

## Meta-Analysis of Acupuncture Therapy for Blood Pressure Reduction in Pre-Elderly with Hypertension

Danang Aji Prabowo<sup>1)</sup>, Hanung Prasetya<sup>2)</sup>, Bhisma Murti<sup>1)</sup>

1)Masters Program in Public Health, Universitas Sebelas Maret

2)Study Program of Acupuncture, Health Polytechnics, Misnistry of Health Surakarta

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### ABSTRACT

**Background:** Blood pressure tends to increase with age. Hypertension or high blood pressure often occurs in pre-elderly individuals, who are aged between 45-59 years. Acupuncture is one of the therapies with mild side effects that can reduce blood pressure in pre-elderly individuals. This study aims to evaluate the effectiveness of acupuncture therapy in lowering blood pressure in pre-elderly individuals with hypertension based on similar previous research.

**Subjects and Methods:** This study employed a systematic review and meta-analysis based on PICO framework: Population: Pre-elderly individuals with hypertension. Intervention: Acupuncture therapy. Comparison: Non-acupuncture therapy. Outcome: Blood pressure. Data were obtained from the PubMed, MEDLINE, Science Direct, BMC, and Google Scholar databases. The search process utilized keywords such as "acupuncture", "hypertension", "Pre elderly", "acupuncture for hypertension", AND "acupuncture for blood pressure". Article selection was performed using the PRISMA flowchart, and the results were analyzed using Review Manager 5.3 software.

**Results:** A total of 9 articles originating from the United States, Germany, South Korea, China, India, and Taiwan, with a sample size of 492 subjects, indicated that acupuncture therapy for blood pressure reduction in pre-elderly individuals was not significant for systolic blood pressure (SMD= -0.00; 95% CI= -0.81 to 0.81; p=1.00), but it was significant for diastolic blood pressure (SMD= -1.33; 95% CI= -2.60 to -0.05; p= 0.04).

**Conclusion:** Acupuncture therapy for blood pressure reduction in pre-elderly individuals is not significant for systolic blood pressure, but it is significant for diastolic blood pressure.

**Keywords:** acupuncture, hypertension, pre-elderly, blood pressure, meta-analysis

### Correspondence:

Danang Aji Prabowo. Master's Program of Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta, Central Java 57126. Email: danang.aji18@gmail.com. Handphone: 085803253182.

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### BACKGROUND

Hypertension, or high blood pressure, is a condition characterized by an increase in blood pressure in the arteries. Generally, hypertension does not exhibit noticeable symptoms, leading individuals affected by it

to often remain unaware of the high pressure in their arteries. Typically, hypertension is more prevalent in individuals aged 40 years and above (Hariyanto, 2020). Hypertension is a condition in which blood pressure remains consistently high, with

systolic pressure above 140 mmHg and diastolic pressure above 90 mmHg, increasing the risk of heart disease, neurological disorders, vascular diseases, and kidney disease (Situmorang, 2020).

Several factors contribute to an increase in blood pressure, including environmental factors, excessive salt consumption, obesity, and unhealthy lifestyle habits (Lumi et al., 2018). Hypertension is often referred to as the "silent killer" because it can affect various organs and lead to other diseases such as stroke, kidney disease, and heart attacks. Findings from several studies indicate that uncontrolled hypertension can elevate the risk of stroke by up to sevenfold and the risk of heart attacks by up to threefold (Darmawan et al., 2019).

Based on data from the WHO, half of hypertension patients receive treatment, and only 25% of them receive appropriate treatment. WHO estimates that approximately 600 million people worldwide suffer from hypertension, and 3 million of them die each year due to this disease (Azhari, 2017). In 2014, the prevalence of hypertension in the Southeast Asia region was as follows: Thailand (23.6%), Myanmar (21.5%), Indonesia (21.3%), Vietnam (21.0%), Malaysia (19.6%), Philippines (18.6%), Brunei Darussalam (17.9%), and Singapore (16.0%) (WHO, 2016). In this Asian region, hypertension has caused around 1.5 million deaths each year. Overall, countries with high-income levels have a lower prevalence, at around 35%, compared to low- and middle-income countries, which experience a prevalence of approximately 40% (Tarigan et al., 2018).

Pre-elderly refers to the age group between 45 and 60 years old. According to the National Basic Health Survey in 2013, the prevalence of hypertension in the age group of 45-54 years was 35.6%, while in the age group of 55-64 years, it reached 45.9%.

Based on data from the Basic Health Research (RISKESDAS) in 2018, the prevalence of hypertension in Indonesia for individuals aged  $\geq 18$  years reached 34.11% of the total population, with the highest rates recorded in South Kalimantan Province (44.1%), while the lowest rates were found in Papua Province (22.2%). Out of the total hypertension prevalence of 34.11%, it is estimated that only about 8.8% of people are aware that they have hypertension, and only about 13.3% of people adhere to taking anti-hypertensive medications (Ministry of Health of Indonesia, 2019).

Based on several studies revealing the issues of hypertension and the need for appropriate management, the author is enthusiastic to further investigate the potential of acupuncture as an intriguing approach to lowering blood pressure in pre-elderly individuals with hypertension. With this goal in mind, the research will be conducted to explore the effectiveness of acupuncture therapy in assisting with high blood pressure management in pre-elderly individuals. Scientific studies indicate that blood pressure tends to increase with age, and the pre-elderly group is vulnerable to hypertension.

## SUBJECTS AND METHOD

### 1. Study Design

This was a systematic review and meta-analysis. The data were obtained from PubMed, Google Scholar, and Science Direct. The search was conducted using various keywords, including "acupuncture", "hypertension", "Pre-elderly", "randomized controlled trial", "acupuncture for hypertension", "hypertension randomized controlled trial", "acupuncture randomized controlled trial", "acupuncture for primary hypertension", "acupuncture for essential hypertension", AND "acupuncture for blood pressure". In addition to determining the

keywords, the article search was also based on eligibility criteria established using the PICO model:

- Population: Pre-elderly individuals with hypertension
- Intervention: Acupuncture therapy
- Comparison: Non-acupuncture therapy
- Outcome: Blood Pressure

## 2. Steps of Meta-Analysis

Firstly, the researcher determines the research question to be investigated. Then, they collect and analyze the data, and finally report the results. The researcher records the research protocol in detail, stating the objectives, hypotheses to be tested, the groups to be studied, methods, and criteria to be used to identify and select various relevant studies, as well as the methods to be used for data extraction and analysis.

## 3. Inclusion Criteria

The included studies must be complete articles with Randomized Controlled Trial (RCT) design. The article titles must be relevant and related to the effect of acupuncture on reducing blood pressure in hypertensive patients. The articles must be published in English or Indonesian. The articles must provide research results, including the number of respondents, mean values, and standard deviation (SD). The intervention in the experimental group must involve acupuncture (using acupuncture needles). The control group may include sham/placebo acupuncture or non-acupuncture hypertension treatments (such as lifestyle modifications or medications).

## 4. Exclusion Criteria

Studies conducted with study designs other than Randomized Controlled Trial (RCT). RCT studies using acupuncture, herbal usage, moxibustion, and transcutaneous electrical acupoint stimulation in the exper-

imental group. Articles published before the year 2001 will not be included in this study. Research subjects with secondary hypertension or non-essential hypertension will be excluded from this study.

## 5. Operational Definition of Variables

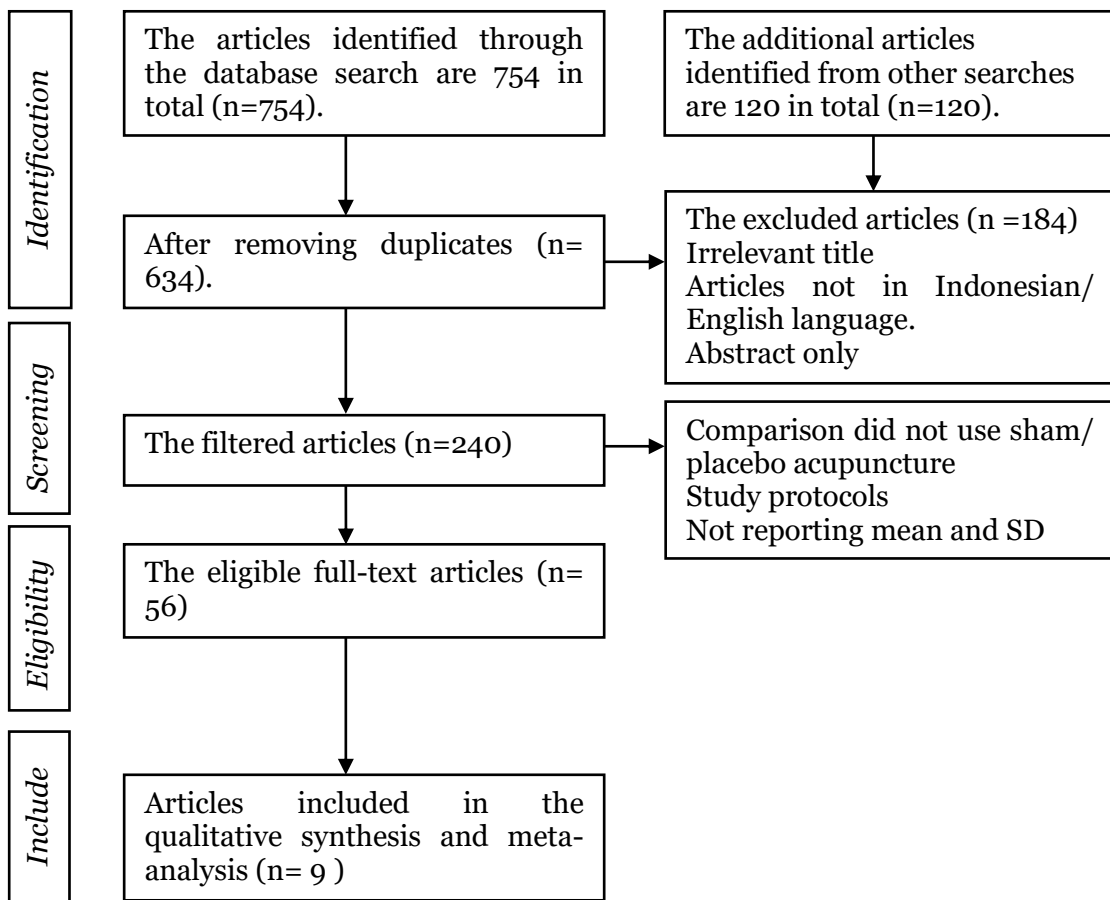
**Acupuncture** is an intervention involving the insertion of a specialized needle (filiform needle) into acupuncture points (acupoints). The tool used is an acupuncture needle. Measurement Scale: Categorical.

**Sham/placebo acupuncture** is an intervention performed by inserting an acupuncture needle, but it is done superficially, so it does not target specific acupuncture points, or it uses different acupuncture points with different functions and purposes from the points that should be used. The tool used is an acupuncture needle. Measurement Scale: Categorical

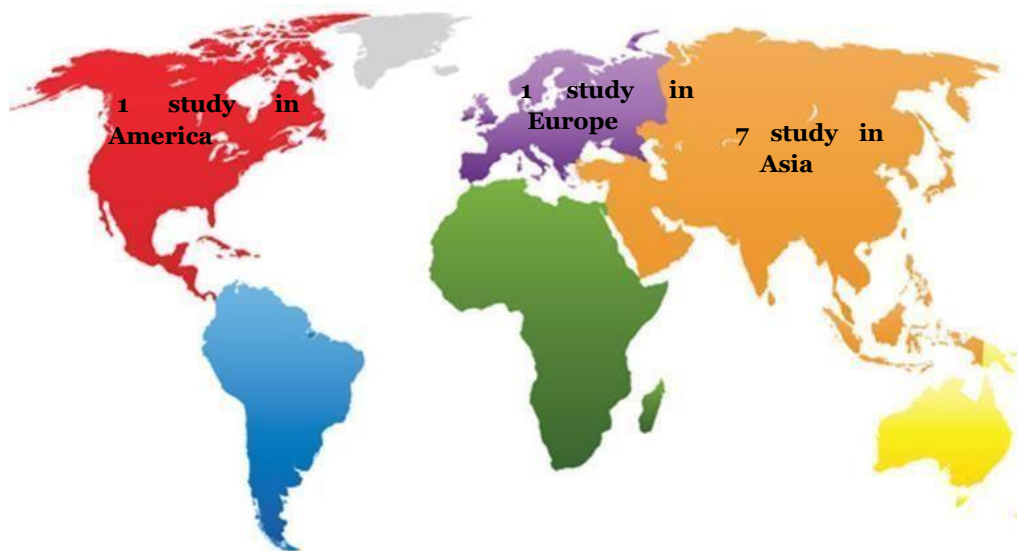
**The reduction of blood pressure in hypertensive patients** is a physiological condition characterized by systolic blood pressure above 140 mmHg and diastolic blood pressure above 90 mmHg. The tool used is a sphygmomanometer or blood pressure monitor. Measurement Scale: Interval

## 6. Data Processing

Data processing starts by identifying articles from several journal databases, followed by a screening stage to ensure that these articles meet the criteria set by the researchers. Articles that pass the eligibility stage are then selected for analysis. The data from these studies are processed and analyzed using RevMan 5.3 software.



**Figure 1. PRISMA flow diagram**



**Figure 2. Research Regions**

## RESULTS

The article screening process can be seen in Image 1. The initial article search process identifies articles from various databases, followed by the addition of articles from other sources. After removing duplicate articles, articles that meet the criteria are reviewed in full text. Full-text articles that are excluded from the study did not meet the criteria, such as outcome not matching

**Table 1. Assessment of the quality of randomized controlled trial studies on acupuncture therapy for reducing blood pressure in elderly individuals with hypertension.**

Primer Study	1	2	3	4	5	6	7	8	9	10	11	12	Total
Maklin <i>et al.</i> , (2006)	1	1	1	1	1	1	1	1	1	1	1	1	12
Flachskampf <i>et al.</i> , (2007)	1	1	1	1	1	1	1	1	1	1	1	1	12
Yin <i>et al.</i> (2007)	1	1	1	1	1	1	1	1	1	1	1	1	12
Park <i>et al.</i> , (2010)	1	1	1	1	1	1	1	1	1	0	1	1	11
Kim <i>et al.</i> , (2012)	1	1	1	1	1	1	1	1	1	0	1	1	11
Liu <i>et al.</i> , (2015)	1	1	1	1	1	1	1	1	1	1	1	1	12
Zheng <i>et al.</i> , (2019)	1	1	1	1	1	1	1	1	1	1	1	1	12
Maheshkumar <i>et al.</i> , (2020)	1	1	1	1	1	1	1	1	1	0	1	1	11
Huang <i>et al.</i> , (2020)	1	1	1	1	1	1	1	1	1	0	1	1	11

### Explanation of the criteria for each question:

1. Has the problem discussed in the study been clearly explained?
2. Is the Randomized Controlled Trial (RCT) suitable for answering the study objectives?
3. Was the sampling for the experimental and control groups conducted randomly?
4. Have the inclusion and exclusion criteria been described?
5. Is the number of research subjects large enough to establish that the findings are not due to chance?
6. Were objective actions or subject participants applied with a 'blinding' system to

the PICO criteria of this research or not providing mean and standard deviation values. The review process is repeated to ensure the selected articles meet the criteria. As a result, 9 articles are eligible for meta-analysis.

Figure 2 depicted that the research articles originate from 3 continents, namely Europe (Germany), America (United States), and Asia (South Korea, India, China, Taiwan).

determine which intervention they were receiving? The study would be more ideal if it used a 'double-blinded' method.

7. Does the effect size found have practical relevance?
8. Are the confident intervals given in the analysis results?
9. Can the results of this research be applied in other studies?

### Explanation of the scoring of answers:

- 0 = No  
1 = Yes



**Table 2. Summary of RCTs for meta analysis**

Author(Year)	Country	Sample Size	P	I	C	O
Maklin et al., (2006)	America	45	Patients with EH grade I-II	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Flachskampf et al. (2007)	Germany	68	Outpatients with EH grade I-II	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Yin et al. (2007)	South Korea	20	Patients with EH grade I-II	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Park et al. (2010)	South Korea	15	Hyperensive patients	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Kim et al. (2012)	South Korea	16	Patients with EH grade I-II	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Liu et al. (2015)	South Korea	15	Patients with EH grade I	Acupuncture therapy	No intervention	Blood pressure reduction
Zheng et al. (2019)	China	214	Patients with EH grade I	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Maheshkumar et al., (2020)	India	64	Patients with EH grade I-II	Acupuncture therapy	Sham acupuncture	Blood pressure reduction
Huang et al. (2020)	Taiwan	35	Hyperensive patients	Acupuncture therapy	Pharmacology	Blood pressure reduction

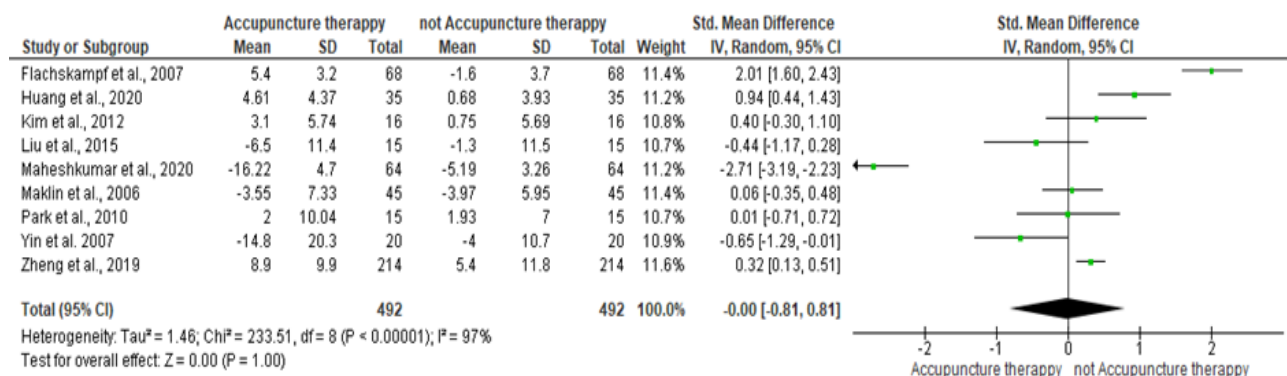
Based on Table 2, the primary studies on Acupuncture Therapy for Lowering Blood Pressure in Pre-elderly with Hypertension that will be included in the meta-analysis consist of 9 articles with diverse research locations, including countries like the United States, Germany, South Korea,

China, India, and Taiwan. In the summary of the primary studies, differences in the sample sizes between the intervention and control groups were found. The smallest sample size in the intervention group was 15, while the largest was 214.

### 1. Systolic Blood Pressure (SBP) level between acupuncture and non-acupuncture groups

**Table 3. Mean and Standard Deviation from pooled RCT of SBP level between acupuncture vs non-acupuncture groups**

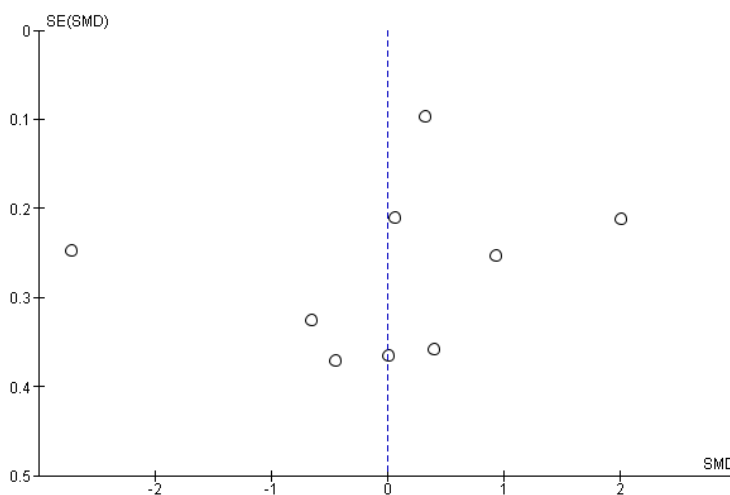
Author (Year)	Acupuncture		Non- acupuncture	
	Mean	SD	Mean	SD
Maklin et al., (2006)	-3.55	7.33	-3.97	5.95
Flachskampf et al., (2007)	-5.4	3.2	-1.6	3.7
Yin et al., (2007)	-14.8	20.3	-4	10.7
Park et al., (2010)	2	10.04	1.93	7
Kim et al., (2012)	3.1	5.74	0.75	5.69
Liu et al., (2015)	-6.5	11.4	-1.3	11.5
Zheng et al., (2019)	8.9	9.9	5.4	11.8
Maheshkumar et al., (2020)	16.22	4.7	-5.19	3.26
Huang et al., (2020)	4.61	4.37	0.68	3.93



**Figure 3. Forest Plot for Systolic Blood Pressure (SBP) Level between Acupuncture and Non-Acupuncture Therapy**

Forest Plot in Figure 3 showed that there was no effect of acupuncture therapy on systolic blood pressure compared to non-acupuncture therapy (SMD=-0.00;

95% CI = -0.81 to 0.81; p= 1.00). There is high heterogeneity (I<sup>2</sup>=97%, p<0.001), indicating that the data dispersion is heterogeneous (Random Effect Model).



**Figure 4. Funnel Plot for Systolic Blood Pressure (SBP) Level between Acupuncture and Non-Acupuncture Therapy**

Based on Image 4, there is evidence of publication bias, indicated by the asymmetry of the funnel plot on the right and

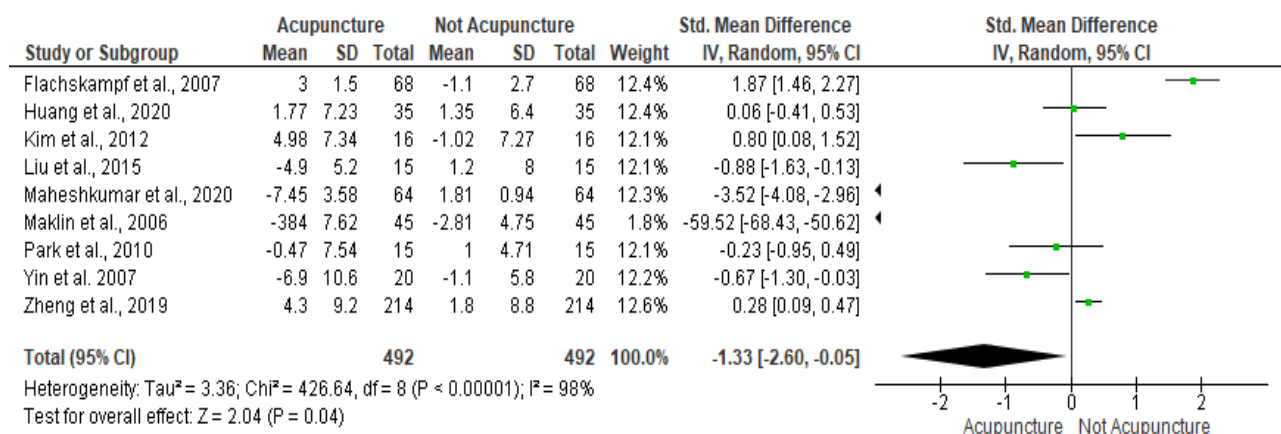
left sides. The funnel plot for systolic blood pressure (SBP) can be seen in Image 4.

**2. Diastolic blood pressure (DBP)**

**Table 3. Mean and standard deviation from pooled RCT of DBP level between acupuncture vs non-acupuncture groups**

Author (Year)	Acupuncture		Non- acupuncture	
	Mean	SD	Mean	SD
Maklin et al., (2006)	-3.84	7.62	-2.81	4.75
Flachskampf et al., (2007)	3	1.5	-1.1	2.7
Yin et al., (2007)	-6.9	10.6	-1.1	5.8
Park et al., (2010)	-0.47	7.54	1	4.71

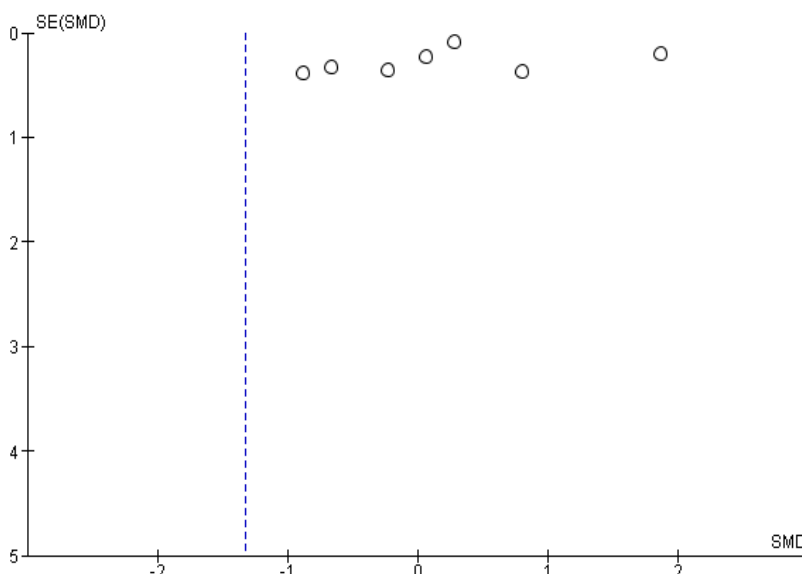
Author (Year)	Acupuncture		Non- acupuncture	
	Mean	SD	Mean	SD
Kim et al., (2012)	4.98	7.34	-1.02	7.27
Liu et al., (2015)	-4.9	5.2	1.2	8
Zheng et al., (2019)	4.3	9.2	1.8	8.8
Maheshkumar et al., (2020)	-7.45	3.58	1.81	0.94
Huang et al., (2020)	1.77	7.23	1.35	6.4



**Figure 5. Forest Plot for Diastolic Blood Pressure (DBP) Level between Acupuncture and Non-Acupuncture Therapy**

Figure 5 depicted the effect of acupuncture therapy in reducing diastolic blood pressure compared to non-acupuncture therapy. Acupuncture therapy reduced diastolic blood pressure 1.33

mmHg than non-acupuncture therapy (SMD = -1.33; 95% CI = -2.60 to -0.05; p= 0.04). It showed that that there is high heterogeneity between studies (I<sup>2</sup>= 98%, p<0.001) (Random Effect Model).



**Figure 6. Funnel Plot for Diastolic Blood Pressure (DBP) Level between Acupuncture and Non-Acupuncture Therapy**



Funnel Plot diagram in Figure 6 depicted the publication bias. It showed that there was a publication bias, indicated by the asymmetry of the funnel plot on the right and left sides.

## DISCUSSION

### 1. Systolic Blood Pressure (SBP)

This study found that there was no significant effect of acupuncture therapy in reducing systolic blood pressure in pre-elderly compared to non-acupuncture therapy. This finding aligns with a study by Hapsari et al., (2021), which suggests that the effectiveness of acupuncture therapy can be influenced by the severity of hypertension. Patients with severe hypertension may require more intensive treatment or a combination of other therapies to achieve significant blood pressure reduction.

### 2. Diastolic Blood Pressure (DBP)

This study found that acupuncture therapy significantly reduced diastolic blood pressure in pre-elderly compared to non-acupuncture therapy.

This study is in line with Zhao et al., (2019), which concluded that the use of acupuncture combined with antihypertensive drugs resulted in better outcomes in reducing both SBP and DBP, improving treatment effectiveness, and addressing Traditional Chinese Medicine (TCM) syndromes in hypertensive patients. Compared to sham acupuncture, the use of acupuncture combined with antihypertensive drugs proved to be more effective. Additionally, acupuncture was found to be superior to the use of antihypertensive drugs alone or sham acupuncture combined with antihypertensive drugs. Therefore, acupuncture is recommended as an adjunct therapy that can be used alongside medical treatment. This allows for the use of lower doses of antihypertensive drugs, with the

aim of reducing potential pharmacological side effects in hypertensive patients.

This study is supported by Chen et al., (2018), which demonstrated that acupuncture enhances the therapeutic response to antihypertensive drugs. Moreover, acupuncture has also been proven effective in reducing blood pressure in cases of pre-eclampsia during pregnancy and post-delivery. It is important to note that acupuncture therapy is relatively safe when performed by experienced and trained practitioners in this field. The use of a combination of acupuncture and antihypertensive drugs has been shown to be more effective in lowering blood pressure compared to using antihypertensive drugs alone (Lazuardi et al., 2018). Acupuncture works by reducing the production of renin and angiotensin concentrations that affect blood vessel tension, as well as reducing the production of aldosterone that regulates fluid and salt retention by the kidneys, which leads to an increase in blood pressure. In other words, acupuncture can regulate the hormone regulation involved in the renin-angiotensin-aldosterone system (RAAS) (Darmawan et al., 2019). The Renin-Angiotensin-Aldosterone System (RAAS) plays a crucial role in regulating arterial pressure balance, tissue perfusion, and extracellular volume homeostasis. The interaction between angiotensin II and the type I angiotensin II receptor protein leads to the activation of various cellular processes, contributing to hypertension and accelerating target organ damage due to hypertension (Pikir et al., 2015).

The side effects of acupuncture are generally mild, such as pain, bleeding, and hematoma, and tend to be minimal. In studies involving large samples, no deaths or permanent injuries caused by acupuncture were found. Therefore, it can be concluded that acupuncture has been

proven to be safe in its use (Lee et al., 2009). The use of acupuncture is also effective in addressing the side effects that arise from the use of antihypertensive drugs, such as diarrhea and fatigue, experienced by some patients. Thus, acupuncture helps maintain patient compliance with the use of antihypertensive drugs (Zhang et al., 2014).

#### **AUTHORS CONTRIBUTION**

Danang Aji Prabowo: Served as the lead researcher in this study, designing the research methodology, collecting data, analyzing data, and writing the research report.

Hanung Prasetya: Contributed to data analysis, reviewing relevant literature and research, and provided contributions to the preparation of the research report.

Bhisma Murti: Contributed to data collection, assisted in data analysis, and provided input and revisions in writing the research report.

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#### **CONFLICT OF INTEREST**

There are no conflicts of interest in this study.

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