International Journal of Community Medicine and Public Health
Abdalla EAM et al. Int J Community Med Public Health. 2017 Jun;4(6):1863-1869
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20172146

Original Research Article

Epidemiology of diabetes among adults in Jabra area '' block 14'' in Khartoum state – Sudan: community based study

Eltagi A. M. Abdalla[1]*, Ragda F. Ahmed[2]

Department of Epidemiology, [1]Faculty of Public and Environmental Health, University of Khartoum, Sudan, [2]Federal Ministry of Health, Khartoum, Sudan

Received: 19 April 2017
Accepted: 09 May 2017

***Correspondence:**
Dr. Eltagi A. M. Abdalla,
E-mail: eltagimohd@yahoo.com

ABSTRACT

Background: Diabetes mellitus is a major public health problem, affecting hundreds of millions of people worldwide. The objectives of the study were to estimate the prevalence of and to identify the possible risk factors associated with diabetes among the study population.
Methods: A descriptive cross sectional community based study was carried out among 236 adults residing in Jabra area in Khartoum State in Sudan. Data were collected used pre tested structured questionnaire, and validated in a pilot study. The questionnaire included; socio-demographic data and possible risk factor such as (stress, physical exercise, history of pancreatic, history of renal problems and obesity). Anthropometric measurement included weight and height for BMI and laboratory data included random blood glucose (RBG) and fasting plasma glucose (FPG).
Results: The present study showed, the prevalence of diabetes mellitus among adults in Jabra area was 18.6%. There was no significant sex difference in the prevalence rate. The results showed there was statistical association between diabetes positivity and marital status, age groups, educational level and family income p-values =(0.0002, 0.0004, 0.0005 and 0.0053) respectively. The multivariate analysis indicated family history of diabetes, obesity, physical activity, renal problems and pancreatic diseases were other risk factors associated with diabetes mellitus positivity OR =(2.19 (95% CI 1.10 - 4.34, p =0.027), 3.11 (95% CI 1.13 – 8.56, p =0.0278), 0.28 (95% CI 0.11 - 0.75, p =0.0113), 7.42 (95% CI 2.00- 27.57, p =0.0028) and 12.18 (95% CI 2.28 - 65.1, p =0.0035) respectively.
Conclusions: The study found a higher prevalence of diabetes among study population. Risk factors showed a significant relation with higher fasting blood glucose.

Keywords: Diabetes mellitus, Khartoum state, BMI, Risk factors, Sudan

INTRODUCTION

Diabetes mellitus (DM), characterized by chronic hyperglycemia is a major global health problem emerging in developing countries.[1] Diabetes Mellitus (DM) is a global epidemic in this millennium. The highest increase in Diabetes Mellitus prevalence is amongst low and middle-income countries. According to WHO, 80% of diabetes deaths occur in low and middle income countries.[2] Non-communicable diseases (NCDs) are the leading cause of death globally and diabetes mellitus is the 4th main contributor.[3] According to the World Health Organization (WHO) Regional Office for Africa, non-communicable diseases including DM, will increase so rapidly in Sub-Saharan Africa (SSA) as an epidemic by year 2020.[4] The global burden of diabetes mellitus is enormous and glaring. The impact on health and economy is substantial, yet this disease is assuming an epidemic proportion worldwide, with its global prevalence estimated at about 366 million today, and 552

million by 2030.[5] Emerging trend of diabetes mellitus (DM) is observed worldwide, as by 2025, its prevalence is projected to be 6.3%, which is a 24.0% increase compared with 2003. There will be 333 million (a 72.0% increase) diabetics by 2030 in individuals of 20 to 79 years of age. The developing world (mainly central Asia and Sub-Saharan Africa) accounted for 141 million people with diabetes (72.5% of the world total) in 2003.[6] The number of people (aged 20-79 years) with diabetes mellitus (diabetes) worldwide is projected to increase from 382 million in 2013 to 592 million in 2035.[7]

The prevalence of diabetes is rapidly rising globally. World Health Organization (WHO) reports show that 32 million people had diabetes in the year 2000.[8] The number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity.[9] In Africa, diabetes mellitus is estimated to affect around 14 million individuals and this is expected to rise to about 28 million by 2030. The rise has been attributed to lack of physical activity, high carbohydrate intake and ageing populations. Importantly, there is an increase in the prevalence in obesity—an important risk factor for type 2 diabetes—in Africa.[10]

Prevalence of DM differs from country to country. The prevalence of diabetes in Nigeria was 3.25%.[7] In Tanzania the overall prevalence of T2DM in adults was 11.9%.[11] The prevalence of DM in Bangladesh was 12.3%.[12] In Vietnamese adults was 5.9%.[13] In India the prevalence in adults was 12.4%.[14] In China was 5.9%.[15] The overall prevalence of DM among population in Jazan was found to be 12.3%.[16]

Diabetes mellitus in Sudan: Several studies have indicated that, the prevalence of DM in Sudan with increasing rates. A house hold survey was carried out in Sudan showed that, the prevalence of diabetes in Sudan is rising from 9.3% in 2010 to 10.6 % in 2013.[17] Other study carried out in four states in Sudan, showed the prevalence of diabetes in rural population was 11.2%.[18]

METHODS

Study design

A descriptive cross sectional community based study which was conducted among adults at Jabra area in Khartoum State, Sudan from January to April 2015.

Study area

This study was conducted at Jabra area " Block 14" in Khartoum state -Sudan, it is urban area locate between Block 12 area from East, Al-Bjraweia area from West, Railway and military zone from South and "Block 13" from North direction. The total population about 35000 people. The houses number about 750 houses. There is one health centre and two government primary school and one secondary school.

Data collection

Two hundred and thirty six (236) participant was obtained using the statistical equation ($n = Z^2 \times pq/e^2$). Where n is the sample size, Z^2 is the abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level is 95%), e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population, and q is 1-p.[17] Data were collected used pre tested structured questionnaire, and validated in a pilot study. The questionnaire included; socio-demographic data such as (Sex, age group, marital status, monthly income, educational level, and family history of diabetes), possible risk factor such as (stress, physical exercise, history of pancreatic, history of renal problems and obesity). Anthropometric measurement included weight and height for BMI and laboratory data included random blood glucose (RBG) and fasting plasma glucose (FPG).

Anthropometric measures

Anthropometric measurements of the subjects were taken using standard apparatus. The measurements included weight, height and blood pressure.

Weight (kg) was measured using the Heine Portable professional adult scale 737. The participants were requested to stand still, with their arms placed on the sides of the body, the measurement were taken the nearest 0.1 kg.

Height (m) was measured to the nearest 0.001 m using a portable meter rule (Seca Brand 217 portable stadiometer was used), with the subject standing on barefooted, without cap or headgear. Participants were requested to put their feet together and, the heels against the backboard and looking straight ahead before the reading could be taken.

Then BMI was calculated as BMI =Weight (Kg) / [Height $(m)^2$]. Body weight categories were defined using WHO cut-offs as follows: underweight =BMI $\leq$18.4 kg/m^2, normal weight =BMI$\geq$ 18.5 $\leq$24.9 kg/m^2, overweigh =BMI $\geq$ 25.0 $\leq$ 29.9 kg/m^2 and obese =BMI $\geq$ 30 kg/m^2 (WHO, 1995).

Laboratory investigation

At the time of the interview, random blood glucose (RBG) of the respondents was measured using capillary finger prick method by ACCU-CHEK® active glucometer. Respondents with RBG ≥200 mg/dl suspected to have diabetes, then were requested to do a follow up fasting plasma glucose (FPG). Researchers requested respondents to fast for at least 8 hours to confirm if they were normal or have diabetes. A person

was confirmed to be diabetic when Fasting Plasma glucose was ≥126 mg/dl.

5 ml of blood were obtained into a clean disposable plastic container containing anticoagulant potassium fluroxide. Sample centrifuged at 3000 rpm for 5 minutes. Plasma was separated and treated with glucose oxidase reagent and colour developed within 15 minutes.

Data analysis

Data were analyzed used SPSS (Statistical Package for Social Science) version 20. Chi-square test was used to determine the significance differences between variables. The Odds ratio (OR) was applied with 95% confidence intervals. Differences to be significant at level of p-value less than 0.05.

RESULTS

A total of 236 adults were participated in this study. Socio demographic characteristics of adults show in (Table 1).

Table 1: Socio-demographic characteristics of the study participants – Jabra area '' block 14''.

Variable	Frequency	%
Study group	236	100
Sex		
Male	99	41.9
Female	137	58.1
Age group		
18 – 30	92	38.9
31 – 45	78	33.1
46 -60	49	20.8
> 60	17	07.2
Marital status		
Married	153	64.8
Unmarried	83	35.2
Educational level		
Illiterate	27	11.4
Basic	23	09.8
Secondary	52	22.0
Graduate	134	56.8
Monthly income		
Poor	107	45.3
Average	82	34.8
High	47	19.9

58.1% (137/236) of participants were females while 41.9% males. Most of participants in age group (18-30) years (38.9%) followed by 31- 45 years of age group (33.1%), 46-60 years of age group (20.8%) and above sixty of age (07.2%). 64.8% of participants were married while 35.2% of them unmarried. Out of 236 participants 134 (56.8%) are graduate level of education, 22.0% having secondary level of education, 11.4% were illiterate and 9.8% having basic education. Regarding to monthly income 45.3% (107/236) having poor income, 34.8% on average income while 19.9% having high income.

The overall prevalence of diabetes among adults in Jabra area "block 14" is 18.6% (44 out of 236), while 81.4% of adults have not diabetes (Figure 1).

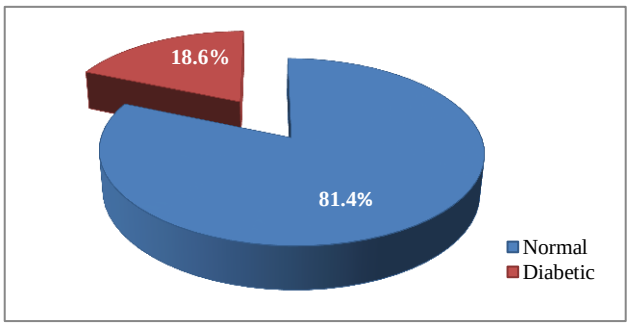

Figure 1: Prevalence of diabetes among respondents (adults) – Jabra area "block 14" (n = 236).

Distribution of participants in the study according to obese and not obese in Figure 2. Only 7.6% (18/236) were obese, while 92.4% of them non obese (47.9% in normal weight, 36.9% overweight and 7.6% underweight (Figure 2).

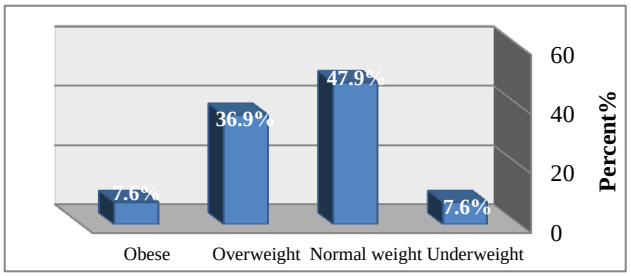

Figure 2: Distribution of respondents (adults) according to the BMI – Jabra area "block 14"

Socio-demographic characteristics associated with diabetes mellitus positivity

Table 2 show the marital status, age groups, educational level and family income were associated with Diabetes mellitus. Diabetes more prevalent among married (25.5%) compared to unmarried (6.2%), there was strong statistical association (p=0.0002 at X^2 =13.443). the result show the diabetes increasing in increasing with age, the prevalence is 41.2% (7/17) among those above 60 years old, 32.3% (16/49) among those in 46-60 of age group, 16.7% (13/78) in those 31-45 of age group and 8.7% in those 18-30 of age group, the results show there was statistical relationship (p =0.0004 at X^2 =18.234). in relation to education level the result show diabetes is more prevalent in those having lower education level 40.7% (11/27) in illiterate and 34.8% (8/23) in basic compared to 15.6% (21/134) in graduate, statistically

there was strong association (p=0.0005 at X^2 =17.533). Income have contributing in diabetes, the result show the prevalence is high among those have high income 23.4% (11/47), 17.8% (19/107) in poor income and 17.1% (14/82) among those their income is average. There was association between diabetes and income (p=0.0053 at X^2 =10.473). The results show there is no differences between sex and DM positivity (p >0.05) (Table 2).

Table 2: Relationship between socio-demographic characteristics and diabetes mellitus among adults in Jabra area "block 14".

Variable	Blood sugar result		Total	Chi- square	p-value
	Diabetic	Non-diabetic			
	No (%)	No (%)	No (%)		
Sex					
Male	16(6.8)	81(35.2)	99(42.0)	0.578	0.447
Female	28(11.7)	109(46.2)	137(58.0)		
Marital Status					
Married	39(16.5)	114(48.3)	153(64.8)	13.443	0.0002*
Unmarried	5(02.1)	78(33.1)	81(35.2)		
Age group					
18-30	08(03.4)	84(35.6)	92(39.0)	18.234	0.0004*
31-45	13(05.5)	65(27.5)	78(33.0)		
46 – 60	16(06.8)	33(14.0)	49(20.8)		
>60	07(03.0)	10(04.2)	17(07.2)		
Income/moth					
Poor	19(08.0)	88(37.3)	107(45.3)	10.473	0.0053*
Average	14(05.9)	68(28.8)	82(34.8)		
High	11(04.6)	13(15.3)	47(19.9)		
Educational level					
Illiterate	11 (04.6)	16(06.8)	27(11.4)	17.533	0.0005*
Basic	08(03.4)	15(06.4)	23(09.8)		
Secondary	04(01.7)	48(20.3)	52(22.0)		
Graduate	21(08.9)	113(47.9)	134(56.8)		

*Significant p <0.05 at CI 95%.

Table 3: Multivariate regression models for the relationship between diabetes mellitus and some selected risk factors.

Variable	Blood sugar result		Total	Odds (Confidence interval) (CI)	p-value
	Diabetic	Non-diabetic			
	No (%)	No (%)	No (%)		
Family history					
Yes	29(12.3)	90(38.1)	119(50.4)	2.19(1.10 – 4.34)	0.0248*
No	15(06.4)	102(43.2)	117(49.6)		
Obesity					
Obese	07(03.0)	11(04.6)	18(07.6)	3.11(1.13 - 8.56)	0.0278*
Non-obese	37(15.7)	181(76.7)	218(92.4)		
Physical activity					
Yes	05(02.1)	60(25.4)	65(27.5)	0.28(0.11 – 0.75)	0.0113*
No	39(16.5)	132(56.0)	171(72.5)		
Stress					
Yes	26(11.0)	137(58.1)	163(69.1)	0.58(0.29 – 1.14)	0.1149
No	18(07.6)	55(23.3)	73(30.9)		
Renal problems					
Yes	06(16.5)	04(48.3)	10(04.2)	7.42(2.00 – 27.57)	0.0028*
No	38(02.1)	188(33.1)	226(95.8)		
Pancreatic diseases					
Yes	05(02.1)	02(0.9)	07(03.0)	12.18(2.28 – 65.1)	0.0035*
No	39(16.5)	190(80.5)	229(97.0)		

*Significant p<0.05 at CI 95%.

Some risk factors associated with prevalence of diabetes mellitus among adults

Multivariate regression analysis demonstrate the relationship between some risk factors such as; family history, obesity, physical activity, renal problems and pancreatic diseases and Diabetes mellitus positivity. The results show there was statistical association between family history and DM positivity OR 2.19 (95% CI 1.10 - 4.34, p =0.027). The findings show the DM more prevalent among obese than Non-obese, statistically significant OR 3.11 (95% CI 1.13 – 8.56, P =0.0278). the study show the, diabetes mellitus more prevalent among respondents have lack/or no practices physical activity OR 0.28 (95% CI 0.11 - 0.75, p =0.0113). The findings show respondents with renal failure are seven-and forty tow times more likely to have DM compared to those have not renal problems OR 7.42 (95% CI 2.00- 27.57, p =0.0028). Also the result show respondents with pancreatic diseases are twelve – and eighteen times more likely to have DM compared to those have not pancreatic diseases OR 12.18 (95% CI 2.28 - 65.1, P =0.0035). The results show there is no statistical association between stress and DM positivity (p >0.05) (Table 3).

DISCUSSION

The present study reported that, the total prevalence of diabetes mellitus among adults in Jabra area was 18.6%. This results were higher than that found in Sudan; 10.6% of population in Sudan to be diabetic in 2013.[17] Other study carried out in four states in Sudan, showed the prevalence of diabetes was 11.2%.[18] Also our results were higher than that reported in different countries; the prevalence of DM was found 3.25% in Nigeria, 11.9% in Tanzania, 12.3% in Bangladesh was, 12.4% in India, the prevalence in adults 5.9% in China.[7,11,12,14,15] Our results lower than that reported in Saudi Arabia 23.7%.[21]

Generally, worldwide diabetes prevalence is similar in men and women, but it is shown to be slightly higher in men greater than 60 years of age[11]. Our results show there was no differences between sex and Diabetes mellitus positivity (p >0.05). This result disagrees with that reported by Ruhembe et al; diabetes was more prevalent in the women of 51-60 years group.[11]

The findings show that, the marital status, age groups, educational level and family income were associated with diabetes mellitus. The present study revealed that, Diabetes mellitus was more prevalent among married (25.5%) compared to unmarried (6.2%). The results showed there was strong statistical association (p =0.0002 at X^2 =13.443).

Regarding to the age group the result show the diabetes increasing in increasing with age, the prevalence was 41.2% among those above 60 years old, compared to 8.7% in those 18-30 of age group. The results show there was statistical relationship (p =0.0004 at X^2 =18.234). This result similar with that found in Nigeria by Ekpenyong et al, the prevalence of diabetes was highest in the 46- 60 age group and lowest in the 18-25 age group.[5] Also agree with that reported by Niti et al mentioned Diabetes more prevalent in age group >40 years old.[2] Our results in line with that found in Bangladesh, diabetes prevalence increased with increasing age reaching a peak at >50 year age group.[12]

The study showed that, Diabetes among adults was more prevalent among those having lower education level 40.7% compared to 15.6% among those having graduate education level, statistically there was strong association (p =0.0005 at X^2 =17.533). Our result consistent with that reported in Bangladesh; the highly educated subjects were found at risk for diabetes.[12]

Family income have contributing in diabetes, our findings showed the prevalence was high among those have high income 23.4% than low income. The result show there was statistical association between diabetes and income (p =0.0053 at X^2 =10.473). This finding similar with what was found in Bangladesh; participants having a high monthly income were found at risk of diabetes.[12] Also agree with that reported in Tanzania, there was a significant association between family history and incident T2DM.[11]

Our study revealed that, family history of diabetes, obesity, renal problems and pancreatic diseases were other risk factors associated with diabetes mellitus positivity. The results show adults with family history of diabetes were two-and one nine times more likely to have diabetes mellitus compared to those who have no family history of diabetes OR 2.19 (95% CI 1.10 - 4.34, p =0.027). This result in line with that reported in Nigeria; family history was a significant risk factors for diabetes among older adults.[19]

The study show there was statistical relationship between lack/or no practices physical activity and diabetes positivity OR 0.28 (95% CI 0.11 - 0.75, P =0.0113). this result consist with that found in sub-Saharan Africa; an increased risk of diabetes associated with reduced amounts of physical activity.[20] Also similar with that found in population in Saudi Arabia, there was an association between diabetes and physical activity. The group with physical activity had the lowest prevalence of DM.[16]

In relation to obesity, our findings show DM more prevalent among obese and obese adults were three – and eleven times more likely to have diabetes than non-obese OR 3.11 (95% CI 1.13 – 8.56, p =0.0278). This result similar with study carried out in Saudi Arabia, study show the univariate analysis showed a significant association between BMI and DM, BMI greater than 30 increases the risk of DM twice.[16] Also our result similar

with that found in adults Nigerians; measures of obesity were significantly higher in diabetics compared to non-diabetics[22].

Regarding to pancreatic diseases the study show, adults have pancreatic diseases more likely to get diabetes than those have not pancreatic diseases by twelve - and one times OR 12.18 (95% CI 2.00- 27.57, p =0.0028). Our findings showed there was statistical association between renal failure/problems and diabetes mellitus positivity OR 7.42 (95% CI 2.00- 27.57, p =0.0028). The study show there is no statistical association between stress and DM positivity (p >0.05).

ACKNOWLEDGEMENTS

We are grateful to all who assisted in conducting this research including administration unit in Jabra, respondents and volunteers. We would like to thank all staff in Department of Epidemiology - Faculty of Public and Environmental Health - University of Khartoum - Sudan.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. OnKin JBKL, Longo-Mbenza B, Okwe N, Kabangu NK, Mpandamadi SD, Wemankoy O, et al. Prevalence and risk factors of diabetes mellitus in Kinshasa Hinterland. Int J Diabetes Metabolism. 2008;16:97-106.
2. Niti S, Amrit V, Gupta BP, Jasdeep S. Prevalence and Risk Factors of Diabetes Mellitus among Adults residing in Field Practice Area of a Teaching Hospital in Punjab. Health line J. 2015;6(1):57-62.
3. Oguejiofor O, Odenigbo C, Onwukwe C. Diabetes in Nigeria: Impact, Challenges, Future Directions. Endocrinol Metab Synd. 2014;3(2):1-9.
4. World Health Organization. Non communicable diseases: A strategy for the African region. WHO Regional Office for Africa, Harare, 2000.
5. Ekpenyong CE, Akpan UP, Ibu JO, Nyebuk DE. Gender and Age Specified Prevalence and Associated Risk Factors of Type 2 Diabetes Mellitus in Uyo Metropolis, South Eastern Nigeria. 2012;41(1):17-28.
6. Kapoor D, Bhardwaj AK, Kumar D, Raina SK. Prevalence of Diabetes Mellitus and Its Risk Factors among Permanently Settled Tribal Individuals in Tribal and Urban Areas in Northern State of Sub-Himalayan Region of India. Int J Chronic Diseases. 2014;380597:1-9.
7. Kyari F, Tafida A, Sivasubramaniam S, Murthy GVC, Peto T, Gilbert CE. Prevalence and risk factors for diabetes and diabetic retinopathy: results from the Nigeria national blindness and visual impairment survey. BMC Public Health. 2014,14:1299.
8. Deepthi R, Chandini C, Pratyusha K, Kusuma N, Raajitha B, Shetty G. Screening for Diabetes and their risk factors among adults in Rural Kolar – A community based study. Int J Res Dev Health. 2013;1(4):152-9.
9. Wild S, Roglic G, Green A, Sicree R, King H. Global Prevalence of Diabetes- Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004; 27:1047-57.
10. Noor SKM, Bushara SOE, Sulaiman AA, Elmadhoun WMY, Ahmed MH. Undiagnosed diabetes mellitus in rural communities in Sudan: prevalence and risk factors. EMHJ. 2015;21(3):146-70.
11. Ruhembe CC, Mosha TCE, Nyaruhjcha CNM. Prevalence and awareness of type 2 diabetes mellitus among adult population in Mwanza city, Tanzania. Tanzania J Health Res. 2014;16(2):89-97.
12. Nazmul Ahasan HAM, Islam Z, Miah T, Nur Z, Mohammed FR, Khan MAI, et al. Prevalence and Risk Factors of Type 2 Diabetes Mellitus Among Secretariat Employees of Bangladesh. J Med. 2011;12:125-30.
13. Pham NM, Eggleston K. Diabetes Prevalence and Risk Factors Among Vietnamese Adults: Findings From Community-Based Screening Programs. Diabetes Care.2015;38:77-8.
14. Govindu S, Krishna BG, Prabhu GR. Prevalence of diabetes mellitus and its association with life style factors among adults in Tirupati, Andhra Pradesh. Int Arch Integrated Med. 2015;2(5):10-7.
15. Li S, Guo S, He F, Zhang M, He J, Yan Y, et al. Prevalence of Diabetes Mellitus and Impaired Fasting Glucose, Associated with Risk Factors in Rural Kazakh Adults in Xinjiang, China. Int J Environ Res Public Health. 2015;12:554-65.
16. Bani IA. Prevalence, Knowledge, Attitude and Practices of Diabetes Mellitus among Jazan Population, Kingdom of Saudi Arabia (KSA). J Diabetes Mellitus. 2015;5:115-22.
17. CBS. Sudan House hold Survey. IN: Statistic, editor. Khartoum 2010.
18. Balla SA, Abu Ahmed H, Awadelkareem MA. Prevalence of diabetes, knowledge and attitude of rural population towards diabetes and hypoglycaemic event, Sudan. 2013. Am J Health Res.2014;2(6):356-60.
19. Mezie-Okoye MM. Diabetes in older adults: experience from a rural community in south-east Nigeria. African J Diabetes Med. 2013;21(2):45-8.
20. Mbanya JCN, Motala AA, Sobngwi E, Assah FK and Enoru ST. Diabetes in sub-Saharan Africa. Lancet. 2010;375:2254–66.
21. Al-Nozha MM, Al-Maatouq MA, Al-Mazrou YY, Al-Harthi SS, Arafah MR, Khalil MZ, et al. Diabetes mellitus in Saudi Arabia. Saudi Med J. 2004;25(11):1603-10.

22. Ejike CECC, Uka NK and Nwachukwu SO. Diabetes and pre-diabetes in adults Nigerians: Prevalence and correlation of blood glucose concentrations with measures of obesity. Academic Journals. Afr J Biochem Res. 2015;9(3):55-60.

Cite this article as: Abdalla EAM, Ahmed RF. Epidemiology of diabetes among adults in Jabra area " block 14'' in Khartoum state – Sudan: community based study. Int J Community Med Public Health 2017;4:1863-9.