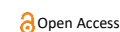


RESEARCH ARTICLE



Risk Factors and Relationship Erythrocyte Sediment Rate (ESR) in Hypertension Satisfactions

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Abstract

Introduction: Hypertension, defined as blood pressure greater than 140/90 mmHg, is a major public health issue globally. Several factors contribute to hypertension, including smoking, obesity, family history, co-morbidities, and the duration of hypertension. Monitoring blood pressure and associated markers such as the erythrocyte sedimentation rate (ESR) is critical to detect tissue damage and prevent complications. ESR serves as an important screening tool for the acute phase response and chronic diseases. **Objective:** This study aimed to determine the relationship between hypertension risk factors and erythrocyte sedimentation rate (ESR) levels. **Method:** This research employed a cross-sectional design with an experimental approach. Blood sedimentation rates were measured using the automatic vision-b method on blood samples with EDTA anticoagulant. Data were analyzed using the Mann-Whitney statistical test. **Result:** The results showed no significant relationship between age and gender with ESR levels ($p > 0.05$). However, there was a significant relationship between smoking, obesity, history of hypertension, co-morbidities, duration of hypertension, and elevated ESR levels ($p < 0.05$) in hypertensive patients at the Health Center in Duren Sawit District. **Conclusion:** Certain risk factors such as smoking, obesity, history of hypertension, co-morbidities, and the duration of hypertension are associated with increased erythrocyte sedimentation rates in hypertensive patients, while age and gender are not significantly related.

Keywords: Hypertension Risk Factors, Hypertension, Erythrocyte Sedimentation Rate.

Introduction

Systolic and diastolic blood pressure increases are known as hypertension, which is typically asymptomatic and often leads to fatal complications (1). The prevalence of hypertension is quite high; according to the World Health Organization (WHO), an estimated 1.13 billion people worldwide suffer from hypertension, with the majority of the increase occurring in developing countries such as Indonesia (2). Hypertension in the elderly is higher compared to younger age groups, including both primary and secondary hypertension (3). Hypertension is associated with an increased risk of mortality. The prevalence of hypertension rises with age, from 15% in young adults to 60% in those over 65 years old (4). Hypertension is one of the most important health issues worldwide because the continuous increase in blood pressure raises the likelihood of cardiovascular, cerebrovascular, and renal vascular events (5). High blood pressure often occurs alongside other risk factors such as obesity, cholesterol, and diabetes, increasing the risk of other health issues. Long-term (sustained) high blood pressure can damage organs such as the heart, kidneys, and brain (6). There are two types of hypertensions: secondary hypertension and primary hypertension, based on their causes. Factors such as smoking, obesity, and a history of hypertension contribute to primary hypertension. Certain systemic disorders in the body, such as comorbid diseases, cause secondary hypertension (7).

Hypertension mechanism involves ACE (Angiotensin-Converting Enzyme), which plays a crucial role in the formation of angiotensin II, one of the causes of hypertension. Angiotensin II constricts blood vessels and increases blood pressure, while ACE inhibitors dilate blood vessels, allowing more blood to flow to the heart, thereby lowering blood pressure (8). High blood pressure symptoms can be asymptomatic and typically cause headaches, dizziness, and may also remain without symptoms, leading to inflammation or inflammatory response in the body. Early prevention is necessary to ensure that high blood pressure does not cause further issues for the patient (9). Factors contributing to hypertension include smoking, obesity, a history of hypertension, comorbidities, and the duration of hypertension (4). Blood pressure in hypertension cases is essential for monitoring the patient and preventing tissue damage that can lead to fatal complications. ESR is a supporting test used to monitor conditions such as infections and tissue damage and also used as a screening test for acute-phase proteins and chronic diseases (10).

The erythrocyte sedimentation rate (ESR) is a non-specific test used to help diagnose and monitor conditions involving inflammation, infection, or tissue damage. It tracks disease progression and acute activity (10). An elevated ESR indicates that the body is undergoing an inflammatory process, with additional tissue damage and both acute and chronic inflammation (11). Monitoring blood pressure in hypertension is vital to prevent inflammation and complications that may lead to death. The ESR test is a common hematological screening tool used globally to detect and monitor inflammation and tissue damage in both acute and chronic diseases (12).

Hatauruk et al. (2022) study states that ESR values in non-hemorrhagic stroke patients were all above normal (high). Stroke patients are also part of the inflammatory parameters, and the causes of stroke include complications from hypertension (13). Asawapattanakul et al. (2021) proved that ESR is influenced by several plasma proteins, with ESR levels gradually increasing from the onset of inflammation and remaining elevated for several weeks after the inflammation has been resolved, additionally infections can lead to increased ESR values, but ESR values cannot be used as a diagnostic determinant and are used as a diagnostic support tool (14).

According to basic health survey data shows that hypertension in Indonesia increased to 34.1% in 2018 while the prevalence of hypertension in DKI Jakarta Province is 20.0% (15). According to medical record of PKC Duren Sawit Jakarta in 2022 its reported that prevalence of hypertension at the Duren Sawit Health Center from 2021-2022 was about 2,931 hypertensive patients per month. This study aimed to measure ESR levels in hypertensive patients and its relation to the risk factors for hypertension complications.

Methods

This observational study was conducted at the laboratory of the Duren Sawit District Public Health Center (Puskesmas), located in East Jakarta. The research took place over a six-month period, from May to October 2022. The primary material used in this study was venous blood obtained from hypertensive patients, while the instruments included alcohol swabs, micropore tape, EDTA tubes, tourniquets, syringes, and the Vision-B analyzer.

The target population comprised patients diagnosed with hypertension who were undergoing treatment at the Duren Sawit Health Center. Participants were selected through a purposive sampling technique, which allowed the selection of individuals based on predetermined characteristics relevant to the research objectives. Sampling was conducted over the course of one month. Each participant donated 3 cc of venous blood, drawn from the vena mediana cubiti and collected into vacutainer tubes containing EDTA as an anticoagulant. Prior to participation, all subjects received an explanation of the study and signed a written informed consent form voluntarily.

Eligible participants were individuals over the age of 30 who had a documented history of hypertension and recorded blood pressure values exceeding 140/90 mmHg. Individuals were excluded from the study if they were under 30 years of age, had no history of hypertension, presented with a blood pressure reading below 140/90 mmHg, or provided an insufficient volume of blood.

The main outcome variable in this study was the erythrocyte sedimentation rate (ESR), serving as the dependent variable. The independent variables included demographic and clinical factors such as age, sex, smoking status, obesity, history of hypertension, comorbidities, and the duration of hypertension. These variables were examined to determine their potential influence on ESR levels in hypertensive patients.

Results

The research was conducted at the Laboratory of the Duren Sawit Subdistrict Health Center. The sample in this study was obtained using the purposive sampling method, which was then linked to the population characteristics that had already been determined based on inclusion and exclusion criteria. The research subjects were observed for 1 month. A 3 cc sample of blood from the Median Cubital Vein was collected and placed into a vacutainer tube with the anticoagulant EDTA.

Univariate Analysis

Frequency distribution on erythrocyte sedimentation rate (ESR) based on mean, median, and SD in the table below:

Tabel 1. Descriptive data of LED among respondent

Variable	Mean	Median	SD
LED	32.2	21.0	24.7

The results of the study in Table 1 show that the ESR sample consists of 65 samples with a Mean value of 32.2, a Median of 21.0, and an SD of 24.7. The frequency distribution of hypertensive patients based on age, gender, smoking, obesity, history of hypertension, comorbidities, and duration of hypertension is shown in the table below

Table 2 Respondent Characteristics

Variable	n	%
<i>Age</i>		
> 57 Year	36	55.4
< 57 Year	29	44.6
<i>Gender</i>		
Female	45	69.2
Male	20	30.8
<i>Smoking</i>		
Yes	39	60.0
No	26	40.0

Table 3 Obesity and Hypertension State among Respondent

Variable	n	%
<i>IMT Obesity</i>		
Obesity	36	55.4
Normal	29	44.6
<i>Hypertension History</i>		
Yes	43	66.2
No	22	33.8
<i>Co-Morbidity</i>		
Yes	36	55.4
No	29	44.6
<i>Hypertension duration</i>		
> 5 Years	35	53.8
< 5 Years	30	46.2

The results of the study in Table 4 show that the hypertensive patient sample based on age category is as follows: those aged > 57 years totaled 36 (55.4%), and those aged < 57 years totaled 29 (44.6%).

Bivariate Analysis

The Relationship Between Age and Erythrocyte Sedimentation Rate (ESR) Value

The Mann-Whitney test for hypertensive patients based on age category with the value of erythrocyte sedimentation rate (ESR), as shown in the table below:

Mann-Whitney test for hypertensive patients with gender categories and erythrocyte sedimentation rate (ESR) values, in the table below:

Table 5. Mann-Whitney test LED value among gender group

Gender	n	Median (Min-Max)	Mean±SD	<i>P</i> *
Women	45	28 (7 – 92)	33±26.39	0.798
Men	20	20 (8 – 80)	28±20.61	

The results in Table 5 show an Asymp.sig (2-tailed) value of 0.798 ($p > 0.05$), indicating that the hypothesis is rejected, meaning there is no relationship between the ESR values of women and men. There is no significant relationship between gender and ESR values, and it can be concluded that there is no significant relationship.

Mann-Whitney Test of Hypertensive Patients Based on Smoking Categories with ESR (Erythrocyte Sedimentation Rate) Values, in the Table Below:

Table 6. Mann-Whitney test LED value among smoker and non-smoker group

Smoking State	n	Median (Min-Max)	Mean±SD	<i>P</i> *
Smoker	39	41 (7 – 92)	42±25.03	<0.001
Non-Smoker	26	12 (9 – 72)	16±13.01	

The results of the study in Table 6 show an Asymp. Sig (2-tailed) value of 0.000 ($p < 0.05$), indicating that the hypothesis is accepted, meaning there is a significant relationship between ESR (Erythrocyte Sedimentation Rate) values and smoking status. A significant association between smoking and ESR values can be concluded.

Cigarettes contain various harmful substances, including nicotine. Smoking introduces many toxic compounds into the body, acting as sources of disease. Smoking can accelerate the pathogenesis of various types of cancer, and exposure to cigarette smoke can lead to chronic systemic inflammatory reactions, including tissue damage (Wibowo, 2017). Systemic inflammation is marked by an increase in inflammatory cytokines, blood cell counts, and blood viscosity, all of which can influence the elevation of ESR (Tsamarah, 2022).

Mann-Whitney Test of Hypertensive Patients Based on Obesity Categories with ESR (Erythrocyte Sedimentation Rate) Values, in the Table Below:

Table 7. Mann-Whitney test LED value among obesity and non-obesity group

Obesity State	n	Median (Min-Max)	Mean±SD	<i>P</i> *
Obesity	38	19 (8 – 92)	30±23.93	<0.001
Non-Obesity	27	29 (7 – 92)	32±24.04	

The results of the study in Table 7 show an Asymp. Sig (2-tailed) value of 0.000 ($p < 0.05$), indicating that the hypothesis is accepted, meaning there is a relationship between ESR (Erythrocyte Sedimentation Rate) values and weight status (normal weight and obesity). There is a significant relationship between obesity and ESR values.

Mann-Whitney Test of Hypertensive Patients Based on Hypertension History Categories with ESR (Erythrocyte Sedimentation Rate) Values, in the Table Below:

Table 8. Mann-Whitney test LED value among Hypertensive and non-Hypertensive group

Obesity State	n	Median (Min-Max)	Mean±SD	<i>P</i> *
Non hypertensive	22	12 (7 – 16)	11.73±2.55	<0.001
Hypertensive	43	41 (10 – 92)	42.70±24.43	

The results of the study in Table 8 show an Asymp. Sig (2-tailed) value of 0.000 ($p < 0.05$), indicating that the hypothesis is accepted, meaning there is a relationship between ESR (Erythrocyte Sedimentation Rate) values and the presence or absence of hypertension. There is a significant relationship between a history of hypertension and ESR values.

Mann-Whitney Test of Hypertensive Patients by Comorbid Disease Category and Erythrocyte Sedimentation Rate (ESR) Values, as Shown in the Table Below:

Table 9. Mann-Whitney test LED value among co-morbidity and no co-morbidity group

Obesity State	n	Median (Min-Max)	Mean±SD	<i>P</i> *
No Co-morbidity	29	12 (7 - 90)	16.31±16.38	<0.001
Co-morbidity	36	41 (15 - 92)	45.03±22.91	

The results of the study in Table 9 show an Asymp. Sig (2-tailed) value of 0.000 ($p < 0.05$), indicating that the hypothesis is accepted, meaning there is a relationship between ESR values in patients with and without comorbidities. A significant relationship exists between comorbid conditions and ESR values.

Discussion

Univariate analysis

Hypertension in the elderly is more common, with isolated systolic hypertension (ISH) being the most frequent, and it is usually primary hypertension (Tuty, 2017). The sample of hypertensive patients based on gender category includes 45 females (69.2%) and 20 males (30.8%). Female respondents are more dominant than males. The difference in numbers based on gender comes from the Riskedas survey of 2018, which showed that women experience hypertension more than men, due to the close relationship between hypertension and hormonal factors in women (Tumondo, 2021).

The sample of hypertensive patients based on the smoking habit category is as follows: smokers totaled 39 (60.0%), and non-smokers totaled 26 (40.0%). Smoking increases blood pressure, and heavy smoking has been linked to an increase in malignant hypertension and the risk of developing renal artery stenosis and atherosclerosis (Nuraini, 2015). The sample of hypertensive patients based on the obesity category includes 36 (55.4%) with obesity and 29 (44.6%) with normal weight. The study by Rahajen (2019) shows that individuals who are overweight by more than 20% due to hypercholesterolemia have a higher risk of developing high blood pressure. The sample of hypertensive patients based on the history of hypertension category includes 43 (66.2%) with a history of hypertension and 22 (33.8%) with no history of hypertension. Research conducted by several respondents revealed that they had high blood pressure in both parents or family members, and the presence of genetic factors in certain families also increases the risk of high blood pressure.

The sample of hypertensive patients based on the comorbidity category includes 36 (55.4%) with comorbidities and 29 (44.6%) without comorbidities. High blood pressure often occurs alongside other risk factors, such as comorbidities like diabetes and high cholesterol, which often increase health risks (Suciana, 2020). The sample of hypertensive patients based on the duration of hypertension category includes 35 (53.8%) with hypertension lasting more than 5 years and 30 (46.2%) with hypertension lasting less than 5 years. Hypertension develops gradually, often going unnoticed. High blood pressure does not develop suddenly but through a long-term process.

The increase in ESR is higher in women than in men, and in both genders, there is an increase with age. Erythrocyte sedimentation rate depends on age, gender, and a slight increase is relatively insignificant (Sugari, 2014). Gender categories do not affect ESR values, so there is no relationship between ESR levels and gender.

Age can affect the erythrocyte sedimentation rate, which tends to increase as a person reaches 60 years of age and older, as elderly individuals are often associated with various declines in health status, particularly physical health, such as joint pain (Cahyani, 2016). The age category does not significantly affect ESR values because the slight increase is relatively not meaningful.

Cigarettes contain various harmful substances, including nicotine. Smoking introduces many toxic compounds into the body, acting as sources of disease. Smoking can accelerate the pathogenesis of various types of cancer, and exposure to cigarette smoke can lead to chronic systemic inflammatory reactions, including tissue damage (Wibowo, 2017). Systemic inflammation is marked by an increase in inflammatory cytokines, blood cell counts, and blood viscosity, all of which can influence the elevation of ESR (Tsamarah, 2022).

Obesity can lead to conditions such as diabetes, dyslipidemia, inflammation, hypertension, and a procoagulant state, which may develop into cardiovascular diseases in an individual (Dinutanayo, 2021). Obesity increases the risk of complications such as metabolic syndrome and atherosclerosis, showing a significant association with body mass index (BMI) (Haris, 2016).

A history of hypertension increases the risk of high blood pressure in certain families who suffer from the condition (Nuraini, 2015). In cases of hypertension, blood pressure must be monitored to prevent tissue damage and complications that could lead to death (Maryati, 2017). Therefore, early preventive measures are necessary to ensure that high blood pressure does not cause further health problems for the patient (Suciana, 2020).

Comorbidities refer to additional diseases or conditions that a person has when already affected by another illness. These conditions can worsen when they occur simultaneously. Comorbidities contribute to hypertension, and when they coexist, they have the potential to exacerbate organ damage. One of the leading causes of death worldwide is hypertension accompanied by comorbid conditions (Alfian, 2017). Erythrocyte Sedimentation Rate (ESR) is commonly used as a supporting examination to establish a diagnosis and to monitor various conditions, such as infections present in the body (Nazarudin, 2019).

Conclusion

According to the results of this study, it concludes that certain risk factors such as smoking, obesity, history of hypertension, co-morbidities, and the duration of hypertension are associated with increased erythrocyte sedimentation rates in hypertensive patients, while age and gender are not significantly related.

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Conflict of Interest

The authors declare that there's no conflict of interest regarding this article.

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