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ERYTHROCYTE SEDIMENTATION RATE IN PREGNANT WOMEN USING THE WESTERGREN METHOD: A DESCRIPTIVE STUDY AT BUNDA THAMRIN GENERAL HOSPITAL

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Abstrak

Pemeriksaan Laju Endap Darah (LED) merupakan salah satu pemeriksaan hematologi yang digunakan sebagai penunjang dalam mendeteksi proses inflamasi dan memantau kondisi klinis pasien. Meskipun peningkatan LED merupakan perubahan fisiologis yang umum terjadi selama kehamilan, data mengenai gambaran nilai LED pada ibu hamil di fasilitas pelayanan kesehatan Indonesia, khususnya di Rumah Sakit Umum Bunda Thamrin, masih terbatas. Keterbatasan data tersebut menyebabkan belum tersedianya informasi lokal yang dapat digunakan sebagai dasar interpretasi hasil pemeriksaan LED pada ibu hamil. Penelitian ini bertujuan untuk mendeskripsikan nilai LED pada ibu hamil menggunakan metode Westergren di Rumah Sakit Umum Bunda Thamrin. Penelitian menggunakan desain deskriptif kuantitatif dengan teknik accidental sampling terhadap 30 ibu hamil yang memenuhi kriteria inklusi. Pemeriksaan LED dilakukan menggunakan metode Westergren dengan antikoagulan natrium sitrat 3,8% sesuai standar pemeriksaan hematologi. Hasil penelitian menunjukkan bahwa 21 responden (70%) memiliki nilai LED meningkat dengan rata-rata 40,2 mm/jam, sedangkan 9 responden (30%) memiliki nilai LED normal dengan rata-rata 10,8 mm/jam. Peningkatan nilai LED ditemukan pada berbagai kelompok usia ibu hamil dan diduga berkaitan dengan perubahan fisiologis selama kehamilan, meskipun kemungkinan adanya kondisi patologis seperti anemia atau inflamasi tetap perlu dipertimbangkan. Hasil penelitian ini menunjukkan bahwa pemeriksaan LED menggunakan metode Westergren dapat dimanfaatkan sebagai parameter penunjang dalam pemantauan kondisi hematologi ibu hamil. Oleh karena itu, interpretasi hasil LED sebaiknya dilakukan bersama informasi klinis dan pemeriksaan laboratorium lainnya agar dapat mendukung pengambilan keputusan klinis secara lebih tepat.

Kata Kunci: *Laju Endap Darah, Metode Westergren, Ibu Hamil, Hematologi, Kehamilan.*

Abstract

The erythrocyte sedimentation rate (ESR) test is a hematological test used to aid in detecting inflammatory processes and monitoring patients' clinical conditions. Although an elevated ESR is a common physiological change during pregnancy, data on ESR values in pregnant women at Indonesian healthcare facilities—particularly at Bunda Thamrin General Hospital—remain limited. This lack of data has resulted in the absence of local information that can serve as a basis for interpreting ESR test results in pregnant women. This study aims to describe ESR values in pregnant women using the Westergren method at Bunda Thamrin General Hospital. The study employed a quantitative descriptive design with accidental sampling of 30 pregnant women who met the inclusion criteria. The LED test was performed using the Westergren method with 3.8% sodium citrate anticoagulant in accordance with hematology testing standards. The results showed that 21 participants (70%) had elevated LED values with an average of 40.2 mm/h, while 9 participants (30%) had normal LED values with an average of 10.8 mm/h. Elevated LED values were found across various age groups of pregnant women and are thought to be related to physiological changes during pregnancy, although the possibility of pathological conditions such as anemia or inflammation still needs to be considered. The results of this study indicate that LED testing using.

Keywords: ESR, Westergren Method, Pregnancy Hematology, Inflammatory Markers, Anemia in Pregnancy

INTRODUCTION

Pregnancy is accompanied by substantial hormonal and hematological adaptations that are necessary to support fetal growth, yet these same physiological changes complicate the interpretation of routine laboratory findings. One important alteration is hemodilution, which occurs because plasma volume increases more rapidly than erythrocyte mass and may contribute to dilutional anemia and changes in several hematological parameters (Nurhajimah et al., 2024). At the same time, increased concentrations of plasma proteins, particularly fibrinogen, promote erythrocyte aggregation and may accelerate the erythrocyte sedimentation rate (ESR). Consequently, pregnant women may present with elevated ESR values even in the absence of overt disease. This phenomenon is clinically crucial because ESR is also used as a nonspecific indicator of inflammation and may increase in anemia, infection, autoimmune disorders, and other inflammatory conditions (Novita et al., 2023; Wulandari et al., 2021). The overlap between physiological and pathological causes creates a risk of underinterpretation or overinterpretation during antenatal care. Academically, pregnancy-specific hematological changes demand context-sensitive interpretation; practically, reliable local ESR information is needed to support clinicians and laboratory personnel in identifying findings that may require further evaluation.

Previous studies have shown that ESR commonly increases during pregnancy and have associated this pattern with plasma volume expansion, hemodilution, reduced hematocrit, increased fibrinogen, and enhanced rouleaux formation (Nurjanah et al., 2023; Agrawal et al., 2025). Other investigations have examined anemia in pregnancy, compared manual and automated ESR techniques, evaluated anticoagulant types, or assessed pre-analytical factors such as storage time and room temperature (Astuti et al., 2023; Hakim et al., 2024; Riana et al., 2023). These studies have strengthened understanding of the biological and technical determinants of ESR measurement. However, the literature remains limited in several respects. Much of the available evidence emphasizes method comparison or analytical performance rather than the distribution of ESR values among pregnant women undergoing routine antenatal assessment. In addition, relatively few studies have generated hospital-based data from Indonesian clinical settings using the Westergren reference method, which remains widely accepted for ESR measurement (Shantika & Kusdiantini, 2023). Consequently, clinicians and laboratory professionals still have limited context-specific benchmarks for interpreting ESR results. At Bunda Thamrin General Hospital, no prior descriptive profile has documented the frequency, range, and age distribution of ESR elevation among pregnant women.

To address this limitation, the present study was designed to generate a descriptive profile of erythrocyte sedimentation rate values among pregnant women examined at Bunda Thamrin General Hospital, Medan. ESR was measured using the manual Westergren method with 3.8% sodium citrate under standardized laboratory procedures, and only non-hemolyzed samples were included to maintain measurement validity. Rather than comparing laboratory techniques or testing treatment effects, the study focuses on the distribution of ESR values in routine clinical samples. Specifically, it aims to determine the proportion of pregnant women with normal and elevated ESR values, identify the observed range and mean values within each category, and describe whether elevated ESR appears across the maternal age range represented in the sample. Through this approach, the study responds directly to the shortage of hospital-based Indonesian evidence and provides baseline information that may strengthen laboratory interpretation in antenatal care. It also clarifies the clinical position of ESR as a complementary hematological parameter that should be interpreted together with symptoms, hemoglobin concentration, leukocyte count, inflammatory markers, and other relevant findings, rather than being used as an independent diagnostic indicator.

The central argument of this study is that pregnancy-related physiological adaptations are expected to produce a predominance of elevated ESR values among pregnant women examined using the Westergren method. Plasma volume expansion and hemodilution reduce hematocrit and alter blood viscosity, while increased fibrinogen promotes rouleaux formation; together, these processes facilitate faster erythrocyte sedimentation (Nurhajimah et al., 2024; Astuti et al., 2023). Therefore, elevated ESR is expected to occur more frequently than normal ESR within the study sample and to be observable across different maternal age groups rather than being confined to older pregnant women. Nevertheless, the study does not assume that every elevated value is purely physiological. Anemia, infection, and inflammatory disorders may produce similar increases, so the meaning of an elevated ESR depends on clinical context and complementary laboratory data (Novita et al., 2023; Wulandari et al., 2021). Accordingly, the working proposition is that pregnancy itself provides the most plausible general explanation for the overall elevation pattern in this descriptive sample, whereas individual high values cannot be classified as physiological or pathological without further evidence. Because the research is descriptive, this proposition guides interpretation but is not tested through inferential causal analysis.

LITERATURE REVIEW

Research on erythrocyte sedimentation rate (ESR) in pregnancy has developed along several interconnected lines. First, physiological studies explain ESR elevation through pregnancy-related hematological adaptations, particularly plasma-volume expansion, hemodilution, reduced hematocrit, increased fibrinogen, and rouleaux formation. Second, clinical studies examine the overlap between physiological ESR elevation and pathological conditions such as iron-deficiency anemia, infection, tuberculosis, diabetes mellitus, stroke, and other inflammatory disorders. Third, methodological studies compare manual and automated ESR measurements, anticoagulant types, storage duration, room temperature, and other pre-analytical or analytical conditions that may influence test accuracy. Fourth, a smaller group of descriptive studies reports ESR patterns among pregnant women in particular communities or healthcare settings. Collectively, these tendencies show that the literature has addressed ESR as both a biological indicator and a laboratory measurement issue. However, the relationships among pregnancy status, physiological adaptation, possible pathology, and measurement standardization remain difficult to interpret because these themes are often examined separately. Consequently, the available evidence is strong in explaining why ESR may increase and how it should be measured, but weaker in providing locally grounded clinical profiles for pregnant women undergoing routine antenatal examinations.

The first major pattern is a physiological orientation that explains elevated ESR as part of normal hematological adaptation during pregnancy. Studies in this group focus on the relationships among pregnancy, plasma-volume expansion, erythrocyte mass, hemoglobin concentration, fibrinogen, and sedimentation behavior. Nurhajimah et al. (2024) emphasize that plasma volume increases more rapidly than erythrocyte mass, producing hemodilution and possible dilutional anemia. In parallel, increased fibrinogen and other plasma proteins enhance erythrocyte aggregation and rouleaux formation, thereby accelerating sedimentation. Mutia Hariani Nurjanah et al. (2023) similarly describe increased ESR among pregnant women as a consequence of pregnancy-related hematological changes. Thematically, these studies position ESR elevation mainly as an expected physiological response rather than an automatic sign of disease. Conceptually, they rely on the interaction between blood composition, viscosity, and erythrocyte aggregation. Methodologically, they commonly employ descriptive or comparative designs and use laboratory values to characterize changes during pregnancy. Their principal contribution is establishing a biological explanation for elevated ESR, but their emphasis on normal adaptation may not adequately distinguish moderate physiological elevation from values associated with concurrent maternal disorders.

The second pattern is clinically oriented and examines elevated ESR in relation to anemia, infection, inflammation, and other pathological conditions. Research on iron-deficiency anemia in pregnancy shows that reduced hemoglobin and altered erythrocyte characteristics may coexist with elevated ESR, thereby complicating interpretation of the test (Wulandari et al., 2021; Novita et al., 2023). Other studies included in the manuscript bibliography investigate ESR among patients with pulmonary tuberculosis, type 2 diabetes mellitus, non-hemorrhagic stroke, and chronic inflammatory conditions. Although these populations are not limited to pregnant women, they reinforce the concept that ESR is a nonspecific marker whose elevation may result from various clinical processes. Thematically, this pattern emphasizes differential interpretation rather than measurement alone. Its conceptual focus lies in the relationships among systemic inflammation, plasma proteins, erythrocyte behavior, and disease status. Methodologically, these studies frequently employ descriptive cross-sectional designs, group comparisons, or laboratory-based observations. This tendency is important because it challenges the assumption that high ESR during pregnancy is invariably physiological. Nevertheless, most studies examine individual diseases or non-pregnant populations, leaving limited evidence regarding how physiological pregnancy and possible pathology intersect among patients undergoing routine antenatal examinations.

The third pattern concentrates on the analytical and technical determinants of ESR measurement. Studies in this category compare manual Westergren testing with automated instruments, examine different anticoagulants, and evaluate the effects of storage duration, room temperature, examination delay, and blood-to-anticoagulant ratios. Riana et al. (2023) investigate the influence of room temperature and citrate-blood storage duration, while Hakim, Widhyasih, and Siridian (2024) compare automatic ESR testing using K3EDTA with manual testing using sodium citrate. Astuti et al. (2023), Wahyudi et al. (2023), and Sukarmin and Iqlima (2019) similarly examine differences between manual and automated approaches. Other studies assess sodium citrate concentrations or alternative diluents, demonstrating that pre-analytical and procedural variations can affect reported ESR values. Thematically, this literature prioritizes validity, comparability, and standardization. Conceptually, it treats ESR as a laboratory measurement sensitive to specimen quality and testing conditions. Methodologically, experimental comparisons and laboratory-based analytical designs dominate. Its contribution is essential for ensuring reliable results, yet it often places technical performance above the clinical distribution and interpretation of ESR among pregnant women receiving hospital-based antenatal care.

Despite these contributions, the three dominant tendencies leave an important issue insufficiently addressed. Physiological studies explain why pregnancy may elevate ESR, clinical studies demonstrate that anemia or inflammation may produce similar findings, and analytical studies clarify how measurement procedures influence the results. However, these bodies of literature rarely converge in a hospital-based description of pregnant women examined under routine clinical conditions using a standardized Westergren procedure. Existing studies also tend to prioritize biological mechanisms, disease-specific associations, or method comparisons, while giving less attention to a practical question faced by clinicians and laboratory personnel: how frequently are normal and elevated ESR values encountered among local pregnant patients, what range of values is observed, and whether elevation occurs across different maternal age groups? The existing manuscript notes that Indonesian evidence remains limited, particularly at the hospital level, and that available studies frequently emphasize analytical comparisons rather than ESR profiles in antenatal populations. Thus, the novelty of the present study does not lie in proposing a new biological mechanism or claiming the superiority of a laboratory technology. Instead, it lies in integrating standardized measurement with a context-specific descriptive profile that can support the cautious interpretation of ESR among pregnant women at Bunda Thamrin General Hospital.

Based on this gap, the present study adopts a context-sensitive clinical laboratory orientation. Its focus is not to establish a causal relationship between pregnancy and ESR, compare diagnostic instruments, or determine whether elevated ESR independently predicts maternal disease. Instead, it describes the distribution of ESR values among pregnant women undergoing examination at Bunda Thamrin General Hospital using the manual Westergren method with 3.8% sodium citrate and standardized specimen procedures. This direction brings together three concerns that previous studies have often treated separately: pregnancy-related physiological adaptation, the possibility of pathological elevation, and the need for analytically reliable measurement. Specifically, the study identifies the proportion of normal and elevated ESR results, the observed range and mean values, and the distribution of elevated findings across the maternal age span represented in the sample. The intended contribution is to provide a local baseline for laboratory-based antenatal assessment rather than to establish a universal pregnancy reference interval. By positioning ESR as a complementary and nonspecific parameter, the study also encourages interpretation alongside hemoglobin concentration, leukocyte count, inflammatory markers, symptoms, and other relevant clinical information. This orientation provides a practical framework for distinguishing expected pregnancy-related changes from findings that may require further clinical investigation.

RESEARCH METHODS

The unit of analysis in this study was the individual pregnant woman undergoing routine hematological examination at Bunda Thamrin General Hospital, Medan, Indonesia. The research focused specifically on the erythrocyte sedimentation rate (ESR) profile of these individuals, including the distribution of normal and elevated values, the observed range, and the mean ESR within each interpretation category. The study employed a quantitative descriptive design because its principal purpose was to present the characteristics of ESR findings as they occurred in the study population, rather than to test causal relationships, compare interventions, or estimate predictive associations. A total of 30 pregnant women who met the inclusion criteria were recruited through accidental sampling during the data-collection period. This sampling strategy enabled the researchers to include eligible participants who attended the hospital and agreed to participate at the time of recruitment. Although this approach limits the generalizability of the findings, it was consistent with the preliminary and descriptive orientation of the study. The design therefore emphasized standardized measurement, numerical summarization, and careful interpretation of ESR findings within the local hospital context.

The study used primary laboratory data obtained directly from venous blood samples collected from the participating pregnant women. Data collection followed a standardized laboratory process. Blood was placed in tubes containing 3.8% sodium citrate at a blood-to-anticoagulant ratio of 4:1, gently homogenized, and aspirated into Westergren pipettes up to the zero mark. The pipettes were positioned vertically, and the sedimentation distance was read after 60 minutes and recorded in millimeters per hour. Samples showing hemolysis or clot formation were excluded, while equipment function, anticoagulant concentration, pipette type, and testing procedures were standardized to reduce analytical variation. The resulting ESR values were then organized, checked, and tabulated according to sample code, maternal age, measurement result, and interpretation category. Data analysis was conducted descriptively through the calculation of frequencies, percentages, ranges, and mean ESR values. Results were classified into normal and elevated categories and presented in tables to facilitate comparison. No inferential statistical analysis was performed because the study did not aim to test relationships or causal effects.

RESULTS AND DISCUSSION

Results

Predominance of Elevated ESR Values

The first result concerns the overall distribution of erythrocyte sedimentation rate values among the 30 pregnant women examined at Bunda Thamrin General Hospital. Table 1 records each participant by sample code, maternal age, ESR value, and interpretation, while Table 2 summarizes the frequency and percentage of normal and elevated results. The participants were between 22 and 40 years of age, and the observed

ESR values extended from 6 mm/hour to 60 mm/hour. Of the total sample, 21 participants were classified as having elevated ESR values and 9 participants were classified as having values within the normal category. In percentage terms, elevated results accounted for 70% of all observations, whereas normal results accounted for 30%. These figures show that elevated ESR constituted the dominant result in the dataset. The visual pattern in both tables is therefore clear: most rows are marked “increased,” but a smaller and still visible group of normal results remains present across the sample. After analyzing 30 samples obtained from the study described below, which measured LED levels in pregnant women at Bunda Thamrin General Hospital, the following results were obtained:

Table 1. Results of LED measurements in pregnant women

No	Sample Code	Age (Years)	ESR (mm/hour)	Interpretation
1	A1	24	29	Increased
2	A2	36	42	Increased
3	A3	30	39	Increased
4	A4	25	30	Increased
5	A5	28	12	Normal
6	A6	22	37	Increased
7	A7	32	48	Increased
8	A8	27	6	Normal
9	A9	26	58	Increased
10	A10	35	28	Increased
11	A11	32	7	Normal
12	A12	22	35	Increased
13	A13	29	55	Increased
14	A14	31	19	Normal
15	A15	30	60	Increased
16	A16	27	27	Increased
17	A17	24	47	Increased
18	A18	26	32	Increased
19	A19	35	10	Normal
20	A20	31	13	Normal
21	A21	38	30	Increased
22	A22	29	48	Increased
23	A23	23	11	Normal
24	A24	26	50	Increased
25	A25	34	14	Normal
26	A26	40	37	Increased
27	A27	32	31	Increased

28	A28	28	6	Normal
29	A29	23	52	Increased
30	A30	26	31	Increased

Source: Results of Erythrocyte Sedimentation Rate (ESR) Tests at Bunda Thamrin General Hospital, Medan

A total of 30 pregnant women who met the inclusion criteria were included in this study. The participants ranged in age from 22 to 40 years. Erythrocyte sedimentation rate (ESR) values ranged from 6 mm/hour to 60 mm/hour. Of the 30 participants, 21 (70%) had elevated ESR values, whereas 9 (30%) had ESR values within the normal reference range (Table 1.)

Restated in simpler terms, seven of every ten pregnant women included in the study showed an elevated ESR result, while three of every ten showed a normal result. The numerical ratio between the two categories was 21 to 9, meaning that elevated findings occurred more than twice as often as normal findings within this group. This pattern can also be followed directly from the sequence of sample codes in Table 1. Elevated values appeared repeatedly from A1 through A4, again at A6 and A7, and continued across many later samples, including A9, A10, A12, A13, A15 to A18, A21, A22, A24, A26, A27, A29, and A30. Normal findings were recorded in a smaller set of samples: A5, A8, A11, A14, A19, A20, A23, A25, and A28. The distribution was therefore not balanced between categories. The field data consistently placed the elevated category as the principal pattern rather than an isolated or occasional observation.

Three descriptive tendencies emerge from the overall distribution. First, the dataset is characterized by a clear predominance of elevated ESR values, as shown by the 70% share of increased results. Second, the presence of nine normal observations indicates that the ESR pattern among pregnant women was not uniform; participants examined under the same study setting did not all produce the same interpretation. Third, the full dataset displayed a wide numerical spread, extending across 54 mm/hour from the lowest value of 6 mm/hour to the highest value of 60 mm/hour. Fourth, elevated and normal results were dispersed throughout the sample sequence rather than appearing only at the beginning or end of data collection. Together, these patterns show a dominant trend accompanied by meaningful individual variation. The central field finding is therefore not merely that high values existed, but that elevated results formed the majority while a substantial minority retained lower values classified as normal under the interpretation used in the study.

Differences in the Magnitude of ESR Values

The second result concerns the difference in the magnitude of ESR values between the two interpretation categories. Table 2 reports that the 21 participants in the elevated category had a mean ESR of 40.2 mm/hour, whereas the 9 participants in the normal category had a mean of 10.8 mm/hour. The difference between these reported means was

29.4 mm/hour. Examination of the individual measurements in Table 1 further shows that elevated values ranged from 27 mm/hour to 60 mm/hour. The lowest elevated measurements were 27 mm/hour in sample A16 and 28 mm/hour in sample A10, followed by 29 mm/hour in A1 and 30 mm/hour in A4 and A21. At the upper end, the highest measurements were 60 mm/hour in A15, 58 mm/hour in A9, 55 mm/hour in A13, 52 mm/hour in A29, and 50 mm/hour in A24. The elevated category thus contained both moderate and markedly higher measurements. This spread confirms that the category represented multiple levels of increase in the observed field measurements.

The normal category displayed a substantially lower numerical profile. Its nine observed values were 12, 6, 7, 19, 10, 13, 11, 14, and 6 mm/hour. These results corresponded respectively to samples A5, A8, A11, A14, A19, A20, A23, A25, and A28. The smallest normal values were 6 mm/hour, recorded in two participants aged 27 and 28 years, while the highest normal value was 19 mm/hour in a participant aged 31 years. Most normal observations were concentrated between 10 and 14 mm/hour, including values of 10, 11, 12, 13, and 14 mm/hour. When these data are restated alongside the elevated category, the separation is easily understood: the normal measurements occupied the lower part of the total 6–60 mm/hour range, while the increased measurements occupied the higher part. There was no overlap between the observed ranges of the two categories under the classification applied in the study. The normal category therefore showed a clearly bounded and comparatively narrow pattern in the recorded dataset.

Table 2 Average Increase in Erythrocyte Sedimentation Rate (ESR) Among Pregnant Women at Bunda Thamrin General Hospital in 2025

No	Interpretation	Frequency	Percentage (%)	Mean ESR (mm/hour)
1	Normal	9	30%	10.8
2	Increased	21	70%	40.2
	Total	30	100%	–

The mean ESR among participants with normal values was 10.8 mm/hour, while the mean ESR among those with elevated values was 40.2 mm/hour (Table 2). Elevated ESR values were observed across all reproductive age groups included in the study, indicating that increased ESR was not restricted to a specific maternal age category.

The predominance of elevated ESR values suggests that physiological changes occurring during pregnancy substantially influence erythrocyte sedimentation. However, because this study used a descriptive design, no statistical inference was performed to determine associations between ESR values and maternal characteristics or pregnancy outcomes.

Four patterns can be identified from the magnitude of the measurements. First, the mean value in the elevated group was almost four times the reported mean in the normal group, showing a large descriptive separation between categories. Second, normal measurements formed a relatively compact cluster from 6 to 19 mm/hour, with five of the nine observations located between 10 and 14 mm/hour. Third, elevated measurements were more widely distributed, spanning 27 to 60 mm/hour and including values in the high twenties, thirties, forties, fifties, and one value of 60 mm/hour. Fourth, the upper portion of the distribution was not represented by a single extreme case; several participants recorded values of 48 mm/hour or higher. These findings indicate that the predominance of elevated ESR was accompanied by a broad range of increased measurements. The results therefore show both categorical dominance and numerical diversity within the elevated group, rather than a concentration around only one increased value.

Distribution of ESR Values Across Maternal Age

The third result concerns the distribution of ESR findings across maternal age. The 30 participants ranged from 22 to 40 years, and elevated results were present at both the younger and older ends of this age span. To make the pattern visible, the data may be organized into four descriptive age groups. Among participants aged 22–25 years, six of seven had elevated ESR and one had a normal result. In the 26–30-year group, nine of twelve had elevated results and three had normal results. Among those aged 31–35 years, three of eight had elevated values and five had normal values. All three participants aged 36–40 years had elevated results. The individual data also show high values at different ages: 52 mm/hour at age 23, 47 mm/hour at age 24, 58 mm/hour at age 26, 60 mm/hour at age 30, 48 mm/hour at age 32, 42 mm/hour at age 36, and 37 mm/hour at age 40.

Restated descriptively, increased ESR was not confined to one narrow maternal age category. Elevated measurements appeared in participants aged 22, 23, 24, 25, 26, 27, 29, 30, 32, 35, 36, 38, and 40 years. Normal results were also distributed across several ages, including 23, 27, 28, 31, 32, 34, and 35 years. At some ages, both categories were represented. For example, participants aged 23 years had values of 11 and 52 mm/hour; those aged 27 years had values of 6 and 27 mm/hour; those aged 28 years had two values of 6 and 12 mm/hour; those aged 31 years had values of 13 and 19 mm/hour; and those aged 32 years had values of 7, 31, and 48 mm/hour. This within-age variation shows that participants of the same chronological age did not necessarily share the same ESR value or interpretation in the observed sample. Thus, age-matched observations still displayed clear differences in both measurement level and interpretation category.

Three main tendencies emerge from the age-based distribution. First, elevated ESR occurred throughout the full observed age span, from 22 to 40 years, demonstrating that the increased category was represented across the study population rather than restricted to one age boundary. Second, the largest number of elevated results was found in the 26–30-year group, which also contained the largest number of participants overall; this is a frequency pattern and should not be interpreted as an age effect. Third, the 31–35-year group contained more normal than elevated results, whereas the other three grouped ranges contained more elevated results. Fourth, identical or similar ages sometimes produced widely different measurements, as illustrated by the values recorded among participants aged 23, 27, and 32 years. The field data therefore show substantial variation within and between age groups. Descriptively, maternal age alone did not create a simple ordered pattern in which ESR consistently rose or fell as age increased.

Discussion

This study examined the erythrocyte sedimentation rate (ESR) profile of 30 pregnant women at Bunda Thamrin General Hospital using the manual Westergren method. The findings showed that elevated ESR was the dominant pattern in the study population. Of the 30 participants, 21 women, representing 70% of the sample, had elevated ESR values, while 9 women, or 30%, had results classified as normal. The mean ESR in the elevated category was 40.2 mm/hour, compared with 10.8 mm/hour in the normal category. Individual ESR measurements ranged from 6 to 60 mm/hour, indicating considerable variation among participants. Elevated values were observed across the maternal age range of 22–40 years and were not limited to a single age group. At the same time, participants of the same or similar ages sometimes showed different ESR results. Overall, the study produced three principal findings: elevated ESR was more frequent than normal ESR, the elevated category contained a broad range of values, and maternal age did not demonstrate a simple or consistent pattern in relation to ESR classification.

The predominance of elevated ESR values can be explained primarily by the hematological adaptations that occur during pregnancy. Plasma volume increases more rapidly than erythrocyte mass, producing hemodilution, reduced hematocrit, and changes in blood viscosity. These conditions facilitate more rapid erythrocyte sedimentation. Pregnancy is also accompanied by increased concentrations of plasma proteins, particularly fibrinogen, which promote erythrocyte aggregation and rouleaux formation. When erythrocytes form rouleaux, they become heavier and settle more rapidly in the Westergren tube, resulting in higher ESR measurements. These mechanisms provide a plausible explanation for why 70% of participants had elevated values and why increased ESR was observed across different maternal ages. However, physiological adaptation cannot fully explain each individual measurement because ESR is a nonspecific parameter. Anemia, infection, inflammatory conditions, and other maternal disorders may also accelerate sedimentation. Therefore, the higher values observed in individual participants cannot automatically be classified as normal pregnancy-related changes. Because the study did not measure hemoglobin, gestational age, infection status, or inflammatory biomarkers, it can describe the elevation pattern but cannot determine the precise cause of each elevated result.

The results are consistent with the findings of Nurjanah et al. (2023), who reported that ESR generally increases among pregnant women as part of pregnancy-related hematological changes. They also correspond with Agrawal et al. (2025), who emphasized the contribution of increased plasma volume and fibrinogen concentration to accelerated erythrocyte sedimentation during pregnancy. Similarly, the possibility that anemia contributes to elevated ESR supports the observations of Novita et al. (2023) and

Wulandari et al. (2021), who discussed anemia and hematological alterations among pregnant women. The present study differs, however, from research that primarily compares manual and automated ESR instruments, anticoagulant types, storage periods, or other analytical variables. Rather than testing the superiority of a method, this study applies the standardized Westergren procedure to describe the actual distribution of ESR results in a hospital-based antenatal population. Its novelty lies in providing local evidence from Bunda Thamrin General Hospital regarding the frequency, magnitude, and age distribution of elevated ESR. Thus, the study connects physiological explanations and laboratory standardization with a context-specific clinical profile that remains insufficiently documented in Indonesian hospital settings.

The findings indicate that an elevated ESR among pregnant women should be understood as a contextual laboratory result rather than as a direct diagnosis of disease. In the social and institutional context of antenatal care, laboratory personnel and clinicians routinely face the challenge of distinguishing normal physiological adaptation from abnormalities requiring further investigation. The predominance of elevated values in this study suggests that applying general interpretations without considering pregnancy status may create misleading clinical conclusions. Historically, ESR has been used as a nonspecific supportive indicator of inflammation, while the Westergren method has remained an important standardized approach because of its accessibility and broad clinical acceptance. Within this context, the meaning of ESR lies not in its ability to identify a specific disease independently, but in its capacity to alert healthcare providers to changes that require contextual assessment. The results also support an evidence-based orientation in maternal healthcare: laboratory numbers should not be interpreted mechanically or in isolation. Instead, their significance emerges from the relationship between physiological pregnancy, clinical symptoms, gestational condition, and complementary hematological findings. The observed elevation pattern therefore represents both a normal possibility and a signal requiring careful professional judgment.

The study findings have both functional and potentially dysfunctional implications for antenatal laboratory practice. Functionally, ESR testing using the Westergren method can provide supportive information regarding the hematological condition of pregnant women. Its relatively simple procedure makes it useful as an additional parameter in routine clinical evaluation, particularly when interpreted together with patient history, physical findings, hemoglobin concentration, leukocyte count, and inflammatory markers. The local distribution identified in this study may also increase awareness among healthcare personnel that elevated ESR is frequently encountered during pregnancy. However, dysfunction may occur when ESR is treated as an independent diagnostic marker. Assuming that every elevated result represents infection or inflammation may lead to unnecessary anxiety, repeated testing, or inappropriate clinical intervention. Conversely, regarding every elevation as physiological may cause relevant anemia, infection, or inflammatory disease to be overlooked. These risks are increased by the limitations of the present study, including the small sample, accidental sampling, descriptive design, and absence of gestational age and complementary laboratory variables. Therefore, the principal reflective lesson is that ESR has clinical value when used as part of an integrated assessment, but its value decreases when interpretation is separated from the broader maternal clinical context.

The findings support several actions to improve laboratory-based antenatal care at Bunda Thamrin General Hospital. First, the hospital laboratory should maintain standardized Westergren procedures, including appropriate sodium citrate concentration, correct blood-to-anticoagulant ratio, vertical pipette positioning, fixed reading time, and exclusion of hemolyzed or clotted samples. Second, ESR reporting for pregnant women should be accompanied by an interpretive note stating that pregnancy may physiologically increase sedimentation and that results must be correlated with clinical findings. Third, markedly elevated ESR values should prompt a structured review of hemoglobin level, leukocyte count, signs of infection, inflammatory biomarkers, gestational age, and relevant maternal history rather than immediate conclusions based on ESR alone. Fourth, antenatal records should integrate laboratory and clinical data so that changes can be monitored across pregnancy. The hospital may also develop a local database documenting ESR according to gestational trimester and accompanying hematological parameters. At the research-policy level, larger analytical studies using probability-based sampling are needed to establish more representative patterns and investigate factors associated with ESR elevation. These actions would transform the present descriptive findings into a practical system of cautious interpretation, quality assurance, and early identification of maternal conditions requiring further evaluation.

CONCLUSION

The most important lesson from this study is that elevated erythrocyte sedimentation rate values are frequently encountered among pregnant women, but such elevations cannot be interpreted automatically as evidence of disease. Of the 30 participants examined using the Westergren method, 21 women, or 70%, had elevated ESR values, with a mean of 40.2 mm/hour, while 9 women, or 30%, had normal values, with a mean of 10.8 mm/hour. Elevated results were found across the maternal age range of 22–40 years, indicating that the pattern was not confined to a particular age category. These findings demonstrate that laboratory results during pregnancy must be interpreted within the physiological and clinical context of the patient. Pregnancy-related plasma-volume expansion, hemodilution, and increased fibrinogen may accelerate erythrocyte sedimentation, but anemia, infection, and inflammatory conditions may produce similar findings. Therefore, the principal insight is that ESR should function as a complementary clinical indicator rather than an independent diagnostic parameter. Appropriate interpretation requires integration with symptoms, medical history, gestational condition, and other laboratory findings.

The principal strength of this study lies in its contribution of hospital-based primary laboratory data on ESR values among pregnant women in an Indonesian clinical setting. Scientifically, the study provides a descriptive dataset showing the frequency, percentage, range, mean, and age distribution of normal and elevated ESR values measured through a standardized Westergren procedure. This evidence adds a contextual dimension to previous literature that has largely focused on physiological mechanisms, disease-specific associations, anticoagulant variation, or comparisons between manual and automated methods. The study also reinforces the concept of ESR as a nonspecific and context-dependent hematological parameter whose clinical significance emerges only when combined with other information. From an analytical perspective, it integrates three aspects that are often discussed separately: pregnancy-related physiological adaptation, the possibility of pathological elevation, and the importance of laboratory standardization. The findings further raise a relevant research question for future investigation: to what extent are ESR variations during pregnancy associated with gestational age, hemoglobin concentration, inflammatory markers, infection status, and maternal clinical conditions? Thus, the study offers baseline evidence and a foundation for developing more comprehensive maternal hematology research.

This study has several limitations that should be considered when interpreting its findings. First, the descriptive design allows the study to present the distribution of ESR values but does not permit causal conclusions or statistical testing of relationships between ESR and maternal characteristics. Second, the sample consisted of only 30 pregnant women recruited through accidental sampling at a single hospital, which limits the representativeness and generalizability of the results to broader populations. Third, the study did not classify participants according to gestational trimester, although physiological and hematological changes may differ across pregnancy stages. Important clinical and laboratory variables, including hemoglobin concentration, hematocrit, leukocyte count, C-reactive protein, fibrinogen level, infection status, nutritional condition, and underlying maternal disease, were also not measured. Consequently, the study could not determine whether individual ESR elevations were predominantly physiological or associated with pathological conditions. Future research should involve larger and more diverse samples, multicenter settings, probability-based sampling, and analytical or longitudinal designs. Further studies should also examine ESR across trimesters and integrate complementary hematological and inflammatory parameters to produce more accurate pregnancy-specific interpretation and stronger clinical evidence.

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