

1 **Waist circumference, Blood pressure and Lifestyle of Sudanese** 2 **population, Khartoum Locality, Sudan 2016**

3 **ABSTRACT**

4 **Aims:** to measure the waist circumference of Sudanese adults in Khartoum Locality and its
5 relationship to blood pressure and lifestyle during celebration of international day of
6 hypertension in May 2016 .

7 **Study Design:** It was a descriptive cross-sectional study.

8 **Place of the celebration:** Khartoum Locality at Alsahaa Alkhadraa (The Green Park)

9 **Methodology:** A total of 364 adult participants, 196 men and 168 women were interviewed
10 using structured questionnaire. Blood pressure (BP) was measured **considering** hypertension
11 as ≥ 140 mmHg and ≥ 90 mmHg for systole and diastole BP respectively. Waist
12 circumference was measured using an anthropometric measuring tape **at** cut-off point of 94
13 cm and 80 cm for men and women respectively. Data was managed by SPSS version 20 and
14 Chi-square test at 95% CL was used to test the association between waist circumference,
15 blood pressure and life style characteristics.

16 **Results**

17 Age distribution of the study population showed 48.2% females and 45.4% males in the
18 **middle age group (38-57 years)**. Two thirds of the study population were hypertensive, 62.8%
19 of males and 64.3% of females. The mean waist circumference of men was $97.82 \text{ cm} \pm 16.7$,
20 mean Systolic BP was 127 ± 22 and mean Diastolic BP was 85 ± 15 . The mean waist
21 circumference of women was 99.31 ± 16.2 , mean Systolic was 128 ± 24 and mean Diastolic
22 BP was 84 ± 17 .

23 Abnormal waist circumference was found in 61.2% of males and 86.9% of females. Fifty
24 nine (30.1%) of the males and 86 (51.2%) of the females with abnormal waist circumference

25 were hypertensive. The association between abnormal waist circumference and high blood
26 pressure was significant among both sexes, P value= 0.001.

27 Physical exercise and fat and salt foods were not significantly associated waist circumference
28 in both men and women.

29 **Conclusion**

30 Two thirds of women and men in the celebrating areas were hypertensive. Half of women
31 and one third of men were significantly hypertensive and having abnormal waist
32 circumference. Doing physical exercise, avoiding fat and salt foods was insignificantly
33 associated with normal waist circumference. Large survey with representative sample is
34 needed to estimate the real Sudanese waist circumference.

35
36 **Key Words:** Waist Circumference, Blood Pressure, Lifestyle.

37 38 39 **1. Introduction**

40 Waist circumference (WC) is a marker of visceral adipose tissue of abdomen and it is an
41 important anthropometric measure that predict hypertension and coronary artery diseases of
42 adults as well as of children, [1- 3].Waist circumference is a good predictor than BMI
43 because it does not influenced by height; however, in meta- analysis of 23 longitudinal
44 observation studies, waist circumference is not a predictor for hypertension except in some
45 Hispanic/Latinos [4].The optimal cut-off points of waist circumference varies between
46 countries due to ethnicity, it ranged from 102/40 to 88/34.6 (cm/inch) in men and 88/34.6 to
47 79/31(cm/inch) in women [5]. The heart foundation defined normal waist circumference as
48 less than 94 cm (37 inches) in men and less than 80 cm (31.5 inches) in women, above which
49 both will be at risk of cardiovascular diseases including hypertension [6].Women have

50 substantially more total adipose tissue than men with more peripheral distribution of fat in
51 early adulthood [7]. The hormonal effect and parity in women contribute to abnormal fat
52 distribution and to the increase of waist circumference compared to men [7, 8]. Modification
53 of life style including diet control and exercise contribute to reduction of waist circumference
54 [9]. Usually; obesity is a strong predictor of abnormal waist circumference. The prevalence of
55 obesity has increased across the globe, particularly in Africa including Sudan[10]. Obesity
56 has been studies thoroughly in Sudan [10], while studies regarding relationship of lifestyle,
57 waist circumference and blood pressure are not abundant; therefore this study was aiming to
58 measure the waist circumference of Sudanese adults in Khartoum Locality and its
59 relationship to blood pressure and lifestyle.

60 **2. Population and Methods**

61 **2.1 Study Design:** This was a cross-sectional descriptive study carried in May 2016
62 during the celebration of international day of hypertension.

63 **2.2 Study Area**

64 The study area was Khartoum locality, which consists of six local administrative units and
65 157 quarters. This area covers a population of 639,598 people, spread across an area of
66 approximately 176 square kilometers. The celebration days was carried out in the centre of
67 Khartoum locality, Alsahaa Alkhadraa (The Green Park).

68 **2.3 Study Population**

69 The target population was adult males and females aged 18 years and above
70 who attended the celebration and came from the six local administrative units
71 of Khartoum locality.

72 **2.4 Sampling and Sample Size**

73 **2.4.1 Sample Size:**

74 Sample size was calculated according to the binomial equation:

$$n = \frac{Z^2 pq}{d^2}$$

75 Where;

76 n is the desired sample size

77 z is standard normal deviate=1.96

78 p is the prevalence of occurrence. It is considered 0.5% to obtain the maximum sample size.

79 q is (1- p) = 0.5

80 d is the desired margin of error = 0.05

81 The calculated sample size was 384 and 364 individuals were responding leaving 5% non-
82 response rate

83 **2.4.2 Sampling Technique:** The sampling technique was a purposive convenient sampling
84 based on the agreement of the eligible adults to participate in the study during the celebration
85 days until the sample size was completed.

86 **2.5 Tools and data Collectors**

87 Data collection tool were structured close ended questionnaire, sphygmomanometers and
88 measuring tapes. The questionnaire was composed of three parts; the first part composed of
89 population characteristics; age, sex, education, marital and working status. The second part
90 was about life style characteristics; physical exercise, fat and salt foods consumption. The
91 third part was the measurement section for recording the systole and diastole blood pressure
92 (BP) and the waist circumference.

93 Hypertension was defined as systolic BP ≥140 mm Hg and diastolic BP ≥90 mm Hg. Blood
94 pressure was measured by calibrated mercury sphygmomanometers before and after the
95 interview. The first measurement was taken after 5 minutes rest while the participant in quiet
96 sitting position with legs uncrossed and the arm at the level of the heart. Systolic blood
97 pressure (SBP) taken upon hearing the first sound, and DBP upon the complete disappearance
98 of Korotkoff sounds. The second BP measurement was taken after the interview with the

99 similar resting position. The range of interview time was estimated to 5-6 minutes. The
100 averages of the two measurements were used for further analysis.

101 For accurate measurement of WC, the data collector asked the respondent to stand with arms
102 at the sides, feet positioned close together so that the weight evenly distributed across the feet
103 [11]. The WC measurement was done twice after the end of a normal expiration. The elastic
104 measuring tape was adjusted at the midpoint between the lower margin of the last palpable
105 rib and the top of the iliac crest [11]. The two measurements were averaged and the WC cut-
106 off points used for male and females were 94 cm and 80 cm respectively [6].

107 Data collectors were the medical doctors with membership in the Sudanese Society of
108 Hypertension (SSH) and semi-final medical students from the Faculties of Medicine in
109 University of Khartoum, International Africa University and Alneelain University. They were
110 trained on data collection, calibration of sphygmomanometers and the skills of measuring BP.
111 They were also trained on how to measure WC using measuring tape. Data collection took
112 about six days from 17th to 22nd of May 2016.

113 **2.6 Data management and analysis:** Data was cleaned, entered and managed in SPSS
114 version 20. Descriptive statistics in terms of frequency counts and percentages were used for
115 qualitative variables. Mean WC was calculated as well as the mean systolic and diastolic BP
116 for both sexes. Chi-square test at 95% CL was used to test the association between waist
117 circumference and blood pressure, physical exercise, fat and salt foods consumption. P value
118 equal to or less than 0.05 is considered as significant.

119 Authorization was obtained from the ethical committee of SSH. An informed consent was
120 signed by the individuals who agreed to participate before filling in the questionnaire and all
121 personal information and measurements were kept confidential.

122 3. Results

123 Age distribution of the study population showed 48.2% were females and 45.4% were males
 124 in the middle age group (38-57 years). Females and males in the age group of 18-37 years
 125 accounted to 38.7% and 29.1% respectively [Table 1]. The married population was
 126 144(73.5%) and 103(61.3%) for males and females respectively [Table 1].Almost half of
 127 males and females had university education and above, 111(56.6%) and 90 (53.6%)
 128 respectively [Table 1].The majority of males were working, 132 (67.3%) and the majority of
 129 females were not, 124 (73.8%) [Table 1].
 130 Almost two third of the study population were hypertensive, 62.8% of males and 64.3% of
 131 females [Fig 1].

132 The mean waist circumference of men was 97.82 cm \pm 16.7, the mean Systolic BP was 127 \pm
 133 22 and the mean Diastolic BP was 85 \pm 15[Table2].The mean waist circumference of women
 134 was 99.31 \pm 16.2, the mean Systolic was 128 \pm 24 and the mean Diastolic BP was 84
 135 \pm 17[Table2].

136 Abnormal waist circumference was found in 61.2% of males and 86.9% of females [Fig
 137 2].Fifty nine (30.1%) of the males and 86 (51.2%) of the females with abnormal WC were
 138 hypertensive [Fig 3].The association between abnormal waist circumference and high blood
 139 pressure was significant among both sexes ,P value= 0.001 [Fig 3].

140 Being practicing exercise and avoiding fat and salt foods was not significantly associated
 141 with waist circumference measure among men and women [Table 3and Table 4].

142 **Table1: Socio-demographic characteristics of study population**

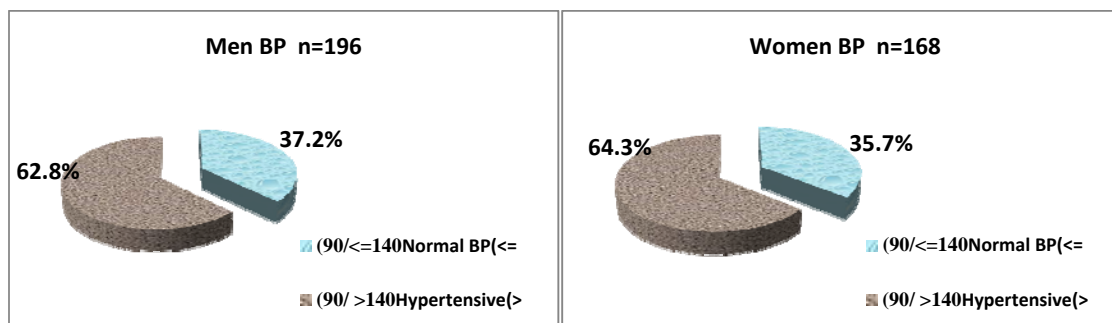
Characteristics of study population(total n=364)		Males (n=196)	Females (n=168)
Age in years	18-37	57(29.1%)	65(38.7%)
	38-57	89(45.4%)	81(48.2%)
	58 and above	50(25.5%)	22(13.1%)
Marital status	Married	144(73.5%)	103(61.3%)
	not married	52(26.5%)	65(38.7%)
Educational status	Basic education*	85(43.4%)	78(46.4%)
	University and above	111(56.6%)	90(53.6%)
Working status	Working	132(67.3%)	44(26.2%)

	Not working	64(32.7%)	124(73.8%)
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143 *Basic education includes Khalwa, primary and secondary schools

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147 **Fig 1: Number distribution of study population by blood pressure and sex**

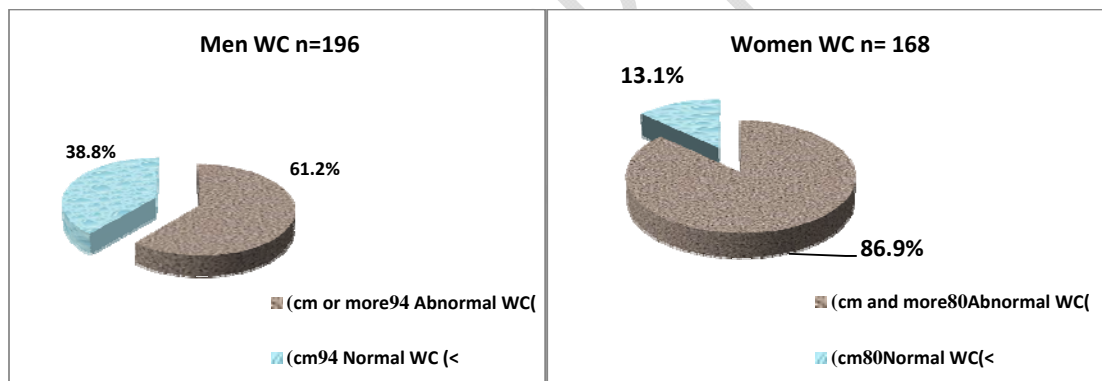
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149 **Table 2: measurement of waist circumference and blood pressure of study population**

Measurement	Men	Women
Mean waist circumference	97.82 cm ± 16.7	99.31 ± 16.2
Mean Systolic BP	127 ± 22	128 ± 24
Mean Diastolic BP	85 ± 15	84 ± 17

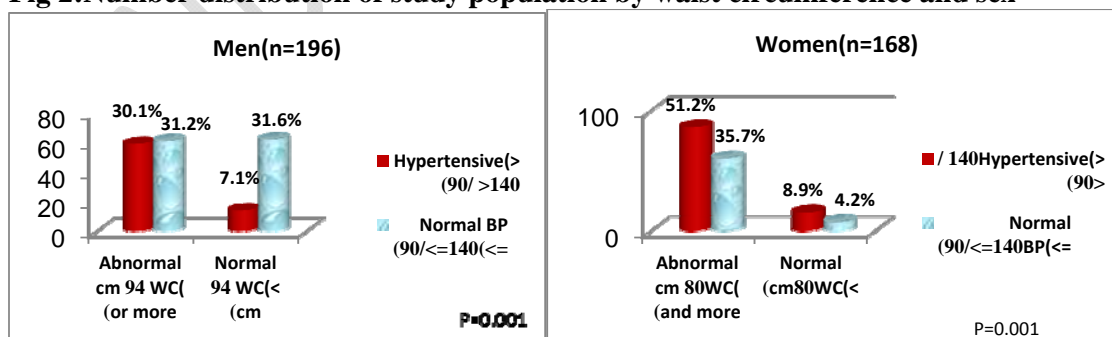
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153 **Fig 2: Number distribution of study population by waist circumference and sex**



154

155 **Fig 3: Association of waist circumference and blood pressure among study population**

156

157 **Table 3: Association of waist circumference and lifestyle characteristics of men (n=196)**

Characteristics		Waist circumference		Sig Level
		Abnormal	Normal	
Physical exercise	Every day	30(15.3%)	22(11.2%)	0.857
	1 to 3 times a week	39(20%)	22(11.2%)	
	Never	50(25.5%)	33(16.8%)	
Rating consumption of fatty foods	Avoid fatty foods	65(33.2%)	38(19.4%)	0.283
	Don't pay attention to fatty foods	34(17.3%)	29(14.8%)	
	Use a lot of fats	21(10.7%)	9(4.6%)	
Rating consumption of salt in food	Avoid foods rich in salt	69(35.2%)	36(18.4%)	0.080
	Don't pay attention to salt in food	37(18.9%)	22(11.2%)	
	Use a lot of salt	14(7.1%)	18(9.2%)	

158

159 **Table 4: Association of waist circumference and lifestyle characteristics of women**
160 **(n=168)**

Characteristics		Waist circumference		Sig Level
		Abnormal	Normal	
Physical exercise	Every day	84(50%)	8(4.7%)	0.944
	1 to 3 times a week	10(6%)	2(1.2%)	
	Never	54(32.1%)	10(6%)	
Rating consumption of fatty foods	Avoid fatty foods	79(47.1%)	11(6.5%)	0.901
	Don't pay attention to fatty foods	46(27.4%)	8(4.7%)	
	Use a lot of fats	21(12.5%)	3(1.8%)	
Rating consumption of salt in food	Avoid foods rich in salt	70(41.7%)	7(4.2%)	0.238
	Don't pay attention to salt in foods	54(32%)	9(5.4%)	
	Use a lot of salt	22(13.1%)	6(3.6%)	

161

162

163 **4. Discussion**

164 The population in this study were voluntary came to the celebration of hypertension days.

165 This is explain the skewedness of age to show two thirds above 38 years and most of them

166 were hypertensive. Although high blood pressure is correlated positively with aging [12] but

167 in this study the sampling methods did not represent the reference population in Khartoum

168 Locality and specific analysis for age and hypertension were not carried out. The population

169 came to celebration areas could be either known hypertensive they needed to check their

170 status or unknown and undiagnosed ones. More than half of the celebrating population were
171 having high education. Being highly educated does not affect the access and utilization of the
172 celebration services, it **is** worth to know that health seeking behaviour is low among
173 population aware of the existence of health services [13]. In this study; almost four quarters of
174 women were having abnormal waist circumference compared to two thirds of men. **The mean**
175 **waist circumference was more than 80 cm among study women approximates the mean waist**
176 **circumference of men. This could be due to that women living in Khartoum as urban city**
177 **having access to modern fast foods would suffer from overweight and obesity.** Sub-Saharan
178 countries including Sudan showed nutritional transition of women towards obesity and
179 overweight due to urbanization [14, 15]. The global scene showed increasing prevalence trend
180 of abdominal obesity that **increases** the waist circumference and positively correlated with
181 changes in lifestyle [16-18]. In this study hypertension was significantly associated with
182 abnormal waist circumference where one third of men and half of women were hypertensive
183 and having large waist circumference. Several studies had shown that the waist
184 circumference is strongly associated with the risk of developing hypertension, diabetes and
185 other devastating physiological symptoms [19-23].

186 Regarding lifestyle and waist circumference, half of women with abnormal waist
187 circumference carried out some sort of physical activities every day compared to 15.3% of
188 men with abnormal waist circumference. **This relationship was insignificant and it is not**
189 **supported by the intervention study of physical activity and reduction of the central obesity**
190 **and waist circumference** [24]. Avoiding fatty food was found to be insignificantly related to
191 normal waist circumference **which** is not supported by the evidence of reduction in fatty diet
192 reduces body weight and central abdominal obesity [25]. Avoiding extra salt in food among
193 celebrating population was insignificantly associated with normal waist circumference. **A**

194 longitudinal study showed significant reduction of waist circumference when lowering salt in
195 food [26].

196 5. Conclusion

197 Almost two thirds of women and men during the internal celebration days of hypertension in
198 Khartoum locality were hypertensive. Four quarters of women and two thirds of men were
199 having abnormal waist circumference with large mean WC among women. Half of women
200 and one third of men were had hypertension that significantly associated with abnormal waist
201 circumference. Doing physical exercise, avoiding fat and salt foods were insignificantly
202 associated with normal waist circumference. Large survey with representative sample is
203 needed to estimate the Sudanese waist circumference and its relationship to details of
204 physical exercise, fat and salt food consumption.

205 6. Limitation

206 This study was carried out among celebrating population that gave up unrealistic
207 association between physical activities, salt and fat foods consumption and waist
208 circumference. This limitation was superimposed by the non-representativeness of
209 Sudanese population in the celebration days and the missing of the types of physical
210 activities, fat and salt foods.

211 Consent

212 An informed consent was signed by the individuals who agreed to participate before filling in
213 the questionnaire and all personal information and measurements were kept confidential.

214

215 Ethical Approval

216 Ethical Clearance was obtained from the ethical committee of the Sudanese Society of
217 Hypertension.

218

219 **Competing Interests**

220 Authors have declared that no competing interests exist.

221

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