



BRIEF NINE

9. Pump it up:

A deep dive into
heart disease

Research briefs on non-communicable diseases in South Africa

Percept has developed a series of briefs aiming to explain, explore and quantify the burden of non-communicable diseases (NCDs) in South Africa. Throughout the briefs both existing quantitative data as well as emerging qualitative data are drawn together. The primary qualitative data - presented in the form of vignettes - has been collected by Dr. Beth Vale, through in-depth ethnographic research. Given the rising global burden of NCDs, particularly in low- and middle-income countries (LMICs) these briefs are incredibly relevant. Given South Africa's high prevalence of HIV, there's also recently been a focus on the link between HIV and NCDs, as the population living with HIV grows increasingly older with the successful uptake of antiretroviral treatment (ART). As we'll explain in the briefs, an ageing population is more at risk for NCDs. Moving towards universal health coverage (UHC), it's imperative to understand the current needs of our population - and how these may change going forward. We have produced fourteen briefs in this series.

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- + Actuarial Society of South Africa (ASSA): ASSA has an interest in being part of the development of high-quality evidence to support resource allocation and decision-making and the interplay between the supply and demand sides of the health system
- + RGA Reinsurance Company of South Africa Ltd (RGA): RGA has an interest in the ways in which life insurance can be responsive to the changing burden of disease and the ways in which we can use data to drive decision-making
- + Board of Healthcare Funders (BHF): BHF is a regional representative body of health funders, administrators, and managed-care organisations. It is committed to universal health coverage, value-based healthcare, and accountability for health. Addressing the NCD burden is an important element to achieve some of its objectives.

Take-home messages

- + Heart disease or cardiovascular disease is used as an umbrella term to describe conditions that affect the heart and surrounding structures, including the vessels, muscles, valves or electrical circuitry. The symptoms, treatment and complications – including strokes and heart attacks – depend on the structure that is affected.
- + Vessels are most commonly affected due to the deposition of cholesterol. Risk factors for this include an unhealthy diet, lack of exercise, obesity and smoking.
- + Heart disease accounted for 4.9% of all deaths in South Africa in 2017, with 61,602 people having heart disease recorded as the cause of death.
- + Heart disease is more common among the elderly and males. However, it's the leading cause of death among women. This may be due to the "female disadvantage" – women are more commonly undertreated and underdiagnosed, and they're excluded from research despite the increased risk of heart disease associated with pregnancy and menopause.
- + Comorbidities are common among individuals with heart disease. The risk of hypertension, diabetes and depression are 3.59, 4.54 and 2.49 times greater among those with heart disease compared to those without heart disease. This has led to significant morbidity among those with heart disease.

Introduction

Heart disease, also known as cardiovascular disease (CVD), is an umbrella term used to describe an array of conditions that affect different structures of the heart. Heart disease occurs when the vessels, muscle, electrical circuitry and valves are damaged in some way. The cause of heart disease is often multifactorial due to the contribution of multiple risk factors, as well as comorbidities that frequently coexist. The complexity of heart diseases makes prevention, diagnosis and treatment challenging.

Globally, heart diseases are the leading cause of death. Approximately 17.9 million people are estimated to have died due to CVDs in 2016. This constitutes 31% of all deaths worldwide. Approximately 37% of all premature deaths due to non-communicable diseases (NCDs) worldwide are caused by CVDs. Lastly, more than 75% of CVD deaths occur in LMICs.¹

In South Africa, CVDs contribute significantly to morbidity and mortality. In this brief, we determine the current state of the heart in South Africa.

Data and methods

We used two broad quantitative data sets for this paper, household survey data and medical scheme data. Survey data includes General Household Survey (GHS) data, Demographic and Health Survey (DHS) data and National Income Dynamics Study (NiDS) data. When we analysed the quantitative datasets for comparison against one another, we standardised based on age and sex, given the relationship between age and NCDs (see brief 2), and sex and NCDs (see brief 3). We do this standardisation against the Statistics South Africa mid-year population estimates for 2018 for all datasets for fair comparison.

Private-sector data were provided by a large healthcare administrator and managed care services provider. The data provided included mental health hospital admission data between 2014 and 2018, and chronic benefit registration data for 2020.

We also used qualitative data in this brief, based on primary data collection in one pocket of South Africa, to marry the quantitative findings to the reality on the ground.

What is heart disease?

Heart disease/CVD is an umbrella term used to describe a range of conditions that affect the heart and surrounding structures. Different structures of the heart can be affected, including – but not limited to:²

- + the blood vessels, particularly the coronary arteries that supply the heart itself with blood (coronary artery disease);
- + heart valves (valvular disease) that can be narrowed (stenosis), leaking (regurgitation), or cannot close properly (prolapse);
- + the muscle of the heart that contracts to push blood out and into the aorta can be stretched (dilated cardiomyopathy) or thickened (hypertrophic cardiomyopathy); and
- + the electrical circuitry of the heart that coordinates the contraction and relaxation of the heart muscle resulting in the heartbeat or rhythm (arrhythmias).

Complications of heart disease can occur as a result of a chronic disease process that gets progressively worse over time, or as an acute event. Examples of chronic complications are heart failure and bulging in the wall of an artery (aneurysm), which can later burst.

Heart failure is a condition that can be caused by various cardiac diseases. It refers to the heart's inability to pump blood effectively.³ This causes the organs and tissues of the body to receive insufficient oxygen and nutrients.³ The body tries to compensate for it by diverting blood away from less essential organs, the heart pumps faster, the heart wall stretches, and the muscle becomes thicker to increase the force with which it pumps.⁴ People with heart failure often experience tiredness and shortness of breath when performing day-to-day tasks.⁴

Examples of common complications of heart disease that present as acute events are heart attacks (myocardial infarctions) and strokes. Coronary artery disease commonly causes myocardial infarctions, and cerebrovascular disease commonly causes strokes. This is when blockages in the coronary arteries or vessels of the brain prevent the surrounding tissues from receiving oxygen, causing them to die. The process is known as ischaemia, and once the tissue has died, it's called an infarction. These blockages are most commonly caused by atherosclerosis, which is the deposition and build-up of fatty material in the inner wall of the blood vessels.

A stroke caused by a blocked artery is termed an ischaemic stroke. In the brain, a fragile vessel may also rupture causing a bleed into the brain, resulting in a haemorrhagic stroke. **Approximately 85% of deaths in those who die due to CVD are attributed to heart attacks or strokes.**¹

The symptoms of heart disease vary depending on the type of disease. Table 1 shows the variety of symptoms that occur with each type of heart disease.

Table 1: Symptoms of heart disease²

HEART DISEASE	SYMPTOMS
Coronary artery disease	Women: chest discomfort, shortness of breath, nausea, extreme fatigue
	Men: Chest pain, chest tightness, chest pressure and chest discomfort (angina), shortness of breath, pain in the neck/left arm
Arrhythmias	Palpitations, racing heartbeat (tachycardia), slow heartbeat (bradycardia), chest pain or discomfort, shortness of breath, light-headedness or dizziness, fainting (syncope)
Cardiomyopathy (dilated)	No symptoms initially Later: Shortness of breath on exertion or at rest, leg/feet/ankle swelling, fatigue, palpitations, dizziness, light-headedness, fainting
Valvular disease (dependent on type)	Fatigue, shortness of breath, irregular heartbeat, feet/ankle swelling, chest pain, fainting

What causes heart disease?

Heart disease has a multifactorial origin with several known risk factors, including hypertension, smoking, high cholesterol levels, physical inactivity and other heart conditions. Most commonly, atherosclerosis causes heart disease. Atherosclerosis involves the deposition and build-up of blood, fats like cholesterol, and other substances in the walls of arteries. This results in the formation of deposits called plaques, which may rupture and cause a clot to form. The plaques may also block the vessel and prevent blood from passing, weakening the wall of the vessel in this area. **Risk factors for the development of plaques include an unhealthy diet, lack of exercise, obesity and smoking.**²

Different types of heart disease have different risk factors, including other types of heart disease. Table 1 lists the causes of some common heart diseases.

Table 2: Causes of heart disease²

HEART DISEASE	SYMPTOMS
Arrhythmias	Heart defects you are born with (congenital heart defects), coronary artery disease, high blood pressure, diabetes, smoking, excessive alcohol or caffeine, drug abuse, stress, valvular heart disease
Dilated cardiomyopathy	Unknown
Hypertrophic cardiomyopathy	Genetic, high blood pressure, ageing
Valvular disease	Rheumatic fever, infections (infective endocarditis), connective tissue disorders

Risk Factors

Heart disease often has multiple causes due to the several risk factors that contribute to the development of the condition. These risk factors also contribute to the development of other metabolic conditions, often causing comorbidities to develop in patients with heart disease. This makes it challenging to identify the cause.

Non-modifiable risk factors: the chicken or the egg

There's a strong link between age and atherosclerosis (see brief 2). Firstly, atherosclerosis develops over time. This makes the risk of developing arterial narrowing increase with age.² Additionally, the elderly are more likely to have weakened or damaged heart muscles, owing to the ageing process itself.²

Heart disease also differs by sex (see brief 3). The risk of heart disease is increased in men.² This difference in risk is thought to be due to the cardiac protection offered by oestrogen in women.⁵ However, following menopause, the risk is also increased in women due to the drop in oestrogen, which is cardio-protective.²

Women's risk of developing heart disease is also complicated by pregnancy. Pregnancy-induced hypertension and diabetes are believed to increase the risk of developing heart disease.⁶ Two theories exist: 1) women with underlying vessel damage develop pregnancy complications and are already at risk of developing heart disease prior to pregnancy, or 2) pregnancy complications result in vessel damage that causes heart disease to develop later in life.⁶

As with many other conditions, family history and genetics play a role in the development of heart disease. The risk is greatest in those with a direct male relative who has developed heart disease before the age of 55, or a direct female relative who has developed heart disease before the age of 65.²

Modifiable risk factors: environmental factors

There are several environmental factors that increase the risk of heart disease. As mentioned in the diabetes brief, these lifestyle factors are often choiceless, given that individuals frequently lack the ability to make healthy choices when their immediate environments aren't conducive to healthy lifestyles. Approximately 80-90% of heart disease cases are caused by preventable risk factors.⁷

Smoking receives a lot of attention as a risk factor. It's been shown that the nicotine in cigarettes causes the constriction of blood vessels, while carbon monoxide damages the inner wall of vessels.² In people with vessels that are already damaged and narrowed, this worsens the blockage significantly, and often causes acute events such as heart attacks.² **Smokers are more than twice as likely to have a heart attack than non-smokers.**⁷

An unhealthy diet, lack of exercise, stress, depression and obesity also contribute to an increased risk of developing heart disease.^{2,8} This is because these risk factors lead to and have overlapping risk factors with other metabolic conditions, such as high blood pressure, diabetes and high cholesterol levels. Diets high in salt may increase the risk of high blood pressure, while diets high in fat increase the risk of high cholesterol. The link between sugar consumption and diabetes has also been highlighted in our diabetes brief.

In 2015, South Africa's alcohol consumption was reported to be 11.5 litres per capita per year, making South Africa among the top 20 highest drinking countries in the world and third in Africa.⁹ South Africa's alcohol consumption is approximately double the global average.⁹ High rates of alcohol consumption can cause high blood pressure, heart failure or stroke, which can result in cardiomyopathy.¹⁰

In those with pre-existing heart disease, poor hygiene and even dental procedures are risk factors for infective endocarditis.² This condition also occurs in intravenous drug users when bacteria is introduced into the blood through contaminated injection needles.¹¹

Comorbidity

The complexity of heart conditions is often compounded by high levels of comorbidity. In those with heart failure, the inability of the heart to adequately pump blood to all organs of the body leads to multi-organ damage. This most often leads to kidney disease, which is the greatest predictor of mortality in those with heart disease.¹²

Additionally, heart disease patients often have diabetes mellitus, chronic obstructive pulmonary disease, obstructive and central sleep apnoea, anaemia, vision loss, back and neck issues, osteoarthritis and cancer, likely due to the overlapping risk factors among these conditions.¹² Among those with heart disease, these conditions are often most prevalent in those with heart failure, followed by those with peripheral artery disease and cerebrovascular disease, and they occur irrespective of age.¹³ Conditions related to metabolic syndrome – such as diabetes, hypertension and obesity frequently occur in patients with heart disease.¹⁴ This is also due to the overlapping risk factors between conditions.¹⁴

These conditions are likely to result in profound disability in heart-disease patients – adult patients with comorbidities are 42.9 times more likely to develop a disability than patients without comorbidities. In particular, depression and anxiety, which are often undiagnosed, contribute significantly to disability.¹⁴ Patients with both heart disease and depression have more frequent episodes of cardiac symptoms, hospitalisation and functional decline as they're less likely to undergo cardiac rehabilitation.¹⁴ They also have longer recovery times following heart attacks and are more likely to have a second heart attack or die compared to those without depression.¹⁴ The risk of having a heart attack or stroke, or to die is 62% greater in those with generalised anxiety disorder and heart disease compared to those with heart disease alone.¹⁴

With the current Covid-19 pandemic, patients with heart conditions are at greater risk of poor outcomes. Although only 8-12% of Covid-19 patients have cardiac involvement, this has a significant impact on outcomes, particularly in those with pre-existing heart conditions, who are often older.^{26,27} The virus causes direct damage to the heart muscle, and the inflammation in the body exacerbates this damage.²⁶ This results in arrhythmias, heart attacks, and clots developing in vessels.²⁷ The presence of underlying cardiovascular comorbidities in patients with Covid-19 is associated with high mortality.²⁷

Heart disease is a debilitating condition that is compounded by the array of comorbidities that are often associated with it. This creates a multifaceted disease entity that requires complex approaches to managing the condition. It's difficult to treat and even harder for patients to understand it. Vignette 1 shows how challenging this can be.

Vignette 1: Comorbidity

As an observer in Karoo clinics, I often found consultations with heart disease patients immensely confusing. This was largely because of their complexity. Patients with heart conditions were often living with multiple comorbidities and taking a host of medications with complex interactions. For example, a 60-year-old man with atrial fibrillation (an arrhythmia) visited a Somerset East clinic in February 2019. In addition to his heart medication, the patient was also taking medication for hypertension, diabetes and cholesterol.

Comorbidity not only makes heart disease more difficult to manage, but can also be a leading risk factor. The next patient arrived at the clinic complaining of chest problems, saying he struggled to breathe when he got dressed in the morning. The doctor explained to the patient that he had stiff lungs, and because of that, his blood was not getting enough oxygen. The doctor prescribed two inhalers. "We can't fix your lungs, but we can give you something to soften them," she said. "Otherwise, [if we don't manage this properly], it's going to affect your heart."

Treatment

The treatment of heart disease is also multifaceted and complex, which adds to the complexity of the disease. Lifestyle modifications that help to reduce the risk of complications include smoking cessation, low-fat and low-sodium diets, and weight management, as well as ensuring that comorbidities like hypertension, diabetes, and cholesterol are controlled.⁸ Medications including diuretics, heart rhythm regulators and angiotensin-converting enzyme inhibitors may also be prescribed, depending on the underlying condition, comorbidity and severity. In some cases of acute complications such as heart attacks and strokes, or when medications don't work, surgical procedures – like valve replacements – are performed.⁸

It can be challenging for health systems to accommodate the wide range of medications and treatment options required, particularly in the constrained public sector. Patients are often prescribed several drugs, increasing their dependency on the health system's stock availability, as well as their interactions with the system. Vignette 2 highlights the impact on patients when the health system can't deliver.

Vignette 2: Medication stock outs

I'd never heard of Digoxin until I started working in clinics in the Eastern Cape Karoo. However, within a few months, references to the drug were a familiar part of daily consultations and I'd soon learn that this chronic heart medication was used to treat a range of conditions, including atrial fibrillation, atrial flutter, and heart failure. It had been prescribed to most of the patients I saw, usually alongside a range of other medications.

Part of the reason there was so much talk about Digoxin in the first quarter of 2019 was because this region of the Eastern Cape Karoo was experiencing medication stock out. Pharmacists and clinicians were in regular conversation about the availability of medicines, and how to manage the stock out, but they didn't always agree about a course of action.

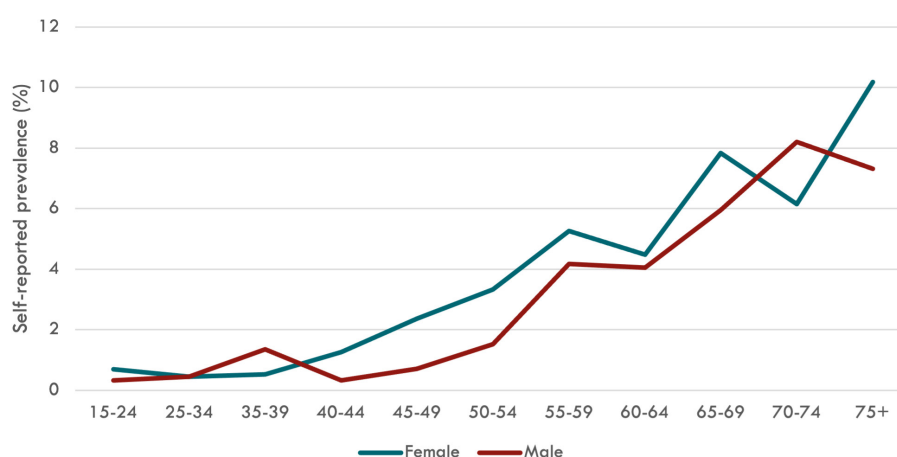
The result was that patients were either stopping or switching their treatment, with inevitable side effects. After some reading, I learned that discontinuing Digoxin could have serious consequences, including hospitalisation and death. Proper care for chronic NCDs demands reliable, continuous access to medication and yet, working in a context of uncertainty, scarcity, and grave risk seemed to have become the norm for health workers, whose only option was to seek any alternatives they could, and move on to the next patient.

The state of the heart: South Africa

Cerebrovascular disease, heart disease (excluding ischaemic heart conditions) and ischaemic heart disease were ranked the third, fourth and ninth leading cause of death in 2017 in South Africa.¹⁵ Heart disease accounted for 4.9% of all deaths, with 61,602 people having heart disease recorded as the cause of death.¹⁵ This is far lower than the global average. South Africa faces the challenge of tackling the high prevalence of both communicable and non-communicable diseases resulting in the quadruple burden of disease.¹⁵

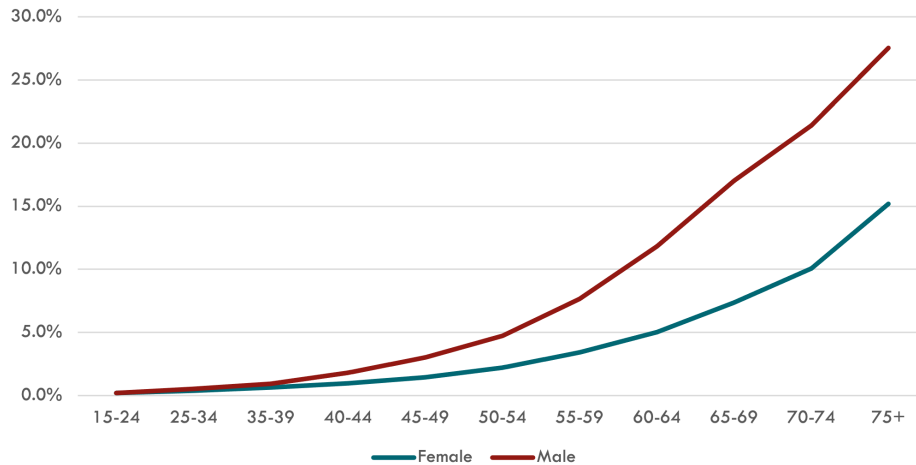
As seen in Figure 2, females have a higher self-reported prevalence of heart disease than males at most ages. The rise in prevalence in postmenopausal females is likely due to a decrease in oestrogen, which increases the risk of heart disease.¹⁶

Figure 1: Self-reported prevalence of heart disease by age and sex (own analysis, NiDS 2017)¹⁷



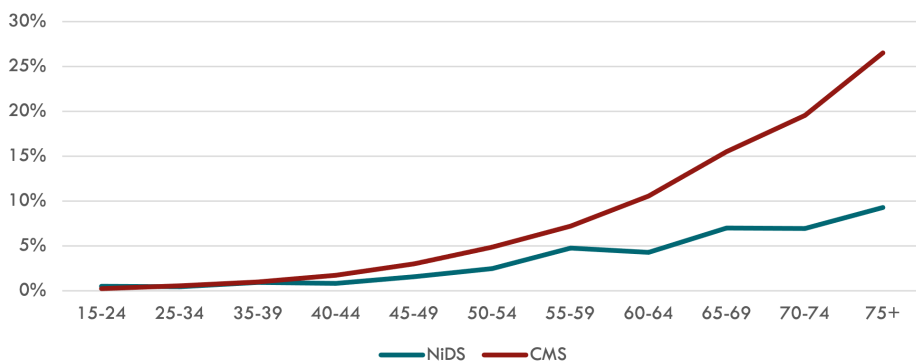
The proportion of males with at least one claim for coronary artery disease is higher than that of females in all age categories (Figure 3). The difference in prevalence among males and females in Figure 2 and Figure 3 is likely due to differences in self-reporting compared to objective measures of heart disease. Although CVD is often considered to affect men more frequently, CVD is one of the leading causes of death in women worldwide.⁵ This may be explained by the “female disadvantage”. Women are often undertreated and underdiagnosed due to a lack of both primary and secondary prevention, as well as a poor recognition of symptoms in this population.⁵ CVD research is also often male-focused, with females largely excluded from studies despite the added CVD risks of pregnancy and menopause.⁵

Figure 2: Proportion of beneficiaries with at least one claim for coronary artery disease (CMS 2017)¹⁸



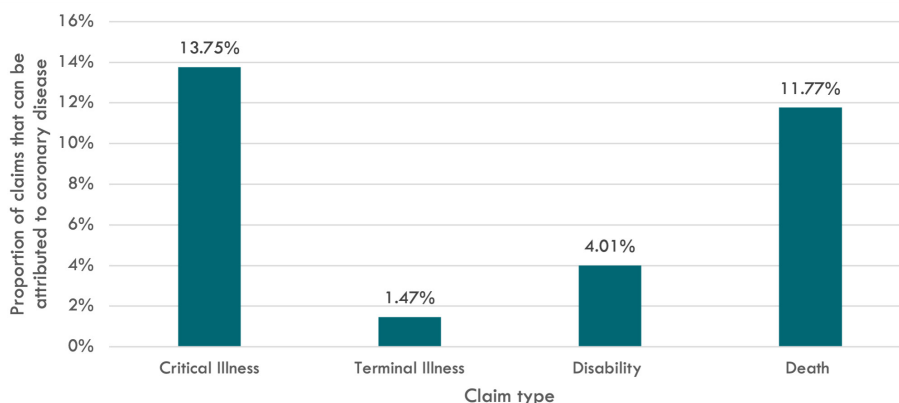
Household surveys estimate the prevalence of heart disease through self-reported measures only, which underestimate true prevalence. This is evident when comparing the self-reported prevalence (NiDS) to the proportion of medical scheme beneficiaries who are registered for chronic benefits related to heart disease, as seen in Figure 6. For this reason, the proportion of medical scheme beneficiaries who are registered for chronic benefits related to heart disease is likely a more accurate measure of the prevalence of heart disease in the South African population. However, quality of care, rates of diagnosis and undertreatment in the public sector need to be considered.

Figure 3: Comparison of self-reported proportion of the population with heart disease (NiDS 2017) and proportion of medical scheme beneficiaries registered for chronic benefits for heart disease (CMS 2017)^{18,19}



A high proportion of life insurance claims can be attributed to coronary disease (Figure 5), and it's particularly true for critical illness and death. This is expected due to the high fatality associated with acute CVD events such as heart attacks. In South Africa, approximately 215 people die daily due to CVD, accounting for 1 in 6 deaths.²⁰

Figure 4: Proportion of insurance claims attributed to coronary disease (RGA 2020)²¹



Comorbidity of other NCDs is very common in patients suffering from heart disease. **The risk of having hypertension in those with heart disease is 3.59 times greater** than that in those without heart disease. This highlights the strong association between heart disease and hypertension (see Table 3). Similarly, **the risk of having diabetes in those with heart disease is 4.54 times greater** than that in those without heart disease.

Due to its high prevalence, hypertension is one of the leading risk factors for heart disease in South Africa.²² Approximately 2 in every 5 heart attacks are as a result of hypertension.²⁰ Diabetes is also a strong risk factor for cardiovascular disease. Being unemployed, black, female, the resident of an urban area and having a secondary education are considered risk factors for diabetes-cardiovascular disease comorbidity.²³ Many of these demographic factors are highly relevant to the South African context due to high rates of urban poverty and unemployment.

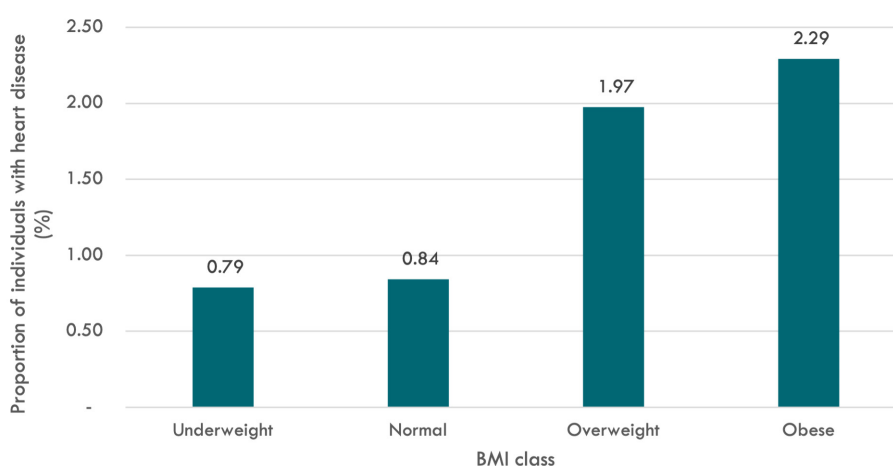
Table 3: Association between diabetes, hypertension and heart diseases (Bonitas)²⁴

ASSOCIATIONS MATRIX	CARDIAC FAILURE AND CARDIOMYOPATHY	CORONARY ARTERY DISEASE	MYOCARDIAL INFARCTION	TOTAL
Prevalence of hypertension in beneficiaries with relevant heart disease	82%	78%	71%	79%
Prevalence of diabetes in beneficiaries with relevant heart disease	41%	41%	38%	41%

ASSOCIATIONS MATRIX	CARDIAC FAILURE AND CARDIOMYOPATHY	CORONARY ARTERY DISEASE	MYOCARDIAL INFARCTION	TOTAL
Risk ratio of having hypertension (compared to beneficiaries without relevant heart disease)	3.47	3.40	2.92	3.59
Risk ratio of having diabetes (compared to beneficiaries without relevant heart disease)	4.16	4.31	3.74	4.54

Another significant risk factor is body mass index (BMI). Figure 5 shows the steep rise in cases of heart disease in those who are overweight or obese.

Figure 5: Prevalence of heart disease by BMI category (NiDS 2017)¹⁹



As described in brief 10, which addresses mental health, depression is closely associated with heart disease. **People living with depression are 2.49 times more likely to have concomitant heart disease** compared to those without depression (Bonitas). This association is bidirectional: consequences of heart disease, such as heart attacks, lead to depression, while depression increases the risk of developing heart disease due to hormonal, neurological and behavioural pathways that increase associated risk factors.²⁵

Conclusion

Heart disease is a complex and multifactorial condition with several disease entities. The high prevalence of heart disease and its related comorbidities in South Africa pose an enormous burden on the health system. The negative health consequences associated with heart disease also contribute to the high mortality and critical illness related to it. While the condition is thought to primarily occur in men, a lack of adequate preventative care and research indicate that women may be undertreated. Heart disease requires a holistic approach to care. Better primary and secondary prevention, particularly in high-risk groups, are required. The large number of risk factors and comorbidities lead to complex management plans. Patient education is therefore paramount to adherence and improved outcomes.

References

1. World Health Organization. Cardiovascular diseases (CVDs). Published 2017. Accessed December 24, 2020. [www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](http://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
2. Mayo Clinic. Heart disease – symptoms & causes. Published 2018. Accessed December 23, 2020. www.mayoclinic.org/diseases-conditions/heart-disease/symptoms-causes/syc-20353118
3. American Heart Association. What is Cardiovascular Disease? Published 2017. Accessed December 23, 2020. www.heart.org/en/health-topics/consumer-healthcare/what-is-cardiovascular-disease
4. American Heart Association. What is Heart Failure? Published 2017. Accessed December 23, 2020. www.heart.org/en/health-topics/heart-failure/what-is-heart-failure
5. Woodward M. Cardiovascular disease and the female disadvantage. *Int J Environ Res Public Health*. 2019;16(7). doi:10.3390/ijerph16071165
6. Johns Hopkins Medicine. Difficult Pregnancies and the Risk of Heart Disease. Published 2020. Accessed December 24, 2020. www.hopkinsmedicine.org/health/wellness-and-prevention/difficult-pregnancies-and-the-risk-of-heart-disease
7. WebMD. Risk Factors for Heart Disease. Published 2020. Accessed December 24, 2020. www.webmd.com/heart-disease/risk-factors-for-heart-disease#1
8. Mayo Clinic. Heart disease – diagnosis & treatment. Published 2018. Accessed December 24, 2020. www.mayoclinic.org/diseases-conditions/heart-disease/diagnosis-treatment/drc-20353124
9. Zamokuhle Mbandlwa, Nirmala Dorasamy. The impact of substance abuse in South Africa: a case of informal settlement communities. *J Crit Rev*. Published online 2020. Accessed March 1, 2021. www.researchgate.net/publication/343280262_The_impact_of_substance_abuse_in_South_Africa_a_case_of_informal_settlement_communities
10. Johns Hopkins Medicine. Alcohol and Heart Health: Separating Fact from Fiction. Published 2020. Accessed December 24, 2020. <https://www.hopkinsmedicine.org/health/wellness-and-prevention/alcohol-and-heart-health-separating-fact-from-fiction>
11. Miró JM, Moreno A, Mestres CA. Infective endocarditis in intravenous drug abusers. *Curr Infect Dis Rep*. 2003;5(4):307-316. doi:10.1007/s11908-003-0007-9
12. Widmer F. Herzinsuffizienz und komorbiditäten. *Ther Umschau*. 2011;68(2):103-106. doi:10.1024/0040-5930/a000127
13. Buddeke J, Bots ML, Van Dis I, et al. Comorbidity in patients with cardiovascular disease in primary care: A cohort study with routine healthcare data. *Br J Gen Pract*. 2019;69(683):E398-E406. doi:10.3399/bjgp19X702725
14. Cardiovascular Disability: Updating the Social Security Listings. National Academies Press; 2010. doi:10.17226/12940
15. Statistics South Africa. Mortality and Causes of Death in South Africa: Findings from Death Notification.; 2017
16. Crawford SL, Johannes CB. The Epidemiology of Cardiovascular Disease in Postmenopausal Women. *J Clin Endocrinol Metab*. 1999;84(6):1803-1806. doi:10.1210/jcem.84.6.5765-4

References

17. The University of Cape Town. National Income Dynamics Study. Published 2017. Accessed April 26, 2021. www.datafirst.uct.ac.za/dataportal/index.php/catalog/712
18. Council for Medical Schemes. Annual Report 2017/18.; 2018
19. Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2017, Wave 5 [Dataset]. Version 1.0.0.; 2018
20. Jessica. CARDIOVASCULAR DISEASE STATISTICS REFERENCE DOCUMENT. Accessed February 16, 2021. www.heartfoundation.co.za
21. RGA Reinsurance Company of South Africa. Claims Dataset.; 2020
22. Jongen VW, Lalla-Edward ST, Vos AG, et al. Hypertension in a rural community in South Africa: What they know, what they think they know and what they recommend. *BMC Public Health*. 2019;19(1):341. doi:10.1186/s12889-019-6642-3
23. Mutyambizi C, Chola L, Groot W, Pavlova M, Labadarios D, Hongoro C. The extent and determinants of diabetes and cardiovascular disease comorbidity in South Africa – results from the South African National Health and Nutrition Examination Survey (SANHANES-1). *BMC Public Health*. 2017;17(1). doi:10.1186/s12889-017-4792-8
24. Bonitas. Claims Dataset.; 2020
25. Brinkmann B, Payne CF, Kohler I, et al. Depressive symptoms and cardiovascular disease: A population-based study of older adults in rural Burkina Faso. *BMJ Open*. 2020;10(12):38199. doi:10.1136/bmjopen-2020-038199
26. Bansal M. Cardiovascular disease and COVID-19. *Diabetes Metab Syndr Clin Res Rev*. 2020;14(3):247-250. doi:10.1016/j.dsx.2020.03.013
27. Guan WJ, Liang WH, He JX, Zhong NS. Cardiovascular comorbidity and its impact on patients with COVID-19. *Eur Respir J*. 2020;55(6). doi:10.1183/13993003.01227-2020