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Cover Page Footnote

Kylah Pollard, Department of Psychology, Kennesaw State University; Mohammed Chowdhury, PhD, Department of Applied Statistics and Analytical Sciences, Kennesaw State University; Sarai Bauguess, Department of Psychology, Kennesaw State University. The dataset used in this study is from a study completed by the National Heart, Blood, and Lung Institute by authors Oberzanek et.al. They are cited in this paper. Correspondence concerning this article should be directed to Kylah Pollard. Email: kylah.pollard@uga.edu.

Prevalence and Incidence of Health Risk Factors Among Adolescent Girls

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ABSTRACT

Heart disease has many different risk factors, including hypertension (high blood pressure) and high cholesterol. Research has shown that hypertension can be identified as early as adolescence, and preventative measures can be instilled in this age. However, the relationship between hypertension, high cholesterol, race, and income have not been studied in detail among adolescents. The present study analyzed the effects of different health factors on blood pressure and cholesterol levels in Caucasian and African-American girls ages 9-21 years old, the prime of adolescence. The dataset was part of a larger study completed by the National Heart, Blood, and Lung Institute and included 2,379 girls from the ages of 9-21 years. The data were analyzed using R- Statistical Software using logistic regression, t-tests for mean, multinomial regression, analysis of variance, and chi-square test of independence. There were significant differences between Caucasian and African-American girls for several different health factors. Caucasian girls were found to have lower systolic and diastolic blood pressures, and African-American girls were found to have higher high density lipoprotein (HDL) levels. Caucasian girls were found to have significantly higher triglyceride levels than African-American girls. Further, income, body mass index, systolic, and diastolic blood pressure were found to be highly related to race. Income and systolic blood pressure were also found to be highly related. As systolic blood pressure increased, the odds of being African-American increased. This was also found to be true in regard to body mass index. Many risk factors seem to have their roots in childhood, and this information may lead to better prevention techniques. Future studies should also investigate these health factors in adolescent boys.

Keywords: Health, Heart Disease, Cholesterol, R, Adolescents

Heart disease is one of the most common killers of Americans (CDC, 2015). Heart disease is a buildup of plaque in the arteries, and it makes blood flow more difficult. The blockage can lead to congestive heart failure, heart arrhythmias, heart attack, or stroke (American Heart Association, 2017). Hypertension and high cholesterol are two main risk factors for heart disease, among other diseases (Sumner, 2009; World Heart Federation, 2017).

Health Factors

Hypertension occurs when Systolic or Diastolic Blood Pressure are abnormally high and is believed to have roots in childhood (Obarzanek et al., 2010). Systolic Blood Pressure is the top number in a blood pressure reading. It is the amount of pressure the heart is exerting on the arteries when it beats (American Heart Association, 2017). A normal Systolic Blood Pressure is below 120mm Hg. Diastolic Blood Pressure is the bottom number in a blood pressure reading

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and is defined as the amount of pressure the heart exerts on the arteries when it rests between beats (American Heart Association, 2017). A number less than 80mm Hg is considered normal. These numbers can increase over time due to many causes including plaque buildup and the stiffening of artery walls. However, the increase of either Systolic or Diastolic Blood Pressure can lead to hypertension and should be addressed (American Heart Association, 2017).

High cholesterol is the buildup of cholesterol and plaque in the arteries. Cholesterol is separated into two categories: Low Density Lipoproteins (LDL) and High Density Lipoproteins (HDL). LDLs add to plaque buildup that can block arteries and increase the risk of heart attacks. HDLs remove triglycerides-a form of fat- and LDLs from the bloodstream and are considered beneficial to the body. A low amount of HDLs can increase the risk of heart disease (American Heart Association, 2017).

Literature Review

Heart disease is the leading cause of death for women in America, and many women die of heart disease between the ages of 65 and 84 years (Pathak, 2016). Women are included as the test population for many heart disease studies, perhaps due to the danger heart disease poses to the population (e.g., Obarzanek et al., 2010). Childhood obesity rates among girls are increasing, which may also increase the risk of hypertension and high cholesterol in women (Sumner, 2009). Early intervention is important as this can lead to lower rates of heart disease in the future. Girls aged 9- to 21-years old are considered in the prime of adolescence, so this is the optimal age to begin intervention techniques (Obarzanek et al., 2010). However, little research exists that studies these factors in age groups so young (Oberzanek et al., 2010). With this being a crucial time in adolescence, it is important to increase the knowledge of the risk factors and help lead to better prevention strategies in the future for women.

Income, or socioeconomic status, is a common categorizing factor used in health studies because of the stark differences between the groups. Many health studies have examined the differences among the socioeconomic groups. Lower socioeconomic groups tend to intake more sodium, which may increase their risk of hypertension and heart disease (de Mestral et al., 2017). Additionally, people in low socioeconomic groups tend to be less physically active than those in higher socioeconomic groups (Lemstra, Rogers, & Moraros, 2015). One study found income was related to heart disease through reporting rates and health care costs (Lemstra et al., 2015). Examining the data by income level, or socioeconomic status, is recommended because of the strong and apparent differences between the groups.

Another factor commonly used to differentiate data in health studies is race/ethnicity. There are racial differences for many health factors in women, and many of these begin to show in adolescence (Sumner, 2009). For example, Body Mass Index tends to be higher in African-American women than in Caucasian women (Ogden, Carroll, & Flegal, 2008). Research has also found that hypertension is more common in African-Americans than Caucasians (Hajjar & Kochten, 2003). African-American women are also at a greater risk of dying of coronary heart disease than Caucasian women (Mochari-Greenberger, Miller, & Mosca, 2012). There are also ethnic differences in the awareness of the disease. African-American women are overall less aware that heart disease is a leading cause of

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death in women than their Caucasian counterparts (Mochari-Greenberger et al., 2012). These discrepancies could be due to educational or cultural differences between the two groups. Many studies only examine the differences between Caucasian and African-American populations (e.g., Quick, Waller, & Casper, 2017; Oberzanek et al., 2010). Perhaps the differences between these two groups are more easily distinguished, or perhaps these groups are the most available at the time of the studies. Our study continued to examine the differences in African-American and Caucasian female populations but from a different perspective- by examining a younger cluster.

The purpose of this study is to examine the interactions among different health factors and ethnicity on the risk of heart disease, specifically high cholesterol and hypertension in Caucasian and African-American girls in adolescence. We predicted that African-American girls would have higher Systolic and Diastolic Blood Pressures, and therefore be at higher risk of hypertension. We also predicted that African-American girls would have lower HDL levels and higher Body Mass Index.

Method

This dataset was selected by a Statistics Professor and brought to the attention of the authors. The authors were given the opportunity to reexamine the data. This experience not only taught the authors about the topic and the statistical software, it also gave the authors real-world experience as it pertains to data.

Due to the nature of the dataset, a detailed description of each variable could not be included. However, socioeconomic status was defined by income levels, which were reported in the census information. It was calculated as the total pre-tax income of the household in the year 1986 (the year before the study commenced). There were nine unevenly-spaced income levels: "Less than \$5,000", "\$5,000-\$7,499", "\$7,500-\$9,999", "\$10,000-\$19,999", "\$20,000-\$29,999", "\$30,000-\$39,999", "\$40,000-\$49,999", "\$50,000-\$74,999", and "\$75,000 or more". These levels are later denoted as levels one to nine with one being the lowest income level reported.

Participants

The dataset is part of a larger study completed by the National Heart, Blood, and Lung Institute (Obarzanek et al., 2010). It includes health information from 2,379 African-American (n = 1,213) and Caucasian (n = 1,166) girls 9- to 21-years old (M = 14.36 years). The data were collected through a longitudinal study, in which each participant began the study at age nine or ten and completed the study at age 21. Demographic information was completed in a census form sent out to all parents. Participants were given a health examination each year until completion of the study, but the data were based on two visits (Oberzanek et al., 2010).

Analysis

The data were analyzed via R-Statistical Software using *t*-tests to compare the means for each variable. Also, logistic and multinomial regressions, analysis of variance, and chi-square test of independence were used to determine the covariate effects on the response variable. A sample of the R-code is listed in Appendix A.

Unlike the study by Oberzanek et al. (2010), which analyzed the prevalence of hypertension and prehypertension, this study analyzed the prevalence of multiple different health factors that often lead to heart disease, including hypertension and high cholesterol. Income, Age, and Race were used as grouping factors during analysis in order to effectively determine differences in the variables. Sometimes, data were separated using multiple grouping variables at once. For example, the data may be split by Race and then Income Level to determine the differences in Systolic Blood Pressure.

Results

The difference between Caucasian and African-American girls for each health factor was tested by income level using a *t*-test for means. There was a significant difference between Caucasian and African-American girls for many different health factors based on income level. Specifically, Systolic and Diastolic Blood Pressure were significantly different between Caucasians and African-Americans for income levels four, five, seven, and eight (see Figures 1-2). Overall, Caucasian girls had a lower Systolic and Diastolic Blood Pressure than African-American girls.

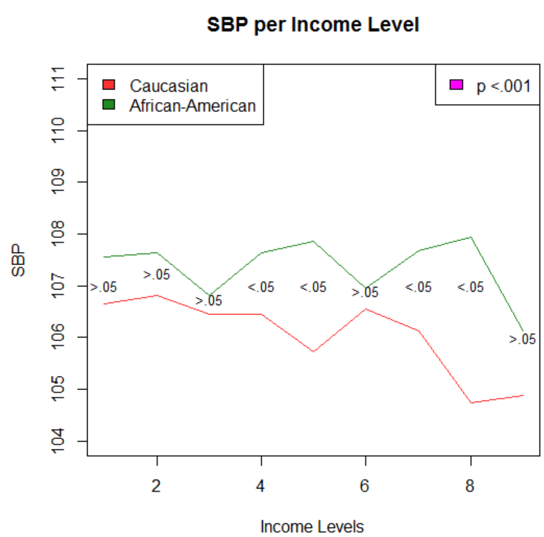

Figure 1. *Systolic Blood Pressure by Income Level Separated by Race*

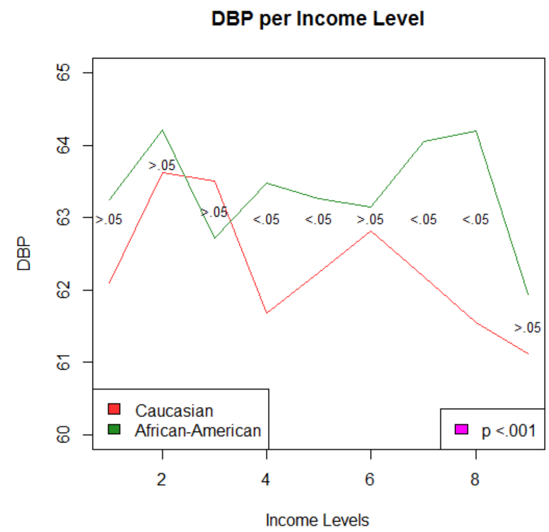

Figure 2. *Diastolic Blood Pressure by Income Level Separated by Race*

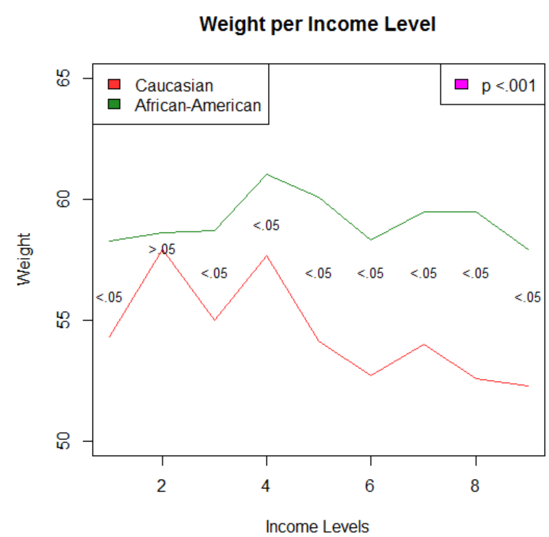

Figure 3. *Weight by Income Level Separated by Race*

Weight was significantly different between the two groups for income levels one and three through nine (see Figure 3). As seen in Figures 4 and 5, HDL and Body Mass Index were significantly different for all but one income level (level two). African-American girls had higher HDL levels than Caucasian girls (see Figure 4).

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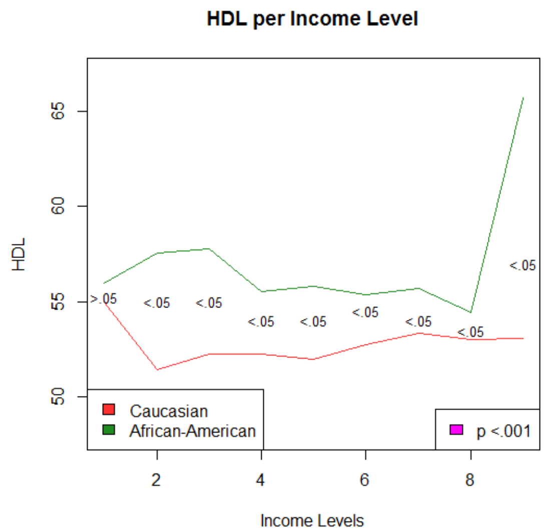

Figure 4. *High Density Lipoproteins by Income Level Separated by Race*

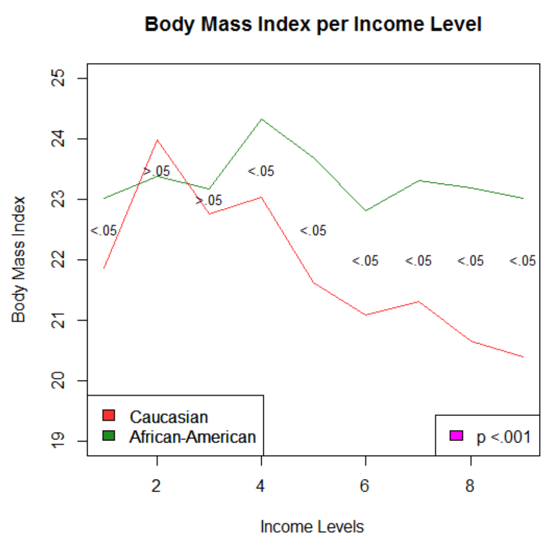

Figure 5. *Body Mass Index by Income Level Separated by Race*

Triglycerides were significantly different for the two groups for all income levels, with Caucasian girls having higher Triglyceride levels (see Figure 6).

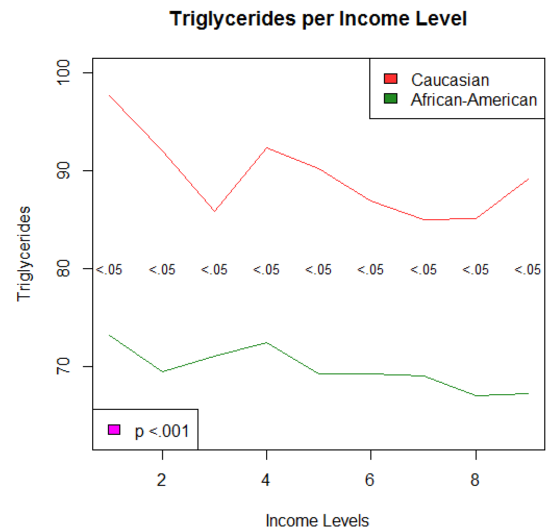

Figure 6. *Triglycerides by Income Level Separated by Race*

Chi-Square Test of Independence was used to test the independence of several different factors. Income, Body Mass Index, Systolic Blood Pressure, and Diastolic Blood Pressure were all dependent on Race ($p < .001$). Likewise, Income and Body Mass Index were also dependent ($p < .001$).

To test whether Systolic Blood Pressure is significantly different at each income level, an analysis of variance was completed. Systolic Blood Pressure was significantly different at each income level for Caucasians as well as overall ($p < .001$). This means that, among Caucasians, no two income levels had the same average Systolic Blood Pressure. However, Systolic Blood Pressure was not significantly different at each income level for African-Americans ($p = .932$). Among African-American girls, at least two of the income groups had the same (or extremely similar) average Systolic Blood Pressure (Figure 1).

Multinomial Regression		
	Systolic Blood Pressure	
	Estimate	p-value
Height	0.195	<.001
Body Mass Index	0.565	<.001
Income	-0.302	<.001

Table 1. *Multinomial Regression Intercepts for Height, Body Mass Index, and Income on Systolic Blood Pressure*

The logistic and multinomial regressions were used to determine the relationships between the response variable and the covariates. The multinomial regression (Table 1) showed that Height, Body Mass Index, and Income all have a significant effect on Systolic Blood Pressure. Height and Body Mass Index both had a positive effect on Systolic Blood Pressure, and Income had a negative effect. The logistic regression showed that there is a significant effect of Race on Systolic Blood Pressure ($p < .001$), Height ($p < .001$), and Body Mass Index ($p < .001$).

Discussion

The purpose of this study was to examine the ethnic differences of health factors that increase the risk of heart disease, specifically high cholesterol and hypertension. Caucasian girls had lower Systolic and Diastolic Blood Pressures and may have a lower risk of heart disease in the future, which aligns with previous research (Oberzanek et al., 2010; Sumner, 2009). African-American girls were found to have significantly higher HDL levels than Caucasian girls, which may lead to lower rates of heart disease. This is contrary to the hypotheses as well as previous research (Mochari-Greenberger et al., 2012). As expected, African-American girls had a higher BMI than Caucasian girls, which could lead to higher obesity rates, which is congruent with previous research as well (Ogden et al., 2008). Interestingly, Caucasian girls had higher levels of triglycerides, which could be due to diet and exercise. Both ethnic groups had significantly different triglycerides when income was also compared. This is similar to previous research showing stark differences between income levels (Lemstra et al., 2015). This could be a possible explanation for Caucasian girls having significantly higher triglyceride levels than African-American girls.

The finding that systolic blood pressure was significantly different at each income level for Caucasians but not for African-Americans is interesting. There are some different theories to explain this. For instance, the lack of difference may be due to a lack of sensitivity in the income measure to detect the differences properly. Additionally, African-American culture may affect the lack of difference as well. However, it is not within the scope of the study to identify the cause of this lack of difference.

This study provides further support for testing health factors in young people. Some of the health risk factors have roots in childhood, and this study identifies more risk factors that are prevalent and may need to be examined more closely. Also, this study further identifies differences between African-American and Caucasian people. Due to this and other evidence of risk factors beginning in adolescence, it may be pertinent to identify and intervene at a young age to lower the risk of heart disease in the future and allow adolescents to make lifestyle changes at an earlier age (Oberzanek et al., 2010).

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The current study only examined the ethnic differences and health factors of girls. Future studies should examine the ethnic differences in boys as well as girls, as gender may play a significant role in the prevalence of these factors. The information about the dataset did not report the variables clearly, so future studies should give clearer operational definitions about the variables. This study did not employ any interventions and was merely used to identify risk factors that could be measured in adolescence. Future studies should monitor these conditions and identify whether it is a true predictor of heart disease and hypertension. Further, future studies should implement intervention techniques and examine their effectiveness. Other studies should also examine other health factors, such as preexisting conditions, to examine how the risk factors are impacted.

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Appendix A

Sample R-code:

```
#Aggregate Mean
aggregate(WAISTMIN ~ INCOME, data = rday1, mean)
#Simple Regression Model
summary(lm(SYSAV ~ HTAV + SMOKE + INCOME + QI, data = newrday1[[1]]))
#Hypothesis Tests
t.test(rday$QI ~ rday$RACE)
#Logistic Regression
mylogit <- glm(as.factor(RACE) ~ SYSAV + HTAV + QI, data = rday, family = "binomial")
Chi Square Test of Independence:
one5 <- rday[,c('QI','RACE')]
one6 <- na.omit(one5)
one6$qi1 <- cut(one6$QI, c(11.17, 18.52, 21.1, 24.8, 56.05), labels = c(1:4))
chisq.test(one2$RACE,one6$qi1)
#ANOVA
summary(aov(rday1$SYSAV~rday1$INCOME))
```


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