

Associations between Diabetes Self-Management and Microvascular Complications among Patients Living in Rural Areas, in Kenya

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Abstract

Diabetes is a major public health concern worldwide. Low and middle-income countries are the most affected. Diabetes self-management can significantly reduce the burden of diabetes complications and mortality. This cross-sectional study was conducted at the outpatient department of a county referral hospital in Kenya, from 1st August 2022 to 30th October 2022. Patients with known type II diabetes of age ≥ 20 years visiting the hospital for routine follow-up visits were included. A 7-item Summary of Diabetes Self-care Activities (SDSAC) Questionnaire was used to assess Diabetes self-care activities. For data entry and statistical analysis, SPSS for Windows version 27.0 was used. There were 96 (39.2%) males and 149 (60.8%) females. Most of the participants were more than 61 years, 148 (60.4%). Significant association was found between the sum scale scores of dietary activities, blood glucose testing, physical activity, foot care, and neuropathy at 95% CI and ($p < 0.001$). Scores on the Blood glucose testing and foot care activities subscale were significantly associated with Retinopathy ($p < 0.001$). Additionally, significant associations were found between the presence of nephropathy and dietary activities, foot care, and physical activity subscale ($p \leq 0.001$). **Conclusions:** Diabetes self-management activities have an impact on microvascular complications in patients with diabetes.

Keywords

Self-Management Activities, Diabetes, Microvascular Complications, Summary of Diabetes Self-Care Activities

1. Introduction

Diabetes poses a significant public health challenge worldwide, with its prevalence reaching epidemic levels [1]. Despite global efforts, morbidity and mortality rates associated with diabetes remain alarmingly high. Particularly, low and middle-income countries (LMICs) bear the brunt of this burden. In these regions, diabetes and its complications impose a substantial economic strain, with projected costs only expected to escalate further [2]. Among the many complications linked to diabetes, microvascular issues involving the kidneys, retina, and peripheral nerves stand out as significant contributors to both mortality and disability among patients [3]. This not only adversely impacts their quality of life but also adds to the burden of care. However, it is widely acknowledged that effective self-management strategies for diabetes can play a crucial role in mitigating complications and reducing mortality rates among affected individuals [4].

Contrary to previous assumptions that predominantly linked diabetes prevalence to urban areas, rural communities have also witnessed a surge in cases [3]. This trend places a considerable burden on healthcare workers stationed at primary health centers and dispensaries, given the scarcity of private or tertiary-level hospitals catering to the healthcare needs of diabetic individuals [5]. Intensifying this challenge is various obstacles encountered by these rural communities. These include limited access to diabetes education and clinical services, inadequate smart cellphone coverage and internet accessibility, constrained transportation options, long distances to travel for medical care, and high levels of poverty [6].

The requirements of individuals with diabetes extend beyond maintaining optimal blood sugar levels to also include the prevention of complications and disabilities [7]. Healthcare providers face a significant challenge in meeting the continued needs and expectations of diabetic patients [8]. Regular monitoring and care from a multidisciplinary team are essential for preventing long-term complications associated with diabetes [9] [10]. However, this poses challenges due to the concentration of over 80% of consultants in urban areas and tertiary hospitals in Kenya, resulting in suboptimal management of diabetes and increased rates of diabetes-related complications [11].

Diabetes Self-Management Activities

Self-care in diabetes involves the process of acquiring knowledge and awareness to effectively manage the complexities of diabetes within a social context [12]. The duty for daily diabetes care primarily falls on patients and/or their families. Seven key self-care behaviors have been identified in individuals with diabetes, which are predictive of outcomes. These behaviors encompass maintaining a healthy diet, engaging in regular physical activity, monitoring blood sugar levels, adhering to medication regimens, possessing effective problem-solving abilities, employing healthy coping mechanisms, and adopting risk-reduction practices [13]-[16]. These self-care measures serve as valuable guidelines for healthcare

professionals and educators involved in patient care, as well as for researchers evaluating novel approaches to diabetes management [17]. Applying self-reporting methods is a practical and cost-effective strategy for assessing self-management abilities [18].

Diabetes self-management encompasses a range of behaviors adopted by individuals with diabetes to effectively regulate the condition independently. These seven behaviors exhibit a positive association with achieving optimal glycemic control, abating complications, and enhancing overall quality of life [9] [19] [20]. Additionally, it is noted that self-care extends beyond only executing these activities but also emphasizing the interrelation between them. Successful diabetes self-care entails substantial lifestyle adjustments by the patient, reinforced by the supportive involvement of healthcare professionals. This collaborative approach contributes to boosting self-assurance and enables successful behavioral modifications [21]-[24].

Diabetes education holds significant importance, yet its true value lies in its translation into actionable steps or self-care practices for optimal patient benefit. Both the American Association of Clinical Endocrinologists and the World Health Organization underline the necessity for patients to actively engage and acquire knowledge to manage their own health [10] [25]. It is crucial to prioritize understanding the condition and the implication of medication, dietary regimens, foot and eye care, as well as the enduring impact of lifestyle modifications, regular physical activity, and self-monitoring of blood glucose levels [26].

Due to the high occurrence of diabetes mellitus (DM) and its associated complications in Nyeri County, there has been a limited number of studies investigating the self-management of diabetes within its population. Therefore, this study aimed to assess the Diabetes self-management practices of diabetes patients residing in rural areas of Nyeri County, Kenya.

2. Materials and Methods

2.1. Study Site

The study was carried out in Nyeri County referral hospital, located in central regional Kenya. The County lies between Mount Kenya and the Aberdare ranges with Agriculture as the main economic activity. The majority of the people living in Nyeri County are predominantly farmers growing tea and coffee as cash crops alongside food crops such as maize, beans, assorted vegetables, and sweet potatoes. Other communities living in the county are mostly engaged in their own businesses or employed by the government. Nyeri County is home to 845,863 people (male 49% and female 51%).

2.2. Study Design

A facility-based, cross-sectional study was conducted at the diabetes clinic and Diabetes outpatient clinic (DOPC). The study duration was from 8th August 2022 till 30th October 2022.

2.3. Sample Size

245 participants were recruited for the study.

2.4. Participant Selection

Participants were recruited using a purposive sampling method. The procedure involved asking about the area of residence among the patients seeking diabetes care and selecting eligible individuals who met the inclusion criteria for participation in the interview. The inclusion criteria were: individuals must be diagnosed with type II diabetes and reside in a rural area within Nyeri County. Other inclusion criteria the participant must be 20 years and above and registered for follow-up in a hospital within Nyeri County. Patients being seen in the emergency or inpatient department, and patients who did not have at least one available record of HbA1c from the last six months were excluded. All patients were included after attaining informed consent. The majority of the participants were under treatment, except two found to have discontinued treatment and medications during the time of the interview.

2.5. Data Collection

Data was collected from the participants using a structured paper-based questionnaire improved from the Summary of Diabetes Self-Care Activities Measure. It included biodata information, Duration of DM and treatment, and HbA1c record from the last six months.

In order to assess their status of self-care, the Summary of Diabetes Self-care Activities (SDSCA) Questionnaire was used. The seven items of SDSCA are used to assess self-care activities. They are divided into 7 subscales: blood glucose testing subscale (item 7, 8, 3A), Diet subscale (item 1, 2, 3, 4, 1A, 5A), Physical exercise subscale (item 5, 6, 2A), smoking subscale (item 11, 12A, 13A, 14A), foot care subscale (item 9, 10, 9A, 10A, 11A), medications subscale (item 6A, 7A, 8A) and self-care recommendations subscale (item 1A, 2A, 3A, 4A). The questionnaire asks patients about their diabetes self-care activities during the past 7 days. If they were sick during the past 7 days, we went back to the last 7 days that they were not sick.

Scoring instructions were. Step 1: For items 1 - 10, use the number of days per week on a scale of 0 - 7. Step 2: Scoring Scales; general Diet = Mean number of days for items 1 and 2 and Specific Diet = Mean number of days for items 3, and 4 where the scale was (0 = 7, 1 = 6, 2 = 5, 3 = 4, 4 = 3, 5 = 2, 6 = 1, 7 = 0); exercise = Mean number of days for items 5 and 6; Blood-Glucose Testing = Mean number of days for items 7 and 8. Foot-Care = Mean number of days for items 9 and 10; Smoking Status = Item 11 (0 = nonsmoker, 1 = smoker), and number of cigarettes smoked per day.

Scoring for Additional Items such as; Recommended regimen = Items 1A - 4A, and items 12A - 14A, no scoring required; Diet = Use total number of days for item 5A; Medications = Use item 6A - OR - 7A AND 8A, use total number of days

for item 6A, use mean number of days if both 7A and 8A are applicable. Lastly; Foot-Care = Mean number of days for items 9A - 11A, after reversing 10A and including items 9 and 10.

For data entry and statistical analysis, SPSS for Windows version 27 was utilized. Patient characteristics were presented as frequency and percentages and compared using Chi square test. For SDSCA overall and its subscales mean and standard deviation (SD) were calculated and for comparison independent sample t-test was applied. The p value ≤ 0.05 was taken as significant.

2.6. Quality Control

Before commencing data collection, we conducted a pre-test of the questionnaire for consistency and suitability at a non-participating institution, namely Murang'a County Referral Hospital. The reliability of the SDSCA questionnaire was assessed using Cronbach's alpha test, yielding an overall reliability coefficient of 0.746. The questionnaire was initially prepared in English, translated into the Kikuyu version, and subsequently translated back into English to ensure accuracy. Data collection involved the participation of four nurses and four clinical officers who were trained a month prior to the study's commencement. Furthermore, all research assistants underwent a pre-testing session before the actual study. Throughout the data collection process, debriefing meetings were held at the end of each day to review data and identify any potential omissions or errors.

2.7. Data Analysis

The data was entered into Microsoft Excel and subsequent analysis using IBM SPSS Statistics version 22. The reliability of the data was assessed through Cronbach's alpha test, while model fitness was evaluated using the Hosmer and Lemeshow test. Descriptive statistics were computed to provide a summary of most variables. Bivariate analysis was conducted to explore the potential association between diabetes self-management practices and the presence of microvascular complications. To ensure the stability of estimates in the subsequent model, only variables with a p-value less than 0.2 in bivariate analysis were included in the subsequent model analysis. Multiple logistic regression analysis was then employed to describe the association between diabetes self-management and microvascular complications. A significance level of $p < 0.05$ was used for all statistically significant tests.

2.8. Ethics Statement

Both written and verbal informed consent for participation was also obtained from all the participants. For written consent, all participants signed the consent form in the questionnaire. Verbal consent was witnessed by the nurse or clinical officer in-charge of the clinic. The study was approved by the Ethical Review Committee of Jomo Kenyatta University of Agriculture and Technology (JKU/2/4/896B), and the National Commission for Science, Technology and Innovation (NACOSTI/P/22/18990) and Nyeri county department of health

(CGN/HEALTH/HRM/6/VOL.II).

2.9. Study Limitations

This study was conducted within a group displaying particular characteristics. It is uncertain whether other groups in different rural areas possess similar traits. Consequently, caution should be exercised when generalizing the findings. However, it does offer insights into the degree of association between diabetes self-management and MVCs, which can guide the development of interventions.

3. Results

3.1. Sociodemographic Characteristics of Study Participants

A total of two hundred and forty-five (245) individuals diagnosed with Diabetes were involved in the study. Of these, 96 (39.2%) were male and 149 (60.8%) were female. The majority of participants were aged over sixty-one years 148 (60.4%) and married 168 (68.6%). Most of the participants occupation was farming 175 (71.4%) (**Table 1**).

Table 1. Sociodemographic characteristics of study participants, Nyeri Rural 2022.

Social demographic Variables	Frequency (%)
Sex	
Male	96 (39.2)
Female	149 (60.8)
Age group	
20 - 35	12 (4.9)
36 - 45	21 (8.6)
46 - 60	64 (26.1)
61 and above	148 (60.4)
Marital status	
Married	168 (68.6)
single	23 (9.4)
Divorced/separated	8 (3.8)
Widowed	46 (18.8)
Level of education	
Primary	140 (57.1)
Secondary	64 (26.1)
Tertiary	13 (5.3)
No schooling	28 (11.4)
Occupation	
Office job	9 (3.7)
Out door	30 (12.2)
Farmer	175 (71.4)
Stay at home	31 (12.7)

3.2. Health Status Characteristics of Study Participants

The study result revealed that most 180 (73.5%) respondents had no family history of diabetes. Most 232 (94.7%) of the respondents were non-smokers. More than two-thirds of the respondents (69%) have experienced diseases more significant than five years of duration. Of the total respondents more than half, 144 (58.8%) had poor glycemic control (**Table 2**).

Table 2. Health status characteristics of study participants, Nyeri Rural 2022.

Variables	Frequency (%)
Family history of diabetes	
Yes	65 (26.5)
No	180 (73.5)
Cigarette smoking	
Yes	13 (5.3)
No	232 (94.7)
Duration of diabetes	
Less than 5 years	76 (31.0)
5 - 10 years	89 (36.3)
More than 10 years	80 (32.7)
Diabetes treatment regimen	
Oral Hypoglycemics	165 (67.3)
Insulin	24 (9.8)
Insulin plus oral hypoglycemics	56 (22.9)
Hb1aC Levels	
Good Control	101 (41.2)
Poor control	144 (58.8)

3.3. Factors Associated with Diabetes Microvascular Complications

The prevalence of Diabetes microvascular complications among the participants was found to be 56.78%, 25.3%, and 14.7% for neuropathy, retinopathy, and nephropathy, respectively. Univariate and bivariate analysis revealed a significant association between age and level of education with all three microvascular complications. Additionally, marital status showed an association with nephropathy and neuropathy, while Hb1Ac levels were associated with nephropathy (**Table 3**).

3.4. Associations between Summary of Diabetes Self-Care Activities and the Diabetes Microvascular Complications

As indicated in **Table 2**, multiple regression analysis indicated a significant association between the sum scale scores of dietary activities, blood glucose testing, physical activity, foot care, and neuropathy at a 95% CI, with a p-value ($p < 0.001$).

Furthermore, scores on the subscales for blood glucose testing and foot care activities were significantly correlated with retinopathy ($p < 0.001$). Additionally, significant correlations were identified between the presence of nephropathy and the subscales for dietary activities, foot care, and physical activity ($p < 0.001$), as detailed in (Table 4).

Table 3. Factors associated with Diabetes Microvascular complications, Nyeri Rural 2022.

Characteristic variable	Total (n = 245)	Neuropathy	p-value	Retinopathy	p-value	Nephropathy	p-value
Age							
20 - 35	12	1 (0.7)		0 (0%)		2 (5.6%)	
36 - 45	21	7 (5.0%)	0.001	3 (4.8%)	0.009	1 (2.8%)	0.02
46 - 60	64	27 (19.4)		11 (17.7%)		3 (8.3%)	
61 and above	148	104 (74.8)		48 (77.4%)		30 (83.3%)	
Marital status							
Single	23	7 (5.0%)		3 (4.8%)		2 (5.6%)	
Married	168	93 (66.9%)	0.003	39 (62.9%)	0.08	20 (55.6%)	0.007
Divorced/Separated	8	4 (2.9%)		2 (3.2%)		0 (0%)	
Widowed	46	35 (25.2%)		18 (29.0%)		14 (38.9%)	
Level of Education							
Primary	140	83 (59.7%)		39 (62.9%)		19 (52.8%)	
Secondary	64	28 (20.1%)	0.003	7 (11.3%)	0.003	6 (16.7%)	0.008
Tertiary	13	5 (3.6%)		3 (4.8%)		1 (2.8%)	
No schooling	28	23 (16.1%)		13 (21.0%)		10 (27.8%)	
Occupation							
Office job	9	3 (2.2%)		3 (4.8%)		0 (0%)	
Outdoor job	30	13 (19.4%)	0.17	4 (6.5%)	0.13	5 (13.9%)	0.06
Farmer	175	104 (74.8%)		43 (69.4%)		22 (61.1%)	
Stay at home	31	19 (13.7%)		12 (19.4%)		9 (25.0%)	
Duration of diabetes							
Below 5 years	76	35 (25.2%)		19 (30.6%)		8 (22.2%)	
5 - 10 years	89	52 (37.4%)	0.05	18 (29.1%)	0.26	14 (38.9%)	0.44
More than 10 years	80	52 (37.4%)		25 (40.3%)		14 (38.9%)	
Diabetes treatment regimen							
Oral Hypoglycemics	165	96 (69.1%)		41 (66.1%)		21 (58.3%)	
Insulin	24	12 (8.6%)	0.73	7 (11.3%)	0.90	6 (16.7%)	0.27
Insulin plus oral hypoglycemics	56	31 (22.3%)		14 (22.6%)		9 (25.0%)	
Hb1aC level							
Good control	101	56 (40.3%)		21 (33.9%)		8 (22.2%)	
Poor Control	144	83 (59.7%)	0.73	41 (66.1%)	0.17	28 (77.8%)	0.01

Values are presented as number (%) and P value for associations.

Table 4. Associations between summary of diabetes self-care activities and the microvascular complications of diabetes, nyeri rural 2022.

SDSAC Variable	Total (n = 245) mean and SD	Neuropathy OR (95% CI)	p-value	Retinopathy OR (95% CI)	p-value	Nephropathy OR (95% CI)	p-value
Dietary Practice	4.44 ± 1.51	0.07 (0.03 - 0.11)	<0.001*	0.04 (-0.001 - 0.07)	0.06	0.06 (0.03 - 0.08)	<0.001*
Blood glucose monitoring	1.52 ± 2.15	0.06 (0.03 - 0.09)	<0.001*	0.03 (0.02 - 0.07)	<0.001*	-0.003 (-0.02 - 0.02)	0.76
Physical Activity	2.39 ± 1.86	0.06 (0.03 - 0.09)	<0.001*	0.03 (0.003 - 0.06)	0.08	0.05 (0.03 - 0.08)	<0.001*
Foot care	4.99 ± 1.63	0.08 (0.02 - 0.09)	<0.001*	0.06 (0.02 - 0.09)	<0.001*	0.06 (0.03 - 0.08)	<0.001*
DM Medication Adherence	7.28 ± 1.55	-0.02 (-0.07 - 0.02)	0.29	0.01 (-0.03 - 0.05)	0.55	0.007 (0.02 - 0.04)	0.62

SD, standard deviation; OR, odds ratio; CI, confidence interval. *p < 0.05.

4. Discussion

This study aimed to assess the association between diabetes self-care practices and the occurrence of microvascular complications in diabetic patients residing in rural areas. Among the study participants, the prevalence rates of diabetes microvascular complications were found to be 56.78% for neuropathy, 25.3% for retinopathy, and 14.7% for nephropathy. These figures are remarkably higher compared to findings from other studies [27] [28]. It is worth noting that our study primarily focused on individuals residing in rural areas, in contrast to previous studies. This difference in results may be attributed to the unique challenges and disparities in diabetes care experienced by rural populations [29].

In this study, participants were stratified based on various demographic factors. Results showed that individuals aged sixty-one years or older had a higher prevalence of Neuropathy and Retinopathy compared to their younger counterparts (p < 0.05). This observation aligns with prior research suggesting that advancing age is a significant risk factor for prediabetes and diabetes [29]. Moreover, microvascular complications are more prevalent among diabetic populations, with the risk of such events often correlated with the duration of diabetes [30].

The educational level was related to all the MVCs. This study agrees with previous studies indicating that educational achievement affects awareness of diabetes self-care, adherence to medication, and an individual's health-seeking behavior [31]. Other studies have noted that individuals with lower levels of education are at a higher risk of developing complications related to diabetes [32].

The current research revealed a remarkable association between dietary habits, physical activity, and the occurrence of neuropathy and nephropathy complications. This linkage can be explained by the consistent adoption of a healthy dietary regimen, which has been linked to a decreased likelihood of microvascular complications among diabetic patients. Additionally, we examined the distribution of carbohydrate intake and consumption of fats. Previous studies have indicated that diets rich in carbohydrates and monounsaturated fats contribute to enhanced insulin sensitivity [33]-[35]. These findings provide a foundation for dietary guidelines designed to mitigate the risk of diabetic microvascular

complications.

Engaging in various forms of physical activity, including walking, gardening, leisure activities, exercise, and occupational movements, has been shown to improve insulin sensitivity. Moreover, it contributes to improvements in lipid profile, BMI, and blood pressure. These findings align with previous findings indicating that physical activity promotes better glycemic control and overall disease management [36]-[38].

Foot care practices were found to have a significant association with all three microvascular complications. Previous research has also indicated that individuals with peripheral neuropathy are at higher risk of developing diabetic retinopathy (DR), macroalbuminuria, and macrovascular complications [39]-[41]. These findings suggest that neuropathy, nephropathy, and retinopathy are indicative of a broader diabetic microangiopathic process, the progression of which may be affected by factors beyond diabetes duration and metabolic control. Therefore, interventions aimed at preventing one microvascular complication may have a direct impact on preventing similar complications [42] [43].

The results indicate a correlation between blood glucose testing and neuropathy and retinopathy in this study align with preceding research. Blood glucose monitoring plays a critical role in the management of individuals with diabetes [44]. It helps to recognize patterns in the fluctuation of blood glucose levels that occur in response to diet, exercise, medications, and pathological processes [45] [46]. It supports improvement of patient outcomes because critical decisions can be made in time.

5. Conclusion

The present research demonstrates a direct association between diabetes-related self-care behaviors and the occurrence of diabetes microvascular complications (MVCs). Specifically, activities such as foot care, dietary habits, physical exercise, and blood glucose monitoring, as well as demographic factors like age, marital status, Hb1Ac levels, and educational attainment, were found to be significantly linked to MVCs among diabetic patients. These findings highlight the importance of promoting diabetes self-care education as a vital strategy for enhancing self-management practices and ultimately improving patient outcomes in diabetes management.

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Authors' Contributions

Rachael Ileri contributed to the conception of the research idea, design data analysis and interpretation, paper drafting and revision. Gideon Kikui contributed to the conception of the research idea, design and revision of the final draft. Susan Mambo contributed to the conception of the research idea, design, and revision of final draft. Besty Cheriro contributed to the conception of the research idea, design, and revision of final draft. All authors approved the final manuscript before publication and agreed to be accountable for all aspects of the work.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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