

ORIGINAL ARTICLE**Factors associated with Diabetes Mellitus and Hypertension in Prolanis Patients at the Regional Health Laboratory of Surabaya City, Indonesia**Umi Widayati¹, Eny Qurniyawati^{2,3*}, Geoffrey Ssekalembe⁴, Rouwida ElKhalil⁵**OPEN ACCESS**

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Affiliation and Correspondence:

¹Master of Epidemiology Study Program, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

²Department of Epidemiology, Biostatistics, Population Studies, and Health Promotion, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

³Research Group for Health and Wellbeing of Women and Children, Universitas Airlangga, Indonesia

⁴Elizabeth Glaser Pediatric AIDS Foundation, Uganda

⁵Institute of Public Health, College of Medicine and Health Sciences, United Arab Emirates University, United

*Email:

eny.qurniyawati@fkm.unair.ac.id

ABSTRACT

BACKGROUND: In Indonesia, 10.9% of people have diabetes mellitus, and 34.11% of people have hypertension, which results in 0.67% of fatalities. Based on medical laboratory tests performed on Prolanis participants at the Regional Health Laboratory in Surabaya City, Indonesia, this study attempts to examine the risk variables linked to diabetes mellitus and hypertension.

METHODS: This study uses secondary data from January to October 2024 to investigate risk variables for these illnesses among 637 Prolanis (The Chronic Disease Management Program) participants at the Regional Health Laboratory using a cross-sectional design and bivariate analysis. Age, sex, waist circumference, blood pressure, BMI, HbA1c, total cholesterol, and LDL levels were among the variables.

RESULTS: High body mass index (OR = 1.45; 95% CI = 1.06–1.98), abnormal waist circumference (OR = 1.85; 95% CI = 1.33–2.58, female (OR = 0.68; 95% CI = 0.49–0.95) and older age (OR = 1.87; 95% CI = 1.19–2.93) were associated with diabetes mellitus. Older age (OR = 2.65; 95% CI = 1.53–4.61) was associated with hypertension.

CONCLUSION: Old age, male gender, and higher waist circumference are key factors linked to diabetes mellitus, while older age is associated with hypertension in Prolanis participants.

KEYWORDS: diabetes mellitus, hypertension, cardiovascular disease, cardiovascular risk factors, non-communicable disease

INTRODUCTION

Globally, diabetes mellitus and hypertension are prevalent non-communicable disorders that frequently coexist. Combining these problems can make a patient's prognosis worse and raise their chance of heart disease and stroke, among other cardiovascular disorders. According to epidemiological research, people with diabetes are 1.5–2 times more likely than people without the disease to have hypertension. Moreover, a global meta-analysis of 2,688 observational studies revealed that between 50 and 75 percent of those with diabetes also had high blood pressure. These findings underscore the significance of diabetes mellitus and hypertension as global public health concerns

requiring serious attention. According to Suratri (2020), the prevalence of physician-diagnosed diabetes mellitus in Indonesia is 10.9%, affecting approximately 20.4 million people. Patients with diabetes mellitus are at risk of developing severe acute and chronic complications, which can lead to mortality. In the meanwhile, 34.11% of Indonesians have hypertension, and 427,218 people, or around 0.67% of the country's entire population, have died from hypertension (1).

Diabetes mellitus (DM) is one of the global's most frequent disorders, ranking fourth among degenerative disease research priorities in various countries in 2022, as indicated by the World Health Organization (WHO). Over 346 million individuals worldwide are estimated by the WHO to have diabetes. Meanwhile, the International Diabetes Federation (IDF) predicts that 537 million people globally, or one in ten, will have diabetes by 2021 (2). According to Davies et al. (2022), excessive blood sugar levels and abnormalities in the metabolism of proteins, fats, and carbohydrates are the hallmarks of diabetes mellitus, a chronic condition. Diabetes has two basic forms: type 1 and type 2. A person with type 1 diabetes' immune system attacks and kills pancreatic cells responsible for insulin production. Laboratory tests that are often used to identify diabetes mellitus include the HbA1c test, random blood glucose (RBG), 2-hour postprandial blood glucose (2HPP) test, and C-peptide insulin test (3).

Chronic hypertension can cause serious side effects such diabetes, renal failure, coronary heart disease, stroke, and blindness. High blood pressure, commonly known as hypertension, occurs when a person's blood pressure exceeds normal levels. It is sometimes referred to as the "silent killer" since it seldom causes any symptoms over an extended length of time. Hypertension is one of the leading causes of premature mortality worldwide. One of the global targets is to decrease noncommunicable disease prevalence by 33% throughout 2010 and 2030. Two-thirds of the world's estimated 1.28 billion hypertensive people aged 30 to 79 live in countries with low or middle incomes. Over 46% of individuals with hypertension do not realize they have the illness. Only over one in five people (21%) have effectively controlled their blood pressure, and less than half (42%) have been identified and are receiving therapy (4).

High blood pressure is a serious public health concern, increasing the risk of heart disease, stroke, and early death, according to the WHO Global Report on Hypertension (2023). According to the report, just 54% of people with hypertension receive a diagnosis, 42% receive treatment, and only 21% are able to adequately manage their disease. These numbers demonstrate how urgently better management strategies and more awareness are needed (5). The number of individuals with hypertension, defined as characterized by blood pressure levels of 140/90 mmHg or above or receiving medication for it, tripled from 650 million to 1.3 billion between 1990 and 2019. Approximately 50% of those with hypertension are not even aware that they have the illness. Approximately, 75% of the global hypertensive demographic lives in low- and middle-income countries (4).

The Chronic Disease Management Program (Prolanis) constitutes one of the programs set up by the Indonesian government to treat and prevent chronic diseases. The program focuses on conditions such as diabetes, hypertension, and heart problems. In order to improve the quality of life for persons with chronic diseases while maintaining efficiency and efficacy in healthcare delivery. Prolanis is a proactive, integrated healthcare system that involves participants, healthcare institutions, and the BPJS Health Program. For Prolanis participants with hypertension, laboratory tests include blood chemistry analysis (microalbumin, urea, creatinine, total cholesterol, LDL, HDL, triglycerides). Diabetic participants undergo blood chemistry tests and HbA1c evaluation. In Surabaya, the Prolanis program serves patients from various community health centers under the jurisdiction of the Surabaya Health Office, in collaboration with the Regional Health Laboratory for laboratory testing.

Laboratory-based surveillance plays a crucial role in early diagnosis, epidemiological monitoring, disease control, and prevention. This study aims to detect diabetes mellitus and hypertension through examinations conducted at the Regional Health Laboratory Surabaya, contributing to government efforts to reduce the prevalence of these conditions, particularly in Surabaya. Routine examinations are essential in chronic disease management, playing a key role in early detection and complication prevention. However, the scope of these

examinations often depends on factors such as patient demographics and health behaviors.

This study uses an epidemiological approach to analyze the distribution and determinants of diabetes mellitus and hypertension among Prolanis patients. Given the high incidence of these diseases in Surabaya and the novelty of this research, which investigates risk factors for diabetes mellitus and hypertension across 21 community health centers within the operational area of the Surabaya Health Office, this study attempts to examine the risk variables related with diabetes and hypertension based on medical laboratory examinations of Prolanis participants at the Regional Health Laboratory of Surabaya City, explore the relationships between influencing factors, with a focus on Health and Well-Being (SDGs 3).

METHODS

Study design: This study utilized a cross-sectional research approach to analyze risk factors based on medical laboratory examinations for diabetes mellitus and hypertension among Prolanis patients at the Regional Health Laboratory of Surabaya City. It utilizes secondary data collected between January and October 2024 at the Regional Health Laboratory of Surabaya City, East Java, Indonesia.

Sample: The research population included those involved participating in the Prolanis program (Chronic Disease Management Program) who underwent medical examinations at the Regional Health Laboratory of Surabaya City. The program is intended for patients with certain chronic diseases, particularly type 2 diabetes mellitus and hypertension. The study subjects were drawn from 21 community health centers under the Surabaya Health Office that were scheduled to implement the Prolanis program during the study period from January to October 2024. The sample approach utilized was non-random cluster sampling combined with total sampling, meaning that all Prolanis participants from these 21 health centers who underwent medical examinations at the Regional Health Laboratory of Surabaya City were included in the study. This is categorized as total sampling

because the selection was based on research criteria.

The sample size for this study is 637 individuals, consisting of patients diagnosed with diabetes mellitus and hypertension, who underwent HbA1c, blood pressure, cholesterol, and LDL examinations during the study period. Inclusion criteria include patients aged over 25 years with a history of diabetes mellitus or hypertension. The secondary data utilized in this investigation came from the physical examination forms of Prolanis patients and the laboratory test results at the Regional Health Laboratory of Surabaya City.

Variables: This study examines both dependent and independent variables. The dependent variables are the occurrence of diabetes mellitus and hypertension, while the independent variables include age, sex, waist circumference (defined as abnormal if >90 cm in males and >80 cm in females), BMI (Body Mass Index), HbA1c levels, blood pressure, total cholesterol levels, and LDL levels.

Analysis: The chi-square measure was used for analysis of statistics with a 95% confidence interval (CI) in cross-tabulation. The alternative hypothesis (H_1) was accepted if the odds ratio (OR) was statistically significant and the p-value was less than $\alpha = 0.05$. This indicates that the independent and dependent variables are related.

Ethic consideration: This study has obtained ethical clearance from the Universitas Airlangga Faculty of Public Health's Ethics Commission under the number 75/EA/KEPK/2025. It followed the rules of research ethics, which included getting participants' informed permission.

RESULTS

Distribution of Prevalence of Diabetes Mellitus and Hypertension in prolanis patients: The distribution of Prolanis patients from 21 community health centers undergoing medical laboratory examinations at the Regional Health Laboratory of Surabaya City indicates a high prevalence of diabetes mellitus and hypertension. The analysis revealed that 67% of patients (427 individuals) were diagnosed with diabetes mellitus, while 33% (210 individuals) had

hypertension, based on initial diagnostic examinations.

Distribution Frequency for Diabetes Mellitus and Hypertension: As shown in Table 1, in 2024, a total of 637 Prolanis participants underwent examinations at the Regional Health Laboratory of Surabaya City. The majority were female (66%), while male participants accounted for 34%. This suggests that females may have a higher risk of developing diabetes mellitus and hypertension compared to males. In terms of age distribution, the high-risk group was primarily above 45 years old, whereas individuals in the 25–45 age range were at a relatively lower risk. The analysis indicates that 84% of Prolanis participants diagnosed with diabetes mellitus and hypertension fall into the high-risk category, while the remaining 16% are classified as low risk.

Based on Table 1, it can be concluded that the general health condition of the patients requires further attention. The majority of patients have HbA1c levels indicating the presence of diabetes. In this study, 334 patients (52%) with uncontrolled HbA1c levels ($>6.5\%$) outnumber those with controlled levels. In terms of blood pressure measurement, the average systolic and diastolic blood pressure of Prolanis patients indicates that the majority remain within the normal range ($<140/90$ mmHg). However, 33% of patients have elevated blood pressure ($\geq 140/90$ mmHg). Regarding total cholesterol levels, 57% of patients have high total cholesterol, particularly among those suffering from diabetes mellitus and hypertension. Meanwhile, LDL testing revealed that 72% of Prolanis patients have LDL levels within the normal range. Although the majority of patients (72%) have normal LDL levels, these findings suggest that these patients still face relatively high health risks, which can significantly impact their diabetes mellitus and hypertension conditions.

Table 1: Distribution of Laboratory Examination Results Frequency for Prolanis Patients at Regional Health Laboratory of Surabaya City (n = 637)

Category	N (%)
Age	
Adult (25 – 45 years)	104 (16.0)
Elderly (>45 years)	533 (84.0)
Gender	
Male	217 (34.0)
Female	420 (66.0)
HbA1c Test	
Normal ($<5,7$)	303 (48.0)
Diabetes ($>6,5$)	334 (52.0)
Blood Pressure	
Normal ($< 140/90$ mmHg)	427 (67.0)
High ($\geq 140/90$ mmHg)	210 (33.0)
Total Cholesterol	
Normal (< 200 mg/dL)	276 (43.0)
High (≥ 200 mg/dL)	361 (57.0)
LDL Test	
Normal (< 150 mg/dL)	458 (72.0)
High (≥ 150 mg/dL)	179 (28.0)
BMI (Body Mass Index)	
Normal (< 25 kg/m ²)	318 (49.0)
Obesity (≥ 25 kg/m ²)	319 (51.0)
Waist Circumference	
Normal	215 (34.0)
Abnormal	422 (66.0)

Factors associated with Diabetes Mellitus: As shown in Table 2, the prevalence of diabetes mellitus is higher among women (70%) compared to men. However, statistical analysis indicates that women have a 0.32 times lower risk of developing diabetes mellitus compared to men (OR = 0.68; 95% CI = 0.49–0.95; p = 0.026). In terms of age, the majority of diabetes mellitus patients (81%) belong to the elderly age group (>45 years), compared to the adult age group (25–45 years). The analysis shows that elderly individuals have a 1.87 times higher risk of developing diabetes mellitus than adults. A bivariate analysis confirms an association between age and diabetes mellitus (OR = 1.87; 95% CI = 1.19–2.93; p = 0.006). The results showed that a BMI ≥ 25 was associated with a higher risk of diabetes mellitus compared to a BMI < 25 (p = 0.019). Based on waist circumference, those with an abnormal waist circumference were more at risk of diabetes

mellitus than those with a normal waist circumference ($p < 0.001$).

Table 2: Factors associated with Diabetes Mellitus.

Variable	Diabetes Mellitus (DM)				OR	CI (95%)		p-value
	Diabetes		Normal			Lower Limit	Upper Limit	
	N	%	N	%				
Gender								
Male	100	30	116	38				
Female	234	70	187	62	0.68	0.49	0.95	0.026
Age								
Adult (25 – 45 years)	64	19	34	11				
Elderly (> 45 years)	270	81	269	89	1.87	1.19	2.93	0.006
BMI (Body Mass Index)								
Normal (< 25kg/m ²)	152	47.8	166	52.2				
Obesity (≥25 kg/m ²)	182	57.1	137	42.9	1.45	1.06	1.98	0.019
Waist Circumference								
Normal	91	42.3	124	57.7				
Abnormal	243	57.6	179	42.4	1.85	1.33	2.58	<0.001

Factors associated with Hypertension: The prevalence of hypertension is greater in female patients (69%) than in male patients, as seen in Table 3 but there was no association between gender and hypertension (OR = 1.22; 95% CI = 0.85–1.73; $p = 0.269$). Elderly people are 2.65 times more likely than adults to have hypertension (OR = 2.65; 95% CI = 1.53–4.65; $p < 0.001$).

In terms of total cholesterol, 59% of individuals with hypertension had high levels

(≥200 mg/dL). There is no association between total cholesterol levels and hypertension (OR = 1.07; 95% CI = 0.76–1.49; $p = 0.690$).

For LDL levels, the majority of hypertension patients (72%) have normal LDL levels (<150 mg/dL), while 36% have elevated LDL levels (≥150 mg/dL). High LDL levels were not associated with hypertension (OR = 0.95; 95% CI = 0.66–1.37; $p = 0.802$).

Table 3: Factors associated with hypertension.

Variable	Hypertension				OR	CI (95%)		p-value
	High		Normal			Lower Limit	Upper Limit	
	n	%	n	%				
Gender								
Male	65	31	151	35				
Female	145	69	276	65	1.22	0.85	1.73	0.269
Age								
Adult (25 – 45 years)	17	8	81	19				
Elderly (> 45 years)	193	92	346	81	2.65	1.53	4.61	<0.001
Total Cholesterol								
Normal (< 200 mg/dL)	87	41	184	43				
High (≥ 200 mg/dL)	123	59	243	57	1.07	0.76	1.49	0.690
LDL Test								
Normal (< 150 mg/dL)	152	72	305	71				
High (≥ 150 mg/dL)	58	28	122	29	0.95	0.66	1.37	0.802

* = p -value ≤ 0,05; OR = Odds Ratio; CI = Confidence Interval; LDL = Low-Density Lipoprotein

DISCUSSION

Our data indicated factors associated with development of diabetes mellitus and hypertension among Prolanis participants examined at Regional Health Laboratory of Surabaya City including age, sex, HbA1c levels, blood pressure, total cholesterol, and LDL levels.

Based on this study, the majority were female, comprising 66%, while male participants made up only 34%. This implies that women are more likely than men to acquire hypertension and diabetes mellitus. This finding is consistent with a study by Pouncey, A. L., & Woodward, M. (2022), which explains that although the prevalence of diabetes mellitus is higher in females, biological factors such as body fat distribution and insulin resistance influenced by estrogen hormones may reduce the risk of disease progression in females compared to males (6). However, disparities in access to healthcare services and awareness of early detection also contribute to differences in prevalence (7). According to a study by Silvi Ameliana Sari (2021) on the Utilization of the Chronic Disease Management Program (Prolanis), it was found that 88.5% of hypertensive patients were female. This is because women tend to spend more time seeking healthcare services than men. Additionally, there is a behavioral difference between men and women when it comes to consulting a doctor, with women being more likely to do so (8).

This study's findings suggest that the patients' general health needs more care. The majority of patients have HbA1c levels indicating the presence of diabetes. In this study, 334 patients (52%) with uncontrolled HbA1c levels (>6.5%) outnumber those with controlled levels. These findings align with a study conducted by Haryati & Tyas (2022), which showed that 94.4% of diabetes patients had HbA1c levels $\geq 6.5\%$ (9). A global study by the American Diabetes Association (2023) further reinforces this finding, revealing that 60% of diabetes patients in low- and middle-income countries have HbA1c levels >7%, which is associated with limited access to regular glucose monitoring and self-management education (10). This underscores the urgency of the Prolanis program in enhancing patient health

literacy. Most patients have health conditions that require attention, particularly concerning diabetes, high blood pressure, and elevated cholesterol levels. While LDL levels are within the normal range, overall health risk remains a primary concern to prevent more serious complications in the future. A patient may have high blood pressure and elevated total cholesterol but normal LDL levels. This suggests that even though one aspect of their health is well-managed, the risk for heart disease remains high due to other factors that also need to be addressed. Therefore, it is crucial for these patients to focus on overall healthy eating habits and lifestyle choices that can reduce high health risks, which may lead to future complications. By managing blood pressure and cholesterol levels while maintaining stable LDL levels, patients can minimize the risk of heart disease and other complications (11).

According to this research, compared to males, women have a protective factor for the chance of having diabetes mellitus. This means that although more women are diagnosed with DM, their risk of developing the disease is actually lower than that of men. Men and women have distinct biological factors that can affect the risk of DM; for example, women have estrogen hormones that may provide some protection against Diabetes Mellitus (12,13). Additionally, lifestyle variables could also be important since women are able to maintain regular physical exercise and appropriate eating habits, both of which can lower the chance of having DM (14).

According to the research, the chance of acquiring diabetes mellitus is 1.87 times higher in older people than in adults. This study is in line with a study that discovered a substantial association between those over 45 and diabetes mellitus. Diabetes mellitus is more likely to affect those over 45 years of age. In older age, individuals are more susceptible to glucose intolerance and the aging process, which can reduce insulin production by pancreatic beta cells (15). This mechanism aligns with a study by Tabák et al. (2014), which demonstrated a decline in pancreatic β -cell function by 1–4% per year after the age of 45, along with a 3–6% decrease in insulin sensitivity per decade (16). Our results

showed that a BMI ≥ 25 (obesity) was significantly associated with a higher risk of Diabetes mellitus compared to a BMI < 25 . The term "obesity" refers to the excessive buildup of fat, or "ectopic fat," in different bodily areas or organs. Obesity is an unavoidable contributing factor to the rising incidence of this condition. Type 2 diabetes is characterized by low β -cell insulin releases and peripheral insulin resistance, which elevates fatty acid levels. enhanced hepatic glucose production, reduced glucose transport into muscle cells, and enhanced fat breakdown are the outcomes of this (17).

Diabetes mellitus was higher in those with high waist circumference. The findings demonstrated that type 2 diabetes mellitus is caused by an increase in belly circumference that exceeds normal limits(18).

The proportion of female patients with hypertension is higher, reaching 69% compared to male patients. This study is consistent with the research conducted by Ayu et al. (2022), which stated that, based on respondent characteristics by sex, the data showed that female respondents had the highest proportion, with 70.4%, compared to male respondents. Sex is an unmodifiable risk factor, where men have a higher risk of increased blood pressure than women. However, after menopause, the prevalence of hypertension in women increases, particularly after the age of 65, as hormonal factors in women contribute to a higher incidence of hypertension compared to men (19). This occurs because men and women tend to respond to health issues differently.

According to study by Anna Loise et al. (2022), women are twice as likely as males to have hypertension. One significant modifiable risk factor is blood pressure control; a 10 mmHg reduction in systolic blood pressure reduces the risk of stroke death by 40% and cardiac death by 30% (6). Men are generally less likely to seek care, monitor their health, or undergo regular check-ups with healthcare services. On the other hand, women face an increased risk of hypertension after menopause (20). During menopause, women experience hormonal changes that lead to weight gain and a more reactive blood pressure response to sodium

intake, ultimately resulting in increased blood pressure (21).

However, we have not found association between gender and hypertension. This result is consistent with a research by Lauren et al. (2023) that found no connection between the incidence of hypertension and sex. Among respondents aged 45–59 years, females were more dominant. However, both males and females in this age group showed no substantial difference in hypertension incidence, likely due to hormonal changes and lifestyle factors (22).

Our results showed that there is a significantly increased risk of hypertension in people over 45. This study supports the findings of Nuraeni E. (2019), who found that individuals over 45 have an 8.4-fold higher risk of hypertension (95% CI: OR 2.9–24.2) than those under 45. The arteries get bigger and stiffer as people age, which decreases the blood vessels' flexibility and ability to hold blood (23). This decline results in an increase in systolic blood pressure. Additionally, neurohormonal systems including the renin-angiotensin-aldosterone pathway are disrupted by aging, which raises peripheral plasma concentration. The vasculature undergoes morphological and functional changes with age, such as wall thickening and endothelial dysfunction. Reduced distensibility and arterial rigidity, which are hallmarks of aging and are exacerbated in hypertension, are caused by these changes. Aging also contributes to vascular fibrosis, a process that leads to increased arterial stiffness and is associated with hypertension. Increased matrix metalloproteinase production and activation, as well as the activation of proinflammatory and profibrotic signaling pathways, are the molecular mechanisms behind these events (24). The interplay between aging and vascular remodeling is complex, involving structural changes such as increased tunica intima thickness and functional impairments like reduced endothelial vasodilation. These changes, along with fibrosis in organs like the kidneys and intestines, contribute to increased vascular resistance and hypertension.

Our data indicates that total cholesterol levels do not show a significant association with

hypertension. This result contradicts the study conducted by Permatasari et al. (2022), which found a significant correlation between blood pressure and total cholesterol levels in hypertensive patients aged ≥ 40 years (25).

The data analysis indicates that patients with high LDL levels do not show a significant association with the incidence of hypertension. Although considered normal, LDL remains a risk factor that should also be addressed in the prevention of complications. This result is in line with the study of Karwiti et al. (2023), which discovered no connection between the degree of hypertension and LDL levels. High LDL levels are not usually seen in people with stage 2 hypertension, and prehypertensive patients do not necessarily have lower LDL levels than hypertensive patients (26). The association between blood pressure and Low-Density Lipoprotein (LDL) cholesterol levels in hypertensive individuals has been the subject of several investigations. The European Study on Cardiovascular Risk Prevention and Management looked at the blood pulse and cholesterol measurements of a broad European population. LDL cholesterol levels were shown to be substantially linked with diastolic and systolic blood pressure. For each mmol/L increase in LDL cholesterol, both diastolic and systolic blood pressure rose by 0.93 and 0.96 mmHg, respectively (27). A study involving 1,448 Japanese women found significant correlations between LDL cholesterol and blood pressure (28). These studies suggest a positive association between LDL cholesterol levels and blood pressure, highlighting the importance of monitoring and managing both parameters in hypertensive patients.

Hypertension is associated with lipid abnormalities, where dyslipidemia increases the risk of developing hypertension. Total serum cholesterol levels rise as blood pressure increases. High serum concentrations in hypertension patients than normotensive persons imply an increased risk of cardiovascular and cerebrovascular consequences, such as coronary artery illness and stroke. Hypertension people with high cholesterol levels (21).

This research has a number of significant advantages. The statistical robustness and representativeness of the Prolanis population in Surabaya are improved by the comparatively high sample size ($n = 637$) obtained from 21 community health clinics. The use of objective laboratory measurements, including HbA1c, blood pressure, total cholesterol, and LDL levels, minimizes information bias and strengthens the validity of the findings. A more thorough evaluation of the variables linked to diabetes mellitus and hypertension is also made possible by the addition of certain cardiometabolic risk factors, such as waist circumference and BMI. The utilization of real world secondary data from a government based chronic disease management program also increases the practical relevance of the findings for public health policy and intervention strategies.

This study has several limitations. Its cross-sectional design limits causal inference, and reliance on secondary data excludes important confounding factors like lifestyle, socioeconomic status, and medication adherence. Non-random sampling may introduce selection bias and restrict generalizability. Measurement variability across health centers and a predominance of female participants could also affect interpretation, especially regarding sex-specific findings.

In conclusion, older age is the most significant contributors to diabetes mellitus and hypertension. The effect of earlier age screening and lifestyle modification to mitigate the development of diabetes mellitus and hypertension among Prolanis participants need to be investigated.

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REFERENCES

1. Suratri MAL. The Effect of Hypertension on the Incidence of Periodontal Disease (Periodontitis) in the Indonesian Population (2018 Riskesdas Data). Pengaruh Hipertensi Terhadap Kejadian Penyakit Jaringan Periodontal (Periodontitis) pada Masyarakat

- Indonesia (Data Riskesdas 2018) (Indonesia). *Bul Penelit Kesehat.* 2020;48(4):227–34.
- Hartono, Ediyono S. The Relationship Between Educational Level, Duration of Illness, and Knowledge of the 5 Pillars of Diabetes Mellitus Management in the Service Area of the Sungai Durian Community Health Center, Kbu Raya District, West Kalimantan. Hubungan Tingkat Pendidikan, Lama Menderita Sakit Dengan Tingkat Pengetahuan 5 Pilar Penatalaksanaan Diabetes Mellitus Di Wilayah Kerja Puskesmas Sungai Durian Kabupaten Kbu Raya Kalimantan Barat (Indonesia). *Shine Cahaya Dunia S-1 Keperawatan.* 2024;9(01):2018–22.
 - Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, et al. Management of Hyperglycemia in Type 2 Diabetes, 2022. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care.* 2022;45(11):2753–86.
 - WHO. Hypertension 16. World Heal Organ. 2023;(May):4–7.
 - Kario K, Okura A, Hoshida S, Mogi M. The WHO Global report 2023 on hypertension warning the emerging hypertension burden in globe and its treatment strategy. *Hypertens Res.* 2024;47(5):1099–102.
 - Pouncey AL, Woodward M. Sex-specific differences in cardiovascular risk, risk factors and risk management in the peripheral arterial disease population. *Diagnostics.* 2022;12(4):808.
 - Hassan S, Gujral UP, Quarells RC, Rhodes EC, Shah MK, Obi J, et al. Disparities in diabetes prevalence and management by race and ethnicity in the USA: defining a path forward. *lancet Diabetes Endocrinol.* 2023 Jul;11(7):509–24.
 - Silvi Ameliana Sari. Factors Influencing the Utilization of the Chronic Disease Management Program (PROLANIS) at the Kedai Durian Community Health Center. Faktor yang Mempengaruhi Pemanfaatan Program Pengelolaan Penyakit Kronis (PROLANIS) di Puskesmas Kedai Durian (Indonesia). 2021.
 - Haryati AI, Tyas TAW. Comparison of HbA1c Levels in Patients with Type 2 Diabetes Mellitus with and without Hypertension at the Duri Regional General Hospital, Mandau, Bengkalis, Riau. Perbandingan Kadar HbA1c pada Pasien Diabetes Melitus Tipe 2 yang Disertai Hipertensi dan Tanpa Hipertensi di Rumah Sakit Umum Daerah Duri, Mandau, Bengkalis, Riau (Indonesia). *J Kedokt dan Kesehat.* 2022;18(1):33.
 - Tabák AG, Jokela M, Akbaraly TN, Brunner EJ, Kivimäki M, Witte DR. Trajectories of glycaemia, insulin sensitivity, and insulin secretion before diagnosis of type 2 diabetes: an analysis from the Whitehall II study. *Lancet.* 2009;373(9682):2215–21.
 - Barega B, Seifu L, Melkie A, Abebe S, Taye M. Blood Pressure Control among Adults with Hypertension at a Tertiary Hospital in Ethiopia. *Ethiop J Health Sci.* 2023 Jul;33(4):563–70.
 - Ding EL, Song Y, Malik VS, Liu S. Sex differences of endogenous sex hormones and risk of type 2 diabetes: a systematic review and meta-analysis. *JAMA.* 2006 Mar;295(11):1288–99.
 - Yoon J, Kim J, Son H. Gender Differences of Health Behaviors in the Risk of Metabolic Syndrome for Middle-Aged Adults: A National Cross-Sectional Study in South Korea. *Int J Environ Res Public Health.* 2021;18(7): 3699.
 - Yao H, Wang X, Wu X, Liu Y, Chen Y, Li L, et al. Sex differences in association of healthy eating pattern with all-cause mortality and cardiovascular mortality. *BMC Public Health.* 2024;24(1):2363.
 - Pahlawati A, Nugroho PS. The Relationship Between Educational Level and Age and the Incidence of Diabetes Mellitus in the Service Area of the Palaran Community Health Center, Samarinda City, in 2019. Hubungan tingkat pendidikan dan usia dengan kejadian diabetes melitus di wilayah kerja Puskesmas
-

- Palaran Kota Samarinda tahun 2019 (Indonesia). *Borneo Stud Res.* 2019;1(1):1–5.
16. Shahid R, Shoker M, Chu LM, Frehlick R, Ward H, Pahwa P. Impact of low health literacy on patients' health outcomes: a multicenter cohort study. *BMC Health Serv Res.* 2022;22(1):1148.
 17. Chandrasekaran P, Weiskirchen R. The Role of Obesity in Type 2 Diabetes Mellitus—An Overview. *Int J Mol Sci.* 2024;25(3): 1882.
 18. Darsini D, Hamidah H, Notobroto HB, Cahyono EA. Health risks associated with high waist circumference: A systematic review. *J Public health Res.* 2020;9(2):94–100.
 19. Ayu D, Sinaga AF, Syahlan N, Siregar SM, Sofi S, Zega RS, et al. Factors Contributing to Hypertension in the Medan Tenggara Subdistrict. Faktor - Faktor Yang Menyebabkan Hipertensi Di Kelurahan Medan Tenggara (Indonesia). *J Kesehatan Masy.* 2022;10(2):136–47.
 20. Suryonegoro SB, Elfa MM, Noor MS. Literature Review: The Relationship Between Hypertension in Postmenopausal and Elderly Women and Quality of Life. Literature Review: Hubungan Hipertensi Pada Wanita Menopause Dan Usia Lanjut Terhadap Kualitas Hidup (Indonesia). *Homeotasis*, Vol 4 No 2, Agustus 2021 387–398. 2021;4(2):387–98.
 21. Anjarwati AAA, Suryandari D, Mustikarani IK. The Relationship Between Low-Density Lipoprotein (LDL) Levels and Blood Pressure in Hypertensive Patients at Karanganyar Regional General Hospital. Hubungan Kadar Low Density Lipoprotein (LDL) Dengan Tekanan Darah Pada Pasien Hipertensi Di RSUD Karanganyar (Indonesia). *Univ Kusuma Husada Surakarta.* 2022;18(1):4.
 22. Lauren G, Febriyanty D, Wahidin M, Heryana A. Factors Associated with the Prevalence of Hypertension Among Patients Aged 45–59 at the Bintaro Community Health Center in South Jakarta in 2022. Faktor – Faktor Yang Berhubungan Dengan Kejadian Hipertensi Pada Pasien 45-59 Tahun Di Puskesmas Bintaro Jakarta Selatan Pada Tahun 2022 (Indonesia). *J Kesehatan Masy.* 2023 May;11(3):308–17.
 23. Nuraeni E. The Relationship Between Age and Gender and the Incidence of Hypertension at Clinic X in Tangerang City. Hubungan Usia Dan Jenis Kelamin Beresiko Dengan Kejadian Hipertensi Di Klinik X Kota Tangerang (Indonesia). *J JKFT.* 2019;4(1):1.
 24. Harvey A, Montezano AC, Lopes RA, Rios F, Touyz RM. Vascular Fibrosis in Aging and Hypertension: Molecular Mechanisms and Clinical Implications. *Can J Cardiol.* 2016 May;32(5):659–68.
 25. Permatasari R, Suriani E, Kurniawan D. The Relationship Between Total Cholesterol Levels and Blood Pressure in Hypertensive Patients Aged 40 Years and Older. Hubungan Kadar Kolesterol Total Dengan Tekanan Darah Pada Pasien Hipertensi Pada Usia ≥ 40 tahun (Indonesia). *J Labora Med.* 2022;6:16–21.
 26. Karwiti W, Nasrazuhdy N, Rezekiyah S, Nurhayati N, Asrori A. Profil Lipid dan Kejadian Hipertensi. *J Telenursing.* 2023;5(2):2956–64.
 27. Rutan MC, Sammon JD, Nguyen D-D, Kilbridge KL, Herzog P, Trinh Q-D. The Relationship Between Health Literacy and Nonrecommended Cancer Screening. *Am J Prev Med.* 2021 Feb;60(2):e69–72.
 28. Oda E, Kawai R. LDL Cholesterol Is Associated With Blood Pressure in Japanese Women. *Diabetes Care* [Internet]. 2009 Sep 1;32(9):e113–e113.
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