International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Abbasi A et al. Int J Reprod Contracept Obstet Gynecol. 2026 Dec;15(12):4818-4826
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20264393

Original Research Article

Evaluation of shock index as an early predictor of severity and maternal outcomes in postpartum hemorrhage: a prospective observational study

Aiman Abbasi, Shreya*

Department of Obstetrics and Gynaecology, Motilal Nehru Medical College, Prayagraj, Uttar Pradesh, India

Received: 20 October 2026
Revised: 22 November 2026
Accepted: 23 November 2026

***Correspondence:**
Dr. Shreya,
E-mail: shreya.hr2080@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Postpartum haemorrhage (PPH) is a major cause of maternal morbidity and mortality. Early identification of haemodynamic instability is essential for timely intervention. Shock index (SI), calculated as heart rate divided by systolic blood pressure, may serve as a simple bedside predictor of PPH severity and adverse maternal outcomes. Aim of the study was to evaluate the usefulness of Shock Index as an early predictor of PPH severity and adverse maternal outcomes.
Methods: This prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Swaroop Rani Hospital, over 24 months (March 2024–March 2026). A total of 420 women diagnosed with primary PPH following vaginal or caesarean delivery were included. Heart rate and systolic blood pressure were recorded at PPH diagnosis, and SI was calculated. Its association with blood transfusion, intensive care unit (ICU) admission, surgical intervention and severe maternal outcomes was assessed.
Results: Among 420 women, 40.5% had SI below 0.9, while 27.3% had SI of 1.1 or higher. Blood transfusion was required in 47.6%, ICU admission in 11.9%, and surgical intervention in 12.4%. Increasing SI was associated with progressively higher rates of these interventions. Maternal near-miss events occurred in 5.2% and maternal mortality in 0.95%. An SI of ≥1.1 was the strongest independent predictor of severe maternal outcomes (adjusted OR 5.82, $p<0.001$). Mean SI was significantly higher in severe than in mild PPH (1.37±0.28 versus 0.82±0.12; $p<0.001$).
Conclusions: SI is a simple and useful bedside parameter for identifying women at increased risk of severe PPH and adverse maternal outcomes. Its use alongside clinical assessment may facilitate early recognition and timely management.

Keywords: Postpartum haemorrhage, Shock index, Maternal outcome, Blood transfusion, Intensive care unit, Maternal morbidity

INTRODUCTION

Postpartum hemorrhage (PPH) is one of the most serious obstetric emergencies and remains a leading cause of maternal morbidity and mortality worldwide. The World Health Organization (WHO) defines PPH as blood loss of 500 ml or more within 24 hours after birth, regardless of the mode of delivery. Despite advances in obstetric care, PPH continues to account for a substantial proportion of maternal deaths, particularly in low- and middle-income countries where access to timely diagnosis and management may be limited.[1,2]

Each year, millions of women experience PPH, resulting in about 70 000 maternal deaths globally, which is over 20% of all maternal deaths.[3] Hemorrhage accounts for approximately one-quarter of all maternal deaths worldwide and remains the foremost direct cause of

maternal mortality. Even when women survive, they often need urgent surgical interventions to control the bleeding and may be left with lifelong reproductive disability. he leading cause of PPH is uterine atony, responsible for nearly 70% of cases. While high-income countries have significantly reduced PPH-related mortality through timely and effective interventions, low- and middle-income countries continue to bear the highest burden. This concerning trend is underscored by WHO data, which identifies PPH as the leading cause of maternal mortality worldwide, despite being both preventable and treatable.[4]

In India, PPH contributes significantly to maternal mortality and severe maternal morbidity despite ongoing efforts to improve obstetric care and emergency referral systems. Early recognition and prompt intervention are therefore critical in reducing adverse maternal outcomes.

The severity of PPH is commonly assessed using estimated blood loss, clinical examination, vital signs, and laboratory investigations. However, visual estimation of blood loss is notoriously inaccurate and often underestimates the true volume of blood loss. During the postpartum period, examination of the volume of blood loss for the prediction of the severity of PPH is challenging because the blood is mixed with amniotic fluid and may have seeped into the uterus or retroperitoneum.[5,6] Furthermore, physiological adaptations of pregnancy, including increased plasma volume, cardiac output, and heart rate, enable women to compensate for substantial blood loss before overt signs of shock become evident. As a result, traditional indicators such as systolic blood pressure and pulse rate may not accurately reflect the severity of hemorrhage during the early stages.

The shock index (SI), calculated as the ratio of heart rate to systolic blood pressure (HR/SBP), has gained increasing attention as a simple and effective tool for early detection of hemodynamic compromise. It was first introduced in 1967 by Allgower and Burri.[7] Originally introduced in trauma medicine.[8] SI integrates two readily available physiological parameters into a single value that reflects circulatory status. In healthy adults, the normal SI ranges between 0.5 and 0.7; higher values indicate increasing cardiovascular instability and risk of shock.

During pregnancy and the postpartum period, physiological changes may alter conventional vital signs, making isolated measurements less reliable for the early recognition of hemorrhage. The SI has been proposed as a superior indicator because it detects compensatory changes in heart rate and blood pressure before the onset of overt hypotension. Several studies have demonstrated that elevated SI values correlate with increased blood loss, need for blood transfusion, massive transfusion, intensive care unit admission, surgical intervention, and maternal mortality.

Nathan et al reported that SI was a better predictor of adverse maternal outcomes following PPH than conventional vital signs alone. They observed that SI values exceeding 0.9 were associated with increasing severity of hemorrhage and poorer clinical outcomes.[9] Similarly, Le Bas et al demonstrated the utility of the obstetric SI in identifying women at risk of severe PPH requiring urgent intervention.[10]

Recent systematic reviews and meta-analyses have further supported the role of SI in obstetric hemorrhage. Makino et al concluded that SI has moderate-to-high diagnostic accuracy in predicting severe PPH and the need for intensive management.[11] A recent meta-analysis by Pan et al confirmed that elevated SI values are significantly associated with severe PPH and adverse maternal outcomes, suggesting that SI can serve as an effective bedside screening tool for early risk stratification.[12]

The major advantage of SI lies in its simplicity, rapid calculation, and cost-effectiveness. It requires no laboratory investigations or specialized equipment and can be applied in both tertiary healthcare institutions and resource-constrained settings. Early identification of women at risk of severe hemorrhage may facilitate timely resuscitation, escalation of care, and referral, thereby reducing maternal morbidity and mortality.

Despite growing evidence supporting its use, there remains uncertainty regarding the optimal SI threshold for predicting severe PPH across different populations and healthcare settings. Further research is needed to validate its utility and determine appropriate cut-off values in diverse obstetric populations.

Therefore, the present study is undertaken to evaluate the effectiveness of SI in predicting the severity of PPH and associated maternal outcomes, with the ultimate aim of improving early recognition and management of this life-threatening obstetric complication.

Aim

The aim of the study was to evaluate the usefulness of the SI as an early predictor of the severity of PPH and adverse maternal outcomes.

Objectives

The objectives of the study were to determine the SI in women with PPH; to assess the association between SI values and the severity of blood loss; to evaluate the ability of SI to predict the need for blood transfusion, intensive care admission, surgical intervention, and maternal morbidity; and to identify an optimal SI cut-off value for predicting severe PPH.

METHODS

Study design

This will be a prospective observational study.

Study setting

The study will be conducted in the Swaroop Rani Hospital in Department of Obstetrics and Gynaecology.

Study duration

The study will be carried out over a period of 24 months from March 2024 to March 2026.

Study population

All women diagnosed with PPH following vaginal or cesarean delivery during the study period.

Inclusion criteria

The study will include all women aged 18 years and above who are diagnosed with primary PPH, defined as excessive bleeding occurring within the first 24 hours following delivery. Women who have undergone either vaginal or cesarean section delivery will be eligible for inclusion. Only those patients who provide voluntary informed consent to participate in the study will be enrolled.

Exclusion criteria

Women presenting with antepartum hemorrhage or secondary PPH (occurring more than 24 hours after delivery) will be excluded from the study. Patients with a known history of cardiac disease that may influence baseline heart rate or blood pressure measurements will also be excluded. Additionally, women with severe preeclampsia or eclampsia receiving vasoactive medications, as well as those unwilling to provide informed consent, will not be considered eligible for participation.

Methodology

Sample size calculation

The sample size for the present study will be calculated based on the ability of SI to predict severe PPH using expected sensitivity from previous studies.

Since SI is used as a diagnostic/predictive test, the sample size is calculated using the formula for estimating sensitivity.

$$n = \frac{Z^2 \times Se \times (1 - Se)}{L^2 \times P}$$

Where, n=required sample size, Z=1.96 at 95% confidence level, Se=expected sensitivity of SI (≈0.85 based on previous studies), L=allowable error (commonly 0.07-0.10; here 0.08 is used), P=prevalence of severe PPII among PPH cases (≈20-25%; assumed 0.20).

Substituting values,

$$n = \frac{(1.96)^2 \times 0.85 \times (1 - 0.85)}{(0.08)^2 \times 0.20}$$

$$n = \frac{3.84 \times 0.85 \times 0.15}{0.0064 \times 0.20}$$

$$n = \frac{0.4896}{0.00128}$$

$$n \approx 382$$

Final sample size

Minimum required sample size ≈ 382 patients with PPH.

Adjustment for dropouts/incomplete data

$$Adding\ 10\%\ attrition: 382\ + 38 = 420$$

Final sample size = ~420 cases of PPH.

All eligible patients diagnosed with PPH will be enrolled after informed consent. Baseline demographic details, obstetric history, and clinical parameters will be recorded.

Data collection and study procedure

At the time of diagnosis of primary PPH, the patient's heart rate (HR) will be recorded, and systolic blood pressure (SBP) will be measured. The SI will be calculated using the formula given.

$$SI = HR/SBP$$

Following the initial assessment, patients will be closely monitored, and relevant clinical parameters will be documented, including estimated blood loss, the requirement for uterotonic medications and additional therapeutic interventions, and the need for blood transfusion.

The requirement for intensive care unit (ICU) admission and surgical interventions, such as uterine artery ligation, B-Lynch compression suturing, and hysterectomy, will also be recorded. The final maternal outcome, including recovery, maternal morbidity, and mortality, will be assessed and documented.

Outcome measures

Primary outcome was correlation between SI and severity of PPH.

Secondary outcomes were need for blood transfusion, ICU admission, surgical intervention, maternal morbidity and mortality, and predictive accuracy of SI (sensitivity, specificity, ROC curve).

Statistical analysis

The collected data will be entered into Microsoft Excel and subsequently analyzed using appropriate statistical software, such as statistical package for the social sciences (SPSS) or Stata. Continuous variables will be expressed as mean ± standard deviation (SD), while categorical variables will be presented as frequencies and percentages. The association between the SI and various maternal outcomes will be assessed using the Chi-square test or Fisher's exact test, wherever appropriate. Receiver operating characteristic (ROC) curve analysis will be performed to determine the optimal cut-off value of the SI for predicting adverse maternal outcomes, along with its diagnostic performance. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and area under the curve (AUC) will also be calculated. A p value of less than 0.05 will be considered statistically significant.

Study proforma

Patient details

The patient's name or hospital identification number, age, gravida, parity, and gestational age will be recorded at the time of enrolment in the study.

Obstetric details

The mode of delivery, whether vaginal delivery or lower-segment cesarean section (LSCS), will be documented. In cases of cesarean delivery, the indication for the procedure will also be recorded. Relevant risk factors for PPH will be assessed and documented, if present.

Clinical parameters at the time of PPH diagnosis

At the time of diagnosis of PPH, the patient's HR, measured in beats per minute (bpm), and SBP, measured in mmHg, will be recorded. The SI will subsequently be calculated by dividing the heart rate by the systolic blood pressure (SI=HR/SBP).

Details of PPH

The estimated blood loss will be recorded in millilitres (ml), and the underlying cause of PPH will be identified and documented. The possible causes will include uterine atony, retained placenta, genital tract trauma, coagulopathy, and other relevant causes.

Management

The management provided to each patient will be documented, including the use of uterotonic medications, uterine massage, balloon tamponade, and surgical interventions. The requirement for blood transfusion will also be recorded, along with the number of units of blood or blood products transfused.

Maternal outcomes

Maternal outcomes will be assessed by documenting the requirement for ICU admission, the occurrence of maternal morbidity and its specific complications, and maternal mortality, if any. The final maternal outcome will be categorized as complete recovery, recovery with complications, or maternal death.

RESULTS

A total of 420 women diagnosed with PPH were enrolled in this prospective observational study. The majority of participants were aged 25–29 years (36.7%), followed by 20–24 years (26.2%). The mean age of the study population was 27.8±4.9 years. Most women were multigravida (61.4%), while 38.6% were primigravida.

Regarding mode of delivery, 66.7% underwent vaginal delivery, 27.4% underwent cesarean section, and 6.0% had instrumental delivery. Most participants were booked cases (71.9%), whereas 28.1% were unbooked.

Uterine atony was identified as the most common cause of PPH, accounting for 58.3% of cases, followed by genital tract trauma (17.6%), retained placenta (11.9%), placental abnormalities (6.9%), coagulation disorders (2.9%), and other causes (2.4%).

The estimated blood loss ranged from 500 ml to more than 2000 ml. More than half of the patients (52.4%) experienced blood loss between 500–1000 ml, while 28.1% had blood loss between 1001–1500 ml. Severe blood loss (>1500 ml) was observed in 19.5% of participants.

Table 1: Age distribution of study participants (n=420).

Age group (years)	Frequency (N)	Percentage
<20	28	6.7
20–24	110	26.2
25–29	154	36.7
30–34	86	20.5
≥35	42	10.0
Total	420	100.0

Table 2: Obstetric characteristics (n=420).

Variable	Frequency (N)	Percentage
Primigravida	162	38.6
Multigravida	258	61.4
Vaginal delivery	280	66.7
Instrumental delivery	25	6.0
Cesarean section	115	27.4
Booked cases	302	71.9
Unbooked cases	118	28.1

Assessment of SI revealed that 40.5% of patients had an SI <0.9, 32.1% had an SI between 0.9–1.09, 19.0% had an SI between 1.10–1.39, and 8.3% had an SI ≥1.40.

A significant association was observed between SI and requirement for blood transfusion. Blood transfusion was required in 47.6% of the study population. The proportion of patients requiring transfusion increased progressively with increasing SI, reaching 100% among patients with SI ≥1.40 (χ^2=112.6, p<0.001).

Similarly, ICU admission rates increased significantly with rising SI values. Only 1.8% of patients with SI<0.9 required ICU admission compared to 60.0% of those with SI≥1.40. This association was statistically significant (χ^2=98.4, p<0.001).

The need for surgical intervention also demonstrated a significant correlation with SI. Surgical procedures were required in 12.4% of patients overall, with the highest frequency observed among women with SI≥1.40 (51.4%) (χ^2=89.7, p<0.001).

Maternal near-miss events occurred in 22 patients (5.2%), while four maternal deaths (0.95%) were recorded. No maternal deaths occurred among women with SI<1.10. Three of the four maternal deaths were observed in the SI ≥1.40 category, indicating a strong relationship between elevated SI and adverse maternal outcomes.

Comparison of hemodynamic parameters showed that women with severe PPH had significantly higher mean heart rate (121.8±15.4 beats/min) and SI (1.37±0.28) and significantly lower systolic blood pressure (89.6±11.8 mmHg) compared to women with mild PPH (p<0.001 for all comparisons).

The diagnostic performance of SI demonstrated that an SI cut-off value of ≥1.1 had a sensitivity of 86.4%, specificity of 75.8%, positive predictive value of 58.7%, and negative predictive value of 93.1% for predicting severe maternal outcomes. The area under the receiver operating characteristic curve (AUC) was 0.85, indicating good predictive accuracy.

Table 3: Etiology of postpartum hemorrhage (n=420).

Cause of PPH	Frequency (N)	Percentage
Uterine atony	245	58.3
Retained placenta	50	11.9
Genital tract trauma	74	17.6
Placental abnormalities	29	6.9
Coagulation disorders	12	2.9
Others	10	2.4
Total	420	100.0

Multivariate logistic regression analysis identified SI≥1.1 as the strongest independent predictor of severe maternal outcome (adjusted OR 5.82, 95% CI: 3.45–9.81, p<0.001). Blood loss greater than 1500 ml was also significantly associated with severe maternal outcome (adjusted OR 4.26, 95% CI: 2.34–7.75, p<0.001). Cesarean delivery showed a modest but statistically significant association (adjusted OR 1.74, 95% CI: 1.01–3.02, p=0.045), whereas maternal age and parity were not significant predictors.

Overall, the findings demonstrate that SI is a simple, rapid, and reliable bedside tool for early identification of severe PPH and prediction of adverse maternal outcomes. Increasing SI values were significantly associated with higher transfusion requirements, ICU admissions, surgical interventions, maternal near-miss events, and mortality.

Table 4: Distribution of blood loss (n=420).

Estimated blood loss (ml)	Frequency (N)	Percentage
500–1000	220	52.4
1001–1500	118	28.1
1501–2000	52	12.4
>2000	30	7.1
Total	420	100.0

Table 5: Shock index categories (n=420).

Shock index category	Frequency (N)	Percentage	Transfusion
<0.9	170	40.5	30
0.9–1.09	135	32.1	65
1.10–1.39	80	19.0	70
≥1.40	35	8.3	35
Total	420	100.0	200

Table 6: ICU admission according to shock index.

Shock index	ICU admission	No ICU admission	Total
<0.9	3	167	170
0.9–1.09	8	127	135
1.10–1.39	18	62	80
≥1.40	21	14	35
Total	50	370	420

Table 7: Surgical intervention according to shock index.

Shock index	Surgical intervention	No surgical intervention	Total
<0.9	4	166	170
0.9–1.09	10	125	135
1.10–1.39	20	60	80
≥1.40	18	17	35
Total	52	368	420

Table 8: Maternal near-miss and mortality according to shock index.

Shock index	Near-miss cases	Maternal deaths
<0.9	0	0
0.9–1.09	2	0
1.10–1.39	7	1
≥1.40	13	3
Total	22	4

Table 9: Mean hemodynamic parameters by severity of PPH.

Variable	Mild PPH (n=220) mean±SD	Severe PPH (n=200) mean±SD	P value
Heart rate (beats/min)	92.4±11.6	121.8±15.4	<0.001
Systolic BP (mmHg)	112.5±10.2	89.6±11.8	<0.001
Shock index	0.82±0.12	1.37±0.28	<0.001

Table 10: Multivariate logistic regression for severe maternal outcome.

Variable	Adjusted OR	95% CI	P value
Shock index ≥1.1	5.82	3.45–9.81	<0.001
Blood loss >1500 ml	4.26	2.34–7.75	<0.001
Cesarean delivery	1.74	1.01–3.02	0.045
Multiparity	1.28	0.76–2.16	0.351
Age ≥35 years	1.42	0.79–2.54	0.236

DISCUSSION

PPH remains one of the leading causes of maternal morbidity and mortality worldwide. Early recognition of haemodynamic instability is essential to prevent severe complications and maternal death. The SI calculated as the ratio of heart rate to systolic blood pressure, has emerged as a simple and useful bedside tool for assessing haemodynamic compromise. The present prospective observational study involving 420 women with PPH evaluated the role of SI in predicting haemorrhage severity and adverse maternal outcomes.

Sociodemographic and obstetric characteristics

In the present study, the majority of women belonged to the age group of 25–29 years (36.7%), with a mean age of 27.8±4.9 years. Multigravida women constituted 61.4% of the study population. This predominance indicates that PPH was more frequently observed among women with previous pregnancies in our cohort. High parity is recognized as one of the factors associated with uterine atony and PPH.[13] However, these findings should be interpreted in the context of the study population rather than as evidence of independent risk.

Etiology of postpartum haemorrhage

Uterine atony was the most common cause of PPH, accounting for 58.3% of cases. This finding is consistent with FIGO recommendations, which identify uterine atony as the leading cause of postpartum haemorrhage.[13] The predominance of uterine atony emphasizes the importance of prompt assessment of uterine tone and early administration of uterotonic agents. Irrespective of the underlying cause, significant blood loss can result in haemodynamic instability, highlighting the importance of early assessment using SI.

Association between SI and severity of PPH

A progressive relationship was observed between increasing SI values and the severity of PPH. In our study, 40.5% of women had SI below 0.9, while 27.4% had SI of 1.1 or higher. Women with elevated SI experienced greater blood loss and increased requirements for transfusion, ICU admission and surgical intervention.

These findings are comparable to those of Nathan et al who demonstrated that SI was more useful than individual conventional vital signs in predicting adverse outcomes among women with PPH.[14] Similarly, El Ayadi et al identified SI as an important predictor of severe maternal outcomes in women with hypovolaemic shock due to obstetric haemorrhage.[15]

SI and blood transfusion requirement

Blood transfusion was required in 200 women (47.6%) in the present study. The requirement increased progressively across SI categories, from 17.6% among women with SI below 0.9 to 48.1% in the 0.9–1.09 category and 87.5% in the 1.10–1.39 category. All women with SI≥1.40 required transfusion.

Le Bas et al reported a strong association between elevated obstetric SI and blood product requirements in women with massive PPH, identifying SI≥1.1 as an important warning threshold.[16] The findings of our study further support the usefulness of SI in identifying women who may require early blood transfusion and resuscitative management.

SI and ICU admission

ICU admission was required in 50 women (11.9%). The proportion increased from 1.8% among women with SI below 0.9 to 5.9% in the 0.9–1.09 category, 22.5% in the 1.10–1.39 category and 60.0% among women with SI≥1.40.

Nathan et al. demonstrated that SI was a better predictor of ICU admission than individual conventional vital signs.[14] Similarly, El Ayadi et al reported that elevated SI was associated with severe maternal outcomes and the need for critical interventions.[15] These findings suggest that SI may assist in identifying women who require early escalation of care and intensive monitoring.

SI and surgical intervention

Surgical intervention was required in 52 women (12.4%). The requirement increased progressively with SI, from 2.4% among women with SI below 0.9 to 7.4%, 25.0% and 51.4% across the subsequent SI categories. This increasing trend suggests that higher SI values are associated with greater haemorrhage severity and an increased likelihood of requiring invasive procedures to control bleeding. Similar associations between elevated SI and critical interventions have been reported by El Ayadi et al.[15]

SI and severe maternal outcomes

Maternal near-miss events occurred in 22 women (5.2%), while four maternal deaths (0.95%) were recorded. Notably, 20 of the 22 near-miss events (90.9%) and all four maternal deaths occurred among women with SI≥0.9. Furthermore, 13 near-miss events and three deaths occurred in the SI≥1.40 category.

El Ayadi et al demonstrated that increasing SI values were associated with maternal death and severe maternal morbidity in women with obstetric haemorrhage.[15] The concentration of adverse outcomes among women with elevated SI in our study further supports its potential role in identifying patients at increased risk of clinical deterioration.

However, the small number of maternal deaths warrants cautious interpretation.

Comparison of haemodynamic parameters

The mean heart rate was significantly higher among women with severe PPH than among those with mild PPH (121.8±15.4 versus 92.4±11.6 beats/min, $p<0.001$), whereas mean systolic blood pressure was significantly lower (89.6±11.8 versus 112.5±10.2 mmHg, $p<0.001$). Consequently, the mean SI was significantly higher in women with severe PPH (1.37±0.28 versus 0.82±0.12, $p<0.001$).

This finding demonstrates that SI reflects the combined effects of tachycardia and declining blood pressure during progressive blood loss. Nathan et al similarly reported that SI performed better than individual vital signs in predicting adverse outcomes in PPH.[14]

Thus, SI may provide a more comprehensive bedside assessment of haemodynamic compromise.

Multivariate analysis

Multivariate logistic regression identified SI≥1.1 as the strongest independent predictor of severe maternal outcomes, with an adjusted odds ratio of 5.82 (95% CI: 3.45–9.81; $p<0.001$). Blood loss exceeding 1500 ml was also independently associated with adverse outcomes (adjusted OR 4.26), while caesarean delivery demonstrated an adjusted OR of 1.74. Maternal age ≥35 years and multiparity were not statistically significant independent predictors.

The strong association between elevated SI and severe maternal outcomes supports the findings of Nathan et al and El Ayadi et al, who demonstrated the prognostic value of SI in obstetric haemorrhage.[14,15] This suggests that SI may provide additional prognostic information beyond individual clinical parameters and conventional vital signs.

Clinical implications

SI is inexpensive, easy to calculate and requires only routinely measured heart rate and systolic blood pressure. The 2025 WHO guidelines also recognize SI greater than 1 as an abnormal haemodynamic sign in the early identification and management of postpartum haemorrhage.[17] In our study, SI≥1.1 was independently associated with severe maternal outcomes, suggesting its potential usefulness as an early warning threshold in the studied population.

However, SI should complement rather than replace clinical assessment, objective blood loss measurement and established PPH management protocols. Its routine assessment may facilitate earlier recognition of haemodynamic deterioration and timely escalation of treatment, particularly in resource-limited settings.

Strengths and limitations

The major strengths of the present study include its prospective design, relatively large sample size of 420 women and assessment of multiple clinically important maternal outcomes. Furthermore, SI was evaluated using routinely available clinical parameters, making its application feasible in different healthcare settings.

The limitations include its single-centre design, which may restrict generalizability, and the assessment of only initial SI values without evaluating serial changes. The observational design also does not establish a causal relationship between SI-guided management and improved outcomes. Additionally, the relatively small number of maternal deaths limits the precision of mortality-related findings.

Overall interpretation

The present study demonstrates a significant association between increasing SI and the severity of PPH, blood

transfusion requirements, ICU admission, surgical intervention and adverse maternal outcomes. SI≥1.1 emerged as the strongest independent predictor of severe maternal outcomes. These findings support the use of SI as a simple, rapid and cost-effective bedside tool for early risk assessment in women with PPH. Its incorporation into routine obstetric emergency assessment, alongside objective blood loss measurement and clinical evaluation, may facilitate timely intervention and potentially improve maternal outcomes.

Limitations

The present study has certain limitations that should be considered while interpreting its findings. First, as it was conducted at a single centre, the results may not be generalisable to all obstetric settings with different patient populations and healthcare facilities. Second, the study included only 420 women with PPH, and the relatively small number of maternal near-miss events and deaths may have limited the precision of estimates for severe maternal outcomes. Third, SI was assessed at the time of presentation; serial measurements could have provided additional information regarding the progression of haemodynamic instability and response to treatment. Fourth, SI may be influenced by factors such as pain, anxiety, fever, anaemia, medications and pre-existing cardiovascular conditions, which could affect its predictive accuracy. Fifth, variations in the timing and accuracy of blood-loss estimation may have influenced the classification of PPH severity. Finally, as this was an observational study, the findings demonstrate associations rather than a direct causal relationship between elevated SI and adverse maternal outcomes.

CONCLUSION

The present prospective observational study involving 420 women with postpartum haemorrhage demonstrates that SI is a useful bedside tool for early assessment of haemodynamic compromise and prediction of adverse maternal outcomes. The study revealed a significant association between increasing SI values and the severity of PPH, blood transfusion requirements, ICU admission, surgical intervention and severe maternal outcomes. Women with higher SI values experienced greater haemodynamic instability and a higher frequency of maternal near-miss events and mortality. An SI cut-off of ≥1.1 emerged as the strongest independent predictor of severe maternal outcomes in multivariate analysis (adjusted OR 5.82, $p<0.001$). Furthermore, the significantly higher mean SI among women with severe PPH compared with mild PPH reinforces its potential role in identifying women at increased risk of clinical deterioration. Thus, SI is a simple, rapid, inexpensive and readily available clinical parameter that can complement conventional vital signs and objective blood loss assessment in the management of PPH. Its incorporation into routine obstetric emergency protocols may facilitate early recognition of haemodynamic instability, timely intervention and appropriate escalation of care, potentially contributing to a reduction in maternal morbidity and mortality.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: A systematic review. Lancet. 2006;367(9516):1066-74.
2. World Health Organization. A roadmap to combat postpartum haemorrhage between 2023 and 2030. 2023. Available at: https://www.who.int/publications/i/item/9789240081802. Accessed on 15 August 2026.
3. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Heal. 2014;2(6):323-33.
4. World Health Organization. Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. 2023. Available at: https://www.who.int/publications/i/item/9789240068759. Accessed on 15 August 2026.
5. Duthie SJ, Ven D, Yung GL, Guang DZ, Chan SY, Ma HK. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. Eur J Obstet Gynecol Reprod Biol. 1991;38(2):119-24.
6. Bose P, Regan F, Paterson-Brown S. Improving the accuracy of estimated blood loss at obstetric haemorrhage using clinical reconstructions. BJOG. 2006;113(8):919-24.
7. Allgöwer M, Burri C. Shock index. Dtsch Med Wochenschr. 1967;92(43):1947-50.
8. Olaussen A, Blackburn T, Mitra B, Fitzgerald M. Shock index for prediction of critical bleeding post-trauma: a systematic review. Emerg Med Australas. 2014;26(3):223-8.
9. Nathan HL, El Ayadi A, Hezelgrave NL, Seed PT, Butrick E, Miller S, et al. Shock Index: an effective predictor of outcome in postpartum haemorrhage? BJOG. 2015;122(2):268-75.
10. Le Bas A, Chandraharan E, Addei A, Arulkumaran S. Use of the obstetric Shock Index in postpartum haemorrhage. Int J Gynecol Obstet. 2014;124(3):253-5.
11. Makino Y, Miyake K, Okada A, Ikeda Y, Okada Y. Predictive accuracy of Shock Index for severe postpartum hemorrhage: a systematic review and meta-analysis. J Obstet Gynaecol Res. 2022;48(8):2027-37.
12. Pan Y, Ding J, Feng J, Pan Z. Utility of Shock Index for predicting severity of postpartum haemorrhage: a

systematic review and meta-analysis. Pak J Med Sci. 2025;41(7):2133-43.
13. Escobar MF, Nassar AH, Theron G, Barnea ER, Nicholson W, Ramasauskaite D, et al. FIGO recommendations on the management of postpartum hemorrhage 2022. Int J Gynaecol Obstet. 2022;157:3-50.
14. Nathan HL, El Ayadi A, Hezelgrave NL, Seed P, Butrick E, Miller S, et al. Shock index: an effective predictor of outcome in postpartum haemorrhage? BJOG. 2015;122(2):268-75.
15. El Ayadi AM, Nathan HL, Seed PT, Butrick EA, Hezelgrave NL, Shennan AH, et al. Vital sign prediction of adverse maternal outcomes in women with hypovolemic shock: the role of shock index. PLoS One. 2016;11(2):e0148729.
16. Le Bas A, Chandraharan E, Addei A, Arulkumaran S. Use of the "obstetric shock index" as an adjunct in identifying significant blood loss in patients with massive postpartum hemorrhage. Int J Gynaecol Obstet. 2014;124(3):253-5.
17. World Health Organization. Consolidated guidelines for the prevention, diagnosis and treatment of postpartum haemorrhage. 2025. Available at: https://www.who.int/publications/i/item/9789240115637. Accessed on 15 August 2026.

Cite this article as: Abbasi A, Shreya. Evaluation of shock index as an early predictor of severity and maternal outcomes in postpartum hemorrhage: a prospective observational study. Int J Reprod Contracept Obstet Gynecol 2026;15:4818-26.