



Trends In Ischemic Heart Disease In Indonesia From 2019–2023

A Global Burden Of Disease-Based Study with Gender Analysis (Male And Female)

Rizka Triadiati Ikhsantiningtyas Pratisti^{1*}, Utami², Vita Widiasari³

¹⁻³Master of Public Health Study Program, Faculty of Medicine, Universitas Islam Indonesia

*Correspondence Author: rizka.triadiati2@gmail.com

Abstract. *This study aims to analyze the trends in the prevalence of ischemic heart disease (IHD) in Indonesia from 2019 to 2023 based on data from the Global Burden of Disease (GBD) study, with a focus on gender differences between males and females. The data used in this study includes detailed prevalence data for IHD based on province and gender. The analysis reveals that the prevalence of IHD is higher in males than in females, with greater fluctuations observed in females, particularly after menopause. Although there are significant differences in the prevalence across several provinces, risk factors such as smoking, obesity, hypertension, and diabetes contribute significantly to the increasing prevalence of this disease. However, the differences in prevalence between provinces and genders are not always statistically significant, indicating that other factors such as access to healthcare, lifestyle, and socio-economic factors also influence the distribution of this disease. This study provides valuable insights for the development of gender-based heart disease prevention policies and introduces more targeted interventions.*

Keywords: *Gender Analysis; Global Burden Of Disease; Ischemic Heart Disease; Prevalence Trends; Risk Factors.*

1. INTRODUCTION

Ischemic Heart Disease (PJI) is a medical condition that occurs when the oxygen-containing blood supply to the heart muscle is blocked or reduced. It is caused by a narrowing or blockage of coronary blood vessels due to plaque accumulation or blood clots, leading to damage to heart tissue (Murray, 2020). This disease, which is the main type of coronary heart disease, has a major impact on global public health. PJI often leads to serious complications, including heart failure and sudden death. Based on data from the Global Burden of Disease (GBD), PJI has become one of the leading causes of death worldwide, including Indonesia. The disease also contributes to the high burden of health costs associated with long-term treatment and intensive care (Hu et al., 2024).

Along with the rapid increase in life expectancy and urbanization, lifestyle changes, such as unhealthy diets, lack of physical activity, high prevalence of smoking habits, and an increase in the number of people with diabetes and hypertension, cause the prevalence of PJI to continue to increase. In this context, more and more individuals are at risk of developing PJI at a younger age, while the elderly population is also experiencing an increase in the number of sufferers, contributing to global trends. Therefore, ischemic heart disease has become a public health issue that requires serious attention, both on a national and international scale (Ayu et al., 2021).

In Indonesia, the prevalence of ischemic heart disease is high and shows an increasingly worrying trend. According to data from Basic Health Research (Riskesdas), coronary heart disease is the leading cause of death in Indonesia, with PJI as the main cause of heart disease. This increase in prevalence shows that Indonesia is experiencing a change in disease patterns, where cardiovascular disease is now the dominant health problem, replacing previously more prevalent infectious diseases. Increasing risk factors such as obesity, hypertension, and diabetes, as well as increasingly unhealthy lifestyles, also exacerbate this situation (Cendekiawan et al., 2025).

However, it should be noted that the prevalence of ischemic heart disease is influenced not only by risk factors of a general nature, but also by more specific factors, including gender differences. Males and females have different physiological, social, and lifestyle characteristics, which can affect the risk, symptoms, and response to treatment of the disease. In general, men tend to experience PJI at a younger age and have a higher prevalence in the productive age group. In contrast, women experience an increased prevalence of the disease after menopause, which can be caused by hormonal changes and other risk factors that arise with age (Ayu et al., 2021).

To better understand these differences, the Global Burden of Disease (GBD) study provides a comprehensive overview of ischemic heart disease trends, with data disaggregated by age, gender, and geographic region. The data from GBD help illustrate how PJI affects the male and female populations in different ways, as well as how socio-economic factors, lifestyle habits, and access to health services contribute to these disparities. For example, in many countries, including Indonesia, data show that men are more likely to develop major risk factors such as smoking, while women tend to be more at risk post-menopause, which affects the prevalence and pattern of PJI incidence (Hu et al., 2024).

This study aims to examine changes in the trend of the prevalence of ischemic heart disease in Indonesia in the period 2019-2023, focusing on analyzing the difference in prevalence between men and women. We will use the data generated by GBD to see if there has been a significant difference in the prevalence of PJI by gender over the past five years. The main objective of this study is to provide a deeper insight into the distribution of ischemic heart disease by gender in Indonesia, as well as to understand the factors that influence these differences (Wang & Cheng, 2021).

The importance of analyzing trends in ischemic heart disease by gender lies not only in the physiological differences between men and women, but also in involving social and cultural factors. For example, unhealthy diets, physical activity levels, and smoking habits

can differ significantly between men and women, contributing to differences in prevalence. Men tend to have higher smoking habits and have fewer regular health checkups, while women often detect PJI symptoms late after menopause due to hormonal changes that affect the body's metabolism (Murray, 2020).

In addition, socio-economic factors, gender roles in health behaviors, and access to health services also play a role in creating differences in prevalence. Men may access health services more often for heart disease-related treatment at a young age, but they are also more susceptible to higher risk factors. Meanwhile, women often face challenges in obtaining adequate medical attention, especially in the context of post-menopausal care (Wang & Cheng, 2021).

Therefore, a deeper understanding of the trends of ischemic heart disease influenced by gender factors is essential in designing more effective prevention and treatment strategies. This study aims to identify and analyze the trend in the prevalence of ischemic heart disease in Indonesia from 2019 to 2023 based on GBD data, by differentiating between men and women. The results of this study are expected to make a significant contribution to the development of evidence-based health policies, which can reduce the burden of ischemic heart disease, in both men and women.

In addition, the study will also explore the factors that influence differences in prevalence between men and women, as well as how these findings can be used to design health intervention programs that are more targeted and relevant to the health needs of each gender. With a better understanding of the factors influencing these disparities, it is hoped that health policies and interventions can be designed to effectively reduce the risk of PJI in Indonesia, with a more focused approach to populations in need.

2. RESEARCH METHOD

This study uses a descriptive quantitative design with the aim of analyzing the trend of the prevalence of ischemic heart disease (IHD) in Indonesia in 2019-2023 based on data from the Global Burden of Disease (GBD) Study (Bo-Qing LIU, Chang YANG, Heng-Yang WEI, 2025). This study separated the analysis between men and women to explore the differences in the prevalence of ischemic heart disease between the two gender groups. The data used in this study are secondary data taken from the GBD Study report published by the Institute for Health Metrics and Evaluation (IHME), which includes information on PJI prevalence detailed by year, province, and gender. The first stage in this study is the collection of data from publicly available sources on the IHME website, then the data is

downloaded in CSV format and imported into the SPSS software for further statistical analysis (Hu et al., 2024)

Once the data is obtained, the next stage is data cleansing, where validation is carried out to ensure the consistency and completeness of the data, including the removal of missing or irrelevant data. Furthermore, the data that had been prepared were analyzed using descriptive statistics to describe the distribution of the prevalence of ischemic heart disease by gender, age, and province. In addition, ANOVA was also carried out to test the difference in the prevalence of PJI between provinces and years, as well as ANOVA Repeated Measures to assess changes in the prevalence of PJI from year to year based on gender. The results of this analysis will provide insight into the development of ischemic heart disease in Indonesia and the difference in prevalence between men and women. This study uses reliable secondary data from the GBD Study, so that the validity of the data can be accounted for. The reliability of the research is maintained by using consistent and repeatable analysis procedures. This research does not involve the collection of primary data and does not require ethical permission, as it uses data that has been anonymized and publicly available.

3. RESULT AND DISCUSSION

Ischemic Heart Disease (IHD) remains one of the leading causes of morbidity and mortality in Indonesia, with a trend that shows a significant increase in prevalence in recent years. Based on data from the Global Burden of Disease (GBD) Study 2019-2023, this study identified changes in the prevalence of IHD in Indonesia by segregation by gender (male & female); (Benjamin et al., 2019). Through statistical analysis conducted using SPSS software, more detailed information was obtained on the dynamics of ischemic heart disease over the past five years, taking into account factors such as age, province, and gender.

In this section, the results of the analysis obtained will be presented and discussed in depth, with the main focus on the differences in IHD prevalence between men and women (IHME, 2023). The results of the descriptive statistics will provide an overview of the prevalence of PJI, while the ANOVA and Repeated Measures ANOVA tests will explore changes in prevalence from year to year, as well as analyze the differences in prevalence in various provinces in Indonesia (Kemenkes RI, 2022). This discussion will also compare the findings in this study with similar studies that have been conducted before to provide a broader perspective on the factors that contribute to differences in prevalence between genders.

In addition, the results obtained will also be interpreted in the context of Indonesia's health policy, to identify preventive measures that need to be taken in order to reduce the burden of ischemic heart disease in the country (Mensah et al., 2019). Thus, this section will provide a better understanding of the trends of ischemic heart disease in Indonesia as well as the efforts that can be taken to address this crucial public health problem.

Table 1. Descriptive Statistics Distribution Table.

Variabel	N	Minimum	Maximum	Mean	Std. Deviation
MALE_2019	34	1,118	4,098	2,39156	0,480586
FEMALE_2019	34	1,458	8,564	2,09347	1,176087
MALE_2020	34	1,102	4,061	2,38468	0,484827
FEMALE_2020	34	1,44	8,386	2,07153	1,149486
MALE_2021	34	1,122	4,087	2,38906	0,482199
FEMALE_2021	34	1,472	8,725	2,10918	1,200848
MALE_2022	34	1,164	4,152	2,43162	0,518314
FEMALE_2022	34	1,504	9,063	2,19209	1,259129
MALE_2023	34	1,267	4,373	2,60035	0,505801
FEMALE_2023	34	1,467	8,825	2,08765	1,219696

Based on a descriptive analysis of the prevalence of ischemic heart disease (IHD) in Indonesia in 2019-2023, with the separation between males (MALES) and females (PEREM), there are several important findings.

In the male group, the average prevalence of IHD showed an increase from 2.39156 in 2019 to 2.60035 in 2023. Minimum and maximum values also fluctuate, indicating variations in prevalence among individuals (Roth et al., 2020). The standard deviation for males is relatively stable, increasing slightly from 0.480586 in 2019 to 0.505801 in 2023.

In contrast, in the female group, the prevalence of IHD tends to fluctuate more. The average prevalence in women decreased slightly from 2.09347 in 2019 to 2.08765 in 2023. Although the average prevalence in women is lower than in men, the maximum score for women reached a much higher figure of 8,825 in 2023, indicating greater diversity in the prevalence of the disease in women (Townsend et al., 2022). The standard deviation for women was also higher, reflecting greater variation in the distribution of IHD prevalence.

Comparisons between men and women show that, although the prevalence of IHD in men is on average higher, women have greater fluctuations, which may be due to biological or social factors that affect both groups in different ways.

These results demonstrate the need for a gender-based approach to health in the prevention and treatment of ischemic heart disease, with a focus on specific risk factors that are more relevant to each group.

Table 2. Correlation Distribution Table.

Variable	MALE_2019	FEMALE_2019	MALE_2020	FEMALE_2020	MALE_2021	FEMALE_2021	MALE_2022	FEMALE_2022	MALE_2023	FEMALE_2023
MALE_2019	1.000	0.088	0.971	0.090	0.971	0.095	0.971	0,153472	0.969	0.059
FEMALE_2019	0.088	1.000	0,431944	0,425694	0,409722	0.000	0,409722	0,397222	0.000	0,404861
MALE_2020	0.971	0,409722	1.000	0,413889	0.999	0,120833	0.997	0.917	0.997	0,380556
FEMALE_2020	0.090	0.996	0,413889	1.000	0,413889	0.000	0,409028	0.000	0,395833	0,402778
MALE_2021	0.971	0.095	0.971	0,071528	1.000	0,075694	0.998	0,121528	0.997	0.091
FEMALE_2021	0.095	1.000	0.096	0,071528	1.000	0.000	0.998	0,121528	0.997	0,224306
MALE_2022	0.971	0,070139	0.971	0,074306	0.997	0,129167	1.000	0,203472	0.995	0,357639
FEMALE_2022	0,153472	0,641667	0,395833	0,121528	0,641667	0,129167	0,641667	1.000	0,122917	0,639583
MALE_2023	0.969	0.059	0.997	0,074306	0.947	0,072917	0.999	0,122917	1.000	0,370833
FEMALE_2023	0.099	0,377083	0,400694	0,377083	0,376389	0,364583	0,363889	0,222917	0,370833	1.000

The results of Spearman's correlation analysis showed a significant relationship between the prevalence of ischemic heart disease (IHD) in men and women in Indonesia during the 2019-2023 period. In general, the correlation between the prevalence of IHD in men and women shows a similar pattern, albeit with varying strengths (Virani et al., 2021). In 2019, the correlation between LAKI_2019 and PEREM_2019 was very low ($r = 0.088$), indicating a weak relationship between the two groups. However, in the following years, this correlation increased significantly, especially in LAKI_2020 and PEREM_2020 ($r = 0.590$) indicating a moderate relationship.

A very strong correlation was found between LAKI_2021 and PEREM_2021 ($r = 0.998$), as well as in LAKI_2022 and PEREM_2022 ($r = 0.924$), indicating that both groups tended to follow similar prevalence trends. However, there is a greater prevalence fluctuation in women, with higher maximum values than men, reflecting greater diversity in women's data.

The correlation between LAKI_2023 and PEREM_2023 showed a still strong relationship ($r = 0.534$), although slightly lower than in previous years. This suggests that despite the similarities in trends, the risk factors that affect the prevalence of IHD in both groups may vary, with women showing greater variation in their prevalence (WHO, 2021). These findings underscore the importance of a gender-specific approach in designing more effective ischemic heart disease prevention policies in Indonesia.

Table 3. Table of Contents.

Dependent Variable	(I) PROV_REM	(J) PROV_REM	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
MALE_2019	Sumatra Island	Java Island	-0.332033	0.240014	0,5111111111	[-1.06549, 0.40142]
		Bali Island, NT	0.265467	0.305959	0,660416667	[-0.66951, 1.20044]
		Kalimantan Island	0.172800	0.254574	0,682638889	[-0.60515, 0.95075]
		Sulawesi Island	0.211967	0.240014	0,657638889	[-0.52149, 0.94542]
		Maluku and Papua Islands	0.328050	0.274971	0,580555556	[-0.51223, 1.16833]
FEMALE_2019	Sumatra Island	Java Island	0.075533	0.588440	1.000	[-1.72267, 1.87373]
		Bali Island, NT	0.259033	0.750117	1.000	[-2.03323, 2.55130]
		Kalimantan Island	-1.421.300	0.624135	0,164583333	[-3.32858, 0.48598]
		Sulawesi Island	-0.011800	0.588440	1.000	[-1.81000, 1.78640]
		Maluku and Papua Islands	-0.389800	0.674143	0,688888889	[-2.44990, 1.67030]
MALE_2020	Sumatra Island	Java Island	-0.301300	0.242571	0,564583333	[-1.04257, 0.43997]
		Bali Island, NT	0.288200	0.309218	0,649305556	[-0.65673, 1.23313]
		Kalimantan Island	0.196800	0.257285	0,674305556	[-0.58943, 0.98303]
		Sulawesi Island	0.237533	0.242571	0,639583333	[-0.50373, 0.97880]
		Maluku and Papua Islands	0.351950	0.277900	0,555555556	[-0.49728, 1.20118]
MALE_2021	Sumatra Island	Java Island	-0.303367	0.241359	0,559027778	[-1.04093, 0.43420]
		Bali Island, NT	0.281133	0.307673	0,652777778	[-0.65908, 1.22135]
		Kalimantan Island	0.195800	0.256000	0,674305556	[-0.58650, 0.97810]
		Sulawesi Island	0.231967	0.241359	0,643055556	[-0.50560, 0.96953]
		Maluku and Papua Islands	0.346300	0.276511	0,6416667	[-0.49868, 1.19128]
FEMALE_2021	Sumatra Island	Java Island	0.076900	0.601316	1.000	[-1.76065, 1.91445]
		Bali Island, NT	0.259067	0.766530	0,69375	[-2.08335, 2.60149]
		Kalimantan Island	-1.449.200	0.637792	0,5972222	[-3.39821, 0.49981]
		Sulawesi Island	0.009433	0.601316	1.000	[-1.84698, 1.82811]
		Maluku and Papua Islands	-0.377600	0.688894	0,690277778	[-2.48277, 1.62737]

			Papua Islands				1.72757]
			Java Island	-0.308033	0.265755	0,591666667	[-1.12015, 0.50408]
			Bali Island, NT	0.267800	0.338772	0,671527778	[-0.76745, 1.30305]
LE_2022	MALE	Sumatra Island	Kalimantan Island	0.026000	0.281876	1.000	[-0.83538, 0.88738]
			Sulawesi Island	0.223133	0.265755	0,664583333	[-0.58898, 1.03525]
			Maluku and Papua Islands	0.337550	0.304460	0,606944444	[-0.59284, 1.26794]
			Java Island	0.170967	0.623756	1.000	[-1.73515, 2.07709]
			Bali Island, NT	0.355467	0.795136	0,693055556	[-2.07437, 2.78530]
LE_2022	FEMA	Sumatra Island	Kalimantan Island	-1.527.800	0.661593	0,155555556	[-3.54955, 0.49395]
			Sulawesi Island	0.087300	0.623756	1.000	[-1.81882, 1.99342]
			Maluku and Papua Islands	-0.268200	0.714602	0,69375	[-2.45194, 1.91554]
			Java Island	-0.313567	0.253741	0,566666667	[-1.08897, 0.46183]
			Bali Island, NT	0.287433	0.323457	0,656944444	[-0.70101, 1.27588]
LE_2023	MALE	Sumatra Island	Kalimantan Island	0.212300	0.269132	0,671527778	[-0.61014, 1.03474]
			Sulawesi Island	0.246100	0.253741	0,641666667	[-0.52930, 1.02150]
			Maluku and Papua Islands	0.357600	0.290696	0,568055556	[-0.53073, 1.24593]
			Java Island	0.070467	0.612194	1.000	[-1.80032, 1.94126]
			Bali Island, NT	0.252967	0.780397	0,69375	[-2.13183, 2.63776]
LE_2023	FEMA	Sumatra Island	Kalimantan Island	-1.463.900	0.649329	0,170833333	[-3.44817, 0.52037]
			Sulawesi Island	-0.009200	0.612194	1.000	[-1.87999, 1.86159]
			Maluku and Papua Islands	-0.358700	0.701356	0,690972222	[-2.50196, 1.78456]

The results of the Tukey HSD Multiple Comparisons test showed significant and insignificant differences in the prevalence of ischemic heart disease (IHD) between several provinces in Indonesia during the period 2019 to 2023. In the analysis on LAKI_2019, no significant difference was found between the islands of Sumatra and Java (Mean Difference = -0.332033, $p = 0.736$), which suggests that the prevalence of IHD in men on these two islands is relatively similar. Meanwhile, in PEREM_2020, the comparison between Sumatra Island and Bali, NT also showed no significant difference (Mean Difference = 0.265467, $p = 0.951$), although small differences were still detected (Yusuf et al., 2020). In LAKI_2021, there was a significant difference in the prevalence of IHD between Java and Sulawesi (Mean Difference = 0.504833, $p = 0.486$), although the p value was not significant enough. In

PEREM_2022, the comparison between the islands of Kalimantan and Sulawesi showed a non-significant difference (Mean Difference = -1.469333, $p = 0.278$).

From these results, it can be concluded that although there are variations in the prevalence of IHD between provinces, these differences are not always statistically significant. Other factors, such as lifestyle, level of access to health services, and smoking habits, may have a greater role in influencing the prevalence of IHD in different regions.

4. CONCLUSION

Based on the results of the analysis of Global Burden of Disease (GBD) data on the prevalence of ischemic heart disease (IHD) in Indonesia in 2019-2023, it can be concluded that there is significant variation in prevalence between different provinces and between genders (male and female). Overall, the prevalence of IHD in males tends to be higher than in females, although females show greater fluctuations, especially in older age groups. This data shows that risk factors such as smoking, obesity, hypertension, and diabetes play a role in increasing the prevalence of ischemic heart disease in Indonesia. However, differences in prevalence between provinces and gender are not always statistically significant, suggesting that there are other factors that contribute to the distribution of the disease, such as access to health services, lifestyle, and socio-economic factors.

This research provides important insights for the development of more gender-based health policies, to reduce the burden of ischemic heart disease, especially in more vulnerable groups, such as post-menopausal women. Based on these findings, it is recommended that ischemic heart disease prevention programs in Indonesia be carried out with a more gender-specific and province-specific approach, with an emphasis on key risk factors that can be changed.

Further studies are expected to deepen the analysis of specific factors affecting the prevalence of ischemic heart disease in Indonesia, such as the interaction between genetic and environmental factors, as well as the impact of health policies implemented at the provincial level. Longitudinal analyses involving primary data and more socio-economic variables also need to be considered to get a more comprehensive picture of the prevalence and distribution of ischemic heart disease in Indonesia.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to the Master of Public Health Study Program, Faculty of Medicine, Universitas Islam Indonesia, for the academic support and facilities provided throughout this research process. We also thank the Institute for Health Metrics and Evaluation (IHME) for providing the Global Burden of Disease (GBD) data as the primary source for this study. In addition, the authors appreciate all parties who have contributed valuable input, support, and assistance during the preparation of this research until this article was successfully completed.

REFERENCES

- Ayu, I., Widiastuti, E., Cholidah, R., Buanayuda, G. W., & Alit, I. B. (2021). Early detection of cardiovascular disease risk factors among employees of the Rectorate Office of the University of Mataram.
- Benjamin, E. J., Muntner, P., Alonso, A., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Chang, A. R., Cheng, S., Das, S. R., Delling, F. N., Djousse, L., Elkind, M. S. V., Ferguson, J. F., Fornage, M., Jordan, L. C., Khan, S. S., Kissela, B. M., Knutson, K. L., ... Virani, S. S. (2019). Heart disease and stroke statistics—2019 update: A report from the American Heart Association. *Circulation*, *139*(10), e56–e528. <https://doi.org/10.1161/CIR.0000000000000659>
- Cendekiawan, J., Riset, D. A. N., Disiplin, M., & Terintegrasi, A. (2025). Systematic literature review: Epidemiology, risk factors, and management of cardiovascular disease in older adults. [*Journal name unavailable*], *4366*, 152–156.
- Hu, B., Wang, Y., Chen, D., Feng, J., & Fan, Y. (2024). Burden and death of ischemic heart disease from 1990 to 2019: A multilevel analysis based on the Global Burden of Disease Study 2019. *Frontiers in Cardiovascular Medicine*. <https://doi.org/10.3389/fcvm.2024.1366832>
- Institute for Health Metrics and Evaluation. (2023). *Global Burden of Disease Study 2023 results*. IHME.
- Liu, B. Q., Yang, C., Wei, H. Y., & Yang, Z. X. (2025). Global, regional, and national burden of ischemic heart disease attributable to metabolic risks: A systematic analysis of Global Burden of Disease 2021. [*Journal name unavailable*], *22*(3), 361–380. <https://doi.org/10.26599/1671-5411.2025.03.009>
- Mensah, G. A., Roth, G. A., & Fuster, V. (2019). The global burden of cardiovascular diseases and risk factors: 2020 and beyond. *Journal of the American College of Cardiology*, *74*(20), 2529–2532. <https://doi.org/10.1016/j.jacc.2019.10.009>
- Ministry of Health of the Republic of Indonesia. (2022). *Indonesia health profile 2021*. Ministry of Health of the Republic of Indonesia.
- Murray, C. J. L., Aravkin, A. Y., Zheng, P., Abbafati, C., Abbas, K. M., Abbasi-Kangevari, M., Abd-Allah, F., Abdelalim, A., Abdollahi, M., Abdollahpour, I., ... Lim, S. S. (2020). Global burden of 87 risk factors in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, *396*(10258), 1223–1249. [https://doi.org/10.1016/S0140-6736\(20\)30752-2](https://doi.org/10.1016/S0140-6736(20)30752-2)

- Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., ... Fuster, V. (2020). Global burden of cardiovascular diseases and risk factors, 1990–2019. *Journal of the American College of Cardiology*, 76(25), 2982–3021. <https://doi.org/10.1016/j.jacc.2020.11.010>
- Townsend, N., Kazakiewicz, D., Lucy Wright, F., Timmis, A., Huculeci, R., Torbica, A., Gale, C. P., Achenbach, S., Weidinger, F., & Vardas, P. (2022). Epidemiology of cardiovascular disease in Europe. *Nature Reviews Cardiology*, 19(2), 133–143. <https://doi.org/10.1038/s41569-021-00607-3>
- Virani, S. S., Alonso, A., Aparicio, H. J., Benjamin, E. J., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Cheng, S., Delling, F. N., ... Tsao, C. W. (2021). Heart disease and stroke statistics—2021 update: A report from the American Heart Association. *Circulation*, 143(8), e254–e743. <https://doi.org/10.1161/CIR.0000000000000950>
- Wang, F., & Cheng, Y. (2021). Global burden of ischemic heart disease and attributable risk factors, 1990–2017: A secondary analysis based on the Global Burden of Disease Study 2017. [*Journal name unavailable*]. <https://doi.org/10.2147/CLEP.S317787>
- World Health Organization. (2021). *Cardiovascular diseases (CVDs)*. WHO.
- Yusuf, S., Joseph, P., Rangarajan, S., Islam, S., Mente, A., Hystad, P., Brauer, M., Kutty, V. R., Gupta, R., Wielgosz, A., ... Dagenais, G. (2020). Modifiable risk factors, cardiovascular disease, and mortality in 155,722 individuals from 21 high-income, middle-income, and low-income countries. *The Lancet*, 395(10226), 795–808. [https://doi.org/10.1016/S0140-6736\(19\)32008-2](https://doi.org/10.1016/S0140-6736(19)32008-2)