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The Practices and Glycated Hemoglobin Levels of Adults with Diabetic Neuropathy in Nakuru County, Kenya

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ABSTRACT

Diabetic neuropathy is a common complication of diabetes that can significantly impact patients' quality of life. Practices play a crucial role in managing the condition and preventing further complications. This cross-sectional study examined the practices and glycated hemoglobin levels among adult patients with diabetic neuropathy. The study employed a cross-sectional design. A sample of adult patients diagnosed with diabetic neuropathy at Nakuru referral and teaching hospital was recruited. Data on dietary practices, including food choices, meal patterns, and dietary restrictions, were collected through structured interviews. Nutrient intake was assessed using dietary recall methods and analyzed using descriptive statistics. The chi-square test was used across the glycated hemoglobin (HbA1c) levels to compare categorical variables. Adherence to dietary recommendations was evaluated based on established guidelines for diabetic neuropathy management. Preliminary findings reveal sub-optimal practices in adults with diabetic neuropathy. Those with one or two daily meals reported significantly elevated HbA1c levels [χ^2=11.808, p=0.008]. Skipping meals, especially breakfast and lunch, correlated with elevated HbA1c [χ^2=17.622, p=0.001]. Smokers and alcohol consumers had a higher proportion of elevated HbA1c [χ^2=7.269, p=0.007] and [χ^2=15.610, p<0.001], respectively. Regular exercise, particularly daily or 1-3 times a week, is associated with lower HbA1c [χ^2=37.329, p<0.001]. Elevated HbA1c correlated significantly with daily intake of animal products [χ^2=18.931, p<0.001], fats and oils [χ^2=12.211, p =0.00], fruits [χ^2= 22.106, p<0.001], and cereals [χ^2=21.728, p<0.001]. Conversely, daily consumption of vegetables [χ^2=8.255, p=0.016], pulses, and legumes [χ^2=53.757, p<0.001] were associated with normal HbA1c. However, occasional sugar and honey intake did not significantly impact HbA1c [χ^2=1.082, p=0.582]. In conclusion, our study highlights sub-optimal practices in adult diabetic neuropathy patients, particularly in those consuming one or two meals daily, skipping breakfast and lunch, and engaging in smoking or alcohol. Regular exercise correlates with lower HbA1c, while certain dietary habits influence glycemic control. These insights inform targeted interventions for improved patient care.

Keywords: Nutrition, dietary practices, diabetic neuropathy, cross-sectional study, glycemic control, glycated hemoglobin (HbA1c)

INTRODUCTION

Amid the global health landscape, the silent burden of diabetic neuropathy casts its shadows on countless lives. Diabetes mellitus is a significant global health challenge affecting millions of individuals worldwide. It is characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (Khan et al., 2020)prevalence, and burden of suffering of diabetes mellitus based on epidemiological data from the Global Burden of Disease (GBD. The chronic hyperglycemia associated with diabetes can lead to various complications, and one of the most common and debilitating among them is diabetic neuropathy (Badireddy, 2022). Diabetic neuropathy is a nerve disorder that arises due to prolonged high blood sugar levels, leading to nerve damage and impairing sensations, primarily in the extremities. This condition manifests as pain, tingling, numbness, and weakness, significantly affecting the quality of life of affected individuals(Amelia et al., 2019).

The importance of nutrition in managing and preventing chronic diseases, including diabetes, is well-established in global health literature. Proper dietary practices are crucial in glycemic control, reducing complications, and improving overall health outcomes for diabetic patients (Gropper, 2023). However, the specific practices adopted by adult patients diagnosed with diabetic neuropathy and their potential impact on glycated hemoglobin (HbA1c) levels remain relatively unexplored in the research domain.

Diabetes is a global public health concern, and its prevalence continues to rise rapidly (WHO, 2021). According to the International Diabetes Federation (IDF), approximately 537 million adults were living with diabetes in 2021, and this number is projected to rise to 643 million by 2030 and 783 million by 2045 (Federation, 2021). Diabetic neuropathy is a prevalent complication of diabetes, affecting a significant proportion of individuals living with the condition (Feldman, 2023). The global burden of diabetic neuropathy underscores the urgency for understanding and implementing effective dietary interventions to manage the situation and improve the overall well-being of affected individuals.

Africa is experiencing a rising prevalence of diabetes, largely driven by urbanization, sedentary lifestyles, and dietary transitions. The IDF estimates that 13 million adults aged 20-79 had diabetes in Africa in 2021, expected to reach 47 million by 2045 (IDF Africa, 2021). The burden of diabetic neuropathy is also growing in the region, affecting the quality of life of numerous individuals. However, limited research has been conducted in Africa to explore the dietary practices of patients with diabetic neuropathy and their impact on glycemic control. Understanding the dietary habits of this African population can inform targeted interventions and contribute to improved diabetes management and prevention of complications.

In Kenya, diabetes is a major public health concern, with an estimated prevalence of 3.3% in adults aged 18-69 years, according to WHO (WHO, 2019). The prevalence of diabetes is higher in urban areas, including the capital city, Nairobi and other major towns like Nakuru County (Mohamed et al., 2018). Diabetic neuropathy is a significant concern for patients with diabetes in Kenya, impacting their daily activities and overall well-being(Kuka et al., 2022). Despite the importance of nutrition in diabetes management, limited research has focused on the dietary practices of patients with diabetic neuropathy in the Kenyan context. Exploring the dietary practices and their association with glycemic control in this population can offer valuable insights for healthcare providers and policymakers to design targeted interventions for improved diabetes care.

Nakuru County, located in the Rift Valley region of Kenya, is among the counties experiencing an increasing burden of diabetes and its complications. The prevalence of diabetes in Nakuru County reflects the national trend, with diabetic neuropathy contributing to the disease burden (Mohamed et al., 2018). Despite this, there is a scarcity of research on the dietary practices of patients with diabetic neuropathy in Nakuru County. Understanding the dietary habits and their relationship with glycemic control in this local context can have significant implications for healthcare providers and community stakeholders in tailoring nutrition interventions and support for individuals with diabetic neuropathy(Hussein & Soliman, 2023)particularly for patients with type-2 diabetes mellitus (T2DM. The study aimed to explore the dietary practices and their association with glycemic levels of adult patients diagnosed with diabetic neuropathy in Nakuru County, Kenya.

MATERIALS AND METHODS

Study Area

The study was conducted at Nakuru Teaching and Referral Hospital in Nakuru County, serving as the primary site for participant recruitment, data collection, and medical examinations. As a pivotal healthcare institution equipped with specialized departments in diabetes management and neurology, the hospital's status as a teaching and referral facility ensures a diverse patient population, attracting individuals from Nakuru County and neighboring areas seeking specialized healthcare services. Leveraging the hospital's comprehensive healthcare infrastructure, including laboratories, medical imaging facilities, and diabetes care clinics, the study collaborates with healthcare professionals to access a pool of participants diagnosed with diabetic neuropathy, ensuring a robust sample. This hospital-based approach allows for a focused examination of dietary practices and glycated hemoglobin levels among adults with diabetic neuropathy in a clinical context, ensuring thorough medical assessments and providing valuable insights to inform clinical practices and interventions aimed at improving dietary habits and glycemic control in individuals with diabetic neuropathy.

Study Design

A cross-sectional study was conducted to explore the dietary practices of 118 adult patients diagnosed with diabetic neuropathy and their glycated hemoglobin (HbA1c) levels attending Nakuru Teaching and Referral Hospital.

Study Participants

The study participants consisted of adult patients aged 18 years and above who consented to participate in the study, had been diagnosed with diabetic neuropathy, and were receiving treatment or follow-up care in the Nakuru teaching and referral hospital diabetic special clinic at the time of the study. Participants were identified through medical records and referrals from healthcare providers. Patients who were critically ill and those who did not consent to participate were excluded from the study.

Sample Size Determination

This study sample size was calculated by the use of a standard formula by Fishers,

(1994), for the research population of fewer than 10,000 respondents. The formula is as indicated below;

nf = n / (1+ (n/N)), 9 . ..

Where:

nf= Desired sample size in a population of not more than 10,000 respondents.

n= sample size desired.

N= Estimated Population Size = 176 (Average number of adults diagnosed with diabetic neuropathy visiting Nakuru level 5 hospital monthly according to hospital Records of 2021.

n = constant = 385

Nf = 120.784

Nf = 121

The desired sample size = 121

The sample size was 121; an additional 10% was calculated to provide for non-response, totaling 133 DN patients. However, the researcher only succeeded in collecting data from 118 DN patients, representing 89% of the total anticipated sample size for the study and 11% non-response.

Inclusion and Exclusion Criteria

The study included adults 18 and above diagnosed with diabetic neuropathy at Nakuru Level 5 Teaching and Referral Hospital's diabetic special clinic, confirmed through medical records and clinical assessments. Exclusion criteria comprised individuals with cognitive impairments affecting informed consent or study participation, as well as those with comorbidities like severe renal disease or active malignancies. Pregnant individuals were excluded to maintain homogeneity, ensuring a focused examination of dietary practices and glycated hemoglobin levels in adults with diabetic neuropathy.

Sampling Procedure

Participants were selected from the pool of adults aged 18 and above diagnosed with diabetic neuropathy actively seeking care at Nakuru Level 5 Teaching and Referral Hospital's diabetic special clinic. The systematic aspect involved choosing every alternative participant to ensure a representative and diverse sample until the sample size was attained. The research team approached potential participants, and after explaining the study's objectives and obtaining informed consent, comprehensive assessments of practices and glycated hemoglobin levels were conducted through surveys, interviews, and medical examinations. This approach aimed to capture a broad spectrum of individuals with diabetic neuropathy attending the clinic during the study period, enhancing the generalizability of the findings to the wider population of adults with diabetic neuropathy in Nakuru County. The method also minimized selection bias and ensured a comprehensive examination of the relationship between dietary practices and glycated hemoglobin levels in this specific patient group.

Data Collection Instruments

The data collection instruments included structured questionnaires, dietary recall interviews, and medical record review forms. The structured questionnaires were designed to collect demographic information, medical history, diabetes duration, diabetes treatment regimens, and other relevant clinical information from the participants. On the other hand, dietary recall interviews were conducted to gather information on the participants' dietary practices, including their typical daily food intake, meal frequency, portion sizes, and consumption of specific food groups. Last, we used medical record review forms to extract data related to the participants' glycated hemoglobin (HbA1c) levels, diabetes diagnosis, and other relevant clinical information.

Data Collection Procedure

Before the commencement of data collection, ethical approval was obtained from Kabarak University Research Ethical committees, Informed consent was obtained from all study participants, who were assured confidentiality and privacy. A pilot test for the data collection tool was done at Kericho District Hospital among 10 participants. Trained research assistants conducted face-to-face interviews with the participants using structured questionnaires to gather demographic and clinical information. The dietary recall interviews were conducted, and participants were asked to recall their food intake over the past 24 hours or specific meal patterns if necessary. Glycated hemoglobin (HbA1c) levels were extracted from the participant's medical records. Anthropometric measurements, including height, weight, and waist circumference, were also taken during the data collection.

Data Analysis

Statistical analysis was conducted using SPSS IBM version 26.1. Descriptive statistics, frequencies, and percentages were used to summarize the participants' demographic, clinical, and dietary data. Categorical variables were compared across the different levels of glycated hemoglobin using the chi-square test. Fisher's exact test was used to compare the difference between categorical variables across the normal and elevated levels of HbA1c. Practices and food frequency were also compared across HbA1c levels using a chi-square test.

Ethical Considerations

Ethical considerations were paramount throughout the study. Informed consent was obtained from all study participants before data collection, and the confidentiality of their information was ensured. The institutional review boards and ethical committee of Kabarak University reviewed and approved the study protocol, Ref. No. KUREC-160622 and a research permit was sought from National Commission For Science ,Technology and Innovation, Licence No: NACOSTI/P/22/19046.

RESULT

Comparison of General Characteristics of Participants Across the Glycated Hemoglobin Levels

Among 118 participants, 73(61.9%) with DN were female, 45(38.1%) male. Elevated HbA1c was significantly higher in females (χ^2=11.475, p=0.001). The mean age was 51.190±14.520 years. The majority attained secondary 40 (33.9%) and tertiary education 43 (36.4%). DN patients with normal HbA1c were significantly higher than those with elevated HbA1c compared to those without formal, primary, and secondary education (χ^2=65.381, p<0.001). Diabetic neuropathy (DN) proportions increase with longer diabetes duration: 1-3 years 19 (16.1%), 4-7 years 27 (22.9%), 8-11 years 36 (30.5%), and ≥ 12 years 36 (30.5%). Duration ≥8 years significantly associated with elevated HbA1c (χ^2=37.004, p<0.001). Most DN cases were type II diabetes (79, 66.9%), with significantly higher elevated HbA1c in type II than in type I (χ^2=7.619, p=0.006). OGLAS treatment was common, showing no significant difference between normal and elevated HbA1c levels (χ^2=5.203, p=0.074). The majority of DN patients were obese, notably higher among those with elevated HbA1c (χ^2=40.428, p<0.001). Elevated blood pressure significantly correlated with elevated HbA1c (χ^2=17.709, p=0.001). Waist circumference was elevated in those with elevated HbA1c (t=-7.991, p<0.001). Most participants, especially those with elevated HbA1c, were highly knowledgeable about diabetes (χ^2=7.292, p=0.007).

In dietary analysis, a small percentage reported daily fast-food consumption 11 (9.3%), while the majority occasionally ate 63 (53.4%), with no significant frequency difference between normal and elevated HbA1c groups. Most had three meals per day, 68 (57.6%). Those with one or two meals had significantly elevated HbA1c (χ^2=11.808, p=0.008). Skipping meals, especially breakfast and lunch, was significantly associated with elevated HbA1c (χ^2=17.622, p=0.001). The preferred cooking method (frying) showed no significant difference between normal and elevated HbA1c (χ^2=0.858, p=0.836). Non-alcoholic participants were prevalent, but daily and weekly alcohol consumers had significantly higher elevated HbA1c (χ^2=15.61, p<0.001). Nutritional counseling did not correlate substantially with HbA1c (χ^2=3.140, p=0.370). Practices such as regular physical exercise is linked to lower HbA1c (χ^2=37.329, p<0.001). Smoking prevalence was higher among those with significantly elevated HbA1c (χ^2=7.269, p=0.007). Regular checkups significantly correlated with normal HbA1c (χ^2=26.778, p<0.001). No significant association was found between reasons for skipping meals and HbA1c levels (χ^2=0.171, p=0.918), as shown in Table 1.

Table 1.

Demographic and Socio-economic Characteristic of Adult Patients Diagnosed with DN by Glycated Hemoglobin Levels.

Variable	Total n (%)	Normal HbA1c n (%)	Elevated HbA1c n (%)	t/χ^2	P value
Sex					
Male	45(38.1)	25(21.2)	20(16.9)	11.475	0.001
Female	73(61.9)	18(15.3)	55(46.6)		
Age(M±SD)	51.19±14.52	48.63±14.397	52.65±14.481	-1.456	0.148
18-30	15(12.7)	8(6.8)	7(5.9)	4.180	0.382
31-43	25(21.2)	9(7.6)	16(13.6)		
44-56	42(35.6)	17(14.4)	25(21.2)		
57-69	28(23.7)	7(5.9)	21(17.8)		
70 and above	8(6.8)	2(1.7)	6(5.1)		
Level of Education					
No formal education	8(6.8)	1(0.8)	7(5.9)	65.381	<0.001
Primary	27(22.9)	2(1.7)	25(21.2)		
Secondary	40(33.9)	4(3.4)	36(30.5)		
Tertiary	43(36.4)	36(30.5)	7(5.9)		
Disease Duration in Years					
1-3	19(16.1)	15(12.7)	4(3.4)	37.004	<0.001
4-7	27(22.9)	17(14.4)	10(8.5)		
8-11	36(30.5)	6(5.1)	30(25.4)		
≥12	36(30.5)	5(4.2)	31(26.3)		
Diabetes Type					
Type 1	39(33.1)	21(17.8)	18(15.3)	7.619	0.006
Type 2	79(66.9)	22(18.6)	57(48.3)		
BMI					
Normal	32(27.1)	25(21.2)	7(5.9)	40.428	<0.001
Obese	42(35.6)	7(5.9)	35(29.7)		
Underweight	10(8.5)	6(5.1)	4(3.4)		
Overweight	34(28.8)	5(4.2)	29(24.6)		
Blood Pressure					
Normal	25(21.2)	17(14.4)	8(6.8)	17.709	0.001
Elevated	34(28.8)	14(11.9)	20(16.9)		
Stage 1 HTN	26(22.0)	5(4.2)	21(17.8)		
Stage 2 HTN	33(28.0)	7(5.9)	26(22.0)		
Waste Circumference (M±SD)	102.97±20.535	86.88±14.287	112.20±17.725	-7.991	<0.001
Knowledge score level					
Less knowledgeable	55(46.6)	13(11.0)	42(35.6)	7.292	0.007
Highly knowledgeable	63(53.4)	30(25.4)	33(28.0)		

Practices of Adult Patients Diagnosed with Diabetic Neuropathy

Based on the analysis, only a small percentage of patients, 11(9.3%), reported eating in fast food restaurants daily, while the majority, 63(53.4%), reported eating occasionally, and 44(37.3%) did not. The frequency of fast food restaurant visits did not differ significantly (Value) between those with normal and elevated HbA1c levels. In terms of meal frequency, the current results show that the majority of participants (68(57.6%) and 24(20.3%) ate three meals and four meals per day, respectively. Furthermore, the findings revealed that most of those who had one or two meals had significantly elevated HbA1c [2=11.808, p=0.008]. Out of 118 participants, 57(48.3%) reported not skipping meals. However, few who reported skipping breakfast and lunch had significantly elevated HbA1c [χ^2=17.622, p=0.001]. Most of the respondents' preferred cooking method was frying 46(39.0%). However, no statistical significance difference was reported in the proportion of those with normal and elevated HbA1c levels [=0.858, p=0.836]. Concerning alcohol consumption, the majority of our respondents were non-alcoholic 60(50.8%). Nevertheless, those who reported consuming alcohol daily and once a week had a significantly higher proportion of them having elevated HbA1c [χ^2=15.61, p<0.001]. According to the present results, 81(68.6%) participants reported receiving nutritional counseling from a nutritionist. The findings did not show any association between nutritional counseling and HbA1c levels [χ^2=3.140, p=0.370]. Frequency of self-reported physical exercise was associated with low HbA1c; patients who reported doing exercise daily or 1-3 times a week significantly had low HbA1c [χ^2=37.329, p<0.001]. In this study, there were 20 smokers (16.9%), while the majority were non-smokers 98(83.1%). The majority of smokers had significantly elevated HbA1c than non-smokers [χ^2=7.269, p=0.007]. On the other hand, most of our participants, 62(52.5%), visited the hospital for regular checkups, and the majority significantly reported normal HbA1c than their counterparts [χ^2=26.778, p<0.001]. Finally, no statistically significant correlation was identified between the reasons for skipping meals and HbA1c levels [χ^2 =0.171, p=0.918], as shown in Table 2

Table 2:

Practice of Adult Patients Diagnosed with Diabetic Neuropathy across Glycated Haemoglobin Levels

Practices	Total n (%)	Normal HbA1c n (%)	Elevated HbA1c n (%)	χ^2	P value
Frequency of Eating Fast Food					
Daily	11 (9.3)	3(2.5)	8(6.8)	0.491	0.782
Occasionally	63 (53.4)	23(19.5)	40(33.9)		
Don't eat	44 (37.3)	17(14.4)	27(22.9)		
Number of Meals per Day					
One	6 (5.1)	0(0.0)	6(5.1)	11.808	0.008
Two	20(16.9)	5(4.2)	15(12.7)		
Three	68(57.6)	23(19.5)	45(38.1)		
Four	24(20.3)	15(12.7)	9(7.6)		
Skipped Meals					
Always breakfast	25(21.2)	3(2.5)	22(18.6)	17.622	0.001
Always lunch	32(27.1)	7(5.9)	25(21.2)		
Always supper	4(3.4)	2(1.7)	2(1.7)		
Don't skip	57(48.3)	31(26.3)	26(22.0)		
Preferred Method of Cooking					
Frying	46(39.0)	17(14.4)	29(24.6)	0.858	0.836
Boiling	39(33.1)	14(11.9)	25(21.2)		
Roasting	25(21.2)	8(6.8)	17(14.4)		
Steaming	8(6.8)	4(3.4)	4(3.4)		

Practices	Total n (%)	Normal HbA1c n (%)	Elevated HbA1c n (%)	χ^2	P value
Alcohol Consumption Frequency					
Everyday	23(19.5)	3(2.5)	20(16.9)	15.617	<0.001
Once a week	35(29.7)	8(6.8)	27(22.9)		
Don't drink	60(50.8)	32(27.1)	28(23.7)		
Source of Nutritional Counseling					
Doctor	7(5.9)	3(2.5)	4(3.4)	3.140	0.370
Nutritionist	81(68.6)	33(28.0)	48(40.7)		
Internet	15(12.7)	4(3.4)	11(9.3)		
Nurse	15(12.7)	3(2.5)	12(10.2)		
Frequency of Physical Exercise					
Daily	17(14.4)	14(11.9)	3(2.5)	37.329	<0.001
1-3 times per week	27(22.9)	17(14.4)	10(8.5)		
Less than once a month	46(39.0)	9(7.6)	37(31.4)		
Never	28(23.7)	3(2.5)	25(21.2)		
Smoking Status					
Smoke	20(16.9)	2(1.7)	18(15.3)	7.269	0.007
Do not smoke	98(83.1)	41(34.7)	57(48.3)		
Reason for Visiting Hospital					
For regular checkup	62(52.5)	36(30.5)	26(22.0)	26.778	<0.001
Family advice	33(28.0)	3(2.5)	30(25.4)		
Disease worsening	23(19.5)	4(3.4)	19(16.1)		
Reason for Skipping Meals					
Medicine finished	30(25.4)	10(8.5)	20(16.9)	0.171	0.918
Normal blood glucose	37(31.4)	14(11.9)	23(19.5)		
No medicine and normal blood glucose	51(43.2)	19916.1)	32(27.1)		

Food Frequency of Adult Patients Diagnosed with Diabetes Neuropathy

The majority of the patients only consumed fruits twice a week, 47(39.8%) and once a week 33(28.0%), as opposed to daily consumption, 38(32.2%). There was a statistically significantly higher (χ^2= 22.106, p<0.001) proportion of DN patients with elevated HbA1c among those patients who consumed fruits daily 28(23.7%) and those who consumed twice a week 37(31.4%) than those who consumed once a week.10(8.5%). The proportion of those who consumed vegetables daily was significantly higher (χ^2=8.255, p=0.016) among those with normal HbA1c levels than those with elevated HbA1c levels. Patients whose pulse and legume consumption frequency was once a week were proportionately significantly higher among those with elevated HbA1c levels than those who consumed them every day and twice a week (χ^2=53.757, p<0.001). The proportion of those with elevated HbA1c was significantly higher (χ^2=18.939, p<0.001) among those who consumed animal products daily. Individuals who reported daily or biweekly consumption of cereals and cereal products exhibited a significantly higher proportion of DN patients with elevated HbA1c levels (χ^2=21.728, p<0.001). The frequency of roots and tubers consumption was not directly linked to HbA1c levels among DN patients (χ2=5.294, p=0.071). Of 118 participants, 92(78.0%) reported using fats and oils daily. Individuals who reported daily use of fats and oils were statistically significantly more (χ^2=12.211, p =0.002) among those with elevated HbA1c 66 (55.9%) compared to to those with normal HbA1c levels 26 (22.0%).

Table 3:
Food Frequency Table of Adult Patients Diagnosed with Diabetic Neuropathy by HbA1c Levels

Food frequency	Total n (%)	Normal HbA1c n (%)	Elevated HbA1c n (%)	χ^2	P value
Fruits					
Everyday	38(32.2)	10(8.5)	28(23.7)	22.106	<0.001
Twice a week	47(39.8)	10(8.5)	37(31.4)		
Once a week	33(28.0)	23(19.5)	10(8.5)		
Vegetables					
Everyday	93(78.8)	53(44.9)	40(33.9)	8.255	0.016
Twice a week	19(16.1)	2(1.7)	17(14.4)		
Once a week	6(5.1)	1(0.8)	5(4.2)		
Pulses and Legumes					
Everyday	6(5.1)	5(4.2)	1(0.8)	53.757	<0.001
Twice a week	39(33.1)	30(25.4)	9(7.6)		
Once a week	73(61.9)	8(6.8)	65(55.1)		
Animal Products					
Everyday	56(47.5)	12(10.2)	44(37.3)	18.939	<0.001
Twice a week	35(29.7)	12(10.2)	23(19.5)		
Once a week	27(22.9)	19(16.1)	8(6.8)		
Cereals and Cereals Products					
Everyday	61(51.7)	12(10.2)	49(41.5)	21.728	<0.001
Twice a week	23(19.5)	8(6.8)	15(12.7)		
Once a week	34(28.8)	23(19.5)	11(9.3)		
Roots and Tubers					
Everyday	8(6.8)	1(0.8)	7(5.9)	5.294	0.071
Twice a week	41(34.7)	20(16.9)	21(17.8)		
Once a week	69(58.5)	22(18.6)	47(39.8)		
Fats and Oils					
Everyday	92(78.0)	26(22.0)	66(55.9)	12.211	0.002
Twice a week	16(13.6)	10(8.5)	6(5.1)		
Once a week	10(8.5)	7(5.9)	3(2.5)		
Sugar and Honey					
Everyday	6(5.1)	1(0.8)	5(4.2)	1.082	0.582
Twice a week	22(18.6)	8(6.8)	14(11.9)		
Once a week	90(76.3)	34(28.8)	56(47.5)		

DISCUSSION

Findings from 118 adult DN patients indicated that type II diabetes is more common in patients with diabetes neuropathy than type I diabetes. Similarly, an across-sectional study on diabetes patients' knowledge, attitudes, and behavior regarding diabetic nephropathy, neuropathy, and retinopathy (Dia et al., 2022) conducted in Lebanon revealed that the prevalence of type II diabetes and type I diabetes was 82.23% and 15.65%, respectively. Yet another institutional cross-sectional study carried out in Pakistan found that the prevalence of type II and type I diabetes was 91.3% and 8.66%, respectively (Shamim et al., 2022). According to a report from the most recent research done in the United States, diabetic neuropathy affects between 6 and 51% of the diabetic population. At the onset of the illness, adults with type 1 diabetes have a 6% prevalence of diabetic peripheral neuropathy, which rises to 30% after 13-14 years (Sempere-Bigorra et al., 2021). The current study's findings, as well as those of previous studies, show that diabetes neuropathy is more common in type II diabetes than in type I diabetes. However, research has shown that diabetes neuropathy is caused by uncontrolled or elevated glycemia. Patients with type II diabetes had significantly elevated HbA1c compared to those with type I diabetes. Therefore, this can explain why type I diabetes has a significantly lower prevalence of diabetes neuropathy, which is a blood glucose level-dependent complication. There is no known pathophysiology reason for such disparity in the prevalence of diabetes neuropathy in both type II and type I diabetes(Amelia et al., 2019). Therefore, further research should be conducted to determine the pathophysiological cause of the low prevalence of diabetes neuropathy complications among diabetes type I patients compared to those with type II diabetes.

The study's preliminary results revealed that a significant proportion of adult patients with diabetic neuropathy exhibited suboptimal dietary practices. Patients who reported skipping meals, particularly breakfast and lunch, had significantly elevated glycated hemoglobin (HbA1c) levels. This observation highlights the potential detrimental effects of irregular meal patterns on blood glucose control in diabetic neuropathy patients. Similarly, a study conducted in Finland reported the same findings; the findings further revealed that skipping breakfast is associated with higher mean blood sugar levels and a reduced likelihood of having adequate glycaemic control(Ahola et al., 2019)meal frequency, and breakfast consumption habits of adult individuals with type 1 diabetes (n = 1007. Several other studies conducted elsewhere have reported the same trend, keeping in record with findings from our present study(Iwasaki et al., 2019a; Mirghani, 2018; Ruhee & Mahomoodally, 2015; Shawahna R et al., 2021)479 Japanese adults with hemoglobin A1c (HbA1c. This trend can be attributed to the fact that if you frequently miss meals, your body may eventually struggle to control blood sugar levels, resulting in elevated HbA1c readings. As HbA1c is a gauge of blood sugar averages over the previous two to three months, skipping meals infrequently can still greatly affect your HbA1c readings.

In addition to raising HbA1c levels, skipping meals might result in overeating or bad food decisions later in the day (Iwasaki et al., 2019b). As a result, it's critical to consume regular, well-balanced meals throughout the day to support stable blood sugar levels and guard against the emergence of diabetes or other health issues (Nakamura et al., 2021).

Additionally, patients who reported being smokers and consuming alcohol had higher HbA1c levels compared to their counterparts. These lifestyle factors are known to affect diabetes management adversely and can contribute to poor glycemic control and worsen neuropathic symptoms. Although there are no similar studies with findings agreement with ours, a recent review indicated that alcohol consumption elevated blood glucose levels and hence accelerates neuropathy (Bell & Goncalves, 2021). However, other studies have reported conflicting findings indicating that alcohol consumption is inversely associated with HbA1c (Hong et al., 2016; Inada & Koga, 2017; Wiss, 2019)we studied the effect of alcohol consumption on the plasma glucose and glycaemic control indicators in non-diabetic men. Methods: The study enrolled 300 non-diabetic men who received a complete medical checkup (age: 52.8 ± 6.5 years, body mass index: 24.4 ± 2.8 kg/m2. There is no known explanation for the disparity between the findings of the previous study and the present study; therefore, more research should be conducted to validate the findings

On the other hand, previous studies have reported that smokers and secondhand smokers had the risk of elevated HbA1c, which culminates in neuropathy (Akkuzulu et al., 2020; Choi et al., 2018; Moore et al., 2019)but few studies have explored this interaction. We explored an interaction among 574 never-smoking adults from the Singapore Chinese Health Study. At baseline (age 59 ± 8 years. Another study by the University of Sumatera Utara, Medan, in Indonesia, reported that HbA1c concentrations increased in smokers compared to non-smokers among diabetic patients (Sari et al., 2018). This phenomenon of HbA1c levels increasing among smokers than non-smokers can be due to chemicals in cigarette smoke, which are produced when a person smokes, which can lead to insulin resistance, which makes it more difficult for the body to use insulin efficiently. The hormone insulin regulates blood sugar levels, and when the body develops insulin resistance, blood sugar levels may increase and result in hyperglycemia(CDC, 2022). Additionally, smoking can cause insulin resistance as well as inflammation, both of which can exacerbate blood sugar regulation and further impede insulin activity(Maddatu et al., 2017). Stopping smoking can improve blood sugar control, lower the risk of complications from diabetes, and improve general health, among other health benefits.

The dietary choices of patients with diabetic neuropathy were also found to be associated with glycemic control. Patients who reported daily consumption of animal products, fats and oils, fruits, cereals, and cereal products had higher HbA1c levels. On the other hand, those who consumed vegetables, pulses, and legumes daily had significantly lower HbA1c levels. These findings emphasize the importance of a balanced and nutrient-rich diet in diabetes management, focusing on plant-based foods and limited intake of animal products and fats.

A healthy diet high in fiber and low in carbohydrates will help control blood sugar levels and lower HbA1c levels. For those with diabetes, foods with a low glycemic index, such as whole grains, non-starchy vegetables, legumes, and nuts, are best because they barely affect blood sugar levels. A healthy diet high in fiber and low in carbohydrates will help control blood sugar levels and lower HbA1c levels. For those with diabetes, foods with a low glycemic index, such as whole grains, non-starchy vegetables, legumes, and nuts, are best because they barely affect blood sugar levels(Forouhi et al., 2018). Studies have indicated that consumption of fresh or whole fruits was associated with a decreased risk of HbA1c among patients with diabetes(Du H et al., 2017; Li et al., 2023; Yu et al., 2022) substantial uncertainties remain about its potential effects on incident diabetes and, among those with diabetes, the risks of death and vascular complications. We aimed to assess the associations of fresh fruit consumption with the risk of incident diabetes and diabetic vascular complication. Fresh fruit consumption in relation to incident diabetes and diabetic vascular complications. PLoS Med [revista en Internet] 2017 [acceso 2 de noviembre de 2021]; 14 (4. These findings contradict our present study, which indicated that a higher proportion of individuals who reported frequently using fruits had elevated HbA1c levels. However, this disparity may be due to the fact that most of our participants might have been consuming ripe fruits with high glycemic index and low glycemic load which have been found to increase HbA1c levels (Rasaei et al., 2023) the relationship between glycemic index (GI. Bananas, mangoes, pineapples, and watermelons are fruits with a high glycemic index that can quickly raise blood sugar levels. Yet low-glycemic fruits, like berries, apples, pears, and citrus fruits, are preferable because they have little effect on blood sugar levels(Cervoni, 2023). Fruits with high glycemic index are relatively cheap compared to those identified to have a high glycemic load. Most patients, being low-income earners, always resolve to buy inexpensive fruits(Miller et al., 2016)but their intake is thought to be low worldwide. We aimed to determine the extent to which such low intake is related to availability and affordability. Methods We assessed fruit and vegetable consumption using data from country-specific, validated semi-quantitative food frequency questionnaires in the Prospective Urban Rural Epidemiology (PURE.

Additionally, previous studies demonstrated that eating fruits and vegetables can lower HbA1C levels, which can effectively lower difficulties associated with diabetes(Tabesh et al., 2013; Yen et al., 2022) plasma lipids, blood pressure, vegetable intake and anthropometric measurements were assessed at baseline and end line of 12 weeks intervention. A regression analysis was conducted using differences in HbA1C between baseline and 12 weeks as the dependent variable. Student's t test was conducted for the changes of biochemical indicators from baseline to end line during the period of 12 weeks intervention. Glycaemic control improved in the intervention group and mean HbA1C, fasting blood glucose and post-prandial blood glucose in the intervention group decreased significantly along with body weight, waist circumference and total cholesterol. The finding suggested that the intervention which emphasised raw vegetable intake contributed to improved glycaemic control among Indonesian adults with type 2 diabetes mellitus. Additionally, another study in Denmark further supported these findings by indicating that higher consumption of cruciferous and green leafy vegetables was linked to a low HbA1c and a statistically significant decreased risk of T2D(Pokharel et al., 2022). The following reasons can explain this trend of low HbA1c among patients who frequently use vegetables. First, Vegetables are high in fiber, which slows down the body's absorption of sugar and carbohydrates. This lessens the likelihood of insulin resistance and the problems associated with diabetes by preventing sudden spikes in blood sugar levels(McRae, 2018). Second, most veggies are low in carbs and barely affect blood sugar levels. Therefore, They are a great option for those with diabetes or high HbA1c levels (Weickert & Pfeiffer, 2018). Third, Vegetables are a good source of vitamins, minerals, and antioxidants that can help lower oxidative stress and inflammation, both of which are linked to diabetes issues. Vegetables are a good source of vitamins, minerals, and antioxidants that can help lower oxidative stress and inflammation related to diabetes issues (Sharifi-Rad et al., 2020).

A high-fat, high-oil, high-animal-product diet may increase the risk of developing insulin resistance and high blood sugar, raising HbA1c levels. A diet high in saturated and trans fats can cause inflammation, insulin resistance, and dyslipidemia, raising HbA1c levels. On the other hand, red meat, processed meats, and dairy products are examples of animal products high in protein that can cause insulin resistance, especially when consumed in large quantities. Inflammation may be exacerbated by them, raising HbA1c levels (Zhuang et al., 2020). Patients who frequently used fats, oils and animal products reported elevated HbA1c. Similarly, studies have reported similar findings (Garonzi et al., 2021; Giosuè et al., 2022; Zhuang et al., 2020)Web of Science, Scopus, and Embase according to PRISMA. Thirteen meta-analyses are included in the study providing 175 summary risk ratio estimates. The consumption of 100 g/day of total or red meat, or 50 g/day of processed meat, were associated with an increased risk; RR and 95 % CI were respectively 1.20, 1.13–1.27; 1.22, 1.14–1.30 and 1.30, 1.22–1.39. White meat (50 g/day.

A meta-analysis of 41 randomized controlled trials found that eating pulses and legumes significantly reduced HbA1c levels in adults with and without diabetes. The benefit was greater in those with diabetes, implying that certain foods may be more beneficial to those with the disease (Hafiz et al., 2022). Several studies have examined the relationship between pulse and legume consumption and HbA1c levels (Bielefeld et al., 2020; Hafiz et al., 2022; Lukus et al., 2020). Frequent consumption of pulses and legumes was associated with normal HbA1c levels in our current study. The results of our study suggest that eating pulses and legumes may be an effective dietary strategy for improving glycemic control and lowering the risk of diabetes complications. It's important to remember that these are observational studies, and more research is needed to validate these links and investigate the processes underlying the beneficial effects of pulses and legumes on blood glucose control.

CONCLUSION

Our findings highlight sub-optimal practices in diabetic neuropathy adults, linking one or two daily meals to elevated HbA1c and meal skipping to increased levels. Smokers and alcohol consumers exhibited higher HbA1c, while regular exercise showed protective effects. Daily consumption of animal products, fats and oils and fruits related to elevated HbA1c, contrasting with vegetables, pulses, and legumes linked to normal levels. Occasional sugar and honey had a limited impact. These insights inform targeted interventions for improved dietary habits and glycemic control in diabetic neuropathy patients.

RECOMMENDATIONS

We recommend promotion of balanced meals, discouraging meal skipping, and reducing the daily intake of certain foods while increasing vegetables, pulses, and legumes. Awareness campaigns should clarify the limited impact of occasional sugar and honey consumption on HbA1c. These measures aim to improve dietary habits and glycemic control in diabetic neuropathy patients.

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