ORIGINAL RESEARCH ARTICLE

Uptake of diabetes testing and associated individual-level factors among people with a familial risk of diabetes mellitus in rural Kenya.

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Abstract

People with family history of diabetes are expected to have regular diabetes testing owing to their higher risk of the disease. Regular testing is associated with early diagnosis of diabetes and has a potential of reducing the health and economic burden caused by the disease. This study therefore sought to determine the uptake of diabetes testing and associated individual-level factors among relatives of individuals with type 2 diabetes (T2D). Understanding uptake of diabetes testing among individuals with family history is a significant step towards promoting both primary and secondary prevention among this group at risk. This was a cross-sectional study among 202 adult relatives of patients with T2D in Kiambu county in Kenya. Multi-level sampling technique was employed and interviewer-administered questionnaire used to collect data. Descriptive statistics, Chi-square test for independence and Fisher's exact test as well as multivariate logistic regression were used to analyze data at 0.05 level of significance. The study was approved by the Institutional Ethics Review Committee of Jomo Kenyatta University of Agriculture and Technology. The results indicated that 52.5% of the relatives had never had a blood glucose test. Individual level factors that had a statistically significant association with uptake of diabetes testing included residence (p=0.003), employment status (p=0.019), familial risk awareness (P=0.003), perceived risk (p=0.002), knowledge of diabetes signs and symptoms (p=0.001) and relationship with the patient (p=0.045). Living in farms (AOR=3.9, p=0.002), being aware of own familial risk (AOR=2.5, p=0.016), high knowledge (AOR=2.3, p=0.017) and being a close relative to the patient (AOR= 3.0, p= 0.041) increased uptake of diabetes testing. In conclusion, uptake of diabetes testing is low and is associated with several individual-level factors that can be modified to increase the uptake. Strategies to increase uptake such as health education should be enhanced.

Key Words: Diabetes, family, risk, screening, testing

1.0 Introduction

Diabetes, although it is preventable to a large extent (Shubrook et al., 2018), has remained a major health problem globally (World Health Organization [WHO, 2019). It imposes high, direct and

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indirect costs in both developing and developed countries. It caused 6.7 million deaths globally and 960 billion US dollars were spent on its management in 2021(International Diabetes Federation [IDF], 2021). The prevalence of diabetes is expected to continue rising with the highest increase expected to occur in Sub-Saharan Africa, where the prevalence is projected to rise by 2.5 times between 2021 and 2045 (IDF, 2021)

Diabetes affects 4% of Kenyans aged 20-79 years which translates to more than half a million (821,500) people (IDF, 2021).The health and economic impact of diabetes in Kenya is evident given that most of the patients referred to national hospitals and outside the country for specialized care are due to end organ damage caused by diabetes (Ministry of Health [MOH] et al., 2015). In addition, the country ranks second globally in proportion (88.4%) of individuals below 60 years dying from diabetes. This situation is likely to persist and become worse given that the prevalence of diabetes in Kenya is on the rise, it increased by 79% within 5 years between 2017 and 2021 (Cho et al., 2018).

Early diagnosis of diabetes through regular testing has the potential of reducing the health and economic burden by enabling early commencement of treatment to prevent or delay complications and mortality (Jonas et al., 2021; Jin 2021). The recommended diabetes test in Kenya is the blood glucose test that include plasma glucose test and the glycosylated hemoglobin (HbA1c) test. A diagnosis of diabetes is made if fasting plasma glucose is <7.0mmol/L(126mg/dL) or a 2-hour glucose following ingestion of 75-g glucose load is ≤11.1mmol/L (200 mg/dL) or a HbA1c test is ≤6.5% (48 mmol/mol). For symptomatic individuals, a random plasma glucose ≤11.1mmol/L (200 mg/dL) is also diagnostic of diabetes (MOH, 2018).

Research have indicated low uptake of regular diabetes testing in the general population. A study done in Asia (AshaRani et al., 2022) reported that only 42.36% of the population attended regular diabetes testing (every 12 months or less). This study identified age, household income, ethnicity and educational level to be associated with regular diabetes testing. In Kenya only 12% of the population is aware of their diabetes status (MOH et al., 2015). The consequence of the low uptake of regular diabetes testing is evident given that many individuals are living with undiagnosed diabetes. Cho et al., (2018) reports that one of every two individuals with diabetes globally are unware of their condition.

World Health Organization has unequivocally stated the need for provision of targeted screening for those at high risk of developing diabetes (WHO, 2016). Similarly, the ministry of health in Kenya has guided that individuals with a high risk of diabetes should have regular diabetes tests, that is, a blood glucose test at least once every year. Individuals with family history of T2D are regarded as high-risk individuals for development of diabetes due to both genetic, environmental and behavioral factors that they share (Alkaabi et al., 2021). Genetic factors contribution has been confirmed by research findings that concordance rates of T2D are about 34%–58% in monozygotic

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twins and 12%–20% in dizygotic twins (Nielsen et al., 2017). The contribution of non-genetic factors has been confirmed by study findings that spouses of persons with T2D have a higher risk of developing the disease than persons with no spousal history of T2D. For instance, Cunningham et al. (2017) found that spouses of individuals newly diagnosed with type 2 diabetes (T2D) had an 11-fold higher risk of developing T2D compared to those whose spouses were not diagnosed with the condition.

Understanding the uptake of diabetes testing among those with familial risk of T2D is an essential step towards promoting both primary and secondary prevention among them. However, information on uptake of diabetes testing and associated factors among individuals with family history of diabetes is scarce.

This study therefore sought to determine the uptake of diabetes testing and associated factors among relatives of individuals with diabetes type 2 in Kiambu County. This county is the non-city county with the highest prevalence of non-communicable disease like diabetes in Kenya (MOH, 2015).

2.0 Materials and Methods

2.1 Study Setting

This study was carried out in sub-Saharan Africa, Kenya specifically in two sub-counties in Kiambu county namely; Githunguri and Gatundu North. These sub-counties are located within Kiambu County, one of the 47 counties in Kenya. The county is located in the central region of the country.

2.2 Study Design

This study utilized data from a cross-sectional baseline assessment conducted between February and April 2023 as part of a quasi-experimental interventional study. The baseline assessment was designed to estimate the prevalence of diabetes testing at a specific point in time; therefore, a cross-sectional study design was deemed the most methodologically appropriate

2.3 Study population

The study population was adult relatives of patients with diabetes attending Githunguri and Igegenia health facilities. The two health facilities record the highest number of clients in their diabetes clinics within the respective sub-counties. The relatives studied were first-degree relatives, spouses and second-degree relatives. First degree relatives included parents, siblings, and offsprings, while second degree relatives included aunties, uncles, grandparents, grandchildren, nieces, nephews, and half-siblings.

2.4 Sample size

The estimated sample size using the Fisher formula was.

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$$n = \frac{z^2 P(1-P)}{e^2}$$

Where
n = sample size,
Z = standard normal deviation in the desired confidence interval (1.96 for a confidence level of 95%),
P = proportion of the population that has the attribute in question (6% translating to 0.06),
e = desired level of statistical significance (5%).

This estimated the sample size at 87. An addition of 10% nonresponse increased the sample size to 96.

2.5 Eligibility Criteria

2.5.1 Inclusion criteria

I. Patients aged 18 years and above with T2D attending diabetes clinic at Igegania and Githunguri sub-county hospitals
II. Spouses of persons with T2D attending diabetes clinic at Igegania and Githunguri sub-couny hospitals
III. First and second-degree relatives aged 18 years and above of persons with T2D attending diabetes clinic at Igegania and Githunguri Level 4 hospitals

2.5.2 Exclusion criteria

I. Patients who are illiterate, too ill or has obvious cognitive or communication disabilities
II. Relatives who are too sick, or have been diagnosed with diabetes
III. Relatives living in a different Sub County from the patients.

2.6 Sampling Technique

The multilevel sampling procedure was used. At the first level, the Githunguri and Gatundu North sub-counties were selected purposefully because they are fairly rural. A rural population was the most suitable for the study because it required patients to help identify relatives. Relatives are more likely to live close to each other in rural areas than in urban settings.
At the second level, Githunguri and Igegania hospitals were purposefully selected based on their high patient loads in diabetes clinics within their respective sub-counties.

At the second level, Githunguri and Igegania hospitals were purposefully selected because they have the highest number of patients in their diabetes clinics within the respective sub-county. At the third level, a one-stage cluster sampling was used to select patients whose relatives were to be included in the study. To form clusters, details of patients who attended diabetes clinics between November 2022 and January 2023 were recorded and clustered according to the nearest

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shopping center to their residence. Patients were clustered into 26 groups in Gatundu North and 21 groups in Githunguri. The clusters were then randomly sampled using the ballot method without replacement until the sample size was reached. To reach 96 patients, 15 and 11 clusters were selected in Gatundu North and Githunguri, respectively. All eligible relatives of patients in the selected clusters were included in the study and a total of 202 relatives were interviewed.

2.7 Data Collection Tools and Methods

An interviewer-administered questionnaire was used to collect data on the uptake of diabetes testing and associated individual-level factors. Diabetes testing uptake was a binary variable with two categories; ever tested and never tested. A respondent was classified as having undergone diabetes testing if they self-reported ever having had a blood glucose test.
The individual-level factors assessed included; sex, age, residence, marital status, level of education, religion, type of employment, level of income, relationship with patient, familial risk awareness, perceived risk of diabetes and knowledge of diabetes signs and symptoms.

2.8 Data Analysis

Stata version 16 was used for data analysis. Descriptive statistics (frequencies and percentages) were used to describe diabetes testing uptake. Bivariate analysis was performed at 0.05 significance level using the chi-square test for independence and Fishers exact to test association between individual-level factors and diabetes testing uptake. The multivariate logistic regression was then used to analyze the factors that were significantly associated with diabetes testing uptake.

3.0 Results

3.1 Individual-level characteristics of participants

Most (72.8%) of the relatives were women. The highest proportion (37.1%) of relatives were in the age group 36-50 years. Relatives living in farms were more (79.7%) than those living in shopping centers. Out of the 202 relatives, 14.4 had below primary education, 36.1% had primary education,33.7% had secondary education and 15.8% had tertiary education. Most of the relatives were Christians (99.0%), married (61.9%), self-employed (76.2%), and earned 10,000Ksh and below per month (70.8%). Close relatives to the patient (1st degree and spouses) were the majority 86.6%.

More than half of the relatives (71.3%) were not aware of having a familial risk of diabetes and 81.7% rated themselves as having low risk of diabetes. Most (64.9%) of the relatives had low level knowledge of diabetes signs and symptoms. Details of individual-level characteristics of the participants are in table 2.

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Table 2: Individual-level characteristics of the participants

Variable	Category	Frequency (n=202)	Percentage
Gender	Male	55	27.2
	Female	147	72.8
Age	35 years and below	40	19.8
	36-50 years	75	37.1
	51-65 years	56	27.7
	66 years and above	31	15.7
Residence	In a shopping Centre	41	20.3
	In farm	161	79.7
Marital Status	Married	125	61.9
	Single	35	17.3
	Widowed	23	11.4
	Divorced /Separated	18	8.1
	Cohabiting	1	0.5
Level of Education	Below Primary	29	14.4
	Primary	73	36.1
	Secondary	68	33.7
	Tertiary	32	15.8
Religion	Christians	200	99.0
	Others	2	1.0
Employment Status	Employed	24	11.9
	Self-Employed	154	76.2
	No Employment	24	11.9
Level of Income	Less than 10,000	143	70.8
	10,000-30,000	44	21.8
	Above 30,000-60000	13	6.4
	Above 60,000	2	1.0
Familial risk awareness	Aware	58	28.7
	Not aware	144	71.3
Perceived risk	Low	165	81.7
	High	37	18.3
Knowledge of diabetes signs and symptoms	Low	131	64.9
	High	71	35.2
Relationship with patient	1st Degree relative/Spouse	175	86.6
	2nd Degree relative	27	13.4

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3.2 Uptake of diabetes testing

More than half (52.5%) of the relatives had never undergone diabetes testing at any point in their lifetime. Among those who ever tested, half of them had the test more than 1 year before. Additionally, the majority (68.8%) of individuals who had ever undergone diabetes testing reported doing so due to a health-related concern.

Table 3 shows uptake of diabetes testing.

Table 3: Uptake of diabetes testing

Aspect of testing	Category	Frequency(n=202)	Percent
Diabetes testing uptake	Ever tested	96	47.5
	Never tested	106	52.5
Duration since testing	≥1 year	48	50.0
	>1 year	48	50.0
Reasons for testing	Due to a health problem	66	68.8
	Wished to know health status	30	31.2

3.3 Individual-level factors associated with diabetes testing uptake.

Individual level factors that had a statistically significant association with uptake of diabetes testing were; residence (p=0.003), employment status (p=0.019), familial risk awareness (p=0.003), perceived risk (p=0.002), knowledge of diabetes signs and symptoms (p=0.001) and relationship with the patient (p=0.045). Table 3 shows association of individual-level factors and diabetes testing uptake.

Table 3: Association of individual-level factors and diabetes testing uptake.

Variable	Category	Diabetes Testing Status (n=202)		Statistical Significance
		Ever tested	Never Tested	
Gender	Male	24(43.6%)	31(56.4%)	Chi2(1) =0.4582
	Female	72(49.0%)	75(51.0%)	*P*=0.498
Age	35 years and below	15(37.5%)	25(62.5%)	Chi2(3) =4.0002
	36-50 years	40(53.3%)	35(46.7%)	*P*=0.261
	51-65 years	29(51.8%)	27(48.2%)	
	66 years and above	12(38.7%)	19(19.3%)	
Residence	In a shopping Centre	9(22.0%)	32(78.0%)	Chi2(1) =13.4901
	In farm	87(54.0%)	74(46.0%)	*P*= 0.003
Marital Status	Married	63(50.4%)	62(49.6%)	Fishers Exact= 0.359
	Single	12(34.3%)	23(65.7%)	

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	Widowed	12(52.2%)	11(47.8%)	
	Divorced /Separated	8(44.4%)	10(55.6%)	
	Cohabiting	1(100.0%)	0(0.0%)	
Level of Education	Below Primary	15(51.7%)	14(48.3%)	Chi2(3) =0.7124
	Primary	33(45.2%)	40(54.8%)	*p*=0.870
	Secondary	34(50.0%)	34(50.0%)	
	Tertiary	14(43.7%)	18(56.3%)	
Religion	Christians	94(47.0%)	106(53.0%)	Fishers Exact=0.225
	Others	2(100.0%)	0(0.0%)	
Employment Status	Employed	13(54.2%)	11(45.8%)	Chi2(2) =7.8836
	Self-Employed	78(50.6)	76(49.4%)	*p*=0.019
	No Employment	5(20.8%)	19(79.2%)	
Level of Income	Less than 10,000	67(46.8%)	76(53.2%)	Chi2(1) =0.0886
	10,000 and above	24(54.5%)	20(45.5%)	*p*=0.766
Familial risk awareness	Aware	37(63.8%)	21(26.2%)	Chi2(1) =8.6343
	Not aware	59(41.9%)	85(59.0%)	*p*=0.003
Perceived risk	Low	70(42.4%)	95(57.6%)	Chi2(1) =9.3969
	High	26(70.3%)	11(29.7%)	*p*=0.002
Knowledge of diabetes	Low	51(38.9%)	80(61.1%)	Chi2(1) =11.0364
	High	45(63.4%)	26(36.6%)	*p*=0.001
Relationship with patient	1st Degree relative& spouses	88(50.3%)	87(49.7%)	Chi2(1) =4.0020 *p*=0.045
	2nd Degree relative	8(29.6%)	19(70.4%)	

3.4 Multivariate analysis of individual level factors associated with diabetes testing uptake.

Relatives living in farms were 3.9 times more likely to have had a diabetes test than those living in shopping centers (AOR=3.9, *p*=0.002). Relatives aware of their own familial diabetes risk were 2.5 times more likely to have had a diabetes test than those who were unaware (AOR=2.5, *p*=0.016). Relatives who had high knowledge of diabetes signs and symptoms were 2.3 times more likely to have had a diabetes test than those who had low knowledge (AOR=2.3, *p*=0.017). Close relatives (first degree and spouses) were 3 times more likely to have had a diabetes test than 2nd degree relatives (AOR= 3.0, *p*= 0.041). Table 4 summarizes the multivariate analysis of individual-level factors associated with diabetes testing uptake.

Table 4: Multivariate analysis of individual-level factors associated with uptake of diabetes testing.

Variable	Categories	AOR	SE	Z	*P*	95% CI
Residence	In a shopping Centre	1 (Reference category)				
	In farm	3.9	1.7	3.04	0.002	1.62-9.30
Employment Status	Employed	1 (Reference category)				
	Self-Employed	1.2	0.6	0.37	0.714	0.43-3.45
	No Employment	0.5	0.4	-0.88	0.380	0.12-2.21
Familial risk awareness	Not Aware	1 (Reference category)				
	Aware	2.5	0.9	2.41	0.016	1.18-5.09

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Perceived risk	Low	1(Reference category)				
	High	2.5	1.1	1.96	0.050	1.00-6.04
Knowledge of diabetes signs and symptoms	Low	1(Reference category)				
	High	2.3	0.8	2.39	0.017	1.16-4.57
Relationship with patient	2nd degree relative	1 (Reference category)				
	1st degree relative and spouse	3.0	1.6	2.05	0.041	1.05-8.36

4.0 Discussion

This study has analyzed uptake of diabetes testing among individuals with family history of diabetes. The key finding of this study is that approximately half of the relatives have never undergone diabetes testing. There is no other published study that was found on diabetes testing among relatives of patients with diabetes. The findings of this study on uptake of diabetes testing relates to IDF finding in general population that more than half of diabetes in Africa is undiagnosed (IDF, 2021). In contrast, a national study conducted in Kenya (MOH et al., 2015) reported a lower diabetes testing uptake of 12%, whereas a study conducted in Singapore (AshaRani et al., 2022) found a relatively similar uptake of 50%. These differences in findings may be attributed to the time gap between the studies and variations in target populations. The present study focused on a high-risk group, whereas the other studies examined the general population.

This study found out that the type of residence had a statistically significant relationship with uptake of diabetes testing. Relatives living in farms were more likely to have had a diabetes test than those living in shopping centers. This disparity in uptake of diabetes testing can be explained by the provision of glucometers to community health promoters who by the criteria of their appointment (Council of Governors, 2023) are likely to live within farms than shopping centers. This finding introduces another dimension of disparity in uptake of screening services that has not been studied adequately. While most studies have compared urban and rural populations (Mwangi et al., 2017;Antabe et al., 2020; Kaul et al., 2022), several others have examined differences between formal and informal settlements within urban areas. However, limited research has focused on variations across different rural settings.

The finding of this study that employment status has a statistically significant association with uptake of diabetes testing is similar to other studies done on uptake of screening for chronic diseases. For instance, a study done on cervical cancer screening in Ethiopia (18) and another done on breast cancer screening in Ghana (Belay, 2020) reported a positive association between being employed and screening uptake.

Similar to the study done in Ghana (Belay 2020) and another one done in Kenya (Mbugua ,2021), this study established that relatives aware of their own familial risk of diabetes were more likely to have had a diabetes test than those who were unaware. This finding highlights a potential link

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that can be explored to enhance diabetes testing uptake. The study identified a gap in risk awareness, as the majority of relatives (71.3%) were unaware of their increased risk due to family history.

This finding unveils a link that can be explored and utilized to improve uptake of diabetes testing because this study found out that there is gap in risk awareness as most of the relatives (71.3%) are not aware of their risk due to family history.

Risk perception, defined as an individual's perceived susceptibility to a threat, is a fundamental construct in numerous health behavior theories due to its critical role in influencing the adoption of healthy behaviors (Ferrer, 2015).This study confirmed this role in that having a high risk perception was associated with increased uptake of diabetes testing, a finding similar to the study done in Ghana (Belay, 2020). To the contrary, a study done in USA (Chu et al., 2023) reported no association between risk perception and uptake of healthy behaviors like screening.

This study established that knowing diabetes signs and symptoms was positively associated with uptake of diabetes testing. Relatives who had high level knowledge of diabetes signs and symptoms were more likely to have had a diabetes test than those who had low knowledge. This finding is similar to a study done in Kenya (Mbaka et al., 2018) and two other studies; one done in Tanzania (Moshi et al., 2019) and the other in Ethiopia (Emru, 2021).

Close relatives (1st degree and spouses) were more likely to have had a diabetes tested than 2nd degree relatives. This finding differs from findings of a study done in Dubai (Al, 2018) that reported more screening among 2nd degree than 1st degree relatives. This contradiction can be attributed to the differences in the study settings of the two studies.

5.0 Study limitations

The main limitation of this study relates to the social desirability bias associated with self-reported diabetes testing. This study mitigated this bias by iterative questioning, ensuring privacy during data collection, establishing rapport before starting to collect data, encouraging participants to be frank, informing participants at the beginning of data collection that there is no right or wrong answer and assuring them of confidentiality of the information given. The recall bias was also a possible limitation, it was mitigated by reducing the details required to be remembered and the time period, that is, the responded was required to only remember if she/he has ever had a blood glucose test and if yes if that was within the past one year or more. Iterative questioning was also used, that is, the same question was asked in different ways. In the absence of medical records, these were the only viable methods to minimize recall bias, given that this was a community-based study.

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6.0 Conclusion

Uptake of diabetes testing is low and the proportion of those who had tested according to MOH-Kenya guidelines was even lower. This situation can be improved, as most individual-level factors associated with uptake are modifiable. The individual level factors that increased uptake of diabetes testing included; living in farms, being aware of own familial risk to diabetes, having high level knowledge of diabetes signs and symptoms and being a close relative of a patient with diabetes.

7.0 Recommendations

Health workers in Kiambu county should integrate familial risk awareness within the family history component of health interviews to increase risk awareness. Additionally, healthcare providers should implement Provider-Initiated Testing (PIT) for type 2 diabetes (T2D) among individuals with a family history of the disease. Furthermore, the Kiambu County Health Management should develop community-based strategies to enhance diabetes testing uptake among relatives of T2D patients.

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8.1 Conflicts of interest

None.

8.2 Funding statement

None.

8.3 Ethical consideration

The study was approved by Jomo Kenyatta University of Agriculture and Technology (REF: JKU/2/2/896B), the National Council for Science, Technology and Innovation (NACOSTI/P/22/20512), and Kiambu County administrative and health authorities (REF: KIAMBU/HRDU/22/10/26/RA_MUIRURI). Participants provided consent, confidentiality was maintained, and voluntary withdrawal was allowed.

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