



Prevalence of hypertension among office workers in a multi-national company in the Niger-Delta with the 2017 American College of Cardiology/American Heart Association Blood Pressure Guidelines[☆]

Sandra N. Ofori^{a,*}, Jide Obosi^b

^a Department of Internal Medicine, University of Port Harcourt, East-West road, Choba, Rivers state, Nigeria

^b TOTAL E&P, Port Harcourt, Nigeria

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ABSTRACT

The 2017 American College of Cardiology/American Heart Association (ACC/AHA) hypertension guidelines propose a new classification of blood pressure (BP).

The objective was to compare the prevalence of hypertension among staff of a multinational oil/gas company in Niger-Delta, Nigeria using the 2017 ACC/AHA guidelines and the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) guidelines.

Cross-sectional analysis of 235 individuals who presented for their annual medical review between March 2017 and February 2018 was done. Demographic, medical and family history data were obtained with a questionnaire. Blood pressure was measured using the recommended procedure. Fasting blood samples were analysed for blood glucose and lipids. Ten-year cardiovascular risk was estimated with the 2008 modified Framingham risk score (FRS).

The prevalence of hypertension using the JNC7 and the 2017 ACC/AHA guidelines was 25.9% and 53.9% respectively. With the former, family history of hypertension and increased BMI were independently significantly associated with hypertension. With the latter, male gender, family history of hypertension, BMI and physical inactivity were significant predictors of hypertension. 184 (78.3%) were categorised as low CVD risk, 38 (16.2%) intermediate risk and 13 (5.5%) high risk for CVD.

The 2017 ACC/AHA guidelines doubled the prevalence of hypertension from 25.9% to 53.9%. Adoption of this guideline will necessitate careful consideration of the consequences of labeling individuals as hypertensive as well as an increment of the health care budget provided by companies for its staff to meet the increased burden of hypertension.

1. Introduction

Hypertension is defined as persistent elevation of systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) of more than or equal to 140 mmHg and/or 90 mmHg respectively (Chobanian et al., 2003). Hypertension is a risk factor for cardiovascular disease. Oftentimes it is asymptomatic and the first presentation can be with a catastrophic event like stroke or acute left heart failure. This is why it is referred to as the “silent killer”. This cut-off value for diagnosis is based on readings obtained in a clinic office visit. However, lower levels on ambulatory or home blood pressure (BP) measurements define hypertension. The Global Burden of Disease report published in 2017 identified hypertension as one of the world's leading cause of disability

and death (Forouzanfar et al., 2017). High blood pressure is one of the most consistent risk factors for cardiovascular disease across the world. Cardiovascular disease (CVD) refers to diseases of the heart and blood vessels. It includes but are not limited to stroke, coronary artery disease and peripheral vascular disease (Roth et al., 2017). The burden of CVD across the world is very high as it is currently the leading cause of morbidity and mortality and over 80% occur in low middle-income countries (Bowry et al., 2015). The rising prevalence of CVD can be attributed to the rising prevalence of its risk factors. In sub-Saharan Africa, the most prevalent risk factor is hypertension with an overall prevalence rate of 16.2% (Twagirumukiza et al., 2011). This is projected to increase by 65% to affect 125.5 million people by 2025 (Bowry et al., 2015). The consequences of this are evident as the

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* Corresponding author.

E-mail addresses: Sandra.ofori@uniport.edu.ng (S.N. Ofori), jide.obosi@total.com (J. Obosi).

prevalence of stroke, hypertensive heart disease with heart failure and chronic kidney disease is increasing accordingly (Damasceno et al., 2012; Kaze et al., 2018; Owolabi et al., 2015). Studies have shown that in sub-Saharan Africa, the demographic affected by this differs in certain ways from the developed countries in that the patients are typically younger and suffer CVD almost a decade earlier than their western counterparts (Moran et al., 2013). Rapid urbanisation, adoption of western diets and sedentary lifestyles result in obesity and are all contributing factors to the increasing prevalence of hypertension.

The updated guideline recommendations for treatment strategies for hypertension were released by the American College of Cardiology (ACC) and the American Heart Association (AHA) in 2017. They defined lower blood pressure values for hypertension and lower treatment targets than those recommended in the JNC VII guidelines i.e., hypertension was re-defined as a systolic blood pressure of 130 mmHg or greater or a diastolic blood pressure of 80 mmHg or greater (Whelton et al., 2018). Although this is a United States (US) guideline, if it is adopted in other world regions, its impact on the prevalence of hypertension could be substantial. With already low awareness and control rates of hypertension especially in developing countries like Nigeria (Adeloye et al., 2015), the problem has the potential for significant negative consequences.

In Nigeria jobs in the oil and gas industry are hard sought after due to the attractive remuneration packages that come with it. With the increasing prevalence of cardiovascular disease, it has become imperative to measure indices of cardiovascular health as part of the workplace health promotion activities. Activities in the workplace such as prolonged sitting periods among office workers and stressful jobs that involves long hours and night shifts among field workers have an impact on the general health of workers especially on their cardiovascular health. This has the potential to negatively impact on their job performance. Cardiovascular disease and its risk conditions like hypertension and diabetes mellitus are chronic conditions requiring investment of time and resources on the part of the individual and on the company that bears the cost. This excludes the time spent away from work due to multiple clinic visits for follow up. With the recent ACC/AHA guidelines, the lowered threshold for diagnosis will mean more individuals will be classified as having hypertension. This will have implications on the individuals themselves but also increase the financial burden on the company as they have to cater for an expanding pool of patients. This study aimed to determine the prevalence of hypertension and other cardiovascular risk factors among workers in a multinational oil and gas company who present for their annual medical review, and to determine how the new ACC/AHA definition of hypertension impacts on the prevalence of the condition.

2. Methods

2.1. Study population

We used data collected over a one-year period (March 2017 to February 2018), from the occupational health clinic of a multinational oil and gas company based in Rivers State, Nigeria. Rivers State is one of the 36 States and is in the south-south geopolitical zone of Nigeria and occupies an area of 1077 km.sq. with a population of 5,198,716 people (Population Council, 2007).

The occupational health clinic database comprises a cross-sectional collection of data from staff on an annual basis during their annual medical review. The review is comprehensive and uses well-structured questionnaires and standard laboratory tests and procedures (in an ISO-certified laboratory). During annual reviews, participants are interviewed with a structured questionnaire about life style risk factors. History of alcohol use was assessed by asking each respondent if on any typical day they could consume at least 1 standard drink for females and 2 standard drinks for males, for which they answered 'yes' or 'no'. A personal and family history of hypertension, diabetes and

cerebrovascular disease was also obtained. Each participant's weight and height were measured with a mechanical weighing scale and stadiometer to the nearest 0.5 kg and 0.5 cm respectively with the subject wearing only light clothing. These values were used to calculate the body mass index that was then classified according to the World Health Organisation (WHO) criteria. Blood pressure was measured using an automated Omron machine with an appropriate cuff size on the patients' right arm in the seated position with feet on the floor after a five-minute rest in a quiet room. Three measurements were taken at two-minute intervals and the average of the two last blood pressure measurements was used.

For this study, we included all individuals with complete data on blood pressure, smoking history, alcohol use, history of type 2 diabetes and family history of CVD, as well as if they had recorded serum lipid and glucose values. Those already identified as being on treatment for hypertension were excluded from the analysis. A participant was considered to have hypertension if the average of the last two BP measurements was > 140 mmHg systolic and/or > 90 mmHg diastolic.

2.2. Ethical considerations

The data was anonymised and for the purposes of this study, no patients were directly involved and thus we sought and obtained approval from the clinical director to utilize the data for research purposes only.

2.3. Statistical analysis

This was performed with Statistical Package for the Social Sciences version 21.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean (standard deviation) and categorical data as proportions and percentages. Logistic regression analysis was used to determine the factors associated with the outcome variable of interest which was hypertension. *P* values < 0.05 were considered statistically significant.

3. Results

3.1. Demographic characteristics

Data from a total of 235 individuals were analysed. Majority 211 (89.8%) were males and 24 (10.2%) were females. The mean age was 43.34 ± 7.77 years (range: 27–59 years). Majority (92.8%) of the respondents were office-based workers in Port Harcourt, the capital city of Rivers State, Nigeria and the rest were field-based staff.

Regarding the medical/family history of the respondents, 91 (38.7%) had family history of hypertension, 65 (27.7%) had family history of first degree relative with diabetes mellitus, 45 (19.1%) had family history of first degree relative with stroke, 17 (7.2%) had a family history of hypercholesterolemia, 12 (5.1%) had a history of first degree male relative with myocardial infarction (MI) and only 3 (1.3%) had history of first degree female relative with MI (Table 1).

3.2. Anthropometric and biochemical parameters

Only 27 (11.5%) participants had normal body mass index (BMI) while 127 (54.0%) were overweight and 81 (34.5%) were obese. The mean weight, height and BMI was 87.38 ± 12.99 kg, 1.73 ± 0.08 m and 29.08 ± 3.94 kg/m² respectively (Table 2).

With regards to lifestyle habits, 124 (57.0%) consume alcohol regularly, 22 (9.4%) were current cigarette smokers, 25 (10.6%) were sedentary and 128 (54.5%) exercise, but not up to guideline recommended levels (Table 2).

Twenty-four (10.2%) of the patients had high fasting blood sugar, 61 (26.0%) had high total cholesterol, 128 (54.5%) had high low-density lipoprotein, 34 (14.5%) had low high-density lipoprotein, and

Table 1
Demographic characteristics and family history of 235 study participants.

Variable	N (%)
Gender	
Male	211 (89.8)
Female	24 (10.2)
Age (years) Mean \pm SD	43.34 \pm 7.77
Age group (years)	
\leq 30	8 (3.4)
31–40	85 (36.2)
41–50	92 (39.1)
> 50	50 (21.3)
Family history of hypertension	91 (38.7)
Family history of diabetes mellitus	65 (27.7)
Stroke in first degree relative	45 (19.1)
Family history of dyslipidaemia	17 (7.2)
Myocardial infarction in first degree relative	15 (6.4)

SD - standard deviation.

Table 2
Anthropometric, lifestyle risk factors and biochemical characteristics of the 235 participants.

Variable	N (%)
BMI category	
Normal weight	27 (11.5)
Overweight	127 (54.0)
Obese	81 (34.5)
Weight (kg) mean \pm SD	87.38 \pm 12.99
Height (m) mean \pm SD	1.73 \pm 0.08
BMI (kg/m ²) mean \pm SD	29.08 \pm 3.94
Waist circumference in males ($n = 211$)	
Mean \pm SD	93.27 \pm 8.50
N (%) > 102 cm	24 (11.4)
Waist circumference in females ($n = 24$)	
Mean \pm SD	90.55 \pm 10.84
N (%) > 88 cm	14 (58.3)
Waist: hip ratio in males Mean \pm SD	0.87 \pm 0.07
Waist: hip ratio in females Mean \pm SD	0.84 \pm 0.08
Current smokers	22 (9.4)
Alcohol use	
^a Significant	9 (8.1)
Non-significant	115 (48.9)
None	101 (43.0)
Physical activity	
Very active	82 (34.9)
Active but not meeting recommendation	128 (54.5)
Sedentary	25 (10.6)
Mean SBP \pm SD (mmHg)	129.13 \pm 17.00
Mean DBP \pm SD (mmHg)	79.31 \pm 11.80
Fasting blood sugar (FBS)	
Mean \pm SD	6.10 \pm 1.70
FBS \geq 7.0 mmol/l n (%)	24 (10.2)
Total cholesterol (TC)	
Mean \pm SD	4.43 \pm 1.23
TC \geq 5.0 mmol/l n (%)	61 (26.0)
Low density lipoprotein (LDL)	
Mean \pm SD	3.30 \pm 1.01
LDL \geq 3.0 mmol/l n (%)	128 (54.5)
High density lipoprotein (HDL)	
Mean \pm SD	1.24 \pm 0.32
HDL < 1.0 mmol/l n (%)	34 (14.5)
Triglyceride (TG)	
Mean TG \pm SD	1.27 \pm 1.04
TG > 1.7 n (%)	32 (13.6)

^a Significant alcohol use defined as > 21 units a week for men and 14 units a week for women; BMI - body mass index; SBP - systolic blood pressure; DBP - diastolic blood pressure; SD - standard deviation.

32 (13.6%) had high triglyceride level (Table 2). With the Framingham risk score, 184 (78.3%) were categorised as low risk, 38 (16.2%) intermediate risk and 13 (5.5%) high risk (Fig. 1).

3.3. Blood pressure status and prevalence of hypertension

The hypertension status of patients was assessed using two different systolic/or diastolic blood pressure cut-off points: (i) systolic blood pressure (SBP) of \geq 140 mmHg and/or diastolic blood pressure (DBP) of \geq 90 mmHg and (ii) systolic blood pressure (SBP) of \geq 130 mmHg and/or diastolic blood pressure (DBP) of \geq 80 mmHg. The prevalence of hypertension using the former was 25.9% ($n = 60$), while the prevalence of hypertension using the latter was 53.9% ($n = 125$). Fig. 2 highlights the number of participants in the various categories of blood pressure.

3.4. Risk factor variables

Association of hypertension with independent study variables was assessed using the two different cut-off scales used to categorize patients as having hypertension in this study. Logistic regression analysis was used to assess the strength of the association between hypertension and significant independent variables. In the unadjusted analysis, variables significantly associated with hypertension defined as SBP \geq 140/DBP \geq 90 mmHg, included age (OR 5.182; 95% CI 2.269–11.835; $p < 0.001$), having a first degree relative with hypertension (OR 2.923; 95% CI 1.389–6.153; $p = 0.005$) and BMI (OR 4.706, 95% CI 1.306–16.962; $p = 0.018$). However, in the adjusted model only a family history of hypertension (AOR = 3.021 95% CI 1.326–6.679; $p = 0.008$) and BMI (AOR = 4.871, 95% CI 1.207–19.664; $p = 0.0026$) remained statistically significant (Table 3).

Using the SBP \geq 130/DBP \geq 80 mmHg cut-off, the factors that showed statistical significance when odds ratio was unadjusted were male gender (OR = 0.130; 95% CI 0.043–0.393; $p < 0.001$), age (OR = 3.180; 95% CI 1.501–6.739; $p = 0.003$), family history of hypertension (OR = 3.349; 95% CI 1.140–9.838; $p = 0.028$), BMI (OR = 4.231; 95% CI 1.676–10.682; $p = 0.002$), physical inactivity (OR = 0.379; 95% CI 0.150–0.959; $p = 0.040$) and FBS level (OR = 6.306; 95% CI 1.826–21.782; $p = 0.004$). However, when the odds ratio was adjusted, the only variables that remained significant were male gender, family history of hypertension, BMI, and physical inactivity ($p < 0.05$) (Table 4).

4. Discussion

In this study, there was a high prevalence of hypertension among apparently healthy workers. The prevalence of hypertension was 25.9% and when the lower BP cut-off was applied, was 53.9% indicating a doubling in the prevalence rate. Increasing age, obesity and a family history of hypertension were significant predictors of hypertension whether defined as \geq 140/90 or \geq 130/80 mmHg. With the lower threshold BP \geq 130/80 mmHg, male gender and physical inactivity were additional significant variables.

It is important to evaluate how these new guidelines impact on the prevalence of hypertension in a setting like this multinational oil and gas company because although Nigeria has a hypertension guideline, it has not been updated in the last decade and the JNC7 guideline is still widely applied in clinical practice. Application of the new guideline in various populations around the world has shown a significant increase in the burden of hypertension. In Bangladesh, the prevalence of hypertension among a nationally representative sample of 1843 adults studied in 2015 aged 18 years and over was 17.9% using the JNC7 guidelines. This increased to 40.7% when the 2017 ACC/AHA definition was applied (Islam et al., 2018). Similarly, in the United States and China respectively, applying the new guidelines led to a 26.8% and 45.1% increase in the prevalence of hypertension as demonstrated by

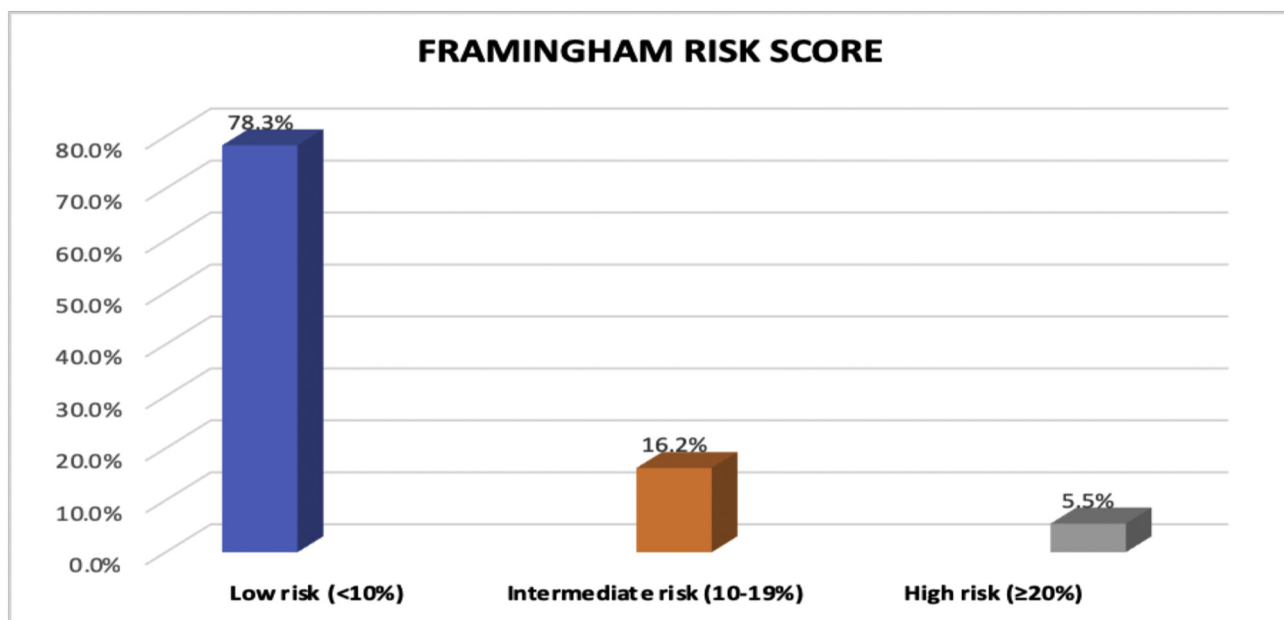


Fig. 1. Ten-year CVD risk of study participants.

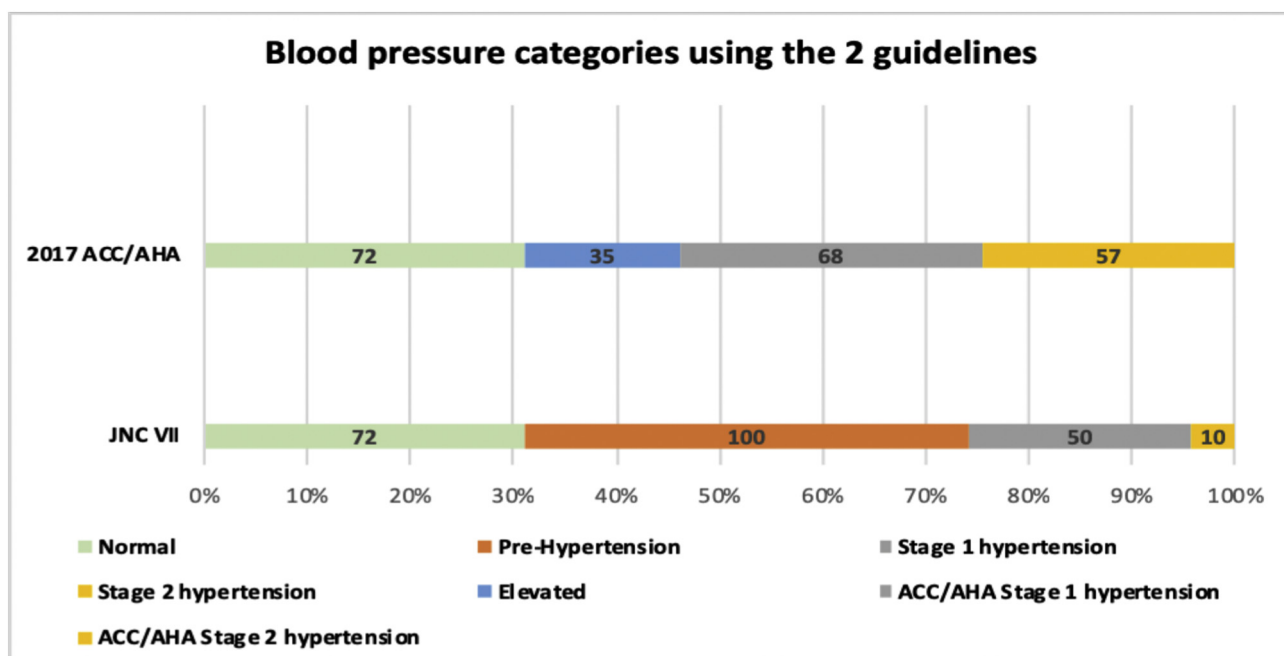


Fig. 2. Blood pressure status of study participants.

Khera et al. in their observational study of nationally representative data (Khera et al., 2018). The psychological impact of getting a diagnosis of hypertension among individuals who would have otherwise

been considered pre-hypertensive is important as studies have shown that disease labeling carries psychological morbidity (Mechanic, 1986). In addition, lower treatment thresholds in the new guidelines may

Table 3
Predictors of hypertension defined as SBP ≥ 140 mmHg/DBP ≥ 90 mmHg.

Variable	OR	95% CI for OR		p-Value	AOR	95% CI for AOR		p-Value
		Lower bound	Upper bound			Lower bound	Upper bound	
Age (years)	5.182	2.269	11.835	< 0.001	2.097	0.761	5.778	0.152
BMI kg/m ²	4.706	1.306	16.962	0.018	4.871	1.207	19.664	0.026
First degree relative with hypertension	2.923	1.389	6.153	0.005	3.021	1.326	6.879	0.008

OR - odds ratio; AOR - adjusted odds ratio.

Table 4
Predictors of Hypertension defined as SBP \geq 130 mmHg/DBP \geq 80 mmHg.

	OR	95% CI for OR		p-Value	AOR	95% CI for AOR		p-Value
		Lower bound	Upper bound			Lower bound	Upper bound	
Male gender	0.130	0.043	0.393	< 0.001	0.155	0.043	0.550	0.004
Age (years)	3.180	1.501	6.739	0.003	1.799	0.625	5.174	0.276
First degree relative with hypertension	3.349	1.140	9.838	0.028	4.267	1.104	16.496	0.035
BMI kg/m ²	4.231	1.676	10.682	0.002	7.433	2.431	22.733	< 0.001
Sedentary lifestyle	0.410	0.169	0.998	0.050	0.260	0.089	0.761	0.014
FBS	6.306	1.826	21.782	0.004	2.250	0.554	9.135	0.256

OR - odds ratio; AOR - adjusted odds ratio.

expose more individuals to drug therapy with potential adverse effects (Wallis et al., 2002).

On a national level in Nigeria, the prevalence of hypertension was found to be 28.9% (using a BP threshold of 140/90 mmHg) in a systematic review of all published studies in Nigeria between 1980 and 2013 (Adeloye et al., 2015). More recently however, among a nationally representative sample of 15,505 adults above 40 years, Murthy et al. found a higher prevalence rate of hypertension 44.9%. Increasing age, male gender, residence in an urban area and increasing BMI were significant risk factors for hypertension (Murthy et al., 2013). This higher prevalence may be a result of the predominantly older population when compared to our study. The global action plan of 2008–2017 for workers' health endorsed by the Sixtieth World Health Assembly, called for the institution of workplace health programmes by all 193-member states with the purpose of promoting occupational health and preventing non-communicable diseases (WHO, 2007). Emphasis was laid on healthy dietary lifestyle modification and increased physical activity among workers in that action plan. Despite the availability of a standard health facility with adequate human and capital resources and well-planned annual health screening programs that include CVD risk factor screening in this oil and gas company, the prevalence of modifiable risk factors among this study population was still considerable. Hypertension is known to be common among office workers and this may be due to their sedentary lifestyles with long working hours (Health Dubey, 2018). Furthermore, in a country like Nigeria, the social construct in which wealth is exhibited by a more robust physique may also be an underlying determinant to the high prevalence of obesity observed among this study population. Increasing BMI was associated with hypertension regardless of the threshold used to define it. In a 2017 study among 28,000 German employees, it was also found that obesity was associated with a four-times higher risk of hypertension (Scheerbaum et al., 2017). Similarly a systematic review of the determinants of hypertension among 34,919 workers in West Africa found that obesity was a significant predictor of hypertension (Bosu, 2016). Workplace policies that include physical activity, provision of healthier dietary options in the canteen and environmental changes like standing workstations may help workers modify their risk (Gudzune et al., 2013).

The JNC7 guidelines recommend that in all patients with hypertension, lifestyle modification be instituted to mitigate the CV risks and complications. In Nigeria's hypertension guidelines which is based on the WHO/ISH guidelines, the recommendation for initiating pharmacologic treatment is for SBP \geq 160 mmHg and/or DBP \geq 100, or SBP 140–159 mmHg and/or DBP 90–99 mmHg if there is evidence of high-risk conditions like diabetes, renal disease or target organ damage (Nigerian Hypertension Society, 1996). In the 2017 ACC/AHA guideline, based on evidence of a reduction in the risk of major adverse CV events, the BP target for high risk groups is lower than in the previous guidelines. Considering that with the previous more conservative thresholds the rate of BP control was already poor in resource limited settings (Dzudie et al., 2012), the implementation of these new guidelines will be even more difficult as many more patients will be

considered to have untreated or uncontrolled blood pressure. On the other hand, if the ACC/AHA guidelines are to be considered, the higher burden of hypertension may drive necessary focus on CVD prevention as more individuals will be made aware of the condition at an earlier stage. However, the capacity of the existing health care resources in terms of facilities and personnel may likely be overstretched except concerted efforts are made to prioritise CVD prevention starting from the primary health care level.

5. Study limitations

The cross-sectional design allows us make inferences only about associations and not causation. Furthermore, the convenience sampling method used to obtain the data limits the generalizability of this study's findings. The blood pressure measured in the office setting without confirmation with ambulatory blood pressure measurements may have caused us to include individuals with white coat hypertension in the group categorised as hypertensive. Nevertheless white coat hypertension has been shown to be associated with CVD if anti-hypertensives are not instituted and such individuals require close long term surveillance (Huang et al., 2017).

6. Conclusion

The 2017 ACC/AHA guidelines doubled the prevalence of hypertension among this sample population from 25.9% to 53.9%. This implies that the health care budget provided by companies for its staff will have to increase to meet the increased burden and well as highlights the need for implementation of preventive programs among staff especially the higher risk groups like those with obesity and a positive family history of hypertension.

Disclosure

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that there are no conflicts of interest.

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