

## Relationship of High Stress with Hypertension in Adults: Meta Analysis

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### ABSTRACT

**Background:** Hypertension is a condition that causes a person to experience a drastic increase in blood pressure. Hypertension is often referred to as the silent killer because it can damage target organs such as the brain, eyes, kidneys, heart and arteries. Based on the cause, the increase in blood pressure can occur due to essential or primary hypertension such as high stress. The aim of this study was to estimate the relationship between high stress and hypertension in adults, with a meta-analysis of the primary study conducted by the previous authors.

**Subjects and Method:** This study is a meta-analysis using the PICO ie, population: adults; Intervention: high stress; Comparison: low stress; Result: hypertension. The articles used in this study were obtained from two databases, namely Pubmed and Google scholar. The keywords in the article search were “adults” AND “high stress” AND “low stress” AND “hypertension” cross-sectional or “Stress” AND “hypertension”. The included article is in full English with a cross-sectional study design for 2014 to 2021 and reports the adjusted odds ratio (aOR) in a multivariate analysis. Article selection using PRISMA flow chart. Article analysis using the Review Manager 5.3 application.

**Results:** 10 articles with a cross sectional study involving 3,436 adults from 4 continents namely Asia, Europe, Africa and America to be used as a systematic review and meta-analysis. The data collected showed that high stress had a relationship with the occurrence of hypertension in adults as much as 1.66 times compared to adults with low stress (aOR=1.66; 95%CI= 1.28 to 2.17; p= 0.002).

**Conclusion:** High stress has a relationship with hypertension in adults.

**Keywords:** adults, high stress, hypertension

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### BACKGROUND

Hypertension is one of the most common non-communicable cardiovascular diseases and occurs in the community. This degenerative disease can affect a person's quality of life and productivity. Based on World Health Organization (WHO) data in 2015 around 1.13 billion people in the world have hypertension, meaning that 1 in 3 people in

the world are diagnosed with hypertension, it is estimated that in 2025 there will be 1.5 billion people affected by hypertension and an estimated 9.4 million people will die from hypertension. and its complications each year. Hypertension is a major health problem globally because of its magnitude and the associated risks, how difficult it is to manage, and the high medical and social

costs. Hypertension (High Blood Pressure) is a condition where the systolic blood pressure is >140 mmHg and/or diastolic is >90 mmHg (WHO, 2013). The World Health Organization (WHO) estimates that the number of people with hypertension will continue to increase along with the increasing population. Hypertension is a long-term medical condition, 7.1 deaths per year affecting about 35% of adults. High stress is an increase in blood pressure and the risk of developing hypertension, stress factors occur due to lifestyle (lack of physical activity, smoking, obesity, alcohol use, sleep disorders, depression, salt intake, excess oil) (Conversano et al., 2021).

Cardiovascular-related diseases are the leading cause of death worldwide, each year there are more than 9 million deaths caused by complications of hypertension. Hypertension is driven by demographic and socio-economic changes that affect the lifestyle, diet and work of the population among adults. One of the factors in the occurrence of hypertension is the repetitive stress felt by adults (Bhelkar et al., 2018).

Hypertension is a risk factor for damage to important organs such as the brain, heart, kidneys, retina, large blood vessels (aorta) and peripheral blood vessels (Indonesian Hypertension Doctors Association, 2019). In many countries today, the prevalence of hypertension increases with lifestyle changes. Hypertension has become a public health problem and will become a bigger problem if not addressed. This condition can be a burden both from a financial perspective, due to reduced productivity of human resources due to complications of this disease, as well as from a health system perspective (Muhammad Hafiz Bin Mohd Arifin et al., 2016).

One of the causes of hypertension is stress. Stress is a psychological variable that has long been listed among potential and

important risk factors for hypertension and coronary heart disease. Stress has been defined as a process in which environmental demands exceed the adaptive capacity of an organism. This can result in psychological and biological changes that can put people at risk for disease (Agyei et al., 2014).

Stress is a physiological and psychological response of humans trying to adapt and regulate both internal and external pressures. Stress is a response to the perception of an individual's physical or psychological events as potentially harmful or emotional distress. In line with this opinion, stress is defined as a non-specific response of the body to any demands (Tangku-dung, 2018).

Long-term periods of stress can cause devastating changes in the body. Stress is divided into three levels, including mild stress, moderate stress and severe stress (Ganesh et al., 2014). Stress is prone to occur in productive ages, namely 15 to 64 years (Cuffee et al., 2014). While mental or psychosocial stress according to (Jadhav et al., 2014) is one of the main risk factors for hypertension which is a risk factor for various other cardiovascular diseases.

Based on this background description, a comprehensive review of various primary studies is needed on the relationship between high stress and hypertension in adults. The aim of this study was to estimate the relationship between high stress and hypertension in adults, with a meta-analysis of the primary study conducted by the previous authors.

## SUBJECTS AND METHOD

### 1. Study Design

This research is a systematic research and meta-analysis. The articles used were obtained from the Google Scholar and Pubmed databases between 2014 and 2021. Identification of articles using PRISMA flow-

charts. The search keywords were “adults” AND “high stress” AND “low stress” AND “hypertension” cross sectional or “stress” AND “hypertension”.

## 2. Inclusion Criteria

The inclusion criteria in this research article are full text using a cross sectional design, the research subjects are adults, the research results are hypertension, to measure the relationship using multivariate analysis with Adjusted Odds Ratio (aOR).

## 3. Exclusion Criteria

The exclusion criteria in this research article are national articles (in Indonesian) and statistical results in the form of bivariate analysis.

## 4. Operational Definition of Variables

PICO is one way of determining the search for articles related to the results. Population: adults, Intervention: high stress, low stress ratio, Outcome: hypertension.

**High stress** is conditions faced by all adults from time to time, in the short and long term and lead to depression due to psychological and physical pressure in responding to various types of demands, threats and pressures of life. The instrument used is a structured and validated questionnaire. The measurement scale is categorical.

**Hypertension** is adult blood pressure status above 140/90 due to high stress and depression due to psychological and physical pressure in response to various types of demands, threats and pressures of life. The instrument used is a questionnaire containing the results of an adult's blood pressure examination. The measurement scale is categorical

## 5. Study Instruments

This research is guided by the PRISMA flow chart and critical appraisal using the 2018 critical appraisal skills program (CASP, 2018).

## 6. Data Analysis

The analysis in this study was carried out using the Review Manager application (RevMan 5.3). Forest plots and funnel plots were used to measure the degree of correlation and heterogeneity of the data.

## RESULTS

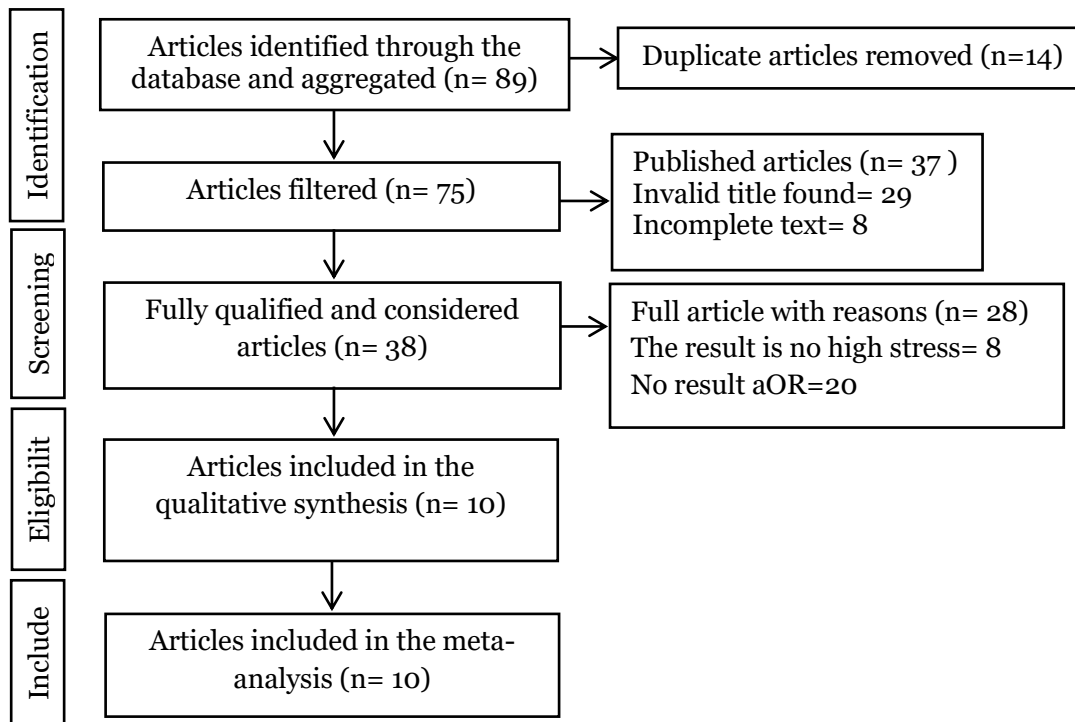
The research process begins with conducting a research question to obtain a PICO which will be used as a reference as a search for related articles. Google Scholar and PubMed are databases for article searches.

Figure 1 Review articles can be seen through the PRISMA flow chart. Research related to high stress on hypertension in adults consisted of 10 articles from the initial search process of 89 articles, after deletion of published articles 38 of them were complete articles that met the requirements and were considered for further full-text review. The 10 articles that met the quality assessment were included in the quantitative synthesis using a meta-analysis. Figure 2 research articles from 4 continents, namely Asia (Thailand, China, India), America (America, Washington DC), Africa (Ethiopia, Nigeria) and Europe (Netherlands, Lithuania). Table 1 researchers conducted an assessment of the study quality assessment of 10 articles through CASP 2018.

Table 2 describes 10 articles from cross-sectional studies that have evidence that high stress is associated with hypertension in adults. Figure 3 results of the cross-sectional forest plot study shows that adults with high stress on hypertension have an effect of 1.66 times compared to adults with low stress on hypertension (aOR= 1.66; 95%CI= 1.28 to 2.17; p= 0.002) with results were statistically significant. High heterogeneity is indicated by the value of  $I^2 = 80\%$  so that the random effects model is used. Figure 4 The funnel plot results show no bias, indicated by a sym-

metrical distribution between the right and left plots. There are 3 squares on the right,

3 squares on the left and 4 squares touching the vertical line.



**Figure 1. PRISMA flowchart**



**Figure 2. Map of the research area**

**Table 1. Assessment of study quality published by the 2018 critical appraisal skills program (CASP 2018)**

No	Indicators	Publication (Author and Year)				
		Agyei et al. (2014)	Hu et al. (2015)	Damtie et al. (2021)	Grazuleviciene et al. (2021)	Apidehkul et al. (2021)
1	Does the study address clearly focused questions/problems?	2	2	2	2	2
2	Is the research method (research design) appropriate to answer the research question?	2	2	2	2	2
3	Is the subject selection method (employee, team, division, organization) clearly explained?	2	2	2	2	2
4	Can the way the sample is obtained give rise to (selection) bias?	2	2	2	2	1
5	Is the sample of subjects representative of the population to which the findings will be referred?	2	2	2	2	2
6	Was the sample size based on pre-study considerations of statistical power (AOR)?	2	2	2	2	2
7	Was a satisfactory response rate achieved?	2	1	2	2	1
8	Is the measurement (questionnaire) possible valid and reliable?	2	2	2	2	2
9	Was statistical significance assessed?	2	2	2	2	2
10	Was a confidence interval given for the main outcome?	2	2	2	2	2
11	Could there be a confounding factor that hasn't been taken into account?	1	2	1	2	2
12	Can the results be applied to your organization?	2	2	2	2	2
<b>Total</b>		<b>23</b>	<b>23</b>	<b>23</b>	<b>24</b>	<b>22</b>

**Description:**

2: Yes; 1: Can't tell; 0: No

**Table 2. Cont.**

No	Indicator	Publication (Author and Year)				
		Langford et al. (2021)	Ganesh et al. (2014)	Asmare et al. (2021)	Okunrin boye et al. (2019)	Xiaoxiao et al. (2020)
1	Does the study address clearly focused questions/problems?	2	2	2	2	2
2	Is the research method (research design) appropriate to answer the research question?	2	2	2	2	2
3	Is the subject selection method (employee, team, division, organization) clearly explained?	2	2	2	2	2
4	Can the way the sample is obtained give rise to (selection) bias?	2	2	2	2	2
5	Is the sample of subjects representative of the population to which the findings will be referred?	2	2	1	2	2
6	Was the sample size based on pre-study considerations of statistical power (AOR)?	2	2	2	2	2
7	Was a satisfactory response rate achieved?	1	2	2	1	1
8	Is the measurement (questionnaire) possible valid and reliable?	1	2	2	2	2
9	Was statistical significance assessed?	2	2	2	2	2
10	Was a confidence interval given for the main outcome?	2	2	2	2	2
11	Could there be a confounding factor that hasn't been taken into account?	2	1	1	1	1
12	Can the results be applied to your organization?	2	1	2	2	2
<b>Total</b>		<b>22</b>	<b>22</b>	<b>22</b>	<b>22</b>	<b>22</b>

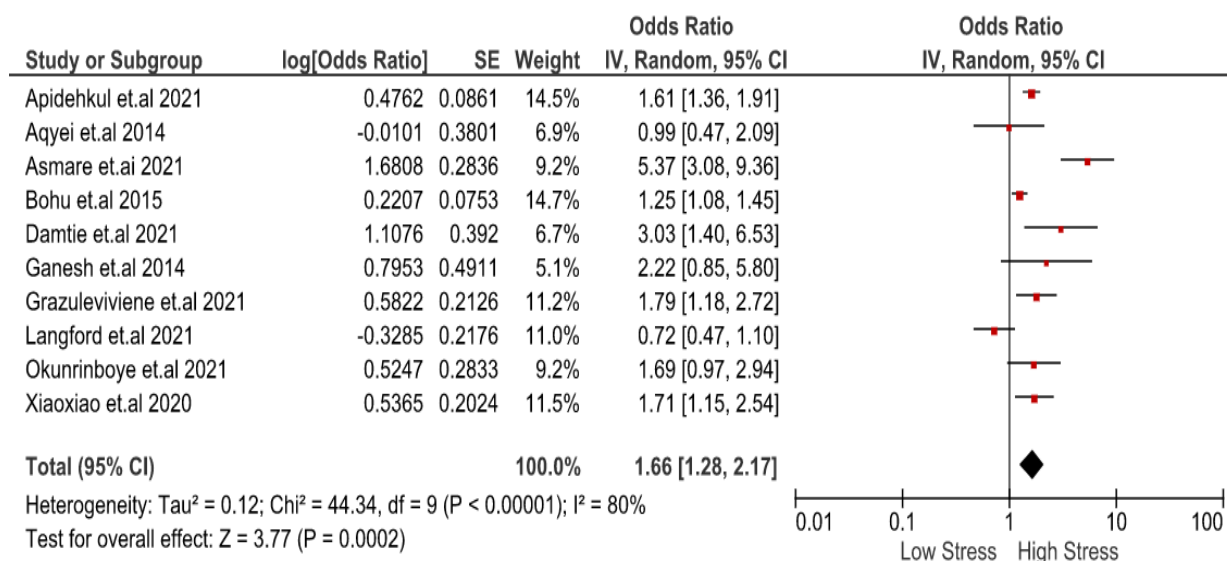
**Description:**

2: Yes; 1: Can't tell; 0: No

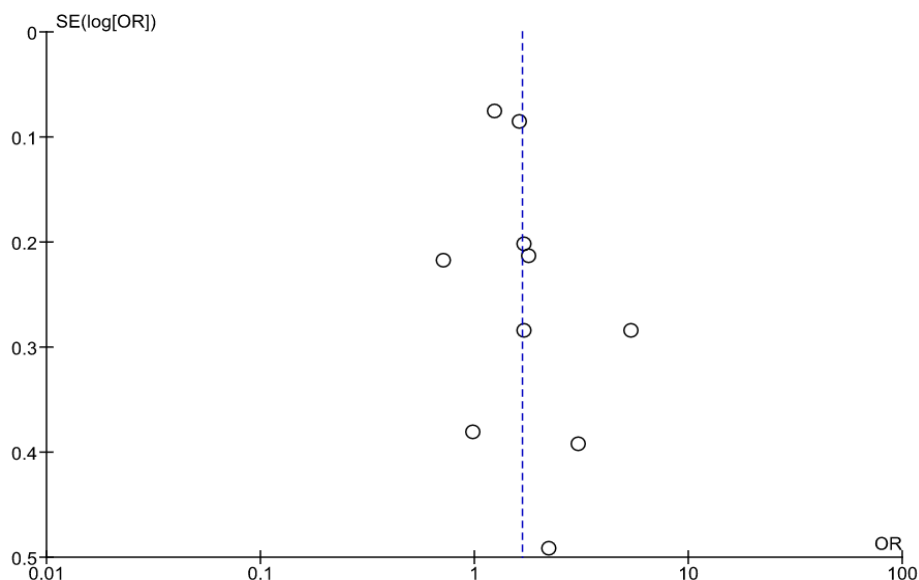
**Table 3. Description of the main studies included in the primary study of the meta-analysis**

Author (year)	Country	Study Design	Sample Size		P Population	I Intervention	C Comparison	O Outcome	aOR (95%CI)
			Total	High Stressed					
Agyei et al. (2014)	Amsterdam, Netherlands	cross-sectional	212	78 (35.5)	Adults 18-65 years old	High stress	low stress	Hypertension	0.99 (0.47 to 2.08)
Hu et al. (2015)	Hebei, China	cross-sectional	5976	2298 (38.45)	Adults 40-60 years old	High stress	low stress	Hypertension	1.25 (1.08 to 1.45)
Damtie et al. (2021)	Bahir Dar, Northwest Ethiopia	cross-sectional	222	29 (13.6)	Adults 20-60 years old	High stress	low stress	Hypertension	3.03 (1.40 to 6.53)
Grazuleviciene et al. (2021)	Kaunas, Lithuania	cross-sectional	1086	293 (52.5)	Adults 18-64 years old	High stress	low stress	Hypertension	1.79 (1.18 to 2.72)
Apidehkul et al. (2021)	Changhai, Thailand	cross-sectional	2552	7 (0.3)	Adults > 30 years old	High stress	low stress	Hypertension	1.61 (1.36 to 7.36)
Langford et al. (2021)	America	cross-sectional	1819	269 (14.8)	Adults 58 years old	High stress	low stress	Hypertension	0.72 (0.47 to 1.10)
Ganesh et al. (2014)	Puducherry, India	cross-sectional	396	89 (22.5)	Adults 25-59 years old	High stress	low stress	Hypertension	2.22 (0.85 to 5.80)
Asmare et al. (2021)	Addis Ababa, Ethiopia	cross-sectional	416	55 (13.2)	Adults > 18 years old	High stress	low stress	Hypertension	5.37 (3.08 to 9.35)
Okunrinboye et al. (2019)	Ondo State, Nigeria	cross-sectional	400	37 (30.1)	Adults 18-64 years old	High stress	low stress	Hypertension	1.69 (0.97 to 2.94)
Xiaoxiao et al. (2020)	Washington DC – Baltimore	cross-sectional	530	281 (52.8)	Adults > 18 years old	Stres tinggi	stress rendah	Hypertension	1.71 (1.15 to 2.54)





**Figure 3. Forest Plot relationship between high stress and hypertension in adults**



**Figure 4. Funnel plot relationship of high stress and hypertension in adults**

**DISCUSSION**

Systematic studies and meta-analyses in this study have a significant relationship between high stress and hypertension in adults. This study discusses high stress in adult life which is considered important because it is the cause of hypertension.

A number of studies have shown that age is a risk factor for increasing hypertension, in various regions of the world the male group aged 30 to 39 years (48.1%)

while the female group aged 50 to 59 years (50.1%) is hypertensive. Constant exposure to stress can lead to the development of hypertension (Tengnah et al., 2019).

In the United States, African Americans and Americans have a prevalence of cardiovascular disease morbidity and mortality (CDV), the combined effect of stress and depressive symptoms through the LS7 metric, namely physical activity, diet, BMI, smoking status, blood pressure, total cho-



lesterol and fasting blood glucose is the main mediator to obtain the results of the relationship between high stress and hypertension, through the LS7 matrix with poor health status for smoking (OR= 0.52; 95% CI= 0.35 to 0.78) and physical activity (OR= 0.71; 95% CI= 0.52 to 0.95) . Given that Africans and Americans have a high burden of stress and hypertension (Langford et al., 2021).

The stress process in which environmental demands burden the adaptive capacity of organism which results in psychological demands as well as biological changes that can place a risk has been proven in his study that high stress was significantly associated with hypertension (OR= 2.49; 95% CI= 1.06 to 5.86; p= 0.035). Trigger factors such as obesity, obesity and lack of physical activity, especially in adulthood, have a relationship with hypertension (Bhelkar et al., 2018).

High stress is associated with severe anxiety and depression where the negative effects of the cardiovascular system are mediated through immune and neuroendocrine pathways. Primary outpatients with hypertension and coronary heart disease with high stress levels should be monitored extra for controlling lifestyle risk factors that cause hypertension (OR= 5.79; 95% CI = 4.18 to 8.03; p= 0.003) (Pogosova et al., 2021).

On the level of anxiety, behavioral, social, psychological and economic influences provide the development of the course of hypertension in the general population over the years. Longitudinal study of African American race, the presence of job discomfort, low status work, inadequate work is a high stress that causes hypertension (aOR= 0.99; 95%CI= 0.95 to 1.04) (Levenstein et al., 2001).

In the research of Septiyawati et al. (2021) case control type where there is a

significant effect between high stress on the incidence of hypertension in adults (30 to 50 years) OR= 0.251; p= 0.053 means the higher the stress level, the higher the risk of hypertension.

Hypertension in adults can appear for workers who have high stress levels in a cross-sectional study of disorders of physical, psychological or social conditions related to work (PR= 6.27; 95% CI= 1.71 to 23.06; p= 0.006) (Rengganis et al., 2020). In line with the research of Rahmadani et. al (2019) a stress level of 8% occurs in Air Traffic Control employees at the airport because there is no physical activity during work and spends a lot of mental energy while controlling the plane, if repeatedly it can cause hypertension.

Several studies have stated that an unhealthy lifestyle such as not managing a healthy diet, not doing enough physical activity, not getting enough rest, smoking, drinking alcohol triggers high stress and causes hypertension, in a study conducted by Metungku et. al (2021) using an analytical survey with a cross-sectional approach, there is a relationship between stress and hypertension value P value = 0.0045 (p = 0.05) occurs because of an unhealthy lifestyle. In contrast to research by Esaningsih et. al (2018) that stress levels affect hypertension status with Chi-square test, p= 0.021 and PR= 1.507; 95% CI= 1,214 to 1,870, the causative factor is genetics not lifestyle.

The relationship between high stress and hypertension states that individuals who have high levels of perceived stress are 71% more likely to develop hypertension than those with low stress levels (OR= 1.71; 95% CI= 1.15 to 2.54), lifestyle changes Like an unhealthy diet, it has been found to increase the susceptibility to developing hypertension. Thus, stress management is very important in everyday life so as not to

cause hypertension to get worse (Xiaoxiao et al., 2017).

There are various ways of managing stress, Basically it is best to eliminate as many stressors as possible, finding practical and emotional ways to better deal with the remaining stressors. One of the simplest and most effective stress management techniques that can be done regularly: maintain the right attitude, take care of yourself, create the right atmosphere, maintain healthy habits, exercise, good nutrition (Addison, 2015).

Hypertension can be prevented by controlling risky behaviors such as smoking, unhealthy diet (less consumption of vegetables and fruit, excessive salt consumption), obesity, lack of physical activity, alcohol consumption, and stress. If someone has hypertension, then the effort that must be done is to control blood pressure. Hypertension is a chronic disease that cannot be cured. So, if someone's blood pressure has reached the target, it doesn't mean he's cured, but it's under control. If it is controlled, it is hoped that heart disease, stroke, and kidney failure will reduce the risk (Ministry of Health, 2021).

In the end, high stress that is not managed properly can cause hypertension, uncontrolled hypertension will cause other chronic diseases. Various kinds of high stress factors cause hypertension in adults, non-specific responses of the body to any pressure or demands arising from pleasant or unpleasant conditions, stress can cause hypertension through activation of the sympathetic nervous system resulting in an intermittent increase in pressure. When a person experiences stress, adrenaline will be released as a result, increasing blood pressure through arterial contractions and heart rate, if left unchecked and continues, blood pressure will remain high so that person will experience hypertension (Yuli-

anto et al, 2020). The limitation of this study is the search for articles because it only uses two databases and high stress interventions that are still general in nature, for further research it is better to use more databases and more specific stress interventions.

#### **AUTHORS CONTRIBUTION**

Siti Khamidahtun Ni'mah and Sukma were the main researchers who chose the topic, searched for and collected research data. Meanwhile, Nindita Arum Veibiani and Bhisma Murti reviewed the research documents.

#### **FUNDING AND SPONSORSHIP**

This study was self-funded by Siti Luluk Khamidahtun Ni'mah and Sukma.

#### **CONFLICT OF INTEREST**

There is no conflict of interest in this study.

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