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Original Article

Prediabetes and some Associated Risk Factors in Children and Young Adults in Rural and Urban Communities in Kassena Nankana District, Ghana

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Abstract

Background: Due to the increasing trend of prediabetes and diabetes globally, the study investigated the prevalence of these dysglycaemic conditions in children and young adults of 5-20 years of age, assessed some risk factors of diabetes, as well as the awareness of diabetes among subjects in the Kassena Nankana District of Upper East region, Ghana. **Materials and Methods:** This cross sectional survey was conducted from January to May 2012 on three hundred and five healthy volunteers who were randomly selected from six clusters in the district. Demographic data was collected from the study population using a structured questionnaire, followed by anthropometric and fasting blood glucose measurements. **Results:** The sex distribution of the study participants were 48.2% males and 51.8% females, and the overall mean age was 12.04±4.15 (±SD). About 49.2% and 50.8% of the respondents were from the rural settlements and urban communities respectively. The mean BMI of the respondents was 18.13±3.6 kg/m^2, whilst 9.8% were overweight and obese, with a BMI ≥85th percentile for age and gender. The mean fasting blood glucose level was 4.96±0.51 mmol/l, and 11.5% had impaired fasting blood glucose, while none of the participants had diabetes. A positive family history of diabetes and hypertension was reported in 7.5% and 23.9% of the participants, respectively. There is a positive association between prediabetes and obesity, family history of diabetes and hypertension. **Conclusion:** The early detection of preclinical state of diabetes will create an opportunity for delaying and preventing the onset of the disease and its associated complications.

Key-words: Prediabetes, impaired fasting glucose, diabetes mellitus, prevalence, urban, rural.

Introduction

Diabetes mellitus (DM) has currently been established as a chronic disease all over the world, affecting a large number of individuals. The number of people affected is increasing in alarming proportions. The worldwide prevalence of DM in 2000 was 171 million individuals and it is projected to rise to 366 million by the year 2030.[1] In sub-Saharan Africa, the prevalence of DM is estimated at 12 million people recently and it is expected to double to 24 million in the next two decades.[2,3] The developing nations, including those of sub-Saharan Africa may encounter the largest proportional increase in DM prevalence.[1]

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Although DM (especially type 2 diabetes mellitus) is largely found in adults, there is an increasing prevalence of DM among children and adolescents in recent times.[4,5] After asthma, DM is the most prevalent disease of childhood, it is therefore

important and urgent for public health professionals to monitor the trends in childhood diabetes.[6] As a result of the worldwide epidemic of diabetes, the health of a large number of individuals, especially children and the youth is threatened.[7] In the pathophysiology of DM, there exists an intermediate state between normal glucose metabolism and that of type 2 DM, known as prediabetes. It is categorized as impaired fasting glucose (IFG), impaired glucose tolerance (IGT) or both.[8] In the state of prediabetes, blood glucose concentrations are elevated but not high enough to be diagnosed as diabetes. The gradual transition from prediabetes to clinical or clear diabetes may take a long time, often years. It has been reported that about 70% of persons with prediabetes finally develop diabetes.[9] The gradual change to DM from prediabetes can be delayed or prevented through modification of lifestyles of affected individuals.[10] Preventing or delaying the onset of DM is likely to be the best alternative of overcoming the associated adverse outcomes of the disease. It therefore provides an opportunity for intervening to prevent the progression to real diabetes, thus reducing the health and economic burden that comes with DM.[11] Recently, much concern has been placed on early detection of prediabetes and diabetes, not only in adults but in children and adolescents, so that prevention strategies can be put in place to delay and prevent the progression of prediabetes to diabetes. The purpose of this study was to estimate the prevalence of diabetes and prediabetes through a fasting blood glucose test in children and young adults. Some risk factors such as obesity, family history of diabetes were also assessed, as well as the knowledge of DM among the subjects and their care givers.

Materials and methods

This a cross-sectional survey was conducted over a five-month period, from January to May, 2012 at the Kassena Nankana District of the Upper East region, Ghana. The participants were healthy children and young adults of 5-20 years of age, residing in the Kassena Nankana District. The district is located within the Guinea Savanna zone of Ghana and covers a total land area of 1,675 km^2 along the Ghana-Burkina Faso border. There are two main climatic seasons, the wet and dry seasons. The mean annual rainfall of the area is 1,365mm, while the mean monthly temperature ranges from 22.8^oC to 34.4^oC. The total population of the district as at December, 2010 was 153,856 people with a majority been rural inhabitants.

Community stratification

The Navrongo Health and Demographic Surveillance System (NHDSS) of the Navrongo Health Research Centre has divided the districts into five zones; namely North, South, East, West and Central, which are further partitioned into clusters.[12] Six clusters were randomly sampled and the participants were further selected randomly from the six clusters. The minimum sample size of 305 participants was computed by using a crude prevalence of DM of 6.0%, an error margin of ±0.03 at 95% confidence interval and a non-response rate of 10%.

Selection criteria

Children and young adults of 5-20 years old, apparently healthy and who gave their consent to participate, were recruited into the study. They should have had an overnight fast of 10-12 hours. Severely-ill subjects were not eligible to participate in the study.

Participant recruitment

The selected participants were followed up to the community and recruited into the study; a written consent was obtained from the participants and their caregivers who agreed to be part of the study. A structured questionnaire which was pre-tested for appropriateness was used to collect data from the participants. The demographic parameters assessed were age, gender and educational status. Weight was measured in kilogram using a physician scale, height was measured in cms using a wall-mounted meter-rule, and waist circumference was measured in cms using a tape measure. The family history of diabetes and hypertension of the participants and their knowledge of diabetes were also assessed. The body mass index (BMI) of the participants were computed as BMI (kg/m^2) = weight (kg)/ $(height)^2$ (m^2). Fasting blood glucose (FBG) was analysed from blood obtained from a finger prick using a blood glucose meter (Onetouch-SELECT, LifeScan, Milpitas-CA, USA), which was approved by the US Food and Drug Administration for analysing blood. Subjects who had fasting blood glucose concentrations that were ≥5.6 mmol/L had their tests repeated and the average values were obtained.

Operational definitions

Overweight and obesity in the participants was considered when the BMI exceeded the 85th and the 95th percentile respectively, specific for age and gender.[13] When FBG concentration is from 5.6 - 6.9 mmol/L, or 6.1 – 6.9 mmol/L, it is classified as prediabetes (impaired fasting glycaemia, IFG) according to the American Diabetes As-

sociation (ADA) criteria or World Health Organization/International Diabetes Federation (WHO/IDF) criteria respectively, and diabetes was defined as FBG of ≥ 7.0 mmol/L.[14] Ethical approval of the study protocol was obtained from the Committee on Human Research, Publication and Ethics of Kwame Nkrumah University of Science and Technology and Komfo Anokye Teaching Hospital and the Institutional Review Board of the Navrongo Health Research Centre.

Data analysis

Data was analysed with the Statistical Package for Social Sciences (SPSS) version 18.0 for windows. For continuous variables, means and standard deviations were computed, while for categorical variables, proportions or percentages were determined. Differences between means were assessed by the analysis of variance (ANOVA). Pearson's chi square (χ^2) was used to determine the differences in proportions, and the logistic regression model was used to compute the odds ratio for each risk factor. Statistical significance was considered at a p-value of <0.05.

Results

A total number of 305 children and young adults residing in rural and urban communities in the study area were recruited as study subjects. The study subjects ages ranged from 5 to 20 years old with a mean age of 12.04±4.15 years. The age distribution and education status of the study participants are shown in table 1. The number of participants residing in urban communities was 155 (50.8%) and that in the rural communities was 150 (49.2%). There were 275 (90.2%) participants who were of normal weight, 24 (7.9%) were overweight and 6 (2.0%) participants were obese. Out of the 305 subjects studied, 270 (88.5%) participants had normal fasting blood glucose levels, 35 (11.5%) according to the ADA criteria and 10 (3.3%) according to the WHO/IDF criteria had impaired fasting glucose levels and none of the participants had diabetes (Table 1). The mean FBG level was 4.96±0.51 mmol/L, it was similar in the males (4.90±0.52) and the females (5.0±0.50), (p=0.551), although the number of females with prediabetes was higher than the males (19 versus 16). The proportion of individuals with prediabetes was similar in the urban and rural communities (18 versus 17, p=0.372), as in table 3. Table 2 indicates the knowledge of DM among the participants and some factors associated with DM, including the family history of DM and hypertension. Around as 59.7% of the participant and this care givers did not have any knowledge of diabetes. Participants obtained their information on diabetes from various sources as shown in figure 1. It was recorded that 23 (7.5%) and 73 (23.9%) of the participants had a positive family history of DM and hypertension respectively. There were more females affected with diabetes (60.9%) and hypertension (74.0%) than males among the relatives with diabetes and hypertension.

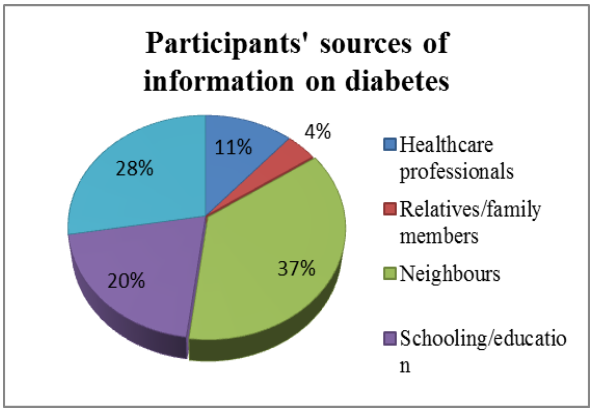

Fig 1. The sources where participants obtained their information on diabetes

Table 1. Baseline characteristics of study participants

Age (yrs)	
Mean ± SD	12.04 ± 4.15
Range	n(%)
5-9 yrs	105 (34.4)
10-14	105 (34.4)
15-20	95 (31.2)
Gender	
Male	147 (48.2%)
Female	158 (51.8%)
Educational status	n(%)
No education	57(18.7)
Pre-primary	33(10.8)
Primary	114(37.4)
High School (JHS & SHS)	101(33.1)
Body Mass Index (kg/m^2)	
Mean ± SD	18.13 ± 3.6
18.5–24.9 (<85th percentile)	275 (90.2%)
25.0 – 30.0 (85th-95th)	24 (7.9%)
>30.0 (≥ 95th)	6 (2.0%)
Waist circumference(cm)	
Mean ± SD	63.3 ± 8.0
<60 CM	110 (36.1%)
60 – 80	191 (62.6%)
>80	4 (1.3%)
Fasting Blood glucose (mmol/L)	
Mean ± SD	4.96 ± 0.51
<5.0 MMO 1/2	174 (57.0%)
*5.0 – 5.6	96 (31.5)
**5.6 – 6.9	35 (11.5)

Means are in value ± SD while the proportions are in value (%).
* indicates using the ADA criteria and ** shows the WHO/IDF criteria of diagnosis of impaired fasting glucose – prediabetes

Table 2. Some risk factors associated with hyperglycaemia among the study participants
HPT = Hypertension, DM = Diabetes Mellitus X^2 = Pearson's Chi Square, OR= Odds Ratio

Risk factor	Hyperglycaemia (FBS≥5.6mmol/L) n=35	Normoglycaemia (FBS<5.6mmol/L) n= 270	Significance
Knowledge of Diabetes Mellitus			O R= 0.860
Yes	13 (37.1%)	110 (40.7%)	[95%Cl=0.415– 1.779]
No	22 (62.9%)	160 (59.3%)	P = 0.683
			X^2 = 0.167
Family History of Diabetes Mellitus			
Yes	3 (8.6%)	20 (7.4%)	OR= 1.172
Parent	1 (2.9%)	6 (2.2%)	[95% Cl=0.330-4.165]
Grandparent	2 (5.7%)	12 (4.5%)	P = 0.806
Other	-	2 (0.7%)	X^2 =0.060
No	32(91.4%)	250 (92.6%)	
Family History of Hypertension			
Yes	12 (34.3%)	61 (22.6%)	OR= 1.789
Parent	-	20 (7.4%)	[95% Cl=0.840-3.802]
Grandparent	8 (22.9%)	35 (13.0%)	P = 0.127
Other	4 (11.4%)	6 (2.2%)	X^2= 2.327
No	23 (65.7%)	209 (77.4.7%)	

Table 3. Biochemical and anthropometric characteristics of the rural and urban subjects

Characteristics	Urban subjects (n =155)	Rural subjects (n =150)	P-value
Fasting Blood glucose (mmol/L)			
Mean	4.9 ± 0.58	5.0 ± 0.43	P = 0.372
≥5.6	18 (11.6%)	17 (11.3%)	
<5.6	137 (88.4%)	133 (88.7%)	
BMI (Kg/m²)			
Mean	18.1 ± 3.8	18.1 ± 3.3	P = 0.944
Overweight & obese	17 (11.0%)	13 (8.7%)	
Normal weight	138 (89.0%)	137 (91.3%)	
Waist circumference (cm)			
Mean	64.0 ± 8.4	62.6 ± 7.5	P = 0.123
>88	1 (0.6%)	0 (0.0%)	
≤88	154 (99.4%)	150 (100.0%)	

Discussion

In this study, although there was no child or young adult with diabetes, it indicates that some of the participants are at an increased risk of developing diabetes. The presence of prediabetes in the children and young adults in the Kassena Nankana District is 11.5%. This is similar to that found in most sub-Saharan countries in Africa.[15] It is reported that prediabetes is prevalent in about 10-20% of the general population.[16] Data on the prevalence of prediabetes in children in sub-Saharan Africa is scarce, making it difficult to make comparisons with these results. In an adult population, a prevalence of 7.8% was recorded in Jordan in 2004.[17] The similarity in mean glucose levels of males and females is not in conformity with findings documented by a previous study in which females recorded higher FBG than males (WHO, 2006), and Amoah (2003) who rather reported that FBG was higher in males than females in. Ghana.[18,19] The mean FBG was similar in both urban and rural subjects and this does not corroborate with findings of Adediran and colleagues, who reported higher prevalence of elevated FBG in urban settlers, compared to their age-matched rural counterparts.[20] Modern influences and westernization in urban areas is expected to pose an effect on the FBG levels of the urban subjects, as compared to the rural ones. The mean FBG of the overweight and obese was higher than that of the normal weight subjects, which supports studies that indicate that there is high fasting glucose level with increasing BMI. A study in Ibadan reported that high BMI was associated with increased blood glucose levels.[21] Individuals who are obese would tend to acquire insulin resistance and insulin insensitivity which may lead to high blood glucose levels. Our study documented lower knowledge of DM (40%) among the study population and approximately three-quarters of the participants and their caregivers had a misconception that DM is caused by eating too much sugar or sugary foods. They also have the belief that DM can be cured. Shafaee and co-abusers has reported a good correlation between high awareness of DM and educational status.[22] Notwithstanding this fact, the study population with a high literacy rate (81.3%) did not have much knowledge of DM, and this observation may be due to the lower level of education among the study population. Majority of the participants were in the pre- and primary levels, where learning of diseases, especially DM is not practised. The few participants who were aware of DM had their information from various sources (figure 1) including from relatives, the media, school, healthcare professionals and neighbours. Obtaining information from healthcare professionals represents a small proportion of sources of awareness among the participants, highlighting the need for more efforts on educating the general population on diabetes and its complications through the Primary Health Care system. Positive family history of DM among the study population was low (7.5%) and there was a weak positive association between prediabetes and a positive family history of DM (Odds Ratio= 1.172, 95% CI= 0.330-4.165). Findings from recent studies from various countries have reported that individuals with a positive family history of DM had two to six times the risk of diabetes, compared to persons without a positive family history of the disease.[23,24] Despite the weak association of prediabetes with positive family history of DM in this study, it is imperative that individuals with a relative with DM should seek health screening for DM. Similarly, a positive association was obtained between prediabetes and a positive family history of hypertension, because individuals with a relative with hypertension has about a two-fold increase in the risk of developing prediabetes (OR=1.988, 95% CI= 0.697-5.672), compared to persons without a positive family history of hypertension. There are several limitations inherent in our study. The cross-sectional nature of the study could result in potential bias and could make generalization of the findings difficult. The inability to repeat the tests for all the subjects, due to inadequate resources and time constraints is another limitation. The reference ranges used for the study were not locally generated, but data from the developed world, especially the cut-off points of the American Diabetes Association for prediabetes.

Conclusion

The prevalence of DM was zero percent, the proportion of children and young adults with prediabetes (impaired fasting glucose) in the study area was 11.5%, which is within intermediary range, which implies a risk of developing DM and cardiovascular diseases in the study population. There is no clear difference between male and females, urban and rural subjects when considering prediabetes, but family history of DM and hypertension were clearly associated with prediabetes. Screening people on a large scale for prediabetes and emphasizing on the education of the general public on the awareness of diabetes and its associated complications in the district are therefore warranted.

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