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High Blood Pressure, an Epidemic Inadequately Diagnosed and Poorly Controlled: A Community-based Survey in Kinondoni District, Dar Es Salaam Tanzania

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Methods: We conducted a cross-sectional, community-based survey in January 2016, 1831 persons were recruited. Physical activity was assessed using the physical activity vital sign scale (PAVS) and alcohol dependence was assessed by the CAGE questionnaire. Trained personnel measured and recorded blood pressure and anthropometric measures. Hypertension was defined according to the 7th Report of the Joint National Committee (JNC 7) or use of blood pressure lowering medications. Multivariate logistic regression analyses were performed to assess for factors associated with high blood pressure.

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Results: The mean age of participants was 43.6 years and 63.5% were women. 1.1% were current smokers, 5.3% were alcohol dependent, 64.3% had excess body weight, and 67% were physically inactive. 63.3% of individuals had hypertension, and 51% of these were unaware of their hypertensive status. Among those with hypertension awareness, 17.5% had their hypertension controlled. Age ≥40, male sex and BMI ≥25 were strongly associated with a newly diagnosed hypertension status, (OR 5.7, 95% CI 4.2-7.8, p<0.001; OR 1.6, 95% CI 1.1-2.2, p<0.01; and OR 2.9, 95% CI 2.1-4.1, p<0.001 respectively).

Conclusions: Our findings suggest that excess body weight is a single modifiable risk factor strongly associated with high blood pressure. Majority of persons with high blood pressure are undetected and thus unaware of their hypertensive status. Furthermore, hypertension control rates are very low.

Keywords: high blood pressure, hypertension, excess body weight, physical inactivity, hypertension control, hypertension awareness, obesity.

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I. Background

While infectious diseases continue to plague sub-Saharan Africa, the rapid increase in non-communicable diseases (NCDs) is exacerbating an already distressing situation. Faced by impoverished health care systems and poor infrastructure, a rising trend of NCDs in Africa is making the battle against the ever present infectious diseases even more difficult. Cardiovascular disease is currently the number one killer in developing countries, claiming as many lives as HIV, TB and malaria combined.[1-3] With a 7% attribution to the global burden of disease, hypertension is indeed the single most substantial cause of disability and mortality worldwide.[4-6] Accountable for about 50% of deaths due to heart disease, kidney failure and stroke in 2013, hypertension remain a significant threat to global health and development.[7-9]

Despite having a high asymptomatic potential, easy diagnostic modality, and a clear management strategy, the rates of hypertension awareness, treatment and control is very low especially in developing nations.[10] Tanzania like other third world countries is witnessing an upsurge of NCDs with hypertension among the leading etiologies. This community-based survey conducted in Kinondoni district, Dar es Salaam, aimed to determine the prevalence, awareness, control and associated factors for high blood pressure in the targeted urban population.

II. Methods

a) Study Oversight & Definition of Terms

In January 2016, we conducted a community-based cross-sectional survey in Kinondoni district, the largest district in Dar es Salaam city. 1831 persons who voluntarily came to the screening grounds after hearing

the screening advert through the media were recruited and screened. Socio-demographic parameters were gathered through interviews utilizing a structured questionnaire. We grouped age into 4 categories; children: <18 years, young adults: 18-39 years, middle age 40-54 years and elderly: ≥55 years. [11] Physical activity was assessed using the Physical Activity Vital Sign (PAVS) scale[12]; with scores of 0 minutes/week denoting inactivity, 1 - <150 minutes/week signifying underactivity and ≥150 minutes/week indicating physical activeness. Weight and Height were measured using the standard measuring scales and BMI for those aged 20 years and above was calculated by a ratio of weight (in kilograms) to height (in meters) squared. For those under 20 years, a CDC BMI calculator for children and teens[13] was utilized. We defined underweight as BMI<18.5 kg/m^2, normal: BMI 18.5-24.9 kg/m^2, overweight: BMI 25-29.9 kg/m^2 and obese: BMI ≥30 kg/m^2.[14] Individuals who smoked at least 1 cigarette in the past 6 months were regarded as current smokers, those who last smoked over 6 months or self-reported quitting smoking were considered past smokers and those who never smoked but currently live with a smoker were regarded as passive smokers. Alcohol drinking was defined as at least a once consumption every week. Alcohol dependence was assessed by the CAGE questionnaire[15], where a total score of 2 or greater was used to define alcohol dependence. Blood pressure (BP) was measured by digital BP machines where a systolic blood pressure (SBP) <120 mmHg and a diastolic blood pressure (DBP) <80 mmHg was used to define normotension/optimal BP. Pre-hypertension was defined by SBP of 120-139 mmHg or DBP of 80-89 mmHg, while SBP ≥140 mmHg or DBP ≥90 mmHg indicated hypertension.[16] A hypertensive subset with SBP ≥180 mmHg or DBP ≥ 110 mmHg was regarded as hypertensive crisis.[17] Awareness of hypertension was defined as a self-report of any prior diagnosis of hypertension in a health facility and/or use of anti-hypertensives. Controlled hypertension/BP was defined as awareness of hypertension associated with a SBP <140mmHg and DBP <90mmHg. All interviewers and medical personnel involved in the screening were familiar with the study aims and methods.

b) Statistical analysis

All statistical analyses were performed by STATA v11.0 software. Summaries of continuous variables are presented as means (± SD) and categorical variables are presented as frequencies (percentages). Categorical and continuous variables were compared using the Pearson Chi square tests and Student's T-test respectively. Bivariate analyses were performed to assess for factors associated with high blood pressure. Significant variables ($p<0.05$) were then entered in a multivariate logistic regression model to control for confounders. Odd ratios with 95% confidence intervals and p-values are reported. Statistical significance was set at $p<0.05$ and all tests were two tailed.

III. Results

a) Study Population

Table 1 displays the socio-demographic characteristics of 1831 recruited persons. The mean age was 43.6 ± 16.8 years, and 63.5% were women. Primary education was the highest level attained in 58% of participants, married subgroup comprised the largest proportion (58%) with regard to marital status and 4.4% had health insurance.

b) Risk Factors for High Blood Pressure

Smoking status, alcohol intake and physical activity was assessed among persons aged 18 years and above (n = 1708). Regarding smoking history; 1.1% (19/1708) were current smokers, 5.2% (89/1708) were past smokers and 4.2% (72/1708) were passive smokers. Current use of alcohol was reported by 11% (188/1708) of participants, 48.4% of whom were alcohol dependent. The mean PAVS score was 59.8 minutes/week. About 67% (1144/1708) of participants were inactive, 18.3% (313/1708) were underactive and 14.7% (251/1708) were active. While age and BMI differences displayed similar rates of physical inactivity, female sex was associated with a 70% increased chance of being inactive compared to males, (OR 1.7, 95% CI 1.3-2.3, $p<0.001$).

The mean BMI of participants was 27.8 ± 7.1. Overall, 97 (5.4%) were underweight, 544 (30.3%) had normal BMI, and 1155 (64.3%) were overweight or obese; Table 2. Age ≥40 and female sex displayed a higher likelihood for being overweight and/or obese, (OR 4.0, 95% CI 3.2-5.0, $p<0.001$ and OR 2.3, 95% CI 1.8-2.8, $p<0.001$ respectively).

c) Blood Pressure Control and Hypertension Awareness

Of the 1796 persons who responded to the questions regarding history of chronic disease, 688 (38.3%) had a history of at least one chronic illness. Cardiovascular related diseases were reported by 612 (88.9%) of those with a positive history of chronic illness, 559 (91.3%) of whom had hypertension awareness.

The prevalence of hypertension in this study was 63.3% (1137/1796) and 49.2% (559/1137) of these were aware of their hypertensive status. The mean SBP and DBP of persons aware of their hypertensive status was 166.0 ± 29.8 and 100.6 ± 17.7 respectively. During screening, 82.5% (461/559) of persons with hypertension awareness had their BPs uncontrolled, with 45.3% (209/461) of these falling under the hypertensive crisis range. Sex and BMI differences displayed a similar pattern of BP control, however age ≥40 displayed a 3 times increased likelihood for poor

BP control compared to age <40, (OR 3.2, 95% CI 1.3-7.2, p<0.01).

Blood pressure range of persons with no prior history of hypertension (n=1237) by age, sex and BMI status is displayed in Table 3. Of these, 19.2% (237/1237) had optimal BP, 34.1% (422/1237) had pre-hypertension and 46.7% (578/1237) were newly diagnosed with hypertension. 20.4% (118/578) of the new hypertensives had their BPs within the hypertensive crisis range. During multivariate logistic analysis; age ≥40, male sex and BMI ≥25 were strongly associated with a newly diagnosed hypertensive status, (OR 5.7, 95% CI 4.2-7.8, p<0.001; OR 1.6, 95% CI 1.1-2.2, p<0.01; and OR 2.9, 95% CI 2.1-4.1, p<0.001 respectively).

d) Echocardiography Findings

We performed echocardiograms (ECHO) on 205 newly-diagnosed and 340 persons aware of their hypertensive status. Overall, 47% (256/545) of ECHOs revealed features of hypertensive heart disease (HHD), 9.4% (51/545) dilated cardiomyopathy (DCM), 2.0% (11/545) valvular heart disease (VHD) and 41.6% (227/545) had normal findings. Of the ECHOs performed on newly diagnosed hypertensives, 34.1% (70/205) revealed HHD, 5.4% (11/205) DCM, 1.5% (3/205) VHD and 59.0% (121/205) had normal findings.

IV. Discussion

Nearly two-thirds of individuals in this recent urban community-based screening had high blood pressure. In contrast to previous studies, these findings are substantially high. In a systematic review of hypertension studies in Africa by Addo[18] et al, there was a wide variation in hypertension prevalence ranging from 9.3%[19] in Ethiopia to 48.1%[20] in Mozambique. Our findings nevertheless are in unison with another population-based Tanzanian study which found a prevalence of 70%[21], this study however involved persons aged above 70 years.

Correlates of high blood pressure included age ≥40, male sex and BMI ≥25 which were associated with up-to 5-fold increased chance of being hypertensive. These factors and others including physical inactivity are well established risk factors that have been consistently demonstrated in several studies.[22,23] The rates of hypertension were nearly similar to the rates of excess body weight in this study. This potentially implied that overweight/obesity was the strongest modifiable factor associated with hypertension. Physical inactivity was not a significant factor for hypertension in this present study, it should be noted however that the population we screened was predominantly inactive. Moreover, the observation that females were more likely to be inactive than males was reciprocated in the BMI measurement in the sense that females displayed higher likelihood for excess body weight compared to males. The overall rates of obesity in this present study were almost twice the rates found by Shayo[24] et al in the same setting in 2010. In unison to Shayo et al study, we also found higher rates of obesity among females. We were intrigued by the observation that although females were significantly obese than males, hypertension rates were higher in males compared to females. Androgen mediated abnormalities in pressure natriuresis is currently the plausible theory explaining the differences in hypertension rates between sexes.[25]

One in every two persons with high blood pressure in this study was unaware of their hypertensive status. Reported rates of hypertension awareness in Africa ranges from 12.3% among Nairobi slum dwellers to 81% in urban Tunisia.[26,27] Remarkably, one out of every five persons who were unaware of their hypertensive status had BP elevated to crisis levels. It is well known that such high BP is critical and warrant immediate evaluation as can result to multiple organ failure including blindness, kidney failure, heart failure and stroke.[17] One third of newly diagnosed hypertensives had echocardiographic changes consistent with hypertension (i.e. left ventricular hypertrophy). This finding reflects the high asymptomatic potential of hypertension and suggests that regular BP measurement is important. Hypertension control rates are uniformly low amongst studies and according to a systematic review by Kayima et al, Tanzanian populations whether urban or rural had the lowest control rates of <7%.[3] In contrast to these findings, our control rates were over twice as much and even so should be regarded as low.

This study has a number of strengths including; (i) we recruited over 1800 persons, a good number suitable for subgroup analyses, (ii) the use of standard tools which allow for comparability among studies, and (iii) we performed ECHO on a subset of individuals aware of their hypertension status and those newly diagnosed to assess for cardiovascular changes associated with hypertension. Our study had some few limitations including; (i) the recruitment process and measurements (weight, height and BP) could have potentially introduced selection bias and non-differential bias respectively, and (ii) our hypertension rates could be somewhat overestimated as we relied on a single occasion BP measurement to make the diagnosis. Future studies in this area should thoroughly assess dietary habits and salt intake and its association with excess body weight and hypertension.

V. Conclusions

In conclusion, our findings suggest that excess body weight is a single modifiable risk factor strongly associated with high blood pressure. Moreover, majority of persons with hypertension are undetected and thus unaware of their hypertension status. In view of this,

communities living especially in resource-limited settings need to be educated and continuously reminded on the importance of regular health check-up, exercising consistently and healthy eating as crucial strategies in implementing primary prevention. Furthermore, counseling on the importance of adherence to medication and life-style modification should be incorporated in all consultations.

Declarations

Ethical Consideration

The study was approved by the Unit of Research of the Jakaya Kikwete Cardiac Institute (JKCI) and the permission to conduct the study was granted by the Office of the Kinondoni District Commissioner. All the participants or their legal proxy's verbally consented to participate in the screening. Participants who were in a clinically unstable state were rushed to the Mwananyamala district hospital for appropriate attention and intervention. Prescription amendments and new drug prescriptions were issued accordingly. Persons who required a further assessment and clinic enrolment were scheduled as appropriate to attend the JKCI or Mwananyamala district hospital.

Availability of Data and Materials

The final version of data set supporting the findings of this paper may be found in the Jakaya Kikwete Cardiac Institute website (www.jkci.or.tz). The corresponding author will be more than willing to email the data set to the editorial committee whenever it's needed.

Competing interest: The authors declare that they have no conflict of interest to declare.

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Authors Contributions: MJ, PK, and PP made contributions in conception and design of the study. PP and PN contributed in analysis and manuscript development. PK, MA, MS, TS and MJ revised the manuscript. All authors have read, contributed to and approved the final version for publication

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Tables and Captions

Table 1 : Socio-Demographic Characteristics of Screened Persons

Characteristic		n (%)
Age: mean (SD), years		43.6 (16.8)
Age groups		
	<18	123 (06.7%)
	18-39	601 (32.8%)
	40-54	615 (33.6%)
	≥55	492 (26.9%)
Sex		
	Female	1163 (63.5%)
	Male	668 (36.5%)
Education level		
	None	130 (07.1%)
	Primary	1062 (58.0%)
	Secondary	515 (28.1%)
	Post-Secondary	124 (06.8%)
Marital status		
	Single	467 (25.5%)
	Married	1061 (58.0%)
	Divorced	106 (05.8%)
	Widowed	197 (10.7%)
Income: mean (SD), USD		128 (165)
Income category		
	<$1/day	177 (14.7%)
	$1-2/day	210 (17.5%)
	>$2-5/day	601 (50.0%)
	>$5/day	213 (17.8%)

Health Insurance	
Insured	81 (04.4%)
Uninsured	1750 (95.6%)

*Income assessment represents 1201 households; $1 was assumed to be equivalent to 2000Tsh

Table 2 : BMI's of Screened Persons by Age and Sex

Characteristic		BMI category			
		underweight	normal	overweight	Obese
Overall		97 (05.4%)	544 (30.3%)	499 (27.8%)	656 (36.5%)
Age group					
	<18	44 (50.0%)***	39 (44.3%)	1 (01.1%)***	4 (04.6%)***
	18-39 ∞	34 (05.7%)	277 (46.0%)	152 (25.3%)	138 (23.0%)
	40-54	10 (01.6%)***	120 (19.5%)***	191 (31.1%)*	294 (48.8%)***
	≥55	9 (01.8%)**	108 (22.0%)***	155 (31.5%)*	220 (44.7%)***
Sex					
	Female	52 (04.5%)	279 (24.4%)	285 (24.9%)	528 (46.2%)***
	Male	45 (06.9%)*	265 (40.6%)***	214 (32.9%)***	128 (19.6%)

Key: ∞: reference group ; *: p<0.05 ; **: p<0.01 ; ***: p<0.001

Table 3 : Blood Pressure Range of Persons with Negative History of Hypertension

Characteristic		Blood Pressure Range		
		normotensive	pre-hypertensive	hypertensive
Overall		237 (19.2%)	422 (34.1%)	578 (46.7%)
Age group				
	<18	12 (60.0%)	7 (35.0%)	1 (05.0%)***
	18-39 ∞	149 (29.1%)	209 (40.8%)	154 (30.1%)
	40-54	53 (12.5%)	145 (34.1%)	227 (53.4%)***
	≥55	23 (08.2%)	61 (21.8%)	196 (70.0%)***
Sex				
	Female	156 (20.1%)	280 (36.0%)	342 (43.9%)
	Male	81 (17.6%)	142 (30.9%)	236 (51.5%)**
BMI Category				
	Underweight	20 (45.5%)	16 (36.4%)	8 (18.1%)***
	Normal ∞	126 (30.1%)	143 (34.2%)	149 (35.7%)
	Overweight	48 (13.4%)	117 (32.6%)	194 (54.0%)***
	Obese	43 (10.3%)	146 (35.1%)	227 (54.6%)***

Key: ∞: reference group ; **: p<0.01 ; ***: p<0.001