



Understanding Cardiovascular Risk: Insights From Coastal Communities in Southeast Sulawesi

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ABSTRACT

Cardiovascular Disease (CVD) remains the leading cause of death worldwide, with a greater impact on low- and middle-income countries, particularly coastal communities that depend on fragile ecosystems. This study explores the effects of sociodemographic, behavioral, and metabolic factors on CVD incidence among the coastal population of Soropia, Konawe, Southeast Sulawesi. This research employs a quantitative approach with a cross-sectional design and applies Structural Equation Modeling (SEM) using Smart PLS software. Data collection was conducted through standardized questionnaires and physical examinations. The findings reveal that age significantly reduces CVD risk ($p = 0.043$, $\text{Exp}(B) = 0.378$), while gender and occupation show no significant impact. Among behavioral factors, a history of Non-Communicable Diseases (NCDs) significantly lowers CVD risk ($p = 0.024$, $\text{Exp}(B) = 0.158$), whereas smoking, alcohol consumption, and physical activity are not associated with CVD Risk. In the metabolic group, Low-Density Lipoprotein (LDL) is the only significant factor influencing metabolic risk ($p = 0.026$, $\text{Exp}(B) = 0.615$). Other metabolic markers, including waist circumference and blood glucose, show weak associations. These results highlight the critical role of addressing behavioral and metabolic risk factors in reducing CVD burden, particularly through targeted public health interventions tailored to the unique challenges faced by coastal populations. The study underscores the importance of integrating behavioral modifications and metabolic risk management in health programs to mitigate CVD risks effectively.

INTRODUCTION

Coastal and island nations across the Pacific region, including Indonesia, are home to nearly half of the global population and are marked by their geographic and cultural diversity. These areas often face distinct structural challenges, such as fragile ecosystems and limited healthcare access. In recent decades, many of these countries have experienced a surge in Non-Communicable Diseases (NCDs), such as obesity, hypertension, and diabetes, driven in part by economic transitions and dietary shifts. This epidemiological shift has led to a growing burden of CVD in coastal populations.^{1,2}

Cardiovascular Disease (CVD) continues to be the leading cause of death globally, responsible for 17.9 million fatalities in 2019, accounting for approximately 32% of all deaths. The most common causes of CVD-related mortality are heart attacks and strokes, with more than three-quarters of these deaths occurring in low and middle-income countries. In the same year, CVD was responsible for 38% of premature deaths (under the age of 70) due to noncommunicable diseases. These alarming statistics emphasize the urgent need to address modifiable behavioral risk factors, such as smoking, unhealthy dietary habits, obesity, lack of physical activity, and excessive alcohol consumption.³

Coastal and island communities face unique health challenges because of their proximity to the sea and reliance on fragile ecosystems. These populations are particularly vulnerable to environmental and social factors, including poverty, unstable income, and limited access to health and educational services. These factors exacerbate negative health behaviors and increase the prevalence of noncommunicable diseases, including CVD. Additionally, rising sea levels and climate change are expected to disproportionately impact small island states, intensifying the burden of disease and complicating health interventions.^{4,5}

Several modifiable risk factors contribute to CVD, including hypertension, dyslipidemia, diabetes mellitus, obesity, smoking, and inactivity. These conditions often coexist and amplify health risks. National data indicate that hypertension affects 23.9% of adults, while overweight and dyslipidemia affect over one-third of the population.^{6,7} Addressing these factors through lifestyle interventions is essential, es-

pecially in resource-limited coastal communities.^{6,7}

These factors, through lifestyle interventions, are essential, especially in resource-limited coastal communities. Based on Figure 1, the American Heart Association emphasizes the importance of maintaining "cardiovascular health," which includes four essential lifestyle behaviors: quitting smoking, maintaining an optimal Body Mass Index (BMI), engaging in regular physical activity, and following a nutritious diet. Additionally, it includes four key clinical health indicators: total cholesterol levels, blood pressure, fasting blood glucose, and non-smoking status. This framework offers a holistic approach to CVD prevention by addressing both behavioral and physiological risk factors.^{1,7,8}

The VOS viewer analysis (Figure 2) of CVD risk factors revealed prominent clusters focusing on "social determinants of health," "obesity," "smoking," and "biological markers," which align with the major known risk factors of CVD, such as hypertension, diabetes, and dyslipidemia. However, when contextualized within the scope of coastal and island communities, as outlined in this study, there is a clear research gap in examining the unique interplay between socioeconomic disparities, environmental stressors, and cultural factors specific to these populations. While global studies emphasize modifiable behavioral risk factors, limited attention has been given to how these factors manifest and interact in coastal and island populations, particularly in low and middle-income countries such as Indonesia. This gap highlights the need for targeted research that incorporates region-specific challenges, such as limited healthcare access, dietary changes, and occupational health risks among fishermen and other coastal workers, to inform more effective prevention and management strategies for CVD in these vulnerable populations.

Low and middle-income countries are undergoing an epidemiological transition with an increasing burden of non-communicable diseases, such as CVD. These nations face significant challenges, including inadequate healthcare infrastructure, limited resources for prevention and management, and high poverty levels. Health systems must prioritize screening and early detection of CVD, particularly in high-risk communities such as coastal and island populations, to

mitigate the disease’s economic and social impacts.³

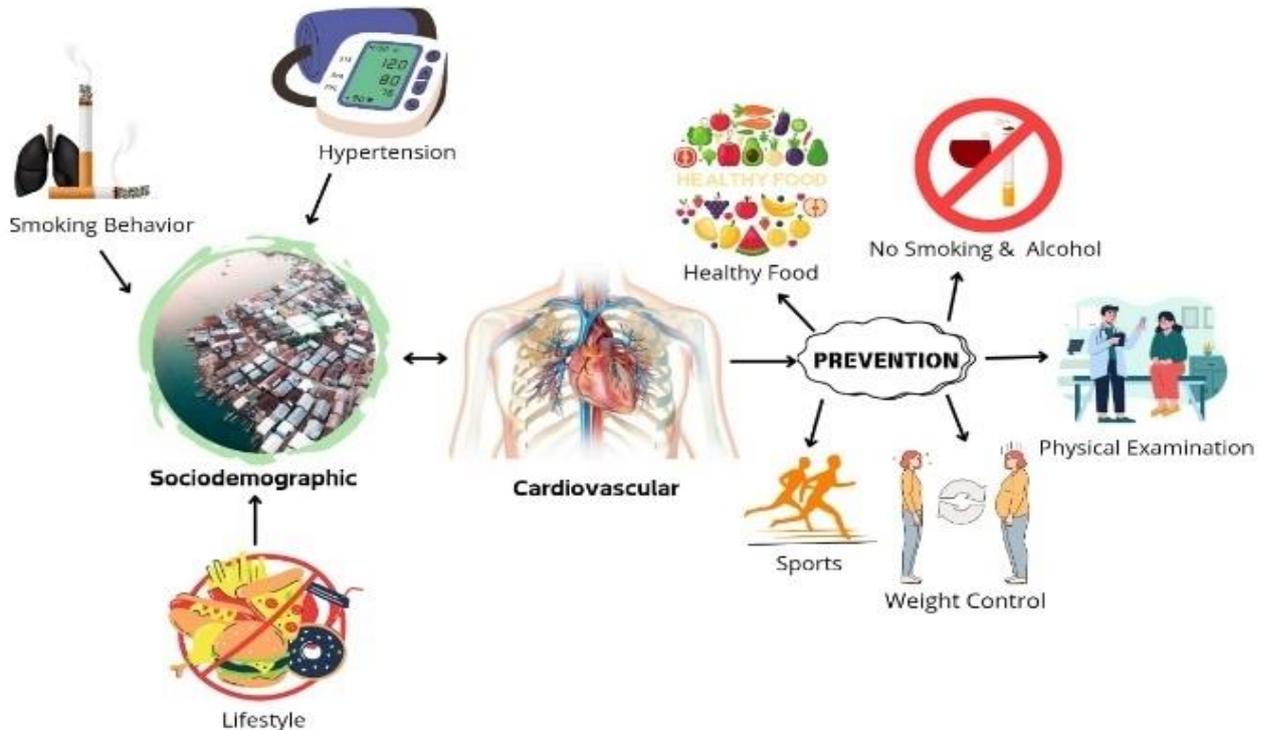
MATERIAL AND METHOD

This study employed a cross-sectional design to examine the prevalence and interrelationships of Cardiovascular Risk Factors (CRF) among healthy adults residing in coastal and island communities in North Konawe, Indonesia. The study included various independent variables, such as sociodemographic characteristics, lifestyle factors, physical examination results, and laboratory data, including blood pressure and lipid profiles. Respondents were selected through purposive sampling, covering eight sub-districts and 20 coastal villages, aged 20 to 70 years. Data were collected using standardized questionnaires and physical examinations performed by trained personnel. Ethical approval for this study was obtained from the Ethics Committee of the Ministry of Health of Kendari Polytechnic (approval number: DP.04.03/F.XXXVI.15/013/2024).

To examine the relationship between individual variables and CVD, a bivariate analysis was

first conducted using logistic regression to assess the association between each observed variable and CVD outcomes. This approach provided an initial understanding of the direct effects and statistical significance.

Subsequently, a multivariate analysis was performed (SEM) using Smart Partial Least Squares (SmartPLS) software. This method is particularly effective for examining the complex interactions between latent variables and their indicators, enabling the assessment of both direct and indirect effects. SmartPLS was used to explore the relationship between cardiovascular risk factors, which were categorized into sociodemographic, behavioral, and metabolic components, and the occurrence of CVD. Each latent variable was measured using multiple observed indicators, and path coefficients were calculated to determine the strength and significance of these relationships. This method ensures robust handling of data with minimal assumptions about the distribution while effectively managing collinearity among variables.



Source: Own Elaborate

Figure 1. Risk Factor of Cardiovascular Disease

0.935. This implies that higher LDL levels are moderately associated with the risk of CVD. Other metabolic variables, such as abdominal circumference, BMI, blood glucose, triglycerides, and HDL, were not statistically significant predictors ($p > 0.05$). Their Exp(B) values and wide confidence intervals further support the lack of strong association.

The Relationship of Cardiovascular Factor Risk (CFR) with The Incidence of CVD

This study shows (Figure 3) that the occurrence of CVD in the coastal populations of Konawe, Southeast Sulawesi, is influenced by three primary risk factor groups: sociodemographic, behavioral, and metabolic. Sociodemographic variables, including age, sex, and occupation, had a minimal impact on CVD incidence, with a coefficient of 0.036. In contrast, behavioral factors such as smoking, alcohol consumption, physical activity, medical history, and waist circumference had the most substantial effect, with a coefficient of 4.690, highlighting that unhealthy behaviors are the predominant contributors to increased risk of

CVD. Metabolic factors, including blood glucose levels, HDL cholesterol, LDL cholesterol, triglycerides, and body mass index, also played a significant role, with a coefficient of 2.135. These findings underscore the necessity of public health initiatives that prioritize behavioral modifications and metabolic condition management to lower the risk of CVD among coastal populations.

DISCUSSION

This study found a significant correlation between age and CVD risk in the coastal population of Soropia ($p = 0.043$; $p < 0.05$; $\text{Exp}(B) = 0.378$). Unexpectedly, older individuals showed a lower likelihood of CVD, contrary to the common view that aging increases the risk. This trend may reflect protective lifestyle or sociocultural factors, such as heart-healthy dietary habits and higher physical activity linked to local occupations and the environment.⁹⁻¹¹

Table 1. Relationship and Prevalence of Sociodemographic Factors with CVD in Coastal Residents in Konawe, Southeast Sulawesi

Risk Factor Group	Soropian Coastal Communities			
	Logistic Regression Variables in the Equation			
	Sig (2-sided)	Exp (B)	Lower Bound	Lower Bound
Sociodemographic Group Risk Factors:				
Age	0.043	0.378	0.148	0.969
Gender	0.448	2.476	0.238	25.752
Work	0.424	1.962	0.376	10.244

Source: Primary Data, 2024

Table 2. Relationship and Prevalence of Behavioral Factors with CVD in Coastal Residents in Konawe, Southeast Sulawesi

Risk Factor Group	Soropian Coastal Communities			
	Logistic Regression Variables in the Equation			
	Sig (2-sided)	Exp (B)	Lower Bound	Lower Bound
Risk Factor Behavior Group:				
History of PTM	0.024	0.158	0.032	0.782
Smoking Habits	0.926	0.913	0.134	6.206
Alcohol Consumption	0.528	2.765	0.118	64.914
Physical Activity	0.618	1,514	0.297	7.723

Source: Primary Data, 2024

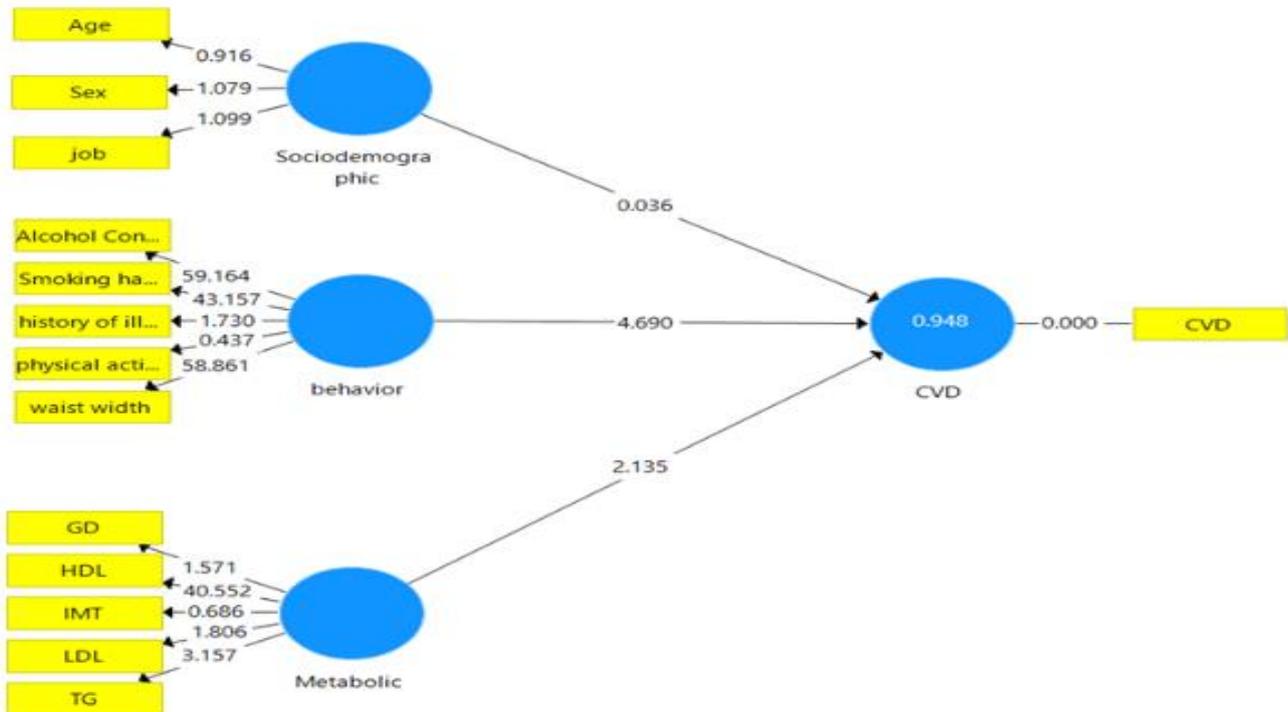
In contrast, sex and occupation showed no significant associations with CVD risk ($p= 0.448$ and $p=0.424$; $p>0.05$), despite the $\text{Exp}(B)$ values suggesting a non-significant tendency toward increased risk (2.476 and 1.962, respectively). The lack of statistical strength may result from homogeneity in work types and gender-related

behaviors within this community.¹²⁻¹⁵ These findings support previous evidence that broader determinants, such as socioeconomic status, cultural norms, and environmental conditions, can overshadow individual factors, including gender and occupation in shaping cardiovascular health.¹⁶⁻²⁰

Table 3. Relationship and Prevalence of Metabolic Risk Factors with CVD in Coastal Residents in Konawe, Southeast Sulawesi

Risk Factor Group	Soropian Coastal Communities			
	Logistic Regression Variables in the Equation			
	Sig (2-sided)	Exp (B)	Lower Bound	Lower Bound
Metabolic Risk Factor Group:				
Ab Dominal Circumference	0.342a	0.460	0.082	2.293
Body Mass Index (BMI)	0.344a	0.885 0.260 3.105	0.260	3.105
Blood Sugar	5.899a	0.054 0.947 3.192	0.947	3.192
Triglycerides	0.546a	0.149	0.688	344.712
HDL	2.385a	0.174	0.097	11.769
LDL	0.026a	0.615	0.147	1.525

Source: Primary Data, 2024



Source: Primary Data, 2024

Figure 3. The Relationship of Cardiovascular Factor Risk (CFR) with The Incidence of Cardiovascular Disease (CVD)

Future research should further investigate how cultural practices and environmental factors interact with traditional risk determinants to influence CVD in coastal populations.^{21,22} Identifying protective factors associated with aging can inform targeted prevention strategies and community-specific interventions to strengthen cardiovascular health.^{23,24}

The findings from the study on the coastal population of Soropia revealed a significant association between a history of NCDs and CVD risk. Specifically, the analysis showed a p-value of 0.024 ($p < 0.05$) and an Exp(B) of 0.158, indicating that individuals with a history of NCDs were less likely to develop CVD in this context. This inverse relationship may seem counterintuitive; however, it could be explained by increased health awareness and proactive management of cardiovascular risk factors among patients with prior NCD diagnoses. Such individuals may engage in more frequent healthcare visits, adopt healthier lifestyles, or adhere to medical recommendations, which collectively mitigate the risk of developing CVD.^{25,26}

In contrast, behavioral risk factors such as smoking, alcohol consumption, and physical activity did not show statistically significant correlations with CVD risk, with p-values of 0.926, 0.528, and 0.618, respectively ($p > 0.05$). Although the Exp(B) values for alcohol consumption (2.765) and physical activity (1.514) indicated possible trends toward increased risk, these associations were not statistically significant. This lack of significance may be attributed to the distinctive characteristics of the study population, where cultural or environmental influences might mitigate the effects of these behaviors on cardiovascular health. For instance, lower consumption levels, traditional lifestyles, and dietary practices may dilute the measurable effects of these risk behaviors.^{27,28} The absence of significant associations for smoking and physical activity further emphasizes the complexity of behavioral influences on CVD and highlights the necessity for further exploration of how these factors interact with sociodemographic and environmental variables in coastal communities.^{1,29,30}

The study on the coastal population of Soropia highlights the significant role of Low-Density Lipoprotein (LDL) in metabolic risk, with a p-value of 0.026 ($p < 0.05$) and an Exp(B) of 0.615.

These findings align with the existing literature, which links LDL to metabolic syndrome and cardiovascular diseases through mechanisms such as atherogenesis and lipid imbalance.^{26,31}

Dietary patterns in coastal communities, particularly seafood consumption rich in cholesterol, may elevate LDL levels and influence metabolic risk profiles.³² In contrast, traditional markers such as waist circumference, BMI, blood glucose, triglycerides, and HDL showed no significant associations ($p > 0.05$), suggesting that their effects may be modulated by environmental or sociodemographic factors unique to coastal populations.^{33,34} The absence of significant correlations between BMI and waist circumference, which are usually strong predictors of metabolic risk, further indicates the possible role of protective cultural or dietary practices that merit deeper investigation.³⁵

The weak association between HDL and metabolic risk challenges its presumed protective role, indicating the need to reassess its relevance in specific populations.^{31,36} The limited significance of markers beyond LDL suggests that genetic, environmental, and sociodemographic factors may play a greater role in shaping metabolic risk.^{37,38} Future studies should explore these interactions to inform the development of tailored interventions, including dietary education and lipid-lowering strategies, to address the unique metabolic challenges faced by coastal populations.^{36,39}

The findings of this study revealed that CVD among coastal populations in Konawe, Southeast Sulawesi, is influenced by three main groups of risk factors: sociodemographic, behavioral, and metabolic. Sociodemographic factors, including age, sex, and occupation, exhibited a relatively small influence on the occurrence of CVD, with a coefficient of 0.036. This suggests that while sociodemographic characteristics contribute to CVD risk, their impact is less significant than that of other factors, as supported by previous research indicating that socioeconomic status and demographic factors have a limited effect on cardiovascular health outcomes.^{40,41}

Among the examined factors, behavioral aspects such as smoking, alcohol consumption, physical activity, medical history, and waist circumference exerted the greatest impact, with a coefficient of 4.690. This finding underscores the crucial role of unhealthy lifestyle choices in

elevating CVD risk. The significant influence of these behavioral factors highlights the importance of addressing modifiable lifestyle habits to mitigate CVD risk in this population. Previous studies have consistently demonstrated that dietary patterns and physical activity play vital roles in preventing cardiovascular diseases.^{42,43} Furthermore, smoking and obesity are well-established risk factors for CVD, reinforcing the need for targeted public health initiatives aimed at promoting healthier behaviors.⁴⁴

Metabolic factors, such as blood glucose, HDL, LDL, triglycerides, and BMI, significantly contributed to CVD risk, with a coefficient of 2.135. These findings emphasize the importance of managing metabolic conditions, such as dyslipidemia and diabetes, as a comprehensive preventive strategy against CVD.⁴⁵ Existing literature shows that dyslipidemia and diabetes markedly increase cardiovascular risk, underscoring the need for systematic monitoring of metabolic markers.^{46,47} Overall, the findings highlight the importance of public health interventions focused on behavior modification and metabolic risk management to reduce CVD risk in coastal communities in Konawe.

This study emphasizes the multifactorial nature of CVD risk and the need for integrated strategies that combine behavioral modifications and metabolic health management to improve outcomes in vulnerable coastal populations. Public health initiatives should focus on education, early screening, and lifestyle adjustments to effectively reduce CVD prevalence in these communities.^{48,49,50}

CONCLUSION AND RECOMMENDATION

This study revealed that the incidence of CVD among coastal communities in Soropia, Konawe, Southeast Sulawesi, is influenced by sociodemographic, behavioral, and metabolic risk factors. Age was significantly associated with a reduced risk of CVD, whereas sex and occupation showed no notable influence. Among the behavioral factors, a history of NCDs was associated with a lower risk, whereas smoking, alcohol consumption, and physical activity did not exhibit significant associations. Within the metabolic category, LDL was the sole factor significantly contributing to metabolic risk, whereas other variables, including waist circumference, body mass index,

blood glucose, triglycerides, and HDL, showed no substantial effects.

These findings emphasize the need to implement community-based interventions tailored to resource-limited coastal settings. Public health programs should integrate screening and early detection with practical measures, such as nutrition education, smoking cessation, and the promotion of physical activity, aligned with local livelihoods. Strengthening primary healthcare with culturally appropriate health promotion is essential for reducing cardiovascular risk and ensuring the sustainability of interventions in vulnerable populations.

In practical terms, this study highlights the importance of translating research findings into actionable health policies and culturally sensitive strategies, such as encouraging seafood-based balanced diets, promoting physical activity through traditional occupations, and expanding accessible lipid and blood pressure monitoring services in coastal communities.

Nevertheless, this study had certain limitations. The cross-sectional design restricts causal inference, and the self-reported behavioral data may be subject to recall bias. Moreover, the findings are based on a specific coastal population, which may limit their generalizability to other regions. Future research should consider longitudinal designs to better establish causal relationships, explore genetic and environmental interactions, and evaluate the effectiveness of culturally adapted lifestyle modifications and community-based screening programs in resource constrained coastal settings.

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AUTHOR CONTRIBUTION

S was responsible for the conceptualization, methodology, and supervision of this study. LR handled the data curation, formal analysis, and initial draft preparation. RDU conducted the investigation, contributed to the visualization, and participated in the review and editing of the manuscript. I was involved in the software utilization, validation, and statistical analysis. ABB supervised the research, secured funding, and contributed to the review and editing of the final manuscript. S contributed to field coordination, community engagement, and implementation of data collection instruments. MFA assisted with the literature review, reference management, and interpretation of the results during manuscript preparation. All authors actively contributed to the research and manuscript preparation, ensuring the integrity and accuracy of the study. S = Syahrianti; LR = Lilin Rosyanti; RDU = Reni Devianti Usman; I = Ismail; ABB = Agus Bintara Birawida; S = Sumarheni; MFA = Muhammad Fahmi Aziz.

REFERENCES

1. Mboi, N. *et al.* The state of health in Indonesia's provinces, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Global Health*. 2022;10:e1632–e1645. [https://doi.org/10.1016/s2214-109x\(22\)00371-0](https://doi.org/10.1016/s2214-109x(22)00371-0)
2. Astutik, E., Puspikawati, S. I., Dewi, D. M. S. K., Mandagi, A. M. & Sebayang, S. K. Prevalence and Risk Factors of High Blood Pressure among Adultss in Banyuwangi Coastal Communities, Indonesia. *Ethiopian Journal of Health Science*. 2020;30:941–950. <https://doi.org/10.4314/ejhs.v30i6.12>
3. Mensah, G. A., Roth, G. A. & Fuster, V. The Global Burden of Cardiovascular Diseases and Risk Factors: 2020 and Beyond. *Journal American College of Cardiology*. 2019; 74:2529–2532. <https://doi.org/10.1016/j.jacc.2019.10.009>
4. Azzeri, A. *et al.* A Review of Published Literature Regarding Health Issues of Coastal Communities in Sabah, Malaysia. *International Journal Environmental Research and Public Health*. 2020;17:1–14. <https://doi.org/10.3390/ijerph17051533>
5. Kim, J. H. & Jang, S. N. Seafarers' Quality of Life: Organizational Culture, Self-efficacy, and Perceived Fatigue. *International Journal Environmental Research and Public Health*. 2018;15. <https://doi.org/10.3390/ijerph15102150>
6. Hong, X. *et al.* Prevalence and Clustering of Cardiovascular Risk Factors: A Cross-Sectional Survey Among Nanjing Adults in China. *BMJ Open*. 2018;8. <https://doi.org/10.1136/bmjopen-2017-020530>
7. Malik, R. *et al.* Midlife vascular risk factors and risk of incident dementia: Longitudinal Cohort and Mendelian Randomization Analyses in the UK Biobank. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*. 2021;17:1422–1431. <https://doi.org/10.1002/alz.12320>
8. Wu, J. *et al.* Prevalence and Clustering of Major Cardiovascular Risk Factors in China: A Recent Cross-sectional Survey. *Medicine (United States)*. 2016;95:1–10. <https://doi.org/10.1097/md.00000000000002712>
9. Amidei, C. B. *et al.* Association of Physical Activity Trajectories with Major Cardiovascular Diseases in Elderly People. *Heart*. 2022;108:360–366. <https://doi.org/10.1136/heartjnl-2021-320013>
10. Mou, C., Wang, Z. & Ke, Z. Exploring the Relationship Between Physical Activity and Multimorbidity: Insights from the CHARLS Database. *Research Square*. 2024. <https://doi.org/10.21203/rs.3.rs-5277243/v1>
11. Merz, A. A. & Cheng, S. Sex Differences in Cardiovascular Ageing. *Heart*. 2016;102: 825–831. <https://doi.org/10.1136/heartjnl-2015-308769>
12. Bolijn, R. *et al.* Gender-related Characteristics and Disparities in Estimated Cardiovascular Disease Risk in A Multi-Ethnic General Population: The HELIUS

- study. *International Journal of Cardiology*. 2021;327:193–200.
<https://doi.org/10.1016/j.ijcard.2020.11.041>
13. Cho, C.-M. & Lee, Y.-M. The Relationship Between Cardiovascular Disease Risk Factors and Gender. *Health (Irvine Calif)*. 2012;04:309–315.
<http://dx.doi.org/10.4236/health.2012.46051>
 14. Petersen, C. B. *et al*. Occupational Heavy Lifting and Risk of Ischemic Heart Disease and All-cause Mortality. *BMC Public Health*. 2012;12.
<https://doi.org/10.1186/1471-2458-12-1070>
 15. Nyberg, S. T. *et al*. Job Strain and Cardiovascular Disease Risk Factors: Meta-Analysis of Individual-Participant Data From 47,000 Men and Women. *PLoS One*. 2013;8:e67323.
<https://doi.org/10.1371/journal.pone.0067323>
 16. O'Neil, A., Scovelle, A. J., Milner, A. & Kavanagh, A. Gender/Sex as a Social Determinant of Cardiovascular Risk. *Circulation*. 2018;137:854–864.
<https://doi.org/10.1161/circulationaha.117.028595>
 17. Abdulaali, F. K., Jasim, A. K. & Mahmoud, R. A. Relationship Between Socio-Demographic Characteristics and the Employees' Knowledge About Occupational Hazards in Al Nasiriya Heart Center, Iraq: 2021-2022. *International Journal of Health Sciences*. 2022;13536–13542.
<https://doi.org/10.53730/ijhs.v6nS1.8381>
 18. Chung, W. & Kim, R. Differential Risk of Cognitive Impairment Across Paid and Unpaid Occupations in the Middle-Age Population: Evidence from the Korean Longitudinal Study of Aging, 2006–2016. *International Journal Environment Research Public Health*. 2020;17:3124.
<https://doi.org/10.3390/ijerph17093124>
 19. Zamani, N. Occupational and Environmental Factors Contributing to Knee Pain in Hospital Staff: Results from a Cross-Sectional Study in Iran. *Research Square*. 2024;1-13.
<https://doi.org/10.21203/rs.3.rs-5423234/v1>
 20. Nikolova, P., Danev, S., Kundurzhiev, T. & Madjarov, N. Screening of Pathophysiological Mechanisms and Psychological and Occupational Factors, Determining Risk of Cardiovascular Diseases in High-Risk Professions. *Acta Medica Bulgarica*. 2020;47:5–10.
<http://doi.org/10.2478/amb-2020-0038>
 21. Biswas, M., Rahaman, S., Biswas, T. K., Haque, Z. & Ibrahim, B. Association of Sex, Age, and Comorbidities with Mortality in COVID-19 Patients: A Systematic Review and Meta-Analysis. *Intervirolgy*. 2021;64:36–47.
<https://doi.org/10.1159/000512592>
 22. Hayashi, R., Iso, H., Cui, R. & Tamakoshi, A. Occupational Physical Activity in Relation to Risk of Cardiovascular Mortality: The Japan Collaborative Cohort Study for Evaluation for Cancer Risk (JACC Study). 2016;89:289–291.
<https://doi.org/10.1016/j.jpmed.2016.06.008>
 23. Félix, N. D. de C. *et al*. Analysis of the Concept of Cardiovascular Risk: Contributions to Nursing Practice. *Revista Brasileira Enfermagem*. 2022;75(4):1-8.
<https://doi.org/10.1590/0034-7167-2021-0803>
 24. Hazari, A. Effect of 8 Weeks Badminton Session on Cardiovascular and Neuromuscular Functions Among Older Adults in United Arab Emirates: A Quasi-Experimental Study. *F1000research*. 2023;28(12):1522.
<https://doi.org/10.12688/f1000research.142339.1>
 25. Basu, S. Non-Communicable Disease Management in Vulnerable Patients During Covid-19. *Indian Journal Medical Ethics*. 2020;5(2):103–105.
<https://doi.org/10.20529/ijme.2020.041>
 26. Amadi, P. U., Gu, H., Yin, K. & Zhang, D. Editorial: Lipid Metabolism and Human Diseases. *Frontiers in Physiology*. 2022;4:13.
<https://doi.org/10.3389/fphys.2022.1072>

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27. Ahmed, I. *et al.* Assessment of WASH Infrastructure in Schools in Central Sulawesi, Indonesia Using Structured Observations and Principal Interviews. *Journal of Water, Sanitation and Hygiene for Development*. 2023; 13(6); 375–390. <https://doi.org/10.2166/washdev.2023.147>.
28. Shapiro, M. D. & Fazio, S. Apolipoprotein B-Containing Lipoproteins and Atherosclerotic Cardiovascular Disease. *F1000research*. 2017;6:134. <https://doi.org/10.12688/f1000research.9845.1>
29. Yao, Y. *et al.* The Cardiovascular and Cerebrovascular Health in North China From 2006 to 2011: Results from the KaiLuan Study. *Frontiers in Cardiovascular Medicine*. 2021;8. <https://doi.org/10.3389/fcvm.2021.683416>
30. Budrevičiūtė, A. *et al.* Management and Prevention Strategies for Non-Communicable Diseases (NCDs) and Their Risk Factors. *Frontiers Public Health*. 2020;8. <https://doi.org/10.3389/fpubh.2020.574111>
31. Colivicchi, F. *et al.* Non-High-Density Lipoprotein Cholesterol Versus Low-Density Lipoprotein Cholesterol in Clinical Practice: ANMCO Position Paper. *Journal Cardiovascular Medicine*. 2021;22(8):609–617. <https://doi.org/10.2459/jcm.0000000000001175>
32. Hidaka, H. *et al.* Consumption of Nonfat Milk Results in a Less Atherogenic Lipoprotein Profile: A Pilot Study. *Annals of Nutrition and Metabolism*. 2012;61(2):111–116. <https://doi.org/10.1159/000339261>
33. Zhang, Y. *et al.* Association Between Cumulative Low-Density Lipoprotein Cholesterol Exposure During Young Adulthood and Middle Age and Risk of Cardiovascular Events. *JAMA Cardiology*. 2021;6(12):1406–1413. <https://doi.org/10.1001/jamacardio.2021>.

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34. Zhang, Y. *et al.* Global Occurrence, Distribution, and Ecological Risk Assessment of Psychopharmaceuticals and Illicit Drugs in Surface Water Environment: A Meta-analysis. *Water Research*. 2024;263:122165. <https://doi.org/10.1016/j.watres.2024.122165>
35. Shiffman, D. *et al.* LDL Subfractions Are Associated with Incident Cardiovascular Disease in the Malmö Prevention Project Study. *Atherosclerosis*. 2017;263:287–292. <https://doi.org/10.1016/j.atherosclerosis.2017.07.003>
36. Chary, A. Association of LDL-cholesterol Subfractions with Cardiovascular Disorders: A Systematic Review. *BMC Cardiovascular Disorder*. 2023;23(533):1–10. <https://doi.org/10.1186/s12872-023-03578-0>
37. Zhu, L. *et al.* The Correlation Between Lipoprotein(a) Elevations and the Risk of Recurrent Cardiovascular Events in CAD Patients with Different LDL-C Levels. *BMC Cardiovascular Disorder*. 2022;22(1):171. <https://doi.org/10.1186/s12872-022-02618-5>
38. Márk, L. *et al.* Non-HDL Cholesterol Goal Attainment and Its Relationship with Triglyceride Concentrations Among Diabetic Subjects with Cardiovascular Disease: A Nationwide Survey of 2674 Individuals in Hungary. *Atherosclerosis*. 2015;241(1):62–68. <https://doi.org/10.1016/j.atherosclerosis.2015.04.810>
39. O'Donoghue, M. L. *et al.* Lipoprotein(a) for Risk Assessment in Patients with Established Coronary Artery Disease. *Journal of the American College of Cardiology*. 2014;63(6):520–527. <https://doi.org/10.1016/j.jacc.2013.09.042>
40. Leopold, J. A. & Antman, E. M. Ideal Cardiovascular Health in Young Adults With Established Cardiovascular Diseases. *Frontiers in Cardiovascular Medicine*. 2022;

9:814610.

<https://doi.org/10.3389/fcvm.2022.814610>

41. Leening, M. J. *et al.* Sex Differences in Lifetime Risk and First Manifestation of Cardiovascular Disease: Prospective Population Based Cohort Study. *BMJ*. 2014;349:g5992-g5992.
<https://doi.org/10.1136/bmj.g5992>
42. Huffman, M. D. *et al.* Cardiovascular Health Behavior and Health Factor Changes (1988–2008) and Projections to 2020. *Circulation*. 2012;125(21):2595–2602.
<https://doi.org/10.1161/CIRCULATIONAHA.111.070722>
43. Nasiłowska-Barud, A. & Barud, M. Psychological Risk Factors for Cardiovascular Diseases. *Wiadomości Lekarskie*. 2020;73(9):1829–1834.
<https://wiadlek.pl/wp-content/uploads/archive/2020/WLek2009104.pdf>
44. Smith, G., Fitzgerald, G. & Thompson, D. Cardiovascular Health Behaviors and Risk Factors Among Argentine and American University Students. *International Journal of Public Health Science*. 2014;3(2):117.
<http://doi.org/10.11591/ijphs.v3i2.4683>
45. IuA, K. The Role of Statins in Prevention of Cardiovascular Diseases in Real Clinical Practice. *Doctor Ru*. 2021;20(11):17–27.
<https://doi.org/10.31550/1727-2378-2021-20-11-17-27>
46. Lemp, J. M. *et al.* Use of Lifestyle Interventions in Primary Care for Individuals with Newly Diagnosed Hypertension, Hyperlipidaemia or Obesity: A Retrospective Cohort Study. *Journal of the Royal Society of Medicine*. 2022;115(8):289–299.
<https://doi.org/10.1177/01410768221077381>
47. Goldberg, R. *et al.* Effects of Long-Term Metformin and Lifestyle Interventions on Cardiovascular Events in the Diabetes Prevention Program and Its Outcome Study. *Circulation*. 2022;145(22):1632–1641.
<https://doi.org/10.1161/CIRCULATIONAHA.121.056756>
48. Patnode, C. D., Redmond, N., Iacocca, M. O. & Henninger, M. Behavioral Counseling Interventions to Promote a Healthy Diet and Physical Activity for Cardiovascular Disease Prevention in Adults Without Known Cardiovascular Disease Risk Factors. *JAMA*. 2022;328(4):375.
<https://doi.org/10.1001/jama.2022.7408>
49. Al-Mayahi, A. M. M. Healthy Lifestyle Behaviors and Risk of Cardiovascular Diseases Among Nursing Faculty During COVID-19 Pandemic. *Revista Brasileira de Enfermagem*. 2023;76(1).
<https://doi.org/10.1590/0034-7167-2022-0372>
50. García-Lunar, I. *et al.* Effects of a Comprehensive Lifestyle Intervention on Cardiovascular Health: The TANSNIP-PESA Trial. *European Heart Journal*. 2022;43(38):3732–3745.
<https://doi.org/10.1093/eurheartj/ehac378>