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Comparison of Clinical Outcomes After Coronary Artery Bypass Grafting (CABG) With Percutaneous Coronary Intervention (PCI) in Coronary Artery Disease (CAD) Patients With Kidney Disorders: Systematic Review

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ABSTRACT
According to data from the WHO, heart disease continues to be the top cause of mortality worldwide. The 2018 Riskesdas shows that the prevalence of heart disease, including CAD, based on doctors' diagnoses in Indonesia is 1,5%. Management measures in CAD patients are CABG or PCI. The research design used in this study was a literature review using a systematic review method. A systematic literature review comparing CABG and PCI costs is needed to determine optimal therapeutic options in CAD patients. For articles published during the last ten years, a literature search was done using four databases: PubMed, SagePub, Google Scholar, and Science Direct. Based on the Preferred Reporting Items for Systematic Review and Meta-Analyses Protocol (PRISMA-P) 2020 protocol, a literature review was conducted. Eight texts in all met the inclusion and exclusion criteria for the study. Five literatures stating that CABG is better, two other literatures stating that there is no significant post-rehabilitation difference between CABG and PCI, and one literature stating that PCI has better survival after 5 years in CAD patients with impaired renal function. CABG is considered more effective and is recommended as the primary treatment option in CAD patients with a kidney disorder. Nevertheless, PCI can be utilized as an alternate therapy in CAD patients when kidney function and concomitant illnesses are considered.

Keywords: CABG, Clinical Outcome, Coronary Artery Disease, Impaired Kidney Function, PCI.

INTRODUCTION

Coronary artery disease is one of the most prevalent cardiovascular conditions people experience (CAD) (Mehvari et al., 2024). The Indonesian Ministry of Health estimates the prevalence in Indonesia to be between 352,618 and 442,674 for men and women, respectively. The myocardium receives insufficient blood and oxygen when there is coronary artery disease (Khan et al., 2024). The myocardium's blood flow and oxygen supply are disrupted as a result (Picano et al., 2024).

Coronary artery disease is brought on by plaque buildup in the arteries that supply blood to the heart (Alisherovich, 2024). This plaque is made up of cholesterol deposits (Okan & Topaloglu, 2024). Over time, plaque buildup causes the arteries' inner diameter to close, resulting in coronary disease (Müftüoğulları et al., 2024). Huon Gray divides coronary heart disease into three groups: angina pectoris, acute myocardial infarction, and silent ischemia (asymptomatic) (heart attack) (Chang et al., 2022).

Due to the high rates of morbidity and mortality brought on by CAD, it is imperative to take extra precautions when trying to improve the clinical results for CAD patients and when using medications related to these patients' clinical outcomes. Patients with coronary artery disease frequently undergo Coronary Artery Bypass Grafting (CABG) and Percutaneous Coronary Intervention (PCI), two surgical procedures (PCI). The history of vascular disease, mortality, repeat revascularization, stroke, and myocardial infarction can all be decreased by this surgical technique. In patients with coronary heart disease, CABG is utilized as the first step in coronary revascularization (Lin et al., 2024). Still, PCI is recommended if the patient has inflammation, uremia, or anemia and has reduced renal function (Guo et al., 2020).

There have been several studies comparing CABG and PCI surgery on the clinical outcomes of CAD patients conducted worldwide (Zhai et al., 2019). Still, publications in the form of a literature review have yet to address the subject by considering renal function (Ochoa-Arvizo et al., 2023). It is deemed crucial to conduct a systematic literature review to get complete and accurate information that will serve as the foundation for future CAD case management (Al Naqbi et al., 2024). The clinical outcomes of CAD patients with decreased renal function were analyzed, including the death rate from various causes, recurrent revascularization, and myocardial infarction, which led the authors to conduct research using a systematic literature review method.

METHODS

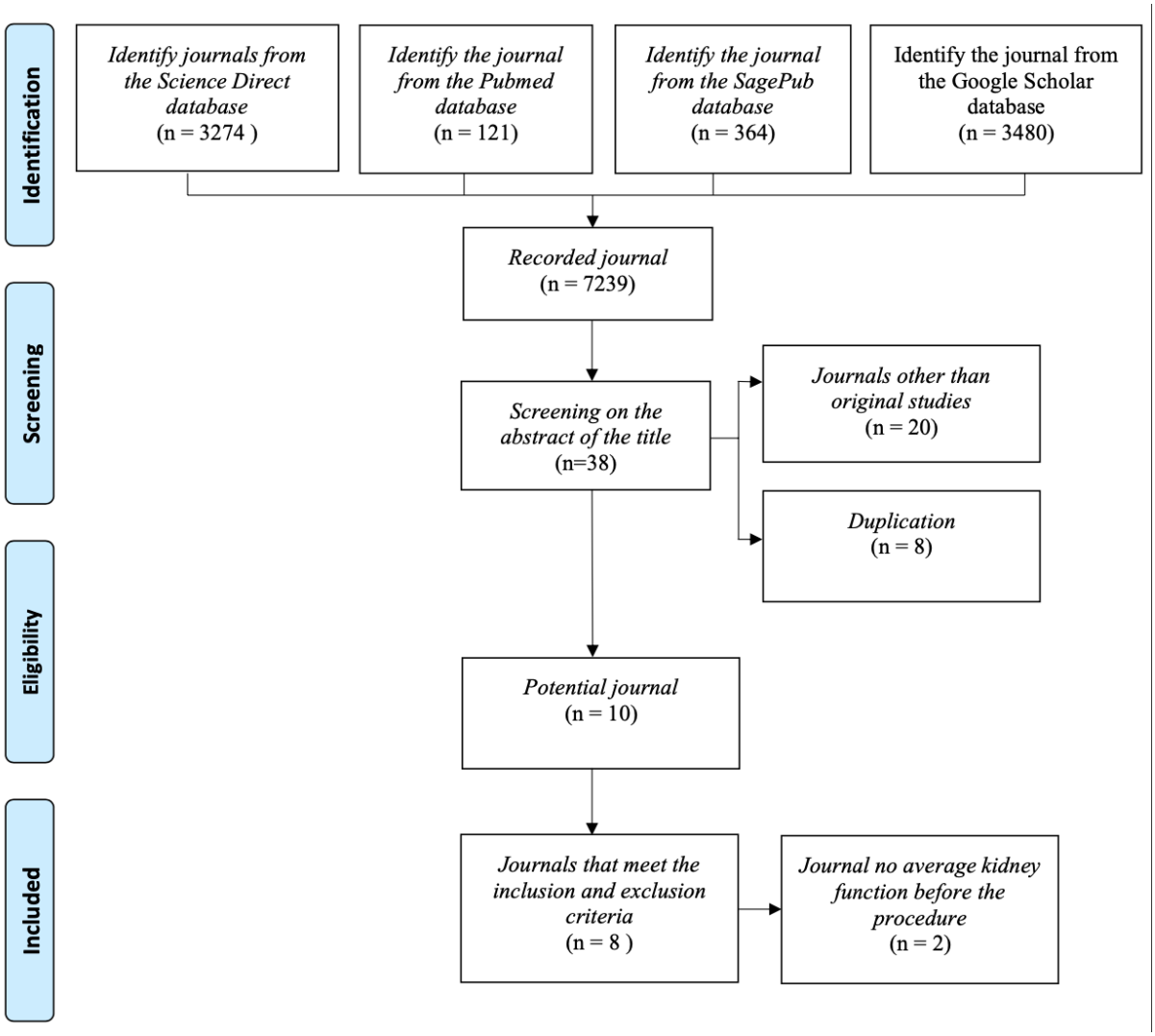
Based on the 2020 PRISMA checklist, locating and choosing literature was conducted methodically. In December 2022, a literature search was conducted. Four electronic databases—ScienceDirect, PubMed, SagePub, and Google Scholar—were included in the search area. According to Table 1, keyword combinations were chosen using the research PICO criterion.

Table 1. PICO Literature Search Strategy

Population	Coronary Artery Disease
Intervention	Coronary Artery Bypass Grafting
Comparison	Percutaneous Coronary Intervention
Outcome	Impaired renal function (Creatinine/Glomerular Filtration Rate), death, myocardial infarction, revascularization

Operands are all keywords. As can be seen in Table 2 below, a total of 7239 items of literature were located based on searches in the four research databases using the keywords entered.

Table 2. Systematic Review Flow Diagram



The search results were then modified by the following research inclusion criteria: Patients with CAD who also underwent revascularization and decreased renal function were included in the clinical outcomes following CABG and PCI operations. The studies also met the following criteria: 1) they were published within the previous ten years; 2) they involved CAD patients with CKD complications; 3) they involved deaths or myocardial infarctions; and 4) they were sourced from the Scopus, PubMed, Google Scholar, and Science Direct databases. Following literature selection, exclusion criteria were used, which comprised the following: 1) literature on narrative reviews, meta-analysis reviews, and article reviews; 2) Avoid using English; 3) utilizing samples from patients undergoing CABG and PCI who were both males and women who were hospitalized; 4) in both the male and female populations who didn't perform CABG and PCI.

Articles modified to include the keywords, inclusion and exclusion criteria will be extracted from search engines and converted into a summary in the data extraction table. The identity of the researcher, publication year, study title, design, population, and sample, assessed clinical outcomes, and research description is all included in the data extraction table.

The Joanna Briggs Institute's (JBI) critical assessment tools for Randomized Clinical Trials will be used to assess and rate the quality of papers that meet the requirements for research (RCT). Articles are categorized as "good," "moderate," or "poor" depending on how much of the total JBI score they receive. A list of randomized controlled trials with 13 questions was used to conduct the evaluation.

Table 3. JBI Assessment Checklist for Randomized Clinical Trials

No.	Evaluation
1.	Was the proper randomization used for allocating participants to treatment groups?
2.	Are allocations for treatment groups hidden?
3.	In the beginning, were the treatment groups comparable?
4.	Did the participants need to learn about the treatment assignment?
5.	Do those giving the treatment need to be made aware of the treatment assignment?
6.	Did the outcome assessor not know about the course of treatment?
7.	Other than the intervention of interest, were the treatment groups administered the same care?
8.	Is the follow-up finished? And if not, were the variations in follow-up between the groups properly examined and explained?
9.	Participants underwent analysis in randomized groups.
10.	The treatment groups' outcomes were they assessed in the same ways?
11.	Are outcome measures carried out reliably?
12.	Does the research use proper statistical analysis?
13.	Was the trial's design adequate, and were any RCT design Standards violations—such as parallel-group person randomization—accounted for during its execution and analysis?

RESULTS AND DISCUSSION

Data Extraction

The researchers will harvest data from 8 journals altogether. Examining the common elements employed allows for journal extraction. The author and publication year, the subject group, gender, age, the number of occurrences (death from various causes, revascularization, myocardial infarction, kidney function), and the conclusions were all noted. Table 4 shows the summary as follows:

Table 4. Data Extraction Results

Author	Subject Group	Number of Events, Percentage			Conclusion
		Age	Gender (M/F)	Death from various causes	
(Roberts et al., 2017)	CABG	62 (53,71)	M	8 (1.4%)	This study demonstrated no significant difference in mortality between CABG and PCI, except for a reduced risk of death in CKD patients treated with CABG.
	PCI	64 (56,72)	M	13 (0.8%)	
	P-*Value*	<0.0001	<0.0001	0.27	
(Biancari et al., 2014)	CABG	46 (3,9)	F	6,0%	The death rate is 30 times higher after CABG compared to PCI. PCI is associated with a trend toward better survival after 5 years.
	PCI	45 (4,5)	F	1,5%	
	P-*Value*	<0.0001	0.18	0,017	
(Giustino et al., 2018)	CABG	73 (7.8)	M	17 (3%)	There was no appreciable difference between repeated revascularizations in the main side effects of PCI compared to CABG, even though the revascularization rate was lower during the follow-up period following CABG compared to PCI. At 30 days after PCI, the incidence of acute renal failure was considerably decreased.
	PCI	73 (7.8)	M	11 (2%)	
	P-*Value*	<0.0001	<0.0001	<0.0001	
(Freitas et al., 2019)	CABG	69 (61−76)	M	73 (25,3%)	Compared to PCI, CABG had a significantly decreased incidence of all-cause death,
	PCI	69 (60−77)	M	18 (29,6%)	

	P-*Value*	<0.001	0.028	0,212	myocardial infarction, and stroke after 5 years (HR: 0.74; 95% CI: 0.56 to 0.98; p = 0.036).
(Kim et al., 2015)	CABG	62.2 (9.9)	M	21 (12.4%)	CABG has the lowest incidence of revascularization and Major Adverse Cardiac, and Cerebral Events (MACCE) compared to PCI.
	PCI	60.8 (11.3)	M	19 (14.6%)	
	P-*Value*	0.38	0.82	0.31	
(Sugumar et al., 2014)	CABG	68 (11,7)	F	13.5%	In this study, CABG had a lower death rate than PCI and had the potential to offer long-term survival after a year. There is a tendency for long-term mortality with PCI in patients with coronary disease, as shown in individuals with significant renal impairment.
	PCI	69 (11,4)	F	18.9%	
	P-*Value*	0.78	0.48	0.80	
(Chan et al., 2015)	CABG	75 (7.5%)	M	141 (15.8%)	This study showed that the CABG group had lower revascularization and mortality rates than the PCI group within 3 years.
	PCI	75 (9.4%)	M	192 (21,5%)	
	P-*Value*	0.69	0.54	0,002	
(Chang et al., 2013)	CABG	74 (7.5%)	F	8,87%	This study demonstrates that death and revascularization rates are lower following CABG than after PCI at 5 years. PCI might be less successful in individuals with CKD due to elevated inflammation, uremia, or anemia. CABG is employed as the initial coronary revascularization method in patients with
	PCI	74.4 (7.5%)	F	9,13%	
	P-*Value*	-	-	-	

	multivessel chronic heart disease.

COMPARISON OF THE EFFECT OF CABG INTERVENTION WITH PCI ON DEATH CAUSES DUE TO VARIOUS CAUSES

Each literature review mentioned in Table 4 identified up to 8 studies showing a difference between the percentage of CABG and PCI affecting mortality in patients with coronary artery disease. According to two investigations, particularly by Roberts et al., the death rate increased more in the PCI group. In contrast, a study by Biancari et al. found that PCI patients died less frequently than CABG patients.

Table 5. Comparison of the mortality effects of CABG and PCI treatments

Author	Number of Events and Percentage of CABG	Number of Events and Percentage of PCI	P *value*
(Roberts et al., 2017)	1,4%	0,8%	0,27
(Biancari et al., 2014)	6,5%	1,5%	0.01
(Giustino et al., 2018)	3%	2%	0.01
(Freitas et al., 2019)	25,3%	29,6%	0.21
(Kim et al., 2015)	12,4%	14,6%	0,31
(Sugumar et al., 2014)	13,5%	18,9%	0,80
(Chan et al., 2015)	15,8%	21,5%	0,02
(Chang et al., 2013)	8,87%	9,13%	-

COMPARISON OF THE EFFECT OF CABG INTERVENTION AND PCI ON REPEATED REVASCULARIZATION EVENTS

Table 5 summarizes five studies in total, individuals with coronary artery disease and reduced kidney function may need new revascularization procedures. These patients may have clinical results in the form of repeated revascularization. Researchers Roberts et al., Biancari et al., Kim et al., Chan et al., and Chang et al. found similar results showing that the PCI group had a greater risk of revascularization.

Table 6. Comparison of the effect of CABG intervention with PCI on repeated revascularization

Author	Number of Events and Percentage of CABG	Number of Events and Percentage of PCI	P *value*
(Roberts et al., 2017)	1,2%	2,2%	0,13
(Biancari et al., 2014)	1,3%	3%	0.34
(Kim et al., 2015)	0,6%	11,5%	0,01
(Chan et al., 2015)	1,2%	16,4%	0,01
(Chang et al., 2013)	1,76%	8,05%	-

COMPARISON OF THE EFFECT OF CABG INTERVENTION AND PCI ON MIOCARD INFARCTION

As listed in Table 4.7, 8 literatures cover clinical outcomes in the form of myocardial infarction. Only one of the eight pieces of literature—the study by Biancari et al.—shows the same proportion of myocardial infarction occurrences. One study of Kim et al. indicates no percentage of myocardial infarction occurrences in CABG. Giustino et al. found a greater risk of myocardial infarction in CABG, in contrast to one research. In contrast, five other studies—Roberts et al., Freitas et al., Sugumar et al., Chan et al., and Chang et al.—found that the PCI group experienced more myocardial infarction occurrences than the CABG group did.

Table 7. Comparison of the effect of CABG intervention with PCI on myocardial infarction

Author	Number of Events and Percentage of CABG	Number of Events and Percentage of PCI	P *value*
(Roberts et al., 2017)	41,8%	46,8%	0,01
(Biancari et al., 2014)	19,1%	19,1%	1,00
(Giustino et al., 2018)	6,6%	4,0%	0,27
(Freitas et al., 2019)	23%	30%	0,7
(Kim et al., 2015)	0%	3,8%	0,22

(Sugumar et al., 2014)	35,1%	43,2%	0,41
(Chan et al., 2015)	3,3%	13,1%	0,01
(Chang et al., 2013)	29%	30,9%	-

When clinical outcomes from eight investigations of individuals with coronary artery disease and impaired renal function were compared, differences were seen at each analyzed clinical outcome point. In contrast, five literature studies found better CABG, and one literature review found better PCI in terms of long-term survival. Two literature reviews revealed no significant difference in the clinical outcome aspect of the incidence of mortality from different causes. As many as five studies indicate a higher degree of revascularization risk in the PCI group regarding the clinical outcome element of revascularization occurrences. Six studies demonstrate that CABG is superior to PCI in terms of clinical outcomes following myocardial infarction, one study shows equally impressive findings. One study demonstrates the superiority of the PCI group over CABG.

Finding efficient treatment plans for patients with renal function and coronary artery disease is the aim of this investigation. In CAD patients, renal impairment carries a substantial risk of death and future coronary events. This study found that CABG increases the long-term survival of cardiovascular disease patients with impaired renal function. The overall combined result of selecting CABG as the initial method for coronary disease revascularization was equivalent to the necessity for more frequent revascularization. Compared to PCI, CABG has a somewhat decreased risk of revascularization.

These results imply that PCI may be marginally less successful than CABG in the population with significantly impaired renal function and an eGFR (eGFR less than 30 ml/min/1.73 m2). The sample of patients for PCI appeared to have a greater rate of myocardial infarction in this research. In a group of patients with multivessel CAD, CABG is related to a reduced risk of dying compared to medical therapy for individuals with mild, moderate, and severe disease. More extensive registry analyses have shown that CABG has a mortality advantage over PCI for multivessel disease in patients with impaired renal function. The main arguments in favor of PCI are that CABG is a major procedure with the possibility of significant operational mortality and morbidity (Armstrong, 2006). Currently, PCI is primarily used in patient groups as an alternate therapy to CABG or as an acute emergency treatment for coronary disease (Manuca et al., 2024). According to this data, CABG is a more resilient surgery than PCI (Doenst et al., 2019). Few studies studied the result following CABG in patients between the ages of 40 and 50, and they estimated the 10-year survival rate to be around 75%.

In the group with an eGFR of 30-59 mL/min/1.73 m2, the mean age of patients receiving CABG was 1.5 years higher, although significantly more patients with prior MI underwent PCI (Li et al., 2024). With the most severe renal impairment (less than 30 mL/min/1.73 m2), dialysis was necessary in 35% of PCI patients compared to 23% of CABG patients ($p = 0.17$). Patients having PCI had an average of around one-fourth of the lesions addressed during the index operation across all three strata of renal function. There was a tendency toward more significant long-term mortality with PCI in the patient group with an eGFR of 30-59 mL/min/1.73 m2 and an eGFR less

than 30 mL/min/1.73 m2. However, PCI involves a significant risk of long-term death in individuals with mild, moderate, or severe renal impairment. According to current recommendations, individuals with coronary artery disease who are ineligible for CABG should be given the option of PCI, particularly if they have a history of postoperative inflammation and uremia. Because of these factors, CABG is still preferred over PCI for treating coronary artery disease in individuals with impaired renal function.

CONCLUSION

The CABG surgery offers better long-term survival results than PCI in terms of the risk of clinical outcomes in myorcardial infarction and revascularization, according to the systematic literature evaluation that has been undertaken. Due to the risk of long-term death, patients with coronary disease and an eGFR less than 30 mL/min/1.73 m2 are less likely to benefit from PCI. In CAD patients with impaired kidney function, PCI intervention may be employed as an alternative therapy given surgical inflammation, and uremia history.

REFERENCES

Al Naqbi, H., Bahroun, Z., & Ahmed, V. (2024). Enhancing Work Productivity through Generative Artificial Intelligence: A Comprehensive Literature Review. *Sustainability*, *16*(3), 1166.

Alisherovich, T. T. (2024). ISCHEMIC HEART DISEASE. *Proceedings of International Conference on Educational Discoveries and Humanities*, *3*(2), 156–159.

Armstrong, M. (2006). *A Handbook of Human Resource Management Practice* (10th ed.). Kokan Page. https://doi.org/10.1017/CBO9781139062381.069

Chang, H. W., Han, H. J., & Park, K.-H. (2022). Long-term patency of bilateral internal thoracic artery Y composite coronary artery bypass grafts—determinants and impact on survival. *Journal of Thoracic Disease*, *14*(6), 1909.

Doenst, T., Haverich, A., Serruys, P., Bonow, R. O., Kappetein, P., Falk, V., Velazquez, E., Diegeler, A., & Sigusch, H. (2019). PCI and CABG for treating stable coronary artery disease: JACC review topic of the week. *Journal of the American College of Cardiology*, *73*(8), 964–976.

Guo, Z., Liu, J., Sun, G., Song, F., Lei, L., He, Y., Liu, B., Chen, S., Liu, Y., & Chen, J. (2020). Post-PCI acute heart failure is an independent predictor of long-term mortality in patients with chronic kidney disease. *International Journal of Cardiology*, *320*, 119–123.

Khan, S. U., Khan, S. U., Suleman, M., Khan, M. U., Khan, M. S., Arbi, F. M., Hussain, T., Alsuhaibani, A. M., & Refat, M. S. (2024). Natural Allies for Heart Health: Nrf2 Activation and Cardiovascular Disease Management. *Current Problems in Cardiology*, *49*(1), 102084.

Li, M., Liu, X., Jiang, M., Lei, Y., Li, Z., Li, S., Mao, Y., Cao, X., & Yan, L. (2024). Prognostic Capability of Clinical SYNTAX Score in Patients with Complex Coronary Artery Disease and Chronic Renal Insufficiency Undergoing Percutaneous Coronary Intervention. *Reviews in Cardiovascular Medicine*, *25*(1), 18.

Lin, L., Ding, L., Fu, Z., & Zhang, L. (2024). Machine learning-based models for prediction of the risk of stroke in coronary artery disease patients receiving coronary revascularization. *Plos One*, *19*(2), e0296402.

Manuca, R.-D., Covic, A. M., Brinza, C., Floria, M., Statescu, C., Covic, A., & Burlacu, A. (2024). Updated Strategies in Non-Culprit Stenosis Management of Multivessel Coronary Disease—

A Contemporary Review. *Medicina*, *60*(2), 263.

Mehvari, S., Karimian Fathi, N., Saki, S., Asadnezhad, M., Arzhangi, S., Ghodratpour, F., Mohseni, M., Zare Ashrafi, F., Sadeghian, S., & Boroumand, M. (2024). Contribution of genetic variants in the development of familial premature coronary artery disease in a cohort of cardiac patients. *Clinical Genetics*.

Müftüoğulları, A., Süner, M., & Sarper, B. (2024). The effect of bifurcation angulation on flow characteristics and hemodynamic indicators in an idealized left coronary artery. *International Journal of Thermofluids*, *21*, 100554.

Ochoa-Arvizo, M., García-Campa, M., Santos-Santillana, K. M., Klatte, T., García-Chairez, L. R., González-Colmenero, A. D., Pallares-Méndez, R., Cervantes-Miranda, D. E., Plata-Huerta, H. H., & Gutiérrez-González, A. (2023). Renal functional and cardiovascular outcomes of partial nephrectomy versus radical nephrectomy for renal tumors: a systematic review and meta-analysis. *Urologic Oncology: Seminars and Original Investigations*.

Okan, T., & Topaloglu, C. (2024). Association of ratios of monocyte/high-density lipoprotein cholesterol and neutrophil/high-density lipoprotein cholesterol with atherosclerotic plaque type on coronary computed tomography. *Cardiovascular Journal of Africa*, *2*.

Picano, E., Pierard, L., Peteiro, J., Djordjevic-Dikic, A., Sade, L. E., Cortigiani, L., Van De Heyning, C. M., Celutkiene, J., Gaibazzi, N., & Ciampi, Q. (2024). The clinical use of stress echocardiography in chronic coronary syndromes and beyond coronary artery disease: a clinical consensus statement from the European Association of Cardiovascular Imaging of the ESC. *European Heart Journal-Cardiovascular Imaging*, *25*(2), e65–e90.

Zhai, C., Cong, H., Hou, K., Hu, Y., Zhang, J., & Zhang, Y. (2019). Clinical outcome comparison of percutaneous coronary intervention and bypass surgery in diabetic patients with coronary artery disease: a meta-analysis of randomized controlled trials and observational studies. *Diabetology & Metabolic Syndrome*, *11*(1), 1–17.