KIBOGORA POLYTECHNIC SCIENTIFIC JOURNAL

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Prevalence of diabetes mellitus and factors associated with screening uptake in Kanjongo, Nyamasheke District, Rwanda

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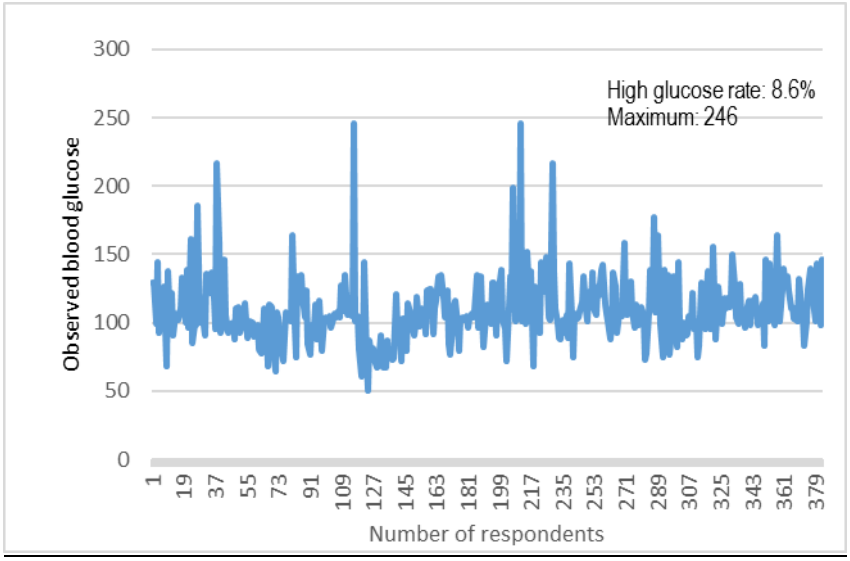
HIGHLIGHTS

- We estimated the prevalence of diabetes mellitus through blood glucose laboratory testing;
- We surveyed the respondents to identify the factors associated with diabetes screening;
- The prevalence of diabetes was lower than the prevalence estimate in Sub-Saharan Africa;
- Factors associated with diabetes screening were related to community sensitization; therefore, we recommend community-based sensitization and screening programs.

GRAPHICAL ABSTRACT



Blood glucose measurements during Umuganda at Kanjongo, Nyamasheke, Rwanda, Aug 2017

ARTICLE INFORMATION

Article history:
Received 08 January 2018
Received in revised form 14 February 2018
Accepted 15 March 2018
Available online 11th April 2018

Keywords:
Prevalence
Diabetes mellitus
Screening
Rwanda

ABSTRACT

The prevalence of diabetes mellitus in Sub-Saharan Africa was 13.7% in 2016 (Werfalli, Engel, Musekiwa, Kengne, & Levitt, 2016), which is higher than 8.7%, the global diabetes prevalence in 2015 (WHO, 2016). Fewer studies explored the factors associated with diabetes early detection for its prevention and control (WHO, 2016). Study objectives were: (1) to determine the prevalence of diabetes mellitus among the population attending the monthly community work in a selected sector, and (2) to identify the factors associated with diabetes screening and early detection. All 383 respondents who were attending the community monthly work were invited to be screened for diabetes and to be surveyed using an interview-guide questionnaire. Out of 383 respondents, 60.3% were female and 39.7% were male. The prevalence of diabetes was 8.6%, and only 27.9% have been tested before. The majority (95.3%) perceived regular testing beneficial, 62.4% perceived themselves susceptible to get diabetes, and 94.8% perceived diabetes as a serious disease. The sources of information were radio and television (89.6%), health care staff (79.4%), mass campaigns (73.1%), Community Health Workers (CHWs) (67.1%), and the neighbors (57.7%). Reported barriers to screening were lack of information (87.5%), delay of health insurance (79.1%), lack of readiness of the health care staff (75.7%), perceived quality of health care (52.2%) and the perceived cost (46.5%). The factors associated with the screening were the

ISSN: 2616-7506

age (p=0.01), occupation (p<0.000), the perceived susceptibility (p< 0.000), the perceived threat (p=0.005), community sensitization by CHWs (p=0.003), mass campaign (p=0.001), and neighbors (p=0.009). Diabetes prevalence was lower than the Sub-Saharan prevalence estimates. Community sensitization through CHWs, mass campaigns and neighbors, information provision, disease perception, age, occupation, and quality of health care were the predictors of diabetes screening. Decentralized community sensitization and screening programs are highly recommended.

1. Introduction

Non-communicable diseases (NCDs) including diabetes constitute the main public health threat nowadays, as they kill 40 million each year, which constitute 70% of total deaths globally (Lobstein & Brinsden, 2014). More than 80% of these deaths occur in low-and-middle-income countries (LMIC). Screening and early detection of NCDs are viewed as key cost-effective strategies to reverse the course of these diseases, particularly in LMIC (Kibret & Mesfin, 2015; Shin & Varghese, 2014). The global report by the World Health Organization showed that the prevalence of diabetes was 8.7% in 2016 across the World (WHO, 2016). In Sub-Saharan Africa, this prevalence was estimated at 13.7% which is higher that the global estimates (Werfalli, *et al*., 2016). Projections show that diabetes will increase from 19.8 million to 41.5 million between 2013 and 2035 in Sub-Saharan Africa, which is a very high increase in only two decades (Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). It is in this context that the researcher is motivated to undertake a study on the prevalence of diabetes and the factors influencing the screening and early detection. Evidence showed that early detection for diabetes mellitus has tangible outcomes including prevention of complications, better treatment outcomes, and cost effectiveness of health care delivery for individuals and countries (Mbanya, *et al.*, 2010; Pastakia, Pekny, Manyara, & Fischer, 2017).

A study conducted in South Africa and Zambia showed that the prevalence of diabetes mellitus was 3.5% in Zambia, and 7.2% in South Africa (Bailey *et al.*, 2016). The study showed that the most vulnerable groups included those with older age and obesity. Also it was found that among those who had diabetes, 34.5% in Zambia and 12.7% in South Africa did not know that they had diabetes before, and those who were previously diagnosed with diabetes, the majority were not on treatment, 66.0% in Zambia and 59.4% in South Africa. A study conducted in Sierra Leone and other 16 countries of the West Africa region found the prevalence of diabetes to be 6.2% (Sundufu, Bockarie, & Jacobsen, 2017), with much disparities between age groups whereby the prevalence was 8.4% among patients aged between 40 to 49 years, 19.0% among patients aged between 50 to 59 years, and 25.0% among patients aged between 60 years and older. In Uganda a similar study that was conducted found the prevalence of diabetes to be 7.4% (Mayega *et al.*, 2013). Diabetes mellitus among many other NCDs is called “a silent killer” since it does not cause the physical pain at its onset like other acute diseases (Lobstein & Brinsden, 2014; WHO, 2016).

In the same context, individual characteristics including the age, gender, education level, occupation, religion, and culture among many others can influence people in taking action for using a preventive measure with much differences within and between countries (Hall, Thomsen, Henriksen, & Lohse, 2011; Mbanya, *et al.*, 2010). In addition, several modifying factors including media, community sensitization programs to increase knowledge and awareness, perceived susceptibility to get the disease, perceived threat or seriousness of the disease, among many others, these will lead the people to taking actions, especially when they perceive that the benefits for taking action or the proposed preventive measure outweigh the cost for taking that action (Rosenstock, 2005). This research study had interest in this regard and sought to understand the key predictors for diabetes mellitus screening and early detection among these above-mentioned.

Evidence showed that Sub-Saharan Africa is facing several challenges in fighting against diabetes-related morbidity and mortality including lack of community awareness about diabetes and its prevention, lack of readiness of health systems in terms of policy making and strategic planning specifically for the NCDs, lack of qualified personnel, medications, and lack of funding in the contexts of limited resources (Lobstein & Brinsden, 2014; Pastakia, *et al.*, 2017). Community-based programs aiming at community sensitization and screening for early detection of diabetes are viewed as the priority and cost effective strategies, since diabetes management at its early stage is feasible at lower cost with maximum treatment outcomes, specifically the prevention of the complications which are difficult to manage with poor treatment outcomes in general (Lobstein & Brinsden, 2014; Pastakia, *et al*., 2017).

2. Methods

The survey was conducted in August 2017 during the monthly community work, called “Umuganda” in Kinyarwanda in Kanjongo Sector of Nyamasheke District, Rwanda. Study objectives were: (1) to determine the prevalence of diabetes among the population attending the monthly community work in a selected sector, and (2) to identify the enablers and barriers to early detection and screening. The study used a descriptive cross-sectional design to collect and measure the random blood glycemia and survey the respondents. The study design followed the Health Beliefs Model (HBM); the health promotion theory which describes and analyze the predictors of action taking such as screening uptake. These predictors include individual characteristics as above-mentioned, modifying factors including the perception of the severity of the disease and perception of susceptibility to get the disease, and cues to action including the media, sensitization campaigns, and peers (Rosenstock, 2005). This model fit well the current study and the design was based on it. The blood samples were collected and immediately measured using the blood glucose machine, and individual respondents were at the same time interviewed using an interview-guide questionnaire. The respondents were explained the nature of the survey, and all consented voluntarily to participate in the survey.

3. Results

3.1 Demographic characteristics of the respondents

The respondents were 383, out of which 231 (60.3%) were female and 152 (39.7%) were male (Table 1). Most of the respondents were aged between 35-49 years old (39.4%) and other age groups, 18-34 and 50 years and above were almost equal, 30.5% and 30% respectively. Single respondents were 192 (50.1%), 185 (48.3%) were married, and six (1.6%) were divorced. A number of 251 (65.5%) were able to read and write, and 132 (34.5%) were not. The majority, 212 (55.4%) had primary school, 53 (13.8%) had secondary level, 13 (3.4%) had university level, and a good number, 105 (27.4%) did not have any level of formal education. The occupation of the majority of the respondents was agriculture, 229 (59.8%), equally those who had a formal business and employment were 38 (9.9%), and those without any job were 78 (20.4%). The majority of the respondents, 271 (70.8%) were protestants, 94 (24.5%) were catholic, 16 (4.2%) were seventh day Adventists, and the Muslims were 2 (0.5%).

3.2 Prevalence of hyperglycemia

As shown in the Table 2, it was found that 33 (8.6%) respondents had elevated blood glucose. Any blood glucose from 7.8 mmol/L or 140 mg/dL and above, which is the higher limit of normal blood glucose of the majority of healthy individuals 2 hours after eating, was considered to be above normal ranges. The mean was 109.4 mg/dL, the median was 105 mg/dL and the mode was 104 mg/dL with Standard Deviation of 24.73. This choice was made based on the fact that the respondents have come for community work, and it was assumed that the majority of them have eaten something before.

Table 1: Demographic characteristics of the respondents

Variables		Frequency (n)	Percentage (%)
Gender	Female	231	60.3
	Male	152	39.7
Age	18-34	117	30.5
	35-49	151	39.4
	50 and above	115	30
Marital Status	Single	192	50.1
	Married	185	48.3
	Divorced	6	1.6
Can read and write	Yes	251	65.5
	No	132	34.5
Education level	None	105	27.4
	Primary	212	55.4
	Secondary	53	13.8
	University	13	3.4
Occupation	No job	78	20.4
	Agriculture	229	59.8
	Business	38	9.9
	Employed	38	9.9
Religion	Protestants	271	70.8
	Catholic	94	24.5
	Adventists	16	4.2
	Muslims	2	0.5

Table 2: Prevalence of blood glucose among the participants

Variable		Frequency (n)	Percentage (%)
Blood glucose above normal ranges	**Yes**	33	8.6
	No	350	91.4
Total		**383**	**100**

3.3 History of diabetes testing and perceived benefit of early screening

As the Table 3 shows, 107 (27.9%) respondents have been tested before the time of this survey, and a big number of them, 276 (72.1%) have never been tested before. The majority 369 (96.3%) reported that they plan to get tested regularly and only 14 (3.7%) were not planning to do so. It was found that the majority of the respondents, 365 (95.3%) reported that they find testing for diabetes beneficial, and only 18 (4.7%) reported that they do not find it beneficial.

Table 3: History and perception of blood glucose testing among the participants

Variable		Frequency (n)	Percentage (%)
Have you ever been tested before?	Yes	107	27.9
	No	276	72.1
Do you plan to get tested regularly?	Yes	369	96.3
	No	14	3.7
Is getting tested beneficial?	Yes	365	95.3
	No	18	4.7

3.4 Perceived susceptibility and seriousness of the disease

The Table 4 shows that the majority of the respondents, 239 (62.4%) felt that they are susceptible to get diabetes; while a good number of them, 144 (37.6%) reported the opposite. It was found that a big number of the participants, 363 (94.8%) perceived diabetes as a serious disease, and 20 (5.2%) did not perceive it as a serious disease.

Table 4: Perceived susceptibility and seriousness of the disease

Variables		Frequency (n)	Percentage (%)
Can you get diabetes?	Yes	239	62.4
	No	144	37.6
Is diabetes a serious disease?	Yes	363	94.8
	No	20	5.2

3.5 Sources of information

The Table 5 shows that the main sources of information on diabetes testing and management were radios and television (TV) 89.6%, followed by health care staff 79.4%, mass campaigns 73.1%, Community Health Workers (CHWs), 67.1%, and the neighbors, 57.7%.

Table 5: Sources of information on diabetes testing and management

Variables		Frequency (n)	Percentage (%)
CHWs sensitize us	Yes	257	67.1
	No	126	32.9
We get information from radio and TV	Yes	343	89.6
	No	40	10.4
We get information from health care staff	Yes	304	79.4
	No	79	20.6
We get information from mass campaigns	Yes	280	73.1
	No	103	26.9
We get information from neighbors	Yes	221	57.7
	No	162	42.3

3.6 Reported barriers and enablers for diabetes screening uptake

The Table 6 shows that the main barriers to diabetes screening uptake included the lack of necessary information (87.5%), the delay of health insurance (79.1%), the lack of readiness of the health care staff to help (75.7%), perceived poor health care delivery at health facility levels (52.2%), and the perceived cost for screening (46.5%).

Table 6: Reported barriers on diabetes mellitus screening uptake

Variables		Frequency (n)	Percentage (%)
Is diabetes screening expensive?	Yes	178	46.5
	No	205	53.5
Is the lack of necessary information a barrier?	Yes	335	87.5
	No	48	12.5
Is the lack of readiness (staff not helpful) of health care staff a barrier to screening?	Yes	290	75.7
	No	93	24.3
Is the poor health care delivery at HC a barrier to screening?	Yes	200	52.2
	No	183	47.8
Is the delay of health insurance a barrier to screening?	Yes	303	79.1
	No	80	20.9

3.7 Factors associated with diabetes screening uptake

The factors that were associated with diabetes screening uptake are summarized in Table 7. These were the demographic characteristics including the age (Chi-square 8.35, p=0.01) and the occupation (Chi-square 40.20, p<0.000). The perceived susceptibility of getting

diabetes was associated with gender (Chi-square 12.14, p<0.000), and occupation (Chi-square 13.92, p=0.003). The perceived threat of the disease was associated with the perceived susceptibility (Chi-square 7.71, p=0.005). Also the perceived susceptibility was associated with the cues to action including the community sensitization by the Community Health Workers (CHWs) (Chi-square 8.74 p=0.003), the mass campaign (Chi-square 10.76, p=0.001), and the sensitization by the neighbors (Chi-square 6.73, p=0.009). Also the perceived susceptibility was associated with planning to get tested regularly (Chi-Square 9.08, p=0.003), as well as the perceived quality of health services delivery (Chi-Square 1.485 and p<0.000).

4. Discussion

The findings of this study showed the prevalence of elevated blood glucose of 8.6%, which is almost equal to the global prevalence of diabetes which was 8.7% in 2016 (WHO, 2016), and this is less that the prevalence of diabetes in Africa which was 13.7% in 2015-2016 (Werfalli, *et al.*, 2016), but higher than 6.4% of the prevalence of diabetes mellitus found in Sierra Leone and other 16 West African countries (Sundufu, *et al.*, 2017). The current study found that 72.1% have never been tested before; which is higher than 34.5% of the respondents in Zambia and 12.7% in South Africa who were not aware of their diagnosis before the mass screening (Bailey, *et al.*, 2016). The current study found that many respondents (94.8%) had a high perception that diabetes is a severe disease and a good number of them (62.4%) perceived themselves as susceptible to get diabetes. Also most of them perceived that getting tested regularly is beneficial and they were planning to do so.

These findings are similar to others found previously in African countries (Mayega, *et al.*, 2013; Mbanya, *et al*., 2010; Todowede & Sartorius, 2017). In South Africa, many patients (82.6%) knew that diabetes mellitus is a serious disease which causes serious complications (Mabaso & Oduntan, 2016). The study findings showed that the lack of necessary information (87.5%), was the main barriers to get tested for diabetes, this together with delayed health insurance (79.1%), perceived lack of readiness of health facilities (75.7%), which is whether the health care providers are helpful or not, and perceived quality of health services delivery (52.2%), which is the perception whether these services are well delivered or not. Several studies found hindrances diabetes screening including disparity of health care systems, lack of qualified personnel, lack of sufficient equipment and consumables, lack of policy and guidelines, among many others (Ekeke *et al.*, 2017; Hall, *et al*., 2011; Todowede & Sartorius, 2017). These factors are system-based and there is paucity of studies which reported on individual factors associated with diabetes screening and early detection.

The current study showed that personal characteristics namely the age and occupation, the respondents' perception of their susceptibility and severity of diabetes and the benefits of getting tested regularly were the predictors of having been tested before. Previous studies conducted in Africa, most of them recommending the need to take community-based interventions. These findings confirm several findings from although they did not study the predictors of screening and early detection among the populations (Mwanri, Kinabo, Ramaiya, & Feskens, 2015; Pastakia, *et al.*, 2017). Other predictors of getting tested were the community sensitization through CHWs, mass campaigns, the neighbors, and the quality of health care delivery.

Table 7: Bivariate analysis of the factors associated with diabetes screening uptake

Demographic characteristics		Yes (%)	No (%)	Chi-square	P-value
Age	Between 18-34 Years	21 (21.8)	96 (78.2)	8.351	.01*
	Between 35-49 Years	49 (32.4)	102 (67.6)		
	Between 50 +	37 (32.1)	78 (67.9)		
Education level	None	36 (34.2)	69 (65.8)	5.892	.15
	Primary	53 (25)	159 (75)		
	Secondary	12 (22.6)	41 (77.4)		
	University	6 (46.1)	7 (53.9)		
Marital Status	Single	55 (28.6)	137 (71.4)	0.211	.9
	Married	50 (27)	135 (73)		
	Divorced	2 (33.3)	4 (66.7)		
Occupation	No job	43 (55.1)	35 (44.9)	40.205	.000*
	Agriculture	42 (18.3)	178 (81.7)		
	Business	13 (47.3)	25 (52.7)		
	Employed	9 (23.6)	29 (76.4)		
Religion	Protestants	78 (28.7)	193 (71.3)	3.818	.282
	Catholic	22 (23.4)	72 (76.6)		
	Adventists	7 (43.7)	9 (56.3)		
	Muslims	0 (0)	2 (100)		
Perceived susceptibility: Can you get diabetes?					
Gender	Female	128 (55.4)	103 (44.6)	12.124	.000*
	Male	111 (70)	41 (30)		
Occupation	No job	37 (47.4)	41 (52.6)	13.927	.003*
	Agriculture	151 (65.9)	78 (34.1)		
	Business	21 (55.2)	17 (44.8)		
	Employed	30 (78.9)	8 (21.1)		
Perceived threat	Is diabetes serious disease?	369 (96.3)	14 (3.7)	7.712	.005*
Cues to action	CHWs sensitize us	257 (67.1)	126 (32.9)	8.746	.003*
	Health staffs sensitize us	304 (79.3)	79 (20.7)	3.96	.05
	Mass campaigns	280 (73.1)	103 (26.9)	10.766	.001*
	Neighbors sensitize us	221 (57.7)	162 (42.3)	6.735	.009*
Taking action	Do you plan regular test?	365 (95.3)	18 (4.7)	9.08	.003*
	Poor services delivery	303 (79.1)	80 (20.9)	1.485	.000*

Significance level: *p<0.05 at 95%Cl

5. Conclusion

The prevalence of diabetes was lower than the Sub-Saharan prevalence estimates. Community sensitization through CHWs, mass campaigns, neighbors, health information provision, perception of the diseases and susceptibility, age, occupation, and the quality of health care delivery were predictors of diabetes screening. Decentralized community interventions aiming at community sensitization and mass screening and improved quality health care delivery are highly recommended

Conflict of interest

We declare that there is no conflict of interest with this work.

Acknowledgements

We would like to acknowledge the contribution of the Department of Nursing and Midwifery staff for the hard work throughout all the steps in conducting this study, from its conception, data collection, data analysis and the results dissemination. We thank Kibogora Polytechnic for allowing the study to be done, availing the staff and cover financial needs.

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