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RESEARCH ARTICLE

Relationship between diabetes knowledge, self-management practices, and glycaemic control among patients attending diabetic clinic at a tertiary level hospital in Johannesburg, South Africa

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Background: Diabetes mellitus (DM) has reached epidemic proportions in South Africa. Targets for adequate glycaemic control are rarely being met. DM self-management is a cornerstone of effective DM care and people with DM should be adherent to various self-care behaviours. This study aims to describe the behavioural factors contributing to DM management control and how they relate to glycaemic control.
Method: A cross-sectional survey used the Diabetes Self-Management Questionnaire (DSMQ) to assess knowledge and self-management behaviours of physical activity, glucose management, dietary control, and health care use amongst patients attending a diabetic clinic at a tertiary hospital in Johannesburg. Regression analysis models were used to determine the relationship between the independent variables of DM knowledge and self-care behaviours and the outcome variable glycaemic control.
Results: A total of 214 participants were enrolled; the majority were African (55.6%) and Coloured (30.4%). Only 14% of patients achieved a target HbA1c of less than 7%. Participants scored the highest average scores on the DSMQ for the healthcare use subscale, followed by glucose management, then physical activity. The lowest mean score was noted for the dietary subscale. The dietary control subscale of the DSMQ was most significantly associated with HbA1c (OR 0.79 [CI 0.64–0.96], *p*-value 0.020). Overall compliance with diabetes self-management behaviours is associated with improved glycaemic control, whereby patients who scored higher on the DSMQ were less likely to have poor glycaemic control (OR: 0.51 [CI 0.28–0.94], *p*-value 0.030).
Conclusion: The barriers to effective DM control are vast and complex. This study shows that effective self-management overall is associated with better glycaemic control. Dietary control is most significantly associated with HbA1c. Most people living with DM find it challenging to adhere to a nutritious and diverse DM diet. There is room for further research and intervention regarding medical nutrition therapy that will be culturally and financially appropriate for the South African population.

Keywords: diabetes mellitus, diabetes self-management education, glycated haemoglobin (HbA1c), medical nutritional therapy, diabetes self-management questionnaire

Introduction

The global burden of diabetes mellitus (DM), estimated by the 2021 International Diabetes Federation (IDF) Atlas, is 536 million adults and is expected to rise to 783 million by 2045.[1] With 4.2 million people living with diabetes (PLWD), South Africa is reported to have the highest incidence of diabetes in the Africa region.[1] Obesity, which is an important risk factor for type 2 diabetes (T2DM), is also increasing at an alarming rate with up to 49% of men and 39% of women in South Africa being reported as obese in a 2016 health survey.[2]

The economic consequences associated with the expenses of managing DM and its related complications hold considerable importance. This is particularly significant in Africa, given that DM primarily impacts individuals in the working age group (between 40 and 60 years old).[1] According to a study conducted in 2020, the estimated costs directly linked to PLWD in South Africa exceeded 2.7 billion rand, with roughly half of this amount allocated to the management of DM-related complications.[3]

To mitigate these expenses, it is crucial for PLWD to effectively manage their condition to lower the likelihood of complications. This involves maintaining proper glucose control and reaching the recommended glucose objectives. Data from South Africa conducted in both the private and public sectors indicate that 67% to 85% of patients are not attaining the desired glycaemic targets, specifically an HbA1c level of less than 7%.[4–6]

The management and prevention of DM and its complications includes medical management with various pharmaceutical therapies, as well the application of self-management behavioural techniques to improve overall outcomes.[7] The American Association of Diabetic Educators has outlined seven core behaviours that compromise diabetes self-care. These include: healthy eating, being active, monitoring of blood glucose and other health-related parameters, medication taking, problem solving, healthy coping skills, and risk reduction behaviour.[8]

Barriers to effective DM management and self-care in the African context are multifactorial. The majority of the South African population receive health care from the public sector, which is known to be overburdened.[9] Nurses in primary care are often understaffed and under-skilled to provide quality care and education to PLWD.[10] Emotional reactions, cultural beliefs, and mistrust of traditional Western antidiabetic

strategies have contributed to poor outcomes.[10] The DM diet is often cited as a significant barrier, due to high costs of healthy eating and lack of gustatory satisfaction.[10]

In 2015 a clinical audit at Helen Joseph Hospital (HJH) Diabetic Clinic reported that only 15.3% of the cohort achieved an HbA1c of less than 7%.[11] A subsequent study in 2016 showed that inadequate DM control has a negative impact on the health-related quality of life (HRQOL) of PLWD.[12]

Our study was designed to explore the reasons why patients struggle to attain goals set out by DM guidelines by assessing the role in which self-management behaviours could be contributing to these poor outcomes.

Aim

The aim of this study is to describe the behavioural factors contributing to DM management and how they relate to glycaemic control in patients living with DM at the Helen Joseph Diabetic Clinic.

Methods

Study setting

This study was set at Helen Joseph Hospital, a tertiary institution based in Auckland Park. The catchment area of the hospital is mainly Region B of the Johannesburg municipality, extending to some parts of Regions C and D. The DM clinic serves patients who have been referred for poor glycaemic control or target organ damage. Diabetic education is offered by the nurses at the clinic where patients have interactive one-on-one sessions with the nurse. Ad hoc diabetes self-management education (DSME) is also offered by the dietitians while the patients wait in the queue to see the doctors.

Study design and sample

This study was a prospective cross-sectional survey. Data were collected from February 2020 to August 2020. A total of 214 patients were enrolled for the study. A sample size of 218 patients, calculated using Fisher's sampling method, based on previous work done in a 2015 study by Dr S Bulbulia at the Helen Joseph Diabetic Clinic, found that 84% of 321 patients studied failed to reach a glycaemic target HbA1c of < 7%.[13]

Inclusion criteria

- Type 1 or Type 2 diabetes.
- Informed consent.
- Age > 18 years old.

Exclusion criteria

- Age < 18 years old.

Data collection

Each patient was surveyed by the principal investigator. A questionnaire was administered to collect demographic data, duration of diabetes, highest level of education, history of DSME, and monthly income of the participants.

To assess DM self-management behaviours, a validated tool called the Diabetes Self-Management Questionnaire (DSMQ) was used. This is a 16-item questionnaire comprising the following subscales:

- glucose management (5 items);
- dietary control (4 items);
- physical activity (3 items);
- healthcare use (3 items).

The questionnaire is worded in such a way that a higher score is indicative of more effective self-care behaviours. The questions used to assess healthcare utilisation were as follows: Regarding my diabetes care I should see my medical practitioners more often; I tend to avoid diabetes-related doctor's appointments; I keep all doctor's appointments recommended for my diabetes treatment.

To assess knowledge of DM, the participant was asked to explain what DM is in their own words. The answers were assessed using a rubric that entailed 5 criteria related to a basic definition of DM and advanced understanding of DM under the following scales:

- Poor: scores less than 2/3 for basic definition.
- Fair: scores 2–3/3 for basic definition.
- Good: scores 2–3/3 for basic definition and 1–2/2 for advanced understanding.

To assess glycaemic control, blood results for HbA1c within the last three months of the survey date were used; if there were no recent HbA1c results, a blood sample for HbA1c was drawn by the principal investigator at the time of the survey. All blood samples were processed by the National Health Laboratory Services (NHLS).

Data analysis

Data were analysed using STATA version 15.0 (StataCorp LLC, College Station, TX, USA). Categorical variables such as sex were presented as frequencies and percentages. For continuous variables such as age, a Shapiro–Wilk test was conducted to determine distribution of the data. Normally distributed variables were presented as means and standard deviations, while skewed variables were presented as medians and interquartile ranges.

Knowledge of DM was described as frequencies and percentages for the following categories: good knowledge; average knowledge; and poor knowledge.

The overall score of DM self-management was calculated by adding the score of each item for each subscale with the maximum score being 10 out of 10. The results are presented as means for normally distributed scores and medians for non-normally distributed scores. All statistics analysed at the 5% significance level, effect sizes, confidence intervals, and *p*-values are presented for each inferential analysis.

Ethical consideration

The University of the Witwatersrand Human Research Ethics Committee (Medical) approved the primary study and the current study (Clearance certificate number: M191055). Written informed consent was obtained from all participants.

Results

Sociodemographic and clinical characteristics of the study patients

A total of 214 patients were enrolled in this study. Females were in the majority at 59.4% and the median age across all patients was 54 years. The majority of patients were African (55.6%) followed by Coloured (30.4%). Three-quarters (75.2%) of the patients were diagnosed with T2DM. Only 14.0% of participants had an HbA1c of less than 7%, with a mean HbA1c of 9.8%. The median duration of DM was 10 years. Less than half (42.0%) of the participants had an average monthly income of R1 000–R3 000 and a similar number (42.0%) of patients had a higher level of education of secondary school without matric. Of note, 47.7% of participants had attended no diabetes education sessions. A detailed list of sociodemographic characteristics is presented in Table 1.

Table 1: Sociodemographic and clinical characteristics of the study patients ($n = 214$)

Characteristic	Median	IQR
Age (years)	54	40–64
Duration (number of years with diabetes)	10	4–18
	n	%
Sex		
Female	127	59.3
Male	87	40.7
Race		
Black	119	55.6
Coloured	65	30.4
Indian	13	6.1
White	17	7.9
Highest level of education		
None	1	0.5
Primary school	25	11.7
Secondary school without matric	91	42.5
Matric	42	25.7
Tertiary	24	19.6
Monthly income		
No income	76	35.5
< R1 000	6	2.8
R1 000–R3 000	90	42.1
R3 500–R6 000	22	10.3
≥ R6 000	20	9.3
Diabetic education		
None	102	47.7
1 session	31	14.5
2–4 sessions	56	26.2
4–6 sessions	14	6.5
> 6 sessions	11	5.1
Diabetes		
Type I	52	24.3
Type II	161	75.2
Missing	1	0.5
HbA1c		
Good	30	14.0
Poor	184	86.0

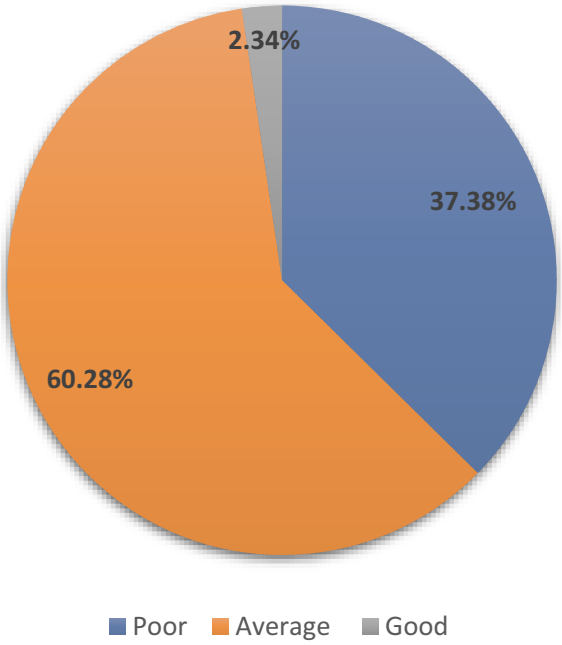

Figure 1: Self-reported perception and knowledge of diabetes mellitus by patients attending diabetes clinics.

Knowledge of DM

Regarding the assessment of basic definition of DM and advanced understanding of DM, 60.3% of the cohort had average knowledge, whilst 37.4% were described as having poor knowledge, and only 2.3% of participants had good knowledge and understanding of DM. Figure 1 show the distribution of self-reported knowledge of DM.

Self-management behaviours

The median score for glucose management is 8 out of 10, for physical activity 6.7 out of 10, and for healthcare use participants had a median score of 10 out of 10. The mean score for dietary control is 5 out of 10 (Table 2).

Association between DM knowledge and glycaemic control

Patients who scored 'poor' on knowledge of DM were likely to have a poor HbA1c but this association was not statistically significant (OR 1.07 [CI 0.40–2.84]; *p*-value 0.89).

Association between DM self-management behaviours and glycaemic control

Dietary control was significantly associated with glycaemic control whereby patients who scored higher for this subscale were more likely to have better glucose control, as measured

Table 2: Self-management of diabetes using the DSMQ

DSMQ subscale	Median (Out of 10)	IQR
Glucose management	8	6.67–9.33
Physical activity	6.67	4.44–8.88
Healthcare use	10	7.78–10
	Mean	SD
Dietary control	5.02	2.58

Glucose management, physical activity, and healthcare use were skewed, hence medians and IQRs were reported. Dietary control was normally distributed, hence a mean (SD) was reported

Table 3: Univariate and multivariate logistic regression analysis assessing the association between diabetes self-management and glycaemic control

Characteristic	Univariate		Multivariate	
	Unadjusted OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Perceptions and knowledge of diabetes				
Poor	1.07 (0.40–2.84)	0.893	0.90 (0.32–2.47)	0.834
Average	1		1	
Good	-		-	
Glucose management	0.96 (0.7801.19)	0.713	1.09 (0.86–1.38)	0.479
Dietary control	0.79 (0.64–0.96)	0.020	0.77 (0.62–0.96)	0.018
Physical activity	0.95 (0.81–1.12)	0.598	1.01 (0.85–1.19)	0.930
Healthcare use	0.82 (0.59–1.16)	0.271	0.82 (0.58–1.18)	0.292
DSMQ total	0.51 (0.28–0.94)	0.030	0.57 (0.29–1.13)	0.106

by a lower HbA1c (OR 0.79 [CI 0.64–0.96]; *p*-value 0.02). There was a positive association between physical activity, glucose management, healthcare use, and glycaemic control; however, these were not statistically significant. The total DSMQ score was independently associated with glycaemic control. Patients who scored higher on the DSMQ were less likely to have poor glycaemic control (OR: 0.51 [CI 0.28–0.94]; *p*-value: 0.03) (Table 3).

Association between sociodemographic characteristics and DM self-management subscales

When adjusting for other sociodemographic variables, DSME was, overall, associated with better glucose management. Patients who attended 2–4 sessions of DSME were significantly less likely to score poorly on glucose management in comparison with those who did not attend any diabetic education training (OR: 0.87 [CI 0.09–1.64]; *p*-value: 0.03). Gender was independently associated with physical activity scores, where males were more likely to score poorly (OR: 1.03 [CI 0.21–1.85]; *p*-value 0.02). Age was independently associated with healthcare use. The older a patient the less likely they were to score poorly on the healthcare use subscale (OR: 0.02 [CI −0.01–0.03]; *p*-value: 0.01). There was no significant association between most of the sociodemographic characteristics and diabetes self-management behaviours (Supplementary Tables IV–VII).

Assessment of linear regression for the factors associated with dietary control

Dietary control is the only subscale that demonstrated statistical significance with a relationship to HbA1c. Supplementary Table V presents the results of univariate and multivariate logistic regression of the independent variables (sex, race, highest level of education, monthly income, and history of diabetic education) compared with the dependent variable (dietary control). Notably there was no significant association with any of these factors given the wide confidence intervals, but some (non-significant) inferences can be made about this study population. Being female had a more positive correlation to dietary control than being male. Coloured and Indian participants had a negative correlation compared with their Black counterparts. With regard to the highest level of education, tertiary education had a negative correlation compared with the less formally educated. No monthly income was negatively correlated with diet. Participants who attended more than four diabetic education sessions actually had a negative correlation and poor diet control, but it should be noted that all these findings are regarded as statistically insignificant.

Discussion

DM represents a significant and widespread cause of morbidity and mortality in South Africa and globally. The practice of DM self-management is one of the cornerstones of achieving optimal DM control. This study sought to evaluate the patterns of DM self-management behaviours and their relationship with glycaemic control in patients receiving care at the DM clinic at Helen Joseph Hospital. Remarkably, 85.0% of patients in this cohort failed to meet an HbA1c of less than 7.0%, which aligns with the findings of prior studies.[5,6,11] Local data indicate that South African patients are consistently falling short of achieving their target HbA1c levels. The 'South African cohort of the International Diabetes Management Practices study' demonstrated that the average HbA1c of patients attending the private healthcare setting had an HbA1c of 8.8%, whilst our study showed a mean HbA1c of 9.8%.[4]

The DSMQ was used to assess the four self-care behaviours: glucose management, physical activity, healthcare utilisation, and dietary control. Participants scored highest on the healthcare utilisation subscale, with a median score of 10 and interquartile range of 7.78–10.0.

These elevated healthcare utilisation scores can be attributed to the fact that the patients sampled for this study were already at the hospital for their scheduled follow-up appointment, and we are thus not able to assess the compliance rates of those not at clinic. Previous studies have indicated that patients often face challenges accessing adequate health care due to factors such as the remote location of clinics and their limited financial resources, making it difficult for them to afford transport and medication.[14] Improved access to health care and healthcare utilisation has been associated with better glycaemic control and DM outcomes; however, this correlation was not noted in this cohort.[15]

The next domain in which participants obtained high scores was glucose management. The median score for glucose management was an impressive 8 out of 10, which is notably high. This is likely due to the fact that patients at this clinic are issued with a glucometer and monthly Hemo Glucose Test (HGT) strips. This observation is consistent with a study performed in a tertiary hospital setting in Tshwane, where it was found that 92.0% of patients were compliant with self-monitoring of blood glucose.[3] However, it is important to note that this level of compliance is not a true reflection of most South African patients, as many of them do not have access to glucometers.[10,16] Despite higher rates of compliance with glucose monitoring in this cohort of patients there is no significant

association with improved glycaemic control. Notably the questions related to glucose management did not assess whether the patient has knowledge of how to interpret and respond to abnormal readings. In a systematic review of self-management in sub-Saharan Africa, none of the studies reported on the ability of a patient to analyse test results.[16] A KwaZulu-Natal hospital-based DM clinic study showed that despite having a good (66%) or fair (26%) understanding of the symptoms of hypoglycaemia, less than a quarter (24%) of the participants knew what appropriate actions to take in response to hypoglycaemia.[17]

Furthermore, the data revealed a positive association between glucose management and DSME. Patients who had attended 2–4 sessions of diabetic DSME were less likely to score poorly compared with those who attended none. This underscores the importance of DSME in helping patients improve their self-monitoring of blood glucose, though this did not improve their overall glucose management. A possible confounder to this is that DSME offered at this DM clinic is on an ad-hoc or non-structured basis. The Society for Endocrinology, Diabetes and Metabolism of South Africa (SEMDSA) advocates for regular and ongoing DSME by a trained and accredited healthcare professional. DSME should take place at four crucial time points: at diagnosis, annually, when new complicating factors arise, and when transitioning into different life stages.[18]

Higher than average rates of compliance with exercise were observed in our cohort, with the median score for physical activity being 6.7 out of 10. This is in contrast to findings from the majority of studies conducted in sub-Saharan Africa, which consistently report low rates of engagement in physical activity.[16] For instance, a study conducted in Mamelodi, Pretoria showed that 92.0% of participants had limited knowledge of the benefits of exercise and weight loss.[19] A systematic review of low- and middle-income countries revealed adherence rates to exercise ranging from 26.7% to 69.0%.[20] Several factors contribute to these low rates, including older age, physical impairments, and residing in urban areas where convenient and affordable places to exercise are scarce.[10] Additionally, this study indicates that male gender is associated with poorer scores for physical activity. Our study most likely showed higher rates of exercise compliance than expected because the average age of participants was 54 years, which could be considered a relatively younger population of PLWD, compared with Europeans who have a higher prevalence of DM in age groups older than 65 years.[1] In contrast to expectations, the high rates of glucose management and compliance with exercise in our cohort did not correlate with improved glycaemic control.

Participants achieved the lowest scores (mean 5.0) on the dietary control subscale. These findings are consistent with the studies conducted in sub-Saharan Africa. A qualitative meta-analysis demonstrated that most PLWD understand the importance of consuming the correct food.[10] However, it also reported that adhering to a DM diet was perceived as expensive and often not aligned with cultural norms and practices.[10] A systematic review of self-care behaviours in low-/middle-income countries demonstrated a 58% adherence rate to dietary recommendations.[20] In a study in Pretoria involving 217 participants, it was found that a striking 99% of the participants did not adhere to a controlled and planned diet.[19]

There was also a statistically significant association between low scores on this subscale and high HbA1c levels. These data suggest that the biggest contributor to poor glycaemic control in this cohort of patients is poor dietary control. Medical nutrition therapy (MNT) has been shown to reduce HbA1c by 0.5–2.0% in people with T2DM.[17] Nutrition education programmes have been reported as helpful with regard to teaching patients about limiting starchy foods and healthier portion control.[21] A randomised control trial of a nutrition education programme in a resource-limited setting in the North West, South Africa showed a –0.6% mean difference of HbA1c between the intervention and control groups, but this finding was non-significant.[22] A larger randomised control trial set in community healthcare centres in Cape Town, where the intervention was a structured education programme, also failed to demonstrate a significant reduction of HbA1c by 1.0% in the intervention arm.[23] This is in contrast to an American randomised control trial of 203 patients, which demonstrated a significantly sustained improvement in HbA1c from a mean of 8.3% at baseline to 7.4% at 6 weeks, and 7.2% and 7.4% at 3 months and 6 months respectively, following a nutrition care intervention.[24]

Dietary advice offered by healthcare professionals should be relayed in a simple and easy-to-understand manner. There is no clear superiority of any specific dietary approach for managing DM. However, a diverse diet is generally recommended to ensure adequate nutrition. There are, nevertheless, many barriers to adequate nutrition. When assessing nutrition status in the South African population, it is important to consider the broader dietary patterns where diets tend to be low in fruit and vegetables, while being high in fat, sugar, and other refined carbohydrates such as mealie meal.[18]

A national survey in 2009, which included 3 827 South Africans across 9 provinces, demonstrated poor dietary diversity at a national level. Factors associated with greater dietary diversity, in this survey, were linked to better socioeconomic conditions, such as earning a salary, and having access to running water and electricity.[25] In addition, it has been noted that those living in urban areas find it difficult to adhere to dietary recommendations because food insecurity is a challenge faced by many, with a large number of people reporting hunger at the end of the month before receiving wages or support grants. There is also lack of space for planting of vegetable gardens, leaving people in peri-urban areas dependent on fruits and vegetables sold by street vendors. The quality of these products has been described as poor and expensive.[26]

SEMDSA acknowledges the lack of efficacy of general nutritional messages such as handing out of pamphlets and, rather, recommends that medical nutrition therapy (MNT) be provided by registered dietitians who can assess and provide individualised nutrition and behaviour modification.[18] This approach may not be feasible in many resource-constrained environments in South Africa. Dietary control is a complex and multifactorial challenge to DM self-management but it is definitely an area that needs more attention in order to attain better results in terms of glycaemic control.

It is intriguing to find that the level of education and the average monthly income did not have a significant impact on DM self-management behaviours in this study. This contrasts with an American study, which demonstrated that the most influential socioeconomic factors affecting diabetes self-care were education and income.[27] A Tshwane-based study showed that wealthier participants exhibited greater dietary diversity and engagement in physical activity.[3] Similarly, a

Chinese study revealed that adults with T2DM who had higher levels of education and income were more likely to exhibit better self-care behaviours.[28] These findings highlight the complex interplay of socioeconomic factors and DM self-management across different populations.

The design of the DSMQ was deliberate in that it incorporated self-care activities known to be linked with glycaemic control.[29,30] Our study found that participants who achieved higher total DSMQ scores were more likely to have better HbA1c levels. This discovery aligns with findings from a Malaysian study involving 340 individuals, which also demonstrated that higher self-efficacy scores were associated with improved glycaemic control.[31] These results provide support for our hypothesis that effective overall self-management behaviour leads to better DM control.

Limitations

The primary limitation of this study is the reliance on self-reported data, which introduces the potential for social desirability bias, especially during face-to-face interviews. Data related to weight were not collected. This would be of value, however, considering the low dietary compliance and high rates of obesity in South Africa. HbA1c was categorised as a binary measure of good and poor. We acknowledge that SEMDSA does accept targets of up to 8.5% in patients with advanced age and multiple comorbidities, and this may have contributed to large numbers of poor HbA1c rates.[18] Insulin usage and oral hypoglycaemic agents used were not recorded, thus giving a biased view of the effect of self-management behaviour alone being related to glycaemic control. It is reported that treatment inertia of escalating anti-diabetes therapy is common in these populations.[4] The DSMQ has never been used in the South African context. The principal investigator relied on her language skills to administer the questionnaire as she speaks English, Afrikaans, Zulu, and Sotho.

Of note is that this study was conducted from March to August of 2020, which was at the peak of COVID-19 lockdown regulations in South Africa. A qualitative study focusing on the experience of 20 adults during COVID-19 lockdown portrayed diverse experiences. Some people were able to maintain continuance of DM routines whilst others felt their routines were disrupted, such that those who led active routines pre-COVID-19 struggled to adjust. Participants in the study reported higher fluctuations in blood sugar readings due to the stress of COVID-19, especially as PLWD had been noted to have more severe presentations of the virus. Some people also admitted to poor dietary compliance associated with comfort eating, whereas others found that lockdown allowed them to focus more attention on taking care of DM.[32]

A large cross-sectional online survey conducted between May 2020 and November 2020 surveyed 679 PLWD. The survey included the DSMQ as well as data on treatment of long-term microvascular DM complications and diagnosis of COVID-19. This study revealed greater fluctuations in blood glucose levels; reduced access to DM medication, especially insulin; and reduced access to the recommended DM diet.[33] All these factors highlight the complex interaction of self-management, medication, and the effects of a global pandemic in the management of DM control.

Conclusions and practice implications

DM has reached epidemic proportions in SA. The socioeconomic implications of DM and its complications can be catastrophic. DM self-management is an essential tool in the armamentarium of DM care and is associated with better glycaemic control. The barriers preventing PLWD from achieving DM targets are multifactorial in the African setting. This study found that dietary control is the most challenging of self-care behaviours and has the most significant impact on HbA1c. Maintaining a diverse and nutritious DM diet is limited by expensive prices and a lack of cultural acceptance. MNT is often limited by socioeconomic status, and has had mixed results in clinical trials. There is a clear need for additional research and interventions in the realm of MNT that are both culturally sensitive and financially accessible to PLWD in SA.

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