BRIEF EIGHT

8. The not so sweet truth:

A deep dive into diabetes

PERCEPT

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15 JANUARY 2022

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 – was collected by Dr. Beth Vale through in-depth ethnographic research, which was gathered in a community in the Karoo. Given the rising global burden of NCDs, particularly in low- and middle-income countries (LMICs) these briefs are incredibly relevant. They also present important insights as Covid-19 continues to attack those with pre-existing conditions more fatally.

Given South Africa's high prevalence of HIV, there's also recently been a focus on the link between HIV and NCDs, especially since the population living with HIV grows increasingly older with the successful uptake of 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.

Percept is grateful for the generous funding provided by the following three partners The views presented are however the authors' own.

- 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

- Diabetes occurs when the body is unable to effectively produce or use insulin, which is required to move glucose into cells of the body. This causes high sugar (glucose) levels in the blood, while cells are starved of energy.
- High blood sugar levels cause various complications, including kidney failure, blindness, limb numbness and amputations as a result of damage to the nerves and blood vessels. Diabetes often clusters with other conditions such as dementia, cardiovascular disease and liver disease.
- Although risk factors related to lifestyle, such as an unhealthy diet and a lack of exercise, increase the chances of getting diabetes, many other factors also come into play. Individuals could be predisposed to developing diabetes if it runs in the family, or if the mother has pregnancy-related diabetes.
- Diabetes accounted for 25,255 (5.5% of) deaths in South Africa in 2017 and was the leading cause of death among women. The high rates of obesity among adult South Africans (27%) contribute to the high prevalence of diabetes.
- Private- and public-sector data show that patients have a higher likelihood of diabetes with age.
- Objective measures of diabetes, show high prevalence of undiagnosed or poorly managed diabetes. Only 30% of men and women with diabetes reported that they had previously been diagnosed with diabetes.
- The risk of developing complications related to Covid-19 is increased among the diabetic population, and blood sugar levels are increased as a result of Covid-19, making glucose control worse.
- The proposed South African Diabetes Charter from the Diabetes Alliance includes five components aimed at improving the prevention and treatment of people with diabetes in a cohesive way, which aligns with international standards.
- Although sugar taxes have been implemented, food environments remain unhealthy, especially among impoverished communities. With high rates of undiagnosed individuals, more needs to be done to prevent the disease and ensure that individuals are diagnosed in order to prevent complications. Digital tools are being proposed as a way to achieve this.

Introduction

Diabetes was once considered an uncommon disease primarily affecting the wealthy, with low-income countries largely unaffected.[1] However, the combination of an ageing population and a rapid demographic and economic transition seen in LMICs, such as South Africa, has resulted in a substantial increase in prevalence from 4.5% in 2010[2] to 12.8% in 2020.[3] While diabetes is classified as an NCD, it is often "communicable" in nature due to environmental, lifestyle and genetic factors such as nutrition, physical exercise and hereditary predispositions, which are often not a choice for individuals.[4]

In this brief, we explore the lifestyle and environmental factors that put South African households at an increased risk to develop diabetes. We also discuss the lack of communication between patients, the health system and government, which has resulted in many people remaining undiagnosed or at a high risk of developing diabetes. Finally, we evaluate the need for a cascade of care that is individualised and results in long-term behaviour change, and therefore avoids the costly consequences of diabetes-related complications.

Data and methods

Two broad quantitative data sets were used: household survey data and medical scheme data. Survey data includes General Household Survey (GHS) data, Demographic and Health Surveys (DHS) data and National Income Dynamics Study (NiDS) data. When analysing the quantitative datasets for comparison against one another, we standardised them based on age and sex, given the relationship between age and NCDs (see brief 2), and sex and NCDs (see brief 3). This standardisation was done against the 2018 Statistics South Africa (Stats SA) mid-year population estimates for all datasets to achieve fair comparison.

Private-sector data were provided by a large healthcare administrator and managed-care services provider. The prevalence of diseases in the medical scheme population is estimated by finding the proportion of beneficiaries who are registered for chronic disease benefits for the relevant disorder. Where relative prevalence ratios are calculated, this refers to the ratio of prevalence in one subgroup of the medical scheme population compared to another.

We also use 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 diabetes?

Diabetes is a disease in which a person is susceptible to high blood glucose (or "blood sugar") levels, called hyperglycaemia, which damages the body. Those with diabetes are at risk of premature mortality. Diabetes causes damage to the blood vessels nerves and is therefore closely associated with cardiovascular disease. Coronary heart disease is recognised as the cause of death in 80% of diabetics.[5] Over time, if left undiagnosed or uncontrolled, diabetes leads to complications such as blindness, kidney failure, stroke and lower-limb amputation.[6] The total cost associated with type 2 diabetes in the public sector is estimated to reach R 35 billion in diagnosed patients by 2030, with approximately 49% of costs attributed to complications.[7]

Diabetes is typically considered to be linked to diet and exercise, because glucose comes from the food we eat. As food is digested, glucose moves into the blood so that it can be transported to our cells and used for energy. If the energy is not immediately needed, the glucose lingers in the blood. The hormone insulin, made in the pancreas, takes some of the glucose into storage or allows glucose to enter the cells so that the blood glucose level returns to normal. However, when the body experiences regular episodes of high blood glucose levels, the pancreas takes strain. It becomes less and less able to produce sufficient and/or effective insulin, which increases the risk of future episodes of hyperglycaemia (high blood glucose).

This reinforcing loop describes diabetes mellitus or type 2 diabetes, but there are also two other types. The first is gestational diabetes which presents in pregnant women and is often a precursor to type 2 diabetes in mothers.[8] The second is type 1 diabetes, which is caused by genetic factors that result in an autoimmune reaction. This autoimmune reaction causes the body to attack its own insulin-producing cells. Affected people require daily insulin injections to survive.[9] It usually presents in children and young adults and accounts for about 1 in 10 diabetics.[3] The term diabetes generally refers to diabetes mellitus because it's the most common form, accounting for 90% of all diabetes cases both globally3 and in sub-Saharan Africa.[10] These briefs therefore focus on type 2 diabetes.

Diabetes can be treated and even reversed.[11] The problem is that the symptoms may be subtle, so the disease may progress until it leads to a diabetic complication or health crisis, such as a diabetic coma.

Even with observable symptoms (Figure 1) and risk factors, diabetes can only be clinically diagnosed with a blood test. This hurdle possibly contributes to the high proportion of undiagnosed diabetics, who have an increased risk of adverse outcomes.[12]

[a] Metabolic syndrome is a cluster of conditions that increase the risk of heart disease, stroke and diabetes.

Figure 1: Symptoms of diabetes (International Diabetes Federation 2020)[3]

The primary test analyses the HbA1c level, which refers to the haemoglobin in the blood that is bound to glucose.[13] It provides information about the average blood glucose level over the three months preceding the test.[13] A result of 6.5% or higher is categorised as diabetes, and 5.7%-6.4% indicates insulin resistance – where the disease is in the process of developing but can be treated and reversed without medication.[14] The HbA1c test is also used to check how well a diabetic person's condition is being managed and to adjust medications accordingly.

Complications and multimorbidity

As discussed in brief 11, NCDs seldom come alone. Diabetes clusters with other chronic inflammatory diseases[15] and conditions as part of metabolic syndrome[a].[16] Even after adjusting for age and sex, diabetics are at a higher risk for many diseases, as indicated in Table 1 – with an almost 10 times higher risk of lower-limb amputation and retinopathy (loss of vision).

	ALZHEIMER'S & DEMENTIA	CHRONIC RENAL FAILURE	CARDIO-VASCULAR DISEASE	LOWER-LIMB AMPUTATION	NON-ALCOHOLIC FATTY LIVER DISEASE	RETINOPATHY
Prevalence in non-diabetics	0.43%	0.16%	15.6%	0.02%	0.49%	0.06%
Prevalence in diabetics	1.30%	1.89%	78.16%	0.33%	2.50%	1.10%
Ratio of diabetic to non-diabetic	3.05	11.51	4.99	13.86	5.08	17.21
Age and gender adjustment	2.32	2.03	1.99	1.45	1.67	2.08
Risk adjusted ratio	1.32	5.68	2.51	9.56	3.03	8.29

[a] Metabolic syndrome is a cluster of conditions that increase the risk of heart disease, stroke and diabetes.

Risk factors

Diabetes can start in the womb

Dr. Norbert Freinkel, an endocrinologist, first described the theory of "fuel-mediated teratogenesis" in 1980, which highlighted the negative long-term consequences of maternal high blood sugar levels that are passed to infants in utero.[17] It has since led to extensive research that has shown that mothers with gestational diabetes can give birth to infants with macrosomia – which is when the baby is considered too large for their gestational age.[18] Macrosomia places infants at a higher risk for being overweight or obese during childhood, and gives them an increased lifetime risk of metabolic syndrome from as early as adolescence.[19,20]

Epigenetics

Epigenetic factors refer to environmental factors that modify the expression/physical presentation of various inheritable genes from as early as conception, without altering the genetic material itself.[21] This may explain the increased risk observed in the case of gestational diabetes. Pregnancy-related factors and both maternal and paternal factors, such as dietary intake, may affect the uterine environment and result in the increased intergenerational risk of diabetes.[22] The process of ageing, obesity, low levels of physical fitness, nutrition and metabolism are all epigenetic factors associated with type 2 diabetes.[23]

The emphasis is often placed on glycaemic control, which refers to maintaining the blood glucose level within the normal non-diabetic range.[24] However, in some individuals, complications may occur despite being well controlled, as a result of "metabolic memory", which causes the genes to be expressed despite the removal of the external factor.[25] Metabolic memory provides an explanation for how the course of the disease is determined by the initial environmental exposure.

"Communicable" environmental factors and the metabolic-syndrome epidemic

Diabetes is often framed as the consequence of poor lifestyle or health choices, but many of the risk factors are more a function of environment than personal choice. Industrialisation, globalisation, economic development, and rising incomes in LMICs have changed the nature of work and food production. This has resulted in more sedentary lifestyles, leading to increased rates of obesity and its consequences, including diabetes.[26] The global increase in the prevalence of metabolic syndrome has meant that it is now an epidemic.[27] In South Africa, the high burden of NCDs, including metabolic syndrome, is compounded by the other three components of South Africa's quadruple burden of disease: the HIV/AIDS and TB epidemics, high maternal and child mortality, and violence and injuries

Urbanisation

The prevalence of diabetes is predicted to increase in Africa due to an increase in population growth, resulting in increased urbanisation.[28] This is also true for South Africa, where many people move to urban areas to increase their earnings and improve their standard of living.[29] It has resulted in an increase in deprived urban areas characterised by overcrowding and poor living conditions.[30] Approximately two-thirds of individuals living with diabetes in South Africa reside in urban areas.[31]

The sedentary lifestyle associated with living in an urban environment has been linked to an increased risk of obesity and metabolic syndrome, which are both risk factors of diabetes.32 While a higher socio-economic status is linked to a higher prevalence of diabetes overall, the rate of undiagnosed diabetes is greater in those of a lower socio-economic status.[33]

Living in urban areas increases the exposure of impoverished individuals to "obesogenic environments",[34] through an increased exposure to affordable unhealthy food, a lack of recreational space for physical activity, and stressful working lifestyles.[35] With the increased spread of urbanisation, peri-urban regions have been created in close proximity to rural areas. Therefore, these obesogenic environments are also spreading, leading to an increase in the incidence of diabetes in rural areas too.[36]

There is also strong evidence to suggest that diabetes is socially determined. Diabetes clusters in homes and neighbourhoods that share similar socio-psychological features. In previous briefs, we explored the literature on syndemics (see brief 5)[b]. Researchers have shown a synergistic relationship between diabetes, violence and depression in South Africa.[37] In a South African study[37] with diabetic women in Soweto, many participants attributed their diabetes to psychological and social distress – linked to violence, grief and family pressures. This distress also affected participants' ability to manage their diabetes.

These social environments often lead to metabolic syndrome. The greater the number of components of metabolic syndrome an individual has, the greater the risk of developing diabetes.[38] This risk is heightened further if glucose intolerance develops.[38] These components have similar lifestyle-related risk factors.

Nutrition and exercise

Conventionally, the primary target of interventions has been diet. This is likely due to the link between diabetes and food. Diets that are high in sugary foods with a high glycaemic index, which cause a rapid increase in blood sugar, have been associated with an increased risk of type 2 diabetes.[39,40] Conversely, high-fibre plant-based foods, which are low-glycaemic foods, have been seen to lower the risk of diabetes.[41]

In overweight or obese individuals, lower-calorie diets resulting in weight loss have also been found to reduce the occurrence of diabetes.[42] Low total physical activity, including active exercise and general movement, has been found to increase the relative risk of developing diabetes by up to 40%.[41]

[b] At a population level, a syndemic is the co-occurrence of two or more epidemics (whether social or biological) that interact synergistically and are therefore mutually reinforcing.

These risk factors indicate the need to target behaviour change. However, they also indicate that a large proportion of individuals who are susceptible to developing diabetes lack the ability to prevent it due to factors beyond their control. Furthermore, due to the geographic legacy of apartheid, many South Africans live in impoverished, densely populated, urban areas – with few green spaces, high crime rates and limited access to affordable, fresh produce.[43,44] While diet and exercise, which are modifiable, are often targeted through interventions, agency needs to be carefully considered in relation to these, often choiceless, lifestyle choices. Vignette 1 explores these themes in more depth.

Vignette SEQ Vignette * ARABIC 1: Diabetes and 'communicability'

In February 2019, I observed a consultation at a public clinic in the small town of Somerset East. A young woman, perhaps in her thirties, had been newly-diagnosed with diabetes. Her mother was also diabetic. The doctor tried to explain, in as simple terminology as possible, how diabetes affected the body. The woman was prescribed two pills per day. She sat silently, nodding intermittently, as the doctor explained her diagnosis and treatment. At the end, she only had one question: "Will I give it to my child?"

Answering this question is complicated, precisely because diabetes' "communicability" is complicated. Of course, the mother's diabetes is not transmissible through touch or breath or body fluids: in this respect she cannot 'give' diabetes to her child. But there are certainly ways that mothers could 'give' diabetes to their children. For this patient, diabetes seems to run in the family. This predisposition to diabetes might be hereditary, or it might be the result of shared living conditions, food environment and eating practices – or both. Either way, the patient's child would be considered at greater risk of developing diabetes than a child without diabetic relatives.

The mother's question also speaks to a much larger social milieu around illness and mothering in South Africa.

For many patients, particularly mothers, HIV has become a major frame of reference for understanding lifelong illness. It has been important to say that illnesses like diabetes are not transmitted through birth, or breastmilk, or blood, like HIV. Mothers whose children have contracted HIV perinatally have often been blamed and stigmatised. Despite diabetes not being directly transmissible, mothers also find themselves at risk of blame and shame in the context of a diabetes epidemic. Because mothers are often tasked with feeding their families and diabetes is strongly associated with diet, mothers risk being held responsible for diabetes in the family. All of this means that when mothers are diagnosed with illness, many worry over whether they're a real and/or perceived threat to their child.

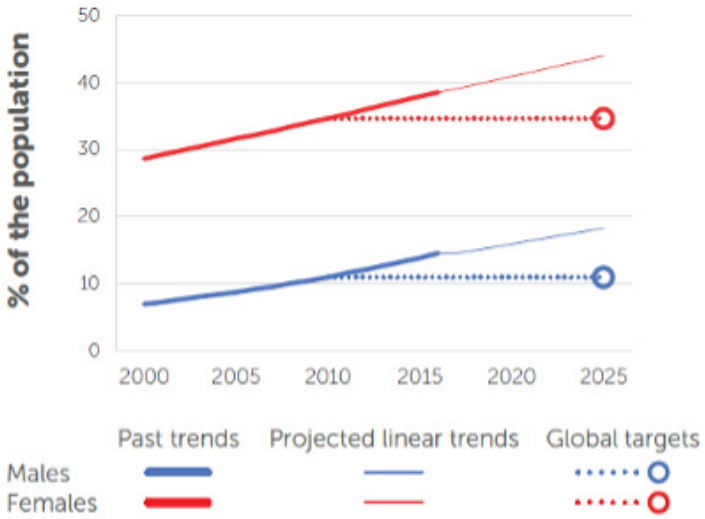
It's important to communicate the ways in which diabetes is and isn't communicable carefully. This communication should be accurate and protective, but also sensitive to how stigma and gender discrimination operate.

Diabetes in South Africa: prevalence in the private vs public sector

In 2017, diabetes directly accounted for 25,255 (5.5%) of deaths in South Africa and was the leading cause of death among women.[45] Given the close link to hypertensive diseases, it could have indirectly contributed to a further 4.4% of deaths.[46] Among medical scheme beneficiaries registered as diabetic, the prevalence of diabetes increased by 28% over the period 2012 to 2017 from 25.66 to 31.28 cases/1,000 beneficiaries – an average annual growth rate of 5%.[47] However, a broader definition of prevalence suggests that 53 per 1,000 beneficiaries are diabetic.[47]

Blood glucose levels tend to be higher in people who are older and/or overweight.[48] Obesity, especially around the abdomen (central obesity), is also recognised as a risk factor and is linked to metabolic disease. South Africa faces a high and growing obesity rate, with 27% of adults and 39% of adult women being obese.[49] Figure 2 shows the projected trends of obesity among both men and women. By 2025, South Africa will have far exceeded the global targets. South African child obesity rates are also increasing and are among the highest in the world.[50]

Figure 2: South African obesity rates, trend and global target (World Health Organization 2018)[49]



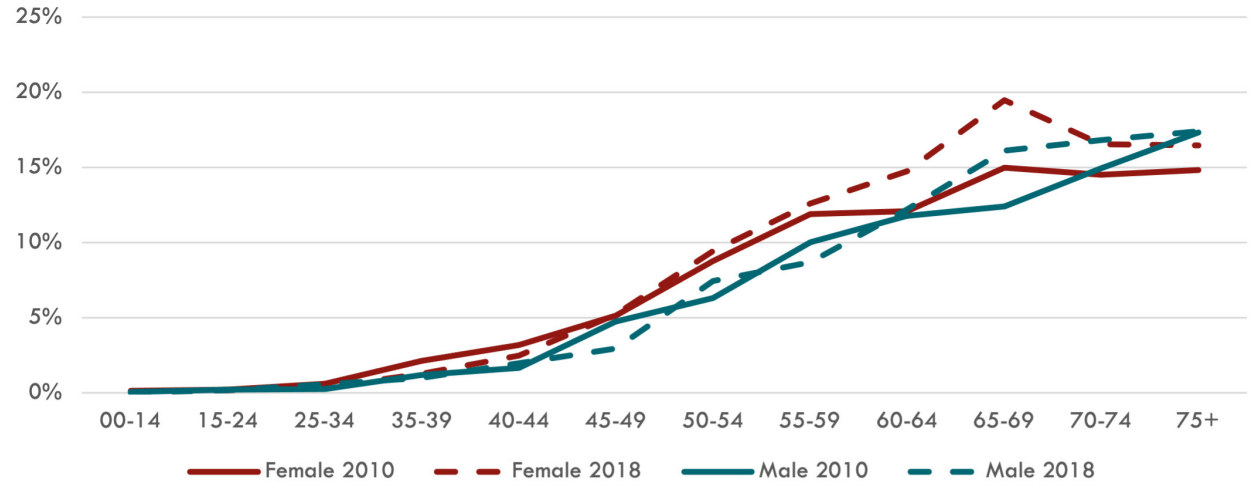
Relative to men, a higher percentage of women have raised blood glucose levels[49] and die from diabetes.[45] As discussed in brief 3, the differences in NCD risk factors by sex are located within a broader context of South Africa being a developing country with large gender disparities.[51] Lifestyle choices are shaped by gender roles and norms cultivated by society, which may have a disproportionate impact on women.

The following sections compare the estimated diabetes prevalence in the public and private health sector populations using both household survey data, the South African Health and Demographic Survey (SADHS) of 2016, the GHS of 2018, and aggregated medical scheme data from the South African Council for Medical Schemes (CMS) for 2018. Both the SADHS and the GHS are nationally representative surveys.

Public sector population[c]

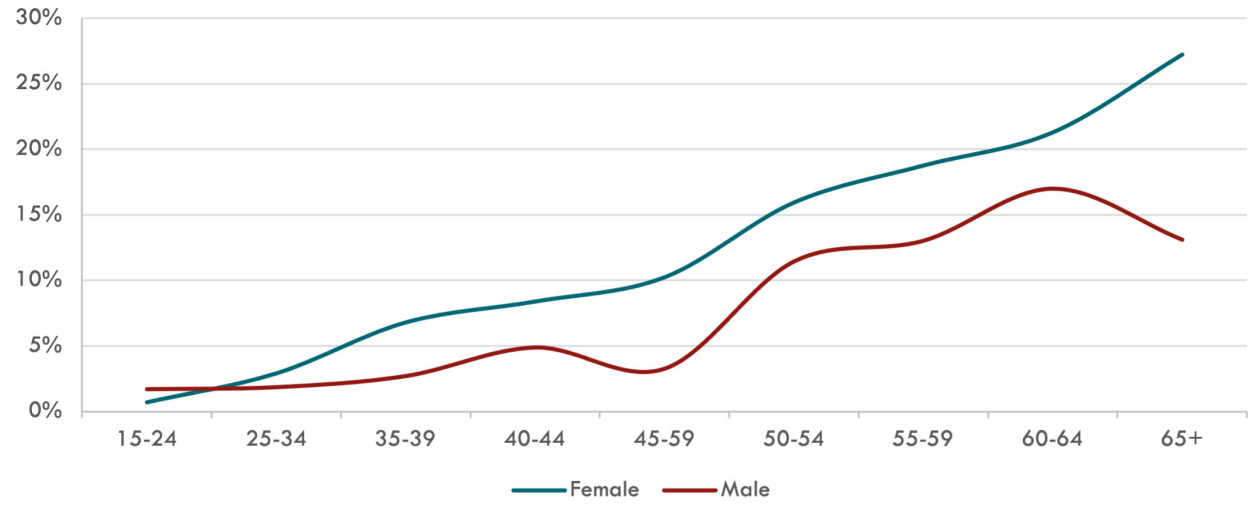
Figure 3 shows estimates the self-reported prevalence of diabetes. The prevalence increases with age and is higher among women than men, up until approximately 70 years. The increase in prevalence appears to be driven by the over-50 age group.

Figure 3: Self-reported diabetes prevalence by age and sex, 2010 vs 2018 (GHS 2010 and 2018)[52]



However, self-reported data underestimate the true burden of disease. According to HbA1c tests done in the SADHS, there is a high prevalence of undiagnosed and/or poorly managed diabetes (individuals with HbA1c test results higher than 6.5% indicate unmanaged diabetes, which could be because the patient is unaware that they have diabetes, or because their diabetes is poorly managed at the time of the test). As seen in Figure 4, prevalence of undiagnosed or poorly managed diabetes increases with age, and is higher in women.

Figure 4: Prevalence of undiagnosed or poorly managed diabetes, from HbA1c test results (SADHS 2016)[53]

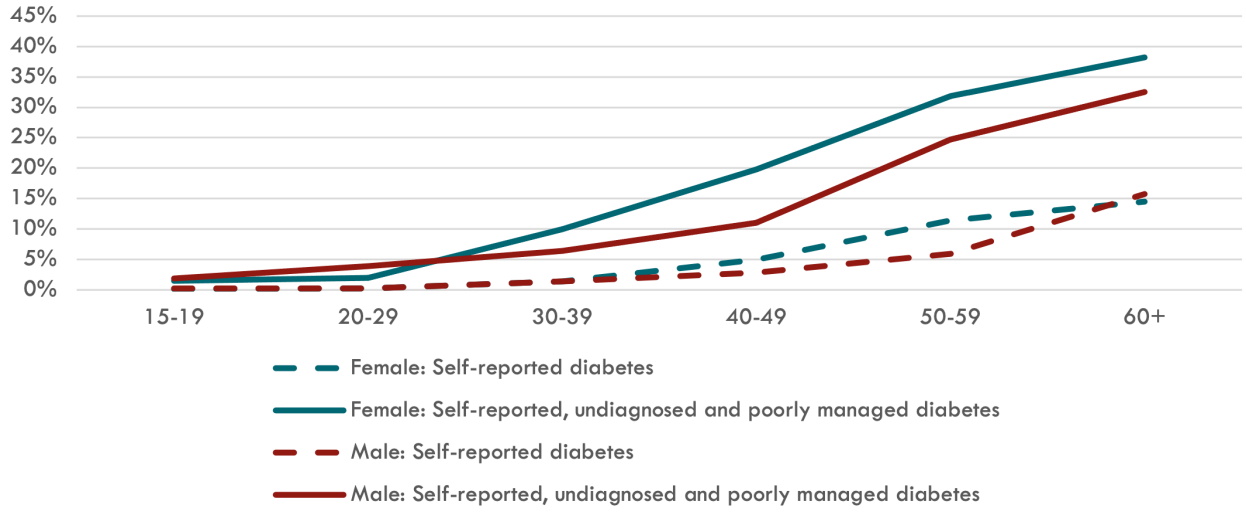


[c] The prevalence estimates presented using household survey data have not been age-standardised.

The HbA1c tests also showed that 41.8% of women and 38% of men over the age of 15 years have insulin resistance. Therefore, according to the SADHS, 50.5% of women and 43% of men either have undiagnosed or poorly managed diabetes or are at very a high risk of developing it.

Figure 5 compares the estimated prevalence of diabetes (individuals with HbA1c test results that indicate undiagnosed or poorly managed diabetes and/or individuals who reported that they had previously been diagnosed with diabetes) to the proportion of people who were aware they had diabetes[d], by age and sex. The results show an increase in the proportion of individuals with diabetes, based on both subjective and objective measures, with an increase in age. However, it is apparent that many individuals with diabetes are unaware of it. While the age standardised prevalence of diabetes is estimated to be 7.8% for men and 10% for women, only 2.4% of men and 2.9% of women (age-standardised) reported that they had diabetes. That is, only 30% of men and women who have diabetes reported that they had previously been diagnosed.

Figure 5: Prevalence of diabetes (self-reported, and undiagnosed or poorly managed diabetes) compared to self-reported diabetes (SADHS 2016)[53]



Considering results of the HbA1c tests in the SADHS data only (i.e. only including individuals with undiagnosed or poorly managed diabetes), we estimated some of the associations between risk factors and diabetes using logistic regressions[e]. We estimated two regressions. The first estimated the relationship between risk factors such as body mass index (BMI), sex, age, socio-economic status[f] (SES), and race and diabetes (as per HbA1c results). The second estimated the relationship between these risk factors and insulin resistance (as per HbA1c results)..

The results show that people who are overweight (odds ratio [OR]: 1.87) or obese (OR: 4.07) are significantly more likely to have diabetes compared to those with a normal BMI. The odds of having diabetes were also higher in older age groups[g]. Indian/Asian people were found to be more than twice as likely as black people to have diabetes, whereas white people are about half as likely as black people to have diabetes. SES was not found to be significantly associated with the likelihood of having diabetes.

[d] These respondents reported that they had been told by a nurse or health professional that they had diabetes.

[e] Standard errors were adjusted in these regressions to account for similarities between households.

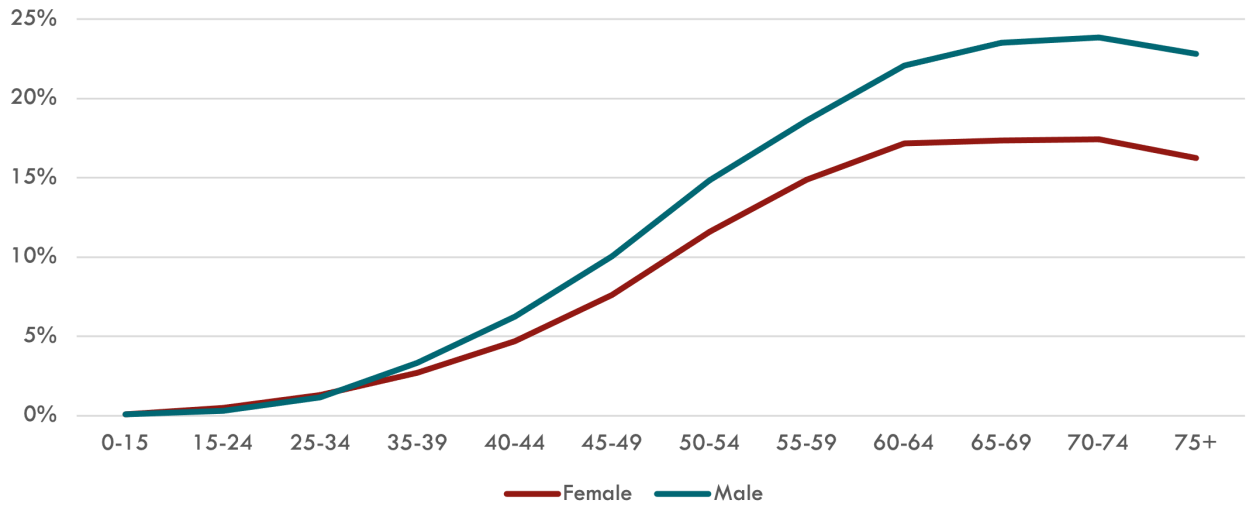
[f] Socio-economic status is estimated using a wealth index, which is a composite measure of the house's aggregate living standard, based on household asset ownership. This wealth index divides households into wealth quintiles – poorest, poorer, middle, richer, and richest.

[g] Those aged 25 to 49 (OR: 3.11) and those aged 50 and older (OR: 12.6) had higher odds of having diabetes compared to those aged 15 to 24. All ORs are statistically significant at the 1% level.

BMI and sex didn't have a statistically significant relationship with having insulin resistance; however, SES did. Insulin resistance was most prevalent in the poorest quintile. In comparison, the richest quintile statistically had a significantly lower risk of having insulin resistance (OR: 0.72). Coloured people (OR: 0.72) were also found to be significantly less likely to have insulin resistance than black people, but this was not found for white and Indian/Asian people compared to black people.

Although these results and figures are based on objective measures of blood sugar levels, they may be biased as only 65% of SADHS respondents agreed to have their blood sugar tested; therefore, the true prevalence cannot be estimated with certainty. It may also affect the estimates of associations, as respondents' refusal may be associated with their actual or perceived health status. However, these findings do confirm some of the previously discussed associations, such as the association between diabetes and obesity and older age. The relationship between SES and insulin resistance is likely due to urbanisation and the development of impoverished urban areas with obesogenic environments.

Figure 6: Proportion of beneficiaries who made least one diabetes-related claim (CMS 2018)[54]



Both CMS and SADHS data show that the likelihood of having diabetes increases with age. The prevalence rates for diabetes are also lower in the medical scheme population than they are in the public-sector population. However, it is possible that both these estimates are underestimated. The source of bias in the CMS prevalence estimates may also be the same as that in the SADHS data: only those who are tested for diabetes and diagnosed are likely to make a claim. There may also be a sizable share of the private sector population living with undiagnosed diabetes.

As mentioned, the complications associated with undiagnosed and untreated diabetes are incredibly costly to both the private and public sectors. Given that diabetes is preventable and insulin resistance is reversible, it is in the interest of medical schemes to incentivise regular screening for diabetes among their clients, especially high-risk individuals, such as those who are older than 50, overweight or obese.

Sweet secrets

Currently, South Africa has the highest prevalence of obesity in sub-Saharan Africa.[55] A large part of this has been linked to added sugar intake, which increases the risk of obesity, diabetes, and other metabolic conditions.[56] The World Health Organization (WHO) recommends less than 12 teaspoons of granulated sugar per day.[57] However, this isn't the reality for most South Africans, who consume high-sugar food such as sugary drinks as a result of addiction, habit and/or the lower cost in comparison to healthier alternatives.[56,58]

South Africa has attempted to combat this through the introduction of the Health Promotion Levy (HPL), which is an 11% tax on sugary drinks. The aim of this levy is to decrease the consumption of these drinks and the rate of obesity by 10% by 2025. This tax has caused manufacturers to decrease the amount of sugar added to many drinks, or to reduce their size. It's also raised approximately R 3 billion, which is added to the National Revenue Fund.[59] In general, these prevention-based interventions have been found to be cost-effective in LMICs.[60]

While it reflects a step in the right direction, it's not sufficient. The WHO recommends a 20% or greater tax for this intervention to be effective.57 A South African study found that with the recommended 20% tax, obesity rates would drop by 3,8% and 2.4% in men and women, respectively.61 This would prevent 220,000 cases of adult obesity and 72,000 deaths, 550,000 stroke-related health-adjusted life years lost and more than R 5 billion in costs over 20 years.[61,62]

Although strategies such as the HPL have been put in place as part of the health-promotion agenda, they've not addressed the availability of healthy foods and the marketing of unhealthy, sugary foods in townships. These locales are targets of soft drink marketing through advertising.[63] Impoverished individuals consume cheap, high-calorie, overly processed foods that are promoted by big food companies.64 Therefore, despite these progressive health policies, low-income neighbourhoods remain obesogenic environments.[64] This is described more vividly in Vignette 2.

Vignette SEQ Vignette * ARABIC 2: Changing foodscapes and access to quality food

In the Eastern Cape Karoo, the past fifty years have seen dramatic changes in residents' diets. Rather than being about individual tastes; these changes have been driven by social, political, economic, and environmental forces far beyond residents' dinner tables.

Big Food has arrived in the region – in the form of shops like Spar, U-Save, Shoprite and Pick 'n Pay. Local food economies have struggled to compete with larger ones, and many are eating food that is produced far outside of the Karoo.

The introduction of the minimum wage, along with mounting economic constraints on farms, has meant that relationships between farm owners and farm labourers have shifted dramatically. In the past, wages were often paid in kind through a feudal-like system. Housing was subsidised and farm produce was rationed, with workers receiving regular packages of vegetables, meat, sugar, coffee and more, as well as a small monetary amount.

Farms were far more self-sufficient, producing fruit, vegetables, dairy and grain beyond the livestock they sold. Today, the number of permanent farm workers have decreased dramatically, while the number of contract workers has grown. Workers are paid almost exclusively in cash and must purchase their food, often many kilometres away. Transport costs and high food prices have meant that cheaper, processed, non-perishable foods have gained more prominence in farm labourers' kitchens. Meanwhile, without access to cheap, consistent labour, many farms have moved away from producing food for self-sustenance.

Regional urbanisation has seen an influx of people from farms into towns, where they have greater access to schools, shops, and essential services. The rise of game farms and the consolidation of smaller farms into larger ones, has also resulted in many farms shedding labour. Families have been displaced into towns, where they have little or no access to land and struggle to grow their own food. Instead, they're thrust into an exclusively cash-based economy in which food (along with everything else) is bought, and likely produced in a factory.

Finally, while drought has always been a feature of Karoo life, many residents suggest that recent droughts have been the worst they've seen in their lifetime. Access to water is restricted and expensive, which doesn't present ideal conditions for growing food. It also makes larger food production more expensive.

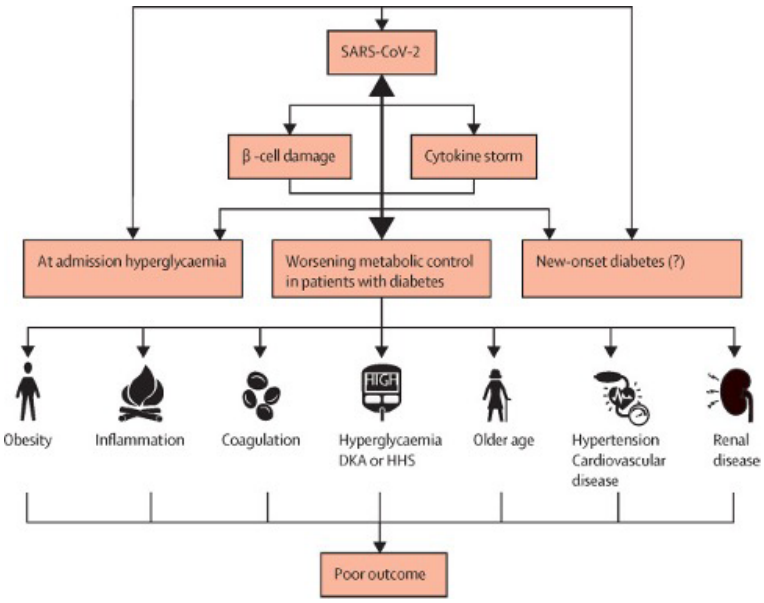
In brief 4, which deals with NCDs and geography, we told the story of Tekkies, whose family was displaced to town in the early 1990s after the farm on which they lived was converted into a game lodge. Tekkies described dramatic changes to his diet, as well as job insecurity and limited access to land. A few years after moving to town, he was diagnosed with diabetes and high blood pressure. While this correlation may be coincidental, related to age as well as improved access to testing in screening, Tekkies only became symptomatic after moving to town following a number of dramatic changes to his life and livelihood.

Diabetes and Covid-19

There's been a strong focus on Covid-19 patients with underlying comorbidities, particularly diabetes. Although those with diabetes don't have an increased risk of contracting the virus, they have worse outcomes compared to the general population.[65] A study found that in Cape Town, approximately 40% of hospitalised diabetic Covid-19 patients die.[66] The risk is exacerbated in diabetic patients who are elderly males and have comorbidities such as hypertension, clotting disorders, cardiovascular disease and obesity.[65] These comorbidities often coexist in the form of metabolic syndrome. However, patients with well-controlled diabetes appear to have the same Covid-19 mortality risk as the general population, which highlights the need for screening.[67]

The risk associated with developing diabetic complications is also increased in those with severe Covid-19 infections. Figure 6 illustrates the potential course of the Covid-19 infection. Once a susceptible individual is infected, the body releases chemicals required to fight the virus. This is known as a cytokine storm. However, these may also be harmful to the body. The β cells in the pancreas, which normally produce insulin, are damaged by these chemicals and the infection, and can therefore no longer produce insulin. This creates a diabetes-type environment and hyperglycaemia. This environment worsens the condition in people with pre-existing diabetes by causing a lack of glycaemic control, potentially leading to hospitalisation for an array of complications, and may even cause new-onset diabetes in those at risk. This leads to the poor outcomes observed.[65]

Figure 7: Diabetic complications in patients with Covid-19 (Apicella 2020)[65]



A way forward

Where the cascade of care fails

In order to achieve optimal care in those with both diabetes and insulin resistance, adequate screening, diagnosis, treatment initiation, and chronic care are required. A potential missed step in this pathway may lead to inappropriate or inadequate care.

Screening is an effective form of disease prevention. However, both patient- and system-related barriers exist. Patient-related factors include the lack of knowledge about diabetes and the initial lack of symptoms.[68] In more rural areas, barriers to healthcare, such as a lack of health facilities and transport costs, make access to screening onerous.[69] The attitudes and knowledge of healthcare workers also play a substantial role in whether the need for screening is identified and whether it is ultimately performed.[70]

Once a diagnosis is made, the initiation of care is required. While metformin, the first-line drug of choice, is often initiated in those diagnosed with diabetes, the initiation of insulin is often unsuccessful. Initiating insulin requires patients to inject themselves, which they're often afraid to do.[71,72] They may also feel a sense of failure in initiating insulin when oral medication is no longer sufficient.[72] A lack of knowledge and understanding, difficulties with temperature-controlled supply chains, as well as limited access to water and sanitation to safely inject, make insulin treatment a challenge to maintain.[71] The need for patient self-management is essential for ensuring glycaemic control and patient adherence.[73] This is largely driven by patient empowerment, and this is reportedly reduced due to a lack of emotional support provided to patients.[73]

Systemic barriers also exist. Practitioners often lack the adequate time needed to explain to patients how to administer medication in detail.[71] Furthermore, there is often a lack of continuity of care between patients and providers, making understanding and monitoring challenging.[71] With a lack of continued care, patient- and system-related issues are left unaddressed, leading to a lack of adherence and poor diabetes control.[71] Ultimately, this cycle leads to complications and consequences that come at a cost to both the patient and healthcare system.

What the health system communicates to patients

These barriers to disease prevention also provide guidance as to what can be addressed in order to improve care, particularly among high-risk individuals. A diabetic patient advocate interviewed for this brief expressed that the efforts currently in place to address diabetes have been performed inconsistently and in silos. Pharmaceutical companies are expected to provide disease-prevention material as part of the state-sector tenders they're awarded, which primarily take the form of printed educational material. However, this material is often not contextually relevant and does not account for cultural differences. Many times, content is pitched at a level of education that is far higher than that

of the target population, and only provided in English. Research into developing appropriate dietary guidelines for diabetics is often highly complex and fraught with differing scientific and ideological views on nutrition. As a result, it often doesn't get very far.

There has recently been a shift in providing behaviour-change coaching to those living with diabetes, provided by organisations such as Guidepost.[74] However, this is currently not scalable. Among the medical scheme population, just under half of diabetic patients report that they're not on any lifestyle management programmes.[73] Sweet Life is developing practical and appropriate guides addressing topics such as food, adherence, physical activity, weight loss and motivation. Furthermore, pilot studies are underway evaluating the use of WhatsApp for the distribution of health-promotion material.

The Covid-19 pandemic has placed a spotlight on the need for improved care among those with diabetes. However, no formal strategic plan had previously existed. In order to address this, the Diabetes Alliance has proposed a South African Diabetes Charter.[75] It consists of five key areas that work in conjunction with each other to improve diabetes care. It includes the following[75]:

1. Awareness and prevention aimed specifically at those with prediabetes
2. Education of those living with diabetes to improve self-management
3. Management and access to care through integration in order to achieve normal glucose levels among patients
4. Surveillance to measure impact of current strategies
5. Innovation and research such as cost-effective solutions such as digital health tools

Although efforts are being made to address the high prevalence of diabetes in South Africa, there are still gaps and room for intervention. Current initiatives are primarily facility-based. This creates a gap in care for those who are most vulnerable, lack access to care, and remain undiagnosed. Furthermore, the prevention and care currently provided seeks to improve patient knowledge with little emphasis on behaviour change. This has created a shift in responsibility and implies that patients have the ability to change their circumstances based on the provided information. However, this is often not the case as those who are vulnerable remain trapped by their circumstances, unable to address the "choiceless" lifestyle factors they're faced with.

Conclusion

Type 2 diabetes and insulin resistance are highly prevalent among South Africans and associated with significant morbidity and mortality. The elderly and women, undiagnosed patients, and individuals with insulin resistance, obesity or metabolic syndrome, are at increased risk. Furthermore, the Covid-19 pandemic has created an additional risk factor for uncontrolled diabetics who face worse outcomes.

Environmental and lifestyle factors have been targeted by disease prevention strategies; however, diabetes is often "communicable" in nature. A genetic predisposition to diabetes is widespread, and many South Africans live in poor, underserviced areas with little access to healthier food alternatives or safe public outdoor spaces where they can be physically active. "Big food" has spread into townships and rural areas bringing with it highly processed, cheap and sugary foods – with obesity, metabolic syndrome, and diabetes following.

A two-pronged approach is needed to address these contextual factors. Firstly, the existing health-policy interventions need to address advertising, particularly to children, and food labelling. Secondly, the communication gap between patients and the health system must be bridged to promote screening and prevent complications, as highlighted in the Diabetes Alliance's proposed South African Diabetes Charter. This should be addressed at each point in the patient's journey with a particular focus on high-risk groups.

References

1. Hu FB. Globalization of diabetes: The role of diet, lifestyle, and genes. In: Diabetes Care. Vol 34. American Diabetes Association; 2011:1249-1257. doi:10.2337/dc11-0442
2. International Diabetes Federation. IDF Diabetes Atlas 4th Edition. IDF; 2009
3. International Diabetes Federation. About diabetes. Published 2020. Accessed September 18, 2020. https://www.idf.org aboutdiabetes/what-is-diabetes.html
4. Link BG, Phelan J. Social conditions as fundamental causes of disease. J Health Soc Behav. 1995; Spec No:80-94. doi:10.2307/2626958
5. Diabetes.co.uk. Diabetes and Heart Disease. Published 2019. Accessed September 8, 2020. https://www.diabetes.co.uk diabetes-complications/heart-disease.html
6. World Health Organization. Diabetes fact sheet. Published 2018. https://www.who.int/news-room/fact-sheets/detail diabetes
7. Erzse A, Stacey N, Chola L, Tugendhaft A, Freeman M, Hofman K. The direct medical cost of type 2 diabetes mellitus in South Africa: a cost of illness study The direct medical cost of type 2 diabetes mellitus in South Africa: a cost of illness study. Published online 2019. doi:10.1080/16549716.2019.1636611
8. Barbour LA. Metabolic culprits in obese pregnancies and gestational diabetes mellitus: Big babies, Big Twists, Big picture. Diabetes Care. 2019;42(5):718-726. doi:10.2337/dci18-0048
9. Centers for Disease Control and Prevention. Type 1 Diabetes. Published 2020. Accessed September 17, 2020. https:/ www.cdc.gov/diabetes/basics/type1.html
10. Atun R, Davies JI, Gale EAM, et al. Diabetes in sub-Saharan Africa: from clinical care to health policy. Lancet Diabetes Endocrinol. 2017;5(8):622-667. doi:10.1016/S2213-8587(17)30181-X
11. Noakes PT, Wellington N, Bennett S. Diabetes is reversible. In: ASSA Convention.; 2019
12. Association AD. Classification and diagnosis of diabetes. Diabetes Care. 2015;38(Supplement 1):S8-S16. doi:10.2337 dc15-S005
13. Diabetes.co.uk. What is HbA1c? – Definition, Units, Conversion, Testing & Control. Published 2019. Accessed September 17, 2020. https://www.diabetes.co.uk/what-is-hba1c.html
14. U.S. Department of Health and Human Services. The A1C Test & Diabetes | NIDDK. Published 2018. Accessed September 18, 2020. https://www.niddk.nih.gov/health-information/diagnostic-tests/a1c-test
15. Franceschi C, Garagnani P, Morsiani C, et al. The continuum of aging and age-related diseases: Common mechanisms but different rates. Front Med. 2018;5(MAR). doi:10.3389/fmed.2018.00061

References

16. Saltiel AR, Olefsky JM. Inflammatory mechanisms linking obesity and metabolic disease. J Clin Invest. 2017;127(1):1-4. doi:10.1172/JCI92035

17. Freinkel N. Of pregnancy and progeny. Diabetes. 1980;29(12):1023-1035. doi:10.2337/diab.29.12.1023

18. KC K, Shakya S, Zhang H. Gestational Diabetes Mellitus and Macrosomia: A Literature Review. Ann Nutr Metab. 2015;66(2):14-20. doi:10.1159/000371628

19. Järvelin MR, Vääräsmäki M, Pouta A, et al. Adolescent manifestations of metabolic syndrome among children born to women with gestational diabetes in a general-population birth cohort. Am J Epidemiol. 2009;169(10):1209-1215. doi:10.1093/aje/kwp020

20. Gu S, An X, Fang L, et al. Risk factors and long-term health consequences of macrosomia: A prospective study in Jiangsu Province, China. J Biomed Res. 2012;26(4):235-240. doi:10.7555/JBR.26.20120037

21. Dupont C, Armant DR, Brenner CA. Epigenetics: Definition, mechanisms and clinical perspective. Semin Reprod Med. 2009;27(5):351-357. doi:10.1055/s-0029-1237423

22. Rosen ED, Kaestner KH, Natarajan R, et al. Epigenetics and epigenomics: Implications for diabetes and obesity. Diabetes. 2018;67(10):1923-1931. doi:10.2337/db18-0537

23. Ling C, Groop L. Epigenetics: A molecular link between environmental factors and type 2 diabetes. Diabetes. 2009;58(12):2718-2725. doi:10.2337/db09-1003

24. Perlmuter LC, Flanagan BP, Shah PH, Singh SP. Glycemic control and hypoglycemia. Diabetes Care. 2008;31(10):2072 2076. doi:10.2337/dc08-1441

25. Villeneuve LM, Reddy MA, Natarajan R. Epigenetics: Deciphering its role in diabetes and its chronic complications. Clin Exp Pharmacol Physiol. 2011;38(7):451-459. doi:10.1111/j.1440-1681.2011.05497.x

26. Ellulu M, Abed Y, Rahmat A, Ranneh Y, Ali F. Epidemiology of obesity in developing countries: challenges and prevention. Glob Epidemic Obes. 2014;2(1):2. doi:10.7243/2052-5966-2-2

27. Saklayen MG. The Global Epidemic of the Metabolic Syndrome. Curr Hypertens Rep. 2018;20(2). doi:10.1007/s11906 018-0812-z

28. Gassasse Z, Smith D, Finer S, Gallo V. Association between urbanisation and type 2 diabetes: An ecological study. BMJ Glob Heal. 2017;2(4):e000473. doi:10.1136/bmjgh-2017-000473

29. Puja M. Relationship between Urbanisation and Industrialisation.; 2014

30. Kyobutungi C, Ziraba AK, Ezeh A, Yé Y. The burden of disease profile of residents of Nairobi's slums: Results from a Demographic Surveillance System. Popul Health Metr. 2008;6(1):1. doi:10.1186/1478-7954-6-1

References

31. United Nations Department of Economic and Social Affairs. World Urbanization Prospects, the 2014 Revision, Highlights.; 2014

32. Assah FK, Ekelund U, Brage S, Mbanya JC, Wareham NJ. Urbanization, physical activity, and metabolic health in sub Saharan Africa. Diabetes Care. 2011;34(2):491-496. doi:10.2337/dc10-0990

33. Mutyambizi C, Booysen F, Stokes A, Pavlova M, Groot W. Lifestyle and socio-economic inequalities in diabetes prevalence in South Africa: A decomposition analysis. Devleesschauwer B, ed. PLoS One. 2019;14(1):e0211208. doi:10.1371/journal.pone.0211208

34. Whiting D, Unwin N, Roglic G. Diabetes: Equity and Social Determinants.; 2010

35. UNITE FOR SIGHT. Urban Versus Rural Health – Global Health University. Accessed September 14, 2020. http://www uniteforsight.org/global-health-university/urban-rural-health

36. Sahadew N, Singaram VS. A diabetes profile of the eight districts in the public health sector, Eastern Cape Province, South Africa. South African Med J. 2019;109(12):957-962. doi:10.7196/SAMJ.2019.v109i12.13972

37. Mendenhall E. Syndemic suffering in Soweto: violence and inequality at the nexus of the health transition in South Africa. Ann Anthropol Pract. 2015;38(2):300-316

38. Shin JA, Lee JH, Lim SY, et al. Metabolic syndrome as a predictor of type 2 diabetes, and its clinical interpretations and usefulness. J Diabetes Investig. 2013;4(4):334-343. doi:10.1111/jdi.12075

39. Jannasch F, Kröger J, Schulze MB. Dietary Patterns and Type 2 Diabetes: A Systematic Literature Review and Meta Analysis of Prospective Studies. J Nutr. 2017;147(6):1174-1182. doi:10.3945/jn.116.242552

40. Diabetes UK. Glycaemic index and diabetes. Accessed September 17, 2020. https://www.diabetes.org.uk/guide-to diabetes/enjoy-food/carbohydrates-and-diabetes/glycaemic-index-and-diabetes

41. Kolb H, Martin S. Environmental/lifestyle factors in the pathogenesis and prevention of type 2 diabetes. BMC Med. 2017;15(1):1-11. doi:10.1186/s12916-017-0901-x

42. Aucott L, Poobalan A, Smith WCS, et al. Weight loss in obese diabetic and non-diabetic individuals and long-term diabetes outcomes – a systematic review. Diabetes, Obes Metab. 2004;6(2):85-94. doi:10.1111/j.1462-8902.2004.00315.x

43. Smit W, De Lannoy A, Dover RVH, Lambert E V, Levitt N, Watson V. Making unhealthy places: The built environment and non-communicable diseases in Khayelitsha, Cape Town. Heal Place. 2015;35:11-18. doi:10.1016/j. healthplace.2015.06.006

44. Hunter-Adams J, Battersby J, Oni T. Food insecurity in relation to obesity in peri-urban Cape Town, South Africa: Implications for diet-related non-communicable disease. Appetite. 2019;137:244-249. doi:10.1016/j.appet.2019.03.012

References

45. Statistics South Africa. Mortality and Causes of Death in South Africa, 2016: Findings from Death Notification.; 2018

46. Sowers JR, Epstein M. Diabetes Mellitus and Associated Hypertension, Vascular Disease, and Nephropathy. Hypertension. 1995;26(6):869-879. doi:10.1161/01.HYP.26.6.869

47. Cairncross C-A, Govuzela M. Prevalence of Chronic Diseases in the Population Covered by Medical Aid Schemes in South Africa.; 2019

48. Percept. Sweet Life / Allegra Blood Glucose Data Analysis.; 2019

49. World Health Organization. Noncommunicable Diseases Country Profiles 2018.; 2018. doi:10.1002/9781119097136.part5

50. Shung-King M, Lake L, Sanders D, Hendricks M. Child and Adolescent Health: Leave No One Behind. Children's Institute, University of Cape Town; 2019

51. South African Human Rights Commission. Research Brief on Gender and Equality in South Africa 2013-2017.; 2017

52. Statistics South Africa. General Household Survey 2018 [Dataset]. Version 1.; 2019. doi:10.25828/9tmn-fz97

53. National Department of Health (NDOH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), ICF. South Africa Demographic and Health Survey 2016.; 2019

54. Council for Medical Schemes. CMS Annual Report 2017-2018: Annexures

55. South African National Department of Health. STATS SA Key Indicator Report. Published 2017. Accessed September 11, 2020. www.statssa.gov.za

56. Bosire EN, Stacey N, Mukoma G, Tugendhaft A, Hofman K, Norris SA. Attitudes and perceptions among urban South Africans towards sugar-sweetened beverages and taxation. Public Health Nutr. 2020;23(2):374-383. doi:10.1017/S1368980019001356

57. World Health Organization. Taxes on sugary drinks: Why do it? Published 2017. Accessed September 11, 2020. https:/apps.who.int/iris/handle/10665/260253

58. Okop KJ, Lambert E V., Alaba O, et al. Sugar-sweetened beverage intake and relative weight gain among South African adults living in resource-poor communities: longitudinal data from the STOP-SA study. Int J Obes. 2019;43(3):603-614. doi:10.1038/s41366-018-0216-9

59. Pilane P, Green A. Sugary drinks tax turns one – amid opposition | Health-e. Published 2019. Accessed September 11, 2020. https://health-e.org.za/2019/04/01/sugary-drinks-tax-turns-one-amid-opposition/

60. Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: Health effects and cost-effectiveness. Lancet. 2010;376(9754):1775-1784. doi:10.1016/S0140-6736(10)61514-0

References

61. Manyema M, Veerman LJ, Chola L, et al. The Potential Impact of a 20% Tax on Sugar-Sweetened Beverages on Obesity in South African Adults: A Mathematical Model. Nishiura H, ed. PLoS One. 2014;9(8):e105287. doi:10.1371/journal.pone.0105287

62. Manyema M, Veerman LJ, Tugendhaft A, Labadarios D, Hofman KJ. Modelling the potential impact of a sugar-sweetened beverage tax on stroke mortality, costs and health-adjusted life years in South Africa. BMC Public Health. 2016;16(1):405. doi:10.1186/s12889-016-3085-y

63. PRICELESS SA. Big Food & Public Health Policy: the case for the sugary drinks tax/ health promotion levy. In: State of Dis-Ease.; 2019

64. Kroll F, PLAAS. Mapping obesogenic food environments. In: State of Disease Transdisciplinary Workshop.; 2019

65. Apicella M, Campopiano MC, Mantuano M, Mazoni L, Coppelli A, Del Prato S. COVID-19 in people with diabetes: understanding the reasons for worse outcomes. Lancet Diabetes Endocrinol. 2020;8(9):782-792. doi:10.1016/S2213-8587(20)30238-2

66. A Coetzee JJTSSHMCMC-SJAD. Diabetes mellitus and COVID-19: A review and management guidance for South Africa. South African Med J. 2020;110(8). Accessed September 25, 2020. http://www.samj.org.za/index.php/samj/article/view/12991

67. CDE. Corona Virus (COVID-19) and Diabetes-Q & A.; 2020

68. World Health Organization. Screening for Type 2 Diabetes.; 2003

69. Brown E, Natoli N, McLaughlin R, Mehta K. Pathways and Barriers to Diabetes Screening: Observations from Rural Kenya. Procedia Eng. 2015;107:387-394. doi:10.1016/j.proeng.2015.06.096

70. Roux M le, Walsh C, Reid M, Raubenheimer J. Diabetes-related knowledge, attitude and practices (KAP) of adult patients with type 2 diabetes mellitus in the Free State province, South Africa. South African J Clin Nutr. 2019;32(4):83-90. doi:10.1080/16070658.2018.1468536

71. Haque M, Emerson SH, Dennison CR, Navsa M, Levitt NS. Barriers to initiating insulin therapy in patients with type 2 diabetes mellitus in public-sector primary health care centres in Cape Town – PubMed. S Afr Med J. 2005;95(10):798-802

72. Karter AJ, Subramanian U, Saha C, et al. Barriers to insulin initiation: The translating research into action for diabetes insulin starts project. Diabetes Care. 2010;33(4):733-735. doi:10.2337/dc09-1184

73. Council for Medical Schemes. PATIENT EXPERIENCE SURVEY: MEDICAL SCHEMES' BENEFICIARIES LIVING WITH DIABETES 2019/20.; 2021

74. Guidepost South Africa | Diabetes Coaching. Accessed September 21, 2020. https://guidepost.net/za/

75. Sweet Life. The Inaugural South African Diabetes Summit 2021. Accessed September 27, 2021. https://sweetlife.org.za diabetes-summit-2021/