

Profile Of Fasting Blood Glucose Among Secondary School Students In Dar Es Salaam Region: A Cross-Sectional Study

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Abstract

Introduction: Of recent eras, there has been a dramatic increase in type 2 diabetes mellitus among children and adolescents. Female gender, childhood hypertension, overweight and obesity have been reported as the main risk factors for pre-diabetes and diabetes among children and adolescents. Screening children and adolescents for type 2 diabetes mellitus helps earlier detection and interventions for the disease.

Objective: The aim of this study was to determine the profile of fasting blood glucose among secondary school students in Dar es Salaam.

Methods: This was a descriptive cross-sectional study among secondary schools in Dar es Salaam. Structured questionnaires were used to obtain demographic information. Anthropometric measurements were taken using standard methods. Fasting blood samples were collected for blood glucose. The American Diabetic Association and International Diabetic Federation criteria were utilized.

Results: A total of 217 participants were enrolled; 32% (69) were males and 68% (148) were females, 75% (162) were in 14-17 years age group. Students from private and public schools were 52% (113) and 48% (104) respectively. Fasting blood glucose levels were distributed as follows; normal level 87% (189), impaired/pre-diabetes 11.5% (25) and diabetes 1.4% (3). Impaired fasting blood glucose was significantly higher among students aged 18-19; 16.4% (9) with p-value 0.044. Similarly, diabetes was significantly higher among students within age group of 18-19 years 3.6% (2) than 14-17 age group counterparts.

Prevalence of central obesity was 22% (48) which was higher among pre-diabetes 46% (22) and diabetes 6.1% (3) groups, and the difference was statistically significant (p value <0.001).

Conclusion: Normal fasting blood glucose among secondary school students in Dar es Salaam is 6.7 fold of the abnormal with pre-diabetes being the commonest abnormality which is significantly prevalent among private schools and elder students with central obesity.

Keywords: fasting blood glucose; pre-diabetes, diabetes, secondary schools; students

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I. Introduction

Over the past few years there has been rapid increase of type 2 diabetes mellitus incidences among children and adolescents globally. Impaired fasting blood glucose, impaired glucose tolerance and insulin resistance have been recognized as key indicators of type 2 diabetes mellitus among adolescents [1] [2]. The American Diabetic Association (ADA) and International Diabetic Federation (IDF) recommend pre-diabetes testing for children and adolescents as one of the preventive strategies against type 2 diabetes mellitus [3]. Despite this recommendation, data regarding blood glucose profile among children and adolescents in many countries including Tanzania is scarce.

Fasting blood glucose is a simple, safe and common test for diagnosing pre-diabetes and diabetes mellitus. The American Diabetic Association (ADA) and International Diabetic Federation (IDF) categorize fasting blood glucose levels as normal (<5.6mmol/L), pre-diabetes/impaired (5.6mmol/L to 6.9mmol/L) and diabetes (\geq 7.0mmol/L) [3].

Profile of fasting blood glucose (FBG) among adolescents has been shown to vary globally. For instance, some studies have shown a prevalence of normal fasting blood glucose, impaired fasting blood glucose (Prediabetes) and diabetes being 70.7%, 28.7% and 0.6% respectively in Nigeria [1]. In South Korea, the prevalence of fasting hyperglycaemia increased from the fourth (2007–2009) to the fifth (2010–2012), sixth (2013–2015), and seventh (2016–2018) KNHANES surveys, from 5.39 to 4.79, 10.03, and 11.66 per 100 persons, respectively [4]. The prevalence of pre-diabetes and diabetes among Indian adolescents was found to

be 12.3% and 8.4% respectively [5]. In Tanzania, hyperglycaemia among secondary school adolescents was found to be 13% [2].

Obesity, female gender, younger adolescence, family history of obesity, higher social economic status, physical inactivity, hypertension and dyslipidaemia have been consistently reported to be associated with impaired fasting blood glucose among children and adolescents [1] [2] [4] [5] [6] [7] [8].

The aim of this study was to determine the profile of fasting blood glucose among secondary school students in Dar es Salaam.

II. Methods

Study design/study setting and duration:

A descriptive cross-sectional study was conducted among secondary school students in Dar es Salaam city. This study was conducted between 1st and 31st March 2019.

Sampling and recruitment technique

Multistage sampling was employed to select district and schools for study. Secondary school students who fasted for at least eight hours before the time of data collection and with fully informed consent were recruited into the study.

Variables/Data collection/Measurements

Demographic data (gender, age group and school status) were collected using structured questionnaire. **Waist circumference** was taken at mid-way between lowest rib and iliac crest to the nearest 0.5cm at the end of tidal expiration. After overnight fasting, blood samples for **serum glucose** were collected and transported to the laboratory for analysis within a day using an automated analyser (HUMASTAR 300, Germany).

The American Diabetic Association (ADA) and International Diabetic Federation (IDF) criteria were used to categorize fasting blood glucose (FBG); < 5.6mmol/L normal FBG, 5.6mmol/L to 6.9mmol/L impaired fasting blood glucose (Prediabetes) and ≥ 7.0 mmol/L diabetes.

Data entry and analysis

The data was entered into a computer and analysed utilizing SPSS Version 20. Chi-squared and student's t tests were used for categorical and continuous variables respectively. A p-value <0.05 was statistically significant.

III. Results

A total of 217(69 males and 148 females) secondary school students were enrolled. Majority belonged to 14-17 years age group (75%) as shown in the table 1.

Table1: Demographic data of secondary school students in Dar es Salaam region: n=217

Variable	Frequency (%)
Gender	
Males	69 (32)
Females	148 (68)
Age group	
14-17 years	162 (75)
18-19 years	55 (25)
School	
Public	104 (48)
Private	113 (52)

Overall, 11.5% (25/217) and 1.4% (3/217) had impaired fasting blood glucose and diabetes respectively, which was higher among private school (21.4%, 2.7%; p-value=0.058) and 18-19 years age group (16.4%, 3.6%; p-value=0.044) as indicated in the table 2.

Table 2: Distribution of fasting blood glucose among secondary school students in Dar es Salaam: n=217

FBG categories	ALL	Males	Female	p-	Public	Private(113)	p-	14-	18-	p-
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(mmol/L)	(217)	(69)	s (148)	value	(104)		value	17 year s (162)	19 year s (55)	v al u e
Normal(<5.6)	189(87.1%)	60(87%)	129(87.2%)	1.00	103(99%)	86(76.1%)	0.058	145(89.5%)	44(80%)	0.044
Impaired/Pre-diabetes(5.6 to 6.9)	25(11.5%)	8(11.5%)	17(11.4%)		1(1%)	24(21.2%)		16(9.9%)	9(16.4%)	
Diabetes(≥7.0)	3(1.4%)	1(1.4%)	2(1.4%)		0	3(2.7%)		1(0.6%)	2(3.6%)	

Prevalence of central obesity was 22% (48/217). It was significantly higher among students within impaired fasting blood glucose (22/48; 46% vs 3/169; 2%) and diabetes categories (3/48; 6% vs 0) than those in a normal category (23/48; 48% vs 166/169; 98%), p-value <0.001 as revealed in the table 3.

Table 3: Distribution of fasting blood glucose and waist circumferences among secondary school students in Dar es Salaam: n=217

FBG categories (mmol/L)	Waist circumference(cm)		
	Normal (<80 and <94 for girls and boys respectively)	Central obesity (≥80 and ≥94 for girls and boys respectively)	p-value
Normal(<5.6)	166(98%)	23(48%)	<0.001
Impaired/Pre-diabetes(5.6 to 6.9)	3(2%)	22(46%)	
Diabetes(≥7.0)	0	3(6%)	
Total	169/217(78%)	48/217(22%)	

IV. Discussion

Profile of fasting blood glucose among secondary school students in Dar es Salaam was explored. A total of 217 students from private and public schools were studied. Normal fasting blood glucose was found in 87.1% of them which is similar from other studies [2] [4].

Prevalence of impaired fasting blood glucose (pre-diabetes) was 11.5% like other reports; 11.1% [4], 12.3% [5] and 13.1% [6]. Higher prevalence has been reported by other researchers [1]. Diabetes which was higher from private schools and significantly higher among elder students with central obesity was detected in about 1.4% which is similar to other studies [1] [2].

Impaired fasting blood glucose (pre-diabetes) was most prevalent among students within 18-19 years age group (16.4%) with p-value of 0.044. It was also higher among private school students, though not statistically significant (p-value of 0.058). The high prevalence of pre-diabetes among private school students could be due to high socio-economic status of their parents which could expose them to unhealthy diets and physical inactivity. Others reported female gender, family history of obesity, hypertension and dyslipidaemia being the main risk factors for pre-diabetes and diabetes [1] [4] [5] [6] [7] [8].

The high prevalence of pre-diabetes and diabetes among obese and young secondary school students has been reported by others as well [1] [5], however information that it is higher among private school students has not been stated from these studies. The high pre-diabetes and diabetes prevalence among the elder students is probably due to increased age which is associated with significant increase in insulin resistance as reported in other studies [9] [10].

V. Conclusion:

Normal fasting blood glucose among secondary school students in Dar es Salaam region is 6.7 fold of the abnormal with pre-diabetes being the commonest abnormality which is significantly higher among elder students with central obesity.

Declarations

Ethical consideration: The ethical clearance for conducting this study was sought from Hubert Kairuki Memorial University (HKMU) while permission to collect data was issued by Kinondoni municipal education officer. The informed consent and assent were obtained from study participants.

Consent for publication: Not applicable for this study.

Availability of data and materials: The datasets analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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References

- [1] Oluwayemi, O., Brink, S. J., Oyenusi, E. E., Oduwale, O. A., Oluwayemi M. A. "Fasting Blood Glucose Profile Among Secondary School Adolescents In Ado-Ekiti, Nigeria", *Journal Of Nutrition And Metabolism*, Volume 2015, Article Id 417859, 4 Pages. [Http://Dx.Doi.Org/10.1155/2015/417859](http://Dx.Doi.Org/10.1155/2015/417859)
- [2] Warles, C.L., Yassin, M. "Early Clinical Markers Of Metabolic Syndrome Among Secondary School Adolescents In Dar Es Salaam, Tanzania", *Tanzania Journal Of Health Research*, Volume 22, Number 1, October 2021. [Https://Dx.Doi.Org/10.4314/Thrb.V22i1.3](https://Dx.Doi.Org/10.4314/Thrb.V22i1.3)
- [3] American Diabetes Association Professional Practice Committee. "Improving Care And Promoting Health In Populations: Standards Of Medical Care In Diabetes—2022", *Diabetes Care* 2022; 45:S8–S16. [Https://Doi.Org/10.2337/Dc22-S001](https://Doi.Org/10.2337/Dc22-S001)
- [4] Seung, E. Y., Ji, H. L., Jung, W. L., Hye, S. P., Hye, A. L., Hae, S. K. "Increasing Prevalence Of Fasting Hyperglycemia In Adolescents Aged 10–18 Years And Its Relationship With Metabolic Indicators: The Korea National Health And Nutrition Examination Study (Knhanes), 2007– 2018", *Annals Of Pediatric Endocrinology & Metabolism* 2022;27(1): 60-68. [Https://Doi.Org/10.6065/Apem.2142068.034](https://Doi.Org/10.6065/Apem.2142068.034)
- [5] Kumar P, Srivastava S, Mishra Ps, Mooss Etk. "Prevalence Of Prediabetes/Type 2 Diabetes Among Adolescents (10–19 Years) And Its Association With Different Measures Of Overweight/Obesity In India: A Gendered Perspective", *Bmc Endocrine Disorders* (2021) 21:146. [Https://Doi.Org/10.1186/S12902-021-00802-W](https://Doi.Org/10.1186/S12902-021-00802-W)
- [6] Sheela, N. M., Janet, S., Deborah, E., Kristen, N., Tamara, S. H., "Evaluation And Treatment Of Prediabetes In Youth", *J Pediatr*. 2020 Apr; 219: 11–22. Doi: 10.1016/J.Jpeds.2019.12.061.
- [7] Osman Ha, Elsadek N, Abdullah Ma. Type 2 Diabetes In Sudanese Children And Adolescents. *Sudan J Paediatr*. 2013; 13(2):17-23.
- [8] Boitumelo, P. L., Karin, S.Z., Bianca, B., Edna, N. M., Fabian, K., Natalie, O. Et Al, "Cardiometabolic Risk Factors And Early Indicators Of Vascular Dysfunction: A Cross-Sectional Cohort Study In South African Adolescents", *Bmj Open* 2021; 11:E042955. Doi: 10.1136/Bmjopen-2020-042955.
- [9] Esquivel Zuniga R, Deboer Md. Prediabetes In Adolescents: Prevalence, Management And Diabetes Prevention Strategies. *Diabetes Metab Syndr Obes*. 2021 Nov 25; 14:4609-4619. Doi: 10.2147/Dms0.S284401.
- [10] Moran A, Jacobs Dr Jr, Steinberger J, Cohen P, Hong Cp, Prineas R, Sinaiko Ar. Association Between The Insulin Resistance Of Puberty And The Insulin-Like Growth Factor-I/Growth Hormone Axis. *J Clin Endocrinol Metab*. 2002 Oct; 87(10):4817-20. Doi: 10.1210/Jc.2002-020517.