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Association of Headache Syndromes with Hypertension Incidence (Data from SIMPUS Semarang City 2010-2015)

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Abstract

Hypertension is one of the serious public health problems facing the world. The prevalence of hypertension in Semarang City increased in 2013 by 27.1% to 37.02% in 2018. This prevalence rate has not reached the target of the Semarang City SDG's related to the hypertension prevalence rate, which is 25%. Hypertension becomes very dangerous when it is not controlled, because if it occurs for a long time, it can cause complications of the disease. One of the most common comorbidities of primary headache disorders is hypertension. The purpose of this study is to analyze the epidemiological pattern of hypertension and headache syndromes, as well as the association of headache syndromes with hypertension incidence by gender and age group. This study is a quantitative research with a nested case control study research design, using data from SIMPUS Semarang City from 2010-2015. The variables in this study were hypertension and headache syndromes. The analysis used was univariate (frequency distribution) and bivariate analysis (chi square test). The results of the study show that hypertension is more experienced in women than men. The most cases of hypertension occur in the age group of 50-59 years (men and women). There was a significant relationship between headache syndromes and the incidence of hypertension in the Puskesmas area throughout Semarang City.

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INTRODUCTION

Hypertension is one of the serious public health problems facing the world. Hypertension is a condition in which blood vessels have high blood pressure (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥ 90 mmHg) (Unger et al., 2020). Hypertension is called a "silent killer" because its symptoms are very rarely seen in the early stages (Pokharel et al., 2022). Headache is the tenth most common symptom in elderly women and the fourteenth most common in elderly men (Özge, 2013). One of the most common comorbidities of primary headache disorders is hypertension, which is a comorbidity that aggravates the disease condition and is a relevant risk factor for primary headache disorders (Caponnetto et al., 2021).

According to the World Health Organization (WHO), the prevalence of hypertension in the world has decreased, from 33% in 2019 to 29.2% in 2021 (WHO, 2023). The prevalence of hypertension is higher in men (34%) compared to women (32%). The prevalence of hypertension based on the age group of 30–49 years is 19% in women and 24% in men (Zhou et al., 2021). There has been a decrease in the prevalence of hypertension in Indonesia from 34.1% in 2018 to 30.8% in 2023 (Kemenkes RI, 2018). Based on the Health Profile Book, the prevalence rate of hypertension in Central Java Province has increased from 2022 (29.3%) and 2023 (38.2%) (Dinkes Jawa Tengah, 2023). The highest hypertension case in Central Java Province is Semarang City (Dinkes Provinsi Jawa Tengah, 2022).

The prevalence of hypertension in Semarang City increased in 2013 by 27.1% to 37.02% in 2018 (Kemenkes RI, 2018). This prevalence rate has not reached the target of the Semarang City SDG's related to the hypertension prevalence rate, which is 25%. The highest case of NCD in Semarang City is hypertension of 50.48% suffered by residents aged 45-65 years (Dinkes Kota Semarang, 2022).

DKK Semarang has implemented the SIMPUS (Puskesmas Management Information System). SIMPUS Semarang City has been developed since 2003 until now and is implemented by all health centers totaling 37 health centers in Semarang City. Evaluation of the implementation of SIMPUS has been carried out by previous researchers using the HOT-Fit method showing that in its implementation SIMPUS has been running well, training related to SIMPUS both from the Semarang DKK and internal Puskesmas (Rokim et al., 2024).

SIMPUS has the availability of complete data on patients, medical diagnoses, treatments, and other health histories from the Health Center. SIMPUS data can provide a comprehensive picture related to the health problem or parameter to be studied. The population of Semarang City is 1,562,624 people and the average number of patients per year recorded in SIMPUS Semarang City is 93,278 participants. This shows that 5.97% of the population in Semarang city is recorded as patients at SIMPUS every year.

The research conducted by Caponnetto et al. (2021) using the literature review method with meta-analysis, has limitations, namely only relying on sources from Scopus (Caponnetto et al., 2021). Meanwhile, this study was conducted using electronic medical record data from SIMPUS Semarang (nested case-control method) regarding the association of headache syndrome with the incidence of hypertension based on gender and age group (Phenome-Wide Association Studies). Phenome-Wide Association Studies (PheWAS) is an approach to test the association of genetic variants or their risk scores with various disease phenotypes and outcomes (Bush et al., 2016). The purpose of this study is to analyze the epidemiological pattern of hypertension incidence and the association of headache syndromes with the incidence of hypertension based on gender and age group. This study is expected to determine the association of headache syndrome with hypertension using SIMPUS data in Semarang City so that it can be used as an ingredient in efforts to prevent hypertension complications.

METHOD

This type of research is a quantitative research with a nested case-control study research design This research will be carried out in Semarang City in 2024. The variables in this study include hypertension (code I10) and

headache syndromes (code G44) with an age range of ≥40 years. The sampling technique is using total sampling. The population in this study is all Puskesmas patients in Semarang City recorded in the SIMPUS data in 2010-2015 as many as 466,390 participants. The sample size in this study was 30,577 cases and 435,813 controls.

The data used is secondary data in the form of SIMPUS data in 2010-2015. The instrument in this study is to create a documentation table of Puskesmas patients recorded in the SIMPUS data in Semarang City such as Patient ID, diagnosis of hypertension (I10 Essential (primary) hypertension) and Headache Syndromes (G44 Other Headache Syndromes), date of birth, gender, and examination date. The inclusion criteria in the case group in this study are patient data in 2010-2015, complete data and hypertension I10 code. The inclusion criteria in the control group were patient data from 2010-2015, complete data and code G44 (Other Headache Syndromes). The exclusion criteria in the case and control groups in this study are incomplete data that does not make sense..

The data analysis in this study is univariate and bivariate analysis. In this study, bivariate analysis uses the Chi Square test if it meets the requirements and an alternative test uses the Fisher test, and the calculation of OR (Odds Ratio). Phenome-Wide Association Studies (PheWAS) analysis is shown in association patterns, with p-value parameters. The results of the PheWAS study not only reveal empirical facts that are already known but also open up the potential to find unexpected association patterns that were previously unnoticed. This visualization of PheWAS analysis can lead to better knowledge of previously unobserved complex dynamics of associations between diseases. Research bias occurs when data is entered incorrectly, resulting in inaccurate research results. Data that is not included can be excluded from the study to maintain the accuracy of the results. This research uses ethical clearance with Number: 332/KEPK/FK/KLE/2024.

RESULTS AND DISCUSSIONS

The data of this research was obtained from the data of SIMPUS Semarang City for the 2010-2015 service year which was carried out by all health centers totaling 37 health centers in Semarang City.

Table 1. Hypertension Frequency (I10) Based on Gender and Age Group (Years) at SIMPUS Semarang City

Age Group	Male	Female
40-49	1731	5633
50-59	3056	7974
60-69	2673	4716
70-79	1458	2519
80-89	328	417
>90	37	35

Source: SIMPUS Semarang City data 2010-2015

Table 1 shows the frequency of hypertension patients by gender and age group, it can be seen that hypertension patients are more women (69.64%) than men (30.36%). All of the study respondents were over 40 years old. The most cases of hypertension are in the age group of 50-59 years (in both male and female genders).

The results of this study are in line with Riskesdas in 2018 that hypertension cases in Indonesia are mostly in women, which is 36.9% compared to men, which is as much as 31.3% (Ministry of Health of the Republic of Indonesia, 2018). The National Health and Nutrition Examination Survey (NHANES) conducted in the US in 2015–2016 found a higher prevalence of hypertension in men compared to women aged 19–39 years (9.2% vs. 5.6%) and 40–59 years (37.2% vs. 29.4%). Meanwhile, at the age of >60 years, the prevalence of hypertension in women (66.8%) is higher than that of men (58.5%) (Fryar et al., 2015).

In general, the risk of high blood pressure is greater in men than in women, but when women enter the age of >45 years women have a higher risk because women begin to enter menopause. This is due to a decrease in estrogen production which will affect the cardiovascular system by reducing the elasticity of blood vessels (Regitz-Zagrosek et al., 2016). Women who have not entered menopause have the hormone estrogen which plays a role in increasing High Density Lipoprotein (HDL) levels. These high levels of HDL can prevent atherosclerosis.

During premenopause, women begin to experience a gradual decline in the hormone estrogen, which previously protects blood vessels from damage. This decline continues with changes in estrogen quality as women age, usually occurring between the ages of 45 and 55, and is known as menopause (Barton & Meyer, 2009). Arterial stiffness becomes more pronounced in postmenopausal women than in men, thus contributing to an increase in blood pressure. This results in a higher prevalence of hypertension in women compared to men (Ghosh et al., 2016).

The results of this study are in line with research conducted by Dai et al. (2022) using data from the World Health Organization's study on global AGEing and adult health (WHO SAGE) showing that the highest proportion of hypertension sufferers based on age group is 50-59 years (39.78%) (Dai et al., 2022). The causes are physiological changes in blood vessels with age, as well as increased cellular oxidative stress, low-grade chronic inflammation, increased response to sympathetic nervous system stimuli, changes in the renin-aldosterone relationship, changes in renal and sodium metabolism, and decreased sensitivity to baroreceptors (Buford, 2016).

Table 2. Frequency of Headache Syndromes (G44) Based on Gender and Age Group (Years) in SIMPUS Semarang City

Age Group	Male	Female
40-49	985	4327
50-59	1168	3342
60-69	699	1289
70-79	366	578
80-89	85	91
>90	10	20

Source: SIMPUS Semarang City data 2010-2015

Table 2 shows the frequency of headache syndromes by gender and age group, it can be seen that more women (74.43%) suffer from headache syndromes than men (25.57%). All of the study respondents were over 40 years old. Based on age group, the most cases of headache syndromes are the same as hypertension, namely in the age group of 50-59 years (in both male and female genders). The results of this study are in line with research conducted by Togha et al. (2022) showing that women experience More Other Headache Syndromes compared to men (89.6% vs. 10.4%). Most patients over the age of 50 experience primary headache disorders, with migraines being the most common type, followed by tension-type headaches (Togha et al., 2022).

Tabel 3. Association of Headache Syndromes with Hypertension Incidents Based on Gender and Age Group in SIMPUS Data of Semarang City 2010-2015

Gender	Age Group	OR	95% CI		p-value
			Lower	Upper	
Male	40-49	2.07	1.89	2.24	<0.0001
	50-59	2.14	2.01	2.27	<0.0001
	60-69	2.51	2.35	2.66	<0.0001
	70-79	2.99	2.77	3.20	<0.0001
	80-89	2.01	1.55	2.46	<0.0001
	90-99	9.34	8.02	10.66	<0.0001
Female	40-49	2.16	2.08	2.23	<0.0001
	50-59	2.15	2.08	2.23	<0.0001
	60-69	2.51	2.39	2.62	<0.0001
	70-79	2.67	2.49	2.83	<0.0001
	80-89	2.26	1.83	2.69	<0.0001
	90-99	1.93	0.77	3.09	<0.0001

Table 3 shows that there is a significant relationship between headache syndromes and the incidence of hypertension (p value <0.0001) in both males and females in the age group over 40 years. The people who are most at risk of hypertension are men aged >90 years who have other headache syndromes. Men aged >90 years who have other headache syndromes have a 9.3 times higher risk of developing hypertension compared to people who do not have other headache syndromes in the Puskesmas area in Semarang City.

The results of this study are in line with research conducted by Lund et al. (2019) showing that a history of hypertension is related to the incidence of headache syndrome. Men suffer from headache syndrome more by 26.4% than women by 20.6%. Patients who have had hypertension are 2.4 times more likely to develop

headache syndrome compared to patients who do not have a history of hypertension (Lund et al., 2019). Research by Crespi et al., (2022) also shows that men (59.5%) suffer from headache syndrome more than women (40.5%).

Cluster headache is one of the most severe pain conditions among pain disorders and is clearly included among primary headaches (Burish et al., 2021). For most patients, cluster headache is characterized by two states of the disease: attacks that last for weeks to months in which the attacks occur, and attack-free remission that lasts for months to years. The third version of the International Classification of Headache Disorders, 3rd edition (ICHD-3) classifies episodic patients with annual remission of more than three consecutive months (Zhang et al., 2016).

Hypertension is a medical condition that often does not show typical symptoms, but some of the symptoms that can appear include headaches, fatigue, changes in the retina, dizziness, difficulty breathing, feeling like falling, palpitations, rapid heartbeat, ringing in the ears, and pain in the neck. Headaches can be a symptom associated with hypertension. Headache is also a common complaint in adult patients with hypertension, which can be caused by increased intracranial pressure (Yulianti Bisri, 2018).

Some of the most common comorbidities of headache syndromes are hypertension, which is a comorbidity that aggravates the disease condition and is a relevant risk factor for primary headache disorders (Caponnetto et al., 2021). The intensity of severe headache pain can be associated with an increased risk of hypertension. Increased MHD frequency is associated with an increased risk of hypertension (5–9 MHD, ≥21 MHD) (Buse et al., 2020). The link between migraines and hypertension is driven by environmental factors, biological factors, or genetic susceptibility. Environmental and lifestyle factors associated with migraines and hypertension include smoking, dietary factors (i.e. salty foods), lack of physical activity, chronic stress; both are associated with metabolic syndrome (Voss & Scher, 2013). Occupational stressors have been linked to migraines, higher outpatient blood pressure, and ischemic stroke (Kivimäki et al., 2015).

Nonsteroidal anti-inflammatory drugs are first-line drugs for migraines but are known to cause secondary hypertension. In relation to shared biological factors, the area of the brainstem that controls the cardiovascular system also modulates pain. In addition, the hypothalamus and insula play a role in migraine pathophysiology and control autonomic pathways that are important for controlling blood pressure (Borsook et al., 2016). The renin-angiotensin system may be the underlying mechanism that links migraines to hypertension.

Angiotensin-converting enzyme (ACE) I is thought to be involved in the control of blood pressure and blood vessel tension; Angiotensin-converting enzyme and angiotensin II receptor inhibitors have shown efficacy for migraine prevention (Stovner et al., 2014). Long-term hypertension is associated with migraines due to increased sympathetic nerve activity observed as a consequence of aging (Stovner et al., 2014). Static autoregulation is impaired in the anterior and cerebellar circulation of migraine patients with AURA (Reinhard et al., 2012).

Research by Chou (2018) revealed that the causes of secondary headaches are very diverse and include a variety of structural pathologies, infectious and inflammatory conditions, and vascular disorders, including arterial hypertension. Headaches can arise due to severe arterial hypertension, systolic blood pressure reaching 180 mmHg or more and/or diastolic blood pressure reaching 120 mmHg or more. Headaches usually appear along with a sudden increase in blood pressure and go away after blood pressure returns to normal. Severe pain usually occurs in the front or back of the head, and can be described as constant or throbbing pain. Headaches may be accompanied by other symptoms such as sweating, palpitations, pale face, and/or anxiety (Chou, 2018).

Unhealthy lifestyle factors such as smoking are risk factors for the development of cerebrovascular and cardiovascular diseases such as atherosclerosis, stroke, and cardiac infarction. Lifestyle-related diseases can negatively impact the medical management of cluster headaches.

The prevalence of smoking and smoking history is very high in cluster headache patients (Steinberg et al., 2018). Various hypotheses have emerged about the relationship between smoking and cluster headaches. Nicotine affects trigeminal nociception in healthy people (Holle et al., 2014). Exposure to tobacco, particularly through cadmium in cigarette smoke, can cause toxicity to the hypothalamic-pituitary-gonadal axis, which promotes the development of cluster headaches (Rozen, 2018). Smoking not only worsens the risk of developing cluster headaches but also contributes to the development and progression of hypertension.

Research conducted by Zhang et al. (2021) has shown that smoking is a major risk factor for hypertension, with studies showing a positive correlation between smoking and the incidence of hypertension in different age groups. For each additional year in smoking duration, systolic blood pressure increased by 0.283 mmHg (95% CI 0.252 to 0.314 mmHg, P<0.001) in the Han population and 0.450 mmHg (95% CI 0.380 to 0.520 mmHg, P<0.001) in ethnic minority populations (Zhang et al., 2021).

The limitation of this study is that the data in this study cannot represent the population of Central Java Province, so the results of the study do not reflect the health conditions of the entire Central Java Province. And it is only limited to the demographic variables, namely the age group and gender studied.

CONCLUSION

The conclusion of this study is: There is a significant relationship between headache syndromes and the incidence of hypertension in men and women over 40 years old. The person who is most at risk of hypertension is a >90 year old man who has headache syndromes in the health center area of Semarang City.

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