



CORRELATION BETWEEN HS-CRP LEVELS AND ERYTHROCYTE SEDIMENTATION RATE VALUES IN PEDIATRIC PATIENTS WITH FEVER

HUBUNGAN KADAR HS-CRP DAN NILAI LAJU ENDAP DARAH PADA PASIEN DEMAM ANAK

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Abstract

Fever is the most common disease in children. Fever in children can be found in various conditions such as infection, inflammation, or other unknown causes. One of the laboratory tests that can be used is the hs-CRP and erythrocyte sedimentation rate examination. The purpose of this study was to determine the relationship between hs-CRP levels and erythrocyte sedimentation rate in pediatric febrile patients. The research method was observational with a cross-sectional method using secondary data of 62 samples. Data analysis used the Spearman's rho test. The results of the study showed that most of the pediatric patients who experienced fever were male (59.7%), and the age of the child was 5 years (21%). In pediatric patients with fever, the average hs-CRP level was 19.34 mg/l, and the erythrocyte sedimentation rate was 32.73 mm/hour. The results of the correlation test using the Spearman's rho test method obtained $p = 0.001$ with $r = 0.575$, so it can be concluded that there is a moderate and positive relationship between hs-CRP levels and erythrocyte sedimentation rate in pediatric patients with fever.

Keywords : hs-CRP, ESR, Fever

Abstrak

Demam adalah penyakit yang paling sering menyerang anak-anak. Demam pada anak dapat dijumpai di berbagai keadaan seperti infeksi, peradangan maupun penyebab lain yang tidak



diketahui penyebabnya. Salah satu pemeriksaan laboratorium yang dapat digunakan antara lain hs-CRP dan pemeriksaan laju endap darah. Penelitian ini dapat melihat hubungan antara kadar hs-CRP dan laju endap darah pada pasien demam anak. Metode penelitian bersifat observasional dengan cara cross sectional yang menggunakan data sekunder sebanyak 62 sampel. Analisa data menggunakan uji spearman's rho. Hasil penelitian didapatkan sebagian besar jumlah pasien anak yang mengalami demam berjenis kelamin laki-laki (59,7%) dan usia pada anak terbanyak di usia 5 tahun (21%). Pada pasien anak yang mengalami demam nilai rata-rata kadar hs-CRP sebesar 19,34 mg/l dan laju endap darah 32,73 mm/jam. Hasil uji korelasi menggunakan metode uji spearman's rho didapatkan hasil $p = 0,001$ dengan $r = 0,575$ maka dapat disimpulkan terdapat hubungan yang sedang dan positif antara kadar hs-CRP dengan laju endap darah pada pasien anak yang mengalami demam.

Kata Kunci : hs-CRP, Laju Endap Darah, Demam

1. INTRODUCTION

Fever, or medically known as febris, is a condition where the body temperature rises above the normal limit. Normally, body temperature in the morning ranges around 36°C , while during the day it can rise to about 36.8°C to 37°C . Fever is a common symptom, especially in children. This condition can be caused by various factors such as infections, post-immunization, tissue injury, serious diseases like cancer, side effects of medications, inflammation, hormonal disorders (endocrine), metabolic issues, or even unknown causes (also known as fever of unknown origin) (Widagdo, 2012).

When the body experiences a fever, the hypothalamus, which is the body's temperature control center located in the brain, undergoes changes. If the fever persists for too long, it can lead to dehydration, febrile seizures, and even increase the risk of death. For example, if the body temperature reaches 41°C , the risk of death can be as high as 17%. If the temperature increases to 43°C , the person can experience a coma, and the likelihood of death increases to 70%. In extreme cases, such as 45°C , the fever can become fatal within hours (Wardiyah, 2015).

According to the World Health Organization (WHO), the number of fever cases worldwide is estimated to range from 16 to 33 million people, with 500,000 to 600,000 deaths occurring annually (WHO, 2019). In Indonesia, 31% of children aged 5 years experience fever, while 37% of children aged 6-23 months are affected. Only 74% of them are taken to health facilities, while 26% are not (Ministry of Health, RI, 2018). Data from the Central Statistics Agency (BPS) of DKI Jakarta in 2018 reported 3,007 fever cases, and in 2020, the number of cases increased by 6%, reaching 4,744 cases.

For patients with fever, simple laboratory tests are usually required to establish a diagnosis and determine the cause of the fever. Some tests that can be performed include a complete blood count (CBC), which includes platelet count, leukocyte count and classification, as well as hemoglobin and hematocrit levels. From the results of the complete blood count, it can be determined whether the person is experiencing an infection. If necessary, this test can be repeated daily until the fever subsides. Additionally, several other tests can also be performed to detect infection, such as erythrocyte sedimentation rate (ESR), C-Reactive Protein (CRP), and procalcitonin, which can be performed while the patient is still feverish (Hadinegoro, 2015).



One of the infection marker tests that can be performed during a fever is the high-sensitivity C-Reactive Protein (hs-CRP) and erythrocyte sedimentation rate (ESR) tests. The hs-CRP test is an acute-phase protein synthesized in the liver to monitor both local and systemic diseases in the body. When an infection occurs, the body will respond by producing cytokines that stimulate the synthesis of acute-phase proteins. The hs-CRP levels increase after trauma, bacterial infection, and inflammation. When a person has a fever, the body can produce more inflammatory cytokines, fibrinogen, and C-reactive proteins. Additionally, the number of blood cells can increase, resulting in rouleaux formation (stacking of red blood cells), and blood viscosity can also rise. All these factors can cause the erythrocyte sedimentation rate (ESR) to become higher (Baratawidjaja, 2022).

The ESR test is used to determine inflammation, but it is nonspecific for rapidly evaluating the time it takes for red blood cells to settle over a certain period. This test is used more frequently than hs-CRP because ESR is included in the complete blood count and is part of a routine test specifically for infection, and it is cheaper. However, both ESR and hs-CRP tests are related in supporting the diagnosis of infectious diseases (Depkes RI, 1989). An increased ESR may indicate inflammation, but the result cannot be used as a definitive diagnosis or to determine how long the infection has been present (Khomaroh, 2023).

Fever is often associated with bacterial or viral infections as the cause, but it is still not entirely clear whether there is a direct correlation between hs-CRP levels and ESR. According to a study by Yolanda (2000) titled "Correlation between C-Reactive Protein Levels and Erythrocyte Sedimentation Rate in Widal Positive Patients", a very strong and significant correlation was found between CRP levels and ESR in Widal positive patients. Additionally, a study by Annisatul Khomaroh and Puspitasari titled "Correlation between Leukocyte Count and Erythrocyte Sedimentation Rate with C-Reactive Protein in COVID-19 Confirmed Patients at the General Hospital in Gresik" indicated a correlation between ESR and hs-CRP levels.

A study conducted by Nurmawan (2020) in the Alas Barat Health Center with the title "Correlation between Erythrocyte Sedimentation Rate and C-Reactive Protein (CRP) Levels in Tuberculosis (TBC) Patients" involving 11 patients showed that there was a correlation between the average ESR and hs-CRP levels in TBC patients.

Based on these findings, the researcher plans to conduct a follow-up study on the relationship between hs-CRP levels and ESR in children experiencing fever. Until now, no specific research has been conducted that discusses the correlation between these two indicators in pediatric fever patients.

2. RESEARCH METHOD

This research uses a descriptive correlational design with a cross-sectional approach to examine the relationship between two variables. The research will be conducted at the Prodia Clinic Laboratory from January to May 2025, involving children aged 4 to 10 years who visited the clinic with fever and underwent hs-CRP and erythrocyte sedimentation rate (ESR) tests. The population consists of 62 participants, and total sampling will be used, where all members of the population are included.

Data will be collected through medical records and laboratory test results from the Prodia Clinic. Ethical clearance will be obtained before the research, and permission from the laboratory will be sought to process the data. Data will be processed and analyzed using SPSS version 29.0, applying descriptive statistical analysis to present characteristics of the respondents, including age and gender.



The normality test will be conducted to assess the distribution of the data, followed by Spearman's rho correlation test if the data is not normally distributed. Ethical considerations include ensuring informed consent, maintaining privacy and confidentiality, and respecting participants' rights.

3. RESULTS AND DISCUSSION

Results

The characteristics of the respondents in the child patients with fever were observed based on gender and age, as taken from the medical records of patients who underwent the hs-CRP test along with the erythrocyte sedimentation rate (ESR). The data is presented in Table 1.

Table 1. Frequency Distribution of Fever Patients' Characteristics

No	Respondent Characteristics	n	Percentage (%)
A	Gender		
1	Laki-laki	37	59.7
2	Pe\$re\$mpu\$an	25	40.3
Total		62	100.0
B	Age (Years)		
1	9	12	19.4
2	8	11	17.7
3	7	8	12.9
4	6	8	12.9
5	5	13	21.0
6	4	6	9.7
7	10	4	6.5
Total		62	100.0

Based on the data in Table 1, it is evident that for the child patients with fever, the majority were male, with 37 individuals, making up 59.7% of the sample. In terms of age groups, the highest number of fever patients were 13 children (21.0%) aged 5 years.

The status of respondents who underwent the hs-CRP test and erythrocyte sedimentation rate (ESR) test is taken from the medical records of patients, as shown in Table 2.

Table 2. hs-CRP and ESR Levels in Children Patients

Variable	Mean	SD	Min-Max	N
hs-CRP	19.34	26.57	0-143.5	62
ESR	32.73	25.90	3-105	62

Based on the data in Table 2, for the children with fever who underwent the hs-CRP examination, the average result was 19.34, with a minimum detected level of 0.00 mg/l and a maximum of 143.5 mg/l. The average result for ESR was 32.73, with a minimum value of 3 mm/hr and a maximum of 105 mm/hr.



The data obtained from the 62 respondents were statistically analyzed using SPSS 29.0. The tests performed included a normality test, as seen in Table 3.

Table 3. Kolmogorov-Smirnov Normality Test

Normality Test	Variable	Sig
Kolmogorov-Smirnov	hs-CRP	0.001
	ESR	0.001

The normality test using the Kolmogorov-Smirnov method was chosen due to the sample size of 62 respondents. The results of the normality test showed a p-value of 0.001, which is less than the significance level of 0.05, indicating that the data is not normally distributed. As the data distribution is not normal, a Spearman's rho correlation test was conducted to examine the correlation between hs-CRP levels and ESR.

The results of the Spearman's rho correlation test for hs-CRP levels and ESR in children with fever, taken from the medical records, are shown in Table 4.

Table 4. Spearman's rho and Correlation Coefficient

	Spearman's rho	Correlation Coefficient
hs-CRP	0.001	0.575
ESR		

Based on Table 4, the results of the Spearman's rho test show a p-value of 0.001, which is less than 0.05. This indicates a statistically significant relationship. Additionally, the correlation coefficient (r) value of 0.575 suggests that the relationship between hs-CRP levels and ESR is moderate, with a positive correlation.

The hypothesis testing was carried out using the Spearman's rho test, a non-parametric test, as the data was not normally distributed and the number of respondents exceeded 50. The positive correlation indicates that both variables move in the same direction, meaning that as the hs-CRP level increases, the ESR level also tends to increase.

Discussion of Results

Fever, caused by infections, generally results from the entry of pathogens such as bacteria and viruses. Some diseases that can cause fever include mumps, measles, rubella, tetanus, tuberculosis (TB), typhoid, dengue fever, and pneumonia.

Based on Table 1, the characteristics of the respondents indicate that the majority of children with fever were male (59.7%). This result aligns with a study by Charisma (2020), which also found a predominance of male patients (53.3%) compared to females (46.7%). This could be because males tend to have a higher susceptibility to viral infections. Several studies explain that females generally have stronger immune responses, including macrophage and neutrophil activity, as well as higher antibody production. Additionally, females have more effective CD8+ T and CD4+ cells to fight infections. A study by Ter Horst (2016) also showed



that male cells produce less IFN- α compared to females, which plays a crucial role in the antiviral response.

Table 1 illustrates that the respondents with fever were mostly in the age range of 4–10 years. This age group is part of children still undergoing immune system maturation, making them more susceptible to infections and inflammation. Infections that occur can lead to fever, along with an increase in hs-CRP and erythrocyte sedimentation rate (ESR).

CRP is an acute-phase protein produced by the liver in response to inflammation. This protein functions by recognizing and binding to pathogens to activate the immune system. Meanwhile, the ESR increases during inflammation due to changes in the structure of erythrocytes, which facilitates rouleaux formation, thus increasing the rate of red blood cell sedimentation (Darian, 2019).

The examination results show that the average hs-CRP level is 19.34 mg/L, with the highest value being 143.5 mg/L and the lowest being 0 mg/L. These results suggest that the majority of patients have hs-CRP levels above the normal threshold. According to Oktoria's study (2025), an increase in CRP levels between 10–40 mg/L may indicate a viral infection, while levels between 40–200 mg/L are associated with bacterial infections.

Meanwhile, the average ESR value in the children in this study was 32.73 mm/hr, which is also above the normal reference value. This indicates the presence of inflammation or systemic infection. Unlike CRP, which can rise within hours after an infection, ESR generally increases more slowly, typically over several days.

The Spearman's rho test results show a p-value of 0.001 and a correlation coefficient (r) of 0.575. These results indicate a statistically significant and moderate strength relationship between hs-CRP levels and ESR in children with fever. Since the data were not normally distributed and the number of respondents exceeded 50, Spearman's rho, a non-parametric test, was used. This result is consistent with the study by Ramadhany (2022), which also found a significant correlation between hs-CRP levels and ESR with a p-value of 0.000 and r of 0.307 in active smokers. Similarly, the study by Nurmawan (2020) supports these findings, showing a strong correlation between both parameters in TB patients.

hs-CRP is a more sensitive inflammation marker compared to ESR. hs-CRP levels can rise earlier after an infection and will decline rapidly once the infection subsides, while ESR typically remains elevated for a longer period. hs-CRP works by binding to pathogens and activating the immune system, including neutrophils, and preventing platelet aggregation. When the body experiences an infection, inflammatory cytokines such as IL-1 and IL-6 stimulate the liver to produce CRP as part of the acute-phase response. These cytokines also increase fibrinogen production, which contributes to an increase in blood viscosity and facilitates rouleaux formation. This condition causes the ESR to rise. As the inflammatory process progresses, CRP and fibrinogen levels increase as part of the systemic immune response. Fibrinogen helps form a layer around erythrocytes, causing the cells to lose their electrical charge and bind together in the form of rouleaux, thus accelerating the sedimentation rate (Baratawidjaja, 2022).

This research demonstrates a significant and moderate correlation between hs-CRP levels and the erythrocyte sedimentation rate (ESR) in children with fever. Both parameters can be used simultaneously as indicators of infection or inflammation.



4. CONCLUSION

Based on the data analysis regarding the relationship between hs-CRP levels and erythrocyte sedimentation rate (ESR) values in children with fever, it can be concluded that the average hs-CRP level was 19.34 mg/L in children with fever. The average ESR level was 32.73 mm/hr in children with fever. Therefore, it can be concluded that there is a moderate positive correlation between the hs-CRP level and the ESR value in children with fever, with a p-value of 0.001 and a correlation coefficient (r) of 0.575. This indicates a moderate and positive relationship. Suggestions for future research include determining the severity of the fever, its duration, and identifying accompanying conditions or diagnoses that may contribute to the fever symptoms.

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