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A SEM-PLS ANALYSIS OF HYPERTENSION DETERMINANTS IN WEST JAVA, INDONESIA: SOCIO-ECOLOGICAL MODEL APPROACHES

Yayuk Farida Baliwati[1*], Putri Nur Laely[1], Akifa Laila Rusyda[1]
[1]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Bogor
Email: baliwati@apps.ipb.ac.id

ABSTRACT

The second national highest prevalence of hypertension in 2018 was West Java, with a prevalence rate of 39.6%. The high prevalence of hypertension is driven by the interaction of multiple determinants, including consumption pattern (food intake and tobacco use), environmental status (primary health services and infrastructure) and socioeconomic status. The study aims to analyze the determinants of hypertension using socio-ecological approaches in West Java. The research design was an ecological study, using secondary data for 2019-2020 covering 26 districts or regencies in West Java. The total unit analysis was 52, regarding two years data analysis used. Analysis of data was performed using the partial least squares structural equation modeling (PLS-SEM) approach with bootstrap estimation. The result shows that all indicators of consumption pattern and primary health services and infrastructure variables are significant in forming a model. Findings also show that consumption patterns (intake of protein (meat, milk and eggs), sodium in spices, tobacco use (cigarettes)) and primary health services and infrastructure also directly affect hypertension, with coefficient value of 1.142 and 0.401, respectively. Socioeconomic status also indirectly affects hypertension through consumption variable and primary health service infrastructure variable. The SEM-PLS model built strongly represents the determinants of hypertension in West Java, Indonesia based on the socio-ecological model Approaches (goodness-of fit value= 0.67). Strengthening food resources management and nutrition policies, including reducing sodium intake, and controlling tobacco use can lower risks, while improving healthcare access, infrastructure, and clean water supports hypertension prevention in West Java.

Keywords: *consumption pattern, environmental status, hypertension, socioeconomics*

INTRODUCTION

Cardiovascular disease is the leading cause of death among non-communicable diseases (44%) and the leading cause of death globally (31%) (Roberts et al., 2018). Previous studies stated that hypertension is the most significant factor in causing cardiovascular health problems, such as stroke and other cardiovascular diseases. Blood pressure management is one of the major modifiable risk factors for stroke (Kuriakose & Xiao, 2023a). The World Health Organization (WHO) data reported that, since 2014, the prevalence of hypertension has reached 22% and is estimated to increase to 29% in 2025 or around 1.15 billion of the world's total population (Roberts et al., 2018).

Furthermore, in Indonesia, Basic Health Research data (RISKESDAS) shows that the prevalence of hypertension prevalence in 2018 was 39.6% (Ministry of Health, 2018a). Hypertension in West Java Province has been increasing over time. Previously, it was recorded at 29.4% (2013), but in 2018, the prevalence was the highest after South Kalimantan, with a total of 121,153 respondents measured. The determinant factors of hypertension are unknown with certainty, but several interacting risk factors can increase the possibility, such as high salt intake, overweight, lack of physical activity, stress, air pollution, and smoking (Roberts et al., 2018b).

Interventions to address hypertension must be multidimensional, targeting behavioral changes, policy regulations, healthcare services, and environmental modifications (Abba et al., 2021; Akseer et al., 2020). The socio-ecological model (Dahlberg & Krug, 2002) conceptualizes health as an interaction between individuals, communities, and their social, physical, and

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political environments (Figure 1). Previous studies have identified individual-level factors, such as age, gender, genetics, diet, and nutritional status (Guastadisegni et al., 2020; Kuriakose & Xiao, 2023b; Soleimani et al., 2023; Xu et al., 2018), while socioeconomic factors such as healthcare infrastructure, education, poverty, income, and expenditure have been examined at the broader level (Abba et al., 2021).

In the previous research, determinant of hypertension used many factors in the first level model, including individual biology and personal characteristics (non-modifiable risk factors) such as age, gender, genetics, also diet and nutritional status (modifiable risk factors), which focused on consumption of sugar, salt and fat, vegetables and fruit, alcohol and drug abuse. (Guastadisegni et al., 2020; Kuriakose & Xiao, 2023b; ; Soleimani et al., 2023;Xu et al., 2018).

On the other hand, the majority of research at the second and third levels discusses socioeconomic factors. The socioeconomic status of an area is often described through indicators such as health services and infrastructure, education, poverty levels, income, and expenditure. Abba et al. (2021) found that socioeconomic status and environmental conditions, including residential and occupational settings, play a crucial role in reducing the burden of hypertension. This highlights the need for a more comprehensive analytical approach to understanding the interplay between socioeconomic factors and health outcomes.

To address these gaps, the structural equation modeling-partial least squares (SEM-PLS) method is utilized to examine the intricate associations between risk food consumption, primary healthcare infrastructure, and socioeconomic status in West Java. By employing SEM-PLS, this study aims to uncover how these latent variables contribute to hypertension, thereby providing insights for developing more targeted and effective interventions. One key aspect influencing hypertension is food resource management, as dietary patterns directly impact cardiovascular health.

The National Socio-Economic Survey (SUSENAS) classifies 14 food groups, including grains, fish, meat, eggs, milk, vegetables, nuts, fruit, oils, spices, and tobacco. This study focuses on protein intake from fish, meat, milk, and processed products, as well as sodium consumption from spices and tobacco use. While animal protein can be beneficial for individuals with hypertension, improper selection and preparation methods may have adverse effects. Moreover, smoking—another modifiable risk factor—is strongly linked to hypertension due to its negative impact on physical health and immune function (Moradinazar et al., 2020a).

Beyond dietary factors, environmental risks also contribute significantly to hypertension. HO reports that 24% of global deaths stem from modifiable factors like pollution from industry, transportation, and workplaces (Manisalidis et al., 2020). Noise and air pollution, often linked to motor vehicle density, are recognized

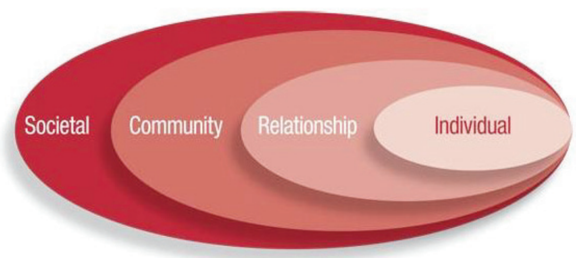

Figure 1. The Socio-Ecological Model: A Framework for Prevention

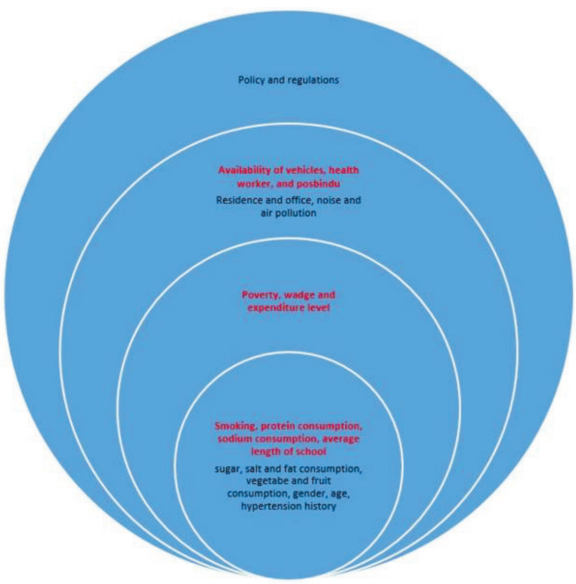

Figure 2. Identification of the variables in this study (red) and variables in previous research (black) using the socio-ecological model

hypertension risks (Basner et al., 2020). In West Java, inadequate healthcare facilities and personnel further exacerbate the burden of hypertension. Expanding health services and infrastructure is crucial for better screening and management.

These factors—diet, environment, and healthcare—interact to influence hypertension risk. Thus, analyzing their correlations using SEM-PLS is essential for targeted interventions.

METHODS

Study Design and Data Sources

The present research is a quantitative study with an ecological study design, by using secondary data published by the West Java Provincial Health Service and the West Java Province Central Statistics Agency (BPS) in 2019-2020. Researchers used 2019-2020 as the period for selecting samples for availability and completeness of up-to-date data. A total of 52 units of analysis were used, representing two years of study and covering all districts/regencies in West Java. The SUSENAS response rate in March 2020 for West Java was 99.49%, covering a total of 25,908 households.

The data types used in this research include hypertension data, food consumption, and physical and social environmental status, and socioeconomic status. Table 1 describes the variable and indicator of the present study.

Data Collection and Analysis

Data were processed and analyzed using Microsoft Excel 2013 and SmartPLS 3.0 software. The independent variables were risk food consumption, primary health services and infrastructure, and socioeconomic status. Furthermore, the dependent variable of the present study was the prevalence of hypertension.

Consumption pattern data were collected from food expenditure questionnaire conducted by BPS-Statistics Indonesia from SUSENAS. Consumption pattern data name the food consumption average in a week per capita for 14 commodities and also tobacco use in a week per capita. The food consumption average data were processed into nutrient intake based on the group. The macronutrient used in this case is protein and the micronutrient is sodium. The protein and sodium content of food is obtained through the Indonesian Food Composition Table (TKPI/ *Tabel Komposisi Pangan Indonesia*) and United States Department of Agriculture (USDA). Also, the tobacco use data were processed into cigarette/day.

The data of primary health services and infrastructure were collected from BPS-Statistics Indonesia, including the number of health workers, the coverage of Posbindu PTM, and number of vehicles. Furthermore, the socioeconomic status data were collected from BPS, including average of length of formal education, poverty level, household income level and household expenditure level.

Table 1. Variable and source of data

Variable	Indicators	Data source
Hypertension	Number of hypertension (person)	Health office of West Java
Consumption pattern	Sodium intake (g/capita/day) Protein (red meats) intake (g/capita/day) Protein (eggs and milk) intake (g/capita/day) Tobacco use (a cigarette/day)	BPS-Statistics Indonesia
Primary health services and infrastructure	Health services: number of health workers (persons) Health services: coverage of Posbindu PTM* (%) Transportation/ infrastructure: motor vehicle ownership (unit)	BPS-Statistics Indonesia BPS-Statistics Indonesia Regional Revenue Agency
Socio-economic status	Household income per capita (rupiah) Household expenditure per capita (rupiah) Length of formal education (year) Poverty level (%)	BPS-Statistics Indonesia BPS-Statistics Indonesia BPS-Statistics Indonesia BPS-Statistics Indonesia

*Posbindu: a monitoring and early detection program for risk factors of non-communicable diseases

Data were analyzed using the partial least squares structural equation modeling (PLS-SEM) approach. PLS-SEM is a statistical method for testing and estimating complex relationships between several dependent and independent variables that focus on explaining the variance in the dependent variable (Edeh et al., 2023). According to the American Society of Hypertension, hypertension is a cardiovascular symptom resulting from other complex and interconnected conditions. Therefore, PLS-SEM is the most suitable analytical method for this study. The analysis steps are designing a model based on the existing model, compiling data for each indicator, determining path diagrams, evaluating measurement and structural models, testing hypotheses, and concluding the results.

The model that will be formed in this research uses a reflective and formative measurement model. In line with previous studies on the direction of causality between constructs and their indicators, the socioeconomic construct is modeled with reflective indicators, assuming causality flows from the construct to the indicators. This implies that any change in the socioeconomic status will be reflected in variations in its indicators, such as household income, household expenditure, length of formal education, and poverty level. Conversely, the risk consumption pattern construct and the primary health services and infrastructure construct are specified with formative indicators, as causality flows from the indicators to the construct. This means that changes in specific indicators, such as the frequency of unhealthy food consumption or the availability of health facilities, collectively shape and determine the overall construct.

The measurement model is then evaluated using several steps (Hair et al., 2017), including (1) Convergent validity, namely reliability indicators (outer loading 0.4-0.7), and average variance extracted (AVE value must be more than 0.5). (2) Discriminant validity, following the cross-loading of the indicator on the latent variable, must be greater than the loading value of the indicator on other latent variables. (3) Composite reliability: the value must be more than 0.6. Meanwhile, evaluating the formative model uses several steps, including (1) the significance of outer weight, a significant indicator forming a construct if $p<0.05$ or the *t*-statistic is $>\alpha$ at the 95% significance level. If the indicator is not significant, it must be supported by the theoretical justification. (2) Collinearity between indicators can be assessed using the VIF, while collinearity in measurement model is evaluated through indicator VIF <5 (Hair et al.,2021).

Evaluation of the structural model is determined by the significance of the path coefficient, Coefficients of determination (R^2), predictive relevance (Q^2), and the SRMR (standardized root mean square residual). (1) Coefficients of determination (R^2) describes how much variance can be explained by the endogenous latent variable with the equation: $R^2 = \sum_{h=1}^{H} \beta_{jh}\, cor\,(X_{jh}, Y_j)$. (2) The path coefficient shows the strength of the relationship between latent variable constructs. (3) Predictive relevance (Q^2) states the model's predictive capability if it is above 0, with the equation: $Q^2 = 1 - (1 - R^2)$. The Q2 value is carried out by blindfolding in SmartPLS. The blindfolding procedure predicts the removed data points for all variables (Hair et al., 2017). Generally, Q^2 values higher than 0.025, 0.15, and 0.35 represent the PLS-path model's small, medium, and large predictive relevance. (4) The SRMR approach measures the discrepancy between the observed and the model's implied correlation matrix. A goodness-of-fit (GoF) measure assesses the model's overall fit, with the equation: $GoF = \sqrt{communality} \times$. Hair et al. (2017) suggested not using the GoF criterion due to the fact that it does not represent the goodness of the model in PLS-SEM.

Furthermore, Henseler et al. (2014) evaluated the effectiveness of the SRMR, a well-established model fit measure in CB-SEM, which had not previously been utilized in the PLS-SEM framework. The SRMR represents the root mean square discrepancy between observed and model-implied correlations. As an absolute measure of fit, an SRMR value of zero signifies a perfect fit. In CB-SEM, a value below 0.08 is typically considered an indicator of a good fit; however, this threshold may be too stringent for PLS-SEM.

RESULTS AND DISCUSSIONS

Evaluation of Measurement Model

The indicators in the latent variable used a reflective and formative model. Validation is carried out to assess the accuracy of the indicators used to form or measure latent variables. Table 2 and 3 shows the evaluation of the measurement model of each indicator for each latent variable.

Based on Table 2 and 3, the criteria of the assessing reflective and formative constructs are different, so, we assess the two constructs separately. The outer loading, composite reliability (CR), and average variance extracted (AVE) of the reflective constructs are shown in Table 2. All indicators have outer loading 0.4-0.7 and are significant at α=5% level. The AVE values are greater than 0.5, suggesting convergent validity at the construct level. The CR values are greater than 0.7, indicting acceptable reliability.

Regarding the formative construct, we assess the formative item weights and collinearity between items. With the exception of "tobacco use" indicator, all other items are significant at α=5% level. Although, the tobacco use indicator is not significant (*t-stat*: 0.854), this item should be included in the measurement model. Therefore, we continued to assess the tobacco use indicator, because conceptually it is included in the risk consumption pattern of hypertension. In addition, all VIF values are less than 3.3 indicating that collinearity is not severe.

Evaluation of Structural Model

The structural model in the present research involves four exogenous latent variables. Table 3 shows the results of direct and indirect connections between variables, regarding to the path coefficient value for each variable.

Table 3 shows that consumption variables and the primary health service and infrastructure had a positive effect, namely 1.142 (p=0.001), 0.401 (p=0.004), respectively. In contrast, the socioeconomic status variables had a negative effect to hypertension (-1.175; p=0.000). Socioeconomic status variables significantly mediate determinant to hypertension by the primary health service and infrastructure and risk food consumption. Indirectly, socioeconomics has a positive effect on hypertension (1.319; p=0.000).

Dietary management plays a crucial role in hypertension prevention (Xu et al., 2018). Table 3 shows that risk food consumption has a significant effect on hypertension of 1.142 (*p-value*: 0.001) meaning that increasing a high-fat protein consumption (red meat, milk and eggs),

Table 2. Measurement properties of reflective constructs

Construct	Indicator	Item loading	*t*-statistic	Composite reliability	*Communality (AVE)*
Socioeconomic status	Household income	0.467	3.081	0.893	0.683
	Household expenditure	0.978	33.287		
	Length of formal education	0.970	26.125		
	Poverty level	0.671	6.739		

Significant at: *t*-statistics >1,96; α=5%

Table 3. Measurement properties of formative constructs

Construct	Indicator	Item Weight	*t*-statistic	*VIF*
Risk Consumption pattern	Sodium intake	0.282	2.898	1.304
	Protein (red meats) intake	0.332	3.060	2.568
	Protein (eggs and milk) intake	0.607	4.551	3.032
	Tobacco use	0.084	0.854	1.480
Primary health services and infrastructure	Health workers	0.561	3.002	1.624
	Posbindu PTM	0.452	2.499	1.622
	Motor vehicle ownership	1.013	8.835	1.271

Significant at: *t*-statistics >1,96; α=5%

Table 4. Influence of risk food consumption, primary services infrastructure and socioeconomic on hypertension

Variable		Influence		*p-value*
Exogen	**Endogen**	**Direct**	**Indirect**	
Risk consumption pattern	Hypertension	1.142	-	0.001*
Primary health service and infrastructure	Hypertension	0.401	-	0.004*
Socioeconomic status	Primary health services and infrastructure	0.732	0.293	0.000*
	Risk consumption pattern	0.898	1.025	0.000*
	Hypertension	-1.175	1.319	0.000*

Significant at: *t*-statistics >1,96; α=5%

sodium in spices and tobacco (cigarettes) use by 10% will increase hypertension by 11.42%. The result of linear regression in the study of Helio et al. (2023), showed also that protein intake was positively related to cholesterol (β = 17.139; 95% CI 2.021, 32.256). Participants with intake protein between 0.8-0.99 g/kgBW per day showed higher blood cholesterol than participants who consumed protein below 0.79 g/kgBW per day (Coelho-Júnior et al., 2023).

Excessive intake of medium-high fat animal protein—such as red meat, offal, duck and processed meat (sausages, ham and sardines)—can elevate blood cholesterol, increasing hypertension risk. High cholesterol leads to vascular blockages, raising blood pressure. The metabolic acidosis resulting from phosphorus- and sulfur-rich meats further contributes to hypertension (Chen et al., 2019). Conversely, protein-rich diets, particularly those including milk and eggs, have been associated with better cognitive function, though individuals with hypertension generally demonstrate lower cognitive scores (Xu et al., 2018).

Fish consumption has been linked to improved cardiovascular health by lowering monocyte-to-HDL cholesterol ratios (Coelho-Júnior et al., 2023). Qi et al. (2020) emphasized the need for increased plant-based protein intake to reduce mortality risk, noting that high plant protein consumption was associated with lower all-cause mortality risk (RR = 0.92; 95% CI: 0.88, 0.96). However, animal protein intake correlated with an increased risk of cardiovascular disease mortality (RR = 1.11; 95% CI: 1.01, 1.22). Food processing techniques, including sodium-heavy seasonings, significantly impact dietary health outcomes.

Food resource management is integral to controlling hypertension prevalence. In West Java, dietary habits include frequent consumption of meats (beef, goat, chicken, offal, processed meats), milk (sweetened condensed, powdered, liquid), and eggs (chicken, duck). Sodium intake from seasonings is a key hypertension determinant, with commonly used condiments including salt, shrimp paste, soy sauce, ready-made chili sauces, and packaged seasonings. The previous research using the Healthy Eating Index (HEI) 2015 instrument reported that high scores for sodium, fatty acids (PUFA and MUFA), and total fruit were associated with a low risk of hypertension. Thus, limiting sodium and consuming foods rich in unsaturated fatty acids rather than saturated fats and high in fiber, such as vegetables and fruit, can reduce the prognosis/risk of hypertension (Pasdar et al., 2022; Putri et al., 2018). An imbalance of vitamins and minerals—excess Na+, high Ca2+, low K+, Mg2+, Zn2+, and vitamins B6, B12, C, D—alters the RAAS and vascular system, exacerbating hypertension (Chiu et al., 2021).

The type of protein that has a significant effect on hypertension based on the consumption patterns of the people of West Java is the meat food group (beef, goat/sheep, chicken, other fresh meat, preserved meat, swallow and offal), milk (sweetened condensed, factory liquid milk, powdered milk, and other milk), as well as eggs (chicken, duck and other eggs). It is also essential to pay attention to the processing processes used in food ingredients, such as adding seasonings and flavorings containing much sodium. Therefore, sodium intake is also an indicator in this study's latent variable of risk food consumption. The sodium in question is sodium that comes from spices. According to the results of a survey of people's consumption patterns, salt, shrimp paste/paste, soy sauce, cooking seasoning (version), ready-made chili sauce, tomato sauce, and pre-packaged spices are the types of spices that the people of West Java often use.

Indonesian diets are increasingly reliant on street food, restaurants, and fast food, characterized by high sugar, salt, and fat content. A study in South Jakarta reported daily sugar intake between 34.9-45.9 g/cap, salt intake between 5.46-7.43 g/cap, and fat intake of 49.0-65.1 g/cap (Andarwulan et al., 2021). WHO guidelines recommend limiting salt intake to 5 g/day to lower hypertension and cardiovascular disease risk. Sodium (Na) and chloride (Cl) in salt help regulate blood pressure, but excess sodium increases blood volume and vessel pressure, leading to cardiovascular strain.

Tauco (fermented soybean product) is a commonly used umami seasoning in West Java. It serves as a natural alternative to artificial flavorings while offering bioactive properties such as antioxidant, antidiabetic, and antihypertensive benefits (Herlina et al., 2022). Proper food resource management, including dietary education and accessibility to healthy alternatives, is crucial in addressing hypertension.

Food consumption patterns directly influence household health and productivity. Tobacco use remains prevalent in West Java, significantly affecting hypertension risk. Research in Iran found that smoking altered lipid profiles, increasing triglycerides, cholesterol, and LDL while reducing HDL levels (Moradinazar et al., 2020b). Nicotine-induced oxidative stress and catecholamine release elevate free fatty acid concentrations, contributing to cardiovascular disease. A study on university students showed a significant increase in plasma hs-CRP, total cholesterol, and LDL among long-term smokers (Elfadil et al., 2020). Restrictive policies, such as public smoking bans and tobacco taxation, are recommended to alleviate smoking-related hypertension burdens.

The present research results show that primary health service and infrastructure significantly affects hypertension of 0.401 (p=0.004). The finding shows that increasing the coverage of primary health service and infrastructure variable indicators, namely the availability of health workers, Posbindu PTM, and the availability of motorized vehicles by 10%, can increase hypertension prevalence by 4.01%. The more primary health services in an area, the wider early detection of non-communicable diseases, blood pressure. However, motorized transport also contributes to air and noise pollution, both known hypertension risk factors (Qin et al., 2021). Traffic noise disrupts sleep and induces oxidative stress, aggravating blood vessel inflammation (Münzel et al., 2021). Epidemiological studies indicate that 60-70% of premature deaths related to air pollution stem from cardiovascular causes (Basner et al., 2020).

The health effects of noise are also known to depend on the level of air pollution. Epidemiological studies show that 60-70% of premature deaths attributed to air pollution exposure are cardiovascular deaths. Mechanically, noise stimulates the afferent-efferent nerves in the sense of hearing and lungs to activate the amygdala and the release of corticotropic hormone (hypothalamus) and cortisol (adrenal cortex). This mechanism mediates the systemic "stress response" to increase insulin retention and inflammation and disrupt sleep (Basner et al., 2020). This systemic inflammation triggers disruption of the function of the vascular endothelium, which causes metabolic disorders such as increased blood pressure (Qin et al., 2021; Münzel et al., 2021).

Not all hypertension sufferers are aware of the disease they suffer from. The health services usually reached by the community, including community health post and Posbindu PTM, were specifically established to help carry out early screening related to non-communicable diseases. The higher the level of participation in Posbindu PTM, the more people will know about their health condition, including information about whether their blood pressure is at risk of hypertension. However, research by Widyanigsih et al. (2022) that investigated that the implementation of Posbindu PTM in Indonesia reflects the ineffectiveness in screening for hypertension and the risk factors. Several barriers include suboptimal coverage, complexities of activities and overlap between different non-communicable disease-related programmes, and lack of resources. Of the 95% of people who visited Posbindu and had their blood pressure measured, 35% of them had an increase in blood pressure. However, less than 25% were followed up to determine the risk factors for NCDs and less than 15% had blood cholesterol examinations (Widyaningsih et al., 2022).

Data from Health office of West Java (2018) show that there are still many hypertension sufferers in West Java who have not received medical treatment; of 11,881,300 people, only 4,128,375 hypertension sufferers (34.7%) have received health services. An integrated approach to improve the implementation of hypertension screening from guidelines to practice is crucial. Health services at first-level health facilities can be improved, especially regarding early screening as an early warning system. This requires cooperation and collaboration between health workers, starting from health promotion, dietary regulation, and others.

Socioeconomic conditions directly impact the primary health service and infrastructure of 0.732, meaning that a 10% increase in socioeconomic status can directly increase 7.32% of the coverage of primary health service and infrastructure indicators. The improving socioeconomic status may determine the provision of facilities and infrastructure. The availability of adequate infrastructure is also expected to facilitate the process of social and economic activities. Like Japan, as one of the developed countries in Asia, it has high spending on health. Studies related to preventive services in Kashiwa City, Japan are significantly effective (Ito et al., 2021). This allows the distribution of health service facilities to be even in villages and cities. In Indonesia, the availability of health services still needs to be improved in several areas, especially in villages with limited access.

Socioeconomic conditions significantly influence health services (0.732), risk food consumption (0.898), and ultimately hypertension (-1.175). Higher socioeconomic status generally correlates with better healthcare access and improved dietary choices, though lifestyle factors remain influential. Urbanization trends in India suggest a dietary shift toward processed foods and animal-based products, mirroring Engel's Law on income elasticity (Pandey et al., 2020). Nevertheless, socioeconomic disparities persist in hypertension prevalence, with lower-income individuals at greater risk due to poor diet and limited healthcare access (Mahwati et al., 2022).

Socioeconomic status indirectly affects hypertension (1.318) via healthcare access (0.293) and risk food consumption (1.025). A 10% increase in socioeconomic status may raise hypertension prevalence by 13.18% due to lifestyle shifts. A Japanese study linked rising incomes to increased alcohol consumption and obesity, while Indonesian studies highlight social influences on smoking behaviors (Lucia et al., 2022; Yanagiya et al., 2020;). The socio-ecological model underscores the need for holistic interventions addressing environmental and social determinants of health (Dahlberg & Krug, 2002).

Model Fit Evaluation

The assessment of the hypertension prevention model in West Java using SEM-PLS analysis reveals variations in model fit, explanatory power, and predictive relevance. SRMR value of 0.1 indicates a certain degree of residual discrepancy, suggesting that while the model may appear well-fitted, it still demonstrates strong predictive capability. Furthermore, a higher SRMR value can be overlooked if the model effectively predicts the dependent variable, reinforcing its significance in hypertension prevention (Hair et al., 2021).

The Goodness-of-Fit (GoF) index of 0.67 (research GoF value >0.36) indicates a substantial model fit, demonstrating that the structural model appropriately represents the relationships among key factors in hypertension prevention. However, the latent variables' predictive relevance (Q^2) values show varying degrees of explanatory power. The risk consumption pattern variable ($Q^2 = 0.494$) exhibits strong predictive relevance, meaning the model sufficiently explains this factor. In contrast, the hypertension variable ($Q^2 = 0.175$) has moderate predictive relevance, while the primary health service and infrastructure variable ($Q^2 = 0.082$) demonstrates weak predictive relevance, implying the model has limited predictive capability for this construct.

Additionally, as emphasized by Hair et al. (2021), the primary focus in PLS-SEM should be on R^2 (explained variance) and Q^2 (predictive relevance) rather than solely relying on fit indices such as SRMR. In this study, an R^2 value of 0.67 is considered substantial, indicating that the model has a strong explanatory capacity in predicting hypertension prevention outcomes. However, variables with lower R^2 values may only exhibit moderate or weak explanatory power, necessitating further refinement.

Figure 3 illustrates the correlation and the power of influence between the variables studied.

The present modelling illustrates the parameter coefficients for the variables of primary health service and infrastructure and risk food consumption are positive, which represents that for every 10% increase in the unit value of primary health service infrastructure and risk food consumption, the hypertension estimate will increase by 4.01% and 11%. Meanwhile, the coefficient of the socioeconomic status is negative, which represents that increasing socioeconomic status may decline prevalence of hypertension. Based on the present model, the socioeconomic status also positively influences the value of primary health service and infrastructure and risk food consumption. Indirectly, socioeconomic status on hypertension is influenced by primary health service and infrastructure and risk food consumption patterns.

CONCLUSION

The determinants of hypertension through the correlation between latent variables, including risk food consumption, primary health services infrastructure, and socioeconomic status in West Java show the total direct and indirect influence, by 11.42%, 4.01%, and 1.44%, respectively.

The findings of this study indicate that the hypertension prevention model in West Java, assessed using PLS, demonstrates a substantial overall fit (GoF = 0.67) and a strong explanatory capacity ($R^2 = 0.67$). While the model effectively predicts risk consumption patterns, it requires improvements in explaining the role of health services and infrastructure in hypertension prevention. Future research should focus on refining the model through enhanced variable selection, improved model specification, and integrating mediating and moderating factors to strengthen its predictive accuracy, particularly by incorporating noise exposure directly affecting hypertension. These refinements will contribute to a more comprehensive understanding of

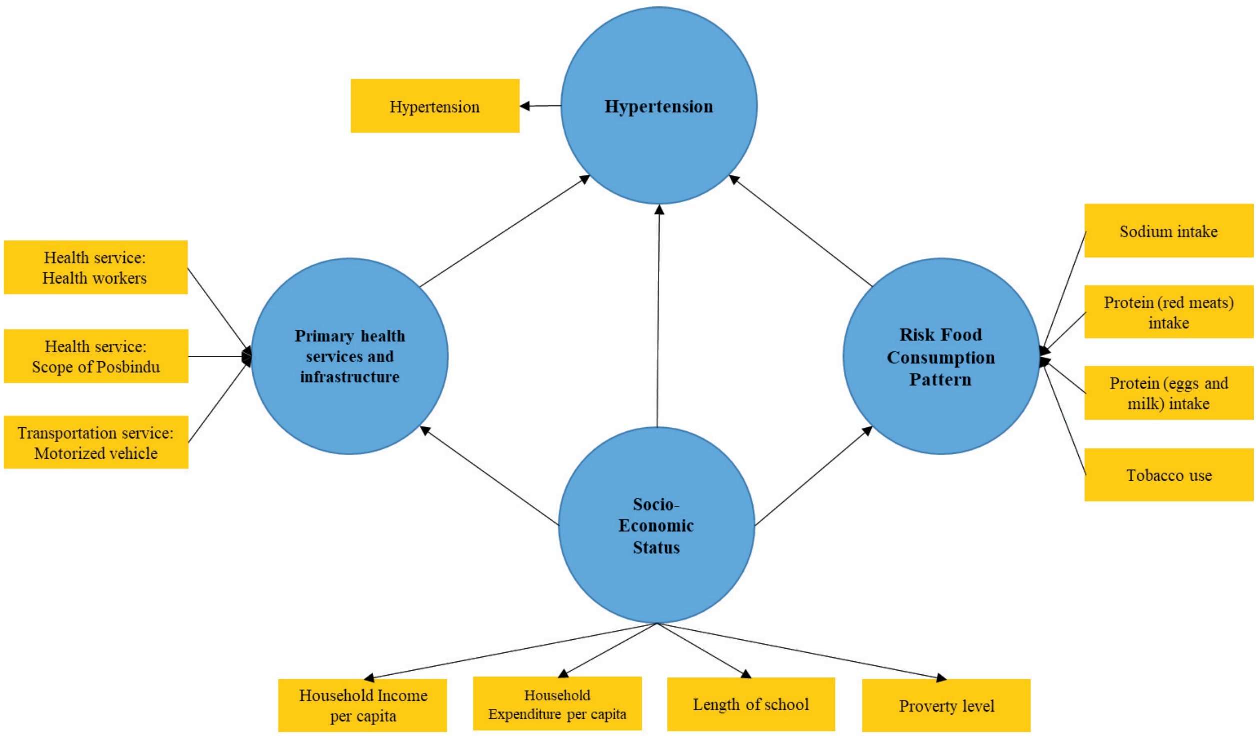

Figure 3. Path Modelling of The Present Study

hypertension prevention strategies and support their integration into public health policies.

To effectively address hypertension, it is crucial to implement an integrated approach that includes the management of food resources and the environment. Strengthening food resource management through policies that promote balanced nutrition, reduce excessive sodium intake, and control tobacco consumption can help mitigate hypertension risk. Additionally, improving environmental factors such as access to primary healthcare services, infrastructure development, and clean water availability will further support hypertension prevention and management efforts in West Java.

Considering food choice of protein type and processing method is still important. Real food with minimum or without oil cooking method such as sautéing, stir frying, steaming, braising, poaching, etc. must be a better option for health. Plant-based diet and lean protein could be an option for food consumption pattern to reduce hypertension leading hypertension prevalence reduction. Moreover, in terms of reduction of salt consumption for adults, the WHO recommends less than 2000 mg/day of sodium. Moreover, salt consumption for adults should be reduced to less than one teaspoon or equal to 2000mg/day of sodium (5 gram of salt).

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