SEHATRAKYAT (Jurnal Kesehatan Masyarakat)
https://journal.yp3a.org/index.php/sehatrakyat
DOI: 10.54259/sehatrakyat.v4i3.5456
e-ISSN 0852-1239 | p-ISSN 2829-9299
Vol. 4 No. 3 (Agustus 2025) 709-721

Diterima Redaksi: 07-07-2025 | Selesai Revisi: 19-07-2025 | Diterbitkan Online: 10-08-2025

The Effect of Lipid Profile and Blood Glucose on Hypertension At Pasar Minggu District Health Center

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Abstract

Hypertension remains a leading metabolic risk factor contributing to morbidity and mortality, particularly in Indonesia's urban populations. This study examined the effect of lipid profile and blood glucose on hypertension incidence among non-communicable disease (NCD) clinic patients at Pasar Minggu District Health Center, South Jakarta. A cross-sectional design was applied, utilizing secondary data from electronic medical records (e-puskesmas) in 2023. The study involved 1,168 patients. Results showed that 88.7% had hypertension, with 65.3% exhibiting high LDL levels, while most had non-risk levels of total cholesterol (57%), HDL (52.7%), triglycerides (67.1%), creatinine (90.5%), and HbA1c (74.6%). Multivariate analysis revealed significant associations between total cholesterol (OR=0.619; 95% CI=0.393–0.974) and HbA1c (OR=0.180; 95% CI=0.128–0.252) with hypertension incidence, after controlling for LDL. Elevated total cholesterol and HbA1c were linked to a reduced hypertension risk in this population. The findings suggest that integrating lipid and glucose control into hypertension prevention strategies, alongside multisectoral collaboration, may enhance early detection and management of NCDs in primary care settings.

Keywords: *Hypertension, Lipid Profile, Blood Glucose, Total Cholesterol, HbA1c.*

INTRODUCTION

Noncommunicable diseases (NCDs) are the leading cause of the global disease burden, killing 41 million people each year, and accounting for 74% of all deaths globally. Every year, 17 million people die from non-communicable diseases before the age of 70, and 86% of them occur in low- and middle-income countries (WHO, 2022). After the Covid-19 pandemic, a meta-analysis study showed a much higher risk of death by 3.36 times in hypertension conditions compared to normotensive subjects (Gordon Patti & Kohli, 2022). It is also seen that Covid-19 and NCDs have a reciprocal effect on each other, that non-communicable diseases increase susceptibility to Covid-19, and that Covid-19 increases risk factors related to non-communicable diseases (U. N. Yadav et al., 2020). According to ICD-10, hypertension is a condition in which there is a persistent increase in arterial blood vessels, systolic blood pressure equal to or greater than 140 mmHg, and diastolic blood pressure equal to or above 90 mmHg (Beckman, 2014; Chen dan Cheng, 2022; Q. Yan et al., 2016). This is called hypertension *silent killer,* Because cases of hypertension are often not detected early, it is too late to receive adequate

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treatment. Hypertension is also one of the risk factors that cause disability and premature death. In addition to being the cause of high morbidity and mortality, hypertension also causes loss of income, health care costs that harm families, and become an increasing burden on health costs (Berek et al., 2021; Chen dan Cheng, 2022; Haba et al., 2019; Purnamasari, 2019; Q. Yan et al., 2016).

The WHO estimates that by 2025 there will be at least 1.5 billion people with hypertension worldwide, and it is estimated that 10.44 million people will die from hypertension and its complications (Chen dan Cheng, 2022). In 2018, according to the results of the Basic Health Survey (Riskesdas), the prevalence of hypertension cases in Indonesia reached 34.1%, an increase of 8.3%, from 25.8% in the results of the 2013 Riskesdas (Ministry of Health, 2019). The most populous region in Indonesia, DKI Jakarta Province, has experienced an increase in hypertension cases, initially recorded at 20% in 2018, rising to 33.4% (Health Research and Development Agency, 2019; Budiman et al., 2013).

Hypertension has two groups of risk factors: modifiable risk factors and non-modifiable risk factors. Modifiable risk factors include an unhealthy diet (excessive salt consumption, a diet high in saturated and trans fats, low intake of fruits and vegetables), lack of physical activity, smoking and alcohol consumption, and being overweight or obese, which can have a direct impact on cholesterol, uric acid, and blood glucose levels. In addition, non-modifiable risk factors for hypertension include a family history of hypertension, age over 65, and comorbidities such as diabetes or kidney disease (WHO, 2023).

According to Riskesdas data, the prevalence of hypertension in South Jakarta increased from 22.8% in 2013 to 29.93% in 2018 (Health Research and Development Agency, 2019; Budiman et al., 2013). The 2022 South Jakarta PTM report recorded 197,744 cases of hypertension in South Jakarta, while hypertension cases in the Pasar Minggu District area were 27,585 cases, the 3rd most cases in the South Jakarta area. Based on the NCD Report in South Jakarta, it can be seen that the number of hypertension sufferers in the Pasar Minggu area is increasing and is the second highest in South Jakarta. Meanwhile, it was reported that the prolanis program was also not achieved in the working area of Pasar Minggu District. The increase in the number of patients will affect the quality of health care and financing spent. So far, the role of health centers, in addition to being a curative health facility, also provides promotive and preventive services. Preventive services, such as screening residents aged >18 years who are at risk of developing non-communicable diseases. It is important to know the association that affects the incidence of hypertension, which can be used as a further plan for screening and as a form of evaluation of the health services provided. Therefore, this study aims to prove the determinant factors of hypertension incidence in the working area of Pasar Minggu District, South Jakarta by using electronic medical record data from e-puskemas. In addition, there has never been an analytical research on big data in the working area of Pasar Minggu District, South Jakarta.

Based on the above background, the formulation of the problem in this study is how does blood fat and blood glucose levels affect the incidence of hypertension after controlling for confounding variables in PTM patients at the Pasar Minggu District Health Center, South Jakarta in 2023.

METHODS

The research design used in this study is *cross sectional*. This study aims to determine the relationship between fatty acid and blood glucose levels to hypertension in the Pasar Minggu Regency Health Center area. Research conducted to determine risk

factors associated with specific diseases and health statuses, an approach model was used *cross sectional*, variabel Researched Include and investigate multiple risk factor observations at the same time. The study also examined its relationship with disease prevalence, distribution, and exposure (Watik, 2014). The sample in this study was patients who conducted examinations at the Pasar Minggu Health Center with a total of 1,168 patients. The data collection of this study began with an examination of hypertension data in the Puskesmas area of Pasar Minggu District, South Jakarta and the findings of relevant variables in the study in accordance with the framework of the research concept. The researcher used the available tools to find the appropriate variables. In this study, secondary data was collected from electronic medical record data (e-puskesmas). E-Puskesmas stands for "electronic Public Health Center." This refers to the application of information systems used in the Public Health Center (Puskesmas) to manage data and information related to public health services. Puskesmas itself is a primary health service unit at the village or sub-district level in Indonesia. This research has received ethical approval from the Health Research Ethics Commission (KEPK) of the Faculty of Public Health, University of Muhammadiyah Jakarta with No. 10.142.B/KEPK-FKMUMJ/VI/2024.

RESULTS

Univariate Analysis

Table 1. Distribution of Hypertension Incidence at Pasar Minggu Health Center in 2023

Hypertension	Sum (n= 1.168)	Percentage (%)
Hypertension	1036	88,7
No Hypertension	132	11,3
Total	1168	100

Table 1 shows the proportion of patients at the Pasar Minggu Health Center in 2023, the majority of patients with hypertension with a total of 1,036 people (88.7%) and non-hypertension as many as 132 people (11.3%).

Table 2. Distribution of Total Cholesterol, LDL, HDL, Trilgiserides, Age, Creatinine, HbA1c, Abdominal Circumference of Pasar Minggu Health Center Patients in 2023

Variabel	Sum (n= 1.168)	Percentage (%)
Kolestrol Total		
Risky	502	43,0
No Risk	666	57,0
LDL		
Risky	763	65,3
No Risk	404	34,7
HDL		
Risky	552	47,3
No Risk	616	52,7
Trigliseride		
Risky	384	32,9
No Risk	784	67,1
Age		
Risky	1085	92,9

No Risk	83	7,1
Creatinine		
Risky	111	9,5
No Risk	1057	90,5
HbA1c		
Risky	297	25,4
No Risk	871	74,6
Abdominal Circumference		
Obesity	563	48,2
Not Obese	605	51,8

From the table above, it is known that of all respondents in this study totaling 1,168 people, the number of patients with total cholesterol at risk was 502 people (43.0%), patients with LDL at risk were 763 people (65.3%), patients with HDL were at risk 552 people (47.3%), and patients with Triglycerides at risk were 384 people (32.9%). The majority of respondents in this study had a risk age of ≥45 years, as many as 1,085 people (92.9%). Patients with creatinine were at risk of 111 people (9.5%), a quarter of patients with HbA1c were at risk of 297 people (25.9%), and as many as 563 patients with obese abdominal circumference (48.2%).

Bivariate Analysis

Table 3. Bivariate Analysis of Total Cholesterol, LDL, HDL, Triglycerides, and HbA1c on the Incidence of Hypertension

Variabel	Incidence of Hypertension				Total		OR (95% CI)	P *Value*
	Hypertension		No Hypertension					
	n	%	N	%	N	%		
Total Cholesterol								
Risky	435	86,7	67	13,3	502	100	0,702 (0,489-1,009)	0,062
No Risk	601	90,2	65	9,8	666	100		
LDL								
Risky	676	88,6	87	11,4	763	100	0,971 (0,663-1,423)	0,923
No Risk	360	88,9	45	11,1	405	100		
HDL								
Risky	485	87,9	67	12,1	552	100	0,854 (0,594-1,227)	0,406
No Risk	551	89,4	65	10,6	616	100		
Trigliseride								
Risky	336	87,5	48	12,5	384	100	0,840 (0,576-1,226)	0,377
No Risk	700	89,3	84	10,7	784	100		
HbA1C								
Risky	219	73,7	78	26,3	297	100	0,186 (0,127-0,271)	0,000
No Risk	817	93,8	54	6,2	871	100		

The results of the analysis of the relationship between total cholesterol and the incidence of hypertension were obtained by patients with total cholesterol at risk as many as 435 people (86.7%) did not have hypertension while patients with total cholesterol were not at risk as many as 601 people (90.2%) had hypertension. The results of *the Chi Square* test were obtained *with a p value* of 0.062 which means that there is no significant relationship between total cholesterol and the incidence of hypertension. From the analysis, the OR result was also 0.702 (CI 95% = 0.489-1.009) which means that patients with total cholesterol are at risk of reducing the risk of hypertension 0.702 times higher compared to patients who have total cholesterol are not at risk.

DISCUSSION

Research Limitations

This research has several limitations and shortcomings in its implementation so that it can affect the research results obtained. The limitations in the research include the following:

1. The data only uses data from the Pasar Minggu District Health Center, so the researcher cannot make a comparison of patients in the Pasar Minggu District Village Health Center.
2. The unavailability of data related to blood glucose variables in the research sample in the data of the prolanis program e-puskesmas makes it impossible to explore the relationship between these variables and their relationship with the incidence of hypertension.
3. In theory, physical activity and family history of hypertension affect the incidence of hypertension, but this variable is also not contained in the data of the prolanis program e-puskesmas, so it is not possible to analyze the relationship between these variables.
4. This study used a cross sectional method which was not able to describe the causal relationship between independent variables and hypertension incidence.
5. The sample in this study only uses data on patients of the Pasar Minggu Health Center PTM Poly, so it cannot describe the representation of the adult age group in the general population.
6. The sample in this study only uses data on PTM Poly patients in the working area of the Pasar Minggu Health Center which cannot describe the representation of the adult age group in the general populationAlthough the limitations of this study are known, the results of this study are the first big data analysis carried out by utilizing e-puskesmas data in the working area of Pasar Minggu District, South Jakarta within a period of one year with a large enough sample number so that it can be describe representatives of adult patients in the Pasar Minggu area, South Jakarta in general related to the incidence of hypertension and its causative factors.

Based on the results of the univariate analysis, it is known that 88.7% of BPJS patients at the PTM Poly in the working area of the Pasar Minggu Health Center have hypertension. These results are in line with research conducted at Dr Soegiri Hospital, Lamongan, of all patients aged <60 years who have been checked for blood pressure using sphygmomanometer and data from patients' medical records, 65.2% of whom have hypertension (Makhfudli et al., 2023). As is well known, hypertension is the most significant risk factor for the disease contributing to the burden of disease in Southeast Asia, East Asia, and Oceania (Turana et al., 2020). In 2017, 34.5% of the 69,307 people in Indonesia who were screened had hypertension. 20% of them did not know they had hypertension, while only 63% received anti-hypertensive treatment (Widyantoro et al., 2019). In addition, the level of public awareness and control is relatively low, where

47.8% of patients suffering from hypertension, 79% of whom have not received a doctor's diagnosis (Hussain et al., 2016).

Based on the results of the bivariate test analysis *chi-square*, it is known that there is no statistically significant relationship between total cholesterol levels and the incidence of hypertension (p *Value* = 0.062), in which patients with total cholesterol levels are at risk of a reduced risk 0.702 times higher compared to patients with total cholesterol at no risk. These results are in accordance with the results of a study conducted by Jamini et al., (2020) stating that there is no relationship between total cholesterol levels and hypertension at Ulin Banjarmasin Hospital. This is because there are several factors that cause hypertension, including stress, lifestyle, age, work, education, obesity, and other factors. Large, long-term follow-up research shows that the prevalence of hypertension increases dramatically with age. Older adults make up the majority of hypertension-related morbidity and mortality. Vascular dysfunction and arterial stiffness due to aging of blood vessels, as well as chronic inflammation and increased cellular oxidative stress due to weakening of physiological function, play a dominant role in the development of hypertension in the elderly, which weakens the effects of dyslipidemia (Buford, 2016). This may contribute to the reason why the association between lipid index and hypertension is not seen in people over 55 years of age. However, it should be noted that based on the results of the analysis, patients with total cholesterol are at risk of 88.8% of them experiencing hypertension, while patients with total cholesterol are not at risk, 91.8% of them are at risk of hypertension. This means that a person's high and low cholesterol levels are not the main factor in having hypertension. TCholesterol will react with other substances and settle in the blood vessels, causing plaque or blockage called arthrosclerosis. Hypertension can be caused by a narrowing of blood vessels, which makes the heart work harder to deliver blood to all tissues (Putri et al., 2021).

Based on the results of bivariate analysis, it can be seen that in this study there is no statistically significant relationship between LDL levels and the incidence of hypertension. These results are in accordance with the research Karwiti et al., (2023) which showed that there was no relationship between LDL and hypertension degree in 100 respondents of the Prolanis Hypertension group, and was supported by the results of the study Xie et al., (2022) which mentioned that no association was found between LDL and blood pressure in a group of individuals aged >52 years. The results of the analysis in this study also found that patients with hypertension do not always have high LDL levels. This is evidenced by patients with the LDL group at risk, 88.6% of whom have hypertension, while patients in the LDL group are not at risk, 88.9% of whom also have hypertension. Similar things were also found in the study of Karwiti et al., (2023) where hypertensive patients did not always have high LDL levels, and vice versa pre-hypertension patients did not always have low LDL levels. The results of this study can be interpreted that LDL levels are not an indicator of hypertension.

The results of *the chi-square test* in this study are known that there is no significant relationship between HDL levels and the incidence of hypertension. These results are in accordance with a study by S. Chen & Cheng (2022) conducted in China on 62,957 adult male subjects in which there was no association between measured HDL levels in subjects with the incidence of hypertension. The study conducted on Prolanis participants is also known to have similar results where there is no relationship between HDL levels and the incidence of hypertension (Karwiti et al., 2023). In the process *of reverse cholesterol transport*, HDL transports cholesterol from peripheral tissues to the liver, where it is broken down and secreted through bile. Thus, HDL prevents organ target damage caused by hypercholesterolemia (Karwiti et al., 2023). Research He et al., (2021) observed that higher triglyceride levels and lower HDL are associated with the incidence of

hypertension, based on a study conducted on 9,540 Chinese citizens aged >40 years. However, in contrast to the recent study in China conducted by Yang et al., (2022) where there was a positive association between HDL and hypertension risk after BMI stratification was performed, and the same association was also found in multivariate logistic regression, which may contradict current research that HDL is known as "good cholesterol". These results can be explained that HDL function is independent of HDL levels, as it has been proven that passive increase in HDL levels does not have a cardiovascular preventive impact.

Based on the results of bivariate analysis, it can be seen that in this study there is no statistically significant relationship between triglyceride levels and the incidence of hypertension. These results are in line with a study by S. Chen & Cheng (2022) conducted in China on 62,957 adult male subjects. In this study, it was found that 91.1% of patients with triglyceride levels were at risk of hypertension compared to 89.1% of patients with triglycerides at risk of hypertension. The results of this study are inconsistent with meta-analysis studies that stated that adults with a high triglyceride index were independently associated with a higher likelihood of hypertension compared to those with a low triglyceride index. However, the results of a univariate meta-regression analysis showed that differences in sample size, mean age, male proportion, mean BMI, and study quality scores among included studies did not have a significant influence on the relationship between triglyceride index and hypertension (P value > 0.10), suggesting that these characteristic differences may not be the primary source of heterogeneity. (Y. Wang et al., 2021).

The results of this study found that there was a significant relationship between HbA1c and hypertension (p *value* = < 0.0001). HbA1c patients at risk reduced the risk of hypertension by 0.181 times compared to patients with HbA1c who were not at risk (OR= 0.180). These results are in line with research conducted by Muhajiriansyah & Binuko (2023) at Darmayu Ponorogo Hospital where Hba1c is significantly related to the incidence of hypertension. Compared to subjects without an incidence of hypertension, subjects with an incidence of hypertension had higher levels of HbA1c (P <0.05). In univariate COX regression analysis, HbA1c was associated with the risk of hypertension (HR: 1.161, 95% CI: 1.105-1.221, P <0.001) (Huang et al., 2023). The results of this study were confirmed to be in line with the research of Omar et al., (2022) where there was a positive correlation between HbA1c levels and newly diagnosed hypertension risk in small cross-sectional studies. In a study involving 9,603 elderly people, Bower et al., (2012) showed that higher HbA1c is not only independently related to the prevalence of hypertension, but also to the incidence of hypertension. A Mendelian randomized study using UK Biobank data showed that higher HbA1c was not only closely associated with hypertension risk, but also positively correlated with systolic blood pressure (Yeung et al., 2020).

In general, hypertension is a chronic disease that occurs in the elderly. The results of this study showed that most of the hypertension patients were at risk age, namely ≥ 45 years old (92.9%). These results are in line with similar studies that prove that the prevalence of hypertension is found to be higher in the at-risk age group, namely 45-64 years (You et al., 2018). However, the results of further analysis showed that age at risk did not have a significant effect on the incidence of hypertension. One of the factors that can affect the results of this study is the environmental factors at the research site. The difference between urban and rural areas that is associated with psychological stress problems can be one of the environmental factors that is closely related to increased blood pressure or hypertension incidence (J. Li et al., 2017). In addition, in this study, it was found that the risk of hypertension can be reduced in at-risk age groups compared to non-

at-risk age groups. These results are not in line with previous studies that prove that the elderly have a greater risk of hypertension, meaning that the older you get, the more risk of hypertension occurs. This can be caused by physiological changes in blood vessels, increased cellular oxidative stress, and chronic inflammation experienced with age (Yoon et al., 2015). Another influencing factor is the decrease in vascular resistance and cardiac output in the elderly (Setters & Holmes, 2017). Other studies also explain that increased blood pressure can occur due to narrowing of blood vessels caused by thickening of arterial walls in the elderly which then causes collagen buildup in the muscle layer.

Hypertension conditions that occur for a long period of time can cause damage to organs of the body, one of which is the kidneys. The most commonly used indicator in the diagnosis of kidney disease is the presence of increased serum creatinine levels associated with uncontrolled high blood pressure (Yogiantoro, 2017). This study showed that most hypertensive patients had non-risky serum creatinine levels (90.5%) and obtained results that creatinine was not significantly reduced. In contrast to the results of previous studies which showed that the prevalence of hypertension was higher in patients with serum creatinine levels above normal standards. Serum creatinine levels have been shown to increase in hypertensive patients (S. C. Yadav, 2016). Other similar studies found a correlation between urea and creatinine levels with systolic blood pressure, while diastolic blood pressure was not correlated. The higher the level of hypertension, the higher the serum urea and creatinine levels, which indicate a decrease in kidney function in hypertensive patients (Hutapea et al., 2021). In addition, vasoconstriction that occurs in hypertension has an impact on reduced blood flow to the kidneys. So that the glomerular filtration rate (LFG) and affects the excretion of urea and creatinine (Hanratty et al., 2011). The difference in the results of this study can be due to the uneven distribution of samples (Joshi et al., 2016)

Abdominal (abdominal) circumference is used as one of the clinical parameters for the assessment of the risk of developing metabolic syndromes, including abdominal obesity or central obesity, as well as high blood pressure or hypertension (Asnaniar & Munir, 2021). Abdominal circumference is part of the factors that can affect the incidence of hypertension (Andriolo et al., 2019). In this study, most of the patients with obese abdominal circumference in this study had high blood pressure or hypertension (90.4%). However, this study did not find a significant association between the patient's abdominal circumference and the incidence of hypertension. These results are not in line with previous studies that suggest that abdominal circumference has a significant relationship with diastolic blood pressure (Arifin et al., 2019). Similar studies also found a significant positive correlation between abdominal circumference and increased systolic blood pressure, but no significant correlation was found with diastolic blood pressure. The results of the study that are not in line with previous research can be caused by the characteristics of the sample determined by the researcher, such as the influence of physical activity factors, smoking habits in individuals with abdominal obesity (Jannah & Ernawaty, 2018), and the association with different consumption patterns in individuals with hypertension (Nurzakiah et al., 2010).

CONCLUSION

Based on the results of the study, it is known that the majority of respondents have hypertension (90.4%), as many as 45.1% of respondents have total cholesterol at risk, LDL at risk (65.6%), HDL at risk (46.6%), Triglycerides at risk (32.9%), age at risk (93.6%), creatinine levels at risk (8.9%), HbA1c at risk (25.9%), and obese abdominal circumference (44%).

The results of statistical analysis using *the chi-square* test found that the variables that affect the incidence of hypertension in the work area of the Puskesmas of Pasar Minggu District, South Jakarta are total cholesterol levels (p *value* = 0.048), and HbA1c (p *value* = 0.000). Meanwhile, the variables of LDL, HDL, Triglyceride levels, age, creatinine levels, and abdominal circumference statistically had no effect on the incidence of hypertension.

The end model of the multivariate variable that is meaningfully related to Blood Pressure is the HbA1c variable. The results of the analysis obtained an OR value of 0.180 (CI 95%: 0.128-0.252) meaning that HbA1c patients who are at risk reduce the risk of hypertension by 0.181 times compared to patients with HbA1c who are not at risk after being affected by variable total cholesterol and LDL. It also obtained a p value of 0.000 which means that there is a significant relationship between HbA1c and blood pressure.

SUGGESTION

For other researchers

1. Conduct follow-up studies on groups of patients at high risk for hypertension and diabetes mellitus, such as patients with a history of cardiovascular or obesity, to understand how lipid profiles and blood glucose affect the risk of hypertension and cardiovascular complications.
2. Conduct studies on different groups of patients, such as patients with type 1 and type 2 diabetes mellitus, to understand how lipid and blood glucose profiles affect the risk of hypertension and cardiovascular complications in each group.
3. Conduct studies that combine other risk factors such as age, gender, obesity, and diet to understand how lipid profiles and blood glucose interact with those factors in increasing the risk of hypertension.
4. Longitudinal Research: Conducting longitudinal studies to monitor changes in lipid and blood glucose profiles in patients with hypertension and diabetes mellitus, as well as compare their effects on the risk of hypertension and cardiovascular complications.

For District Health Center

1. Conducting education with counseling and education programs to the community regarding the importance of managing cholesterol levels, the causes of hypertension, and maintaining blood glucose levels. Provide clear and easy-to-understand information on how to reduce the risk of hypertension, diabetes, and cholesterol through healthy lifestyle changes.
2. Development of an integrated prevention program, including regular checks for cholesterol and blood glucose levels, as well as ongoing management for high-risk patients.
3. Collaboration with relevant parties with hospitals, specialists, and communities to improve the management of hypertension and diabetes cases through a multidisciplinary approach

For the Government

1. Conducting massive education through the ministry and the Health Office which focuses on increasing public awareness of non-communicable and risky diseases, as well as increasing access to affordable health services
2. Improving health services by providing adequate support to every health service from health centers to hospitals in terms of infrastructure, human resources, and funding to increase capacity in chronic disease management services such as hypertension in order to be able to handle it quickly

Provide extensive massive education on the importance of early detection and management of hypertension risk factors such as cholesterol levels and blood glucose control through advertisements that are easy to understand and attractive to the public.

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