International Journal of Medical and Health Sciences Research
2017 Vol. 4, No. 5, pp. 73-87
ISSN(e): 2313-2752
ISSN(p): 2313-7746
DOI: 10.18488/journal.9.2017.45.73.87

PREVALENCE OF PREHYPERTENSION AND ASSESSMENT OF RENAL FUNCTION AMONG THE PREHYPERTENSIVE STUDENTS OF THE COLLEGE OF HEALTH SCIENCES, NNAMDI AZIKIWE UNIVERSITY, NNEWI, ANAMBRA STATE, NIGERIA

Okonkwo A.C[1]
Ogbodo E.C[2+]
Okwara J.E[3]
Ezeugwunne I.P[4]
Analike R.A[5]
Onah C.E[6]
Amah U.K[7]
Oha P.C[8]
Obiorah M.O[9]
Ugwu M.C[10]
Meludu S.C[11]

[1,2,9,10]*Department of Chemical Pathology, Nnamdi Azikiwe University, Nnewi Campus, Nigeria*
[3,5,7]*Department of Chemical Pathology, Nnamdi Azikiwe University, Nnewi Campus; Department of Chemical Pathology, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria*
[4,11]*Department of Chemical Pathology, Nnamdi Azikiwe University, Nnewi Campus; Department of Human Biochemistry, Nnamdi Azikiwe University, Nnewi Campus, Nigeria*
[6]*Department of Chemical Pathology, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria*
[8]*Department of Histopathology, Nnamdi Azikiwe University, Nnewi Campus, Nigeria*


(+ Corresponding author)

Article History
Received: 26 May 2017
Revised: 27 July 2017
Accepted: 3 August 2017
Published: 14 August 2017

Keywords
Hypertension
Prehypertension
Creatinine
Urea
Sodium
Potassium
Chloride
Systolic blood pressure
Diastolic blood pressure.

ABSTRACT

This study was carried out to determine the prevalence of pre-hypertension and assess the renal function in pre-hypertensive students in College of Health Sciences, Okofia, Nnewi. A total of 210 (99 males and 111 females) apparently healthy respondents aged 18-28, were recruited for the initial screening. Their blood pressure readings and body mass index (BMI) were obtained, whereas 5mls of blood sample was collected from 18 prehypertensive and 19 normotensive subjects. 5mls of blood was collect from eligible subjects and dispensed in plain containers for estimation of biochemical parameters. Serum creatinine, urea, Na+, K+, and Cl- were analyzed using standard methods. Result showed a prevalence of 11.4% with a higher percentage in males (12.12%) than in female (10.81%). BMI was significantly higher in pre-hypertensive than in normotensive (26.31±4.76 Vs 21.60±2.44;p> 0.05). Systolic (SBP) and diastolic (DBP)(126.67±5.76 Vs 107.68±9.90; 79.56±6.57 Vs 69.52±7.39;p> 0.05) respectively were significantly higher in prehypertensives than in normotensives. Interestingly, there was no significant difference in the value of renal function markers of the prehypertensives when compared to normotensives (p>0.05). However, there was a positive correlation between SBP and serum urea level(r = 0.628; P =0.009). Therefore, the prevalence of prehypertension in this population was low with reference to studies in other populations. Importantly, this preliminary study did show that the renal functions are not compromised.

Contribution/Originality: This study documents the Prevalence of Prehypertension and Assessment of Renal Function among the Prehypertensive Students of the College of Health Sciences, Nnamdi Azikiwe University, Nnewi, Anambra State, Nigeria, a study which is original to the authors as outlined above.

1. INTRODUCTION

Hypertension is an important public health problem worldwide and is one of the most widely recognizable modifiable risk factor for cardiovascular disease (CVD), cerebrovascular disease (Stroke) and end-stage renal disease [1]. It is defined as a systolic blood pressure of >140mmHg or a diastolic blood pressure of >90mmHg. Pre-hypertension is a medical classification for cases where a person's blood pressure is elevated above normal, but not

to the level considered hypertension (high blood pressure). Pre-hypertension is blood pressure reading with a systolic pressure from 120 to 139 mmHg or a diastolic pressure from 80 to 90 mmHg. Classification of blood pressure is based upon two or more readings at two or more separate occasions separated by at least one week. The seventh report of the Joint National Committee (JNC 7) proposed the new labeling for elevated blood pressure values below 140/90 to more accurately communicate the tendency of blood pressure to rise with age [2]. Risk factors for pre-hypertension include: Being overweight or obese, Age, Sex, Race, Family history of high blood pressure, Sedentary lifestyle, Diet high in salt (sodium) or low in potassium, Tobacco use, Too much alcohol consumption. Certain chronic conditions- including Kidney disease, diabetes and sleep apnea- may increase the risk of prehypertension.

Pre-hypertension is not a disease condition, however, pre-hypertensive patients are known to be at risk for developing hypertension, and even slightly elevated blood pressure increases its associated risks [3]. Like hypertension, pre-hypertension tends to cluster with other metabolic risk factors such as dyslipidemia and obesity, hence, predisposing affected individuals to the higher risk of cardiovascular diseases.

The kidney is also a critical target organ of hypertension-related damage. Long-term regulation of blood pressure predominantly depends upon the kidney. This primarily occurs through maintenance of the extracellular fluid compartment, the size of which depends on the plasma sodium concentration. The rennin-angiotensin system serves as one of the most powerful regulators of arterial pressure and sodium balance. When the glomerular filtration rate (GFR) drops, the stretch receptors in the macula densa signal cells of the juxtaglomerular apparatus to secrete renin. Renin is converted to angiotensin, which effects vasoconstriction, mainly in peripheral arterioles, which increases peripheral vascular resistance, thereby elevating blood pressure. In addition, rennin stimulates release of aldosterone by adrenal cortical cells in the glomerulosa. Aldosterone exerts an effect on the distal renal tubules, causing them to increase sodium reabsorption while secreting potassium. Retention of sodium increases fluid in the vasculaer system to maintain pressure [4]. Although the kidney cannot directly sense blood pressure, changes in the delivery of sodium and chloride to the distal part of the nephron alter the kidney's secretion of the enzyme renin [5]. This results in high blood pressure. Some kidney problems are the result of another disease process, such as diabetes or hypertension [6]. Creatinine, aby-product of muscle energy metabolism that, similar to urea, is filtered from the blood by the kidneys and excreted into the urine [7]. Elevation of blood creatinine is a sensitive indicator of impaired kidney. Measurement of the blood levels of other elements regulated in part by the kidneys can also be useful in evaluating kidney function. These include urea, sodium, potassium, chloride, bicarbonate, calcium, magnesium, phosphorus, protein, uric acid, and glucose [8]. Healthy kidneys filter all proteins from the bloodstream and then reabsorb them, allowing no protein, or only slight amount of protein, into the urine. The persistent presence of significant amounts of protein in the urine is an important indicator of kidney disease. Estimation of GFR is a very sensitive indicator of chronic kidney disease, with GFR <60ml/min/1.73m^2.

The level of blood pressure is associated with CKD and end-stage renal disease (ESRD), and lowering of blood pressure can delay the deterioration of renal function in hypertensive patients [2, 9, 10]. Similarly, pre-hypertension ought to be associated with CKD. However, up to now, the effect of pre-hypertension on the risk of CKD has still been controversial. Only a few studies have addressed the magnitude of pre-hypertension and factors associated with it in Nigerian adults. One of such studies was carried out among adults in the community [9] and the other, among treated diabetic patients in an out-patient clinic [10] both in Northern Nigeria. In a cross-sectional study of pre-hypertensiobn and its associations among apparently healthy adults in Umuahia, South-east, Nigeria, a prevalence rate of 45.5% and 37.8% was gotten for pre-hypertension and hypertension respectively [11]. Also, a study on the prevalence of pre-hypertension among adolescents in secondary schools in Enugu, Nigeria, gave a result of 17.3% [12].

Surprisely, We do not know the prevalence of pre-hypertension among students in our environment and its determinants/association Hence, this study aims to determine prevalence of prehypertension and assessment of

renal function among Prehypertensive students of College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria.

2. MATERIALS AND METHODS

2.1. Study Area

Nnamdi Azikiwe University, Okofia-Otolo, Nnewi campus comprises the college of Health Sciences having the faculties of Basic Medical Sciences, Health Sciences and Technology and Medicine. It is located in the suburb of Nnewi - a popular town in Anambra State Nigeria. The environment is poorly developed and lacking basic amenities such as housing, road, communication, electricity and potable water compared to campuses located in urban areas.

2.2. Study Design

A total of 210 apparently healthy student respondents aged 18-28 were recruited for the initial screening. Their blood pressure readings and body mass index were obtained, whereas 5mls of blood sample was collected from 18 prehypertensive and 19 normotensive subjects. Renal function parameters (Creatinine,Urea) and Electrolytes (Na^+, K^+, Cl) were analyzed using standard methods described by Burtis, et al. [13]; Taylor [14] *and Ion Selective Electrode* respectively While the glomerular filtration rate (GFR) was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) 2009 formula as described by Inker and Levey [15].

2.3. Ethical Consideration

Ethical approval was obtained from the Faculty of Health Sciences and Technology ethical committee, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria for sample collection.

2.4. Inclusion Criteria and Exclusion Criteria

Apparently healthy subjects aged 18-28 years who consented to the study and had no obvious clinical conditions were recruited for the study. Subjects younger than 18years or older than 28years oldwho were acutely or chronically ill-looking, manifested hypertensive emergency or any other form of illness were excluded from this study.

2.5. Statistical Analysis

Statistical package for social science (SPSS) version 20 was employed in the analysis of the result. The results for anthropometric parameters and renal function were expressed as mean± standard deviation and compared between the prehypertensives and normotensives using student's t- test. Level of significance was set at $p<0.05$.

3. RESULTS

Among 210 study respondents, 186 (88.6% were normotensive while 24(11.4%) were found to be prehypertensive. The prevalence of perhypertension was 12.12% among male and 10.81% among the female. Hence, there were higher cases of perhypertension among males than among females.

There was no significant difference in age of the two groups ($P> 0.05$). However, BMI was significantly higher in perhypertensive than in normotensive (26.31± 4.76 vs 21.60± 244; $p<0.05$). Systolic blood pressure was found to be significantly higher in prehypertensive than in normotensive (126.67± 5.76mmHg vs 107.68± 9.09mmHg; $P<0.05$). Also Diastolic blood pressure was found to be significantly higher in prehypersive than in normotensives (79.56± 6.57mmHg vs 69.52±7.39mmHg; $p>0.05$) (see table 1).

The biochemical parameters which were considered in the study were serum urea, creatinine, sodium , chloride, potassium and glomerular filteration rate. Their comparisons can be seen in table 2. It was found that there was no

significant difference in the renal parameters of the prehypertensive subjects when compared to normotensive (P>0.05) thereby indicating that the functions of the kidneys are not affected in this prehypertensive population.

Again, there was a positive correlation between Age and BMI (R = 0.559; P<0.05) among the prehypertensive. The study shows a significant association between the BMI, SBP, DBP of the prehypertensive. Also there was a significant between the SBP and DBP of the normal subjects. BMI was show to have a significant association with weight (P< 0.05) in both the prehypertensive and normotensive subjects (see table 3).

Table 4 shows a statistically significant correlation between SBP and urea levels (r = 0.628; P< 0.05) of the prehypertensive subjects unlike the normotensive subjects. DBP has no significant association with any of the renal parameters (P> 0.05) amongst the whole renal parameters, a statistically significant correlation was shown between creatinine and GFR, sodium and chloride (P<0.05).

Table-1. Anthropometric parameters of prehypertensives and normotensive subjects (mean ±SD).

Variables	Prehypertensive (n= 19)	Normotensives (n= 18)	t-value	p-value
Age (yrs)	24.22±2.38	24.00±2.22	02.94	0.770
BMI	26.31±4.76	21.60±2.44	3.840	0.001*
SBP (mmHg)	126.67±5.76	107.68±9.09	7.530	0.000*
DBP (mmHg)	79.56±6.57	69.52±7.39	4.350	0.000*

*Statistically significant at P<0.05.

Table-2. Renal parameters between Prehypertensives and Normotensives.

Variables	Prehypertensive (n= 18)	Normotensives (n= 19)	t-value	p-value
Urea (umol/1)	2.82±0.65	2.77±0.83	0.20	0.85
Creatinine (umol/1)	100.31±18.79	101.63±28.60	-0.16	0.88
Na^+(mmol/1)	138.81±2.81	138.37±2.67	0.48	0.64
CI^- (mmol/1)	99.38±2.85	99.84±2.73	-0.49	0.63
K^+ (mmol/1)	4.37±0.85	3.98±0.43	1.75	0.09
GFR (ML/min1.73m^2)	1.02±23.18	1.01±33.43	0.08	0.94

*Statistically significant at P<0.05.

Table-3. Correlation of anthropometric parameters among perhypertensives and normotensive

Baseline variable (n = 18)	Perhypertensive (n = 19)	Normotensive		
Pair	r-value	P-value	r-value	P-value
Age (yrs) vs BMI	0.559	0.016	-0.247	0.308
Age (yrs) vs SBP (mmHg)	-0.469	0.050	0.149	0.543
Age (yrs) vs DBP (mmHg)	0.368	0.133	0.056	0.820
BMI vs Weight (Kg)	0.853	0.000*	0.844	0.000*
BMI vs SBP(mmHg)	0.503	0.033*	0.410	0.081
BMI vs DBP (mmHg)	0.494	0.037	0.270	0.264
SBP (mmHg)vs DBP(mmHg)	-0059	0.818	0.686	0.001*

*Statistically significant at P<0.05.

Table-4. Correlation of significant blood Pressure measurement and renal function parameters among prehypertensive and normotensives.

BP measurement	prehypertensive	Normotensives.		
Pair	r-value	P-value	r-value	P-value
SBP vs Urea	0.628	0.009*	0.244	0.313
Creatinine vs GFR	-0.771	0.000*	-0.955	0.000*
Na^+ vs CI^-	0.850	0.000*	0.899	0.000*

*Statistically significant at P<0.05.

4. DISCUSSION

This study investigated the prevalence of pre-hypertension and assessment of renal function in pre-hypertensive students in college of health sciences, Okofia, Nnewi. This population (apparently healthy individuals) were studied because prehypertension is not a disease condition but it can predispose one to hypertension if lifestyle is not modified. In this study it was observed that the prevalence of prehypertension was low in the population contrary to the findings by Ujunwa, et al. [16] who reported a prevalence of 17.3% among adolescents in secondary schools in Enugu, South-east Nigeria and prevalence rate of 45.5% reported in Umuahia, southeast Nigeria [11]. Furthermore, a study on prehypertension among US adults according to the new join national committee reported a prevalence of 60% [17]. This lower prevalence is probably because of the lifestyle of the study population and the less stressful nature of the environment. Since urbanization is an independent predictor of elevated blood pressure [18] the high prevalence reported by these authors can be due to adaptation to westernization and the daily stressful lifestyle peculiar to those living in urban communities. The prevalence of hypertension in this study was higher in males (12.12%) than in female (10.81%). This difference in the observed prevalence may probably be due to the role of male androgen (testosterone). Men are generally at greater risk for cardiovascular and renal diseases than age-matched post-pubertal and premenopausal women [19]. This elevated blood pressure may also be a result of response to stress hormones since young males are and found to be more actives and manual labour which could also contribute to the development of prehypertension. Only 44.28% of the study participants were aware of the condition "prehypertension" while 62.50% of the prehypertensive were aware. This entails that more awareness should be created and study population sensitized about this condition so as to enable early lifestyle modifications and proper management in the appropriate cases. This way, prehypertensive individuals will be prevented will be prevented from progressing to full blown hypertension. Interestingly 62.5% of the prehypertensive subjects had family history of hypertension. This affirms the report that family history of hypertension is a risk factor for prehypertension [16, 20]. The anthropometric variables (age, SBP, DBP and BMI) correlated positively, and this was consistent with the report of several authors [21-23]. The implication of increase in blood pressure with age is that it may continue into adult stage hence further increasing the prevalence of hypertension in the adult group with its attendant morbidity, disability and mortality. This group of individuals in the prehypertensive range are those who might become hypertensive later in life adequate lifestyle modifications such as weight reduction and lifestyle modifications are not institute since a good number of the perhypertensive students are either Overweight (33.33%) or obese (20.8%). Body weight, an important determinant of body mass index, also increase with age in the study population. An increased Body weight is directly proportional to an increased body mass index, systolic and diastolic blood pressure. This means that as the weight of an individual increases, it is inevitable that the BMI will increase. An increase in BMI will in turn bring about more circulation of fats in the blood, the accumulation of "bad fats" mainly cholesterol in the blood vessels forming plaque which occlude the blood vessels. Hence, more force will be exerted in the pumping of blood to the heart causing a subsequent increase in the systolic and diastolic blood pressure. This increased BMI in perhypertensive is consistent with the findings of other researchers that BMI is a strong predictor of perhypertension [24].

In the present study, the mean values of the renal function parameters (urea, creatinine, Na, CI, K and GFR) of the test population were within the normal range, indicating the absence of renal impairment in the perhypertensive subjects. This could be because of the fact that the subjects are of younger age and since their blood pressure is still in the perhypertensive range, no much damage is yet to be observed in the kidney. However, there was a significant correlation between SBP and the Urea levels of the pre-hypertensive subjects unlike the normotensive subjects. DBP has no significant association with any of the renal parameters. This means that urea levels increase as the systolic blood pressure increases though still within the normal range. Glomerular filtration rate (GFR) is the best estimate of number of functioning nephrons and functional renal mass. Accurate measurement of GFR is a

time consuming and expensive, thus measurement of the blood levels of the element regulated by the kidneys can become useful in evaluating kidney functions especially where there are limited resources (ACRG, 2002). There was a significant inverse correlation between creatinine and GFR which is in conformity with the findings by Manjunath, et al. [25] who explained that this might be due to the effects of age, sex, and to a lesser extent race, on creatinine production. Amongst the whole renal parameters, a statistically significant correlation between Sodium and chloride levels was observed both in perhypertensive and normotensive subjects. There was no significant correlation between all the other kidney function markers.

5. CONCLUSION

The study demonstrated an 11.4% prevalence of perhypertension amongst students of college of health sciences Okofia, Nnewi, Anambra State. A low awareness of perhypertension was observed; also a majority of the perhypertensive had a family history of perhypertension affirming the fact that family history is a risk factor of perhypertension. The levels of the renal function markers were within reference range and there was no significant difference between that of the perhypertensives and the normotensive population.

6. RECOMMENDATION

It is recommended that periodic screening and monitoring of blood pressure of adolescents and post-pubertal individuals should be embarked on while general public health education and awareness on perhypertension and its associated risk factors should be strengthened such as keep the population informed. Also concerted that target primary prevention such as change in the lifestyles of general population would result in a lower prevalence of perhypertension and its to hypertension.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Contributors/Acknowledgement: I am highly grateful to God Almighty who has been my constant source of inspiration and strength and made it possible for this work to be success. In him I live, move and have my being and his grace is really sufficient for me. I wonder what the journey would have been like without his abiding love. Appreciation and immense gratitude to my supervisors; Prof. Meludu S.C. for his relentlessness and tireless efforts in overseeing this research study from start to completion. He was phenomenal and inspiring till the completion of this study, providing expertise guidance, immeasurable assistance and directives as well as psychological support and also by being available whenever his presence was required in order to make this work a success. My heartfelt thanks also go to Dr. Okwara John for his guidance and corrections in the course of this research work. Special thanks and recognitions to my parents Mr. and Mrs. Okonkwo for their inestimable encouragement, financial, psychological, moral and spiritual support. Both were fundamental to the completion of this work, being there for me when I needed them most. I must not fail to also acknowledge my Head of Department, Dr. Ibeh Nancy and Deaconess (Mrs.) Nora Mbadugha (Technical Head, Chemical Pathology Department, NAUTH, Nnewi) for their support during the course of this project work.

REFERENCES

[1] P. M. Kearney, M. Whelton, and K. Reynold, "Worldwide prevalence of hypertension: A systematic review," *Journal of Hypertension*, vol. 22, pp. 11-19, 2004. *View at Google Scholar | View at Publisher*

[2] A. V. Chobanian, G. L. Bakris, and H. R. Black, "Seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure," *Hypertension*, vol. 42, pp. 1206-1252, 2003. *View at Google Scholar | View at Publisher*

[3] R. S. Vasan, M. G. Larson, E. P. Leip, W. B. Kannel, and D. Levy, "Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham heart study: A cohort study," *Lancet*, vol. 358, pp. 1682-1686, 2001. *View at Google Scholar | View at Publisher*

[4] C. Manrique, G. Lastra, M. Gardner, and J. R. Sowers, "The renin angiotensin aldosterone system in hypertension: Roles of insulin resistance and oxidative stress," *Medical Clinics of North America*, vol. 93, pp. 569-582, 2009. *View at Google Scholar | View at Publisher*

[5] K. S. Saladin, *Anatomy and physiology, the unity of form and function*: McGraw-Hill, 2009.

[6] A. A. M. Nagah and H. M. Hamad, "Serum creatinine, albumin and urine protein in hypertensive patients," *India Journal of Basic and Applied Medical Research*, vol. 1, pp. 292-295, 2012. View at Google Scholar

[7] J. B. Henry, *Clinical diagnosis and management by laboratory methods*, 20th ed. Philadelphia, PA: W.B. Saunders Company, 2001.

[8] M. Giri, "Choice of renal replacement therapy in patients with diabetic end-stage renal disease," *Journal of Renal Care*, vol. 30, pp. 138-142, 2004. View at Google Scholar | View at Publisher

[9] D. Holmes, "End-stage renal disease: Link between pre-hypertension and risk of ESRD grows stonger," *Nature Review Nephrology*, vol. 9, p. 695, 2013. View at Google Scholar | View at Publisher

[10] Y. Huang, X. Cai, J. Zhang, W. Mai, and S. Wang, "Prehypertension and incidence of ESRD: Asystemic review and meta-analysis," *American Journal of Kidney Disease*, vol. 63, pp. 76-83, 2014. View at Google Scholar | View at Publisher

[11] G. O. Chimezie, C. N. Stanley, J. C. Oluchi, H. E. Tochukwu, U. Kelechukwu, and U. M. Augustus, "Towards prevention of hypertension in Nigeria: A study of prehypertension and its associations among apparently healthy adults in Umuahia," *South-East Nigeria. International Journal of Preventive Medicine*, vol. 6, p. 61, 2015. View at Google Scholar | View at Publisher

[12] A. U. Fortune, N. I. Anthony, R. C. Ada, and M. C. Josephat, "Hypertension and prehypertension among adolescents in secondary schools in Enugu, South East Nigeria," *Italian Journal of Pediatrics*, vol. 37, pp. 2-6, 2013. View at Google Scholar | View at Publisher

[13] C. A. Burtis, E. R. Ashwood, D. E. Bruns, and N. W. Tietz, *Tietz fundamentals of clinical chemistry*, 6th ed. St Louis, Missouri: Saunders, 2008.

[14] H. E. Taylor, *Clinical chemistry*, 4th ed. New York: John Wiley and Sons, 1989.

[15] L. A. Inker and A. S. Levey, "Pro: Estimating GFR using the chronic kidney disease epidemiology collaboration (CKD-EPI) 2009 creatinine equation: The time for change is now," *Nephrology and Dialysis Transplant*, vol. 28, pp. 1390-1396, 2013. View at Google Scholar | View at Publisher

[16] F. A. Ujunwa, A. N. Ikefuna, A. R. Nwokocha, and J. M. Chinawa, "Hypertension and prehypertension among adolescents in secondary schools in Enugu South East Nigeria," *Italian Journal of Paediatrics*, vol. 39, p. 70, 2013. View at Google Scholar | View at Publisher

[17] W. Wang, "Regulation of renal K+ transport by dietary K+ intake," *Annual Revision of Physiology*, vol. 66, pp. 547-569, 2004. View at Google Scholar | View at Publisher

[18] L. Kevin, S. Sunderarajan, V. Hari, C. Laura, B. Doug, T. Sadagopan, and T. Mohan, "Urbanization is an independent predictor of blood pressure in a South Asian population," *Journal of the American College of Cardiology*, vol. 63, pp. 735-1097, 2014. View at Google Scholar

[19] F. R. Jane, "Gender differences in the regulation of blood pressure," *Hypertension*, vol. 37, pp. 1119-1208, 2001. View at Google Scholar | View at Publisher

[20] P. Archana and C. C. Kailash, "Assessment of risk factors associated with hypertension among undergraduate medical students in a medical college in Onitsha," *Advanced Biomedical Research*, vol. 4, pp. 2277-9175, 2015. View at Google Scholar

[21] F. M. Akinkugbe, O. A. Akinwolere, and C. M. Kayode, "Blood pressure pattern in Nigeria adolescents," *West African Journal of Medicine*, vol. 18, pp. 196-202, 1999. View at Google Scholar

[22] E. C. Ejike, C. E. M. Ugwu, L. U. Ezeanyika, and A. T. Olayemi, "Blood pressure patterns in relation to geographic area of residence; a cross sectional study in Kogi State, Nigeria," *Biomedical Central of Public Health*, vol. 8, pp. 411-421, 2008. View at Google Scholar | View at Publisher

[23] H. Y. Jaddou, A. M. Bateiha, A. M. Khawaldeh, Y. M. Goussous, and K. M. Ajlouni, "Blood pressure profile in school children and adolescents in Jordan," *Annals of Saudi Medicine*, vol. 21, pp. 123-126, 2001. View at Google Scholar

[24] Y. Ishikawa, J. Ishikawa, and S. Ishikawa, "Prevalence and determinants of prehypertension in a Japanese general population: The Jichi medical school cohort study," *Hypertension Research*, vol. 31, pp. 1323-1330, 2008.

[25] G. Manjunath, M. J. Sarnak, and A. S. Levey, "Estimating the glomerular filtration rate. Dos and don'ts for assessing kidney function," *Postgraduate Medicine*, vol. 110, pp. 55-62, 2001. *View at Google Scholar | View at Publisher*

BIBLIOGRAPHY

[1] P. J. Allen, "Creatine metabolism and psychiatric disorders: Does creatine supplementation have therapeutic value?," *Neuroscience Biobehavioural*, vol. 36, pp. 1442-1462, 2012. *View at Google Scholar | View at Publisher*

[2] Allhat Collaborative Research Group, "Major outcomes in high-risk hypertensive patients randomized to angiotensin converting enzyme inhibitor or calcium channel blocker vs diuretic: The antihypertensive and lipid -lowering treatment to prevent heart attack trial (ALLHAT)," *JAMA*, vol. 288, pp. 2981-2997, 2003. *View at Publisher*