ORIGINAL ARTICLE

THE PREVALENCE OF DIABETES MELLITUS AMONG INMATES AT KALITY FEDERAL PRISON, ETHIOPIA

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ABSTRACT

Background: *Diabetes mellitus is among the leading causes of morbidity and mortality worldwide. It is responsible for the loss of millions of lives globally. Ethiopia has been reported to have the highest number of people affected by diabetes mellitus in Sub-Saharan Africa. However, its magnitude has not been studied on inmates, and yet no adequate attention has been given to the epidemic, making the provision of appropriate services difficult. Hence, this study assessed the prevalence of diabetes mellitus among Kality Federal prisoners, Addis Ababa, Ethiopia.*

Methods: *An institution based cross-sectional study was conducted from August to September, 2015 at Kality Federal prison. Eight hundred thirty prisoners were selected using the simple random sampling technique. A structured questionnaire adapted from the WHO STEP-wise approach was used. Anthropometric measurement was taken using a standardized technique and equipment. Diabetes Mellitus was confirmed by fasting blood glucose (FBG) tests. The multivariable logistic regression analysis was carried out to identify factors associated with illness. The adjusted Odds Ratio (AOR) with the corresponding 95% confidence interval (CI) was estimated to show the strength of associations. A p-value of <0.05 was used to declare statistical significance.*

Result: *The overall prevalence of diabetes mellitus among Kality Federal prisoners was 4.69% (95% CI=3.26- 6.14). The proportion was high among urban (5.3%) than rural (1.58%) dwellers. The prevalence of diabetes increased with age in both men and women; peak prevalence (13.8 %) was noted among the older (54-63years) group. Out of the 39 subjects classified as diabetic, the proportion of a newly diagnosed DM was 10 (25.6%). Family history of Diabetes mellitus (AOR= 4.99, 95% CI: 2.16-11.54), and being in the 44-53 years age group (AOR= 3.87, 95% CI: 1.07- 14.03) were found to be more associated with the problem.*

Conclusion: *The study revealed that the proportion of diabetes mellitus is considerably high among prisoners, and family history of DM and old age were significantly associated with the disease. Thus, providing access to early screening among the elderly and those with family history is necessary to reduce the risks and complications of diabetes.*

Keyword: *Diabetes Mellitus, Prisoners/Inmates, Addis Ababa*

BACKGROUND

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia(1-3). Evidence shows that it is claiming the lives of 5.1 million people worldwide, and is one of the chronic illnesses with high morbidity and mortality rates globally (4-6). The global burden of diabetes mellitus has been rising dramatically and becoming a pandemic across the globe in the past three decades. In 2013, the International Organization for Diabetes Federation projected that the burden of diabetes will rise from 382 to 592 million in less than the coming two decades(7, 8).

Globally, the prevalence of diabetes mellitus has become heterogeneous across regions. The highest prevalence (37.9%) of diabetes was reported in Tokelau. In north America and the Caribbean regions the prevalence of DM was reported as 11%, followed by North Africa and the Middle East (9.2%) (4, 9-11). The variation is not only across nations but also

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between different groups of communities which share a common interest. Besides, most of the diabetes mellitus studies in Ethiopia were not focused on the stated groups. In Africa, 4.9% of the population has diabetes (15, 18, 19). The highest prevalence in Africa was reported in Seychelles (12.1%) and in Gabon (10.7%). Diabetes in Mali was reported as the lowest in Africa (1.6%). Studies suggest that the number of adults living with diabetes in Sub-Saharan Africa will further rise by more than 23.9 million by 2030(10, 12, 13) . However, due to lack of information about the burden of the disease the proportion of the population at risk remains high.

Despite many efforts to reduce chronic disease epidemic across the globe, the prevalence of DM is affected by behavioral, anthropometric, and medical factors. Among the factors, old age (5, 14, 15), family history of DM(5, 16-18), poor physical activity, obesity, sedentary life(16, 19, 20), hypertension and raised cholesterol level, BMI and waist circumference(16, 21, 22)were some associated with diabetes mellitus.

Like other countries in the region, Ethiopia is challenged by the double burden of chronic communicable and non-communicable diseases(12, 23). It is one of the top five countries in Sub-Saharan Africa with the highest number of people affected by DM which remains a priority health problem in the health system(24, 25). The prevalence of DM among adults in 2011 was 3.5%(5) with regional variations ranging from 0.5 to 8.4% (5, 26, 27). Daily physical activity is not allowed in the prison due to the prevailing inadequate space.

The population in this study is neglected, stressed, and mostly in risk as they are obliged to lead a sedentary life style with no or minimal physical activities that predispose them to various chronic diseases such as diabetes mellitus (28-30). People in prison are prone to poor diet, in appropriate living conditions, unhealthy behavior (such as smoking and drug abuse), and physical inactivity compared to other people. Though diabetes has been recognized as a public health problem, there are few data on diabetes among disadvantaged people such as prisoners.

Furthermore, the scarcity of data on diabetes makes the problem inadequately calling recognized for further reaching (5, 31-34). Information about vulnerable groups, especially prisoners is lacking. Therefore, determining the magnitude and associated factors of DM at prisons provides information to health professionals, policy makers, government and non-government organizations helping the to maximize and strengthen efforts in prioritizing diabetes and introducing tailored interventions.

METHOD

Study setting and study design: An institution-based cross-sectional study was conducted from August to September 2015, at Kality Federal Prison (KFP), Addis Ababa, Ethiopia, from August to September 2015. It is one of the largest federal prisons in the country with a total of 4348 inmates (3601 male and 747 female).

Study participants, sample size, and sampling procedure: Sample size was calculated using Epi-info version 3.7 by considering the following assumption(35): the proportion of controls among overweight as 6.7%, the proportion of DM among overweight people as 12.56%, 80% power, odds ratio of 2, 95% level of confidence, and 10% non-response rate. Accordingly, the calculated sample size was

876. Prisoners' identification numbers obtained from the prison administration were used as the sampling frame, and participants were selected using the simple random sampling technique.

Data collection tools and procedure: An interviewer-administered standardized questionnaire which was adapted from the WHO STEP-wise approach for chronic diseases was used for data collection. The questionnaire, which was prepared in the local language, included questions that assessed diabetic risk factors. Six clinical nurses and two public health officers were recruited as data collectors and supervisors, respectively. Two days intensive training was given regarding the objective of the study, confidentiality of information, and techniques of interview to data collectors. The glucometer machine and test strips were checked periodically for accuracy using the manufacturer's quality control instruments. The tool was also piloted on 5% of the total sample out of the study area, and the acceptability and applicability of the procedures and tools were evaluated during the pretest.

Operational definitions and study variables: The outcome variable, the status of diabetes mellitus, was ascertained by fasting blood glucose tests recommended by WHO (36). Peripheral blood samples were collected by finger puncture early in the morning (after 8 hours fasting) before participants took breakfast. Fasting plasma glucose (FPG) > 126 mg/dl was used to make the diagnosis of DM, and FBG 110-125 mg/dl was the impaired fasting glucose confirmed by repeating the test on another day (2).

Anthropometric variables such as body mass index and waist circumference were measured using a standardized technique and equipment. Body mass index (BMI) was calculated as the ratio of weight in kg to the square of height in meters. Subjects were weighed to the nearest 0.1 kg in light clothing and bare feet or in socks. Height was measured using a standio-meter, while participants stood in erect position without shoes, and the results were recorded to the nearest 0.5cm.

Accordingly, participants were classified as underweight when their BMI was<18.5 kg/m2, normal when it was 18.5 -24.99 kg/m2, overweight when 25-29.99 kg/m2 and obese ≥30 kg/m2. To measure waist circumference, waist girth was used and measured by placing a plastic tape to the nearest 0.5 cm horizontally, midway between the 12^{th} rib, and iliac spine on the mid-axillary line. Consequently, waist circumference was categorized as low risk if it is ≤93.9cm for men, ≤ 79.9cm for women, high risk if it is ≥ 94 cm for men, and ≥ 80cm for women. Participants' anthropometric measurements were taken by health professionals of the same gender. Self-report of medical illness (DM, Dyslipidemia, and Hypertension) and drug intake (medication for Asthma and HAART) was cross checked on patient's medical chart with the consent of the participant.

Among the behavioral variables, physical activity was assessed by asking the participants how much time they spent in vigorous-intense activity per week. If participants engaged in physical activities for greater than 300 minutes per week, they were categorized as physically active; participants who performed physical activities of between 150-300 minutes per week, they were classified as moderately physically active and those who did less than 150 minutes per week were physically inactive(37). Smoking status of respondents was categorized as ever smoking (current and previous smoking), current smokers, and non-smokers regardless of the

amount and frequency of use. Alcohol use was classified as non-drinkers, occasional drinkers (<1 drink/ day), moderate drinkers (1-3 drinks/day), and heavy drinkers (>3 drinks/day).

Data analysis: Data were entered into EPI INFO version 3.5.3 and exported to the Statistical Package for Social Sciences (SPSS) version 20 for further analysis. Descriptive statistics, including frequencies and proportions were used to summarize the study variables; a binary logistic regression was also used. Both bi-variable and multivariable logistic regression analyses were carried out. Variables with a p-value of less than 0.2 in the bivariable analysis were entered into the multivariable analysis. Both Crude Odds Ratio (COR) and Adjusted Odds Ratio (AOR) with a 95% confidence interval were estimated to assess the strengths of associations. The results were considered statistically significant at P <0.05.

Ethics approval and consent to participate: Ethical clearance was obtained from the Institutional Review Board of the University of Gondar. An official permission letter was secured from the Kality Federal Prison Administration Head Quarters, Addis Ababa, and a written informed consent was obtained from each study participant. The right of participants to withdraw from the study at any time without any precondition was disclosed unequivocally.

Moreover, the confidentiality of information obtained was strictly guaranteed by all data collectors and investigators by using code numbers rather than personal identifiers and by keeping the questionnaire locked. Participants were immediately informed of their results. Individuals identified as cases of DM were linked to the chronic clinic for treatment and follow-ups, and those in the impaired blood glucose level were counseled.

RESULT

Socio-demographic and economic characteristics of respondents: A total of 830 participants were included in the study. The majority (82.5%) of the respondents were male with the mean (±SD) age of 38.64 (± 16.15) years. The minimum age was 15 and the maximum 89 years. Most (83.4%) of them were urban dwellers prior to imprisonment, and only 4% were previously imprisoned (**Table-1**).

Behavioral characteristics of participants: Nearly one-third (29.0%) of the respondents never smoked cigarettes, of whom 19(2.3%) were smoking at the moment. About 36.5% were heavy drinkers. More than half (52.3%) did not eat fruit and vegetables daily, and about one-third (36.7%) were physically inactive during their imprisonment (**Table-2**).

Characteristics related to medicine: The majority (82.4%) of the respondents never heard of diabetes. Nearly one sixth (15.5%) had family history of diabetes. The overall prevalence of hypertension in the study was 44.5%.The proportion of isolated blood pressure (systolic blood pressure ≥ 140 mmHg and diastolic blood pressure <90 mmHg) was 11.11%; and Isolated Diastolic blood pressure (systolic blood pressure < 140 mmHg and diastolic blood pressure ≥ 90 mmHg) was 62.6%. In this study, reported history of raised blood cholesterol was (3.4%) and that of asthma was 4.0%. The proportion of individuals with reported HIV and ADIS positivity was 3.9%, and reported history of TB was 6.9%. The proportion of overweight was 27.8%, and obesity accounted for 4.1% of the participants. The proportion of high risk waist circumference was 39.4% **(Table-3)**.

Table 1: Socio-demographic characteristics of the respondents at Kality Federal Prison, Addis Ababa, Ethiopia, 2015 (n=830)

Variables	Frequency	Percent
Sex		
Male	685	82.5
Female	145	17.5
Age in years (Mean=38.64, SD=16.15)		
15-33	416	50.1
34-43	157	18.9
44-53	89	10.7
54-63	80	9.6
64-89	88	10.6
Educational status		
Illiterate	84	10.1
Primary	345	41.6
Secondary	280	33.8
Diploma	61	7.3
Degree and above	60	7.2
Marital status		
Single	379	45.7
Married	379	45.7
Divorced/widowed	72	8.3
Occupation		
Unemployed	167	20.1
Government employee	118	13.2
Non- government employee	116	14
Self-employed	429	15.7
Residence		
Urban	692	83.4
Rural	138	16.6
Length of stay in prison (in years)		
1-3	423	51.0
4-6	199	24.0
7-9	139	16.7
$\geq$10	69	8.3
Previous imprisonment		
Yes	33	4
No	797	96

Table 2: Behavioral characteristics of respondents at Kality Federal Prison, Addis Ababa, Ethiopia, 2015

Variables	Frequency	Percent
Cigarette smoking status		
Current	19	2.3
Previous	222	26.7
Non-smoker	589	71.0
Ever smoker (current and previous smoker)	241	29.0
Daily alcohol consumption		
Yes	410	49.4
No	420	50.6
Alcohol drinking status		
Non-drinkers	420	50.6
Moderate/occasional drinkers	107	12.9
Heavy drinkers	303	36.5
Eat fruit and/ vegetables		
Yes	396	47.7
No	434	52.3
Number of days fruits/vegetables eaten		
1-3 days / week	316	79.8
4-7 days / week	80	20.2
Intensity of physical activity		
Physically inactive	305	36.7
Moderately active	240	28.9
Active	285	34.3
Watch TV during meal		
Yes	432	52
No	395	48

Table 3: Medical related characteristics of respondents at Kality Federal Prison, Addis Ababa, Ethiopia, 2015 (n=830)

Variables	Frequency	Percent
Ever heard of DM		
Yes	684	82.4
No	146	17.6
Family history of DM		
Yes	106	15.5
No	578	84.5
Fasting blood glucose level		
Diabetic	39	4.69
Impaired/Pre-diabetic	90	10.8
Hypoglycemic	21	2.5
Normo-glycemic	680	81.9
Hypertension status		
Normotensive	461	55.5
Hypertensive	369	44.5
Isolated diastolic hypertension		
Yes	41	11.1
No	328	89.9
Isolated systolic hypertension		
Yes	231	62.6
No	138	37.4
History of raised blood cholesterol		
Yes	28	3.4
No	802	96.6
History of Asthma		
Yes	34	4.0
No	796	96
Reported HIV/AIDS positive		
Yes	28	3.9
No	694	96.1
Ever diagnosed with Tuberculosis		
Yes	57	6.9
No	773	93.1
BMI category		
Underweight	65	7.8
Normal	500	60.2
Overweight	231	27.8
Obese	34	4.1
Waist circumference category		
Low risk	503	60.6
High risk	327	39.4

Prevalence of Diabetes Mellitus: In this study, the overall prevalence of DM was found to be 4.69% [95 % CI: 3.26, 6.14]. The proportion of DM for men was 4.5% and 5.5% for women. Using age-specific rates, the prevalence of diabetes increased with age in both men and women; the peak prevalence was noted in the old age group of between 54 and 63 years (13.8%). Out of the 39 subjects classified as having diabetes in the study, the proportion of newly diagnosed DM was 10 (25.6%). The proportion of pre-diabetes (impaired glucose) was 10.8%, and hypoglycaemia accounted for 2.5%.

Factors associated with Diabetes Mellitus: In the bivariable logistic regression analysis, sex, age, educational status, marital status, residence, family history of DM, hypertensiveness, physical activity, raised total cholesterol, BMI, and waist circumference were included in the final model (p-value of less than 0.02). In the multivariable logistic regression analysis, increasing age and family history of DM were significantly associated with the disease. The odds of diabetes mellitus were about 4 times higher among the 44-53 years group than the 15-33 years [AOR= 3.87;95% CI:1.07-14.03].

Similarly, the odds of DM were 14 time higher among the 54-63 [AOR=14.54; 95% CI; 4.58-46.16], and 64-89 years of age groups compared with the odds of participants in the 15-33 [AOR=17.98, 95% CI: 5.40-59.79] years of age group. The study has identified that being KFP inmate, advanced age, and family history are the strongest predictors of DM [AOR=4.99; 95% CI: 2.16-11.54] (**Table-4**).

Table 4: Factors associated with diabetes at Kality Federal Prison, Addis Ababa, Ethiopia, 2015

Variable	Diabetes Mellitus		COR	AOR
	Yes (%)	No (%)	(95%CI)	(95%CI)
Sex				
Male	31(79.5%)	654 (82.68%)	1	1
Female	8 (29.5%)	137 (17.32%)	1.23(0.55,2.74)	2.56(0.96,6.87)
Age (years)				
15-33	6 (15.4%)	410(53.39%)	1	1
34-43	6 (15.4%)	151(19.66%)	2.72(0.86,8.55)	2.46(0.74,8.17)
44-53	5 (12.8%)	84(10.94%)	4.07(1.21,13.64)	3.87(1.07,14.03)**
54-63	11 (28.2%)	69(8.98%)	10.89(3.90,30.42)	14.54(4.58,46.16)**
64-89	11(28.2%)	54(7.03%)	9.76(3.51,27.18)	17.98(5.40,59.79)**
Residence				
Urban	34 (87.18%)	658(83.19%)	1.37(0.53,3.56)	1.14(0.38,3.44)
Rural	5(12.82%)	133(16.81%)	1	1
Educational status				
Illiterate	8(20.51%)	76(9.61%)	3.03(1.29,7.07)	1.67(0.57,4.92)
Primary /Secondary	21(53.85%)	604(76.36%)	1	1
Diploma and above	10(25.64%)	111(14.03%)	2.59(1.18,5.65)	1.44(0.35,5.92)
Marital status				
Single	7(17.95%)	372(47.03%)	1	1
Married	25(64.10%)	354(44.75%)	3.75(1.60,8.79)	2.22(0.86,5.73)
Divorced/widowed	7(17.95%)	65(8.22%)	5.72(1.94,16.86)	1.02(0.23,4.58)
Eat fruits and / vegetables				
Yes	24(61.54%)	372(47.03%)	1.80(0.93,3.49)	1.62(0.76,3.44)
No	15(38.46%)	419(52.97%)	1	1
Physical activity				
Physically inactive	10(25.64%)	295(37.29%)	1	1
Moderately active	17(43.59%)	223(28.19%)	2.25(1.01,5.0)	1.56(0.65,3.76)
Active	12(30.77%)	273(34.51%)	1.29(0.55,3.05)	1.11(0.43,2.94)
Have family history of DM[a]				
Yes	12(30.77%)	94(14.57%)	2.61(1.28,5.32)	4.99(2.16,11.54)**
No	27(69.23%)	551(85.43%)	1	1
Hypertension status				
Normotensive	10(25.64%)	451(57.02%)	1	1
Hypertensive	29(74.36%)	340(42.98%)	3.85(1.84,8.0)	1.29(0.50,3.36)
History of raised blood cholesterol				
Yes	4(10.26%)	24(3.03%)	5.81(2.23,15.18)	1.67(0.53,5.24)
No	35(89.74%)	767(96.97%)	1	1
BMI[b]				
Underweight	6(15.38%)	57(7.21%)	5.71(0.24,14.54))	8.35(0.85,24.52)
Normal	12(30.77%)	488(61.69%)	1	1
Overweight	16(41.03%)	217(27.43%)	2.62(1.19,5.77)	1.78(0.77,4.10)
Obese	5(12.82%)	29(3.67%)	7.01(0.31,21.24)	4.46(0.32,15.03)
Waist circumference				
Low risk	16(41.03%)	487(61.57%)	1	1
High risk	23(58.97%)	304(38.43%)	2.30(1.19,4.43)	1.05(0.42,2.64)

[a] Diabetes mellitus, [b] Body Mass Index, [**] significant at a p-value of <0.05

DISCUSSION

Ethiopia has been implementing a health sector development program since 2010 to decrease the prevalence of diabetes mellitus among adults to be between 1-3% (38). This study has identified a high prevalence of DM among KFP, and old age, and family history of DM are the strongest predictors of diabetes mellitus in prisoners.

The prevalence of DM (4.69%) in this study is somewhat in line with 5.1% and 6.5% [5] reported by studies conducted in northwest Ethiopia and among the employees of the Commercial Bank of Ethiopia, respectively. A similar consistent finding (5.3%) was also noted in a study done in Spain (39). However, the finding is lower than the global upper quartile prevalence of 6.3%. On the other hand, the prevalence of DM is higher than the reports of the national prevalence of Ethiopia (1.9%), Eritrea (1.9%), Somalia (2.5%), Sudan and South Africa (3.4% each), and Botswana (3.6%) (23). This discrepancy might be due to the fact that inmates are in greater risk of DM compared with other segments of the population.

In the study, increasing age was an important risk factor for DM among prisoners', this is consistent with other reports of studies conducted elsewhere (5, 14, 15). This can be so due to the fact that aging incapacitates the strength and functions of the musculature (1). Reports suggested that aging causes a progressive decline in the strength of musculature, leading to muscle atrophy and increasing risk of developing DM (5, 23).

Like the findings of studies conducted elsewhere (5, 17, 18), higher odds of diabetes mellitus were noted among prisoners who had family history. This can be explained by the fact that genetic factors alone can predispose to diabetes is not clearly understood. Life style and living environment within families are most likely to be contributing factors to diabetes. Moreover, as it is stated in barker's hypothesis, infants from diabetic mothers exposed to increased glucose and fatty acid concentration before birth will undergo foetal over nutrition, leading to an increased risk of glucose intolerance and DM in later life (40).

We can't claim that the study is free from limitations; the cross-sectional nature of the design does not enable the work to show temporal relationships. Lack of some details on exposure, like alcohol consumption, khat chewing, and smoking is another limitation. In addition, other psychological factors, like stress are not measured in this study.

CONCLUSION

The prevalence of DM is high among prisoners, particularly those in old age groups and have family history. Thus, early screening of the elderly and those with family history is needed to reduce the risk and complications of diabetes.

List of Abbreviations: AOR, Adjusted Odds ratio; BMI, Body Mass Index; CI, Confidence Interval; DM , Diabetes Mellitus; FBG, Fast blood glucose; KFP, Kality federal prison; mg/dl, milligram per deciliter; SPSS, Statistical software for social science; WC, Waist circumference; WHO, World Health Organization.

Authors' contribution: Conceived, designed and performed the experiments: BBD, SMA, AT and MKY. Analyze the data and wrote the manuscript: BBD, SMA, AT and MKY. All authors gave sugges-

tions, read the manuscript, agreed on its content and approved the final version.

Competing interest: Authors declare that they have no conflict of interest.

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