Annals of Medicine and Medical Sciences (AMMS)
Volume 04, 2025, *Page No.: 93 to 99*
Available at: *http://ammspub.com*

Original Article

OPEN ACCESS

Assessment of Nutrition and Related Risk Factors Associated with Type 2 Diabetes Among Patients Attending Mbagathi Hospital, Nairobi Kenya

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Abstract

Globally, type 2 diabetes (T2D) has almost quadrupled (from one hundred and eight million persons in 1980 to four hundred and twenty-two million persons in 2014). (World Health Organization, 2020). Diabetes disease burden is increasing at a high rate in Africa, where 1 out of 22 adult populations is diabetic, giving a total of twenty-four million diabetic Africans. For Kenya, the population has doubled to forty-six million from twenty-three million in the year 1990, and the increased population is resulting in an overwhelming number of non-communicable diseases, with diabetes among the top list. ***Methods:*** This was a cross-sectional study that included 121 respondents interviewed using structured questionnaires to collect information on socio-economic status and socio-demographic factors, nutritional status via anthropometric measurement, engagement in physical activity, and patient health talk by the healthcare provider on weight loss and engaging in physical exercise. One-way ANOVA was used to determine the relationship between socio-demographic factors, socioeconomic factors, nutritional status, engaging in physical activities, getting health talks on weight loss, doing more exercises, and having diabetes. ***Results:*** The prevalence of diabetes was higher among females than males, 64.5% and 35.5%, respectively. There was a significant relationship between gender and waist-hip ratio (p=0.000). Similarly, there was a significant association between the frequency of vegetable consumption (p= .038) and adding salt to food while eating (p= .000). ***Conclusion:*** There is a need for regular nutritional status monitoring, health education, and the development of targeted preventative measures in the management of type 2 diabetes.

Keywords: ***BMI -Body mass index, DQIP-Diabetes quality improvement project, DM-Diabetes mellitus, NCDs - Non-communicable diseases, WHO- World Health Organization.***

Introduction

Non-communicable diseases (NCDs) kill more than thirty-six million people annually. (Composed of 63% of all global deaths), this figure includes more than fourteen million deaths of people at a young age of between ages 30 and age 70 (Grabowski et al., 2017). Globally, in the past four decades, type 2 diabetes (T2D) has almost quadrupled (i.e., from one hundred and eight million persons in 1980 to four hundred and twenty-two million persons in 2014). (World Health Organization, 2020), this figure includes more than fourteen million deaths of people at a young age of between age 30 and age 70. 86% of these premature deaths occur in developing countries, leading to high total economic losses, which add up to 7 trillion US dollars for the next fifteen years, with millions of its population living in poverty (Grabowski et al., 2017). The disease contributes to 85% of total diabetes cases, affecting 247 million people worldwide and posing a serious health challenge. (Mineralogist, 2022) and is among the top 10 causes of death among the male gender, with an 80% increase in 2016 from 5% in 2000 (Matovu et al., 2017). I am running a few minutes late; my previous meeting is running over.

Sub-Saharan Africa is experiencing an increase in the prevalence of type 2 diabetes, including other LMICs. The high burden of diabetes disease is disproportionately higher in LMIC, with over two million lives estimated to be lost by 2030. One in every two people who have diabetes are not diagnosed, making this the highest proportion in IDF regions 416,000 deaths in 2021 were attributed to diabetes. (International Diabetes Federation, 2021).

In Kenya, communicable diseases (CDs) pose a great challenge due to the high numbers of NCDs. In 2019, NCDs caused 28% of reported deaths. Out of these, 3% were as a result of diabetes. The WHO estimated diabetes prevalence in Kenya to be at 3.3%, with a prediction that it will increase to 4.5% in 2025. (Organisation, 2018). A study carried out reported a 5.3% prevalence of diabetes in Nairobi against a national prevalence of 4%. (Turpin et al., 2018). The increase in patient numbers results in poor monitoring, lack of diet follow-up, and checks on patients' adherence to medicine is affected by additional low public awareness of diabetes. (National Diabetes Control Programme, 2010). Undiagnosed diabetic patients may still be at two-thirds. (Jones Tiffany, 2013).

The objective of this study was to identify risk factors among patients attending the diabetic clinic at Mbagathi Hospital for effective prevention and control.

Received: January 27, 2025; **Revised:** March 07, 2025; **Accepted:** March 10, 2025

Methods

Study design: The study employed a cross-sectional study design was used

Study setting: The study was carried out at Mbagathi Hospital in the Nairobi County government with a bed capacity of 220 patients

Study population: Diabetic patients aged 18 years and over attending the Medical Outpatient Clinic at Mbagathi Hospital

Sample size calculation: The sample size was calculated using Fisher's equation (Fisher et al., 2002), giving a sample size of 121 participants

$$n = \frac{z^2(pq)}{d^2}$$

Sampling Procedure: A systematic sampling technique was used where every fifth member was selected from a randomized list of patients until the study sample was sufficient to constitute study subjects.

The inclusion criteria

1. Patients who were enrolled in the Diabetic MOPC clinic at Mbagathi level 5 Hospital.
2. Patients who were within the age group of 18 years and above
3. Patients who had signed the informed consent form.

The exclusion criteria

1. Patients who had any other non-communicable disease as documented in the hospital records at the records department.

Data collection procedure: Semi-structured interviewer-administered questionnaires were used to gather data on anthropometric measurements, demographic characteristics, socioeconomic status, dietary patterns, and physical activity. Dietary patterns were collected using food history and a 24-hour dietary recall. Nutrition status was assessed using anthropometric data that included weight measured in Kilograms (Kg) and standing height measured in centimeters (cm) with a maximum of one decimal place. Waist circumference (cm) is divided by hip circumference (cm) to give the waist-hip ratio.

Data management: The analysis was done using SPSS for Windows version 25. A thorough examination of variables and socio-demographic characteristics was conducted. Socio-demographic data was summarised using descriptive statistics, including percentages, means, and standard deviation. Independent variables were categorized to assess their association with outcome variables. One-way ANOVA was used to determine the association between independent and dependent variables. Variables demonstrating a significance level of $P < 0.05$ were deemed significant.

Ethical considerations

The research proposal was presented for ethical clearance to the KNH - UoN ERC (Kenyatta National Hospital University of Nairobi Ethical Research Committee **KNH-ERC/RR/272**) and **NACOSTI** (National Commission for Science, Technology, and Innovation), and approval was obtained from the County government.

Results

1. Socio-demographic and socioeconomic characteristics of respondents

The general social demographic characteristics of the patients enrolled have been summarized in ***(TABLE1)*** below, where the youngest respondent was aged 23 years while the oldest was aged 80 years. The majority (64.5 %) of the respondents were female, which is significantly higher than males at 35.5% (p= 0.001) of the total respondents. Similarly, a significant difference was noted in the level of education (p=0.000); a Minority (11.6%) of the respondents had a tertiary level of education, while the majority (7.1 %) had upper primary qualifications. (28.1 %) had secondary level training, 3.3% vocational training, while the rest, 8.3%, had lower primary training.

Table 1: Social demographic characteristics

Socio-demographic Characteristics	Percentage/ Frequency	p-value
Gender		
Male	35.5% (43)	0.001
Female	64.5% (78)	
Total	100.0% (121)	
Respondents religious affiliation		
Christian	91.7% (111)	
Muslim	6.6% (8)	0.000
Others	1.6% (2)	
Total	100.0% (121)	
Respondents education level		
No formal education	1.7% (2)	
Lower Primary	8.3% (10)	
Upper Primary	47.1% (57)	0.000
Secondary	28.1% (34)	
Vocational school	3.3% (4)	
Tertiary level	11.6% (14)	
Total	100.0% (121)	
Respondents marital status		
Single	11.6% (14)	
Widowed/widower	12.4% (15)	0.000
Divorced	3.3% (4)	
Married	72.7% (88)	
Total	100.0% (121)	

2. Nutritional status of the respondents

Many of the respondents were classified as either having ideal weight (40.2%) or overweight (39.3%), and (17.1%) being obese (p=0.000). A minority of the respondents (3.4%) respondents were underweighted. There was a significant difference in the WHR among males (p=0.000), with the majority (61.6%) of them having a moderate waist-to-hip ratio, and 33% were categorized as low. In comparison, the remaining 5.1% were classified as having a high waist-to-hip ratio **(Table 2).**

Table 2: Nutritional status distribution

Nutritional indicators	Percentage/ Frequency	p-value
BMI Ranges		
Underweight	3.4% (4)	
Healthy weight	40.2% (47)	
Overweight	39.3% (46)	0.000
Obese	17.1% (20)	
Total	100.0% (117)	
Waist-hip ratio male		
Low	33.3% (13)	
Moderate	61.6% (24)	0.000
High	5.1% (2)	

Total	100% (39)	
Waist-to-hip ratio female		
Low	23.4% (18)	
Moderate	20.8% (16)	0.003
High	55.8% (43)	
Total	100.0% (77)	
Nutritional indicators	**Percentage/ Frequency**	**p-value**
BMI Ranges		
Underweight	3.4% (4)	
Healthy weight	40.2% (47)	
Overweight	39.3% (46)	0.000
Obese	17.1% (20)	
Total	100.0% (117)	
Waist-hip ratio male		
Low	33.3% (13)	
Moderate	61.6% (24)	0.000
High	5.1% (2)	
Total	100% (39)	
Waist-to-hip ratio female		
Low	23.4% (18)	
Moderate	20.8% (16)	0.003
High	55.8% (43)	
Total	100.0% (77)	

3. Lifestyle practices

A. Smoking and consumption of tobacco products

Variables on smoking were relevant; however, only (2.5%,) of the respondents were actively using tobacco products at the time of the study; 10 respondents (8.3%) had a history of tobacco use. 1 of the three active tobacco users used smokeless tobacco daily **(Table 3).**

Table 3: Smoking and consumption of tobacco products

Tobacco use	**Percentage/ Frequency**	**p-value**
Current tobacco use among respondents		
Yes	2.5% (3)	0.000
No	97.5% (118)	
Total	100.0% (121)	
History of tobacco use in the past	**Frequency**	
Yes	8.3% (10)	0.000
No	91.7% (111)	
Total	100.0% (121)	
Number of cigarette packets used per day	**Frequency**	
Half	27.3% (3)	
1-2 packets	63.6% (7)	0.001
More than two packets	9.1% (1)	
Total	100.0% (11)	
Duration of smoking	**Frequency**	
0-4 years	36.3% (4)	
5-10 years	18.2% (2)	0.012
Over 10 years	45.5% (5)	
Total	100.0% (11)	
Presence of smokers in respondent's environment	**Frequency**	
Yes	18.2% (22)	
No	81.8% (99)	0.000
Total	100% (121)	
Frequency of smoker smoking in respondent's environment	**Frequency**	
Daily	40.9% (9)	
More than once	36.4% (8)	0.000
Occasionally	22.7% (5)	
Total	100% (22)	

B. Alcohol consumption

About 14.3% of the respondents consumed alcohol, and 5.9% of them consumed all varieties. About 43% of the respondents took two units of 500ml beer; the other quantities of beer consumed were not significant **(Table 4).**

Table 4: Alcohol consumption

Alcohol consumption	**Percentage/ Frequency**	**p-value**
Consumption of alcoholic drinks among respondents		
Yes	14.4% (17)	
No	85.6% (101)	0.000
Total	100.0% (118)	
Type of alcoholic drink consumed		
Beer	82.3% (14)	
Spirits	5.9% (1)	0.000
Local brew	5.9% (1)	
All	5.9% (1)	
Total	100.0% (17)	
Units of alcohol taken at a sitting Beer 500mls		
2.0	43% (6)	1.000
3.0	14.3% (2)	
4.0	7.1% (1)	
5.0	14.3% (2)	
6.0	7.1% (1)	
8.0	7.1% (1)	
Total	92.9% (13)	

C. Diet trends

There was a significant (p=0.000) difference in the percentage of respondents who added salt to food while eating. Almost all of the respondents, 92.6%, reported not adding salt to food while eating, while 7.4% added salt to eating. All the respondents used vegetable oil in cooking ***(TABLE 5).***

Table 5: Dietary distribution

Dietary quality	**Percentage/ Frequency**	**P value**
Frequency of eating fruits in a week		
Daily	42.0%(50)	
1-4 days per week 5-6 days per week	53.8%(64) 4.2% (5)	0.000
Total	119(100.0%)	
Frequency of vegetable consumption		
Daily	11.8%(14)	
5-6 days per week	1.7%(2)	0.000
1-4 days per week	86.5%(103)	
Total	100%(119)	
Frequency of red meat consumption		
Daily	14.3% (17)	

3 times per week	52.1% (62)	0.000
Monthly	33.6% (40)	
Total	100% (119)	
Adding salt while eating		
Yes	7.4% (9)	
No	92.6% (112)	0.000
Total	100.0% (121)	
Type of fat used		
Vegetable oil	100.0% (121)	0.000

D. Physical activity engagement

There was no significance in the activities done as part of work (p=0.000); however, carrying/ lifting loads was the most popular (46.3%) type of physical activity. Digging/construction work was the third most popular physical activity, accounting for 20.7% of all respondents. No significant difference was noted (p=0.000) in the time frame of carrying out activities. Sitting/ reclining accounted for 33.1%, while slightly more than half (59.5%) of the respondents carried out work activities for more than 30 minutes. Only a third (33.1%) took 20-30 minutes to carry out work activities. Minority 0.8% and 6.6% of the respondents took 15 minutes and 15-20 minutes **(Table 6**).

Table 6: Physical activity engagement

Physical activities	**Percentage/ Frequency**	**p-value**
Participation in physical activities		
physical activity	100.0% (121)	1.000
Activities done as part of work		
Carrying/lifting loads	46.3% (56)	
Digging/construction work	20.7% (25)	0.000
Sitting or reclining	33.1% (40)	
Total	100.0% (121)	
The time frame for carrying out activities		
More than 15 minutes	0.8% (1)	
15-20 minutes	6.6% (8)	0.000
20-30 minutes	33.1% (40)	
More than 30 minutes	59.5% (72)	
Total	100.0% (121)	
Number of times work activities are carried out.		
Daily	72.7% (88)	
3 times per week	16.5% (20)	0.000
Less than 3 days	10.7% (13)	
Total	100% (121)	
Mode of transport to workstation		
Walking	74% (88)	
Cycling	2.5% (3)	
Motor vehicle	23.5% (28)	0.01
Total	100% (119)	
Time taken to reach work		
Less than 10 minutes	2.5% (3)	0.000
10-20 minutes	52.6% (62)	
More than 20 minutes	44.9% (53)	
Total	100% (118)	
Participation in muscular endurance exercises		
Yes	5.8% (7)	0.000
No	93.4% (113)	
Total	(100.0%) 120	

E. Patient education/health talk

All the patients admitted having been engaged in some form of health talk while visiting the diabetic clinic for check-ups or normal appointments. 89.3% of respondents received advice on sugar intake, while 86.8% of them received health talks on smoking. The majority (94.2%) of the respondents received advice on the importance of engaging in physical exercises.

Table 7: Patient education

Response to Health Talk	**Percentage/ Frequency**	**p valve**
Advice on sugar intake		
Yes	89.3% (108)	0.000
No	10.7% (13)	
Total	100.0% (121)	
Advice on smoking	Frequency	
Yes	86.8 (105)	0.000
No	13.2% (16)	
Total	100.0% (121)	
Advice to do more exercise	Frequency	
Yes	94.2% (114)	0.000
No	5.8% (7)	
Total	100% (121)	

4. Association between socioeconomic status and Nutritional status

There was a significant association between BMI and the waist-hip ratio of the respondents (p=0.000). However, there was no significant relationship between age (p=0.379), marital status (p=0.217), religious affiliation (p=0.321), education level (p=0.293), gender (p=0.804) of the respondents, and waist-hip ratio. There was no significant relationship between religious affiliation and the BMI of the respondents (p=0.445). There was no significant relationship between age (p=0.872), marital status (p=0.618), education level (p=0.591), gender (p=0.804) and BMI of the respondents ***(TABLE 8)***

Table 8: Association between socioeconomic status and nutritional status

Age vs BMI and waist-hip ratio						
		Sum of Squares	Df	Mean Square	F	Sig.
Waist-to-hip ratio	Between Groups	.473	40	.012	1.080	.379
	Within Groups	.866	79	.011		
	Total	1.340	119			
Body mass index	Between Groups	756.222	41	18.444	.723	.872
	Within Groups	2015.741	79	25.516		
	Total	2771.962	120			
Marital status BMI and WHR						
		Sum of Squares	Df	Mean Square	F	Sig.

Body mass index	Between Groups	41.777	3	13.926	.597	.618
	Within Groups	2730.185	117	23.335		
	Total	2771.962	120			
Waist-to-hip ratio	Between Groups	.050	3	.017	1.505	.217
	Within Groups	1.289	116	.011		
	Total	1.340	119			
Education level vs BMI and Waist-hip ratio						
		Sum of Squares	df	Mean Square	F	Sig.
Body mass index	Between Groups	87.077	5	17.415	.746	.591
	Within Groups	2684.885	115	23.347		
	Total	2771.962	120			
Waist-to-hip ratio	Between Groups	.069	5	.014	1.245	.293
	Within Groups	1.270	114	.011		
	Total	1.340	119			
Gender vs. BMI and Waist-hip ratio						
		Sum of Squares	df	Mean Square	F	Sig.
Body mass index	Between Groups	1.445	1	1.445	.062	.804
	Within Groups	2770.518	119	23.282		
	Total	2771.962	120			
Waist-to-hip ratio	Between Groups	.257	1	.257	28.052	.000*
	Within Groups	1.082	118	.009		
	Total	1.340	119			
Religion vs. BMI and waist-hip ratio						
		Sum of Squares	df	Mean Square	F	Sig.
Body mass index	Between Groups	37.927	2	18.963	.815	.445
	Within Groups	2723.021	117	23.274		
	Total	2760.948	119			
Waist-to-hip ratio	Between Groups	.026	2	.013	1.148	.321
	Within Groups	1.294	116	.011		
	Total	1.320	118			

Discussion

1. Sociodemdemographic and socio-economic characteristics

The age of the respondents showed a normal distribution with a mean greater than fifty. The majority of the respondents were Christians and mostly females. The majority of the respondents had some form of career training, most of them having attained O-level secondary education. Most of them were married. These findings were similar to those of a study done in Lagos, Nigeria, which had an average mean age of 59.6+13.0 years. The majority of the respondents were also female (64.6%) and married (65.8%), while (84.2%) of them were Christians (Fa et al., 2019a). Similarly, a study done in Mumbai found the mean age of the respondents to be 56 years, with the majority of them being female at 54.76 (n=92).

2. Association between nutritional status and risk factors associated with diabetes (sociodemographic, socioeconomic status) among study respondents

There was a significant association between age, marital status, religious affiliation, gender, education level of the respondents, and waist-hip ratio. Similarly, there was a significant relationship between religious affiliation and the BMI of the respondents. However, there was no significant association between the age, marital status, education level, gender, and BMI of the respondents. These findings were validated by Hariri et al. (2021); in her study, a higher prevalence of diabetes was observed among respondents with advanced age (50-65 years). The prevalence of diabetes among genders was found to be similar in both sexes (15.3%). Another study (Fa et al., 2019b) found an association between nutritional status and gender, as women had a lower prevalence of normal weight and a higher prevalence of obesity than men. Similarly, a study done in Rwanda had similar findings; there was an association between the frequency of fruit intake and increased risk of diabetes. In the same study, there was an association between sex, age, education level, income level (p=0.030), and risk of developing diabetes. In addition, a study done in Kikuyu, Kenya, by Wahome et al., 2021 showed a significant association between nutritional knowledge and the nutritional status of the respondents. Analysis of Variance showed that those with a normal dietary status had the highest nutritional knowledge score. Significant differences were also noted between the mean scores of the different nutritional status groups. Zhang F.L et al., 2021 found that the prevalence of diabetes in individuals with a college education or above (4.8%) was significantly lower than in other education groups, including primary school and below (11.0%), junior middle school (9.7%), and senior middle school (10.6%). In another study in Khuzestan, Iran, on the prevalence and determinants of diabetes, an association was found between education level, being pre-diabetic, and risk of developing diabetes (Hariri et al., 2021).

3. Association between engagement in physical activity and body mass index and the waist-hip ratio of respondents.

The majority of the respondents in this study had an elevated BMI and WHR. There was a difference in the waist-to-hip ratio between the two genders, with the majority of the males having a moderate and low waist-to-hip ratio, and a minority of them were categorized as having a high waist-to-hip ratio. On the contrary, slightly above half of the females had a high waist-to-hip ratio, with low and moderate categories accounting for the other half. A study in Indonesia associated engagement in physical activity with improved BMI (p=0.003) (Desi et al., 2023). A study done in South Africa also

found a relationship between engagement in physical activity and BMI and WHR (Shozi et al., 2022).

4. Association between Nutritional status and Diabetic status

The mean waist-to-hip ratio was high, and the BMI of the majority of the study population was overweight. These values were way above the normal recommended limits of below for women 0.85 and men 0.9 and a BMI of 18.5 to 24.9 (Okyere et al., 2022). These results are similar to a systematic review study done on anthropometric and adiposity indicators and risk of type 2 diabetes by (Jayedi et al., 2022).

5. Factors associated with body mass index and waist-to-hip ratio

There was no relationship between advice on weight loss, advice to do more exercise, and body mass index. However, there was a significant association between patients being sensitized on weight loss, doing more exercises, sugar, and waist-hip ratio. These results were consistent with a study done in Lagos, Nigeria (Fa et al., 2019b) that concluded dietary counseling had an association with nutritional status.

Gender showed a significant relationship with the waist-hip ratio. These results were similar to those by Abe et al., 2021 who found that women showed an increase in the incidence rates of diabetes with a higher BMI and WC.

The frequency of eating during alcohol consumption was the only dietary variable that had a significant association with BMI. A similar study done by Khamis et al. 2021found that consumption of adequate nutritional diversity was associated with abdominal obesity by WHR but not abdominal obesity by WC and general obesity by BMI.

Conclusion

Nutrition status is a key determinant of getting type 2 diabetes. Nutritional status was influenced by various factors such as age, marital status, gender, religious affiliation, education level, engagement in physical activity, dietary patterns, health education on healthy eating, and weight reduction. Risk factors that were attributed to type 2 diabetes were age, marital status, gender, religious affiliation, and education level. Advancement in age was associated with having a higher risk of getting type 2 diabetes. Females were predisposed to having type 2 diabetes. A low education level was found to be associated with type 2 diabetes, just as nutritional knowledge was associated with the education level of the respondents in the study.

Recommendations

1. Regular nutritional status monitoring using anthropometric measurements such as body mass index and waist-to-hip ratio to identify individuals with a higher risk of getting type 2 diabetes and subsequently coming up with interventions
2. Health education to be integrated into the prevention and management of type 2 diabetes by the use of community health workers in the community and medical personnel like nurses in the hospital
3. Development of targeted preventive and treatment measures based on risk factors like sociodemographic, socioeconomic, dietary practices, and physical activity should address specific needs among the different targeted groups.
4. Social media/radio encourages all individuals across all sociodemographic backgrounds to maintain an active lifestyle by regularly engaging in physical activities promoting insulin sensitivity and maintaining a healthy BMI, thus reducing the chances of getting type 2 diabetes.

Declarations

Ethical Approvals

This research proposal was subjected to an ethical review board and obtained clearance from the Kenyatta National Hospital University of Nairobi Ethical Research Committee (KNH - UoN ERC) P407|07|2023 and approval from the County government through the Deputy Sub County Officer of Education to grant consent for conducting the research in the County. The consent form was signed by the primary caregivers of the children who were included in the study, and teachers who participated signed it.

List of Abbreviations

KNH: Kenyatta National Hospital
UoN: University of Nairobi
BMI: Body mass index
MUAC: Mid-upper arm circumference

Data Availability

The data can be availed upon formal request.

Conflict of Interest

There are no conflicts of interest in this article.

Funding Statement

The study had no external funding and was done through personal savings.

Authors' contributions

Authors' contributions	**BC**	**SN**	**JW**
Research concept and design	√	√	√
Collection and assembly of data	√	--	--
Data analysis and interpretation	√	--	--
Writing the article	√	--	--
Critical revision of the article	√	√	√
Final approval of the article	√	√	√
Statistical analysis	√	--	--

Conflict of Interest

There are no conflicts of interest in this article.

Funding Statement

The study had no external funding.

Acknowledgment

We want to acknowledge the staff and management of Mbagathi Hospital for allowing us to use the facility to conduct the research.

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