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DIAGNOSTIC PARAMETERS KNOWLEDGE, GUIDELINE USE AND DIETARY APPROACHES IN TYPE 2 DIABETES AND PREDIABETES CARE AMONG HEALTHCARE PROVIDERS IN AINAMOI SUBCOUNTY, KENYA

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ABSTRACT

Type 2 diabetes and prediabetes are metabolic diseases which are currently of great public health concern worldwide and which are associated with significant morbidity, mortality and even disability. Correct diagnosis, use of guidelines and optimum dietary care in diabetes care by the healthcare providers (HCPs) are attributed to better outcomes among the patients. This study utilized a cross-sectional design carried out at purposively sampled level 2 to level 5 health facilities of Ainamoi Subcounty, Kericho Kenya. One hundred and fifty participants were recruited by convenience sampling. Structured questionnaire was administered using Open Data Kit (ODK) app and collected by trained enumerators. The questionnaire elucidated data on knowledge of diagnostic parameters for diabetes, access and use of guidelines and dietary approaches prescribed by healthcare providers. Research was approved by University of Eastern Africa Baraton Institutional Ethics Committee and National Commission for Science, Technology Institute, License Number. NACOSTI/P/23/23262. Data was analyzed using statistical package for social sciences (SPSS) version 20 software. Descriptive analyses were conducted for all the variables. Categorical data was summarized as frequencies and percentages. The Chi-square test was used to compare various categorical variables in the study. The statistical significance level was set at $p < 0.05$. Less than a quarter (21%) of the respondents did not use diabetes guidelines suggestions. Up to 88.3% of HCPs prescribed low carbohydrate and only 8.3% prescribed a Mediterranean diet. Additionally, 82.7% of respondents could correctly identify Fasting Plasma Glucose parameter for Type 2 diabetes diagnosis while about two thirds could identify this parameter in Prediabetes diagnosis. Correct identification of glycated hemoglobin A1C (HBA1C) parameter for prediabetes ($p=0.001$) and for T2DM ($p<0.001$) and Fasting Plasma Glucose for Type 2 diabetes diagnoses (0.003) were significantly associated with years of experience. Similarly, statistical significance was noted between access and use of diabetes guideline with level of practice ($p <0.001$) and with years of experience ($p= 0.002$). The findings of this study showed limited usage of guidelines in clinical practice which may be linked to the observed limited awareness of diagnostic criteria used in diabetes care. Low carbohydrate diet was majorly prescribed with low emphasis on Mediterranean diet. Improved access to and utilization of standardized guidelines in dietary diabetes care and aggressive advocacy for the same at all levels of healthcare provisions is recommended to ensure timely and optimum care for better outcomes.

Key words: Diabetes guidelines, Diagnostic criteria, Dietary Approaches, Health Care Provider

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INTRODUCTION

By the year 2021, 531 million adults lived with diabetes worldwide, of whom 24 million were living in Africa. In Kenya, prevalence was at 4% [1], with 3.1% of the Kenyan adult population being pre-diabetic; of those 52.8 % cases were undiagnosed and at a high risk of developing complications related to prediabetes and Type II diabetes [2,3]. Timely and effective management of these conditions will delay the development of comorbidities and complications while improving the patients' outcomes of care. The role of healthcare providers in ensuring this happens is very crucial especially in ensuring correct diagnosis and optimum dietary management.

American Diabetes Association (ADA) has developed a diagnostic criterion for the two diseases which has been widely used in diagnosis worldwide [4] , as shown in Table 1. Disparities have been observed in earlier studies in regards to the level of awareness of these diagnostic criteria among healthcare providers [5,6]. In addition to correct diagnosis, guidelines adherence is a very crucial aspect in diabetes care which is associated with better outcomes including, better glycemic control and even diabetes reversal among the patients [4, 7-10]. Despite this, the healthcare providers have not been able to always access and fully utilize it in their daily clinical practice [11,12], maybe due to time constraints, inadequate sensitization and advocacy on current versions of the guidelines as well as importance of strict adherence to them in their clinical practice. Further, dietary management is a key component in diabetes care. Various dietary approaches have been reported in literature to play a major role in the development, prevention and even reversal of pre-diabetes and newly diagnosed Type 2 diabetes. For instance reducing carbohydrate level, reducing calories, adopting plant-based diets help in lowering of various parameters like elevated glycated hemoglobin A1C (HbA1C), hence reducing the risk of developing diabetes as well as the risk of developing macro vascular and microvascular complications [13,14]. These approaches may vary widely among the healthcare providers (HCPs) depending on various healthcare providers' characteristics, thus the need to assess them in this region.

The objectives of this study, therefore, were to: 1) evaluate healthcare providers' awareness of specific diagnostic laboratory values for diagnosis of type 2 diabetes and prediabetes, 2) to examine the accessibility and usage of diabetes care guidelines among healthcare providers and the factors influencing guideline adherence, 3) describe the type of dietary recommendation prescribed by healthcare providers. By identifying potential gaps in these interconnected areas, the study may contribute to the development of targeted interventions that support healthcare providers in delivering comprehensive, evidence-based diabetes care.

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MATERIALS AND METHODS

Study Setting and Design

The study was conducted in Ainamoi sub-county (0°18'S 35°17'E / 0.3°S 35.28°E / -0.3; 35.28) situated in Kericho county. The sub-county was purposively sampled owing to the fact that it was the most urbanizing sub-county in this region, predisposing its population to the risk factors of developing type 2 diabetes and prediabetes. The study utilized cross-sectional study design to evaluate Dietary Patterns for Type 2 Diabetes and Prediabetes as Prescribed by Healthcare Providers**.** The study was conducted in the healthcare facilities. Level two to level five facilities were purposively sampled in this study owing to the fact that advanced diagnostic services and care on diabetes may be available in these facilities, as opposed to the 17 level 1 facilities in the area, which were excluded. The various healthcare providers were conveniently sampled from these facilities while they were on duty to allow feasibility of the study and improve the response rate especially with the shift working schedule.

Sample size and Data collection procedures

A representative sample of 165 participants was calculated and adjusted based on Fischer's formula. A request to specific departments in the respective facilities was put forth. The healthcare providers who accepted and consented were conveniently sampled and interviewed at their respective workstations. This study eventually utilized data from 150 respondents who managed to complete the study.

A semi-structured questionnaire uploaded on a smart phone app, Open Data Kit (ODK) was the data collection tool used. This was administered by trained enumerators. The questionnaire had two main parts: self-reported access and use of guideline in diabetes care section whereby the HCPs were asked whether they accessed and used the guidelines every time while managing their clients, Diagnosis and management of prediabetes and newly diagnosed Type 2 Diabetes section which included Identifying diagnostic values for HbA1C and Fasting Plasma Glucose (FPG) for prediabetes and type 2 diabetes. The respondents in this section were to provide a correct laboratory value for the mentioned parameters according to their knowledge at that point of interview. They were also allowed to respond on the non-affirmative if they did not remember the value. These values were recorded and later categorized as true or false based on the set cut-off points by the American Diabetes Association [4]. This section also sought to solicit on the recommendations for dietary management of prediabetes and Type 2 diabetes, especially, the specific dietary regimes which were listed for the respondents to identify that which they majorly used in their practice.

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Data Processing and Analysis

The data was downloaded into Statistical Package for Social Sciences (SPSS) version 20 from ODK toolkit. The coding and cleaning was done. Descriptive analyses were conducted on all the variables. Categorical data was summarized as frequencies and percentages. The Chi-square test was used to compare various categorical variables in the study. The statistical significance level was set at $p < 0.05$ for all the tests done.

Ethical Considerations

This study was conducted following the ethical guidelines from the University of Eastern Africa Baraton Institutional Ethics Committee, National Commission for Science, Technology Institute (NaCoSTI) under License Number: NACOSTI/P/23/23262. Further consent was sought from Kericho County Referral Hospital ethical committee. Informed voluntary consent from the participants was finally obtained after explanation of the study details and assurance of confidentiality.

RESULTS AND DISCUSSION

Only 150 respondents representing a response rate of 91% were included in the final analysis of the results. Nutritionists represented 16.7%, Medical Officers were 19.3%, Clinical Officers were 20%, Nursing Officers were 36.7% and Community Health Promoters (CHPS) were 7.3%.

Identification of Laboratory Criteria for Diagnosis by healthcare providers in Ainamoi Sub-County.

A majority of providers (82.7%), could correctly identify the correct fasting plasma glucose (FPG) value to diagnose Type 2 diabetes yet only a third (30%) correctly identified FPG value for prediabetes diagnosis. For HbA1C test criteria, almost equal proportion of a fifth of healthcare providers could correctly identify the value for type 2 diabetes (44%) and prediabetes (40%) (Figure 1).

The findings of this study showed that the ability of the healthcare provider to correctly identify laboratory parameters for diagnosis of both prediabetes and Type 2 diabetes were comparable to earlier findings. An earlier study in Nigeria reported 26.6%, and 10.9% of the healthcare providers could correctly identify diagnostic values for fasting plasma glucose (FPG) and glycated hemoglobin (HbA1C), respectively [13]. Similarly another study showed comparability with the findings of this study by reporting a significant proportion of 50% HCPs correctly identifying the correct FPG criteria for Type 2 diabetes but lower rates FPG (42%) and 31% for HbA1C in prediabetes diagnosis[5]. The findings of this study, therefore, highlight some level of sub-optimal knowledge on the main laboratory diagnostic values for prediabetes and newly diagnosed type 2 diabetes among HCPs. This might be emanating from limited awareness and advocacy on prediabetes care amongst

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healthcare providers by the relevant authorities, as once noted by Somerville *et al.* [14]. This may hinder timely intervention and correct care of the patients predisposing them to life-threatening comorbidities and even increased burden on treatment for individual and the country at large. Generally, if this kind of trend continues, it may lead to prediabetes underdiagnoses, thereby increasing the likelihood of developing full-blown type 2 diabetes and associated comorbidities among the population in this region.

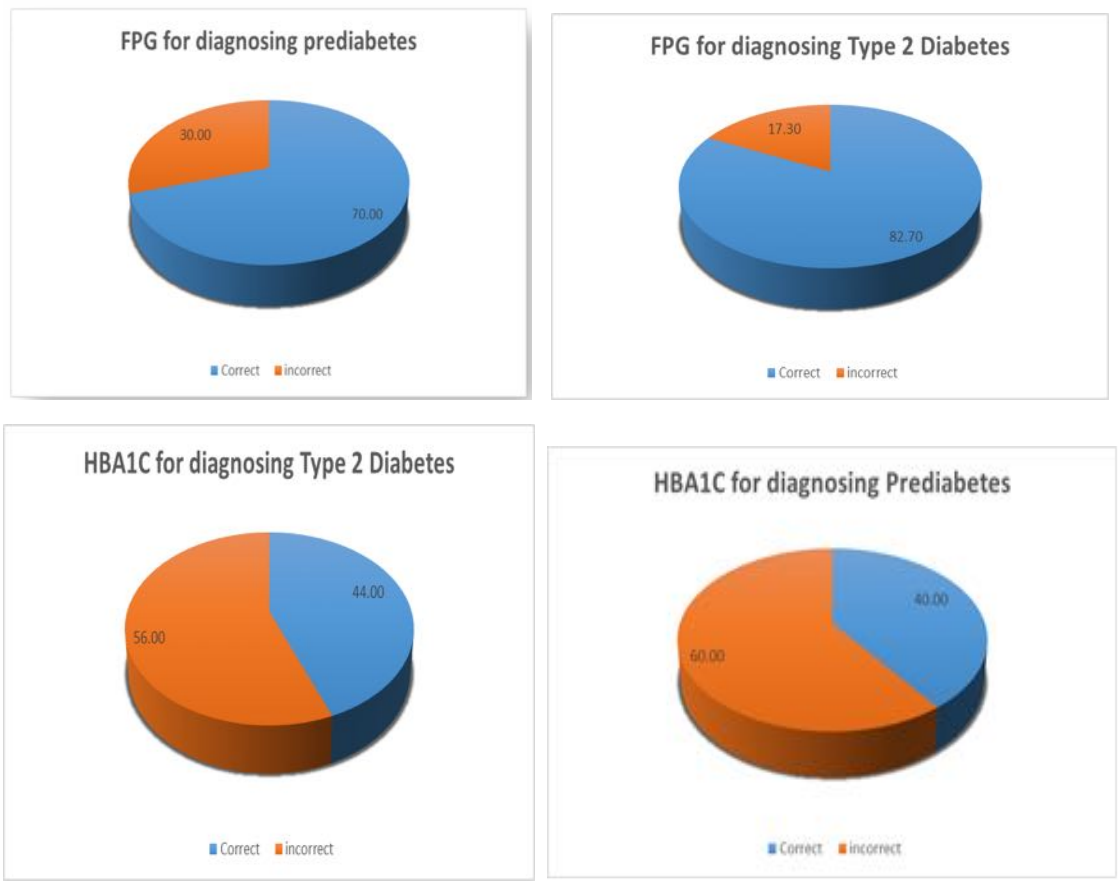

Figure 1: Pie Charts representing proportion of healthcare workers identifying the various laboratory parameters for diagnosis of prediabetes and Type 2 diabetes

Association between Healthcare Providers' Variables with their correct identification of laboratory parameters for diagnosing Type 2 DM and prediabetes

In evaluating the HCP's usage of HBA1C and FPG to diagnose Type 2 diabetes and prediabetes, a statistically significant ($P<0.001$, 0.001 and 0.016, 0.003) association was observed for the years of experience with majority of the respondents being those who had worked for a period of 1 to 5 years. Additionally, a significant association ($p=0.003$) was seen within practice type, and working hours ($p=0.040$)

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in the context of diagnosing Type 2 Diabetes using HBA1C. A majority of the HCPs in this category worked in Ministry of Health (MoH), (50.7%) facilities and worked for extended number of hours (36.7%). Similarly, in the context of the use of FPG to diagnose Type 2 diabetes, there was statistical significance (P<0.001) in those within the 1 to 5 years work experience group and p=0.025 within cadre, majority being the nurses (16.0%). Additionally, diagnostic awareness of FPG in prediabetes diagnosis was statistically significant with cadre (p=0.022) and years of experience (0.016) and majority of the HCWs in these categories were also nurses (16.0%) and had worked for 1 to 5 years (28.0%). No other characteristic was significant for diagnostic accuracy as shown in Table 2.

Contrary to the findings of this study, an earlier study in Nigeria has reported knowledge deficit in regards to these diagnostic procedures (p=0.034) especially with more advanced years of experience [13]. This begs for continuous education sessions among those who are already working in the health facilities to ensure that all are updated in the most current procedures in diabetes care.

Dietary regimes promoted and prescribed by healthcare providers in Ainamoi sub-county, Kericho County

The majority of the responses were those prescribing the low carbohydrate diet and low calorie diet at 88.3% and 72.4%, respectively, while the least prescribed diet in this region was Mediterranean which was prescribed by only 8.3% of the respondents. Systematic review done by Kelly *et al.* [19] noted that up to 48% dieticians prescribed low carbohydrate diet [15]. Most of the prescribed dietary recommendations like the use of low carbohydrate diets and use of the Mediterranean Diets have been championed in most other guidelines by various countries in diabetes care as they have been associated with good glycemic outcomes and reduction of complications among diabetic patients[7, 16-18]. These dietary approaches were associated with better glycemic controls postprandial and reduction of complications in diabetic patients [14,19]. Additionally, a review by earlier researchers, reported few healthcare providers who were prescribing plant-based diet even with great potential of the same in terms of effectiveness and cost [20], just as the finding of this study did.

This current study, similarly, noted that majority of the healthcare providers prescribed low carbohydrates regime. In the current study the Mediterranean diet is the least prescribed by healthcare providers even though an earlier study had reported high prescription rate by the healthcare providers [16, 21].

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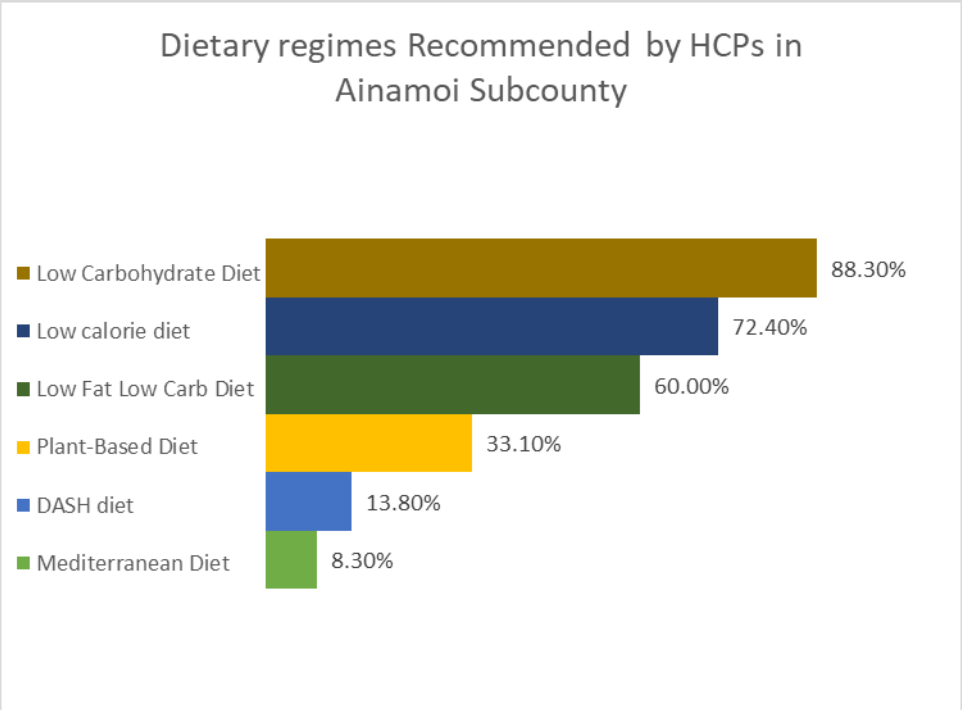

Figure 2: Proportion of HCPs recommending Various Dietary Regimes in Diabetes Care

Access to and use of diabetes Guidelines for prediabetes management by respondents in Kericho County

At the time of this study, 20.6% of respondents reported not having accessed the current guidelines used in diabetes care while 22.7% reported always accessing and using the guidelines in their practice. Slightly over half of the respondents (56.7%) used guidelines stipulations sometimes even if they accessed them as shown in Figure 3. Even with the availability of the diabetes guidelines in Kenya [6], a significant proportion of healthcare providers never accessed and adhered to the guidelines in their practice according to these findings. In an earlier study done by Keck *et al.* [10] only 45.7% of the healthcare providers were aware of and applying diabetes prevention protocols in their region. Another study done way back reported that 53% of the healthcare providers were using the guideline always [11].These earlier findings are in tandem with the findings of this study, showing limited adherence to diabetes guidelines in clinical practice.

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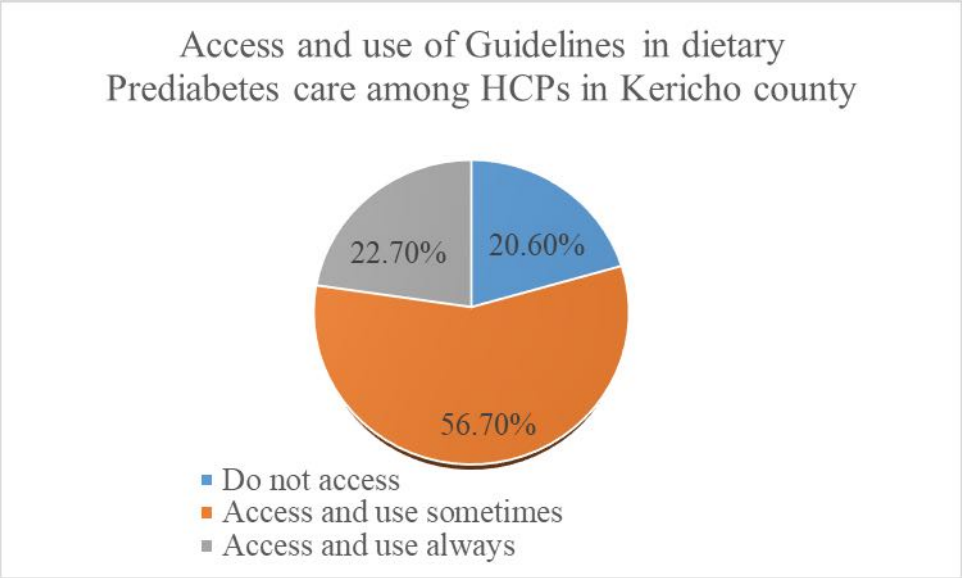

Figure 3: Proportion of HCPs Accessing and Using Dietary Guidelines in Diabetes Care

Association between HCP's Sociodemographic characteristics and the access and use of guidelines in Nutrition management of diabetes in Ainamoi Sub-County, Kericho County

The analysis of the data showed no statistical significance between the access to and use of guidelines in dietary prescription for prediabetes and newly diagnosed Type 2 diabetes patients with age (p=0.295), gender (p=0.710), highest level of education (p=0.376), cadre (p=0.064) and place of practice (p=0.637). However, statistically significant associations were observed in: working hours per day (p<0.001) with a notable proportion among those who worked full time per day (21.3%), the level of practice (p=0.004), especially among those working at the level 5 health facilities (46.7%), age (p=0.020), cadre (0.014) and years of experience (p<0.001), especially among those who have been working for a period between 1 to 5 years (38.0%) (Table 3).

An earlier study had reported a statistically significant association between the use of guidelines and providers' higher level of education, with specialists who are more educated than medical officers being more likely to use guidelines, (p=0.004) [22]. This was contrary to the findings of this study which did not report an association with the level of education.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The findings of this study showed that a significant number of healthcare providers demonstrated difficulty in correctly identifying the correct criteria for diagnosis, which may indicate underdiagnoses of these diseases at the clinical areas, thereby increasing the risk of complications and associated high cost and disability. Even

with easy accessibility of the guidelines, the healthcare providers are still unable to use them always in their clinical practice, posing the question on what other protocols they base their care on. Even though low carbohydrate diet was largely prescribed for diabetes management, there is low emphasis on Mediterranean diet. It was, therefore, recommended that the Ministry of Health prioritize access and proper utilization of guidelines to ensure standardized diabetes care, through correct and timely diagnosis to management. There is, however, a need to do further qualitative study to understand the reasons behind the low level of access and use of the guidelines in practice. This follow-up study should also include the evaluation of the reasons for the healthcare providers applying the dietary approaches, other than those stipulated in the guidelines.

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Conflict of Interest

The authors of this manuscript declare no conflict of interest.

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Table 1: Diagnostic criteria based on American Diabetes Association guidelines

Diagnosis	Fasting Plasma Glucose(FPG) mmol/l	Glycated Hemoglobin A1 C (HBA1C%)
Prediabetes	5.6-6.9	5.7-6.4
Type 2 Diabetes	≥7	≥ 6.5

Adapted from American Diabetes Association(ADA)[23]

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Table 2: Association between Healthcare Providers' Characteristics with correct identification of Laboratory Parameters for Diagnosing Type 2 Diabetes and Prediabetes

HCP CHARACTERISTIC	DIAGNOSTIC PARAMETERS			
	HBA1C for T2D	HBA1cfor Prediabetes	FPG for Prediabetes	FPG for T2D
Gender/				
Male	47(31.3%)	27(18.0%)	39(26.0%)	61(40.7%)
Female	45(30.0%)	39(26.0%)	31(20.7%)	63(42%)
P-Value	***0.035**	**0.334**	**0.138**	**0.342**
Education Level				
Degree (Masters)	3(2.0%)	3(2.0%)	3(2.0%)	5(3.3%)
Degree	37(24.7%)	30(20.0%)	30(20.0%)	54(36%)
Higher National Diploma	5(3.3%)	6(4.0%)	5(3.3%)	10(6.7%)
Diploma	42(28.0%)	25(16.7%)	28(18.7%)	50(33.3%)
Certificate	5(3.3%)	2(1.3%)	4(2.7%)	5(3.3%)
P-value	**0.294**	**0.388**	**0.054**	***0.007**
Cadre/Specialty				
Nutritionist	13(8.7%)	10(6.7%)	9(6.0%)	19(12.7%)
Medical Officer	21(14.0%)	15(10.0%)	18(12.0%)	28(18.7%)
Clinical officer	18(12.0%)	12(8.0%)	15(10.0%)	27(18.0%)
Nursing officer	34(22.7%)	24(16.0%)	2416.0%)	41(27.3%)
Community Health Promoters	6(4.0%)	5(3.3%)	4(2.7%)	96.0%)
P-value	**0.173**	**0.171**	***0.022**	***0.025**
Years of Experience				
Less than 1 year	3(2.0%)	0(0)	2(1.3%)	3(2.0%)
1-5 years	58(38.7%)	37(24.7%)	42(28.0%)	72(48%)
6-10 years	18(12.0%)	14(9.3%)	13(8.7%)	25(16.7%)
more than 10 years	13(8.7%)	15(10.0%)	13(8.7%)	24(16.0%)
P-Value	***<0.001**	***0.001**	***0.016**	***0.003**
Place of practice (Public/Private) hospitals				
Level 2	0(0%)	0(0)	0(0.0%)	1(0.7%)
Level 3	10(6.7%)	8(5.3%)	6(4.0%)	12(8.0%)
Level 4	10(6.7%)	16(10.7%)	8(5.3%)	21(14.0%)
Level 5	72(48%)	42(28.0%)	56(37.3%)	90(60.0%)
P-Value	**0.256**	**0.091**	**0.342**	**0.089**
Working hours per day				
Part-time(locum)	3(2.0%)	0(0)	3(2.0%)	3(2.0%)

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Full-Time(8hours)	34(22.7%)	33(22%)	28(18.7%)	56(37.3%)
Extended Hours (over 8 hours shift)	55(36.7%)	33(22%)	39(26.0%)	65(43.3%)
P-Value	***0.040**	**0.132**	**0.536**	**0.074**
Practice type				
Private (solo/group/NGO)	18(10.7%)	26(14.7%)	14(8.7%)	31(19.3%)
Ministry of Health	74(50.7%)	40(29.3%)	56(38.0%)	91(63.3%)
P-Value	***0.003**	**0.313**	**0.605**	**0.703**
Age(years)				
20-25	9(6%)	5(3.3%)	4(2.7%)	12(8%)
26-30	17(11.3%)	14(9.3%)	8(5.4%)	25(16.7%)
31-35	15(10.0%)	16(10.7%)	18(12.0%)	27(18.0%)
36-40	19(12.7%)	15(10.0%)	14(9.3%)	25(16.7%)
41-45	11(7.3%)	5(3.3%)	10(6.7%)	11(7.3%)
0ver 45	21(14.0%)	11(7.3)	16(10.7%)	24(16.0%)
P-Value	***0.009**	**0.116**	***0.026**	**0.358**

**-statistically significant at 95% Confidence Interval. FPG =Fasting Plasma Glucose, T2D= Type 2 Diabetes, HBA1C= Glycated Hemoglobin*

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Table 3: Association Between Access and Use of Guidelines with HCPs' Characteristics

HCP Characteristic	No access %(n)	Access but use sometimes %(n)	Access and use always %(n)	P-value (CI-95%)
Age				***0.020**
20-25	2.0(3)	2.0(3)	8.7(13)	
26-30	2.0(3)	6.7(10)	10.7(16)	
31-35	6.0(9)	2.0(3)	13.3(20)	
36-40	8.7(13)	1.3(2)	10.0(15)	
41-45	2.7(4)	2.0(3)	4.0(6)	
Over 45Years	3.3(5)	6.7(10)	8.0(12)	
Gender				0.500
Male	10.0(15)	11.3(17)	26.0(39)	
Female	14.7(22)	9.3(14)	28.7(43)	
Highest Level of Education				0.384
Degree (Masters)	0.7(1)	1.3(2)	1.3(2)	
Degree (Bachelor's)	8.7(13)	10.7(16)	19.3(29)	
Higher National Diploma	3.3(5)	2.0(3)	2.7(4)	
Diploma	10.7(16)	5.3(8)	926.7(40)	
Certificate	1.3(2)	1.3(2)	24.7(7)	
Cadre/Speciality				***0.014**
Nutritionist	4.7(7)	6.0(9)	6.0(9)	
Medical Officer	3.3(5)	3.3(5)	12.7(19)	
Clinical officer	6.0(9)	5.3(8)	8.7(13)	
Nursing officer	8.7(13)	3.3(5)	24.7(37)	
CHPS	2.0(3)	2.7(4)	2.7(4)	
Working Hours per day				***<0.001**
Part-time	2.0% (3)	1.3% (2)	0	
Full-Time	16.7% (25)	8.7% (13)	21.3% (32)	
Extended Hours	6.0% (9)	10.7% (16)	10.7% (16)	
Type of practice				0.481
Private	6.7% (10)	5.3% (8)	10% (15)	
Ministry of Health	18% (27)	15.3% (23)	44.7% (67)	
Place of Practice				***0.004**
Level 2	0.7% (1)	0	0	
Level 3	2.7% (4)	3.3% (5)	4.0% (6)	
Level 4	8.0% (12)	2.7% (4)	4.0% (6)	
Level 5	13.3% (20)	17.7% (22)	46.7% (70)	

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Years of Experience				***<0.001**
Less than 1 year	0.7(1)	0.7(1)	4.0(6)	
1-5 years	7.3(11)	12.7(19)	38.0(57)	
6-10 years	6.7(10)	4.7(7)	7.3(11)	
more than 10 years	10% (15)	2.7(4)	5.3(8)	

**- statistically significant p-value, CHPs=Community Health Promo*

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