Dietary Practices of Type 2 Diabetes Mellitus in Nigeria: The Case of Lagos State

PRISCILLAOFFOH[1], PATRICKKOLSTEREN2, YOURITAES[3]
[1]*Department of Human Nutrition and Rural Development, Gent University, Belgium*
[2, 3]*Department of Endocrinology, Gent University Teaching hospital, Belgium.*

Abstract
Background: Type 2 diabetes mellitus (T2DM) is rapidly becoming a significant public health concern in sub-Saharan Africa, largely propelled by dietary and lifestyle shifts associated with urbanization. Although dietary management is crucial for glycemic control, there is limited data concerning the dietary and physical activity behaviors of Nigerian patients with T2DM.

Objective: This study aimed to evaluate the dietary practices, physical activity levels, and diabetes-related risk profiles among adult T2DM outpatients attending Lagos University Teaching Hospital, Nigeria.

Methods: A cross-sectional descriptive study design was employed, involving 56 adult T2DM outpatients. Dietary intake was assessed using a 24-hour recall method and subsequently analyzed with the West African Food Composition Table. Physical activity was quantified via a seven-item occupational activity questionnaire, and principal component analysis was utilized to identify key dimensions of activity. The relationships among dietary intake, physical activity, and body mass index were investigated using multiple linear and logistic regression models.

Results: The participant cohort was predominantly categorized as overweight or obese (mean BMI 28.3 ± 4.3 kg/m²), with 39% also presenting with hypertension. The mean daily energy intake (1883 ± 878 kcal) significantly surpassed recommended levels, characterized by a high consumption of refined carbohydrates and inadequate fiber intake. PCA identified two prominent factors—physical positioning and perceived exertion—which collectively accounted for 58% of the variance in activity. Suboptimal workplace positioning demonstrated a significant association with elevated BMI among women (β = 3.43; 95 % CI 1.71–5.47; p < 0.001), while age exhibited a non-significant inverse trend.

Conclusions: Elevated caloric consumption and limited physical activity represent significant modifiable determinants of obesity among urban Nigerians diagnosed with T2DM. The implementation of culturally appropriate nutritional and physical activity interventions holds the potential to enhance metabolic outcomes within analogous resource-constrained environments.

Keywords: Type 2 diabetes mellitus; dietary practices; physical activity; nutrition transition; Lagos University Teaching Hospital (LUTH).

I. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) constitutes a rapidly escalating global public health concern. Estimates from the International Diabetes Federation indicate that approximately 537 million adults had diabetes in 2021, with projections suggesting an increase to 783 million by 2045 [1]. Sub-Saharan Africa bears a significant portion of this burden, with around 24 million cases, nearly 10% of which are attributed to Nigeria [1, 2]. This escalating prevalence is exacerbated by ongoing nutritional and epidemiological transitions, marked by dietary acculturation, increasing urbanization, and sedentary behaviors [3–5, 25, 33].

The underlying pathophysiology of T2DM is characterized by insulin resistance and pancreatic β-cell dysfunction, processes significantly modulated by dietary habits and lifestyle choices [6]. Throughout Sub-Saharan Africa, a notable shift in dietary patterns is observed, favoring energy-dense provisions high in saturated fats and refined carbohydrates, concurrently with a reduction in physical activity levels [4, 7, 25, 26]. These concurrent trends are instrumental in fostering an increasing prevalence of obesity, hypertension, and dyslipidemia [8, 27].

Dietary modification is recognized as a fundamental component of T2DM management. Consistent adherence to established dietary guidelines, which prioritize complex carbohydrates, fruits, vegetables, and unsaturated fats, has been shown to yield enhanced glycemic control [9, 10]. Nevertheless, research conducted in Ethiopia, Ghana, and Nigeria reveals that less than 50% of patients consistently adhere to these dietary recommendations [11–14, 15, 21, 31]. Contributing factors to this non-adherence

encompass socioeconomic limitations, insufficient access to specialized dietetic services, and deeply ingrained cultural food preferences [12, 13, 22, 26].

Systematic reviews indicate that structured patient education and self-management interventions can enhance glycemic regulation and promote dietary adherence within SSA [17, 23, 24, 30]. Despite these potential benefits, persistent structural impediments remain, notably food insecurity, financial burdens, and the scarcity of culturally congruent counseling strategies [26, 27, 29]. Given Nigeria's accelerating diabetes prevalence and prevailing suboptimal glycemic control, a comprehensive understanding of indigenous dietary and lifestyle patterns is imperative [2, 13, 28].

This study therefore aimed to evaluate aimed to evaluate the dietary practices, physical activity levels, and diabetes-related risk profiles of adults with T2DM receiving outpatient care at the Lagos University Teaching Hospital, Nigeria. The specific objectives included: assessing macronutrient intake and energy consumption against established dietary guidelines, determining occupational physical activity levels, and analyzing the associations among dietary intake, physical activity, and body mass index.

To situate this research within broader policy frameworks, it aligns with the World Health Organization Global Diabetes Compact and the International Diabetes Federation Africa Region priorities, which emphasize preventive nutrition and patient-centered care. Recent analyses further highlight the critical necessity of addressing Africa’s "neglected diabetes epidemic" through policies cognizant of the nutrition transition.

II. MATERIALS AND METHODS

Study Design and Setting

This investigation employed a cross-sectional descriptive design, conducted from December 2011 to January 2012. The study population comprised adult outpatients diagnosed with type 2 diabetes mellitus (T2DM) at the Lagos University Teaching Hospital in Lagos, Nigeria. LUTH, a tertiary healthcare institution, serves a diverse patient population spanning various socioeconomic strata. The geographic context of the study location in Lagos State, a key area in West Africa's epidemiological transition, is visually represented in Figure 1. The primary objective of the study was to evaluate the dietary practices, physical activity levels, and risk profiles of individuals receiving outpatient care for T2DM.

Study Population and Sampling

Participants were adults aged 18 years or older with a clinically confirmed diagnosis of T2DM. Excluded from the study were patients with type 1 diabetes, gestational diabetes, or other medical conditions necessitating specialized dietary interventions. A systematic sampling methodology was implemented, wherein every second patient presenting at the outpatient diabetes clinic was invited to participate until the target sample size was achieved. Of the 86 patients approached, 56 completed the comprehensive questionnaire and were subsequently included in the final analysis.

Data Collection and Measurements

Data collection involved a combination of interviewer-administered questionnaires and a review of hospital records.

Dietary assessment: Dietary intake was assessed using a single 24-hour dietary recall, capturing all food and beverage consumption during the preceding day. To enhance accuracy, participants utilized locally standardized household utensils and price equivalents to estimate portion sizes. Trained health professionals provided assistance, referencing a food instruction manual equipped with visual portion guides. Nutrient content of consumed foods was derived from the West African Food Composition Table, and total energy intake was computed as the sum of energy contributed by carbohydrates, proteins, and fats. Energy and nutrient densities were expressed per 100 grams of edible portion.

Physical activity: Physical activity was quantified using a seven-item occupational activity questionnaire, an adaptation of a previously validated instrument for African populations. This questionnaire assessed work posture, frequency of movement, and perceived exertion. Responses were recorded on a five-point Likert scale, ranging from "never" to "always." A principal component analysis with varimax rotation identified two primary components: "physical positioning at work" and "physical work tiring," which collectively represented distinct facets of occupational physical activity.

Anthropometric and clinical data: Height and weight measurements were sourced from patient hospital records, enabling the calculation of body mass index. Additional clinical and behavioral information, including blood pressure, duration of diabetes, alcohol consumption, smoking history, family history of diabetes, and educational attainment, was compiled from medical records and structured interviews. Educational level was categorized into four tiers: none, primary, secondary, and tertiary.

Ethical Considerations and Registration

This investigation originated as a master's dissertation project at Ghent University, conducted between December 2011 and January 2012. All participants provided oral informed consent in accordance with institutional and national research ethics guidelines, with health service personnel acting as witnesses. Strict measures were implemented to safeguard participant anonymity and confidentiality.

Statistical Analysis

Statistical analyses were executed utilizing SAS software, version 9.2 [35]. For continuous variables, descriptive statistics were computed, whereas categorical variables were summarized through frequencies and percentages. The normality of data distributions was ascertained via the PROC UNIVARIATE procedure. Comparisons between groups were conducted employing either Student's t-tests or chi-squared ($\chi 2$) tests, as deemed appropriate.

Principal component analysis, incorporating varimax rotation, was applied to condense the seven physical activity items into underlying latent components [36]. The selection of the number of components to retain was guided by the eigenvalue-one criterion and visual inspection of scree plots. The resultant component scores were subsequently preserved for their integration into further analytical procedures.

To investigate the determinants of body mass index and diabetes risk profiles, multiple linear regression models were constructed, with adjustments made for sociodemographic and behavioral covariates. Logistic regression models were employed to evaluate the associations between adherence to dietary guidelines and indicators of diabetes risk. The findings are articulated as regression coefficients or odds ratios, accompanied by their respective 95% confidence intervals. A P-value of less than 0.05 was established as the threshold for statistical significance.

Figure 1: Geographic Location of Lagos State University Teaching Hospital (LASUTH) within Africa (The study was conducted in Lagos, a major urban commercial hub, chosen for its high population density and critical role in the country's epidemiological transition.)

III. RESULTS

Participant characteristics

A total of 56 adults diagnosed with type 2 diabetes mellitus successfully completed the study, resulting in a response rate of 65%. The sociodemographic and clinical characteristics of these participants are detailed in Table 1. The mean age of the cohort was 48 ±11 years, with a slight male predominance. The average body mass index for the entire sample was

28.3 kg/m^2, which suggests a significant prevalence of overweight and obesity within the group. Notably, obesity (BMI ≥ 30.0 kg/m^2) was found to affect 52% of females compared to 29% of males (Figure 2)

Specifically, 43% of participants were classified as overweight, and 37% were categorized as obese, with only 20% falling within the normal BMI range. Hypertension was reported in 39% of participants, and over half (55%) had a first-degree relative with a history of diabetes. Most participants (96%) were literate, and 75% demonstrated awareness of recommended dietary practices; however, adherence to dietary control alone was limited, highlighting a reliance on pharmacological interventions.

Table 1. Sociodemographic and Clinical Characteristics of Participants

Variable	Mean ± SD / %
Number (male / female)	56 (32 / 24)
Age (years)	48 ± 11
Body Mass Index (kg/m²) – Male	28.8 ± 3.7
Body Mass Index (kg/m²) – Female	27.7 ± 4.9
Normal (18.5–24.9 kg/m²)	20 %
Overweight (25.0–29.9 kg/m²)	43 %
Obese (≥ 30 kg/m²)	37 %
First-degree relatives with diabetes (%)	55 %
Hypertensive (%)	39 %
Stroke (%)	7 %
Neuropathy (%)	8 %
Nephropathy (%)	2 %
Retinopathy (%)	9 %

Mean BMI was 28.3 kg/m², indicating high prevalence of overweight and obesity. Fifty-seven percent were male; 39 % were hypertensive; 96 % were literate; 75 % knew recommended diets; and 55 % had a parent with diabetes.

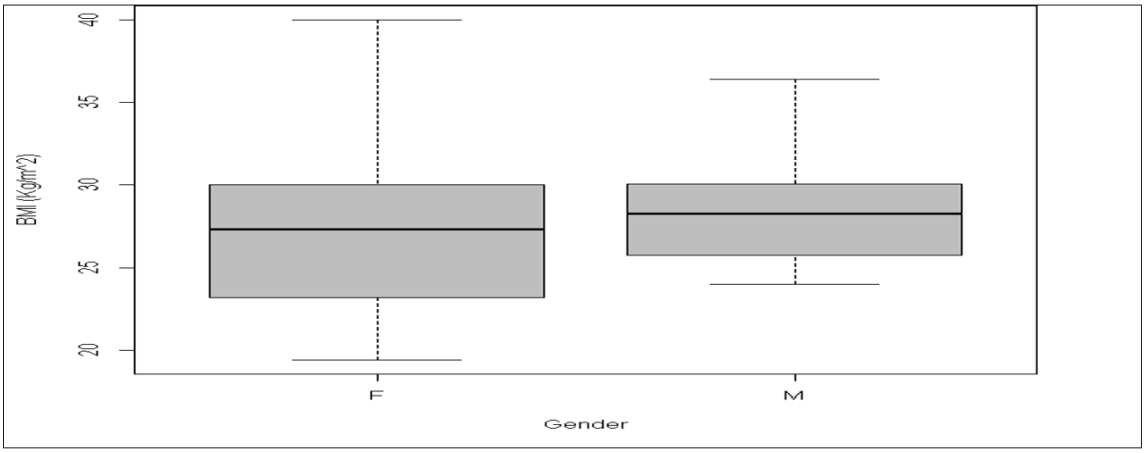

Figure 2. Box and whisker plot for the distribution of BMI by gender (Plot showed that Females tend to have a slightly higher and more variable BMI than males in this sample. The broader spread for females indicates greater diversity in body composition, while males show a tighter clustering around the median)

Energy and nutrient intake

Daily energy and nutrient intake profiles are presented in Table 2. The mean daily energy intake of 1883 ± 878 kcal/day significantly surpassed the American Diabetes Association guidelines of 800–1500 kcal/day recommended for overweight and obese diabetic adults pursuing weight management. Macronutrient distribution within the total energy intake averaged 56% carbohydrates, 28% protein, and 16% fat. This composition aligns with dietary patterns prevalent in Nigerian urban environments, characterized by traditional, yet increasingly refined, carbohydrate-centric diets.

This dietary profile indicates a potential energy imbalance, primarily due to the consumption of calorie-dense starchy staples and animal protein, coupled with comparatively low intakes of dietary

fiber and unsaturated fats. While no significant sex disparities were identified in overall energy intake, women exhibited a tendency to report marginally greater carbohydrate consumption when normalized to body weight.

Table 2. Rotated Factor Pattern and Final Communality Estimates from PCA

Item	Component 1	Component 2	h^2
At work I sit	-0.48	-0.22	0.28
At work I stand	0.82	0.13	0.69
At work I walk around	0.79	-0.12	0.64
After working I am tired	-0.29	0.71	0.59
At work I sweat a lot	0.29	0.83	0.77
Compared to others my age, how heavy is my work	-0.20	-0.68	0.51

Component 1 represents physical positioning at work (occupational activity). Component 2 represents work tiring (perceived exertion). Both were used in regression analysis.

Physical-activity pattern

Occupational physical-activity data underwent principal component analysis. Table 3 presents the rotated factor pattern and final communality estimates. Two principal components, characterized by eigenvalues exceeding 1, were retained, collectively accounting for approximately 58% of the total variance (Figure 3). The first component primarily reflected variations in standing, walking, and posture, while the second component captured self-reported experiences of tiredness and sweating during work. Items with complex or low factor loadings were excluded to enhance construct clarity. The two-factor solution was further corroborated by the scree plot. These identified components delineate distinct yet interconnected domains of occupational activity pertinent to assessing sedentary risk within this cohort.

Table 3. Mean Daily Energy and Nutrient Intake (24-h Recall)

Nutrient	Mean ± SD
Total Energy (kcal/day)	1883 ± 878
Carbohydrate (g)	273 ± 148
Protein (g)	71 ± 32
Fat (g)	59 ± 34

The average intake (1883 kcal/day) exceeded ADA recommendations (800–1500 kcal/day) for overweight/obese T2DM patients.

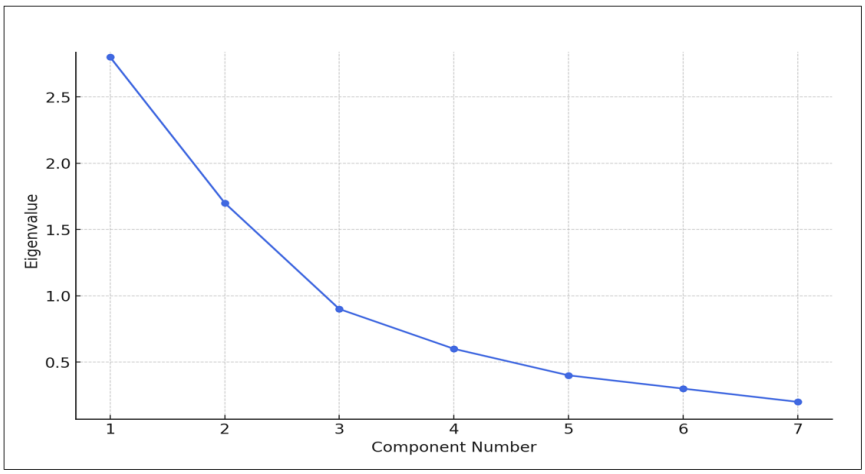

Figure 2. Scree Plot of Eigenvalues for Physical Activity Model (Scree plot of eigenvalues for the physical activity model (Plot suggests all significant factors with eigenvalues greater 1 that will be retained for use in subsequent analysis, with those below the cut off ignored)

Association between BMI and physical activity

Table 4 presents a summary of the findings from the multiple linear regression analysis, which investigated predictors of Body Mass Index. Following adjustments for age, educational attainment, smoking status, and alcohol consumption, workplace positioning was identified as the sole significant behavioral determinant of BMI. Notably, a strong association was observed between suboptimal physical positioning and elevated BMI specifically within the female cohort (β = 3.43; 95 % CI: 1.71–5.47; $p < 0.001$). Although age demonstrated a nonsignificant inverse relationship with BMI (β = –0.05, $p = 0.10$), this finding implies that adiposity in the studied population was more closely related to occupational behaviors than to chronological age. Neither educational level nor infrequent alcohol or tobacco use exhibited an independent association with BMI. Collectively, these results suggest that the combination of sedentary occupational postures and elevated caloric intake contributes synergistically to excess body weight among adults diagnosed with Type 2 Diabetes Mellitus (T2DM) within this specific context. Figure 1 graphically depicts the distribution of the two principal components of physical activity, as derived from Principal Component Analysis, thereby underscoring the prevalence of sedentary and low-exertion work roles among the study participants.

Table 4. Regression Analysis Between BMI and Physical Activity Components

Variable	β Estimate	95 % CI
Age (years)	-0.05	–0.11 – 0.01
Education – Primary	2.25	–3.34 – 7.84
Education – Secondary	3.05	–1.89 – 7.99
Education – Illiterate	7.07*	1.95 – 12.19
Smoking – Seldom	-2.90	–12.25 – 6.45
Alcohol – Seldom	1.61	–8.05 – 11.27
Work Position (female subset)	+3.43**	1.71 – 5.47

*$p < 0.05$, **$p < 0.001$; CI = Confidence Interval. Poor workplace positioning was significantly associated with higher BMI among females.

IV. DISCUSSION

This study investigates the dietary habits and physical activity levels among adults with Type 2 Diabetes Mellitus (T2DM) in Lagos, Nigeria. The findings, consistent with research from Ethiopia, Ghana, and other Sub-Saharan African nations, indicate widespread suboptimal adherence to dietary recommendations and insufficient physical activity among participants [15, 18, 19, 21, 31]. Furthermore, the data on average energy intake and low fiber consumption corroborates the hypothesis of an ongoing nutritional transition characterized by increased consumption of energy-dense foods with diminished micronutrient content [25, 26, 33].

Gender-based disparities in Body Mass Index and physical activity patterns observed in this study resonate with previous investigations in Nigeria and South Africa, which have documented a higher prevalence of sedentary lifestyles and obesity among women [12, 13, 34]. These discrepancies are likely attributable to a confluence of factors, including cultural norms, limitations in mobility, and specific socioeconomic roles.

No statistically significant correlation was identified between total energy intake and BMI, a finding consistent with prior African research that postulates potential underreporting or recall bias in dietary assessments [18, 19, 22]. Nevertheless, Principal Component Analysis revealed a noteworthy association between occupational physical positioning and BMI specifically among women, underscoring the influence of work-related physical activity on body composition [20, 27, 36].

Suboptimal adherence to dietary recommendations persists as a widespread challenge across the African continent. Systematic reviews and multi-country surveys consistently report adherence rates below 50% [15, 21, 22, 31]. Contributing factors encompass low socioeconomic status, inadequate health literacy, prevailing cultural practices, and barriers to accessing healthy food options [26, 29]. Integrated self-management interventions, incorporating dietary

education, psychosocial support, and behavioral reinforcement, have demonstrably improved glycemic control [17, 23, 24, 30].

From a public health vantage point, these results underscore the imperative for implementing nutrition-sensitive diabetes care policies that align with the World Health Organization's prevention objectives and the International Diabetes Federation Africa's regional strategies [37, 38]. The escalating prevalence of diabetes in SSA, often characterized as a "neglected epidemic," mandates integrated intervention approaches addressing both individual behavioral modifications and overarching systemic barriers within the food environment [27, 39, 40].

Public health and clinical implications

The confluence of elevated caloric consumption and reduced occupational physical activity critically necessitates the implementation of behavioral interventions, specifically those addressing workplace ergonomics, structured physical activity, and culturally congruent nutritional guidance. Furthermore, the integration of registered dietitians into outpatient diabetes management clinics in Nigeria is currently limited, which contributes to an inconsistent reinforcement of crucial lifestyle modifications. To address this, community-based peer education initiatives and visual dietary portion guides could substantially enhance patient recall and adherence to recommended lifestyle changes.

From a policy perspective, Nigeria's existing framework for non-communicable diseases disproportionately emphasizes diagnostic screening and pharmacotherapy, rather than robust primary prevention measures. These findings therefore substantiate the necessity of expanding the scope of diabetes care to incorporate structured nutritional education and physical activity promotion programs, meticulously tailored to the socioeconomic contexts of urban adult populations.

Strengths and limitations

This study's strengths are underpinned by its robust methodology, encompassing the application of standardized instruments for dietary recall, principal component analysis for activity scale validation, a systematic sampling approach, and the integration of clinical records for anthropometric data verification. Furthermore, the synthesis of behavioral and clinical data offers a comprehensive perspective, a feature seldom observed in regional investigations.

Conversely, the primary limitations stem from cross-sectional study design, which inherently restricts the establishment of causal relationships. Additionally, reliance on a singular 24-hour dietary recall might not adequately capture the full spectrum of intra-individual dietary variability. Self-reported physical activity measures are susceptible to social desirability and recall biases; however, the utilization of PCA-derived components partially ameliorates potential measurement error. The relatively modest sample size constrains the statistical power for detailed subgroup analyses, and the recruitment of participants from a single tertiary hospital site may limit the generalizability of findings to broader community populations. Nevertheless, the observed internal consistency and congruence with prevailing trends in sub-Saharan Africa lend considerable credibility to the study's conclusions.

V. CONCLUSION

In this urban Nigerian cohort, adults with type 2 diabetes mellitus (T2DM) demonstrated suboptimal adherence to dietary guidelines and primarily engaged in sedentary occupational activities, contributing to a significant prevalence of overweight and obesity. Key behavioral determinants of body mass index were identified as workplace posture and energy intake, particularly evident in the female population. Consequently, the integration of culturally appropriate nutrition education and physical activity counseling into standard outpatient diabetes care is critically necessary to mitigate the escalating burden of obesity-related complications.

Acknowledgments, Ethics, and Conflict of Interest

The author expresses gratitude to the staff and patients of the Diabetes Clinic at Lagos University Teaching Hospital for their invaluable cooperation during the data collection phase. The investigation was conducted in strict accordance with the ethical tenets stipulated in the Declaration of Helsinki. Oversight and approval for the study, which involved exclusively non-invasive, observational procedures, including access to outpatient records and participant interviews, were secured from the LUTH Health Research Ethics Committee. All participants provided oral informed consent, and their

confidentiality was rigorously upheld throughout the entirety of the study.

Authors' Contribution

P.I. Offoh was responsible for the conceptualization and design of the study, the collection and analysis of data, and the initial drafting of the manuscript. Prof. dr. ir. Patrick KOLSTEREN and Dr. Youri TAES provided crucial supervision, critical review, and intellectual guidance throughout both the research process and manuscript preparation. All authors subsequently approved the final version of the manuscript.

Conflict of Interest: The author affirms no competing interests pertinent to this research.

REFERENCE

[1] International Diabetes Federation. IDF Diabetes Atlas, 10th ed. Brussels: IDF; 2021.

[2] World Health Organization. Global report on diabetes. Geneva: WHO; 2016.

[3] Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. Am J Clin Nutr. 2006;84(2):289–298.

[4] Vorster HH, Kruger A. Evidence that nutrition transition in sub-Saharan Africa contributes to the double burden of disease. Public Health Nutr. 2007;10(10):145–150.

[5] Hu FB. Globalization of food patterns and cardiovascular disease risk. Circulation. 2008;118(19):1913–1914.

[6] Misra A, Khunti K, et al. Type 2 diabetes in developing countries: risk factors, challenges, and strategies for prevention. Diabetes Care. 2008;31(Suppl 2):S141–S152.

[7] Steyn NP, et al. Dietary changes and the health transition in South Africa: implications for health policy. S Afr J Clin Nutr. 2012;25(3):87–93.

[8] World Health Organization. Obesity and overweight: key facts. Geneva: WHO; 2023.

[9] American Diabetes Association. Standards of medical care in diabetes—2023. Diabetes Care. 2023;46(Suppl 1):S1–S154.

[10] Franz MJ et al. Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes. Diabetes Care. 2002;25(1):148–198.

[11] Ezenwaka CE, et al. Knowledge, attitude, and practice of dietary management among patients with type 2 diabetes in Nigeria and Trinidad. West Indian Med J. 2003;52(3):188–192.

[12] Adebayo RA, et al. Dietary habits, physical activity and lifestyle in patients with type 2 diabetes in South-West Nigeria. Niger J Clin Pract. 2013;16(1):105–110.

[13] Uloko AE, et al. Prevalence and risk factors for diabetes mellitus in Nigeria: a systematic review and meta-analysis. Diabetes Ther. 2018;9(3):1307–1316.

[14] Ogunbode AM, et al. Assessment of dietary compliance among type 2 diabetic patients in Nigeria. Ann Afr Med. 2015;14(3):163–170.

[15] Mengistu DA, et al. Level of dietary adherence and determinants among type 2 diabetes. PLoS One. 2023;18(6):e0271378.

[16] Teshome S, et al. Dietary assessment of type 2 diabetes in Africa: a systematic review. Public Health Nutr Rev. 2022; 2666970622000075.

[17] Adjei EA, et al. Therapeutic patient education programs on diabetes in sub-Saharan Africa. PLoS One. 2024;19:e0299526.

[18] Abera E, et al. Adherence to recommended diet and glycemic control among adults with diabetes in Ethiopia. BMC Public Health. 2020;20:1175.

[19] Tesfaye T, et al. Adherence to the recommended diet among patients with diabetes: factors and nonadherence. PLoS One. 2023;18:e0289622.

[20] Adeyemi O, et al. Dietary nonadherence and its determinants among diabetes patients in Nigeria. BMC Nutr. 2025;11:42.

[21] Fekadu G, et al. Dietary practice among type 2 diabetic patients in Southern Ethiopia. BMC Endocr Disord. 2020;20(1):67.

[22] Abebe SM, et al. Adherence to dietary recommendation and associated factors among diabetic adults in Addis Ababa. PLoS One. 2019;14(11):e0222769.

[23] Nwankwo MC, et al. Effectiveness of diabetes self-management education and support in sub-Saharan Africa: a systematic review. Front Clin Diabetes Healthc. 2025; 1554524.

[24] Kaggwa R, et al. Self-management interventions for T2DM in Africa: evidence synthesis. JBI Evid Synth. 2024;22(9):155–172.

[25] Nel JH, Steyn NP. The nutrition transition and the double burden of malnutrition in sub-

Saharan Africa. Int J Environ Res Public Health. 2022;19(24):16791.
[26] Osei E, et al. Poverty, price and preference barriers to improving diets in sub-Saharan Africa. Food Policy. 2023;117:102401.
[27] Tayo BO, et al. Review of ongoing activities and challenges to improve care of T2DM across Africa. Front Pharmacol. 2020;11:108.
[28] Asamoah-Boaheng M, et al. Glycaemic control among type 2 diabetes patients in sub-Saharan Africa: a systematic review. Diabetol Metab Syndr. 2022;14(1):59.
[29] Ngugi R, et al. Dietary interventions and glycaemic control in type 2 diabetes: review of African studies. J Public Health Afr. 2020;11(2):1325.
[30] Oboh HA, et al. Diabetes self-care intervention strategies and their effectiveness in Africa. PLoS One. 2023;18:e0305860.
[31] Obirikorang Y, et al. Dietary adherence among persons with type 2 diabetes in Ghana. PLoS One. 2023;18(4):e0302914.
[32] Ganiyu AB, et al. Determinants of dietary adherence among type 2 diabetes: a multicentre study. Diabetes Metab Syndr Obes. 2020;13:2975–2985.
[33] Steyn NP, McHiza ZJ. Obesity and the nutrition transition in sub-Saharan Africa: a review. Afr J Food Agric Nutr Dev. 2014;14(3):1684–1698.
[34] Ndlovu P, et al. Dietary patterns and their sociodemographic correlates in South Africa. Int J Public Health. 2024;69:221–232.
[35] SAS Institute Inc. SAS/STAT 9.2 user's guide. Cary, NC: SAS Institute Inc.; 2010.
[36] Jolliffe IT. Principal Component Analysis. 2nd ed. New York: Springer; 2002.
[37] WHO. Global Diabetes Compact: Accelerating Action. Geneva: WHO; 2023.
[38] IDF Africa Region. Africa Diabetes Report 2023. Brussels: IDF; 2023.
[39] Oti SO, van de Vijver S. The neglected epidemic: diabetes in sub-Saharan Africa. Trop Med Int Health. 2021;26(6):601–603.
[40] Sirdah MM. Diabetes care and nutrition transition: lessons from the developing world. Nutrients. 2024;16(2):231–245.