

Prevalence of and risk factors for hypertension among urban communities of North Sudan: Detecting a silent killer

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ABSTRACT

Background: Hypertension is a common global health problem in many countries including Sudan. The objective of this study was to determine the prevalence of and risk factors for high blood pressure (BP) in River Nile State (RNS), Sudan. **Materials and Methods:** A community-based, cross-sectional study was conducted by a house-to-house survey; all consented adults from the main four cities, Atbara, Shendi, Ed Damer, and Berber, were interviewed using standardized pretested questionnaire to record medical history, sociodemographic and lifestyle characteristics. BP was measured using the standardized technique. Body mass index, waist circumference, and blood glucose were also determined. **Results:** A total of 954 individuals were included in the study. The mean age was 39.5 ± 16.6 years and 54.3% were females. The prevalence of hypertension was 35.7% and the newly diagnosed cases were 22.4%. Increasing age, low educational level, diabetes mellitus, obesity, and central obesity were found to be risk factors for hypertension. **Conclusion:** Hypertension is diagnosed in more than one-third of the population living in urban communities of RNS and correlates well with features of the metabolic syndrome.

Keywords: Hypertension, obesity and diabetes, River Nile State, Sudan

Introduction

Hypertension is a major risk factor for cardiovascular disease (CVD) in the world. It was estimated in the year 2000 that nearly one billion of the world's population, over 25% at that time, had hypertension and this is expected to increase to almost 30% by the year 2025.^[1]

The overall prevalence of hypertension in Sub-Saharan Africa (SSA) is estimated to be 30%, ranging from 16% at the

age of 30 years to 44% at the age of 60.^[2] About 74.7 million individuals are currently hypertensive in SSA, and this number is expected to increase to 125.5 million individuals by the year 2025.^[3] In spite of a large number of population living in SSA, detection and management of hypertension in the region remains suboptimal. Hypertension is the most frequently observed risk factor for CVD in both urban and rural communities in SSA and will contribute to the growing burden of CVD in SSA. Rapid urbanization is the most likely cause of the increase in the prevalence of hypertension in many SSA countries.^[4] In Sudan, the prevalence of hypertension in urban communities witnessed a dramatic increase from 7.5% in 1990 to 18.2% in 2002.^[5,6]

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Salt intake is a recognized risk factor for hypertension. Therefore, the World Health Organization (WHO) has supported interventions to decrease salt intake in SSA to decrease the prevalence of hypertension in the region.^[7]

This study aimed to pinpoint the prevalence of hypertension in urban communities of North Sudan and to specify the associated risk factors.

Materials and Methods

Study design

A prospective, cross-sectional, community-based study was conducted in a house-to-house survey manner.

Study duration

The study was conducted during the period from January to June 2015.

Setting and population

River Nile State (RNS) lies in North Sudan, bordering Khartoum from South and extending to the Northern Sudan borders with Egypt. RNS covers an area of about 124,000 km² and the population is about 1.3 million, most of them are residing alongside the River Nile. The main ethnic groups in RNS include Galeen, Robatab, and Manaseer tribes.

The major traditional economic activities are trading and farming, with other activities among the urban population such as laborers and office working. There are about 350 villages and six main cities in RNS that almost share the same demographic characteristics.

Study population, sampling technique, and sample size

To obtain a representative sample size with a confidence level of 95% and confidence interval of 5%, assuming the prevalence of hypertension 50% (no previous studies from the region), 384 houses/families were selected. A multistage cluster random sampling strategy was used to select study participants from urban locations. These urban centers were divided into multistage clustering to evenly cover the study area. Four cities were selected to represent the urban population of RNS; Atbara, Shendi, Ed Damer, and Berber. Each of these cities was further divided geographically into four regions, North, South, West, and East. Then, two districts were selected from each geographical region by simple tossing technique.

The number of houses was selected proportional to the population size. House-to-house survey was conducted starting from house number 3 on the main street in the district, and vacant houses or families who refused to volunteer were replaced by the next door house.

Inclusion criteria included adults of 18 years and above, permanently residing in one of the selected cities of RNS.

Exclusion criteria included those <18 years age, rural residents, temporal residents, and pregnant ladies.

Data collection tools

The WHO-stepwise approach for noncommunicable disease surveillance was used for data collection. The approach has three levels, a questionnaire to gather demographic, behavioral information, physical measurements including anthropometric measurements, and biochemical tests. Each participant was inquired for demographic data, some relevant clinical symptoms, past medical history, family history, and risk factors of hypertension. In addition, there were questions about drug history including antihypertensive medications. An interviewer-administered, standardized, pretested questionnaire was used to collect data.

Blood pressure measurement

A calibrated mercury sphygmomanometer, with an appropriate cuff size, was used to measure blood pressure (BP) in the sitting position. The average of three readings, each taken after a 5-min rest, was recorded. The criteria of the Seventh Report of the Joint International Committee on Prevention, Detection, and Treatment of high BP were used to classify BP levels as follows:^[8]

- Normal BP is defined as BP <120/80 mmHg
- Prehypertension is defined as systolic BP 120–139 mmHg and diastolic BP 80–89 mmHg
- Stage 1 hypertension: Systolic BP 140–159 mmHg and diastolic BP 90–99 mmHg
- Stage 2 hypertension: Systolic BP 160–179 mmHg and diastolic BP 100–109 mmHg
- Stage 3 hypertension: Systolic BP 180 mmHg or more and diastolic BP 110 mmHg or more.

Risk factor evaluation

Blood glucose measurement

Finger-prick technique after adequate disinfection by alcohol swap was used to obtain capillary blood glucose. Random blood samples were tested for glucose using a glucometer (Accu-Chek, Active Roche Diagnostics, Germany). Any participant who showed blood glucose more than 140 mg/dl was referred to a trusted nearby laboratory to have fasting blood glucose and 2 h postprandial blood glucose to be measured by a spectrophotometer.

In this study, diabetes mellitus, impaired fasting blood glucose, and prediabetes were defined based on the American Diabetes Association:^[9]

Impaired glucose tolerance or prediabetes was defined as random blood glucose between 140 and 199 mg/dl.

Impaired fasting blood glucose was defined as fasting blood glucose between 100 and 125 mg/dl.

Diabetes mellitus was diagnosed as follows: When the participant had symptoms suggestive of diabetes mellitus and his or her

random blood glucose was 200 mg/dl or more in one occasion, or his or her fasting blood glucose was 126 mg/dl or more in one occasion, or if he or she had no symptoms suggestive of diabetes mellitus but had two fasting blood glucose equal or more than 126 mg/dl or two random blood glucose equal or more than 200 mg/dl. Individuals known to be diabetic were also included in this study.

Anthropometric measurements

Anthropometric measurements were taken using standardized and calibrated equipment (balance scale and tape meter for measuring weight and height, respectively), and body mass index (BMI) was calculated using the formula, weight in kilogram divided by height per square meter. BMI was classified according to the National Institute of Health of the US as follows: BMI less than 18.5 is under weight, between 18.5 and 24.9 is normal, between 25 and 29.9 is overweight, 30–34.9 is Class 1 obesity, from 35 to 39.9 is Class 2 obesity, and BMI of 40 or more is Class 3 or morbid obesity.^[10]

Waist circumference

Waist circumference was measured by a tape measure at the level of the umbilicus. A waist circumference of 94 cm or more in males and 80 cm or more in females defines central obesity.^[11]

Ethical clearance

Participants were enrolled in this study after obtaining a verbal and written consent. The following information was given during data collection to ensure that they had the information needed to make the informed consent. That participation is not obligatory. There should be no punishment for refusal. A complete description of the aims of the study, potential benefits and risks, and assurance of confidentiality of any information given, any other additional information requested by participants was provided during data collection, any individual found to have a high blood glucose or any other medical problem was offered a referral to a physician for further investigation and management, free of charge during the study period. All information gathered was kept confidential.

Ethical approval was obtained from the Ethical Committee of the Faculty of Medicine, Nile Valley University.

Statistical analysis

The collected data were analyzed by a computer using Statistical Package for Social Sciences version 21 (SPSS, IBM Statistics, Chicago, IL, USA). The frequencies, mean, and standard deviation were calculated. Pearson’s Chi-square test was used to compare between proportions. The level of significance was considered if $P < 0.05$.

Results

Sociodemographic variables

In this study, 954 individuals living in urban areas of RNS were included in the study. Their age range was 18–90 years

(mean 39.5 ± 16.6) and about two-thirds of participants were 45 years of age or below. Males were 436 (45.7%) and females were 518 (54.3%). More sociodemographic characteristics are displayed in Table 1.

Prevalence of hypertension

The overall prevalence of hypertension among study participants was 35.7% (341/954). Moreover, prehypertension was diagnosed in 41.8% (399). However, normal BP was identified in only 22.4% of participants [Table 2].

Risk factors for hypertension

Significant risk factors for hypertension identified in this study were age, sex, ethnic group, educational level, residence, obesity, family history of hypertension, and diabetes mellitus [Table 3].

Table 1: Sociodemographic characteristics of urban population, River Nile State, Sudan, 2015 (n=954)

Variable	n (%)
Sex	
Male	436 (45.7)
Female	518 (54.3)
Age group	
18-25	266 (27.9)
26-35	204 (21.4)
36-45	166 (17.4)
46-55	148 (15.5)
56-65	98 (10.3)
66-75	41 (4.3)
>75	31 (3.2)
Residence/city	
Atbara	224 (23.5)
Ed Damer	253 (26.5)
Shendi	279 (29.2)
Berber	198 (20.8)
Educational level (years)	
Illiterate	190 (19.9)
<10	195 (20.4)
>10	238 (24.9)
College and above	331 (34.7)
Occupation	
Student	124 (13.0)
Homemaker	319 (33.4)
Farmer	21 (2.2)
Self-employed	232 (24.3)
Employee	231 (24.2)
Unemployed or retired	27 (2.8)

Table 2: Frequency of blood pressure status of urban population in River Nile State, Sudan, 2015 (n=954)

Blood pressure category	n (%)
Normal blood pressure	214 (22.4)
Prehypertension	399 (41.8)
Known hypertension	127 (13.3)
Newly diagnosed hypertension	214 (22.4)

Table 3: Correlations of some risk factors for hypertension among urban population in River Nile State, Sudan, 2015 (n=954)

Risk factor	Normal BP n (%)	Prehypertension n (%)	Hypertension n (%)	χ^2	P
Sex					
Male	87 (20.0)	191 (43.8)	158 (36.1)	11.35	0.01
Female	127 (24.5)	208 (40.2)	183 (35.3)		
Age group					
18-25	91 (34.0)	139 (52.3)	36 (13.5)	18	0.000
26-35	56 (27.5)	97 (47.5)	51 (25.0)		
36-45	32 (19.3)	66 (39.8)	68 (41.0)		
46-55	19 (12.8)	55 (37.2)	74 (50.0)		
56-65	7 (7.1)	27 (27.6)	64 (65.3)		
66-75	5 (12.2)	9 (22.0)	27 (65.8)		
>75	4 (12.9)	6 (19.4)	21 (67.7)		
Educational level (years)					
Illiterate	40 (21.1)	56 (29.5)	94 (59.4)	84.5	0.000
<10	31 (15.9)	74 (37.9)	90 (46.2)		
>10	41 (17.2)	111 (46.6)	86 (36.2)		
College and above	102 (30.8)	158 (47.7)	71 (21.4)		
Occupation					
Student	35 (28.2)	72 (58.1)	17 (13.7)	124.85	0.000
Homemaker	62 (19.4)	104 (32.6)	153 (47.9)		
Farmer	2 (9.5)	8 (38.1)	11 (52.4)		
Self-employed	44 (19.0)	98 (42.2)	90 (38.7)		
Employee	66 (28.6)	109 (47.2)	56 (24.3)		
Unemployed or retired	5 (18.5)	8 (29.6)	14 (51.9)		
BMI					
Underweight	24 (39.3)	25 (41.0)	12 (19.7)	63.2	0.000
Normal	87 (26.6)	151 (46.2)	89 (27.2)		
Overweight	73 (22.0)	132 (39.8)	127 (38.3)		
Class 1 obesity	23 (15.9)	60 (41.4)	62 (42.8)		
Class 2 obesity	5 (7.5)	23 (34.3)	39 (58.2)		
Morbid obesity	2 (9.1)	8 (36.4)	12 (54.5)		
Family history of hypertension					
Yes	97 (22.1)	160 (36.4)	182 (41.4)	33.7	0.000
No	117 (22.7)	239 (46.4)	159 (30.9)		
Most common tribes					
Galeen	143 (22.1)	263 (40.7)	240 (37.2)	42.3	0.03
Shaijiya	23 (26.1)	40 (45.5)	25 (28.4)		
Rubatab	13 (25.3)	19 (37.3)	19 (37.2)		
Nuba	3 (11.1)	15 (55.6)	9 (33.3)		
Residence					
Atbara	47 (21.0)	102 (45.5)	75 (33.5)	51.37	0.000
Ed Damer	48 (19.0)	105 (41.5)	100 (39.5)		
Shendi	75 (26.9)	119 (42.7)	85 (30.4)		
Berber	44 (22.2)	73 (36.8)	81 (41.0)		
Blood sugar status					
Normal	179 (26.3)	298 (43.8)	204 (29.9)	51.78	0.000
IGT	14 (15.4)	37 (40.6)	40 (44.0)		
DM	21 (11.5)	64 (35.2)	97 (53.3)		
WC					
Normal WC (female)	75 (30.9)	96 (39.3)	72 (29.6)	69.4	0.000
Abnormal WC (female)	53 (19.1)	112 (40.3)	113 (40.7)		
Normal WC (male)	77 (22.4)	168 (48.8)	99 (28.8)		
Abnormal WC (male)	9 (10.1)	23 (25.8)	57 (64)		

BMI: Body mass index; BP: Blood pressure; DM: Diabetes mellitus; IGT: Impaired glucose tolerance; WC: Waist circumference

Males were found to have a higher rate of abnormal blood BP, both hypertension and prehypertension, compared to females 80% versus 75.5% ($P = 0.01$). In this regard, the prevalence of hypertension among males was 36.1% compared to 35.3% in females.

Age was found to be a significant risk factor as those above 75 years, showed a higher percentage of hypertension (67.7%) [Table 3].

Educational level was found statistically significant in this study. However, low educational attainment might be a contributing factor to developing hypertension, rather than a risk factor by itself. This finding was evidenced by the fact that only 20% of illiterate individuals had a normal BP and 59.4% were hypertensive, compared to 30.8% and 21.4% of those with college education for the normal BP and hypertension, respectively.

It was also found that BP rose as weight increased. Thus, the highest rate of hypertension (58.2%) was detected among subjects with Class 2 obesity.

Family history of hypertension was found to be a risk factor. As a result, participants with positive family history of hypertension showed a prevalence rate of 41.4% compared to 30.9% among individuals without a family history of hypertension ($P = 0.000$).

Blood sugar status was a significant risk factor as evidenced by the prevalence of hypertension among 29.9%, 44.0%, and 53.3% for normoglycemic, prediabetes, and diabetic individuals, respectively ($P = 0.000$).

Discussion

The current study revealed hypertension prevalence in urban communities of RNS of 35.7% (with 22.4% rate of undiagnosed hypertension). This is nearly two-fold increase in the prevalence of hypertension in urban communities compared to the prevalence of 18.2% found in the year 2002.^[7] For comparison, the prevalence of hypertension in village inhabitants in the Northern State of Sudan was estimated to be 39.6% in 2013.^[12] Recent studies from other urban regions in African countries showed higher prevalence of hypertension. For instance, the prevalence of hypertension in urban areas in Ethiopia, Tunisia, Nigeria, and Namibia was found to be 30%, 28.9%, 33%, and 32%, respectively.^[4,13-15] Furthermore, trial of hypertension in North Africa (Epidemiological Trial of Hypertension in North Africa), an international, multicenter, epidemiological, cross-sectional study conducted in patients consulting primary care physicians of Algeria, Tunisia, and Morocco, showed total prevalence of hypertension was 45.4%.^[16]

The increased prevalence of hypertension in this study might be attributed to obesity, rapid urbanization, increase in prevalence of diabetes, and possibly some other factors including genetic factors. Many studies indicated that diabetes emerged as a strikingly common correlate to hypertension.^[17-19] About 53% of individuals with diabetes in this study were found to have hypertension, emphasizing the importance of screening for hypertension once diabetes is diagnosed and vice versa. The risk factors determined in this study were consistent with those reported in the literature. As compared to many studies, high prevalence of hypertension in this study was associated with increasing age,^[20,21] increasing BMI,^[20,22]

a positive family history of hypertension,^[12,23] and the low level of education.^[24,25] In this study, no statistical difference was observed in the prevalence of hypertension between men and women. Several studies showed a high prevalence of hypertension in men than women while other studies suggested higher prevalence in women.^[26,27] It is likely that different genetic, physiological, and environmental factors contributed to the variation of prevalence of hypertension between men and women.

This study is not without limitations. Generalization of the results to the whole population might not be accomplished by the cross-sectional design study. Another concern is that we did not assess the effect of diet, salt intake, smoking, stress, and physical activity on the prevalence of hypertension, due to difficulty in quantifying such parameters. Despite these limitations, this study is novel and shines a spotlight on the situation of hypertension in urban communities in RNS.

Conclusion

This study identified 35.7% prevalence rate of hypertension among the urban population of RNS. Among them, 22.4% were newly diagnosed with hypertension. Therefore, regular screening for hypertension, in particular among those with risk factors, is highly recommended.

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Conflicts of interest

There are no conflicts of interest.

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