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Prehypertensive Risk among African-American Undergraduates: Do the Extra Pounds Really Matter?

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ABSTRACT

The objective of this study is to examine prehypertension among young African American adults and evaluate the predictive value of easily obtained standard measures of adiposity. Data for this study of 155 primarily African-American undergraduates was collected between April 2010-11. Participants provided family health history and anthropometric measures, including body weight, body mass index (BMI), and waist to hip (WHR) ratio. Percentages were calculated for demographics. The average systolic blood pressure measured over two time periods within a single semester generated prehypertension rates. Univariate and multivariate logistic regression examined the impact of BMI, WHR, weight, and family medical history on prehypertension. A majority of participants (64%) were prehypertensive. Logistic regressions suggest that weight-related measures better predicted prehypertension than family history or WHR. In conclusion, this study showed prehypertensive risk was a significant problem among, young and primarily African-American adults. Furthermore, the best adiposity measure was weight, even when controlling for family history, WHR, and BMI.

Keywords: prehypertension (pHTN), obesity assessment, African-American, young adult, undergraduate.

INTRODUCTION

Cardiovascular disease (CVD), diagnosed in more than 83 million Americans (Go et al., 2013), is the leading cause of preventable death in the United States today, contributing nearly $320 billion per year to national health care costs (Yang et al., 2015). Beyond its economic burden, CVD presents an ongoing social justice concern in the form of persistent health inequities.

Copious research shows that African Americans shoulder a disproportionately high degree of morbidity and premature mortality related to CVD (Yang et al., 2015). Although African Americans comprise 12.8% of the American population, they are more likely than their white counterparts to experience the social and economic deficits that negatively impact health (Williams, Priest, & Anderson, 2016). For example, African Americans are three times more likely to develop CVD as Whites and have twice the mortality risk (Winham & Jones, 2011).

Prehypertension (pHTN), defined as systolic (sBP) 120-139 and diastolic (dBP) 80-89 (Hernandez & Anderson, 2012), is a known risk factor for hypertension (HTN) (Egan & Stevens-Fabry, 2015) and is present in about 30% of the U.S. adult population (Glasser et al., 2011). This is important because HTN, even in isolated bouts, i.e., white-coat HTN, is a key contributor to CVD (Huang et al., 2017) and its array of potentially lethal complications, e.g., stroke (Lee, Sun, Zhou, & Liu, 2014). Here too, inequity is glaring; 3.9% of African Americans have experienced stroke as compared to 2.5% of Whites and 2.7% of Latinos (Go et al., 2013). Overall, one third of American adults are hypertensive (Lackland & Egan, 2015), yet the prevalence among African Americans is 42% (Diaz et al., 2014; Ravenell, & Ogedegbe, 2015) compared to 28% among Whites (Chan, Stamler, & Elliott, 2015). There are similar findings in the pediatric literature. Excess rates of early-onset HTN are clearly present among juvenile and young African Americans (Flynn, 2012). For pHTN however, findings of between-group differences are less clear. Whereas, Glasser and colleagues' (2011) REGARDS study found that African-American adults are at higher risk for pHTN than Whites, an examination of NHANES III data did not (Gu, Burt, Paulose-Ram, Yoon, & Gillum, 2008).

Lifestyle factors associated with raised BP in general include education as a protective condition, whereas older age, male gender, occupation, family history of CVD, abdominal obesity, smoking and alcohol consumption (Xu, Liu, Zhu, Liu, & Han, 2016), poor diet, lack of physical exercise, and excess stress (Senthil, & Krishndasa, 2016) are risk factors. Although evidence suggests that an overall reduction in vascular-disease disparities has been achieved through lifestyle changes (Ravenell et al., 2013), definitive answers as to why African-Americans experience excessive and more virulent rates of HTN (Wei et al., 2011; Ferdinand & Nasser, 2015) and possibly pHTN (Selassie et al., 2011) remain unclear. One answer may be found in studies that point to the significance of social environment over genetics in explaining differences in raised BP across descendants of the African Diaspora. For example, Cooper and colleagues (2015) provided persuasive evidence that persistent racial discrimination and socio-political stress likely explains why Black South Africans and African Americans have similarly higher rates of raised BP compared to three other Afro-origin groups.

Ultimately, if pHTN is indeed more prevalent among African Americans (Covelli, Wood, & Yarandi, 2012; Selassie et al., 2011) and they are at excess risk of blood pressure (BP) related CVD outcomes (Redmond et al., 2016), it is imperative to evaluate risk as early in the lifecourse as possible before vascular damage escalates. The focus of the present study is to examine pHTN risk among college students because at this life stage, individuals are typically asymptomatic for CVD risk and at the same time exploring new-found freedoms, e.g., lifestyle choices and dietary habits (Lai, Ward, & Bolen, 2015). Although young adults are thought to be generally healthy, this assumption may be unwarranted (Yang et al., 2015) in light of early warning signs and subclinical levels of CVD evident among adolescents and juveniles (Caleyachetty et al., 2015). Arguably, if pediatric pHTN is on the rise (Kelly & Magnussen, 2014), young people are at much greater risk than previously thought (Flynn, 2012).

We chose to examine the intersection of pHTN and excess body weight in our population largely because of the "freshman-15" phenomenon; that is, undergraduates, regardless of ethnic/racial background, typically gain weight during their academic careers (Stephens, Althouse, Tan, & Melnyk, 2017.) Recent evidence suggests that approximately 35% of college students are overweight or obese, with the risk of weight gain even higher among young African Americans (Holland, Carthron, Duren-Winfield, & Lawrence, 2014). Given the robust relationship already established between extra body weight and HTN risk (Chan, Stamler, & Elliott, 2015), it stands to reason that being overweight could also predispose one to pHTN.

Despite the clear association between extra body weight and problematic BP, uncertainty remains as to whether the relationship is fueled by a little extra weight or a lot, or at what stage of life the excess weight is gained (Donahue et al., 2014). We also do not yet understand whether the relationship between extra body weight and raised BP is rooted in process, e.g., behavioral differences in dietary intake (Chan, Stamler, & Elliott, 2015) or product, e.g., body fat distribution (Staiano, Gupta, & Katzmarzyk, 2014). Nonetheless, what is known is that African Americans, both younger and older, are more likely to be overweight, have a BMI ≥25, and obese, a BMI ≥30 (Kumanyika, Whitt-Glover, & Haire-Joshu, 2014). For this reason, the purpose of this paper is to examine the prevalence of pHTN in a population of young, primarily African American adults and determine the predictive value of commonly used adiposity measures as risk markers for pHTN. Similar to Mackey et al. (2015), we anticipated that at least half of our participants would be prehypertensive.

Although some previously identified risk factors, e.g., male gender, and family history of CVD (Xu, Liu, Zhu, Liu, & Han, 2016), are inherently immune to alteration, others related to lifestyle are preventable and therefore amenable to change. In this light, excess body weight presents a modifiable pHTN, HTN and CVD risk factor (Wing et al., 2013), one that is especially significant for young African Americans (Falkner, DeLoach, Keith, & Gidding, 2013). Additionally, if carrying extra pounds is a risk factor for problematic BP, a key challenge for public health and care providers is to find a method to easily and reliably assess excess weight in a community setting, such as a college campus.

Body mass index is a frequently used proxy for the numeric assessment of body composition based on a height-weight ratio calculation (Muralidhara, Nor, & Zubaidi, 2016). It is typically used in epidemiological studies to classify one's bodily fat mass as underweight, normal weight, overweight, and obese. Although easy to calculate and noninvasive, BMI's predictive value has been questioned (Karandish, & Shirani, 2015) because its calculation disregards age, ethnicity (Muralidhara, Nor, & Zubaidi, 2016), location of body fat (Ashwell & Gibson, 2016) and fitness level (Ortega, Cadenas-Sanchez, Lee, Ruiz, Blair, & Sui, X. 2018). For these reasons and because of the growing belief that central adiposity measures better predict health risks (Ashwell & Gibson, 2016), such as CVD (Goh, Dhaliwal, Welborn, Lee, & Della, 2014), we also wanted to examine whether WHR might better capture pHTN risk than BMI.

METHODS

The database for this study was derived from the student population of a Historically Black College and University (HBCU) located in the southeastern United States. The campus population of nearly 5,200 represents a diverse mix of first-generation and returning-college students, commuter and resident students. Participant recruitment methods and informed consent are described in detail in an earlier article (Yancu, Lee, Witherspoon, & McRae, 2012). Briefly, when passive recruitment methods (e.g., flyers) failed to yield adequate numbers, we adopted a more active strategy in which our chief research assistant (RA), herself an African American student, gave 5-7 minute presentations about the purpose of our proposed study in eight undergraduate classes. This more focused strategy served well and recruitment blossomed. Study protocol for this pilot was reviewed and accepted by the university's Institutional Review Board.

This convenience sample of 155 male and female traditional and non-traditional college students was gathered over a one year period beginning in April 2010. Recruitment continued until the desired goal of 150 was slightly oversaturated to allow for attrition. Participants ranged in age from 18 to 45 years (M = 21.56, SD = 4.56).

Procedure

All data collection occurred in person over two phases (T1 & T2). At T1, participants completed a brief survey in-house using Survey Monkey™. Interview questions included socio-demographic, health and lifestyle information, e.g. race/ethnicity, age, and sex, parent health history, smoking habits, etc. Once the participant completed the survey, (s)he then had biometric measures recorded by a specially trained RA. The RA then made a follow-up appointment for T2 assessment within 3-4 days of T1. Participants provided their preferred contact information for the appointment reminder. Once the biometric measures were taken at T2, volunteers were again thanked for their participation and given a $15.00 gift card as a token of appreciation for their time and support of the study.

Anthropometric measures. The RAs measured participants' height, weight and body mass index (BMI) using a clinical-grade digital weigh scale with individuals wearing light clothing without shoes. Waist circumference was measured at the halfway point between the iliac crest and sides of the lower ribs. Hip circumference was measured at the point of maximum girth around the buttocks. Waist to hip ratio (WHR) was computed as the circumference of the waist divided by that of the hip.

Blood Pressure. This study used the average of two left-arm BP measures obtained at T1 and T2 using a clinical-grade digital BP cuff with the individual seated, the antebrachium resting on a table, and legs uncrossed. For the few students whose arm did not fit the BP cuff, RAs took forearm readings at midpoint between wrist and elbow while the arm was at rest. This method has been shown to provide a reasonable substitute for a problematic upper arm measure (Leblanc et al., 2013). The RAs ensured that before each reading the participant sat quietly for three-five minutes. As there were no significant demographic or body mass differences between the retained sample and the five persons for whom a BP measure was missing for both T1 and T2, those individuals were dropped from further analyses.

This study focused on systolic BP (sBP) because of recent research that points to systolic as a stronger link in the relationship among BP, CHD and stroke than diastolic (Mahmood, Levy, Vasan, & Wang, 2014). Here pHTN was defined as an average sBP of between 120 and 139, with HTN set at ≥140 as per standard recommendation of the American Academy of Family Physicians and the American College of Physicians (Garrison, & Oberhelman, 2013). One individual in the study clinically qualified for stage-two HTN (sBP ≥ 160). All measures were obtained in-house with at least 3 days between T1 and T2. A mean of the BP was calculated by SPSS, version 21 excluding the 5 persons for whom BP was completely missing.

RESULTS

Descriptive Statistics

One of the main objectives of this study was to estimate the prevalence of pHTN in this young adult population. As we assumed, the sample primarily self-identified as African American (89%). Because we did not predict any race differences apriori, we did not restrict the analyses to African Americans. Only three participants self-reported as being of Hispanic or Latino origin. Thirty-four participants were men and 114 were women. Most participants reported age of between 18 and 21 years (64%). We did not conduct any of the following analyses with race as a predictor for pHTN because excess body weight was the main focus of concern (and any results would come from severely unequal sample sizes for a race variable).

From the 155 participants recruited, participants were excluded from the analyses for several reasons. For the purpose of this study (investigating predictors of pHTN in college-aged students at an HBCU), we wanted to focus on young adult-students so we only examined participants between the age of 18-25 years old. This resulted in our excluding 18 participants who did not fit the age criteria. Another 5 participants were excluded because BP was not recorded at T1 or T2 for them. An additional 17 participants whose BP read as hypertensive were also excluded from the analyses. Thus, a total of 40 participants were excluded from the analyses resulting in a final sample of 115 participants.

A majority of the participants retained in the study were women (89%) and unmarried (90%). As a result of recruiting from an HBCU, most participants reported their race as Black, African American, or Afro-Caribbean (89%). The sample was mostly comprised of seniors (33%), followed by sophomores (25%), juniors (21%), and freshmen (14%).

Most participants were not employed (56%) and 38% reported household incomes of $20,000 or less. A majority of participants were non-smokers (89%) and most women were not using oral (71%) or patch (96%) contraceptives. Some participants reported a family history of heart disease (24%), stroke (30%), and obesity (36%). A majority of the sample reported having a family history of diabetes (61%). These descriptive statistics are displayed in Tables 1-4, and are categorized into participants with normal BP and those with pHTN.

Table 1: Demographics for Pre-Hypertension (N=115)

Variable	Normal (N=42)	Prehypertensive (N=73)
Gender		
Male	9.5% (4)	21.9% (16)
Female	83.3% (35)	74.0% (54)
Missing	7.2% (3)	4.1% (3)
Age		
18-19	14.3% (6)	45.2% (33)
20-21	52.4% (22)	37.0% (27)
22-23	45.2% (11)	15.1% (11)
24-25	7.1% (3)	2.7% (2)
Race		
Black/African-American/Afro-Caribbean	83.3% (35)	91.8% (67)
Not African-American	9.5% (4)	4.1% (3)
Missing	7.2% (3)	4.1% (3)
Marital Status		
Married/Partnered	83.3% (35)	5.5% (4)
Single	9.5% (4)	90.4 % (66)
Missing	7.2% (3)	4.1% (3)

Table 2: Income and Occupation Status for Prehypertension (N=115)

Variable	Normal (N=42)	Prehypertensive (N=73)
Occupational Status		
Employed Full Time	4.8% (2)	6.8% (5)
Employed Part Time	31.0% (13)	34.2 % (25)
Not Employed	57.1% (24)	54.9% (40)
Missing	7.1% (3)	4.1% (3)
Income Range		
$0-$20,000	42.9% (18)	35.5% (26)
$21,000-$50,000	14.3% (6)	21.9% (16)
$50,000+	19.0% (8)	20.5% (15)
Unknown	16.7% (7)	16.4% (12)
Missing	7.1% (3)	5.5% (4)

Table 3: Health-Related Behaviors for Prehypertension (N=115)

Variable	Normal (N=42)	Pre-Hypertensive (N=73)
Tobacco Use		
Non-Users	95.2% (40)	84.9% (62)
Users	2.4% (1)	15.1% (11)
Missing	2.4% (1)	0% (0)
Oral Contraceptives		
Non-Users	61.9% (26)	57.6% (42)
Users	26.2% (11)	20.5% (15)
Not Applicable (Males)	9.5% (4)	20.5% (15)
Missing	2.4% (1)	2.4% (1)
Patch Contraceptives		
Non-Users	88.1% (37)	74.0% (54)
Users	0% (0)	4.1% (3)
Not Applicable (Males)	9.5% (4)	20.5% (15)
Missing	2.4% (1)	2.4% (1)

Table 4: Family Medical History for Prehypertension (N=115)

Variable	Normal (N=42)	Pre-Hypertensive (N=73)
Heart Disease		
Family History	26.2% (11)	21.9% (16)
No Family History	66.7% (28)	75.3% (55)
Missing	7.1% (3)	2.8% (2)
Stroke		
Family History	33.4% (14)	28.8% (21)
No Family History	59.5% (25)	68.5% (50)
Missing	7.1% (3)	2.7% (2)
Diabetes		
Family History	59.5% (25)	61.6% (45)
No Family History	33.4% (14)	35.6% (26)
Missing	7.1% (3)	2.8% (2)
Obesity		
Family History	66.7% (28)	56.2% (41)
No Family History	26.2% (11)	41.1% (30)
Missing	7.1% (3)	2.7% (2)

Prehypertension

In this reduced sample (N=115), 64% of participants were prehypertensive. This exceeded our prediction that about 50 percent of our participants would be prehypertensive. Analyses showed that BMI (M = 26.60, SD = 5.96), weight (M = 167.77, SD = 37.15), and WHR (M = .80, SD = .09) were all significant predictors of pHTN. The results of univariate logistic regression and chi-square analyses, with normal or pHTN as the dependent variable, are indicated in Table 6, Section A. Participants with a BMI ≥ 30 were almost exclusively prehypertensive (92%) whereas participants with a BMI lower than 30 were less likely to be prehypertensive (56%), χ^2(N = 115) = 11.21, p = .001 (see cross-tabulation results in Table 5 and in the results reported as a univariate logistic regression for comparison to the other predictors in Table 6, section A).

Results indicated that for every additional pound in weight, the odds of being prehypertensive significantly increased by 1.04 times. Also, for every one unit increase in WHR, the chances of being prehypertensive increased by 1.21 times. However, family history of obesity, heart disease, stroke, or diabetes (contrast coded as -1 for no family history and 1 for family history for any of these diseases), were not significant predictors of pHTN. These results suggest that although weight, WHR, and BMI were significant predictors of pHTN, family medical history was not. Only the significant predictors of pHTN were included in the subsequent analyses.

Table 5: Cross-Tabulation for Obesity (as indicated by a BMI of 30 or higher) and Prehypertension (N=115)

Variable	Normal (N=42)	Pre-Hypertensive (N=73)
Obesity		
Not Obese (BMI less than 30)	95.2% (40)	68.5% (50)
Obese (BMI 30 or higher)	4.8% (2)	31.5% (23)

Next, in a forward multiple logistic regression analysis, BMI (entered first) and WHR (entered last) were tested as predictors of pHTN (see Table 6, Section B). This analysis showed only BMI, as a measure of obesity, was a significant predictor of pHTN in this sample. Because weight is naturally correlated with BMI (r = .90, $p < .001$), we conducted another forward multiple logistic regression with weight (entered first) and WHR (entered last) as predictors. Again, in this analysis, weight was a significant predictor of pHTN whereas WHR was not (see Table 6, Section C). In both of these analyses, WHR did not explain any further variance in pHTN above BMI or weight. In a subsequent forward regression analysis, we examined if BMI (entered first) or weight (entered last) was a better predictor of pHTN (see Table 6, Section D). This analysis suggested that weight was the only significant predictor of pHTN. Weight explained 26% of the variance in pHTN (R^2 = .26) which means that weight was a stronger predictor of pHTN than BMI (R^2 = .15). Overall, these results suggest that weight-related measures predict pHTN even when controlling for WHR. Furthermore, WHR did not significantly predict pHTN when controlling for BMI or weight.

Table 6: Univariate and Multivariate Logistic Regression Analysis of Prehypertension Risk Factors

	Prehypertension							
	B	S.E.	Wald	df	p	Exp(B)	95% CI	R^2
A. **Univariate**								
BMI	2.22	0.77	8.37	1	=.004	9.20	2.05-41.38	.15
Weight	0.04	0.01	19.77	1	< .001	1.04	1.02-1.06	.26
Waist-to-Hip	0.19	0.05	16.15	1	<.001	1.21	1.10-1.33	.09
Medical Family History	0.30	0.54	.32	1	= .574	1.35	.47-3.85	.01
B. **Multivariate I**								
BMI	0.18	0.06	.937	1	0.002	1.20	1.07-1.34	.22
Waist-to-Hip	2.17	2.73	.63	1	0.43	8.75	0.04-1853.34	
C. **Multivariate II**								
Weight	.03	.01	11.62	1	<.001	1.03	1.01-1.05	.26
Waist-to-Hip	.88	3.22	.07	1	=.79	2.41	.01-1334.06	
D. Multivariate III								
BMI	.31	.97	.10	1	=.75	1.36	.20-9.16	.26
Weight	.03	.01	8.93	1	=.003	1.03	1.01-1.05	

DISCUSSION

In 2016, raised BP remains a global public health concern especially because its lack of obvious symptoms in the early stages result in many people going undiagnosed when their BP could be controllable through lifestyle modifications and/or medication (World Health Organization, 2016). In the United States, 32% of American adults have high BP and one in three is prehypertensive (CDC, 2016). Critically, African Americans continue to have a higher incidence and prevalence of HTN across the lifespan putting them at greater risk for CVD than other racial/ethnic groups in the U.S. (Booth et al., 2017). Evidence also shows that African American males in particular are more likely to transition from normo- to prehypertensive beginning in their second decade of life (Hardy et al., 2017). This study supplements the current gap in our knowledge about disparities in pHTN by focusing on risk among young, primarily African American adults.

Prehypertension Rate

The key finding of this study is that in our sample of African American undergraduates attending an HBCU, 64% of 18 to 25 year-olds were prehypertensive. Given evidence from the

Bogalusa study of the mid-1980s which argued that the transition from childhood pHTN to HTN was even more prevalent among African Americans compared to whites (Savoca et al., 2013) we felt it was important to examine pHTN risk at the young adult stage of life. A review of prior research indicates that in this age group, the incidence of pHTN across the globe varies from approximately 14% (Pengpid, Peltzer, & Ferrer, 2014) among college students in the Philippines to 67% of medical students in India (Kulkarni, Hemagiri, Malavika, & Patril, 2011).

At 64% prevalence, our findings suggest that pHTN is considerably higher than generally believed in this age group. For instance, Dubuque, Elliot and May (2014) found in a sample of 89 American undergraduates that just over 49% were prehypertensive. Critically, few existing studies have focused on pHTN among American college students. In one such study, Balady and Drezner (2013) found excess pHTN was just over 40% among mostly white college athletes. Nonetheless, our findings are in line with Karpinos and colleagues' examination of racially and ethnically-diverse, division-one male athletes drawn from a variety of college sports. Their research found that approximately 61% were prehypertensive (Karpinos, Roumie, Nian, Diamond, & Rothman, 2013).

That the sample for this study is predominantly African American is important because although some pHTN was expected, it came as a surprise that nearly two-thirds (64%) was prehypertenive. This finding raises a number of questions about pHTN in this unique population, especially because education is a known protective factor for HTN (Xu, Liu, Zhu, Liu, & Han, 2016). For example, was the high degree of pHTN we found related to our sample being predominantly African American? Or is it that our undergraduate sample may follow poor dietary practices rooted in the cultural traditions of living in "The South" where food is often fried, laden with fats and excess sugar (Shikany, Safford, Newby, Durant, Brown, & Judd, 2016). Perhaps it is because they are young African Americans who live in a society rife with inequality (Herring & Hynes, 2017)? Or is it simply because they are harried college students? Most likely it is a combination of these conditions.

However, beyond possible racial/ethnic differences in the prevalence of pHTN, the results of the present study are also important because they help establish a baseline for pHTN among young adults. Typically, 18-25 year olds represent an age group that we tend to think of as relatively healthy (Senthil & Krishndasa, 2015) apart from high-risk behaviors and accidents. A pHTN rate of 64%, as seen here, represents a significant opportunity for risk management because pHTN is strongly linked to multiple CVD risk factors, e.g., HTN, especially when present in younger individuals (Pimenta & Oparil, 2009).

Ultimately, for African Americans in the U.S., raised BP represents a major source of health inequity because compared to other racial/ethnic groups, African Americans bear the highest prevalence of HTN, have more CVD, and less access to economic resources that might offer some protective benefits than their white counterparts (Campbell & Rodríguez, 2016). Although excluded for the purpose of this study of pHTN vs. normal BP, it should be noted that 12.9% of our original sample were hypertensive and one individual was super-hypertensive (sBP $\geq$160). This means normal blood pressure was not "normal" in our sample; participants with a normal blood pressure were in the minority. The reasons why African Americans are more vulnerable to HTN remain a point of debate beyond the scope of this study because, practically speaking, we are still some distance from understanding the complex ways in which psychosocial factors, i.e., race/ethnicity, socioeconomic status (SES), and gender combine with innate and acquired biological conditions to influence such CVD-related outcomes (Williams, Priest, & Anderson, 2016).

Predictors of pHTN

A secondary focus of this study was to examine predictors of pHTN in this young adult population. Based on existing HTN studies we predicted that BMI and WHR would be related to pHTN. These data showed that weight-based measures were more predictive than body-shape. Surprisingly, univariate analysis also found that family medical history is less important than we had anticipated based on the literature review. This is in contrast to Al-Majed and Sadek (2012) who found that family history was important. Upon reflection, it is possible that family medical history represents contextual factors such as dietary behaviors more so than genetics and that our sample was fundamentally different from theirs relative to lifestyle and environment.

One social determinate of health is the “Southern diet”, typical of the area. The “Southern diet” has been long associated with low socioeconomic status (SES) and low SES has been cited as contributing to the region earning its “Stroke belt” label (Min et al., 2017). These data showed that overall 60% had a family history of obesity. This suggests that in this sample, food behaviors are likely rooted in family tradition or culture and therefore reflect some intergenerational behavior. Additionally, much research also shows that compared to older cohorts, young adults practice questionable nutrition hygiene habits such as taking in high-calorie foods and sugar-dense beverages (Pelletier, Graham, & Laska, 2014), skipping meals, and binging. College students are no exception. Apart from any social-political stress they may perceive, their lives are all about juggling classes, grades, extra-curricular activities, navigating college-life bureaucracy, family demands and friends. In view of these social pressures, it is hardly surprising that poor dietary habits for them include eating while using media (e.g., video games, TV and social chat sites), purchasing food on campus, and eating on the run (Laska, Hearst, Lust, Lytle, & Story, 2015).

As for risk factors that could be used as an early indicator, extensive research shows a robust relationship exists between being overweight/obese and raised BP. Even among children and adolescents, both HTN and pHTN are more prevalent among those who are overweight/obese (Kelly, Magnussen, Sabin, Cheung & Juonala, 2015). Although obesity is on the rise in the developed world (Ng et al., 2014), rates in the U.S. appear to have plateaued at almost 17% in those aged 2-19 years and 35% among those 20 years and older (Ogden, Carroll, Kit, & Flegal, 2014). Nonetheless, African Americans remain more likely to experience the combination of disproportionately higher obesity rates (Kumanyika, Whitt-Glover, & Haire-Joshu, 2014) and an excess of HTN (Ortega, Sedki, & Nayer, 2015) with all of its health complications. Thus the link between raised BP and excess body weight among young people is reinforced as an important and modifiable early-life risk factor likely to grow worse over time (Theodore et al., 2015).

While overall, 36 % of our sample was obese and two-thirds was prehypertensive, these data also showed that body weight increased pHTN risk by 1.04 times. Almost all (92%) of those who were obese by BMI standards (≥30) were prehypertensive as were more than half (56%) with BMI less than 30. This is worrisome in light of studies that show, at least among children, African Americans with higher body mass are at increased risk for raised BP compared to European Americans (Redwine, & Daniels, 2012; Nandeesha, Bobby, Selvaraj, & Rajappa, 2015).

A core goal of this study was to establish pHTN rates in this unique population of undergraduates. Although much research has examined disparities in HTN, very little research has explored racial/ethnic differences in pHTN. One recent study (Tucker et al., 2015) found no significant differences in either HTN or pHTN between white and African American professional football players. Similarly, in one of very few existing studies that focused on American college students, Godette et al. (2011) also found no significant differences in pHTN by race/ethnicity among college students. Yet, the notion that some 28-35 percent of American undergraduates is overweight or obese (Holland, Carthron, Duren-Winfield, & Lawrence, 2014; Wald, Muennig, O'Connell, & Garber, 2014) is a cause for concern given the strong link between excess body weight and HTN (Go et al., 2014). This is especially worrisome for young African Americans because of the relationship between higher sBP and obesity (Pierce et al., 2012). For this reason, we sought to establish baseline information about pHTN and its relationship to excess body weight among young adults attending an HBCU.

As predicted, we found that excess weight is related to pHTN. This is in line with similar findings by Topè and Rogers (2013) of a correlation between extra pounds around the middle and raised BP among HBCU undergraduates. However, these data showed that in this young adult population, body weight was a better predictor of pHTN than BMI. Moreover, body weight remained predictive when controlling for BMI and WHR. This finding was less of a surprise because, similar to Karanish and Shirini (2015), we too have concerns about the predictive value of BMI especially with a student population. Consider for example, college-age students may be overweight but fit (Arnold et al., 2014). In other words, an athlete's body mass distribution may calculate as overweight/obese and at the same time (s)he is fit from training.

To the extent that excess body weight is related to pHTN, these results are in line with recent investigations of college students in Egypt (Al-Majed & Sadek, 2012), Kuwait (Meng et al., 2012) and the Philippines, (Pengpid, Peltzer, & Ferrer, 2014), as well as young adult medical students in different parts of India (Jain et al., 2014; Debbarma, Bhattacharjya, Mohanty, & Mog, 2015). Similar to Debbarma's (2015) odds ratio of 1.28, our study showed that the odds of having pHTN increased by 1.22 with every one unit increase in BMI. Although we found that body weight was a better predictor, we had expected that WHR, as a measure of central adiposity would be a better predictor of pHTN than BMI.

Limitations

Some caution should be used in the interpretation of these findings. One item of note is that generalizability is limited partially because conclusions are based on a convenience sample. Moreover, it is possible that students who elect to attend a relatively small HBCU may reflect a unique cultural cohort that sets them apart from those who opt for a larger, more diverse university setting. However, this sample was never intended to represent all American college students, African American or otherwise. The larger study from which this sample was drawn was designed to gain a better understanding of obesity-related health disparities.

Strengths

This study highlights the importance of examining pHTN in young adults (age 18-25 years) by providing a baseline; evidence that it can and does strike quite early into the life cycle. Additionally, if as some evidence suggests, pHTN transitions into HTN faster among African Americans, then early diagnosis and intervention is all the more important for this population (Egan & Stevens-Fabry, 2015) and our study shines light on a point in time when they are developing health choices and lifestyle behaviors. This study also introduces a new dimension that of excess body weight, into the wealth of sometimes contradicting research devoted to examining risk factors for problematic BP. We also provide evidence in support of an additional, easy-to-use, non-invasive tool that practitioners may consider for predicting pHTN – body weight (weight related measures).

Future Directions

This study has shed some light on prehypertensive risk among young African Americans, a factor that likely contributes to persistent health disparities. The next step is to replicate findings in a more diverse setting so that possible differences in prevalence rates for pHTN between white and black students can be more fully understood. Perhaps this line of future research may discover that the tools to best predict pHTN may differ based on race, SES, or region. Additionally, in view of the present findings, a culturally-specific intervention for campus outreach is being developed to increase awareness of hypertensive risk among college students.

In thinking about the social environment of our sample, many students came from North Carolina or nearby states, where this HBCU is located. Aptly nicknamed, the "Stroke belt", many African American communities in the southeastern U.S. are disproportionality affected by structural barriers and social determinates of health deeply rooted in political and historical social injustice (Sutton, Gray, Elmore, & Gaul, 2017). Therefore, racism, poverty, and unequal access to educational and employment opportunities are a part of their social environment despite any relative sense of safety to be found at an HBCU. The psychological and social stress associated with such inequality likely accumulates throughout the life course and is associated with raised BP (Cuveas, Williams & Albert, 2017). Future research should investigate these factors as predictors of pHTN.

We have given much thought to the body weight outcome and have concluded that more study needs to be done to gain a better understanding of this phenomenon. For example, are these results for some reason unique to our HBCU sample? Would we have found similar results in a more racially/ethnically diverse sample of undergraduates? Despite recent studies in genetic epidemiology that support long-held assumptions that African Americans are predisposed to HTN for biological reasons (Wei et al., 2011), one must not lose sight of the contribution of social context to race-based disparities. In other words, populations reflect gene pools that live as social groups (Knerr, Ramos, Nowinski, Dixon, & Bonham, 2010) and are subject to the ebb and flow of sociopolitical, cultural, and environmental differences (Green and Darity, 2010). From this perspective it is important to remember that the African American college students who made up our sample represent a group who may share a little DNA; more importantly however, most share intergenerational behavior patterns and about 200 years of sociopolitical, cultural, and environmental history.

As for the relationship seen here and elsewhere between raised BP and extra body weight, it is helpful to remember that higher levels of perceived stress are strongly correlated with more sedentary behavior and indulging in unhealthy nutrition (Reiner, Niermann, Krapf, & Woll, 2015). Typically, food choices and sedentary behavior are viewed as individual choices rather than examining them in a cultural context (Visser, Hutter, & Haisma, 2016). However, it may be more useful to view such health behaviors from a generational (Reiner, Niermann, Krapf, & Woll, 2015) or cultural perspective. For this reason, we plan to utilize a community-based participatory research approach to help uncover key socio-cultural attributes, such as dietary preferences, before moving ahead with a hypertension-risk intervention.

Implications

From a public health perspective, our findings reflect the scope of benefit possible by obtaining indications of raised BP earlier in the life course before it gains momentum on its path to HTN (Haas, Bertsch, & Schwandt, 2014, Materson, Garcia-Estrada, Degraff, & Preston, 2017). The ultimate take-away message from this study is that more research is needed on young adults, especially African Americans, as they may be in greater jeopardy than previously thought and more agreeable than older individuals to making the lifestyle changes necessary to reduce pHTN and hopefully minimize future CVD risk.

College students, regardless of whether they attend an HBCU or more diverse institution, present a prime opportunity for risk awareness education and lifestyle modification interventions because they are already submerged in an educational atmosphere. In a way one could say the pump is primed; they are here to learn. However, we also learned from this study that such an intervention must be shaped by the competing demands of college life. In other words, there is little point in advising stressed out students to eat more fresh fruit and vegetables unless these are convenient, meaning readily obtainable at an affordable price nearby.

What is more relevant to these results is that effective early interventions to counter raised BP could significantly decrease lifetime risk of HTN and its sequelae, e.g., stroke. Mounting evidence suggests that identifying and treating pHTN presents just such a window of opportunity (Haas, Bertsch, & Schwandt, 2014) through studies that show generally those with pHTN are more than twice as likely to develop HTN (Egan & Stevens-Fabry, 2015). It is also plausible that the transition period between pHTN and HTN may be an especially important time for African Americans because, although they have a higher rate of incident HTN compared to Whites (Booth et al., 2017), the same may not hold true for pHTN. In other words, there is some evidence that perhaps pHTN transitions into HTN faster among African Americans than Whites for some reason (e.g., cultural differences, genetics, etc.). This would make early diagnosis and intervention all the more important especially for African Americans (Egan & Stevens-Fabry, 2015).

CONCLUSION

Overall, mounting evidence advises that although, pHTN may not be directly associated with all-cause mortality, it is related to CVD mortality (Guo et al., 2013) and may be more prevalent among African American adults (Glasser et al., 2011). Taken together, this suggests that pHTN is a potentially modifiable risk factor and an important target for screening particularly in light of persistent disparities in health outcomes between African Americans and other racial/ethnic groups. Studies show that even modest improvements in risk factors for CVD, such as HTN, can mean considerable health benefits later in life (Habib, Virani, & Jneid, 2015) and significant reduction in the economic burden of vascular disease (Capewell & Lloyd-Jones, 2010). From a public health perspective, college students, who are presumably old enough to be somewhat self-sufficient, should be a prime target for early diagnosis and intervention.

The present study indicates the need for the development of a comprehensive approach, with special attention to body weight to acknowledge and address the relatively high rate of pHTN among college-aged adults. Given strong evidence of the tendency for unchecked pHTN to migrate towards HTN, the need for early detection cannot be overstated. These findings also show the potential of non-invasive and simple to obtain body weight measures as indicators of pHTN risk and a target for modifiable lifestyle changes. Lastly, these data support a growing belief that although easily used outside of a clinical setting, BMI may not be the best measure of overweight/obesity (Ogden, Carroll, Kit, & Flegal, 2014) in that it is highly correlated with adiposity but does so without taking into account variations in body fat distribution and cardio-fitness level. These data showed that simple body weight can be a highly useful tool to identify risk of pHTN.

REFERENCES

Al-Majed, H., & Sadek, A. (2012). Prehypertension and hypertension in college students in Kuwait: A neglected issue. *Journal of Family and Community Medicine, 19*(2), 105-112.

Arnold, T., Schweitzer, A., Hoffman, H., Onyewu, C., Hurtado, M. E., Hoffman, E. P. & Klein, C. J. (2014). Neck and waist circumference biomarkers of cardiovascular risk in a cohort of predominately African-American college students: A preliminary study. *Journal of the Academy of Nutrition and Dietetics, 114*(1), 107-116.

Ashwell, M., & Gibson, S. (2016). Waist-to-height ratio as an indicator of 'early health risk': simpler and more predictive than using a 'matrix' based on BMI and waist circumference. *BMJ Open*, *6*(3), 1-7.

Balady, G., & Drezner, J. (2013). Tackling cardiovascular health risks in college football players. *Circulation, 128*(5), 477-480. doi:10.1161/circulationaha.113.004039.

Bhatt, H., Safford, M., & Glasser, S. (2015). Coronary heart disease risk factors and outcomes in the twenty-first century: Findings from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) Study. *Current Hypertension Reports, 17*(4), 1-20.

Booth, J. N., Abdalla, M., Tanner, R. M., Diaz, K. M., Bromfield, S. G., Tajeu, G. S., ... & Spruill, T. M. (2017). Cardiovascular Health and Incident Hypertension in Blacks. *Hypertension*, *70*(2), 285-292.

Caleyachetty, R., Echouffo-Tcheugui, J., Tait, C., Schilsky, S., Forrester, T., & Kengne A. (2015). Prevalence of behavioural risk factors for cardiovascular disease in adolescents in low-income and middle-income countries: An individual participant data meta-analysis. *The Lancet Diabetes and Endocrinology, 3*(7), 535-544. Campbell, K. M., & Rodríguez, J. E. (2016). Cardiovascular Health Practices Among Black Patients in an Urban Underserved Clinic. *Journal of the National Medical Association*, *108*(1), 40-44.

Capewell, S., & Lloyd-Jones, D. (2010). Optimal cardiovascular prevention strategies for the 21st century. *The Journal of the American Medical Association*, *304*(18), 2057-2058. doi:10.1001/jama.2010.1641.

Centers for Disease Control and Prevention (CDC). (2011). Vital signs: Prevalence, treatment, and control of hypertension---United States, 1999--2002 and 2005---2008. *Morbidity and Mortality Weekly Report, 60*(4), 103-108. Center for Disease Control and Prevention (CDC). (June, 2016). High blood pressure fact sheet. Retrieved from https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_bloodpressure.htm

Chan, Q., Stamler, J., & Elliott, P. (2015). Dietary factors and higher blood pressure in African-Americans. *Current Hypertension Reports, 17*(10), 1-8. doi:10.1007/s11906-014-0517-x.

Cooper, R., Forrester, T., Plange-Rhule, J., Bovet, P., Lambert, E. V., Dugas, L. R., . . . Luke, A. (2015). Elevated hypertension risk for African-origin populations in biracial societies. *Journal of Hypertension, 33*(3), 473-481. doi:10.1097/hjh.0000000000000429.

Covelli, M., Wood, C., & Yarandi, H. (2012). Biologic measures as epidemiological indicators of risk for the development of hypertension in an African-American adolescent population. *Journal of Cardiovascular Nursing*, *27*(6), 476-484. doi:10.1097/jcn.0b013e31822f7971.

Cuevas, A. G., Williams, D. R., & Albert, M. A. (2017). Psychosocial factors and hypertension: a review of the literature. *Cardiology clinics*, *35*(2), 223-230.

Debbarma, A., Bhattacharjya, H., Mohanty, A., & Mog, C. (2015). Prevalence of pre-hypertension and its relationship with body mass index among the medical students of Agartala government medical college. *International Journal of Research in Medical Sciences, 3*(5), 1097-1101. doi:10.5455/2320-6012.ijrms20150513.

Diaz, K., Veerabhadrapaa, P., Brown, M., Whited, M., Dubbert, P., & Hickson, D. (2014). Prevalence, determinants, and clinical significance of masked hypertension in a population-based sample of Americans African-Americans: The Jackson Heart study. *American Journal of Hypertension, 28*(7), 900-908. doi:10.1093/ajh/hpu241.

Donahue, R., Stranges, S., Rafalson, L., Dmochowski, J., Dorn, J., & Trevisan, M. (2014). Risk factors for prehypertension in the community: A prospective analysis from the Western New York health study. *Nutrition, Metabolism and Cardiovascular Diseases, 24*(2), 162-167. doi:10.1016/j.numecd.2013.06.006.

Dubuque, C. R., Elliott, W. J., & May, R. (2014). Sleep quality, stress, depressive symptoms, and body-mass index as predictors of elevated blood pressures in college students. *Journal of the American Society of Hypertension*, *8*(4), e122.

Egan, B., & Stevens-Fabry, S. (2015). Prehypertension—prevalence, health risks, and management strategies. *Nature Reviews Cardiology, 12*(5), 289-300. doi:10.1038/nrcardio.2015.17.

Ehret, G. B., Munroe, P. B., Rice, K. M., Bochud, M., Johnson, A. D., Chasman, D. I., . . . Pihur, V. (2011). Genetic variants in novel pathways influence blood pressure and cardiovascular disease risk. *Nature*, *478*(7367), 103-109.

Falkner, B., DeLoach, S., Keith, S., & Gidding, S. (2013). High risk blood pressure and obesity increase the risk for left ventricular hypertrophy in African-American adolescents. *The Journal of Pediatrics*, *162*(1), 94-100. doi:10.1016/j.jpeds.2012.06.009.

Ferdinand, K., & Nasser, S. (2015). Understanding the importance of race/ethnicity in the care of the hypertensive patient. *Current Hypertension Reports*, *17*(3), 1-10. doi:10.1007/s11906-014-0526-9.

Flynn, J. (2012). The changing face of pediatric hypertension in the era of the childhood obesity epidemic. *Pediatric Nephrology, 28*(7), 1059-1066. doi:10.1007/s00467-012-2344-0.

Garrison, G., & Oberhelman, S. (2013). Screening for hypertension annually compared with current practice. *Annals of Family Medicine, 11*(2), 116-121. doi:10.1370/afm.1467.

Glasser, S., Judd, S., Basile, J., Lackland, D., Halanych, J., Cushman, M., . . . Howard, G. (2011). Prehypertension, racial prevalence and its association with risk factors: Analysis of the reasons of geographic and racial differences in stroke (regards) study. *American Journal of Hypertension, 24*(2), 194-199. doi:10.1038/ajh.2010.204.

Go, A., Mozaffarian, D., Roger, V., Benjamin, E. J., Berry, J. D., Borden, W. B., Bravata, D. M., . . . Turner, M.B. (2013). American heart association statistical update. *Circulation, 127*(1), e62-245.

Godette, D., Mulatu, M., Carter-Edwards, L., Saunders, M., Forehand, R. (2011). Alcohol consumption and blood pressure among students in a university health center. *Journal of the Georgia Public Health Association, 6*(2), 16-32.

Goh, L. G. H., Dhaliwal, S. S., Welborn, T. A., Lee, A. H., & Della, P. R. (2014). Anthropometric measurements of general and central obesity and the prediction of cardiovascular disease risk in women: a cross-sectional study. *BMJ Open*, *4*(2), 1-9. http://doi.org/10.1136/bmjopen-2013-004138

Green, T., & Darity, W. (2010). Under the skin: Theories from biology and the social sciences to explore the mechanisms behind the black-white health gap. *American Journal of Public Health, 100*(S1), S36-S40. doi:10.2105/ajph.2009.171140.

Gu, Q., Burt, V. L., Paulose-Ram, R., Yoon, S., & Gillum, R. F. (2008). High blood pressure and cardiovascular disease mortality risk among US adults: The third national health and nutrition examination survey mortality follow-up study. *Annals of Epidemiology*, *18*(4), 302-309.

Haas, G., Bertsch, T., & Schwandt, P. (2014). Prehypertension and cardiovascular risk factors in children and adolescents participating in the community-based prevention education program family heart study. *International Journal of Preventive Medicine, 5*(1), 50-56.

Habib, G., Virani, S., & Jneid, H. (2015). Is 2015 the primetime year for prehypertension? Prehypertension: A cardiovascular risk factor or simply a risk marker?. *Journal of the American Heart Association, 4*(2), e001792-e001792. doi:10.1161/jaha.115.001792.

Hardy, S. T., Holliday, K. M., Chakladar, S., Engeda, J. C., Allen, N. B., Heiss, G., . . . Zeng, D. (2017). Heterogeneity in blood pressure transitions over the life course: age-specific emergence of racial/ethnic and sex disparities in the United States. *JAMA Cardiology*, *2*(6), 653-661.

Hernandez, J., & Anderson, S. (2012). Prehypertension: A literature-documented public health concern. *The Author(s) Journal Compilation American Academy of Nurse Practitioners, 24*(1), 3-10. doi:10.1111/j.1745-7599.2011.00684.x.

Herring, C., & Hynes, A. (2017). Race, skin tone, and wealth inequality in America. In L. L. Martin, D. D. Horton . C. Herring, V. M. Keith, & M. Thomas (Ed.), *Color Struck: How Race and complexion Matter in the "Color-Blind" Era.* (pp. 1-17). Rotterdam, The Netherlands: Sense Publishers..

Holland, C., Carthron, D., Duren-Winfield, V., & Lawrence, W. (2014). An experiential cardiovascular health education program for African-American college students. *ABNF Journal*, *25*(2), 52-56.

Huang, Y., Huang, W., Mai, W., Cai, X., An, D., Liu, Z., ... & Xu, D. (2017). White-coat hypertension is a risk factor for cardiovascular diseases and total mortality. *Journal of hypertension*, *35*(4), 677-688.

Jain, J., Mathur, H., Apte, S. Sinha, U., Agarwal, K., & Chanchlani, R. (2014). Prevalence of prehypertension and its correlation with anthropometric measurements in medical students of central India. *Journal of Evolution of Medical and Dental Science, 3*(10), 2429-2433.

Karpinos, A., Roumie, C., Nian, H., Diamond, A., & Rothman, R. (2013). High prevalence of hypertension among collegiate football athletes. *Circulation: Cardiovascular Quality and Outcomes, 6*(6), 716-723. doi:10.1161/circoutcomes.113.000463.

Kelly, R., & Magnussen, C. (2014). Epidemiology of elevated blood pressure in youth and its utility for predicting adulthood outcomes: A review. *World Journal of Hypertension, 4*(4), 29-36. doi:10.5494/wjh.v4.i4.29.

Kelly, R., Magnussen, C., Sabin, M., Cheung M., & Juonala, M. (2015). Development of hypertension in overweight adolescents: A review. *Adolescent Health, Medicine and Therapeutics, 6,* 171-187. doi:10.2147/ahmt.s55837.

Knerr, S., Ramos, E., Nowinski, J., Dixon, K., & Bonham, V. (2010). Human difference in the genomic era: Facilitating a socially responsible dialogue. *BioMed Central Medical Genomics, 3*(20), 1-6. doi:10.1186/1755-8794-3-20.

Kulkarni, M., Hemagiri, K., Malavika, Patril, R. (2011). Prehypertension and associated factors among medical students of SSIMS & RC, Davangere-a cross-sectional study. *Journal of the Indian Medicine Association, 109*, 733-736.

Kumanyika, S., Whitt-Glover, M., & Haire-Joshu, D. (2014). What works for obesity prevention and treatment in black Americans? Research directions. *Obesity Review: An Official Journal of the International Association for the Study of Obesity, 15*, 204-212. doi:10.1111/obr.12213.

Lackland, D., & Egan, B. (2015). Epidemiology awareness, prevalence, and control: Newest findings on hypertension in blacks. In K. C. Ferdinand (Ed.), *Hypertension in high risk African Americans* (pp. 21-33). New York, NY: Humana Press.

Lai, H. L., Ward, R., & Bolin, P. (2015). Cardiovascular health of North Carolina undergraduates. *North Carolina Medical Journal*, *76*(5), 286-292.

Laska, M. N., Hearst, M. O., Lust, K., Lytle, L. A., & Story, M. (2015). How we eat what we eat: Identifying meal routines and practices most strongly associated with healthy and unhealthy dietary factors among young adults. *Public Health Nutrition*, *18*(12), 2135-2145.

Leblanc, M., Croteau, S., Ferland, A., Bussières, J., Cloutier, L., Hould, F. S., . . . Poirier, P. (2013). Blood pressure assessment in severe obesity: Validation of a forearm approach. *Obesity, 21*(12), E533-E541. doi:10.1002/oby.20458.

Lee, H., Sun, T., Zhou, M., & Liu, Y. (2014). The relative effect of hypertension on stroke risk in women compared with men: Random-effects meta-analysis. *American Journal of BioMedicine*, *2*(6), 665-674.

Mackey, E., Schweitzer, A., Hurtado, M. E., Hathway, J., DiPietro, L., Lei, K. Y., & Klein, C. J. (2015). The feasibility of an e-mail–delivered intervention to improve nutrition and physical activity behaviors in African-American college students. *Journal of American College Health*, *63*(2), 109–117. http://doi.org/10.1080/07448481.2014.990971

Mahmood, S., Levy, D., Vasan, R., & Wang T. (2014). The Framingham Heart study and the epidemiology of cardiovascular disease: A historical perspective. *The Lancet*, *383*(9921), 999-1008.

Materson, B. J., Garcia-Estrada, M., Degraff, S. B., & Preston, R. A. (2017). Prehypertension is real and can be associated with target organ damage. *Journal of the American Society of Hypertension,* 11(11),704-708.

Meng, X., Dong, G., Wang D., Liu, M., Liu, Y., Zhao, Y., . . . Zhang, Y. (2012). Epidemiology of prehypertension and associated risk factors in urban adults from 33 communities in China. *Circulation Journal, 76*(4), 900-906. doi:10.1253/circj.cj-11-1118.

Min, Y. I., Anugu, P., Butler, K. R., Hartley, T. A., Mwasongwe, S., Norwood, A. F., ... & Correa, A. (2017). Cardiovascular disease burden and socioeconomic correlates: findings from the Jackson Heart Study. *Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease*, *6*(8), 1-10.

Muralidhara, D. V., Nor, M. M., & Zubaidi, A. L. (2016). Our experiences with human body composition estimations: Low discriminatory power of body mass index to segregate body fatness. *Malaysian Journal of Public Health Medicine*, 16(3), 16-19.

Nandeesha, H., Bobby, Z., Selvaraj, N., & Rajappa, M. (2015). Pre-hypertension: Is it an inflammatory state? *Clinica Chimica Acta, 451*, 338-342. doi:10.1016/j.cca.2015.10.022.

Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., . . . Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: A systematic analysis for the global burden of disease study 2013. *The Lancet, 384*(9945), 766-781. doi:10.1016/s0140-6736(14)60460-8.

Odunaiya, N., Grimmer, K., & Louw, Q. (2015). High prevalence and clustering of modifiable CVD risk factors among rural adolescents in southwest Nigeria: Implication for grass root prevention. *BioMed Central Public Health, 15*(661), 1-9. doi:10.1186/s12889-015-2028-3.

Ogden, C., Carroll, M., Kit, B., & Flegal, K. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Survey of Anesthesiology, 311*(8), 806-814. doi:10.1097/01.sa.0000451505.72517.a5.

Ortega, F. B., Cadenas-Sanchez, C., Lee, D. C., Ruiz, J. R., Blair, S. N., & Sui, X. (2018). Fitness and fatness as health markers through the lifespan: An overview of current knowledge. *Progress in Preventive Medicine*, *3*(2), e0013.

Ortega, L., Sedki, E., & Nayer, A. (2015). Hypertension in the African-American population: A succinct look at its epidemiology, pathogenesis, and therapy. *Nefrología*, *35*(2), 139-145. doi:10.1016/j.nefro.2015.05.014.

Pelletier, J. E., Graham, D. J., & Laska, M. N. (2014). Social norms and dietary behaviors among young adults. *American Journal of Health Behavior*, *38*(1), 144-152.

Pengpid, S., Peltzer, K., & Ferrer, A. (2014). Prehypertension and associated factors among university students in the Philippines. *International Journal of Adolescent Medicine and Health, 26*(2), 245-252. doi:10.1515/ijamh-2013-0303.

Pierce, G., Zhu, H., Darracott, K., Edet, I., Bhagatwala, J., Huang, Y., & Dong, Y. (2012). Arterial stiffness and pulse-pressure amplification in overweight/obese African-American adolescents: Relation with higher systolic and pulse pressure. *Oxford Journals: American Journal of Hypertension, 26*(1), 20-26. doi:10.1093/ajh/hps014.

Pimenta, E., & Oparil, S. (2009). Prehypertension: Epidemiology, consequences and treatment. *Nature Reviews. Nephrology, 6*(1), 21-30. doi:10.1038/nrneph.2009.191.

Ravenell, J., & Ogedegbe, G. (2015). Community programs for hypertension: A means of identification and intervention in the highest-risk population. In K. C. Ferdinand (Ed.), *Hypertension in High Risk African Americans* (pp. 21-33). New York, NY: Humana Press.

Ravenell, J., Thompson, H., Cole, H., Plumhoff, J., Cobb, G., Afolabi, L., . . . Ogedegbe, G. (2013). A novel community-based study to address disparities in hypertension and colorectal cancer: A study protocol for a randomized control trial. *Trials, 14*(1) 287. doi:10.1186/1745-6215-14-287.

Redmond, N., Booth, J. N., Tanner, R. M., Diaz, K. M., Abdalla, M., Sims, M., ... & Shimbo, D. (2016). Prevalence of masked hypertension and its association with subclinical cardiovascular disease in African-Americans: Results from the Jackson Heart Study. *Journal of the American Heart Association*, *5*(3), 1-8.

Reiner, M., Niermann, C., Krapf, F., & Woll, A. (2015). Stress: Personal matter or family affair?: Intra-and inter-individual relationships between stress, physical activity, sedentary behavior and nutrition. *International Journal of Child, Youth and Family Studies*, *6*(1), 68-92.

Redwine, K., & Daniels, S. (2012). Prehypertension in adolescents: Risk and progression. *The Journal of Clinical Hypertension, 14*(6), 360-364. doi:10.1111/j.1751-7176.2012.00663.x.

Savoca, M., Oakley, M., Austin, A., Wideman, L., Martinek, T., & Carter, K. (2013). Heart of hypertension project: Development of a community-based prevention program for young African-American men. *Progress Community Health Partnerships, 7*(2), 163-169. doi:10.1353/cpr.2013.0022.

Selassie, A., Wagner, C., Laken, M., Ferguson, M., Ferdinand, K., & Egan, B. (2011). Progression is accelerated from prehypertension to hypertension in blacks. *Hypertension, 58*(4), 579-587. doi:10.1161/hypertensionaha.111.177410.

Senthil, S., & Krishndasa, S. N. (2015). Pre-Hypertension in apparently healthy young adults: Incidence and influence of haemoglobin level. *Journal of Clinical and Diagnostic Research*, *9*(11), CC10 – CC12.

Senthil, S., & Krishnadasa, S. N. (2016). Prehypertension and its determinants in apparently healthy young adults. *Journal of Clinical and Diagnostic Research*, *10*(9), CC05-CC08. doi: 10.7860/JCDR/2016/20626.8447

Shikany, J. M., Safford, M. M., Newby, P. K., Durant, R. W., Brown, T. M., & Judd, S. E. (2015). Southern dietary pattern is associated with hazard of acute coronary heart disease in the Reasons for Geographic and Racial Differences in Stroke (REGARDS) study. *Circulation*, *132*(9), 804–814. http://doi.org/10.1161/CIRCULATIONAHA.114.014421

Soliman, M., El-Salamony, O., El-Khashab, K., El-Sherbiny, N., & Khamis, K., (2014). Study of hypertension among Fayoum university students. *International Journal of Public Health Research, 2*(2), 15-19.

Staiano, A., Gupta, A., & Katzmarzyk, P. (2014). Cardiometabolic risk factors and fat distribution in children and adolescents. The *Journal of Pediatrics, 164*(3), 560-565. doi:10.1016/j.jpeds.2013.10.064.

Stephens, J. D., Althouse, A., Tan, A., & Melnyk, B. M. (2017). The role of race and gender in nutrition habits and self-efficacy: Results from the young adult weight loss study. *Journal of Obesity*, *2017*, 1-6.

Suchanek, P., Kralova Lesna, I., Mengerova, O., Mrazkova, J., Lanska, V., & Stavek, P. (2012). Which index best correlates with body fat mass: BAI, BMI, waist or WHR. *Neuroendocrinolgy Letters*, *33*(2), 78-82.

Sutton, M. Y., Gray, S. C., Elmore, K., & Gaul, Z. (2017). Social determinants of HIV disparities in the southern United States and in counties with historically black colleges and universities (HBCUs), 2013–2014. *PloS One*, *12*(1), 1-12.

Theodore, R., Broadbent, J., Nagin, D., Ambler, A., Hogan, S., Ramrakha, S., . . . Poulton, R. (2015). Childhood to early-midlife systolic blood pressure trajectories. *Hypertension, 66*(6), 1108-1115.

Topè, A. M., & Rogers, P. F. (2013). Metabolic syndrome among students attending a historically black college: Prevalence and gender differences. *Diabetology & Metabolic Syndrome*, *5*(1), 1-8.

Tucker, A., Lincoln, A., Vogel, R., Black, H. R., Dunn, R. E., Wilson, P. W. F., & Pellman, E. J. (2015). Lack of blood pressure difference by race in professional American football players. *Journal of the American Society of Hypertension*, *9*(5), 370-374. doi:10.1016/j.jash.2015.02.019.

Visser, S. S., Hutter, I., & Haisma, H. (2016). Building a framework for theory-based ethnographies for studying intergenerational family food practices. *Appetite*, *97*, 49-57.

Wald, A., Muennig, P., O'Connell, K., & Garber, C. (2014). Associations between healthy lifestyle behaviors and academic performance in U.S. undergraduates: A secondary analysis of the American college health association's national college health assessment II. *American Journal of Health Promotion, 28*(5), 298-305. doi:10.4278/ajhp.120518-quan-265.

Wei, G., Coady, S., Goff, D., Brancati, F. L., Levy, D., Selvin, E., . . . Fox, C. S. (2011). Blood Pressure and the risk of developing diabetes in African-Americans and whites: ARIC, CARDIA, and the Framingham Heart Study. *Diabetes Care, 34*(4), 873-879. doi:10.2337/dc10-1786.

Williams, D. R., Priest, N., & Anderson, N. B. (2016). Understanding associations among race, socioeconomic status, and health: Patterns and prospects. *Health Psychology*, 35(4), 407-411.

Wing, R., Tate, D., Espeland, M., Gorin, A., LaRose, J. G., Robichaud, E. F., . . . Lewis, C. E. (2013). Weight gain prevention in young adults: Design of the study of novel approaches to weight gain prevention (snap) randomized controlled trial. *BioMed Central Public Health, 13*(300), 1-5. doi:10.1186/1471-2458-13-300.

World Health Organization. (2016). A global brief on hypertension: silent killer, global public health crisis. Retrieved from http://apps.who.int/iris/bitstream/handle/10665/79059/W?sequence=1

Winham, D., & Jones, K. (2011). Knowledge of young African-American adults about heart disease: A cross-sectional survey. *BioMed Central Public Health, 11*(248), 1-11. doi:10.1186/1471-2458-11-248.

Yancu, C., Lee, A., Witherspoon, D., & McRae, C. (2012). Participant recruitment of African-American college students at a historically black college and university (HBCU): Challenges and strategies for health-related research. *Journal of Health Disparities Research and Practice, 5*(1), 55-64.

Yang, Q., Zong, Y., Ritchey, M., Cobain, M., Gillespie, C., Merritt, R., . . . Bowman, B.A. (2015). Vital signs: Predicted heart age and racial disparities in heart age among U.S. adults at the state level. *Morbidity and Mortality Weekly Report, 64*(34), 950-958.

Xu, T., Liu, J., Zhu, G., Liu, J., & Han, S. (2016). Prevalence of prehypertension and associated risk factors among Chinese adults from a large-scale multi-ethnic population survey. *BMC Public Health*, *16*(775), 1-8.