researchers, particularly quantitative research results, and outcomes presented in comparable forms such as means, correlation coefficients, and odds ratios. In correlational meta-analysis, the research design is similar to other types of meta-analytic studies, with a focus on statistical analysis [8].

Data collection was first carried out through accessible journal portals such as ResearchGate, PubMed, and Google Scholar. The search strategy to obtain relevant journals involved using the advanced search terms: postpartum hemorrhage AND vaginal birth AND parity AND inter-delivery interval. In Indonesian, these keywords are: perdarahan pasca lahir DAN persalinan spontan DAN paritas DAN jarak kelahiran.

In the second stage, the articles were filtered based on the following criteria: published more than 6 years ago, full text not accessible, article type being literature review, duplicate articles, articles irrelevant to the keywords, and books. As a result, 678 articles were excluded, and 107 articles were selected.

In the third stage, further filtering was done based on the researcher's criteria: mismatch between title and content, qualitative research type, articles not using suitable designs (case-control, cross-sectional, retrospective cohort), and language (English or Indonesian). As a result, 78 articles were excluded, leaving 29 articles to undergo feasibility testing.

Based on the feasibility test using the JBI Research Appraisal Checklist Approach, 10 articles met the inclusion criteria. These criteria were: articles published between

2016 and 2022, research article type, fully accessible journals, written in English or Indonesian, quantitative research with cross-sectional, retrospective cohort, or case-control design, journals with clear and accredited sources, relevant to the research title, and research results that included *p*-values and pOR (prevalence odds ratios).

RESULT

A. Forest Plot of Parity and the Incidence of Postpartum Hemorrhage

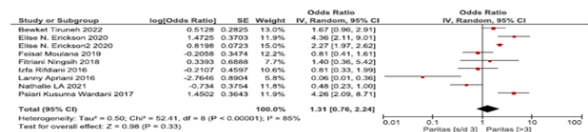


Fig. 1. . Forest plot of parity and the incidence of postpartum

Based on Figure 1, the analysis of parity data from 9 research articles shows that there is no association between parity and the incidence of postpartum hemorrhage, as analyzed using a random effects model. The heterogeneity test results indicate that the variation among studies is heterogeneous, with a *p*-value < 0.0001 and an inter-study variation (I^2) of 85%. The forest plot analysis shows that although 6 out of 9 articles reported an association and 3 articles reported no association, [9] articles based on pOR values indicated that parity was not a risk factor for postpartum hemorrhage. However, after the combined analysis, the overall result showed no significant association between parity and the incidence of postpartum hemorrhage, with a *p*-value > 0.05 , specifically $p = 0.33$.

B. Funnel Plot of Parity and the Incidence of Postpartum Hemorrhage

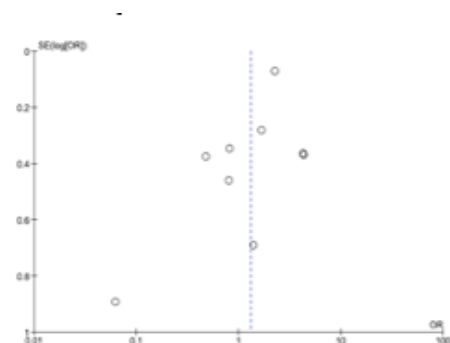


Fig. 2. Funnel plot of parity and the incidence of postpartum hemorrhage test

Based on Figure 2, the funnel plot results indicate the presence of publication bias, as evidenced by the asymmetry of the plots on the right and left sides of the vertical line. Although there are an equal number of plots on both

sides—four on the left and four on the right—with one plot touching the vertical line, the distances and distribution of the plots are highly varied and uneven.

C. Forest Plot of Birth Spacing and the Incidence of Postpartum Hemorrhage

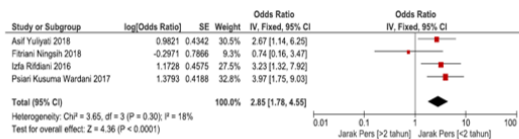


Fig. 3. Histogram Plot for Normality Test

Figure 3 shows The analysis of birth spacing data from 4 research articles showed a significant association between birth spacing and the incidence of postpartum hemorrhage, analyzed using a fixed effects model. The heterogeneity test results indicated that the variation among studies was heterogeneous, with a p -value of 0.00001 (less than 0.05) and an inter-study variation (I^2) of 18%. The forest plot analysis showed a significant association between birth spacing and the incidence of postpartum hemorrhage, with a p -value < 0.0001 (less than 0.05), odds ratio/pOR = 2.85; 95% CI = 1.78 to 4.55. The analysis results indicate that mothers with a birth spacing of less than 2 years are 2.85 times more likely to experience postpartum hemorrhage compared to those with a birth spacing of more than 2 years.

D. Funnel Plot of Birth Spacing and the Incidence of Postpartum Hemorrhage

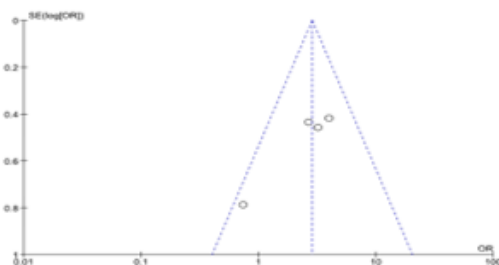


Fig. 4. Histogram Plot for Normality Test

Based on Figure 4, the funnel plot results indicate no publication bias, as evidenced by the symmetrical distribution of plots on both the right and left sides of the vertical line. This is further supported by the Egger's test, which considers the funnel plot symmetrical when the p -value is greater than 0.05; in this case, $p = 0.30$, indicating no evidence of publication bias.

III. DISCUSSION

The Relationship Between Parity and the Incidence of Postpartum Hemorrhage

In nine studies discussing the relationship between parity and the incidence of postpartum hemorrhage, the findings were as follows: Erikson reported a pOR of 4.36, Wardani a pOR of 4.26, Erikson (another study) a pOR of 2.27, Tiruneh a pOR of 1.67, Ningsih a pOR of 1.40, Moulana a pOR of 0.81, Rifriadi a pOR of 0.81, Ambounda a pOR of 0.48, and Apriani a pOR of 0.06. After statistical analysis of the nine studies, the data displayed in the forest plot showed no significant association between parity and the incidence of postpartum hemorrhage, with a p -value > 0.05 ($p = 0.33$) and a pooled odds ratio of 1.31 (95% CI: 0.76–2.24) [10]

The results from three studies showed no association between parity and postpartum hemorrhage. Rifdiani stated that the lack of association may be due to the fact that in women with parity of [11], postpartum hemorrhage was mostly caused by birth canal lacerations, whereas in parity [12, 13] it was often due to uterine overdistension, exhaustion from prolonged labor, or excessive use of oxytocin for labor induction. In women with parity > 3 , it is likely caused by reduced elasticity of uterine muscles [14].

Moulana also found no association between parity and postpartum hemorrhage. This study suggested that the condition might occur because women who have given birth multiple times tend to have a uterus that no longer functions efficiently in each stage of labor. As the uterus becomes more elastic and enlarged, it weakens in its ability to contract effectively, potentially leading to postpartum hemorrhage [15].

Tiruneh's study also showed no association between parity and postpartum hemorrhage, which was attributed to the fact that most women were discharged from the birthing unit within 24 hours due to limited postpartum care space. Furthermore, the distance from the mothers' homes to the hospital contributed to the lack of complete health service data, resulting in data gaps [16].

Five studies, however, reported a significant relationship between parity and postpartum hemorrhage [17, 18, 19, 20]. One contributing factor to postpartum hemorrhage is multiparity. Parity refers to the number of previous pregnancies that have reached viability and resulted in birth. The number of fetuses delivered does not determine parity—whether a woman delivers a single baby, twins, or quintuplets, the parity count remains the same. Likewise, a stillbirth does not reduce parity. A uterus that has delivered many children tends to function less efficiently during all stages of labor. According to the theory of Oxorn

and William (2010), the risk of postpartum hemorrhage increases with multiparity because a uterus that has delivered many children undergoes changes in elasticity, resulting in less efficient contractions throughout labor [21].

A. The Relationship Between Birth Interval and the Incidence of Postpartum Hemorrhage

An analysis of four studies showed varying variances and weights. A heterogeneity test was conducted to objectively determine the role of inter-study variation. The results of the heterogeneity test for the four studies that indicated a relationship between birth interval and the incidence of postpartum hemorrhage showed $I^2 = 18\%$ and a p -value = 0.30. These results suggest low heterogeneity (homogeneous), so a fixed effect model was used to measure the combined effect of the data, using the RevMan 5.4 software. The results obtained were a pooled odds ratio (pOR) of 2.85 (95% CI: 1.78–4.55). The combined effect also produced a Z-score of 4.36 and a p -value of <0.0001 , which is less than 0.05. This indicates a significant relationship between birth interval and postpartum hemorrhage, with a tendency for mothers with a birth interval of less than 2 years to have a 2.85 times higher risk of experiencing postpartum hemorrhage compared to those with a birth interval of more than 2 years.

Findings from three studies showed a significant relationship between birth interval and the incidence of postpartum

hemorrhage. According to Rifriadi, a short birth interval following the previous delivery carries numerous risks that may endanger both the mother and the fetus. These findings are consistent with Wardani's results, which showed that mothers with a birth interval of less than 2 years are three times more likely to experience postpartum hemorrhage compared to those with an interval greater than 2 years. Yuliyati's study also indicated a relationship between short birth intervals and postpartum hemorrhage, stating that when the interval is less than 2 years, the uterus has insufficient time to recover physiologically from the strain of the previous delivery,[10, 14, 22, 23].

IV. CONCLUSION

The relationship between parity and the incidence of postpartum hemorrhage was analyzed using 9 eligible articles, yielding a Z-value of 0.98, $p > 0.05$, and a pooled odds ratio of 1.31 (95% CI = 0.76 to 2.24). A relationship was found between birth interval and the incidence of postpartum hemorrhage through the analysis of 4 eligible articles, with a Z-value of 4.36, $p < 0.0001$, and a pooled odds ratio of 2.85 (95% CI = 1.78 to 4.55).

It can be concluded that mothers with a birth interval of less than 2 years have a 2.85 times higher risk of experiencing postpartum hemorrhage compared to mothers with a birth interval of more than 2 years.

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