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Elevated blood pressure, abnormal urinalysis and Body Mass Index as screening tools for latent kidney diseases among adolescents in Sagamu

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Abstract

Background: The prevalence of non-communicable diseases, such as chronic kidney diseases, is on the increase globally. Therefore, early identification of these conditions through routine screening is desired as a preventive measure.

Objectives: To determine the prevalence of elevated blood pressure among adolescents and relate it to abnormal urinalysis and blood sugar patterns.

Methods: A cross-sectional descriptive study of adolescent secondary school students in Sagamu was carried out. The subjects were selected through random sampling method. Using standard methods, weight, height and blood pressure were recorded and the body mass index (BMI) was calculated. The blood pressure measurements were grouped into pre-hypertension and hypertension using standard charts. Dipsticks and glucometer respectively were used to examine urine and determine random blood glucose levels. Statistical analyses were done to determine the variables associated with elevated blood pressure.

Results: A total of 572 subjects comprising 279 (48.8%) males and 293 (51.2%) females were screened. One hundred and fifty -one (26.4%) were underweight while 4.5% had abnormal urinalysis [urobilinogen (34.6%) and proteinuria (26.9%)]. Prehypertension was present in 7.9% and Stage 1 hypertension in 1.7%. Systolic blood pressure was significantly associated with high BMI. Age and abnormal urinalysis (proteinuria) were also associated with and predicted elevated blood pressure.

Conclusion: Elevated blood pressure is associated with abnormal urinalysis; both conditions are identifiable risk factors for kidney diseases in this environment. We therefore advocate inclusion of periodic blood pressure checks and urinalysis included in the school health program.

Key words: *Adolescents, Abnormal urinalysis, Blood sugar, Hypertension*

Introduction

The kidneys are vital excretory organs which are central to fluid, electrolytes and acid- base homeostasis in humans. Damage to the kidneys portends great danger for growth and systemic functions. In developing countries like Nigeria, the prevalence of preventable kidney diseases is not known.[1]

The global burden of kidney diseases is increasing and several aetiologies of kidney diseases begin in childhood.[2] The risk factors for kidney diseases are particularly common in Africa.[2]

In children, urinalysis is a simple and informative diagnostic test used as a basic component of evaluation of diseases of the kidneys and the urinary tract in conjunction with physical examination and other ancillary tests.[3], Indeed, the presence of proteinuria (> 30mg/dl of proteins

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in urine) may be an indicator of renal diseases or damage. [1,3] The filtration of albumin by the glomerulus is followed by tubular reabsorption thus, proteinuria or albuminuria reflects dysfunctions of these two processes. In addition, urinary proteins may induce pro-inflammatory and pro-fibrotic effects that may directly contribute to chronic tubule-interstitial damage. [4] It follows, therefore, that high grade proteinuria is an independent mediator of a progressive kidney damage. Independent of the underlying cause, there is sustained or permanent loss of selectivity of the glomerular filtration barrier to protein. Therefore, the presence of proteinuria with estimation of glomerular filtration rate is used in the evaluation of chronic kidney diseases. [4] Studies have also suggested that proteinuria is not only a marker of kidney disease but also a predictor of risk for development and progression of chronic kidney disease. [5] According to the Kidney Disease Outcome Quality Initiative (KDOQI) guidelines for kidney diseases, the presence of proteinuria of 1+ grade or greater should be further investigated. [6] The reported prevalence of proteinuria ranges between 1.95% and 4.5% in Nigeria but a systematic review by Neema had reported a prevalence rate as high as 32.5%. [2,7-8]

High body mass index (BMI), increasing age, high blood pressure, elevated fasting blood glucose and proteinuria are reported risk factors for kidney diseases. [1, 7-9] Several studies have established a strong correlation between a high BMI and development of diabetes mellitus as a result of insulin resistance induced by high BMI. BMI is also significantly correlated with high blood pressure. The presence of these factors causes damage to the kidneys. [4,9,10] Hypertension is defined as blood pressure above the 95th percentile for age, sex and height while pre hypertension is defined as blood pressure below 95th percentile for age, sex, height or equal to 120/80mmHg according to the guidelines of the Standard Working Group. [11] It is against this background that the present study was designed to identify some possible risk factors for latent kidney disease amongst adolescents in Sagamu.

Methods

This descriptive, cross-sectional study was conducted in Sagamu Local Government Area (LGA) of Ogun State as part of a larger study to evaluate the risk factors for kidney diseases amongst secondary school students in Ogun State. Sagamu township is the headquarters of Sagamu LGA and it is one of the four major towns in Ogun State. The LGA consists of 15 wards and it has a population of 228,382 according to the National Population Census of 2007.[12] Sagamu is predominantly semi urban.

Ethical approval for this study was obtained from the Scientific and Ethics Review Committee of the Olabisi Onabanjo University Teaching Hospital, Sagamu.

Pre-screening visit: The school Principals /Head teachers were visited prior to the survey in order to obtain permission and intimate them about the purpose of the screening and the benefits to the students.

On the day of the study, the researchers addressed the students and gave them a health talk on the prevention of kidney diseases. Thereafter, the selection of subjects was done using random sampling. This was done using numbers generated from a Table of Random Sampling. The students were given numbers drawn from the numbers in the table. Randomly picked numbers were called out to select students with the corresponding numbers. There was an option of opting out at any stage of the screening.

Evaluation of selected students: The school headteachers gave consent for the study on behalf of the parents. A written assent was obtained from every subject. Subjects with abnormalities of blood pressure, urinalysis or blood sugar were referred to the Teaching Hospital for further evaluation and treatment.

Exclusion: Recruited subjects were thoroughly examined for fever and stigmata of chronic ailments. Any one on medication that could cause proteinuria such as the Non-steroidal Anti-inflammatory Drugs, those with symptoms suggestive of urinary tract infection and known kidney diseases were excluded.

Anthropometric, Blood Pressure and Blood Glucose measurements:

Weight was measured using Bathroom weighing scale. The subjects were weighed with light clothing and after every 10 measurements, the scale was reset for zero error. The measurements were recorded to the nearest 0.1kg. Height was measured using a Stadiometer while observing necessary precautions. The height measurements

were recorded to the nearest 0.1centimeter. The body mass index was computed using the formula: Weight (Kg)/Height (meter^2). [13] Using the body mass index standard chart for age and sex, [14] the subjects were classified as obese, overweight, underweight or normal weight.

Blood pressure was measured using the *Accosson*® mercury sphygmomanometer with appropriate cuffs. The subjects were allowed to rest for about 10 minutes, after which the blood pressure was measured on the right upper arm resting on the table. The first Korotkov sound was taken as the systolic blood pressure while the diastolic blood pressure was recorded at the point of disappearance of the Korotkov sound. Those with high blood pressure values were allowed to rest and a second reading was taken at the end of each day. The average of the two readings was adopted for each subject. The recorded blood pressure was classified using the Fourth Task Force chart on blood pressure measurement in childhood. This method relates the height percentile of the subject to the blood pressure centile for age and sex.

The random blood glucose was estimated using the *On Call Plus Blood Glucose*® Test Strips manufactured by ACON Laboratory Inc USA(C E 0197) LOT 3364469. Using the normal range of 80 - 120mg/dl, the random blood glucose measurements were classified into normal, hypoglycemia or hyperglycemia. Quality assurance was ensured with the immediate closure of the test strip container to prevent oxidative reaction. The strips have also been standardized by the manufacturer prior to packaging and shipping.

Urinalysis was carried out using 2ml of freshly voided, clean catch urine which was collected into a clean and grease-free bottle. The urine sample for each subject was tested using the Medi-Test Combi-9 strip manufactured by the Macherey-Nagel Eurl Lot 32349. For this study, proteinuria was adopted as an indirect marker of kidney disease. Proteinuria was graded as 1+ (30mg/dl), 2+ (100mg/dl), or 3+ (>100mg/dl). Proteinuria of 2+ grade (equivalent to 100mg/dl) was regarded as abnormal. Other parameters tested included urobilinogen, blood, nitrite and glucose. The presence of any quantity of these parameters in urine was considered abnormal.

Statistical Analysis:

The subjects were grouped into early and late adolescents using 14 years as the cut-off age for early adolescence.

Statistical analysis was done using the SPSS statistical package version 19.0. Mean values were calculated for continuous data. Mean values were compared using Student's t-test while proportions and ratios were compared using the Chi-Squared test (χ^2). Pearson correlation test was used to find association between the different continuous parameters. Regression analysis was used to detect predictors of elevated blood pressure among the subjects. P values < 0.05 were taken as statistically significant.

Results

A total of 572 students were screened. There were 279 (48.8%) males and 293 (51.2%) females giving a male-to-female ratio of 0.95:1. Four hundred and twenty four (74.1%) of these were early adolescents while 24.9% were late adolescents.

Blood sugar and body mass index

Obesity was present in 0.7% of the subjects while 26.4% were underweight. Ten (1.7%) subjects had hypoglycaemia while 115 (20.1%) had hyperglycaemia. Hypoglycemia was more frequent among males (2.2%vs 1.4%) while hyperglycemia was more frequent among females (23.2% vs 18.8%).

Blood Pressure, Age, and Gender

Blood pressure was normal among 517 (90.4%) subjects, 45 (7.9%) had pre-hypertension while 10 (1.7%) had stage 1 hypertension. The systolic blood pressure increased with age. There was statistical significant difference between the mean systolic blood pressure (SBP) in the early and late adolescence. The mean SBP in the early adolescence was 99.3 ± 12.8mmHg compared with 103.0 ± 11.4mmHg in the late (t= 3.150 p= 0.002). The mean diastolic blood pressure (DBP) in the early and late adolescent were comparable with 60.1 ± 13.0mmHg and 62.2 ± 12.1mmHg respectively (t= 1.783, p=0.075). Table I shows the association between gender and blood pressure patterns.

Table I: The association between gender and blood pressure patterns

Classification of Hypertension	*Male*	*Female*	X^2	*P Values*
	n=279 (%)	n=293 (%)		
Normal Blood Pressure	252 (90.3)	265 (90.4)	8.19	0.017
Pre-hypertension	18 (6.5)	27 (9.2)		
Stage I Hypertension	9 (3.32)	1 (0.3)		

Urinalysis findings and blood pressure

Twenty-six (4.5%) subjects had abnormal urine parameters which included, urobilinogen (9/26; 34.6%), proteinuria (7/26; 26.9%), nitrite (6/26; 23.1%) and blood (4/26; 15.4%),. The mean SBP and DBP between the group with normal urine parameters and those with abnormal urine parameters were statistically significantly different (t = 2.383, p = 0.018 and t = 2.019, p = 0.044 respectively) as depicted in Table II.

Table II: The association between the mean blood pressure and urinalysis findings

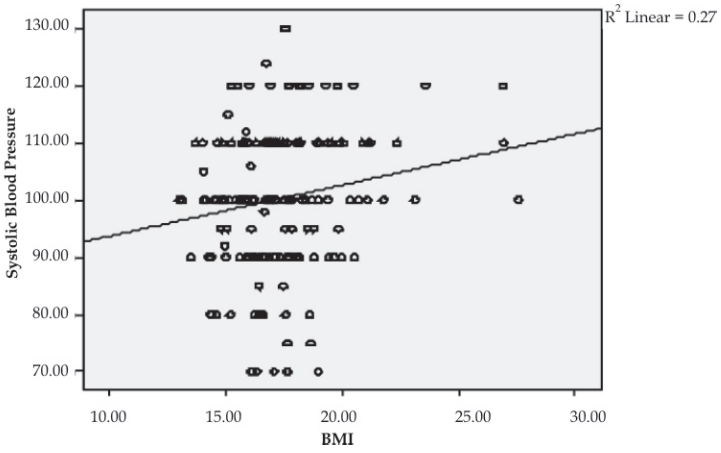
	Normal Urinalysis	*Abnormal Urinalysis*	*T*	*P Values*
Mean Systolic BP (mm Hg)	100.0 ± 12.3	105.9 ± 15.6	.383	0.018
Mean Diastolic BP (mm Hg)	60.4 ± 12.7	65.6 ± 14.1	.019	0.044

Table III shows factors that were associated with elevated blood pressure. Abnormal urinalysis and blood glucose levels were associated with elevated blood pressure.

Table III: Relationship between age, gender, urine finding, BMI and blood glucose versus blood pressure pattern

Variables	*Normal BP*	*Abnormal BP*	X^2	*P Values*
	n=517 (%)	n=55 (%)		
Age Group				
Early Adolescence	393 (92.7)	31 (7.3)		
Late Adolescence	124 (83.8)	24 (16.2)	10.01	0.002
Gender				
Male	252 (90.3)	27 (9.7)		
Female	265 (90.4)	28 (9.6)	0.002	0.961
Urine				
Normal	502.(91.9)	44 (8.1)		
Abnormal	15 (57.7)	11 (42.3)	33.497	<0.001
BMI				
Normal	369 (89.6)	43 (10.4)		
Abnormal	148 (92.5)	12 (7.5)	1.144	0.285
Blood Glucose				
Normal	410 (91.7)	37 (8.3)		
Abnormal	107 (85.6)	18 (14.4)	4.213	0.04

Figure 1 also shows the linear relationship between systolic blood pressure and body mass index.



Pearson's correlation = 0.164 p = <0.001

Figure 1: Linear relationship between Body Mass Index and systolic blood pressure.

Using regression analysis, late adolescence, and abnormal urine parameters were significant predictors of high blood pressure as shown in Table IV.

Table IV: Factors predictive of high blood pressure amongst the study subjects

Variables	*B*	*Wald*	*P*	*Odds Ratio*	*95% Confidence Interval*
Late adolescence	0.693	0.141	0.023	1.999	1.098 - 3.638
Abnormal urinalysis	1.977	20.321	<0.001	7.218	3.056 - 17.046
Abnormal blood glucose level	0.524	2.643	0.104	1.689	0.898 - 3.176

B Regression Coefficient; Wald Chi-Squared value

Discussion

Association between body mass index and blood glucose has been consistently observed but poorly understood because of the interactions with other influencing factors. [9] The observed pattern of relationship between BMI and blood glucose observed in this study is similar to the finding in a study of male Nigerian undergraduates previously reported by Onyesom *et al.* [9] The present study, however, did not do similar gender stratification. It may imply that when gender as a cofounder is eliminated, the relationship may become weak. Therefore, it may be necessary to have gender based reference values.

The pattern of urinary abnormalities in this study is within the reported prevalence rates in the country, [7, 8] though, lower than the reported value of 32.5% by Neema *et al*.[2] Considering the different urinary abnormalities, urobilinogen and proteinuria were the leading abnormalities in this study akin to the report of Akor and Akuse. [8, 15] The presence of proteinuria may be indicative of kidney disease either as a cause or as an effect. However, other adjuvant tests will be needed to support this claim but this is outside the scope of this study.

Abnormal proteinuria was not associated with elevated blood pressure in preschool children in Enugu [16] unlike the finding in the present study where it is found to be associated with elevated blood pressure and a predictor of high blood pressure. An attempt has been made by this study to relate the presence of abnormal urinalysis finding to blood pressure. This has shown that the presence of proteinuria may plausibly be a pointer to kidney disease. The prevalence of pre-hypertension among the adolescents in the environment studied was low compared with an earlier one in the same environment as reported by Oyewole. [17] The difference may possibly be due to the larger population studied in the former study. The linear relationship between BMI and systolic pressure confirmed the findings in earlier studies. [18-21] The observed predictors of elevated blood pressure among this population of adolescents were akin to the findings in previous studies, [18-21] but at variance as abnormal urinalysis has not been previously reported as a predictor of elevated blood pressure, possibly because elevated blood pressure in children is often due to an underlying kidney disease.

Limitation of study: Due to the limited scope of study, the cause and effects of proteinuria among adolescents could not be extensively determined.

Conclusion

It was concluded that elevated blood pressure and abnormal urinalysis may be used as screening tools for latent kidney diseases. Therefore, it is attractive to suggest that periodic blood pressure and urinalysis screening be included in the school health program.

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Authors'contributions: AAF designed the study, participated in data collection, interpretation of results and drafting of the manuscript. OOO[1] and OOO[2] participated in data collection and drafting of the manuscript. FMB supplied some of the test kits used for the study and contributed to the drafting of the manuscript.

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