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ORIGINAL RESEARCH

Determinants of Cardiovascular Diseases in the Elderly Population in Indonesia: Evidence from Population-Based Indonesian Family Life Survey (IFLS)

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Introduction: Cardiovascular disease (CVD) is the leading cause of death worldwide and is the number one mortality cause in Indonesia. The highest percentage of its prevalence occurs in the elderly population. This research aims to assess the determinants of CVDs in the elderly population in Indonesia based on the Indonesian Family Life Survey 5 (IFLS-5), a sub-nationally representative survey data, in 2014–2015.

Methods: A national cross-sectional population-based survey was conducted using multicenter data from approximately 13 provinces in Indonesia in 2014–2015. We included elderly subjects aged 60 years old and above with complete data on sociodemographic, smoking habits, obesity, dietary pattern, and physical activity and diagnosis data on hypertension, diabetes mellitus (DM), and hypercholesterolemia. Multivariate logistic regression was performed to estimate odds ratio (OR) and corresponding 95% confidence interval (95% CI) and p-value.

Results: We included complete data from 2873 respondents. The determinants associated with CVDs in the elderly population in Indonesia included college background (OR 6.26 [95% CI 2.690–14.613], $p < 0.001$), unemployment (OR 1.88 [95% CI 1.294–2.75], $p = 0.001$), urban population (OR 2.11 [95% CI 1.427–3.114], $p < 0.001$), obesity (OR 1.59 [95% CI 0.842–3.02], $p = 0.152$), low and medium physical activities (OR 2.34 [95% CI 1.335–4.121], $p = 0.003$ and OR 2.54 [95% CI 1.449–4.486], $p = 0.001$, respectively), hypertension (OR 4.25 [95% CI 2.945–6.137], $p < 0.001$), DM (OR 2.77 [95% CI 1.683–4.591], $p < 0.001$), and hypercholesterolemia (OR 2.99 [95% CI 1.860–4.812], $p < 0.001$).

Conclusion: The determinants of CVDs in the elderly population in Indonesia based on Indonesian Family Life Survey (IFLS)-5 data are hypertension, hypercholesterolemia, DM, lower physical activity, higher educational background, urban population, unemployment, and obesity. The findings of this current study highlight that more appropriate control measures such as tailored intervention by policymakers and healthcare providers for those at high risk should be initiated and implemented.

Keywords: determinants, risk factors, CVD, Indonesia, elderly population, IFLS

Introduction

According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the leading causes of death globally, accounting for fatalities of 17.9 million people in 2019. Heart attacks and strokes cause approximately 85% of these deaths. More than three-quarters of deaths from CVDs occur in low- and middle-income countries.[1] According to data obtained from the Institute for Health Metrics and Evaluation, ischemic heart disease and stroke in 2019 became the first and second highest causes of death in the elderly population in Indonesia.[2] Between 1990 and 2016, the life expectancy of Indonesian increased by eight years to 71.7 years. This alteration changes the age structure within the

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population, with approximately 65% of the population is now in productive years, and the elderly population aged 60 years above is growing.[3] Simultaneously, Indonesia also faces changing patterns in morbidity, mortality, and disability. This epidemiological transition has caused a burden, especially in the increasing number of non-communicable diseases such as CVDs.[3] The highest prevalence of CVDs in Indonesia occurs in the elderly, primarily those aged 65–74 years.[4]

A total of approximately 31% of deaths are caused by CVDs globally, mainly coronary heart disease (CHD) and cerebrovascular accidents.[5] Aging is considered as one of the critical risk factors in influencing cardiovascular homeostasis. A prior study mentioned that the cost of CVD treatment in the age group of 65–79 years is three times greater than that in the age group of 45–64 years.[6] It is estimated that by 2030, approximately 20% of the population will be aged 65 and over.[7] Additionally, according to a report from Statistics Indonesia, in 2020, there was approximately 26.82 million elderly population in Indonesia, accounting for approximately 9.92% of the total population. It is projected that the number will increase to 19.9% in 2045.[8] Based on the current trend, this increasing prevalence will be estimated to indirectly account for approximately 40% of deaths caused by CVDs.[7]

Various risk factors have been found to be linked with CVDs, including unhealthy diet, lack of physical activity, smoking, and alcohol consumption.[1] In addition, increased blood pressure, blood fat levels, obesity, and diabetes mellitus (DM) are included in the known risk factors for CVDs.[9] Some social factors also affect the event of CVDs, such as low socioeconomic status, including low levels of education, low income, and poor living environment describing the quality of a person's diet.[9,10] A previous study suggested that poor social relationships are associated with an increased risk of coronary heart disease (CHD) by 29% and stroke by 32%.[11] Additionally, physical activity has been known to be associated with reduced risk of CVDs and mortality.[12] Exercise every twice a week, such as walking up and down stairs and standing up from sitting to an upright position, resulting in a significant decrease in systolic blood pressure that could potentially prevent CVDs in the elderly population, as shown by a previous study.[13]

Previous studies have suggested that high preventable cardiovascular risks such as hypertension, obesity, dyslipidemia, and active smoking habits are common in the adult Indonesian population aged 40 years and above.[14–16] Although CVD prevalence remains high in the elderly population above 60 years old, studies investigating the non-modifiable and modifiable determinants among this age group in this specific setting are currently sparse. Thorough information on specific determinants of developing CVDs can be used to plan targeted early interventions to help modify the risk factor in adults and potentially reduce the burden of CVDs when the cohort reaches the elderly age. The Indonesian Family Life Survey (IFLS) is an ongoing longitudinal survey in Indonesia. Secondary data obtained from IFLS can represent 83% of the Indonesian population consisting of more than 30,000 individuals living in 13 provinces.[17] The study aims to assess the determinants of CVD events in the elderly population based on IFLS-5 data.

Materials and Methods

Study Design and Participants

This cross-sectional population-based national study was conducted by analyzing data obtained from the demographic household survey data from the fifth wave of IFLS performed in 2014–2015. IFLS-5 used a multistage stratified sampling design that represents 83% of the Indonesian population conducted in 13 provinces in Indonesia, including North Sumatra, Yogyakarta, West Sumatra, East Java, South Sumatra, Bali, Lampung, West Nusa Tenggara, Jakarta, South Kalimantan, West Java, South Sulawesi, and Central Java.[18] The data are publicly available online at https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html. The subjects of this study were the elderly group of 60 years and above[19] with complete data on sociodemographic, smoking habits, obesity, dietary pattern, and physical activity and diagnosis data on hypertension, DM, and hypercholesterolemia.

IFLS is a longitudinal survey, and IFLS-5 obtained its sample from IFLS1, IFLS2, IFLS2+, IFLS3, and IFLS4 participants. The IFLS sampling scheme was stratified on provinces and urban/rural location and then randomly sampled within these strata. The 13 provinces selected were to maximize the representation of the population and capture the cultural and socioeconomic diversity of Indonesia. Within each of the 13 provinces, 321 enumeration areas (EAs) were randomly selected from a nationally representative sample frame used in the 1993 SUSENAS, a socioeconomic survey in Indonesia. Within a selected EA, households were randomly selected based on the 1993 SUSENAS listings obtained

from the regional Badan Pusat Statistik (BPS) office. Finally, 20 households were selected from each urban EA, and 30 households were selected from each rural EA.

The IFLS-5 re-contact participants were listed below:

1. 1993 main respondents.
2. 1993 household members born before 1968.
3. Individuals born since 1993 in origin 1993 households, also in split-off households if they are children of 1993 IFLS household members.
4. Individuals born after 1988 if they were residents in an origin household in 1993.
5. 1993 household members who were born between 1968 and 1988 if they were interviewed in 2007.
6. Twenty percent random sample of 1993 household members who were born between 1968 and 1988 if they were not interviewed in 2007 [15].

Study Variable and Measurement

The dependent variable in this study was CVD (heart attack, CHD, angina, or other heart problems) diagnosis status. The risk factors associated with CVD status were classified as modifiable and non-modifiable factors. Smoking habits, physical activity, and dietary patterns were categorized as modifiable factors. Alternatively, non-modifiable factors consisted of sociodemographic data such as gender, education, working status, and residential status. Anthropometric measurements included measurement on height and weight. Body mass index (BMI) was calculated as weight in kilograms divided by height in meter squared and classified according to obese ($\geq$30 kg/m^2) and not obese (<30 kg/m^2) based on the obesity criteria from the Western Pacific Region of WHO.[20] Smoking habit was assessed with a question, "Have you ever chewed tobacco, smoked a pipe, smoked self-enrolled cigarettes, or smoked cigarettes/cigars?" (Yes, No).

In addition, physical activity data were collected on the amount of time of respondent's activities during the last 7 days and then converted into Metabolic Equivalent of one Task—minute per week (MET m/w), and the questions were referred to the International Physical Activity Questionnaire (IPAQ)—short version. The data were categorized into high, moderate, and low levels of physical activity. High levels of physical activity included heavy lifting, digging, plowing, aerobics, fast bicycling, cycling with load, etc. Meanwhile, moderate level of physical activity comprised carrying light loads, bicycling at a regular pace, or mopping the floor. Low levels of physical activity involve walking at work and at home, walking to travel from place to place, and any other walking that might be done solely for recreation, sport, exercise, or leisure. We calculated the MET m/w by multiplying the days when respondents engaged in physical activity by the assigned intensity value (3.3, 4, and 8 METs for walking, moderate intensity, and vigorous intensity, respectively). Then, we calculated the total of each MET m/w and categorized by criteria of each category based on the IPAQ scoring protocol. Dietary pattern was assessed with a question, "How many days in a week did you eat [food type] in the last week?". Foods included sweet potato, egg, fish, meat, dairy, green leafy vegetables, banana, papaya, carrot, and mango. The respondent's answers were then converted as Food Consumption Score (FCS) as developed by the World Food Programme. In addition, the FCS was then categorized into the Food Security category and characterized as an unhealthy diet and as a healthy diet.[21,22] Hypertension, DM, hypercholesterolemia, and CVD as self-reported chronic conditions were assessed with a question, "Have you been diagnosed of hypertension/diabetes mellitus (DM)/hypercholesterolemia/CVD by a doctor, nurse, paramedic, and trained mid-wife?" (Yes, No).[18] Although the researchers were not able to confirm those conditions, there was additional information such as who diagnosed the condition (doctor, paramedic, nurse, mid-wife) and whether they are taking prescribed medication on a weekly basis currently or not.

Statistical Analysis

All analyses were conducted with STATA software version 16.0 (Stata Corporation, College Station, TX, USA). Descriptive statistics were used to describe the characteristics of subjects. Bivariate analyses were conducted to assess the difference between having reported CVD diagnosis and each independent variable, based on a chi-squared test for categorical variables. Variables with a p-value of <0.25 in bivariate analysis were included in the initial multivariate model. Multivariate logistic regression analysis was used to assess the determinants of CVDs with manual backward

elimination and to obtain odds ratio (OR) with 95% confidence interval (CI) and p-value. p-values were set at 0.05 for determinants included in the final model.

Results

Table 1 presents the characteristic and descriptive statistics of the participants in this study. The total respondents interviewed in IFLS-5 were 50,148; the total 60+ respondents interviewed were 4007. After the exclusion of 1134 respondents due to incomplete and missing data, the total 60+ respondents who completed all variables and were included in this analysis were 2873 (mean ± standard deviation of age = 67.37 ± 6.31). From the results, 48.21% were male, and 51.79% were female. A total of 20.41% of the population received no formal education, and almost half of the population was working (47.58%) and lived in rural areas (45.66%). In addition, approximately 28.75% was diagnosed with hypertension, and only a small percentage was diagnosed with DM (6.72%) and hypercholesterolemia (7.37%). Overall, 44.41% of the population had a smoking habit, 44.41% of the population had a healthy dietary pattern, 25.44% of the population had a high physical activity, and only 5.74% were classified as obese with a BMI of ≥30 kg/m^2. Table 1 also provides the result from bivariate analysis. Educational background, working status, residential status, obesity, dietary pattern, physical activity, hypertension, DM, and hypercholesterolemia were the included variables in multivariate analysis with a p-value of <0.25.

Table 2 shows the OR from the multivariate logistic regression analysis that assessed the determinants of CVDs among the elderly population in Indonesia. The results suggested that several non-modifiable and modifiable factors were the significant determinants of CVDs. Among the non-modifiable factors, college background appeared to have the highest OR compared to other categories (OR 6.26 [95% CI 2.690–14.613], p < 0.001). In addition, unemployment (OR 1.88 [95% CI 1.294–2.752], p = 0.001) and urban population (OR 2.11 [95% CI 1.427–3.114], p < 0.001, were also found to be significantly associated with CVDs among the elderly population in Indonesia. Moreover, modifiable determinants including comorbidities such as hypertension (OR 4.25 [95% CI 2.945–6.137], p ≤ 0.001), DM (OR 2.77 [95% CI 1.683–4.591], p < 0.001), and hypercholesterolemia (OR 2.99 [95% CI 1.860–4.812], p < 0.001) were found to have a significant result as determinants

Table 1 Characteristics of the Study Participants, Stratified by Cardiovascular Disease Event (n = 2873)

Variable	Cardiovascular Disease Event		p-value
	Yes	No	
Non-modifiable factor			
Gender			
Male	63	1322	0.747
Female	64	1424	
Educational background			
None	9	553	<0.001*
Elementary school	65	1503	
Junior high school	16	274	
Senior high school	22	269	
University	15	147	
Working status			
Working	42	1325	0.001*
Not working	85	1421	
Residential status			
Rural	37	1275	<0.001*
Urban	90	1471	

(*Continued*)

Table 1 (Continued).

Variable	Cardiovascular Disease Event		p-value
	Yes	No	
Modifiable factor			
Smoking habit Smoking Not smoking	 51 76	 1225 1521	0.323
Obesity Obese Not obese	 11 116	 154 2592	0.148*
Dietary pattern Healthy Unhealthy	 64 63	 1212 1534	0.165*
Physical activity Low Moderate High	 56 55 16	 1067 964 715	0.003*
Hypertension Diagnosed with hypertension No hypertension	 78 49	 748 1998	<0.001*
Diabetes mellitus Diagnosed with DM No DM	 20 107	 173 2573	<0.001*
Hypercholesterolemia Diagnosed with hypercholesterolemia No hypercholesterolemia	 23 104	 189 2557	<0.001*
Total n (%)	**127 (4.42)**	**2746 (95.57)**	

Notes: p < 0.25; *Variables included in the initial multivariate regression logistic model.

Table 2 OR of Determinants Associated with Cardiovascular Diseases Among the Elderly Population in Indonesia (n = 2873)

Variable		OR [95% CI]	p-value
Non-modifiable factors			
Educational background	None	Reference	
	Elementary school	2.65 [1.314–5.372]	0.007
	Junior high school	3.58 [1.565–8.223]	0.003
	Senior high school	5.03 [2.283–11.062]	<0.001
	University	6.26 [2.690–14.613]	<0.001
Working status	Working	Reference	
	Not working	1.88 [1.294–2.752]	0.001

(*Continued*)

Table 2 (Continued).

Variable		OR [95% CI]	p-value
Residential status	Rural	Reference	
	Urban	2.11 [1.427–3.114]	<0.001
Modifiable factors			
Obesity	Obese	1.59 [0.842–3.024]	0.152
	Not obese	Reference	
Physical activity	Low	2.34 [1.335–4.121]	0.003
	Moderate	2.54 [1.449–4.486]	0.001
	High	Reference	
Hypertension	Diagnosed with hypertension	4.25 [2.945–6.137]	<0.001
	No hypertension	Reference	
Diabetes mellitus	Diagnosed with DM	2.77 [1.683–4.591]	<0.001
	No DM	Reference	
Hypercholesterolemia	Diagnosed with hypercholesterolemia	2.99 [1.860–4.812]	<0.001
	No hypercholesterolemia	Reference	

Note: $p < 0.05$.
Abbreviations: OR, odds ratio; CI, confidence interval.

for CVDs in the elderly population. Other modifiable factors that were found to increase the odds of CVDs were low and medium physical activities (OR 2.34 [95% CI 1.335–4.121], p = 0.003 and OR 2.54 [95% CI 1.449–4.486], p = 0.001, respectively), and obesity (OR 1.59 [95% CI 0.842–3.024], p = 0.152). However, the association between obesity and CVDs was found to be not statistically significant.

Discussion

Our findings showed that several individuals and demographic-related variables are the potential modifiable and non-modifiable determinants of CVDs in the elderly population in Indonesia. Modifiable variables including comorbidities such as hypertension, hypercholesterolemia, and DM increased the risk of developing CVDs. Other modifiable risk factors included lower physical activity and obesity. Non-modifiable variables that contribute to CVD risk include higher educational background and unemployment. This study also highlighted that people living in urban areas are at a greater risk of CVDs than those in rural areas.

The results suggested that the population with a history of higher education (college) had higher risk (OR 6.26 [95% CI 2.690–14.613], p < 0.001) than those with lower educational background, such as high school, junior, and elementary school. This result was unexpected and in contrast to previous studies; for instance, a study in China showed that the elderly population with a lower educational background was 2.7 times more at risk for CVD.[23] It might be due to the assumption that individuals with higher educational background may understand knowledge about health better.[23] The results of these conflicting studies were possibly due to several factors, such as lifestyle that included diet, physical activity, and income of respondents that may have an effect on the results of the study. A previous study in Indonesia suggested a similar pattern indicating the high CVD burden in the population with higher income and education levels.[24]

Working status was also shown to be significantly associated with an increased risk of developing CVDs in the elderly population, where individuals who were not working were more at risk than those who work (OR 1.88 [95% CI 1.294–2.752],

p = 0.001). This was in line with previous research that suggested that unemployed respondents with low incomes were more at risk of having a stroke than those who have jobs (OR 1.03 [95% CI 1.00–1.07], p = 0.04) [22]. This trend potentially occurred because individuals with low incomes or no income tend to be more likely to experience stress.[25]

Elderly population living in urban areas showed to be at greater risk for CVD events than those living in rural areas (OR 2.11 [95% CI 1.427–3.114], p < 0.001). The result was expected and supported by previous research that suggested that the prevalence of CVD risk factors is high among urban areas. Prior studies also indicated that the population living in urban areas were 1.14 times more at risk of cardiovascular events than those living in rural areas.[26] This might be associated with the possibility of decreasing green areas in urban areas, thus increasing the chance for pollution.[26] The higher the green area in the region, the higher the environment for physical activity, where it plays an important role in cardiovascular health. In addition, the green space can lower environmental temperatures and improve air quality so as to reduce pollution levels.[27]

Obesity has often been associated with higher risk of cardiovascular events, and the results of the current study also suggested a similar trend.[28] Obesity was associated with increased risk of CVD events, although the association was not statistically significant (OR 1.59 [95% CI 0.842–3.024], p = 0.152). Obesity has been often related with low physical activity and dietary pattern.[28] Additionally, the intensity of physical activity for elderly was also considered in this analysis. This study found that those with low and moderate activity habits were at higher risk for CVD than those with intense activity habits (OR 2.34 [95% CI 1.335–4.121], p = 0.003 and OR 2.54 [95% CI 1.449–4.486], p = 0.001, respectively). The intensity of physical activity was measured by calculating the MET value m/w, where the total minutes spent on physical activity in the past week is multiplied by the number of days spent on physical activity and multiplied by the MET value. Furthermore, the total of MET m/w is categorized into low, moderate, and high intensities according to the categories required by IPAQ.

Due to the importance of investigating comorbidities, we also investigate hypertension, DM, and hypercholesterolemia. The results suggested that hypertension was associated with an increased risk of CVDs (OR 4.25 [95% CI 2.945–6.137], p < 0.001). The results of this study are supported by previous research that stated that elderly people with a history of hypertension in China, India, and the Russian Federation are 1.79, 1.32, and 3.8 times at greater risk for angina than those with no history of hypertension.[28] Furthermore, DM was found to be significantly associated with higher risk of CVDs (OR 2.77 [95% CI 1.683–4.591], p < 0.001). A previous study showed that history of DM has an association with the incidence of CVD, as much as 60% at risk of developing CHD.[29]

Another prominent comorbidity that was found to be associated with an increased risk of CVD was hypercholesterolemia (OR 2.99 [95% CI 1.860–4.812], p < 0.001). Previous studies stated that elderly people with dyslipidemia were at increased risk of CVD events.[30,31] Hypercholesterolemia increases the atherosclerosis process leading to the deposition of cholesterol and fatty acids in artery walls, making it at risk for the development of CVD.[32]

Our findings highlight the need for policymakers and healthcare providers to develop tailored interventions targeted at the elderly population. Some of the determinants are modifiable; therefore, preventive measures such as lifestyle management should be initiated early. Additionally, early screening and appropriate therapy for conditions associated with increased risk of CVD, for example, hypertension, DM, and hypercholesterolemia, should be promoted and implemented. Due to the high burden of CVD, the Indonesian government currently responds to the situation by arranging policy strategies for preventing and managing CVD through advocacy and also strengthening the healthcare system.[33] The government has initiated health promotion for the prevention of non-communicable diseases (NCD) through several public health programs in Indonesia, one of which was to encourage community participation in the prevention, early detection, and monitoring of risk factors for NCD called Pos Pembinaan Terpadu (Posbindu) through integrated and routine training for the community.[34] Additionally, another current program with the aim to manage and improve clinical outcomes and patient's quality of life and to prevent disease exacerbation and complication initiated by the government was a non-communicable and chronic disease management program named as Indonesian Chronic Disease Management Program (PROLANIS) with the main focus on DM and hypertension.[35] Although the current programs are not explicitly designed to prevent CVD in the elderly population, the determinants identified in this study can navigate the introduction and implementation of more targeted intervention in the future.

Moreover, while CVDs are one of the leading causes of public health and economic problems associated with morbidity and mortality in Indonesia,[2,24,36] studies that assess the potential determinants of these diseases, especially in

the elderly population, are currently limited. To date, to the best of our knowledge, this study is one of the first analyses that utilize the multicenter data involving a large sample size that assess the potential determinants of CVDs in this specific group of population, which is the main strength of our study. However, this study has its limitations. The data used in the study were collected in a way that respondents were asked to recall when answering the question asked, and this might result in potential recall bias. Moreover, we only included complete data according to our pre-determined selection criteria for participants, which resulted in a reduced sample size and potentially may lead to selection bias. In addition, we used the secondary data obtained from IFLS-5 that was a publicly available data; therefore, pertinent information such as other potential risk factors such as other comorbidities, alcohol consumption, and salt intake was not available. A stepwise approach with manual backward elimination was conducted in the analysis to decide which variables to include in the model, which may be prone to chance findings. Future studies must justify the choice of potential variables included in the model based on the literature. Furthermore, the study was unable to provide causal inferences regarding the association between modifiable and non-modifiable risk factors related to the occurrence of CVD due to its cross-sectional design. Although IFLS-5 represents 83% of the Indonesian population, yet, our findings cannot be generalized to the eastern part of Indonesia. However, a thorough systematic assessment has been followed in the methodology, and we believe that these limitations do not compromise the validity of the analysis.

Conclusion

Several modifiable and non-modifiable determinants associated with CVDs in the elderly population in Indonesia are hypertension, hypercholesterolemia, DM, lower physical activity, higher educational background, urban population, unemployment, and obesity. The more appropriate control measures by both policymakers and healthcare providers are prominent for high-risk groups.

Ethics and Consent

The IFLS-5 survey is under the supervision of the Institutional Review Boards in America (RAND) and has been ethically reviewed by Gadjah Mada University in Indonesia. IFLS-5 data are also equipped with informed consent from all respondents.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. Cardiovascular diseases; 2021. Available from: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1. Accessed December 5, 2022.
2. Direktorat P2PTM Kementerian Kesehatan (Ministry of Health) Indonesia. Indonesia dalam risiko penyakit kardiovaskular [Indonesia at risk of cardiovascular diseases] - direktorat P2PTM. Kementerian Kesehatan (Ministry of Health) Indonesia; 2018. Available from: https://p2ptm.kemkes.go.id/artikel-sehat/indonesia-dalam-risiko-penyakit-kardiovaskular. Accessed December 5, 2022.
3. Mboi N, Murty Surbakti I, Trihandini I, et al. On the road to universal health care in Indonesia, 1990–2016: a systematic analysis for the global burden of disease study 2016. *Lancet*. 2018;392(10147):581. doi:10.1016/S0140-6736(18)30595-6
4. Agency of Health Research and Development (Indonesia). Indonesia basic health research 2018; 2018. Available from: https://ghdx.healthdata.org/record/indonesia-basic-health-research-2018. Accessed December 5, 2022.

5. Stewart J, Manmathan G, Wilkinson P. Primary prevention of cardiovascular disease: a review of contemporary guidance and literature. *JRSM Cardiovasc Dis*. 2017;6:204800401668721. doi:10.1177/2048004016687211
6. Costantino S, Paneni F, Cosentino F. Ageing, metabolism and cardiovascular disease. *J Physiol*. 2016;594(8):2061–2073. doi:10.1113/JP270538
7. North BJ, Sinclair DA. The intersection between aging and cardiovascular disease. *Circ Res*. 2012;110(8):1097–1108. doi:10.1161/CIRCRESAHA.111.246876
8. Badan Pusat Statistik. Statistik Indonesia 2020; 2020. Available from: https://www.bps.go.id/publication/2020/04/29/e9011b3155d45d70823c141f/statistik-indonesia-2020.html. Accessed December 5, 2022.
9. Francula-Zaninovic S, Nola IA. Management of measurable variable cardiovascular disease' risk factors. *Curr Cardiol Rev*. 2018;14(3):153–163. doi:10.2174/1573403X14666180222102312
10. Psaltopoulou T, Hatzis G, Papageorgiou N, Androulakis E, Briasoulis A, Tousoulis D. Socioeconomic status and risk factors for cardiovascular disease: impact of dietary mediators. *Hell J Cardiol*. 2017;58(1):32–42. doi:10.1016/J.HJC.2017.01.022
11. Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart*. 2016;102(13):1009–1016. doi:10.1136/HEARTJNL-2015-308790
12. Colpani V, Baena CP, Jaspers L, et al. Lifestyle factors, cardiovascular disease and all-cause mortality in middle-aged and elderly women: a systematic review and meta-analysis. *Eur J Epidemiol*. 2018;33(9):831–845. doi:10.1007/S10654-018-0374-Z
13. Pepera G, Christina M, Katerina K, Argirios P, Varsamo A. Effects of multicomponent exercise training intervention on hemodynamic and physical function in older residents of long-term care facilities: a multicenter randomized clinical controlled trial. *J Bodyw Mov Ther*. 2021;28:231–237. doi:10.1016/j.jbmt.2021.07.009
14. Ng N, Stenlund H, Bonita R, Hakimi M, Wall S, Weinehall L. Preventable risk factors for noncommunicable diseases in rural Indonesia: prevalence study using WHO STEPS approach. *Bull World Health Organ*. 2006;84(4):305–313. doi:10.2471/BLT.05.023721
15. Hussain MA, Mamun A, Peters SAE, Woodward M, Huxley RR. The burden of cardiovascular disease attributable to major modifiable risk factors in Indonesia. *J Epidemiol*. 2016;26(10):515. doi:10.2188/JEA.JE20150178
16. Holipah H, Sulistomo HW, Maharani A, Glantz SA. Tobacco smoking and risk of all-cause mortality in Indonesia. *PLoS One*. 2020;15(12):e0242558. doi:10.1371/JOURNAL.PONE.0242558
17. RAND. RAND Indonesian Family Life Survey (IFLS). RAND; 2021. Available from: https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html. Accessed December 5, 2022.
18. Strauss J, Witoelar F, Sikoki B. *The Fifth Wave of the Indonesia Family Life Survey: Overview and Field Report: Volume 1*. WR-1143/1-NIA/NICHD; 2016. doi:10.7249/WR1143.1
19. Adioetomo SM, Mujahid G. UNFPA Indonesia | monograph series no. 1: Indonesia on the threshold of population ageing. (Posselt H, ed.). UNFPA Indonesia; 2015. Available from: https://indonesia.unfpa.org/en/publications/monograph-series-no-1-indonesia-threshold-population-ageing. Accessed December 5, 2022.
20. World Health Organization. The Asia-Pacific perspective: redefining obesity and its treatment. Sydney: Health communications; 2000. Available from: https://apps.who.int/iris/handle/10665/206936. Accessed December 5, 2022.
21. INDDEX Project. Data4Diets: building blocks for diet-related food security analysis. USAID Advancing Nutrition. Boston, MA: Tufts University; 2018. Available from: https://inddex.nutrition.tufts.edu/data4diets. Accessed December 5, 2022.
22. Isaura ER, Chen YC, Yang SH. Pathways from food consumption score to cardiovascular disease: a seven-year follow-up study of Indonesian adults. *Int J Environ Res Public Health*. 2018;15(8). doi:10.3390/IJERPH15081567
23. Liu Q, Huang YJ, Zhao L, et al. Association between knowledge and risk for cardiovascular disease among older adults: a cross-sectional study in China. *Int J Nurs Sci*. 2020;7(2):184–190. doi:10.1016/J.IJNSS.2020.03.008
24. Adisasmito W, Amir V, Atin A, Megraini A, Kusuma D. Geographic and socioeconomic disparity in cardiovascular risk factors in Indonesia: analysis of the basic health research 2018. *BMC Public Health*. 2020;20(1):1–13. doi:10.1186/S12889-020-09099-1/TABLES/5
25. Lemstra M, Rogers M, Moraros J. Income and heart disease: neglected risk factor. *Can Fam Physician*. 2015;61(8):698.
26. Hassen HY, Bastiaens H, van Royen K, Abrams S. Socioeconomic and behavioral determinants of cardiovascular diseases among older adults in Belgium and France: a longitudinal analysis from the SHARE study. *PLoS One*. 2020;15(12):e0243422. doi:10.1371/JOURNAL.PONE.0243422
27. Seo S, Choi S, Kim K, Kim SM, Park SM. Association between urban green space and the risk of cardiovascular disease: a longitudinal study in seven Korean metropolitan areas. *Environ Int*. 2019;125:51–57. doi:10.1016/J.ENVINT.2019.01.038
28. Ruan Y, Guo Y, Zheng Y, et al. Cardiovascular disease (CVD) and associated risk factors among older adults in six low-and middle-income countries: results from SAGE wave 1. *BMC Public Health*. 2018;18(1):1. doi:10.1186/S12889-018-5653-9
29. Zafari N, Asgari S, Lotfaliany M, Hadaegh A, Azizi F, Hadaegh F. Impact of hypertension versus diabetes on cardiovascular and all-cause mortality in Iranian older adults: results of 14 years of follow-up. *Sci Rep*. 2017;7(1):1–8. doi:10.1038/s41598-017-14631-2
30. Cho SMJ, Lee HJ, Shim JS, Song BM, Kim HC. Associations between age and dyslipidemia are differed by education level: the Cardiovascular and Metabolic Diseases Etiology Research Center (CMERC) cohort. *Lipids Health Dis*. 2020;19(1). doi:10.1186/S12944-020-1189-Y
31. Achila OO, Araya M, Berhe AB, et al. Dyslipidemia and associated risk factors in the elderly population in Asmara, Eritrea: results from a community-based cross-sectional study. *J Lipids*. 2021;2021:1–13. doi:10.1155/2021/6155304
32. Hedayatnia M, Asadi Z, Zare-Feyzabadi R, et al. Dyslipidemia and cardiovascular disease risk among the MASHAD study population. *Lipids Health Dis*. 2020;19(1). doi:10.1186/S12944-020-01204-Y
33. Kementerian Kesehatan Republik Indonesia (Ministry of Health). Rencana strategis/ renstra kemenkes [Ministry of Health Strategical Plan] 2020–2024. Direktorat Jenderal Kefarmasian dan Alat Kesehatan; 2020. Available from: https://farmalkes.kemkes.go.id/unduh/renstra-kemenkes-tahun-2020-2024/. Accessed December 5, 2022.
34. Kementerian Kesehatan Republik Indonesia (Ministry of Health). Petunjuk teknis pos pembinaan terpadu penyakit tidak menular (posbindu PTM) [Technical instructions for integrated non-communicable disease development posts (Posbindu PTM)]; 2012. Available from: https://p2ptm.kemkes.go.id/uploads/2016/10/Petunjuk-Pelaksanaan-Pos-Pembinaan-Terpadu-POSBINDU.docx. Accessed December 5, 2022.
35. Indonesian National Health Insurance System. *Practical Guideline for Non Communicable and Chronic Disease Management (Panduan Praktis Program Pengelolaan Penyakit Kronis)*. Badan Penyelenggara Jaminan Sosial Kesehatan; 2014.
36. Zakiyah N, Sinuraya RK, Kusuma ASW, Suwantika AA, Lestari K. Cost-effectiveness analysis of sacubitril/valsartan compared to enalapril for heart failure patients in Indonesia. *Clinicoecon Outcomes Res*. 2021;13:863. doi:10.2147/CEOR.S322740