Hypertension in Haitian Adults

By

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Abstract: Two years after the January 2010 earthquake, the Haitian Ministry of Public Health and Population defined hypertension as the greatest cause of morbidity and mortality in Haitian adults with prevalence approaching 45%, higher than HIV, cholera, tuberculosis, and malaria combined. In a very poor developing country with limited facilities, funds for non-communicable disease prevention and treatment are scarce. In 2012, the total expenditure on health was only 7.9% of GNP. Three primary factors contribute to the hypertension disease burden in Haiti: the stroke death rate is the highest in the Caribbean, the Haitian dietary salt intake is 10 times greater than the U.S, and the social determinants of disease are very high from extreme poverty, health care inequity, and socio-ecological stress.

The objectives of the master’s paper are to describe the prevalence and pattern of hypertension, and the relationship between blood pressure, age and gender in Haitian adults living near Port-au-Prince, Haiti. Data from this pilot study will serve as clinical evidence to generate hypotheses for future public health prevention and disease management interventions and for proposal development. The study uses a retrospective, cross-sectional design of clinical data collected during a walk-in mission clinic in fall 2012. The convenience sample was 556 Haitian adults (104 men, 452 women) aged 19-90 years. Patients were seen by 6 U.S. physicians and 7 nurses during a trip led by Family Health Ministries, Durham, NC. The setting was the Blanchard Clinic located near Cite Soleil in NW Port-au-Prince, Haiti.

Patient ID, date, age, and gender were recorded by Haitian staff. Blood pressure and other vital signs were assessed by nurses. Clinical complaints were written by triage volunteers with help of Haitian translators. Patients were seen by general medicine doctors or infectious disease or OB-GYN specialists depending on medical complaints. A medical history and
physical exam were performed, and lab work, treatments and medications were ordered on the
data sheet and taken to nurses in the treatment area.

Of all adults, 254 were hypertensive: 300 (54%) had normal BP, 43 (8%) had systolic
hypertension (SHPT), 52 (9%) had diastolic hypertension (DHPT) and 159 (29%) had both
systolic and diastolic hypertension (S-D HPT). Prevalence of hypertension in this sample was
46%. There was a significant, positive relationship between increasing age and systolic and
diastolic blood pressure (BP) (P<0.001). Severity of hypertension was greatest in those 60-90
years old. Across increasing age categories, prevalence of normal BP decreased 72%, SHPT and
S-D HPT increased 400%, and DHPT decreased 40%. Progressively higher prevalence of
hypertension occurred by both men and women but the patterns varied. A logistic regression
confirmed a significant association of age and hypertension (P=0.000) controlling for gender.

The prevalence of hypertension in Haitian adults was 46%, higher than the 42% in U.S.
blacks. In this non-random sample, age was a primary risk factor for both systolic and diastolic
hypertension in both men and women. Though the data may have limited generalizability to the
entire Haitian population, the availability of these data are a “natural experiment” to answer
important health questions about prevalence of hypertension in Haiti and to generate hypotheses
for future research and treatment strategies using a stratified random sample. The pattern of an
increasing systolic hypertension with age is important in guiding treatment. A concept proposal
is presented here of a future study and treatment protocol that would investigate the relationship
of hypertension to cardiovascular risk factors, clinical symptoms, African ancestry, and cultural
life-style issues such as dietary salt intake, education, environmental stress and poverty.
Collaboration with the Haitian government is essential to plan and implement a chronic disease
prevention and management infrastructure.
INTRODUCTION

Haiti is the poorest country in the Western hemisphere with 80% of the population living under the poverty line and 54% in total poverty (CIA World Factbook, 2014). In 2012 Haiti had a population of 10.174 million. The 2011 growth rate was 0.99% but the net migration rate in 2013 was -5.5/1,000 population moving primarily to the U.S. and Canada (Haiti Demographic Profile, 2013). Racial distribution is 95% black and 5% mulatto and white. The median age is 22 years, and over 90% are <55 years old. In 2013 the gross national income per capita (PPP) was $1300 (CIA, 2014). Total expenditure on health was only 7.9% of the Gross National Product (GNP), and total expenditure on health per capita was $94/year (WHO: Haiti, 2011-2012). Life expectancy at birth was 61 years for men and 64 years for women. Yet the probability of dying between 15-60 years old was 25.8% in men and 22.3% in women/1000 population.

The January 2010 earthquake caused $7.8 billion in damages, over 220,000 deaths and more than 300,000 injured. Four years later, 89% have left the camps, but food insecurity, malnutrition and the cholera epidemic create a demand on people and health facilities. Haiti’s external debt was cancelled by donor countries after the 2010 earthquake, but by 2014 the debt has risen to $1.1 billion. The government relies on international assistance with over 50% of its annual budget coming from outside sources (CIA World Factbook, 2014).

In July 2012, the Haitian Ministry of Public Health and Population (MSPP) published a booklet, “Politique Nationale de Sante,” describing the health problems in Haiti. Hypertension was the greatest cause of morbidity and mortality in Haitian adults, higher than HIV, cholera, tuberculosis, and malaria combined (Jean-Charles, 2014). The prevalence of hypertension may approach 45% in Haiti (Kenerson, 2014). Country estimates of hypertension, hyperglycemia or chronic disease treatment facilities are not available, but 31% of adults are overweight and 8%
are obese (WHO: NCD Country Profiles, 2011). To estimate end organ disease from hypertension, the prevalence of stroke in Haiti in 2002 was 176/100,000 people, compared to 82/100,000 in eastern Hispaniola in the Dominican Republic, the highest in North America and one of the highest in the world (Lavados, Hennie, Fernandez et al, 2007). In a poor developing country with limited health facilities, funds for non-communicable disease (NCD) prevention and treatment are scarce or non-existent. Low/ middle income countries have 66% of hypertension disease burden, but 10% of the resources to manage it (Lawes et al. (2006).

**Background. Current Hypertension Prevalence and Management Guidelines.**

According to the new *Clinical practice guidelines for the management of hypertension in the community* (Weber et al., 2014), approximately one third of adults in the world have high blood pressure (BP). Hypertension is defined by the United States (U.S.) National Joint Committee 7 as a systolic BP ≥ 140 mm Hg. and/or a diastolic BP ≥ 90 mm Hg. (JNC 7, 2004). The global burden of hypertension is growing from an estimated 972 million adults with the disease, 66% who live in developing countries, to a projected increase in prevalence of 1.56 billion, 29% of the population by 2025 (Kenerson, 2014). Hypertension is the most common chronic disease seen by primary care practitioners and is a primary risk factor for CVD (Gaziano, Bitton, Anand, and Weinstein, 2009). CVD is the most important non communicable chronic diseases (NCCD) in both developed and developing countries in terms of morbidity, disability and mortality. Unlike in developed countries, the prevalence of hypertension has accelerated in developing countries (Fuentes, Ilmaniemi, Laurikainen, Tuomileho, and Nissinen, 2000). Patients with hypertension often have additional CVD risk factors such as abnormal serum lipids, diabetes, obesity, a family history of early CVD, and cigarette smoking (Weber et al. (2014). Those with elevated blood pressure and co-morbidities are more prone to ischemic events such as stroke or
myocardial infarction (Gaziano et al. 2009). In the U.S. between 1999-2000 and 2009-2010, hypertension with one or more co-morbid conditions (heart disease, diabetes and cancer) increased 3-6% in adults 65 years or older (Fried, Bernstein and Bush, 2012).

The prevalence of hypertension in the U.S. population increases with age. The pattern of hypertension, classified as isolated systolic, isolated diastolic, or systolic-diastolic hypertension, also changes as people age. Before 50 years most people with hypertension have an elevated diastolic BP (DBP). After 50 years, systolic BP (SBP) continues to rise and DBP may or may not fall (Chobanian, 2007). Isolated systolic hypertension may occur in a variety of cardiac and metabolic conditions, but the majority of cases indicate reduced elasticity of large arteries. The risk of adverse events from CVD increases steadily as either SBP or DBP increase, doubling for every 20 or 10 mm Hg. increase that occurs within the range of 115-185 SBP and 75-115 mm Hg. DBP. Elevated SBP is a more important risk factor for both CVD and renal disease than elevated DBP (Chobanian, 2007). Increased pulse pressure (the SBP - DBP difference) is an independent risk factor for increased CVD mortality in patients with systolic hypertension (Alam, Barri, 2003). The adequate treatment of systolic hypertension should be the primary goal of antihypertensive therapy to reduce total CVD risk (Strandberg, Pitkala (2003).

**Public Health and Economic Implications.** The public health implications of a high prevalence of uncontrolled hypertension are a large number of CVD events could be prevented (Wang, Vasan, 2005). The 2009-2010 U.S. National Health and Nutrition Examination Survey (NHANES) indicated a disproportionately high burden of undiagnosed and uncontrolled hypertension among U.S. minority groups (Yoon, Burt, Louis, Carroll (2012). The overall age-adjusted prevalence of hypertension among U.S. adults ≥18 years was 28.6% in 2009-2010 which increased to 29.1% in 2011-2012. Hypertension was slightly higher for men (30%) than
women (29%) and increased with age: the prevalence was 7% for 18-39 year olds, 32% for those 40-59 years, and 65% among those 60 years and older (Nwankwo, Yoon, Burt, and Gu, 2013). During 2011-2012, 83% of people were aware of their hypertension, and 76% were taking prescribed antihypertensive medication. Control was higher for women (55%), for people aged 40-59 years (58%), for whites (54%) and blacks (50%). Yet control rates for hypertension did not meet the Healthy People 2020 target goal of 61% (Nwankwo et al 2013).

Overall, treatment of hypertension remains inadequate world-wide despite well known diagnostic and treatment methods. Weber et al. estimated that less than half of hypertensive patients have an adequately controlled BP (2014). The increasing prevalence of hypertension occurs from three primary factors: increasing age of populations, increasing rates of obesity globally, and a high dietary intake of salt (Hossain, Kawar, El Nahas, 2007; Weber et al. 2014).

Hypertension in those with African ancestry often occurs at a younger age and is more severe than in whites. Key findings from the 2011-2012 NHANES reported an overall age-adjusted prevalence of hypertension compared by race/ethnicity. The U.S. prevalence was 25% in Asians, 26% in Hispanics, 28% in non-Hispanic white, and 42% in non-Hispanic black (Nwankwo et al. 2013). Black patients may be more sensitive to dietary salt, and if obese they may be more prone to stroke and hypertensive kidney disease. Initial BP control in the black hypertensive population, including those with diabetes, is recommended using a calcium channel blocker or thiazide-type diuretic rather than a beta blocker, an angiotension-converting enzyme inhibitor and/or an angiotensin receptor blocker (James et al. 2014; Weber et al. 2014). Forman et al. found blacks had significantly lower levels of circulating 25-hydroxyvitamin D. To evaluate the effect of vitamin D3 supplements on SBP, a randomized controlled trial found a significant decrease in SBP with each 1-ng/ml increase in 25-hydroxyvitamin D (2013).
Inadequate blood pressure control has substantial economic consequences in developed countries and may pose an even greater health burden for developing countries. Annual and 10-year health care costs from non-optimal BP control, the occurrence of ischemic events such as stroke or MI, and indirect welfare losses were estimated for all seven World Bank regions (Gaziano et al. 2009). In 2001, the global cost of treating non-optimal BP for people >30 years old was $370 billion US dollars, about 10% of the world’s overall healthcare expenditures. In Eastern Europe and Central Asia, the cost to treat high BP was 25% of all health expenses. Over 10 years, global spending for hypertension may cost nearly 1 trillion US dollars.

In a related study, Lawes et al. (2006) estimated the global burden of disease attributable to non-optimal SBP by age and sex in adults ≥30 years old, in deaths or disability-adjusted life years (DALYS). Approximately 67% of stroke and 50% of ischemic heart disease were attributable to non-optimal BP control. The global burden of disease from non-optimal BP accounted for 12.8% of deaths from cardiovascular events and 4.4% of the total DALYS.

**The Problem: Hypertension in Haitians.** Since the 1990’s greater attention has been given to the problem of hypertension in Haiti. In the first population-based study to estimate prevalence of diabetes and hypertension in Haiti, 1620 individuals from Port-au-Prince and its surrounding cities were selected in 2002 through a two-stage cluster sampling design (Jean-Baptiste, Larco, Charles-Larco, Vilgrain, Simon, and Charles, 2006). Prevalence of hypertension was 49% in men and 47% in women, but in adults ≥40 years, the rate increased to 69% in men and 67% in women. The age-adjusted prevalence of diabetes was 5% in men and 9% in women. Hypertension was shown to be a risk factor for pre-diabetes and glucose intolerance in women.

The following Haitian studies of hypertension were performed in rural clinics as part of medical mission visits. A study in 2000 (Lluberas, Parrish, Kling) reported a 45% hypertension
prevalence rate in women, and a 39% prevalence rate in men in a nurse practitioner clinic. From a 1998 medical team visit to a rural mountainous clinic, Niska (2006) determined prevalence of hypertension in adults compared to body weight. Though obesity is relatively rare in Haiti, hypertension was found in 39% of men and 46% of women; 30% of men and 12% of women were underweight, and no men and only 3% of women were overweight. Regression modeling showed age and weight were statistically significant in predicting BP, but other factors such as related chronic diseases, dietary salt intake and family history may have accounted for more of the variation in BP. In 2005 in the same clinic, Niska & Sloand (2010) found hypertension in 45% of Haitian adults 50 years or older, but only 17% in adults aged 15-49 years. The most common diagnoses reported by patients 15-49 years old were muscle/bone pain, *acide* or acid reflux, headache, anemia in women and intestinal parasites in men.

All studies reported at least a hypertension prevalence rate of 39% in Haitian men and 45% of women >50 years. All studies were conducted prior to the 2010 earthquake. Only limited research data are available since the earthquake occurred. Immediately after the earthquake, Roehm (2010), a cardiologist recommended a treatment plan for hypertension when laboratory tests were not available. He suggested cost-effective drug combinations and a hypertension treatment protocol. In a review paper, Kenerson 2014 identified three primary factors that contributed to the hypertension disease burden in Haiti: the stroke death rate in Haiti is the highest in the Caribbean; the Haitian dietary salt intake is 10 times greater than in the U.S. and people with African ancestry have a high incidence of sodium-sensitive hypertension; and the social determinants of disease are very high from the extreme poverty (75% live on < $2/day), health care inequity, and socio-ecological stress.
Studies of hypertension have been done in Haitians living in the U.S. Of 88 Haitian patients seen in a Miami clinic, 88% were hypertensive and only 26% were controlled. Target organ damage was evident in 48% including coronary artery disease (CAD), renal failure, stroke and heart failure (Preston, Materson, Yoham, and Anapol (1996)). Barriers to preventive care by Haitian immigrants in Miami included lack of insurance, a usual place of care, educational level, household income and citizenship (Saint-Jean, Crandall (2005)). The prevalence of stroke is one indication of severe hypertension. In a sample of 175 Haitian-born patients living in Miami and admitted for acute stroke, ischemic stroke was diagnosed in 72%. Hypertension prevalence and medication noncompliance were high (Koch, Pabon, Rabinstein et al. (2005)).

A few studies on hypertension have been conducted in other Caribbean countries. In the French Caribbean region, the prevalence of hypertension in men was 47% and 43% in women older than 50 years (Inamo, Lang, Atllah, et al. (2005)). Barbados had an age-adjusted prevalence of 55% (Hennis, Wu, Nemesure et al. 2002). A more recent study using the Jamaica Health and Lifestyle Survey found 25% of Jamaicans were hypertensive, 25% were obese, but 35% were prehypertensive (BP 120-139/ 80-89 mm Hg.) (Ferguson, Francis, Tulloch-Reid et al. (2011)).

**Objectives.** The objectives of the master’s paper are to describe the prevalence of hypertension in Haitian adults living in a small community near Port-au-Prince, Haiti, who presented themselves for treatment of multiple conditions at the Blanchard clinic. Most importantly, the severity and pattern of hypertension, and the relationship between blood pressure, age and gender will be explored using a series of carefully defined research questions. Blood pressure and demographic data from this retrospective, observational, cross-sectional pilot study will be used as clinical evidence to generate hypotheses for future public health prevention and disease management interventions and for proposal development. The feasibility of
conducting such a study within the Haitian health care infrastructure and the availability of research funds for chronic disease management in developing countries will be considered. Prevalence of hypertension as reported by age and gender in U.S. black and Haitian populations will be used as a benchmark to compare hypertension in this impoverished Haitian population who are survivors of the January 2010 earthquake in Port-au-Prince and local communities.

METHODS

**Study Sample, Design and Setting.** From October 8-11, 2012, approximately 2.75 years after the January 2010 earthquake, a total of 752 Haitians, 556 adults and 196 children, arrived before 8:00 am, usually with family members, at the Blanchard walk-in clinic. For this study, only the clinical data from this sample of adult patients aged 19-90 years will be used; they accounted for 74% of the clinic population. Each day the number of patients seen ranged from 112 to 172. Of the adults, 104 (18.7%) were men and 452 (81.3%) were women. Two women aged 19-39 years had missing BP data.

The study is a retrospective cross-sectional design using clinical data collected from a convenience sample of 556 Haitian adults (Aschengrau, Seage, 2003). Patients were seen by 6 physicians and 7 nurses from the U.S. during a 4-day volunteer medical mission in October, 2012. The trip was organized and conducted by Kathy Walmer, RN, MSN, CPNP, Executive Director of Family Health Ministries (FHM), a faith-based, non-governmental organization (NGO) in Durham, NC. The setting for the study was the Blanchard clinic located on the northwest side of Port-au-Prince, Haiti, and is available by car on paved and dirt roads. The small community of Blanchard is located near Cite Soleil which has a large church, clinic, and school. Blanchard clinic is an open-air, two-story permanent, cement brick structure that contains six patient examining rooms with sinks, an open patient sitting area, a secured storage area, and
bathroom. Examining and meeting rooms and an office with computer and internet capability are on the first floor. The clinic is staffed with 17 Haitian staff hired by FHM. The building survived the January 2010 earthquake with minimal damage. It was built by FHM and is part of a walled and locked compound that includes a private elementary school, a church, and a guest house.

**Research Questions.** Utilizing the self-selected sample of 556 Haitian adults aged 19-90 years old in a community urban clinic, the following research questions were explored:

1. Is there a difference in the distribution of increasing age by gender in Haitian adults?
2. What is the prevalence of hypertension (SBP ≥140 mm Hg. and/or DBP ≥90 mm Hg.) in this sample of Haitian adults?
3. Is there a positive linear relationship between increasing age and systolic BP (SBP) and diastolic BP (DBP) in this sample of Haitian adults?
4. Is there a positive relationship between three increasing age levels (young 19-39 years, middle 40-59 years, and older 60-90 years) and systolic hypertension (SHPT) and diastolic hypertension (DHPT)?
5. Is there a difference between prevalence of hypertension in men and women?
6. Is there a difference between prevalence of hypertension in men and women within increasing age categories?
   a. The difference in normal SBP and systolic hypertension between men and women across 3 age categories.
   b. The difference in normal DBP and diastolic hypertension between men and women across 3 age categories.
7. Is there a relationship between severity of hypertension [Stage 1 (BP 140-159/90-99), Stage 2 (BP 160-179/100-109), or Stage 3 (BP ≥180/≥110)] and increasing age across young, middle, and older Haitian adults?
   a. The relationship between 3 stages of systolic hypertension and 3 age categories.
   b. The relationship between 3 stages of diastolic hypertension and 3 age categories.
8. Is there a relationship across stages of hypertension severity between men and women?
9. Is there a relationship between patterns of hypertension (isolated systolic, isolated diastolic, or systolic/diastolic hypertension) and increasing age in men and women?
a. The relationship between 3 hypertension patterns and 3 age categories in men.

b. The relationship between 3 hypertension patterns and 3 age categories in women.

10. Is there an association between increasing age and systolic hypertension and diastolic hypertension accounting for gender?

**Variables.** For purposes of this pilot study the variables to be analyzed are:

**Dependent:** Systolic and diastolic blood pressure of adults aged 19-90 years.

Hypertension in adults is defined as a systolic blood pressure (SBP) $\geq 140 \text{ mm Hg.}$ and/or a diastolic blood pressure (DBP) $\geq 90 \text{ mm Hg.}$ (JNC 7, 2004).

**Pattern** is the type of hypertension: isolated systolic, isolated diastolic, or systolic and diastolic.

**Independent:** Age in numerical years and by three categories (young adults 19-39 years, middle-aged adults 40-59 years, and older adults 60-90 years old).

**Gender** (Male =0, Female =1).

**Demographic clinical symptoms:** the most frequent clinical symptoms reported by patients the day of their visit. They are discussed to identify treatment needs in a future research protocol.

**Definitions of Hypertension.** Blood pressure data will be analyzed using the definition of hypertension established by the 7th U.S. Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure Guidelines (JNC 7, 2004; Weber et al. 2013). Severity of hypertension will be categorized according to Stages 1, 2 and 3 as established in the JNC 6 (1997) report to enhance the sensitivity of comparing severity of hypertension. The 2003 WHO/ISH hypertension guidelines will be used to stratify risk for prognosis (Whitworth, 2003).

1. **Hypertension** is defined as a systolic blood pressure (SBP) $\geq 140 \text{ mm Hg.}$ and/or a diastolic blood pressure (DBP) $\geq 90 \text{ mm Hg.}$ (JNC 7, 2004).
2. **Isolated Systolic Hypertension** is a SBP $\geq 140 \text{ mm Hg}$ and a DBP $<90 \text{ mm Hg.}$ An increase in SBP, more than an increase in DBP, is a more important risk factor for CV and renal disease in people $>50$ years old (Chobanian, 2007).
3. *Isolated Diastolic Hypertension* is a DBP ≥90 mm Hg and a SBP <140 mm Hg (Alam, Barri, 2003).

4. *Pattern of hypertension* includes three types: isolated systolic hypertension, isolated diastolic hypertension, or an elevation of both systolic and diastolic blood pressure.

5. *Prevalence of hypertension* in this study is the number of people with an elevated SBP or DBP/ 554 (total sample of Haitian adults in the sample with BP values).

6. *Pulse pressure* is the difference of SBP minus DBP (Alam, Barri 2003).

7. *Stages of Hypertension*:
   - Stage 1 is defined as SBP 140-159 / DBP 90-99 (JNC 7, 2004).
   - Stage 2 is defined as SBP 160-179 /DBP 100-109 (JNC 6, 1998).
   - Stage 3 is defined as SBP ≥180 / DBP ≥110 (JNC 6, 1998). Stages 2-3 are combined in JNC 7.

**Data Collection and Research Ethics.** Patients arrived by foot or motorized vehicle and sat in line on benches in order of their arrival. They carried a single sheet of paper for health care providers to record clinical data as they progressed through the clinic. Demographic information, including patient ID, date, name, age, and gender was recorded by Haitian staff who could translate into English. Vital signs: blood pressure, heart rate, temperature, and weight in children were assessed and recorded by nurses. Patients’ clinical complaints were written by triage volunteers with the help of Haitian translators. From triage, patients were taken to general medicine practitioners or specialists in pediatrics, infectious disease or OB-GYN depending on their age and medical complaints. With the help of translators, a brief medical history was taken, a physical exam performed, and lab work, treatment and medication prescriptions were ordered by physicians on each patient sheet and taken to nurses in the pharmacy and treatment area. The clinic has no permanent medical records or contact information for drop-in patients. Patient data sheets from the trip will be destroyed after the study is completed. Application for human subjects review is in progress and should be expedited. De-identified data were retrieved by the PI from each clinical sheet excluding patient name, for the purposes of this study. No other
identifying information was available including relatives or address. A non-identifying patient ID was generated to identify subjects, and vital signs, patient symptoms, medical diagnoses and impressions, laboratory data, and medical orders for treatment were entered into Excel.

**Statistical Procedures.** Descriptive data analyses of variables and their relationships included frequencies and crosstabs with the use of Pearson Chi Square for significance tests (Aschengrau, Sesage, 2003). A Logistic Regression was performed using SPSS statistical software version 22 (SPSS 2013). Statistical consultation was obtained from the University of North Carolina Odum Institute. Assessment of indications for hypertension management need to be based on multiple factors: blood pressure levels, other cardiovascular risk factors, target organ damage and associated clinical conditions (Whitworth, 2003).

**RESULTS**

The results are organized according to the ten research questions listed in the methods section.

**R.Q. 1.** Is there a difference in the distribution of increasing age by gender in Haitian adults? Table 1 depicts the distribution of men and women according to age by decade. The 104 men accounted for 18.75% of the sample, and the 452 women accounted for 81.3% of this convenience sample of adults in a walk-in medical clinic. Both men and women were present in each of the seven decades; the number of people and percentages for each decade are indicated according to gender. The largest percent of men were in the 19-29 year old decade, and the largest percent of women were in the 40-49 year decade. The second most numerous decades were reversed for men and women. There was no significant difference (P = 0.361) in the distribution of men and women by age in decades.

The bottom portion of the table depicts the distribution of men and women in three age categories. To better understand the clinical implications of age, blood pressure was compared by 3 age levels corresponding to 3 life stages used in the U.S. NHANES Survey (Yoon, 2012):
young adults (18-39), middle-aged adults (40-59), and older adults (60 yrs and older). When age categories were compared by gender, no significant difference \((P=0.206)\) was found between the distribution of men and women across the increasing age categories.

### Table 1. Age of Adult Male and Female Subjects by Decade and Age Categories.

<table>
<thead>
<tr>
<th>Age by Decades</th>
<th>Total</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%) / total</td>
<td>N (%) / decade</td>
<td>N (%) / decade</td>
</tr>
<tr>
<td>19-29 yrs</td>
<td>127 (22.8)</td>
<td>25 (24.0)</td>
<td>102 (22.6)</td>
</tr>
<tr>
<td>30-39 yrs</td>
<td>96 (17.3)</td>
<td>14 (13.5)</td>
<td>82 (18.1)</td>
</tr>
<tr>
<td>40-49 yrs</td>
<td>147 (26.4)</td>
<td>23 (22.1)</td>
<td>124 (27.4)</td>
</tr>
<tr>
<td>50-59 yrs</td>
<td>100 (18.0)</td>
<td>20 (19.2)</td>
<td>80 (17.7)</td>
</tr>
<tr>
<td>60-69 yrs</td>
<td>50 (9.0)</td>
<td>13 (12.5)</td>
<td>37 (8.2)</td>
</tr>
<tr>
<td>70-79 yrs</td>
<td>22 (4.0)</td>
<td>7 (6.7)</td>
<td>15 (3.3)</td>
</tr>
<tr>
<td>80-90 yrs</td>
<td>14 (2.5)</td>
<td>2 (1.9)</td>
<td>12 (2.7)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>556 (100.0)</strong></td>
<td><strong>104 (18.7)</strong></td>
<td><strong>452 (81.3)</strong></td>
</tr>
</tbody>
</table>

Chi Sq= 6.585 \(P= 0.361\)

*Age categories are the same as used in the U.S. NHANES survey (Yoon, 2012).

**R.Q. 2.** What is the prevalence of hypertension (SBP >140 mm Hg. and/or DBP >90 mm Hg.) in 556 Haitian adults aged 19-90 years old in a community clinic in Port-au-Prince, Haiti?

The total sample consisted of 556 Haitian adults, but BP data were missing for two women aged 19-39 years old, thus the total sample size for comparisons of BP was 554 adults.

The number of women was 450, and the number of men was 104. As presented in Table 2, 254 adults were hypertensive: 300 (54.2%) had normal BP, 43 (7.8%) had systolic hypertension (SHPT), 52 (9.4%) had diastolic hypertension (DHPT), and 159 (28.7%) had both systolic and diastolic hypertension. The prevalence of hypertension in this sample of Haitian adults was 46%.
Table 2. Prevalence of Hypertension in 554 Haitian Adults.

<table>
<thead>
<tr>
<th></th>
<th>Normal SBP N(%)</th>
<th>Systolic HPT N (%)</th>
<th>Total HPT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBP 85-139</td>
<td>SBP 140-250</td>
<td></td>
</tr>
<tr>
<td>Normal DBP 49-89</td>
<td>300 (54.2)</td>
<td>43 (7.8)</td>
<td>43</td>
</tr>
<tr>
<td>Diastolic HPT 90-133</td>
<td>52 (9.4)</td>
<td>159 (28.7)</td>
<td>211</td>
</tr>
</tbody>
</table>

Note: (%) = percentage for each cell.

R.Q.3. Is there a positive linear relationship between increasing age and systolic BP (SBP) and diastolic BP (DBP) in this sample of Haitian adults?

There was a significant, positive linear relationship between increasing age and SBP, \( r=0.492, P<0.001 \), and increasing age and DBP, \( r=0.327, P<0.001 \). As expected, the relationship between SBP and DBP is highly significant, \( r=0.809, P<0.001 \).

R.Q.4. Is there a positive relationship between increasing age categories (young 19-39, middle 40-59, and older 60-90 years) and systolic (SHPT) and diastolic hypertension (DHPT)?

Table 3 depicts the comparison between normal SBP and SHPT and between normal DBP and DHPT in 554 Haitian adults across three age categories.

Table 3. Prevalence of systolic hypertension and diastolic hypertension across increasing age categories.

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Normal SBP N (%)</th>
<th>Systolic HPT N (%)</th>
<th>Subtotal N (%)</th>
<th>Chi Sq P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-39 years</td>
<td>188 (85.1)</td>
<td>33 (14.9)</td>
<td>221 (39.9)</td>
<td>98.91</td>
</tr>
<tr>
<td>40-59 years</td>
<td>141 (57.1)</td>
<td>106 (42.9)</td>
<td>247 (44.6)</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>60-90 years</td>
<td>23 (26.7)</td>
<td>63 (73.3)</td>
<td>86 (15.5)</td>
<td></td>
</tr>
<tr>
<td>Subtotals</td>
<td>352 (63.5)</td>
<td>202 (36.5)</td>
<td>554 (100.)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age categories</th>
<th>Normal DBP N (%)</th>
<th>Diastolic HPT N (%)</th>
<th>%/Total</th>
<th>Chi Sq P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-39 years</td>
<td>173 (78.3)</td>
<td>48 (21.7)</td>
<td>221</td>
<td>47.04</td>
</tr>
<tr>
<td>40-59 years</td>
<td>135 (54.7)</td>
<td>112 (45.3)</td>
<td>247</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>60-90 years</td>
<td>35 (40.7)</td>
<td>51 (59.3)</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Subtotals</td>
<td>343 (61.9)</td>
<td>211 (38.1)</td>
<td>554 (100.)</td>
<td></td>
</tr>
</tbody>
</table>

There was a significant relationship between increasing age categories and SHPT, (Table 3, \( P<0.001 \), and DHPT, \( P<0.001 \)). Prevalence of systolic and diastolic hypertension increased in frequency across the three age categories. For those aged 19-39 years, prevalence of SHPT was
14.9% and DHPT was 21.7%; for those aged 40-59 years, SHPT was 42.9% and DHPT was 45.3%; and for those aged 60-90 years, SHPT was 73.3% and DHPT was 59.3%. In this sample, prevalence of diastolic hypertension was greater than systolic hypertension in young adults and only slightly greater in middle-aged adults. Systolic hypertension was greater in older adults.

R.Q.5. Is there a difference between prevalence of hypertension in men and women?

Table 4. Prevalence of systolic and diastolic hypertension in men and women.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Normal SBP (%)</th>
<th>SHPT (%)</th>
<th>Totals</th>
<th>Chi Square</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>55 (52.9)</td>
<td>49 (47.1)</td>
<td>104</td>
<td>6.27</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>297 (66.0)</td>
<td>153 (34.0)</td>
<td>450</td>
<td>P = 0.01</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>352 (63.5)</td>
<td>202 (35.5)</td>
<td>554</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Normal DBP (%)</th>
<th>DHPT (%)</th>
<th>Totals</th>
<th>Chi Square</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>58 (55.8)</td>
<td>46 (44.2)</td>
<td>104</td>
<td>2.05</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>285 (63.3)</td>
<td>165 (36.7)</td>
<td>450</td>
<td>P = 0.15</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>343 (61.9)</td>
<td>211 (38.1)</td>
<td>554</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There were statistically significant differences in systolic hypertension (Table 4, P=0.01) between men and women. The rate of SHPT for men was 47% as compared to 34% for women. Thus approximately 13% more men than women had abnormal SBP. This difference may be partly reflected in the clinical reasons for men and women attending the clinic. Many young women in this sample came to the clinic for treatment of acute infections related to gynecologic problems. There were no statistically significant differences in prevalence of DHPT between men and women (P = 0.15). However, men continued to have a greater prevalence of DHPT (44%), as compared to women (37%).

R.Q.6. Is there a difference between prevalence of hypertension in men and women within increasing age categories?
To better understand these gender differences and prevalence of hypertension, the rate of systolic hypertension (SHPT) and diastolic hypertension (DHPT) between men and women were compared across increasing age. The results are presented in Tables 5 and 6 respectively.

Table 5. Difference in systolic hypertension between men and women within increasing age categories.

<table>
<thead>
<tr>
<th>Age</th>
<th>Men SBP &lt;140</th>
<th>SHPT</th>
<th>Total</th>
<th>Men N/Age</th>
<th>%*</th>
<th>Women SBP &lt;140</th>
<th>SHPT</th>
<th>Total</th>
<th>Women N/Age</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-39</td>
<td>26 (47.3)</td>
<td>13 (26.5)</td>
<td>39</td>
<td>33.3</td>
<td>19-39</td>
<td>162 (54.5)</td>
<td>20 (13.1)</td>
<td>182</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>40-59</td>
<td>25 (45.5)</td>
<td>18 (36.7)</td>
<td>43</td>
<td>41.9</td>
<td>40-59</td>
<td>116 (39.1)</td>
<td>88 (57.5)</td>
<td>204</td>
<td>43.1</td>
<td></td>
</tr>
<tr>
<td>60-90</td>
<td>4 (7.3)</td>
<td>18 (36.7)</td>
<td>22</td>
<td>81.8</td>
<td>60-90</td>
<td>19 (6.4)</td>
<td>45 (29.4)</td>
<td>64</td>
<td>70.3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>55 (52.9)</td>
<td>49 (47.1)</td>
<td>104</td>
<td></td>
<td></td>
<td>297 (66.0)</td>
<td>153 (34.0)</td>
<td>450</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pearson Chi Sq. = 14.083, p = 0.001. Pearson Chi Sq. = 88.143, P<0.001.

*Indicates % in each age group with hypertension

In Table 5, the overall prevalence of SHPT was 47% in the 104 men who attended the clinic. The rate increased progressively by age categories and was statistically significant (P = 0.001).

SHPT occurred in 33% of young men, in 42% in middle-aged men, and in 82% of older men. The prevalence rate of SHPT in the 450 women was 34.0%. The rate increased progressively by age categories and was statistically significant (P <0.001). SHPT occurred in 11.0% of young women, in 43% of middle-aged women, and in 70% in older women. Young men (33%) had three times the prevalence rate of SHPT as compared to young women (11%) in this sample.

Table 6. Difference in diastolic hypertension between men and women within increasing age categories.

<table>
<thead>
<tr>
<th>Age</th>
<th>Nor DBP</th>
<th>DHPT</th>
<th>Total</th>
<th>N/Age</th>
<th>%*</th>
<th>Norm DBP</th>
<th>DHPT</th>
<th>Total</th>
<th>N/Age</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>30 (51.7)</td>
<td>9 (19.6)</td>
<td>39</td>
<td>23.1</td>
<td>19-39</td>
<td>143 (50.2)</td>
<td>39 (23.6)</td>
<td>182</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td>40-59</td>
<td>23 (39.7)</td>
<td>20 (43.5)</td>
<td>43</td>
<td>46.5</td>
<td>40-59</td>
<td>112 (39.3)</td>
<td>92 (55.8)</td>
<td>204</td>
<td>45.1</td>
<td></td>
</tr>
<tr>
<td>60-90</td>
<td>5 (8.6)</td>
<td>17 (37.0)</td>
<td>22</td>
<td>77.3</td>
<td>60-90</td>
<td>30 (10.5)</td>
<td>34 (20.6)</td>
<td>64</td>
<td>53.1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>58 (55.8)</td>
<td>46 (44.2)</td>
<td>104</td>
<td></td>
<td></td>
<td>285 (63.3)</td>
<td>165 (36.7)</td>
<td>450</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pearson Chi Sq. =16.903, P<0.001. Pearson Chi Sq. =31.908, P<0.001.

*Indicates % in each age group with hypertension
In Table 6 the prevalence rate of DHPT in the 104 men who attended the clinic was 44%. The rate increased progressively by age categories and was statistically significant (P< 0.001): 23.1% occurred in young men, 46.5% in middle-aged men, and 77.3% occurred in men 60-90 years old. The prevalence rate of DHPT in the 450 women who attended the clinic was 37%. The rate increased progressively by age categories and was statistically significant (P<0.001): 21.4% occurred in young women, 45.1% in middle-aged women, and 53.1% occurred in women aged 60-90 years old. There was little difference in the prevalence rate of DHPT between young men and women (23.1% vs. 21.4% respectively) or in the rate between middle-aged men and women (46.5 vs. 45.1% respectively). However, both the middle-aged men and women had higher rates of DHPT than they did for SHPT. Both men and women aged 60-90 years had higher rates of SHPT than they did for DHPT. But the prevalence rate of DHPT for older men (77.3%) was 24.2% greater than the rate for women (53.1%).

**R.Q.7.** Is there a relationship between severity of hypertension [Stage 1 (BP 140-159/90-99), Stage 2 (BP 160-179/100-109), or Stage 3 (BP ≥180/≥110)] and increasing age across young, middle-aged, and older Haitian adults?

Table 7 depicts the relationship between three stages of systolic hypertension, and Table 8 depicts the relationship between three stages of diastolic hypertension, both across three age categories. The JNC 6 (1997) classification of hypertension severity in three stages was used to gain specificity in estimating severity in an unknown population in a developing country.

**Table 7. The relationship between systolic hypertension in three stages of severity (JNC 6) across increasing age categories.**

<table>
<thead>
<tr>
<th>Severity SHPT in 3 stages</th>
<th>Age 19-39 yr %/ N = 221</th>
<th>Age 40-59 yr %/ N = 247</th>
<th>Age 60-90 yr %/ N = 86</th>
<th>Chi Square</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (85-139)</td>
<td>188/221 (85.1)</td>
<td>141/247 (57.1)</td>
<td>23/86 (26.7)</td>
<td>131.51</td>
<td></td>
</tr>
<tr>
<td>St 1 (140-159)</td>
<td>26 (11.8)</td>
<td>71 (28.7)</td>
<td>23 (26.7)</td>
<td>P&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>St 2 (160-179)</td>
<td>4 (1.8)</td>
<td>19 (7.7)</td>
<td>22 (25.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St 3 (180-250)</td>
<td>3 (1.4)</td>
<td>16 (6.5)</td>
<td>18 (20.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHPT/Age cat</td>
<td>33 (14.9)</td>
<td>106 (42.9)</td>
<td>63 (73.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8. The relationship between diastolic hypertension in three stages of severity (JNC 6) across increasing age categories.

<table>
<thead>
<tr>
<th>Severity DHPT in 3 stages*</th>
<th>Age 19-39 yr %/N = 221</th>
<th>Age 40-59 yr %/N = 247</th>
<th>Age 60-90 yr %/N = 86</th>
<th>Chi Square</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (49-89)</td>
<td>173 (78.3)</td>
<td>135 (54.7)</td>
<td>35 (40.7)</td>
<td>50.35</td>
<td></td>
</tr>
<tr>
<td>St 1 (90-99)</td>
<td>27 (12.2)</td>
<td>64 (25.9)</td>
<td>23 (26.7)</td>
<td>P&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>St 2 (100-109)</td>
<td>13 (5.9)</td>
<td>29 (11.7)</td>
<td>16 (18.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St 3 (110-133)</td>
<td>8 (3.6)</td>
<td>19 (7.7)</td>
<td>12 (14.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DHPT/ Age cat</td>
<td>48 (21.7)</td>
<td>112 (45.3)</td>
<td>51 (59.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The prevalence rate of three stages of hypertension severity increased progressively across three age categories in Haitian adults. In systolic hypertension the rates of severity increased by age: Stage 1 (from 11.8% to 28.7%), Stage 2 (from 1.8% to 25.6%), and Stage 3 (from 1.4% to 20.9%). The relationships were statistically significant (P<0.0001). For diastolic hypertension the rates of severity also increased by age: Stage 1 (from 12.2 to 26.7%), Stage 2 (from 5.9 to 18.6%), and Stage 3 (from 3.6 to 14.0). The relationships were statistically significant (P<0.001). Both Tables 7 and 8 confirm the age patterns noted earlier in Table 3, with increasing level of hypertension in older age categories.

R.Q.8. Is there a relationship across stages of hypertension severity between men and women?

Table 9 depicts the relationship across three stages of systolic and diastolic hypertension severity between men and women. Since the cell sizes for stages 2 and 3 were small, they were also combined into one stage 2, as designated in JNC 7, and compared between men and women.

Table 9. Prevalance of stages of systolic and diastolic hypertension severity between men and women.

<table>
<thead>
<tr>
<th>Stages SHPT</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>Chi Square</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (85-139)</td>
<td>55/104 (52.9)</td>
<td>297 (66.0)</td>
<td>352/554 (63.5)</td>
<td>6.49, P= 0.09</td>
<td></td>
</tr>
<tr>
<td>St 1 (140-159)</td>
<td>30 (28.8)</td>
<td>90 (20.0)</td>
<td>120 (21.7)</td>
<td>(3 stages SHPT)</td>
<td></td>
</tr>
<tr>
<td>St 2 (160-179)</td>
<td>11 (10.6)</td>
<td>34 (7.6)</td>
<td>45 (8.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St 3 (180-250)</td>
<td>8 (7.7)</td>
<td>29 (6.4)</td>
<td>37 (6.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St2 + St 3* *JNC7 standard</td>
<td>19 (18.3)</td>
<td>63 (14.0)</td>
<td>82 (14.8)</td>
<td>6.38, P=0.041</td>
<td></td>
</tr>
<tr>
<td>Stages DHPT</td>
<td>Men</td>
<td>Women</td>
<td>Total</td>
<td>Chi Sq, P value</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>Normal (49-89)</td>
<td>58 (55.8)</td>
<td>285 (63.3)</td>
<td>343 (61.9)</td>
<td>3.45, P= 0.33</td>
<td></td>
</tr>
<tr>
<td>St 1 (90-99)</td>
<td>28 (20.6)</td>
<td>86 (19.1)</td>
<td>114 (20.6)</td>
<td>(3 stages DHPT)</td>
<td></td>
</tr>
<tr>
<td>St 2 (100-109)</td>
<td>10 (9.6)</td>
<td>48 (10.7)</td>
<td>58 (10.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St 3 (110-133)</td>
<td>8 (7.7)</td>
<td>31 (6.9)</td>
<td>39 (7.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>St 2 + St 3**</td>
<td>18 (17.3)</td>
<td>79 (17.6)</td>
<td>97 (17.5)</td>
<td><strong>3.29, P= 0.193</strong></td>
<td></td>
</tr>
<tr>
<td>DHPT/ Gender</td>
<td>46 (44.2)</td>
<td>165 (36.7)</td>
<td>211 (38.1)</td>
<td>(2 stages DHPT)</td>
<td></td>
</tr>
</tbody>
</table>

At each of the three stages of SHPT, a greater prevalence of men had SHPT than women. However, the differences in three stages of SHPT between men and women were not significant, (Table 9, P= 0.09). When stages 2 and 3 were combined with 19 men and 63 women in a new stage 2 (JNC 7 2004), there was a significant difference in stages 1 and 2 between men and women (P=0.041). At DHPT Stages 1 and 3, a greater prevalence of men had DHPT than women, and at Stage 2 a greater prevalence of women had DHPT. The small differences in three stages of DHPT were not statistically significant (P=0.33); nor were the differences statistically significant in two stages of DHPT (P=0.19) between men and women. These patterns with gender are similar to those noted in Table 4.

**R.Q.9.** Is there a relationship between patterns of hypertension (isolated systolic, isolated diastolic, or systolic/diastolic hypertension) with increasing age in men and women?

In Figure 1, the histogram depicts the percentage of patients with normal BP or one of the three patterns of isolated systolic, isolated diastolic or systolic-diastolic hypertension in the total sample and across three age groups. In young adults, 75% had normal BP, 10% had DHPT and 11% had S-D HPT. For the middle-aged, 47% had normal BP, 10% had DHPT, but 36% had S-DHPT. In older adults, 21% had normal BP, 20% had SHPT, only 6% had DHPT, and 54% had S-D HPT. Across increasing age, prevalence of normal BP decreased 72%, prevalence of SHPT increased from 4%-20%, and prevalence of DHPT decreased 40%. But the greatest prevalence occurred in those with S-D HPT that increased progressively with age (from 11% to 54%).
Table 10. The relationship between patterns of hypertension across 3 age categories in MEN.

<table>
<thead>
<tr>
<th>Age cats</th>
<th>Normal BP</th>
<th>SHPT</th>
<th>DHPT</th>
<th>S-D HPT</th>
<th>Total HPT/Total age (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-39 yrs</td>
<td>23 (59.9)</td>
<td>7 (18.0)</td>
<td>3 (7.7)</td>
<td>6 (16.7)</td>
<td>16/39 (41.0)</td>
</tr>
<tr>
<td>40-59 yrs</td>
<td>22 (51.2)</td>
<td>1 (2.3)</td>
<td>3 (7.0)</td>
<td>17 (39.5)</td>
<td>21/43 (48.9)</td>
</tr>
<tr>
<td>60-90 yrs</td>
<td>3 (13.6)</td>
<td>2 (9.1)</td>
<td>1 (4.5)</td>
<td>16 (72.7)</td>
<td>19/22 (83.4)</td>
</tr>
<tr>
<td>Total</td>
<td>48 (46.2)</td>
<td>10 (9.6)</td>
<td>7 (6.7)</td>
<td>39 (37.5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 11. The relationship between patterns of hypertension across 3 age categories in WOMEN.

<table>
<thead>
<tr>
<th>Age cats</th>
<th>Normal BP</th>
<th>SHPT</th>
<th>DHPT</th>
<th>S-D HPT</th>
<th>Total HPT/Total age (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-39 yrs</td>
<td>142 (78.0)</td>
<td>1 (0.6)</td>
<td>20 (11.0)</td>
<td>19 (10.4)</td>
<td>40/182 (22.0)</td>
</tr>
<tr>
<td>40-59 yrs</td>
<td>95 (46.6)</td>
<td>17 (8.3)</td>
<td>21 (10.3)</td>
<td>71 (34.8)</td>
<td>109/204 (53.4)</td>
</tr>
<tr>
<td>60-90 yrs</td>
<td>15 (23.4)</td>
<td>15 (23.4)</td>
<td>4 (6.3)</td>
<td>30 (46.9)</td>
<td>49/64 (76.6)</td>
</tr>
<tr>
<td>Total</td>
<td>252 (56.0)</td>
<td>33 (7.3)</td>
<td>45 (10.0)</td>
<td>120 (26.7)</td>
<td></td>
</tr>
</tbody>
</table>
Table 10 and Table 11 report the relationship between normal blood pressure and the three patterns of hypertension across increasing age for men and women. With men comprising 19% of the sample and women 81% of the sample, the frequency of each pattern of hypertension by gender across the 3 age categories varied considerably. As age increased, the rate of normal BP decreased as was expected. In the younger age group, approximately 60% of men had a normal BP compared to 78% of women. Eighteen percent of young men but only one woman had SHPT, and 17% of men had S-D HPT compared to 10% of women. Yet 11% of young women had DHPT. Within the middle-aged, 8-10% of women and only 2-7% of men had isolated SHPT or DHPT, but 35% of women and 40% of men had S-D HPT. Within the older age group, 23% of women had either normal BP or isolated SHPT, and 47% had S-D HPT. The majority of men, approximately 73%, had S-D HPT, and 13.6% had normal BP.

**R.Q.10.** Is there an association between increasing age and SHPT and DHPT accounting for gender?

A logistic regression was performed as a confirmatory analysis controlling for gender and age in the same model for the dichotomous outcome variables of systolic blood pressure: normal vs. systolic hypertension, and diastolic blood pressure: normal vs. diastolic hypertension. The independent variables were age as a continuous variable and gender as a nominal variable: male and female. Table 12 reports the results of the logistic regression for the association between increasing age on systolic hypertension accounting for gender.

**Table 12. Logistic Regression for effect of increasing age on systolic hypertension accounting for gender.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-0.546</td>
<td>0.248</td>
<td>4.830</td>
<td>1</td>
<td>0.028</td>
<td>0.579</td>
</tr>
<tr>
<td>Age</td>
<td>0.069</td>
<td>0.007</td>
<td>85.232</td>
<td>1</td>
<td>0.000</td>
<td>1.071</td>
</tr>
<tr>
<td>Constant</td>
<td>-3.218</td>
<td>0.404</td>
<td>63.465</td>
<td>1</td>
<td>0.000</td>
<td>0.040</td>
</tr>
</tbody>
</table>
The logistic regression confirms that the previously observed statistically significant association of age and systolic hypertension (P=0.000), remains after controlling for gender. It also confirms a significant gender effect (i.e., a significant difference between males and females) (P=0.028) after controlling for age. As previously noted these findings are due to a higher prevalence of systolic hypertension in older women and higher systolic-diastolic hypertension among middle-aged and older men and women in this sample.

Table 13 reports the results of the logistic regression for the association between increasing age on diastolic hypertension accounting for gender.

**Table 13. Logistic Regression for effect of increasing age on diastolic hypertension accounting for gender.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-0.268</td>
<td>0.233</td>
<td>1.332</td>
<td>1</td>
<td>0.248</td>
<td>0.765</td>
</tr>
<tr>
<td>Age</td>
<td>0.043</td>
<td>0.006</td>
<td>46.518</td>
<td>1</td>
<td>0.000</td>
<td>1.044</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.185</td>
<td>0.356</td>
<td>37.591</td>
<td>1</td>
<td>0.000</td>
<td>0.113</td>
</tr>
</tbody>
</table>

Table 13 confirms that the previously observed statistically significant association of age and diastolic hypertension (P=0.000) remains after controlling for gender. This is due to the higher prevalence of diastolic hypertension among young (11%) and middle-aged (10%) women but less in men. It also confirms the previously noted finding there was no significant gender effect for diastolic hypertension (i.e., no significant difference between males and females) (P=0.248).

Although not analyzed statistically in this study, a wide range of clinical symptoms were also observed in the study sample. These are listed in the appendix of this paper and must be considered when planning any future research or treatment strategies.

**DISCUSSION**

In reviewing this study it is important to state again that the results are based on a non-random “convenience sample” of patients who presented themselves at the Blanchard clinic.
located on the northwest side of Port-au-Prince, Haiti; these patients were seen for a variety of medical conditions, not directly related to the primary conditions that are discussed here, namely, systolic and diastolic hypertension. As such these data may have limited internal validity (for testing hypotheses listed here) and also limited external validity (generalizability to the overall Haitian population). However the availability of these data can be thought of as a “natural experiment” or a pilot study to answer some important health questions about the local population who are seen at the Blanchard clinic and most important as a way to generate hypotheses and future research and treatment strategies for patients served by this clinic.

In this convenience sample of 556 Haitian adults who came to an urban walk-in clinic, the distribution of 104 men and 452 women by age groups was similar. The prevalence of hypertension in this sample was 46%, and approximately the same rate as found in other Haitian studies of hypertension. Niska & Sloand (2010) found hypertension in 45% of Haitian adults 50 years or older living in a rural mountain region. Jean-Baptiste et al. (2006) found a prevalence rate of hypertension in 49% of men and 47% of women living in Port-au-Prince. Kenerson estimated prevalence of hypertension in Haiti may approach 45% (2014). An approximate comparison can be made with hypertension reported in blacks living in the U.S. In the 2011-2012 U.S. NHANES report, the prevalence of hypertension in non-Hispanic black adults living in the U.S. was 42% (Nwankwo et al. 2013). The prevalence rate in the current sample was only 4% greater. Differences between socio-economic and disease related factors that affect hypertension between U.S. blacks and Haitian were unknown. The sample size in the pilot study was much smaller, non random and restricted to one metropolitan area.

The positive linear relationship between increasing age and systolic blood pressure and diastolic blood pressure was highly significant as expected. This finding was supported by other
Haitian studies. In a random stratified sample, Jean-Baptiste et al. (2006) found prevalence of hypertension increased to 69% for men and 67% for women in adults ≥ 40 years old. In a rural clinic, Niska & Sloand (2010) found in adults aged 50 years old or older, 52% of women and 37% of men were hypertensive. When the variable age was divided into young, middle-aged and older adults, the relationship with prevalence of systolic and diastolic hypertension remained highly significant. Age is a primary risk factor for both systolic and diastolic hypertension. Further study is needed to understand factors contributing to a greater prevalence of diastolic hypertension found in this sample of young and middle-aged adults. Systolic hypertension was greater in older adults as expected. The trend reported in the 2011-2012 U.S. NHANES (2013) was similar: hypertension prevalence increased progressively with age, from 7.3% in young adults, 32.4% in middle-aged, to 65.0% in older adults (Nwankwo et al. 2013).

When compared between men and women, prevalence of systolic hypertension was 47% in men, 13% greater than in women. This difference may reflect a selection bias in the sample: an unequal distribution of men and women, and clinical reasons for men and women attending the clinic. Young women frequently came to the clinic for treatment of acute infections related to gynecologic problems. Men also had greater prevalence of diastolic hypertension than women, potentially indicating more chronic disease in this sample. Prevalence of hypertension in the U.S. sample was slightly higher in men (29.7%) than women (28.5%) (Nwankwo et al. 2013).

When prevalence of hypertension was compared across both increasing age and gender, progressively higher prevalence of hypertension occurred in both men and women, but the pattern varied. Young and older men had greater prevalence of systolic and diastolic hypertension. But both middle-aged men and women had greater prevalence of diastolic hypertension; this trend was reversed for older men and women.
The severity of hypertension increased progressively with increasing age. For systolic hypertension, the greatest prevalence occurred in Stage 1 with middle-aged adults. For older adults, prevalence rates were 21-27% across all three stages of severity. The highest prevalence rate for diastolic hypertension occurred in Stage 1 for middle-aged and older adults. The prevalence rates of diastolic hypertension increased across increasing age but were lower. When hypertension severity was compared by gender, differences were unremarkable in this sample.

The pattern of hypertension is important in guiding treatment. Diastolic hypertension is more common at younger ages <50 years, whereas systolic hypertension increases progressively with age as diastolic blood pressure tends to fall (Chobanian (2007)). This widens pulse pressure which also increases risk. Isolated systolic hypertension has been a better predictor of CV risk, and treatment of both systolic and systolic-diastolic hypertension has reduced adverse CV events (Strandberg & Pitkala, 2003).

**Recommendations for future study.** Based on this pilot data, it is recommended that a larger study of hypertension risk assessment of Haitian adults be carried out in the metropolitan area surrounding the Blanchard clinic. Ideally this study would make use of a randomized, stratified sample to identify groups with the highest risk for a hypertension intervention, including those with related clinical symptoms and metabolic or cardiovascular diseases. It can also be used to better establish long term treatment needs for the local population served by the Blanchard clinic. Lastly this assessment is needed to develop a public health prevention and intervention program to manage hypertension in a poor developing country such as Haiti.

Findings from the current study indicate that high risk target groups for this future research study in Haiti may include the following: 1) young adult women with diastolic hypertension; 2) the population of middle-aged men and women who work and have a very high
total dependency ratio of 65% (58% from children and youth and 7% from older adults) with a potential support ratio of only 13.4% (Haiti Demographic Profile, 2013); and 3) men and women 60 years of age and older. The need for this study is also supported by earlier studies of hypertension in Haiti. For example, Lawes et al (2006) had similar findings; 67% of the attributable burden of disease from hypertension occurred among the middle aged (45-69 years) of developing countries.

An initial step to determine patient clinical needs and identify the research population would be to establish a triage system to assess and treat high-risk groups. Standardized clinical assessment is essential. This includes using a blood pressure and vital signs protocol over several weeks; height and weight; laboratory assessment of serum lipids, fasting glucose, hemoglobin, BUN, creatinine, and Vitamin D, urinalysis and EKG; and a review of systems for clinical symptoms. The WHO guidelines for assessment and management of cardiovascular risk (2007) and the WHO/ISH cardiovascular risk prediction charts (2007) give an estimate of the potential CV risk for Haitian. In those who smoke and have Diabetes Mellitus, the 10-year risk of a fatal or non-fatal CV event increases to ≥40% by age 70 years. Initial BP control in a hypertensive black population, including those with diabetes, is recommended using a calcium channel blocker or thiazide-type diuretic rather than a beta blocker, or an angiotension-converting enzyme inhibitor and/or an angiotensin receptor blocker (James et al. 2014; Weber et al. 2014).

To plan appropriate prevention and intervention strategies, the assessment must include a detailed appraisal of demographic and socio-ecological factors that might contribute to the burden of hypertension in Haiti. Some of these factors would include a determination of African ancestry, ethnicity and if possible a genetic history; an assessment of living conditions including the presence of safe housing, clean water and sanitation, and a secure food source. Socio-
economic factors include educational level, language and reading proficiency, work and income, religion, family system, social support, and access to health care and transportation.

The Haitian diet contains a high concentration of salt and is often low in potassium foods such as protein, fruits and vegetables. The high salt diet is a contributing factor to hypertension. Dietary intake is based on income, cultural preferences, the need for a food preservative, and salt as a local industry (Kenerson, 2014). Dietary potassium inhibits salt-sensitivity and can be used as a non-pharmacologic intervention (Rodrigues et al. (2014). Conducting a dietary assessment to identify primary factors contributing to the high dietary salt intake and replacing it with foods containing high potassium such as mangoes and plantains would be a culturally sensitive public health intervention. To address an increasing problem with world-wide hypertension in developing countries, WHO recently released publications on guidelines for salt and potassium intake in adults and children (WHO. Salt, 2012; WHO.Potassium, 2012).

The wide range of clinical symptoms observed in this pilot sample (see appendix) also need to be considered and their measurement should be included as part any future research or treatment strategies. Also to be considered is what appropriate comparison groups might be available for such a study. Since net migration of Haitians is primarily to the U.S. and Canada, data from Haitians and blacks living there could be a comparison group.

The feasibility of working with the Haitian government and the Ministry of Public Health and Population (MSPP) must be determined. The country capacity to detect and respond to NCDs does not exist in Haiti since 2008 (WHO: NCD Country Profile, 2011). National records to estimate prevalence of hypertension, hyperglycemia, or elevated serum lipids, or risk factors such as rate of tobacco use or physical inactivity were lacking. To perform such a study, a computerized record system would need to be available or established.
WHO conducted a survey, “Assessing national capacity for the prevention and control of non communicable diseases” (2012) across six WHO regions. The lowest response rate (83%) was in the AMR region with 6 Caribbean countries having no response including Haiti. The cumulative report of the Americas does not reflect the need for capacity building in that region. To develop a NCD program, the country needs a unit or department in their ministry of health (MOH) that is responsible for the infrastructure. This includes a funding mechanism for NCD prevention, health promotion, surveillance, available of tests and procedures for early detection and monitoring, treatment of high risk target groups, and program evaluation. An agency or academic centre must be designated that supports the MOH by performing functions to prevent and control NCDs. National policies, plans or strategies must be developed to address NCDs and the associated risk factors. The report recommends that the capacity of their health system include primary prevention, risk detection, and risk factor and disease management in their primary health care systems.

Conclusions. Though the sample studied here was not selected using random sampling nor stratified by age or gender, it may be reasonable to consider the sample representative of other poor Haitian adults who live in similar neighborhoods in the capital city, Port-au-Prince and the surrounding metro area of 2.5 million. As such it provides a useful source of information for future research and treatment planning at the Blanchard clinic. Clearly, it can be noted from these data the prevalence and severity of hypertension in adult men and women in Haiti is high and increases with advancing age. Several studies conducted in Haiti have documented this same pattern of a high prevalence of hypertension as men and women age. International agencies such as the World Health Organization and the International Society of Hypertension reported the growing problem of NCD hypertension in developing countries and have recommended a
general treatment plan. The further study of these chronic disease challenges are both a moral
and ethical imperative for Haiti and for other developing nations.

Appendix.

Patient Clinical Symptoms.
Twenty-five common clinical symptoms described by Haitian men and/or women at the time of
their visit to the Blanchard clinic: Total = N/556 (%): Men = N/104 (%); Women = N/452 (%).

a. Diabetes or increased blood sugar
b. Headache
c. Poor vision/blurred vision
d. Cardiovascular symptoms: Chest pain, irregular heart rate, dyspnea on exertion
e. Upper respiratory symptoms: cough, cold, sore throat, asthma, allergies
f. Fever/ elevated temperature
g. Acid reflux (heartburn)/ dyspepsia/ abdominal pain/ nausea
h. Chronic musculoskeletal pain, back pain, arthritis
i. Thyroid disease/ goiter (increased cardio output) (Chobanian, 2007)
j. Anemia or low serum hemoglobin (increased cardio output) (Chobanian, 2007)
k. Dizziness (vertigo), weakness
l. Stroke/ memory loss
m. Pregnancy/ birth in last 3 months/breast feeding (women)
n. Skin/ wound infection
o. Urinary tract infection/ proteinuria
p. Lower extremity edema
q. Intestinal parasites, worms, diarrhea, constipation
r. Skin rash/ itching
s. Dental pain/ infection
t. Hearing loss/ ringing in ears
u. Insomnia/ anxiety/ depression
v. Malnutrition/ anorexia
w. Tissue mass
x. Dysmenorrhea, irregular menses, vaginal infection (women)
y. STD (men)
References

Alam, M., & Barri, Y. (2003). Systolic blood pressure is the main etiology for poorly controlled hypertension. *American Journal of Hypertension*, 16(2), 140-143. doi: 10.1016/S0895-7061(02)03198-9


