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ARTICLE

Diet quality of adults with poorly controlled type 2 diabetes mellitus at a tertiary hospital outpatient clinic in Tshwane District, South Africa

Hanel Duvenage[a], Gerda J Gericke[b] and Jane W Muchiri[b*]

[a]*Department of Consumer & Food Sciences, University of Pretoria, South Africa*
[b]*Department of Human Nutrition, University of Pretoria, South Africa*
**Correspondence: jane.muchiri@up.ac.za; rahabmuchiri@yahoo.com*

Objective: To describe the dietary intake and its quality of patients with poorly controlled type 2 diabetes mellitus (T2DM) by assessing the dietary variety (DVS), dietary diversity (DDS), nutrient adequacy ratio (NAR) and mean nutrient adequacy ratio (MAR).
Design: This was a descriptive, cross-sectional study.
Setting: Diabetes outpatient clinic at a tertiary hospital in Tshwane district, Gauteng province, South Africa.
Subjects: Adults, aged 40–70 years, with poorly controlled T2DM (HbA1c ≥ 8%).
Outcome measures: Dietary intake data were obtained through two, multi-pass, 24-hour recalls. Individual food items were used to determine the DVS and DDS. The SAMRC FoodFinder III software was used to analyse the macro- and micronutrients, from which the NAR and MAR scores were determined. Descriptive statistics were used to analyse the data.
Results: Seventy-seven patients (60 females) participated. Their mean age was 57.2 (±6.6) years. The DDS was adequate at 4.99 (out of a possible 7 food groups); however, the DVS was low (16%) as well as the consumption of vegetables, fruits and legumes. Mean NAR scores indicated insufficient energy intake. Intakes of vitamin D, calcium, folate and iron were below 50% of the recommended daily intake. MAR scores indicated unsatisfactory micronutrient intake at 0.63 (ideal ≥ 1).
Conclusions: In this tertiary healthcare setting, T2DM patients with poor glycaemic control had sub-optimal dietary quality. Interventions such as nutrition education programmes that provide simple and factual information on the benefits of healthy eating and practical ways of achieving healthy diets among people with T2DM are needed.

Keywords: dietary quality, food variety, nutrient adequacy, type 2 diabetes mellitus

Introduction

The burden of type 2 diabetes (T2DM) in Africa is growing,[1] with similar trends being observed in South Africa.[2] In South Africa, few (< 30%) people living with T2DM have acceptable glycaemic control (HbA1c < 7%).[3,4] Optimal glycaemic control can be achieved if people living with T2DM embrace and adopt healthy behaviours including an appropriate diet, exercise and proper use of medication when indicated.[5,6] Nutrition therapy is an integral component of diabetes management.[4] Current dietary guidelines for diabetes recommend a healthy eating plan based on a variety of nutrient dense, high-quality foods in appropriate portions aimed at overall health, improving metabolic control and preventing complications.[5,6]

High-quality diets are associated with a reduced risk for all-cause mortality, cardiovascular disease and diabetes.[7] This evidence underlines why the diabetes dietary recommendations emphasise quality diets.[5,6] For people living with T2DM, low dietary quality was reported in a population from Ireland[8] and shown to be associated with poorer glycaemic control[9] and obesity[10] in populations from Brazil and China respectively. Assessing the dietary quality of people with poorly controlled T2DM diabetes may help healthcare providers to better understand these patients' needs and where to focus dietary intervention efforts. However, data on dietary quality among people living with diabetes are very limited in South Africa.

The term 'diet quality' describes how well a person's diet conforms to dietary recommendations.[11] Diet quality encompasses several aspects including nutrient adequacy, moderation and balance among energy-yielding nutrients. Further, a high-quality diet should contain many servings of fruits and vegetables, whole grains and limited amount of saturated fat, sodium and refined carbohydrates.[11] Dietary diversity and variety alongside nutrient adequacy ratio (NAR) and mean nutrient adequacy ratio (MAR) are diet quality indicators commonly used in developing countries. These indices are simple and useful for assessing the diet quality of both children and adults in developing countries.[12]

In this study, we assessed the dietary intake and dietary quality of adults with poorly controlled T2DM by assessing the dietary variety score (DVS), dietary diversity score (DDS), NAR and MAR.

This study was part of a larger study investigating the efficacy of a nutrition education intervention on glycaemic control (HbA1c) and other outcomes among people with poorly controlled T2DM (HbA1c ≥ 8%).[13]

Methods

Study design and setting

The study employed an observational, descriptive and cross-sectional design using relevant baseline data collected for the larger study. The study setting was a diabetes outpatient clinic at a tertiary teaching hospital in the Tshwane district of Gauteng Province, South Africa.

Study population and sampling

The target population was adults, aged 40–70 years, with uncontrolled T2DM (HbA1c ≥ 8%), who received outpatient services at the clinic. Patients who have had T2DM for one year or more, could understand English and who were on any treatment modality were included. Patients were excluded if they were pregnant, lactating, critically ill or had any major diabetes complications for example proliferative retinopathy, severe renal insufficiency (GFR < 15 ml/min per 1.73 m^2) and amputations. Patients with other medical conditions such as HIV, cancer and stroke were also excluded.

We used convenience sampling to obtain the sample. Sixty-five participants were required based on the formula by Hulley *et al.*[14] $N = 4z_\alpha^2\, S^2 \div W$; where N = total subjects required, S = standard deviation of the variable from the literature, W = the confidence level, and z_α = the standard normal deviation for α (which is 1.96 for α = 0.05 in this study).[14] We used the standard deviation for DDS, which encompasses standard food groups across studies and different communities,[15] unlike the DVS where items in a food group can vary between populations. We selected a standard deviation of 2 for DDS, which was found to yield the largest sample size.[16,17]

Ethical considerations

Ethical approval was obtained from the Faculty of Natural & Agricultural Sciences, Ethics Committee, University of Pretoria (EC180228-175). All ethical procedures were adhered to while collecting data for the larger study (Reference no. 4/2016).

Data collection

Measurement tools and methods

Baseline data for the main study were used in this study. The data were collected during participant enrolment from January to November 2017, prior to the intervention. Data were collected by a qualified dietitian and trained nutritionists. Data were collected through structured questionnaires completed in an individual interview.[13] The data included in this study were demographic, HbA1c values, anthropometric and dietary intake data.

Anthropometry and HbA1c

Participants' weight and height were taken according to standardised methods.[18] We measured two weight and height measurements per participant and used the average to calculate BMI.[18] HbA1c was measured from venous blood samples, if there were no recent results (≤ 3 months) from routine clinical files. Blood analysis was done at the National Health Laboratory Services core laboratory.

Dietary intake

Dietary intake data were collected on two separate days, one weekday and one weekend, using the 24-hour recall (24HDR).[19] We used a 'multiple pass' 24HDR of three passes.[19] Food quantities were determined using standardised household portion estimation aids.

Dietary intake data management and analysis

Dietary intake data were double captured and analysed by the principal investigator (a nutritionist) and a qualified dietitian. We compared the results and resolved any discrepancies. For example, if the output from the dietary analysis software showed a difference in energy intake of a participant, the source of the discrepancy was verified (e.g. incorrect food(s) item code used, or quantity captured) from either the meal analysis outputs, or food items code or raw data and corrective measures undertaken.

Dietary quality was described by analysing the food intake, NAR, MAR, DVS and DDS of the participants.

Food and nutrients intake

We determined the frequency of the food items consumed by listing and counting all food items consumed by each participant over two days. Each food item consumed was counted only once, even if was consumed more than once a day. This prevented over-representation of regularly consumed foods.

Nutrient intake was analysed with the South African Medical Research Council FoodFinder III dietary analysis software program. Data were analysed for the energy, macro- and micronutrient intake. Following nutrient analysis, NAR and MAR were calculated.

Dietary variety

In this study, dietary variety was defined as the number of different food items consumed over two different 24-hour periods, out of the total number of possible food items consumed by all participants and was measured by a dietary variety score (DVS).[16] Each food item was weighted equally.

Dietary diversity

We calculated DDS as the number of different food groups consumed over 2 different 24-hour periods.[15] The seven food groups used in this study were (i) cereals, roots and tubers, for example potatoes and sweet potatoes; (ii) meat, poultry and fish; (iii) eggs; (iv) legumes and nuts; (v) vitamin A-rich fruit and vegetables; (vi) other fruits and vegetables; (vii) milk and dairy. We excluded sugars, fats and oils as they do not significantly contribute to micronutrient intake.[15]

Nutrient adequacy ratio (NAR)

The NAR was calculated as the ratio between intake of a particular nutrient and its recommended daily intake (RDI).[15] We calculated mean (±SD) for different nutrients for the whole population. We used the FAO/WHO[20] and WHO/FAO[21] guidelines for energy and micronutrients RDI respectively. The Institute of Medicine guidelines were used for protein and fibre,[22] while for sugar intake (% total energy) the 2017 Society for Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA) guidelines were used.[6]

Mean adequacy ratio (MAR)

The MAR score is an average of all the different NAR values of an individual. The NAR values are summed and divided by the number of nutrients[23] to indicate overall nutrient intake. When calculating the MAR, we truncated the NAR values at 1 to ensure that nutrients with a high NAR did not compensate for nutrients with a low NAR. A MAR value of 1 or above indicated that overall nutrient intake was equal to or above the recommended intake.[23]

Statistical analysis

The SPSS program (version 23.0) was used for statistical analysis IBM Corp, Armonk, NY, USA). Descriptive statistics were performed. Means (SD) and median were calculated for continuous variables as applicable after normality check. Frequencies were computed for categorical data and count of food items/groups.

Results

Participants' characteristics

Most of the participants were women (79%) (Table 1). Participants had a mean age of 57.2 (±6.6) years (Table 1). Participants had a mean HbA1c value of 10.45% (±1.9). Their mean BMI was 34.3 (±5.4) kg/m^2. Men had a lower BMI (32.6 [±3.5] kg/m^2) than women (34.85 [±5.7] kg/m^2). Most participants were black African people (57.1%), unemployed (68.3%) and had a high school level of education (88.3%). Hypertension was the most prevalent co-morbidity (96.1%). Most participants reported having previously consulted with a dietitian (79%, $n = 61$) (Table 1).

Dietary intake

Commonly consumed foods

Participants' 10 most consumed foods (in descending order) were: chicken, tea, brown bread, margarine, white rice, full-cream milk, potatoes, sugar, low fat milk and sifted maize porridge. The frequency of consumption over a two-day period is presented in Table 2.

Table 1: Participants' characteristics ($n = 77$)

Characteristic	Group	Values Mean (±SD)
Age	All	57.2 (6.6)
	Female	57.1 (6.6)
	Male	57.9 (6.8)
HbA1c	All	10.45 (1.9)
BMI (kg/m^2)	All	34.3 (5.4)
	Female	34.85 (5.7)
	Male	32.6 (3.5)
		***n* (%)**
Ethnicity	Black African	44 (57.1)
	White	18 (23.4)
	Coloured	8 (10.4)
	Indian	7 (9.1)
Gender	Female	60 (77.9)
	Male	17 (22.1)
Education level	Primary school	4 (5.2)
	High school	68 (88.3)
	Tertiary	5 (6.5)
Employment status	Not employed	53 (68.3)
Diabetes medication	Oral hypoglycaemics (OHAs)	3 (3.9)
	Insulin	27 (35.1)
	OHAs + Insulin	47 (61.0)
Co-morbidities	Hypertension	74 (96.1)
	Heart diseases	23 (29.9)
	Dyslipidaemia	46 (59.7)
	Nephropathy (GFR > 15 ml/min per 1.73 m^2)	9 (11.7)
	Non-proliferative retinopathy	4 (5.2)
Lifestyle	Alcohol	7 (18.0)
	Smoking	4 (10.3)
	Dietary supplements	10 (13.0)
Dietitian consultation	Yes	61 (79.2)

Table 2: Ten most commonly consumed foods by participants over the two-day period ($n = 77$)

Food items	Consumption over 2 days (% participants)
Chicken	74.0
Tea	72.3
Brown bread	71.4
Margarine	59.7
White rice	59.7
Potatoes	51.9
Full-cream milk	48.1
Maize porridge (sifted)	46.8
Tomatoes	46.8
Sugar	42.9
Onions	45.5
Apples	41.6
Low-fat milk	39.0
Coffee	37.7

Macro- and micronutrient intake levels and ratios

For the group as a whole, total energy intake comprised carbohydrates (53%), protein (17%), total fats (25%), saturated fats (8%), unsaturated fats (14%) and added sugar (7.8%) (data not shown).

The mean energy and macronutrients intake per day as well as the corresponding NAR values are given in Table 3. Daily energy intake was suboptimal, with NAR scores of 0.69 for men and 0.66 for women. Protein intake was close to the recommended levels. Total fibre intake was only 54% of the recommended value in males and 48% in females.

Table 4 indicates the mean micronutrient intake for males and females and the individual NAR values. We excluded supplements from our analysis. Most micronutrients had NAR values of greater than 0.8 except for calcium, iron, vitamin A (in men), vitamin D and folate. For nutrients that had a NAR of less than 0.8, participants consumed less than 50% of the RDI, except for men's consumption of vitamin A. Vitamin D had the lowest NAR score for both genders at 22% and 23% for men and women, respectively.

The total calculated MAR value (excluding energy and macronutrients) was 0.63 (±0.21); 0,62 (±0.17) and 0.63 (±0.22) for males and females respectively. Only two participants had a MAR value of 1 or more (i.e. at least 100% of RDI).

Dietary variety and dietary diversity

The mean (±SD) DVS was 18.01 (±5.59) out of a possible 113 different food items. This indicates that on average only 15.9% of all possible food items were consumed over a two-day period.

The mean (±SD) DDS was 4.99 (±0.93) out of a possible seven food groups, which excludes fats, oils, sweets, spices and condiments. Figure 1 shows the proportion of participants (%) who consumed each individual food group over the two days. All participants consumed cereals, roots and tubers at least once over two recall days. Nearly all participants (97.4%) consumed meat, poultry and fish at least once over two recall days. The eggs group was the least consumed (23.7%) over the two-day period followed by legumes, nuts and seeds (40.8%). Although

Table 3: Mean energy and macronutrient intake and NAR values of participants ($n = 77$)

Factor	Male ($n = 17$)		Female ($n = 60$)		Male and female
	Intake (±SD)	NAR (±SD)	Intake (±SD)	NAR (±SD)	Intake (±SD)
Energy (kJ)	7649.54 (±1914.82)	0.69 (±0.17)	6070.88 (±2006.96)	0.66 (±0.22)	6887.63 (±1998.86)
Total fibre (g)	20.04 (±11.40)	0.54 (±0.31)	17.86 (±7.72)	0.48 (±0.21)	19.73 (±8.82)
Total sugar* (g)	28.11 (±19.75)	–	32.40 (±17.84)	–	31.41 (±17.89)
Protein (g)	72.32 (±22.87)	0.97 (±0.31)	63.28 (±23.41)	0.90 (±0.33)	68.56 (±22.01)
Fats* (g)	51.94 (±24.50)	–	43.82 (±19.65)	–	46.50 (±20.70)
Saturated fats* (g)	15.90 (±9.11)	–	13.53 (±0.79)	–	14.73 (±6.97)

*No RDI exists.

Table 4: Participants' micronutrient intake and nutrient adequacy ratio (NAR) averaged over two days ($n = 77$)

Factor		Male		Female		Males and females
		Intake (±SD)	NAR (±SD)	Intake (±SD)	NAR (±SD)	Intake (±SD)
Minerals	Ca (mg)	416.93 (±306.59)	0.42 (±0.31)	461.56 (±231.31)	0.46 (±0.23)	473.44 (±229.01)
	Fe (mg)	11.33 (±11.57)	0.39 (±0.40)	8.34 (±3.52)	0.29 (±0.12)	9.85 (±6.24)
	Mg (mg)	285.27 (±133.35)	1.30 (±0.61)	246.38 (±86.10)	1.12 (±0.39)	283.14 (±106.42)
	Zn (mg)	9.98 (±3.51)	2.04 (±0.72)	8.43 (±3.74)	1.72 (±0.76)	9.16 (±3.68)
Fat-soluble vitamins	Vitamin A (µg)	344.39 (±390.58)	0.69 (±0.78)	729.75 (±1411.27)	1.46 (±2.82)	650.43 (±1199.60)
	Vitamin D (µg)	2.24 (±1.79)	0.22 (±0.18)	2.31 (±2.33)	0.23 (±0.22)	2.19 (±2.09)
	Vitamin E (mg)	7.03 (±5.37)	0.94 (±0.72)	6.78 (±5.37)	0.90 (±0.72)	7.76 (±4.84)
	Vitamin K	52.92 (±67.54)	0.96 (±1.23)	101.85 (±132.70)	1.85 (±2.41)	97.92 (±176.92)
Water-soluble vitamins	Vitamin C (mg)	52.49 (±57.51)	1.17 (±1.28)	61.98 (±98.50)	1.38 (±2.19)	70.52 (±190.08)
	Thiamine (mg)	1.26 (±0.77)	1.05 (±0.64)	0.95 (±0.45)	0.79 (±0.35)	1.06 (±0.42)
	Riboflavin (mg)	0.98 (±0.76)	0.76 (±0.58)	1.04 (±0.67)	0.80 (±0.51)	1.11 (±0.65)
	Niacin (mg)	18.40 (±9.62)	1.15 (±0.60)	16.46 (±6.05)	1.03 (±0.38)	18.53 (±7.69)
	Vitamin B_6 (mg)	1.13 (±0.69)	0.87 (±0.53)	1.07 (±0.54)	0.83 (±0.41)	1.14 (±0.48)
	Folate (µg)	160.20 (±73.75)	0.40 (±0.18)	171.10 (±129.67)	0.43 (±0.32)	164.14 (±72.56)
	Vitamin B_{12} (µg)	2.83 (±1.88)	1.18 (±0.79)	5.18 (±12.39)	2.16 (±5.16)	4.83 (±11.46)

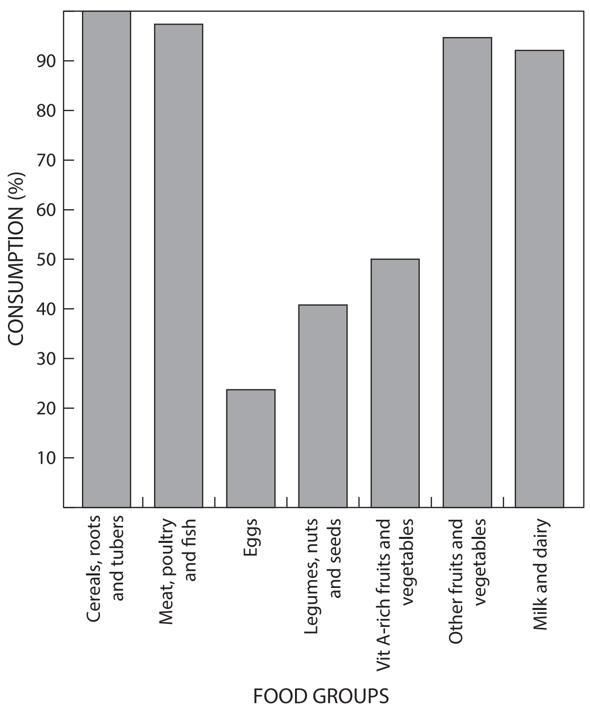

Figure 1: Proportion of participants ($n = 77$) who consumed each of the seven food groups over two days.

we did not analyse these foods as a part of dietary diversity, it is important to note that fats and oils were consumed by 80.3% of participants, and sweets or high sugar-containing products were consumed by over half (57.9%) of participants at least once over two recall days (data not shown).

Discussion

This study assessed dietary intake and the quality thereof among poorly controlled T2DM adults who were assessed to be obese.

Dietary intake

Food items frequency

Major dietary guidelines for T2DM patients stipulate that diets should include fewer fats and refined carbohydrates, and more fibre rich foods including whole grains, vegetables, fruits and legumes, which have various health benefits.[5,24] In this study, participants mostly consumed starchy foods, while legumes, fruits and vegetables were less frequently consumed. Similar findings among people with T2DM have been reported in other South African settings.[24,25] Although vegetable and fruits consumption tends to be low among adults in South Africa (~150 g vs. recommended 400 g),[26] the quantified intake of the two foods in the study participants was reported to be very low (≤ 1 serving/day; ≤ 80 g/day).[13]

The results also indicate that the participants' carbohydrates sources were primarily from refined or low-fibre sources including white rice, potatoes, sifted maize meal and sugar. Additionally, sweets and high sugar foods were consumed by more than half of the participants. The latter and high intake of added sugar explains the participants' energy intake from total sugar exceeding the SEMDSA recommendations of ≤ 5% of total energy intake.[6] Full-cream milk was also among the top 10 consumed food item rather than lower fat milk, contrary to the dietary guidelines for people with T2DM.[6] This result corroborates those reported for the general South African adult population.[26]

Macro- and micronutrient intakes

In our study, participants consumed, on average, 63% of the recommended energy intake. Similar findings were reported in another South African study that reported energy intakes < 70% of RDI among people with T2DM.[24] It should be noted, however, that these energy requirements are based on individuals with a healthy BMI. However, among South African adults in general energy intakes also appear to be low,[26] considering the high levels of obesity in our study, it is possible that participants under-reported their energy intake. Under-reporting of energy intake is more common in obese individuals,[27] especially those with T2DM.[28] Additionally, South African adults seem more likely to under-report their energy intake compared with adults from other African countries.[27] There is no ideal percentage of energy contribution by macronutrients recommended for people with T2DM.[6] Nevertheless, the pattern of intake seen in participants in this study could be considered acceptable as it is within the recommendations by the Institute of Medicine for the general population for reducing the risk of chronic diseases while getting sufficient intake of essential nutrients.[22]

Fibre intake of participants was low (~50% of RDI). Previous South African studies have also reported low fibre intake among the general adult population[26] and people with T2DM.[24,25] The fibre intake reported here may also be explained by the low consumption of vegetables and fruits, legumes and wholegrains. Fibre aids glycaemic control and forms an important part of the diet in people with diabetes.[29] In a systematic review and meta-analysis of RCT, high-fibre diets were shown to reduce absolute values of HbA1c by 0.55%.[30] Fibre can also aid in weight loss by enhancing satiety.[31] In this obese population, eating more fibre by increasing consumption of vegetables and fruits may aid in weight loss[31] and reduce the risk of cardiovascular disease.[32]

Participants in our study had micronutrient intakes that were greater than or close to their specific RDI values, except for calcium, folate, iron and vitamin D, all of which were consumed in very low amounts. The MAR of 0.63 (±0.14) indicated that overall micronutrient consumption was below recommended levels. Low micronutrient intakes have been reported in people with T2DM from Ireland[7] and Japan[33] as well as Cape Town, South Africa.[34] Sufficient micronutrient intake is important for overall health and to help reduce health risks and complications for T2DM patients. In this study, the low intake of calcium and folate intake is concerning. Calcium is a concern given the high prevalence of hypertension (96.1%). Low serum calcium levels have been shown to be linked to increased blood pressure in T2DM patients.[35] Low dietary and blood folate are associated with a higher risk of coronary disease,[35] exacerbating the health risks associated with diabetes.[36]

Dietary variety and diversity scores

In this study, participants had a very low DVS score (18.01, ±5.59). On average, participants consumed only 16% of all possible available food items. Two other South African studies reported similarly low DVS values.[37,38] The low dietary variety observed here is not aligned with the South African food-based dietary guidelines (SAFBDGs), which encourage food variety.[39]

Participants in our study consumed on average 4.99 food groups out of a possible 7 over a two-day period (DDS = 4.99 (±0.93). This value is higher than previously reported for other communities in South Africa, in both urban and rural settings. Mchiza *et al.*[26] reported a DDS value of 4 for South African adults, while two other studies reported mean DDS values of 3.41 and 2.82 for adults in peri-urban settings.[37,38] In our study only 4% of participants had DDS < 4, suggesting that people with poor dietary diversity were in the minority. In contrast Labadarios *et al.*[40] reported that 33% of adults in the general population living in Gauteng had poor dietary diversity (DDS < 4). This higher DDS reported in our study may be explained by most participants having received dietary education on the importance of diet in diabetes management.

Overall dietary quality

Participants' dietary intake seemed balanced because their energy intake was acceptably distributed among the macronutrients. The high DDS also pointed to possible micronutrient adequacy. However, their NAR and MAR scores indicated sub-optimal micronutrient intakes. Additionally, despite the high diversity of food groups, food groups including vegetables, fruits, legumes and low-fat dairy that form part of a high-quality diet (SEMDSA 2017)[6] were less frequently consumed, or, if consumed, they were consumed in very low quantities as indicated by the low dietary fibre and calcium intake. Furthermore, the DVS score showed low dietary variety, indicating that though the groups were sufficiently diverse, variety within group was not adequate, which could lead to micronutrient deficiencies. Participants also consumed more refined sources of carbohydrates, including added sugar, contrary to recommendations to minimise intake of refined carbohydrates and added sugars.[5,6] Their consumption of carbohydrates thus deviated from the guideline to consume nutrient-dense sources that are high in fibre, including vegetables, fruits, legumes and whole grains, as well as low dairy products.[5,6]

Overall, our results indicate low dietary quality of participants in this study. This result is concerning and warrants further investigation given that most participants (79%) had previously seen a dietitian. As diet is a key factor in T2DM management, adopting a healthy diet is crucial to help reduce the risk of complications and improve glycaemic control.[5,6] Globally, non-adherence to healthy diets is mainly driven by food insecurity or insufficient physical and economic access to healthy food,[41] which in part could be true for this study population who were mainly unemployed. Among people with T2DM in South Africa, reported barriers to healthy eating include social context such as cultural beliefs, and conflicts in arranging family meals, hunger, financial constraints, lack of knowledge and poor understanding of the disease.[24,42]

Strengths and limitations of the study

This study adds to the limited knowledge base of the dietary intake and dietary quality of people living with T2DM. Most studies assessing dietary intake and dietary quality do not focus on people with specific conditions such as diabetes. The use of metrics such as DVS and DDS in conjunction with energy and nutrient consumption provides more comprehensive information on dietary quality than when food items or nutrients are used alone. Assessing dietary quality allows for a greater understanding of which areas need to be improved.

This study may be limited by the small sample size. Although we achieved the calculated sample size, the sample was small for effectively assessing food intake and dietary quality. Our findings may also be biased towards women, who were more numerous, which reflects the distribution of diabetes in South Africa.[43] Our study was also conducted in only one tertiary setting and included only participants with poorly controlled diabetes. These factors limit generalisation to other settings.

Conclusion and recommendations

In this tertiary healthcare setting, T2DM patients with poorly controlled diabetes have sub-optimal dietary quality. This indicates a need to identify the barriers to the adoption of healthy eating habits, given that most participants had previously consulted a dietitian. Improving the dietary quality of this population will rely on addressing these barriers using practical and simple tools. The SAFBDGs, which encourage food variety, consumption of lots of vegetables and fruit and consumption of dairy products daily, among others,[39] coupled with guidelines for portions, may be the best starting point towards improving the quality of diets in this population and in South Africa as a whole.

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ORCID

Jane W Muchiri http://orcid.org/0000-0002-5614-3153

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