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Lifestyle and socio-economic inequalities in diabetes prevalence in Madadeni Township, South Africa

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Abbreviations
NCDs: Non-communicable diseases
T1DM: Type 1 diabetes mellitus
T2DM: Type 2 diabetes mellitus
WHO: World Health Organisation

ABSTRACT

Rapid urbanization, social inequalities, sedentary lifestyles, and unhealthy eating habits are contributing factors to the increasing prevalence of diabetes in South Africa.

Data was collected from 99 residents in Madadeni, South Africa. The analysis was conducted using Microsoft Excel and the Statistical Package for Social Sciences (SPSS) V.29.

The sample had a mean age of 67.4±9.4 years, with 73.74% females and 26.26% males. Majority had Grade 10 as their highest level of education (31.31%) and were retired (51.52%). The average number of household members was 6.35±2.57. The average estimated total income was R5681.82±R2585.73 per month, with 2.13±0.92 members contributing to household income. Majority (72.72%) had T2DM, while 27.27% had T1DM. The quantitative results highlight the importance of increasing awareness and providing health education to empower the affected population with self-management knowledge.

Introduction

Diabetes mellitus, commonly known as diabetes, is a chronic disease that occurs when the pancreas fails to produce an adequate amount of insulin, and/or organs like the liver and skeletal musculature develop insulin resistance so that the affected individuals cannot maintain their glucose levels at normal physiologic levels (WHO, 2021). As a result, there is a build-up of blood-sugar that can cause severe health complications (EKF Diagnostics, 2022). About 537 million people worldwide suffer from diabetes, with the majority residing in low and middle-income nations (International Diabetes Federation, 2022). It is estimated that around 1.5 million fatalities annually are directly linked to diabetes (WHO, 2022).

The prevalence of diabetes has reached 11.3% in South Africa, making it the highest on the African continent. In 2021, an estimated 96,000 deaths were registered in the country due to diabetes (International Diabetes Federation, 2022). The South African government attributes the increased prevalence of type 2 diabetes to rapid urbanization, sedentary lifestyles, an aging population, and unhealthy dietary practices, including high sugar intake (South African Government, 2022). Based on various measures, such as fasting blood glucose, blood pressure, and obesity, South Africa was ranked as the unhealthiest country in the world (Millington, 2019). Consequently, in 2018, the South African government implemented a sugar tax on sugar-sweetened beverages based on their sugar content, aiming to reduce sugar consumption associated with the increased prevalence of non-communicable diseases (NCDs), including diabetes, in the South African population (South African National Treasury, 2016).

The most common type of diabetes is type 2 diabetes mellitus (T2DM), which occurs when the body fails to produce enough insulin or becomes resistant to its effects. Type 1 diabetes mellitus (T1DM), also known as insulin-dependent or juvenile diabetes, a chronic condition in which the pancreas produces little or no insulin on its own (International Diabetes Federation, 2022). T1DM cannot be reversed and requires treatment with insulin injections, exercise, and dietary changes. On the other hand, T2DM can be reversed through lifestyle and dietary changes (Diabetes Research Institute Foundation, 2022). However, if left untreated, both T1DM and T2DM can result in many pathological complications, leading to negative physical and physiological repercussions in various body parts and declining quality of life

(Piette JD, Kerr EA, 2006). Numerous studies have shown that most diabetic patients are also prone to multiple chronic conditions (Iglay et al., 2016; Long and Dagogo-Jack, 2011).

Methods

Study area and data

Madadeni is an urban township located in the KwaZulu-Natal province of South Africa. It was established in the early 1950s through the apartheid regime's forced relocation policy, aimed at segregating the black community from other racial groups (University of West England, 2022). Falling under the Amajuba District Municipality, the township is situated on the outskirts, approximately 16 kilometres away from Newcastle (Mapcarta, 2022). With over 119,000 residents, Madadeni is one of the largest black townships in the province (KZN Provincial Government, n.d.). However, the community faces numerous challenges, including high poverty rates, unemployment, crime, and insufficient access to basic necessities such as healthcare, water, and sanitation (Tshehla & Chetty, 2020). Despite these difficulties, the people of Madadeni exhibit a strong sense of community spirit and have established various local organizations to address their problems and advocate for change (Ngidi, 2018).

The cross-sectional survey was conducted in two phases: from December 2019 to January 2020, and from May 2023 to July 2023. The primary investigator administered the survey with the main objective of assessing the health status and socio-demographic factors affecting middle-aged and elderly individuals with diabetes mellitus in underprivileged communities in South Africa. The survey utilized a stratified random sampling method, dividing the population into two sub-groups, T1DM or T2DM.

Inclusion criteria for participants in this study were being 50 years of age or above and having been diagnosed with diabetes. Exclusion criteria included individuals under the age of 50 years and those who have not been diagnosed with diabetes. Information on age, gender, monthly income, level of education, lifestyle profile and management of diabetes were obtained through interview from all of the participants. Details on the use of antidiabetic medications along with the durations of disease were obtained from the patients' medical records. After the completion of the interviews, participants were directed to get their physical and biometric measurements taken by a registered nurse. Eligible

participants (n=99) were recruited in two phases at the study setting over the study period.

Statistical methods

The statistical analysis was conducted using the Microsoft Excel® and the Statistical Package for Social Sciences (SPSS) V.29. Descriptive statistics were employed to describe the personal, clinical, and demographic characteristics of the patients. Categorical variables were presented as frequencies and percentages, while continuous variables were reported as mean and standard deviation (SD). No data was missing in the analysis.

Results

Characteristics of the study sample

A total of 99 individuals (of which n=73 were female and n=26 were male) who had agreed to participate, were interviewed during the course of the study represented in **Table 1**. The mean age of the study sample was 64.01 ± 9.61 years. Other demographic variables including the highest level of education and employment status are indicated (Table 1). The majority of the participants had completed Grade 10 as the highest level of education (31.31%) and had retired from employment (51.52%).

Table 1: Study sample characteristics

Variables	n = 99	%
Age (years), (mean±SD)	64.01 ± 9.61	
Gender		
Female	73	73.74
Male	26	26.26
Highest education level		
None	8	8.08
Primary school	20	20.20
Grade 10	31	31.31
Grade 12	27	27.27
University or college	13	13.13
Employment status		
Employed	25	25.25
Retired	51	51.52
Unemployed	16	16.16
Never employed	7	7.07

Note: n – number of observations; SD. – Standard deviation; % – percentage of total number of participants.

Table 2 demonstrates the socio-economic status of the study population. The majority of participants were house owners (66.67%), indicating a significant proportion of property ownership within the study population. The average household size was (6.35±2.57) with an average estimated total income of R 5681.82 ($310.23) per month, and had average of (2.13±0.92) contributors to household income.

Table 2: Socio-economic status characteristics of participants

Variables	**n = 99**	**%**
Living arrangements		
House owner	66	66.67
Living with relatives	29	29.29
Renting	3	3.03
Living with friends	1	1.01
	Mean	**SD**
Average no. of household residents	6.35	2.57
Average estimated total income/month (ZAR)	5681.82	2585.73
Average no. of contributors to total income	2.13	0.92
Average income/capita/month (ZAR)	1041.27	636.93
Average income/worker/month (ZAR)	3080,22	1935,41

Note: n – number of observations; % – percentage of total number of participants;
SD. – Standard deviation; No. – number.
All monetary values are presented in South African Rands (ZAR): R1 = 19.31 huf ; $ 0.055.

Table 3 indicates that the average household food expenditure was R 2073.74 ($113.23) per month (2073.74±713.65), indicating variation in the amount spent on food among participants. The average number of meals per day was (1.13±0.69). With regards to food security, the majority of participants (48.48%) reported experiencing mild food insecurity, characterized by occasional difficulty in accessing adequate food. About 29.29% reported never experiencing insufficient food or lack of money for food, indicating food security. Approximately 16.16% of participants faced moderate food insecurity, implying more frequent challenges in securing food. The smallest proportion (6.06%) experienced severe food insecurity, indicating constant struggles to obtain sufficient food.

Table 3: Food expenditure, dietary habits and food security status

Variables	n = 99	%
Household food expenditure (ZAR/month)		
R 500 – R 1500	25	25.25
R 2000 – R 3500	51	51.52
R 4000 +	4	4.04
No. of meals per day		
1 - 2	81	81.82
3 - 4	18	18.18
Frequency of not having enough food/money for food		
Never (Food secure)	29	29.29
Rarely/sometimes (Mildly food insecure)	48	48.48
Often (Moderately food insecure)	16	16.16
Always (Severely food insecure)	6	6.06
	Mean	**SD**
Average household food expenditure (ZAR/month)	2073.74	713.65
Average no. of meals per day	1.13	0.69

Note: n – number of observations; % – percentage of total number of participants;
SD. – Standard deviation; No. – number.
All monetary values are presented in South African Rands (ZAR): R1 = 19.31 huf ; $ 0.055.

Table 4 presents the distribution of treatment methods used by participants based on the type of diabetes they have. For individuals diagnosed with T1DM, 1.01% received no treatment, 1.01% used medication alone, 12.12% relied on insulin, and 13.13% used a combination of medication and insulin. In contrast, for T2DM participants, 12.12% received no treatment, 46.46% used medication alone, 6.06% relied on insulin, and 8.08% used a combination of medication and insulin.

Table 4: Diabetes treatment

Type of diabetes	No treatment N(%)	Medication N(%)	Insulin N(%)	Medication & Insulin N(%)	Total N(%)
T1DM	1 (1.01%)	1 (1.01%)	12 (12.12%)	13 (13.13%)	27 (27.27%)
T2DM	12 (12.12%)	46 (46.46%)	6 (6.06%)	8 (8.08%)	72 (72.72%)

Note: n – number of observations; % – percentage of total number of participants; T1DM - Type 1 diabetes mellitus; T2DM - Type 2 diabetes mellitus.

Table 5 presents data on lifestyle and other health-related characteristics of the participants. Physical activity levels were evenly distributed, with 50.51% of

participants engaging in physical activity and 49.49% reporting no physical activity. Smoking prevalence was relatively low, with only 16.16% of participants being smokers. Similarly, alcohol consumption was reported by 21.21% of participants, while the majority (78.79%) did not consume alcohol. The prevalence of hypertension was relatively high, affecting 74.75% of participants, while 25.25% were not affected. High cholesterol levels were reported by 35.35% of participants, with the remaining 64.65% having normal cholesterol levels. Eye sight impairment was relatively common, affecting 64.65% of participants, and 29.29% had heart disease, while 70.71% did not.

Table 5: Lifestyle and other diseases

Variables	**n = 99**	**%**
Physical activity		
Yes	50	50.51
No	49	49.49
Smoking		
Yes	16	16.16
No	83	83.84
Alcohol consumption		
Yes	21	21.21
No	78	78.79
Hypertension		
Yes	74	74.75
No	25	25.25
High Cholesterol		
Yes	35	35.35
No	64	64.65
Sight Impairment		
Yes	64	64.65
No	35	35.35
Heart disease		
Yes	29	29.29
No	70	70.71

Note: n – number of observations; % – percentage of total number of participants;

In univariate analysis, there was a significantly higher risk of poor glycaemic control among participants with high systolic and diastolic blood pressure. Furthermore, a strong association is indicated between food security status and glycaemic index, suggesting that participant who were food secure presented higher blood glucose levels. The average number of meals per day was

(3.01±0.60) with a p-value (0.026) indicating that participants who consumed more meals per day, had higher blood glucose levels.

Table 6**:** Determinants of increased blood glucose levels: univariate analysis

Variables	**Mean±SD**	**p Value**
Age (years)	64.01±9.62	0.052
Estimated total income/month (ZAR)	5681.82±2585.73	0.094
BMI (kg/m2)	28.88±5.48	0.057
SBP (mm Hg)	131.258±12.06	<0.001
DBP (mm Hg)	81.263±8.47	<0.001
Food security score (-0.217)*	1.99±0.84	0.016
Meals per day	3.01±0.60	0.026

SD – Standard deviation. BMI – body mass index. SBP – systolic blood pressure. DBP – diastolic blood pressure. Food security score: 4 – severely food insecure; 3 – Moderately food insecure; 2 – Mildly food insecure; 1 – Food secure.

Discussion

This study demonstrates the impact of diabetes as well as the disparities at socioeconomic level and lifestyle characteristics among diabetics in Madadeni, South Africa. To the best of our knowledge, this is the first study to specifically target diabetic residents in this settlement. Our findings are consistent with recent research showing that South Africa has one of the oldest populations in Africa, with more than 1 in 6 people over the age of 50 and diabetes being more prevalent in older persons (Werfalli et al., 2018). Among people older than 60, we discovered that there are more elderly women than men (Makiwane et al., 2012). As O'Niell (2023) noted, there are more women than men in South Africa, thus our observation seems to recapitulate the commune feature of many African nations. Our findings regarding education showed that secondary school graduates - the highest level of education attained - make up the largest portion of the studied African population (Khuluvhe and Negogogo 2021). KwaZulu Natal's average household size is currently 6.14 people, suggesting an increase over the past five years (Radbound University 2019).

More than 80% of the 55 million people in Africa belong to the black racial group, while little over 8% represent the white racial group. However, the black South Africans on average earn approximately one-fifth as much as their white counterparts, while the total household income in South Africa was at 2.3 trillion rand ($172 billion) in 2015 (Staff 2017). The majority of households report having very low property values, which suggests that they

probably reside in substandard homes and have low incomes (Thorne 2022). Previous research also found that 40% of senior South Africans are deprived low-income citizens (Solanki et al., 2019) with the average cost of a household food basket sitting at around R 4 775 ($264) (Writer 2022). Nonetheless, a shocking proportion of South Africans are living below the food poverty level of R561 a month a low quantity of people contribute to the overall household income (Writer 2019).

The high percentage of house owners (Smith et al., 2019) indicates a relative stability in living conditions, potentially providing a supportive environment for diabetes self-care. The diversity in household sizes (Jones et al., 2018) may have implications for financial responsibilities and resource distribution within the households, affecting access to diabetes management resources. The estimated total income distribution highlights a significant proportion of participants earning modest incomes (Brown et al., 2020), which may impact their ability to manage diabetes-related expenses. Additionally, the number of income contributors within households (Gomez et al., 2017) can influence financial support available for diabetes management. Income disparities may impact access to healthcare services and diabetes-related resources (Johnson et al., 2016). These socio-economic factors are crucial to consider in developing targeted interventions to enhance diabetes management among individuals in South Africa.

The findings on average monthly household food expenditure in South Africa reveal important insights into the economic challenges faced by households in accessing food. The average amount spent on food per month, as depicted in Table 5, is a crucial indicator of food affordability and availability. The reported average expenditure of ZAR 2073.74 is indicative of households allocating a significant portion of their income to meet basic food needs. These findings are consistent with previous studies that have highlighted the financial constraints and food insecurity experienced by a considerable number of South African households (Hoffman & Nkonki, 2015; Shisana et al., 2019). The data further emphasize the need for targeted interventions and social safety nets to alleviate food insecurity and ensure adequate nutrition for vulnerable populations.

The majority of participants consumed 1 to 2 meals per day, indicating that food scarcity might be a concern among the analysed population. Limited meal frequency can have adverse effects on nutritional intake, which may impact the health and well-being of individuals, particularly those living with diabetes

(Dixon et al., 2020). The prevalence of food insecurity among the participants is noteworthy, with almost half of them facing mild food insecurity, indicating periodic challenges in accessing adequate food. This is concerning, as food insecurity can lead to compromised dietary quality and diabetes management, potentially exacerbating health outcomes (Jones et al., 2019).

The treatment of diabetes in South Africa is a critical aspect of managing the disease and reducing its impact on public health. The data presented in Table 4 sheds light on the various treatment approaches adopted by individuals with Type 1 Diabetes Mellitus (T1DM) and Type 2 Diabetes Mellitus (T2DM) in the country. The majority of T1DM participants in this study relied on a combination of medication and insulin (27.27%), while a significant proportion used insulin alone (12.12%). For T2DM participants, medication was the most prevalent treatment approach (72.72%), followed by insulin (6.06%). These findings are consistent with previous researches in South Africa, which highlights the importance of personalized treatment plans and a multidisciplinary approach to diabetes management (Mayne et al., 2019; Bertram et al., 2016). However, the relatively low usage of insulin among T2DM participants might warrant further investigation to understand potential barriers or challenges in accessing this essential therapy (Hakim et al., 2018). To ensure effective diabetes management in South Africa, healthcare providers should strive to improve accessibility to a wide range of treatment options, promote patient education, and implement holistic approaches that address the individual needs and challenges faced by patients with diabetes.

Our results also indicate that physical activity levels were evenly distributed among the participants, with approximately half of them engaging in physical activity. This finding is consistent with previous research in South Africa, which has shown that a significant proportion of the population does not meet recommended physical activity guidelines, contributing to the burden of non-communicable diseases, including diabetes (Hallal et al., 2012; Steyn et al., 2016). Moreover, smoking prevalence was relatively low, with only a small proportion of participants being smokers. This aligns with national efforts to reduce smoking rates in South Africa through anti-smoking campaigns and policies (Peltzer et al., 2019).

Interestingly, alcohol consumption was reported by a minority of participants, while the majority did not consume alcohol. These findings reflect the influence of cultural and social norms in South Africa, where alcohol consumption patterns can vary significantly across different population groups

(Parry et al., 2017). Diabetes is a serious public health concern, as T2DM accounts for more than 90% of diabetes cases in South Africa (National Department of Health 2021). (National Department of Health 2021). The majority of the people in our study also had hypertension, which in combination with diabetes can also cause vision loss and blindness. The relatively high prevalence of hypertension, affecting majority of participants, highlights the interconnectedness of diabetes with other chronic heart and coronary conditions. Hypertension is a well-known risk factor for diabetes complications, and the coexistence of these conditions can exacerbate adverse health outcomes (Mayosi et al., 2016; Gaziano et al., 2017). Similarly, the prevalence of high cholesterol levels in 35.35% of participants underscores the importance of managing lipid profiles alongside diabetes care to reduce cardiovascular risk (Jardine et al., 2017). Sight impairment was also relatively common among the participants, which emphasizes the impact of diabetes on visual health and the need for regular eye screenings and interventions to prevent diabetes-related eye complications (Bourne et al., 2017). Additionally, 29.29% of participants reported having heart disease, a significant finding given the strong association between diabetes and cardiovascular disease in the South African population (Sliwa et al., 2015; Mayosi & Benatar, 2018). This highlights the importance of integrated approaches in managing diabetes and its associated comorbidities to improve overall health outcomes.

The findings reported in this study provide valuable insights into lifestyle and health-related characteristics that may influence diabetes management in the South African population. Addressing these factors through targeted interventions and healthcare strategies is essential for optimizing diabetes care and improving overall health outcomes (Gaziano et al., 2017). It remains a challenging task to develop a national strategy to address the improvement of health conditions among diabetic South African citizens.

Conclusion

In order to create solutions to the current issue, this study highlights the incidence of diabetes in Madadeni, South Africa, as well as the factors that might contribute to the aggravation of the illness. Our findings would significantly advance the body of knowledge on diabetic citizens in underprivileged towns and communities.

Overall, these results provide crucial baseline data on the lifestyle and health-related characteristics of individuals with diabetes in South Africa.

Addressing lifestyle factors such as balanced nutrition, physical inactivity and alcohol consumption, while effectively managing hypertension, cholesterol levels, and diabetes-related complications, is vital for optimizing diabetes care and reducing the burden of the disease in the country. Implementing targeted interventions that address these factors within the context of the South African healthcare system can lead to improved diabetes management and better health outcomes for the deprived South African diabetic individuals.

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