

Effect of Exercise, Diet, Sleep, Fasting, and Water Hydration on Health

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Abstract

People who undertake moderate physical activity are at exceptionally low risk of several chronic illnesses, which include but are not limited to - Type II diabetes, some types of cancers, and cardiovascular disorders (Stanton, Happell, & Reaburn, 2014). However, the corona virus disease 2019 (COVID-19) global pandemic period drastically affected everyone worldwide (World Health Organization, 2020) resulting in social distancing, stay at home, and inactivity.

This study examined the contribution of independent variables 1) sleep, 2) diet, 3) exercise, 4) water hydration, and 5) fasting on dependent variable good health, as defined by body mass index (BMI). The methodology designed a questionnaire and used it to collect data regarding the dependent and independent variables. A sample size of 30 responses were collected. The findings showed the 1) sleep, 2) diet, 3) exercise, 4) water hydration, and 5) fasting each contributes to good health. The study recommended that medical doctors should stress to their patients that 1) sleep, 2) diet, 3) exercise, 4) water hydration, and 5) fasting each contributes to good health. That medical doctors use the multiple regression equation to estimate the health/BMI of a patient and advise the patient according to the inadequate independent variable. The study also recommended

that the World Health Organization and governments around the world should stress likewise to people.

Keywords: Multiple regression, body mass index, hydration, exercise, diet, fasting

Introduction

People who undertake moderate physical activity are at exceptionally low risk of several chronic illnesses, which include but are not limited to - Type II diabetes, some types of cancers, and cardiovascular disorders (Stanton, Happell, & Reaburn, 2014). However, the corona virus disease 2019 (COVID-19) global pandemic period drastically affected everyone worldwide (World Health Organization, 2020) resulting in social distancing, stay at home, and inactivity. Since the Covid-19 pandemic, researchers have examined some of the variables included in this study. Ababei, C., Ababei R, Loredana I, and Ababei, A. (2020) examined the influence of exercise and diet on the improvement of health during the coronavirus pandemic. The research concluded that the training sessions and individualized nutrition plan had a profound effect on health by reducing their cholesterol and triglycerides levels and their body mass.

Several studies have been conducted about factors that contribute to good health (Nakamura, Watanabe, Tanaka, Yasui, Nishihira, & Murayama, 2020; Oftedal, Burrows, Fenton, Murawski, Rayward, & Duncan, 2019; Miller, 2018). However, there is a gap in the literature that determines how each of the factors contribute to good health. Patel and Kuofie (2021) recommended further research on factors such as sleep, exercise, diet, fasting, and water hydration that contribute to good health. This study examined how the independent variables 1) sleep, 2) diet, 3) exercise, 4) water hydration and 5) fasting each contributes to the dependent variable good health, as defined by body mass index (BMI).

The rest of this paper is structured as follows. The Literature Review section synthesized existing literature. The Methodology and Results section discussed the methodology used and the results. The Discussions and Recommendations section discussed the findings of the study and made recommendation for the application of the findings. Finally, the Conclusion section made recommendations for further research and concluded the paper.

Literature Review

Oftedal et al. (2019) examined the efficacy of a mobile health intervention, targeting physical activity, diet, and sleep quality on shift workers. The intervention led to an increase in diet activity but did not show much effect on physical activity and sleep. The authors concluded that a more tailored and prolonged intervention would have led to increase activities in physical activity and sleep. The need for intervention to enable individuals to adjust their activities regarding these variables, highlight the correlation among diet, exercise, rest or sleep and good health.

Marks (2015) stated in his homeostatic obesity theory that there are four strategies to end the obesity epidemic. They are (1) putting a stop to victim-blaming, stigma and discrimination; (2) devalue the thin-ideal; (3) reducing consumption of energy-dense, low-nutrient foods and drinks; and (4) improving access to plant- based diets.

Miller (2018) examined the effect of intermittent fasting on the reduction of body fat. The results showed that intermittent fasting periods reduces obesity. Glucose and fat form the body's primary sources of energy. Therefore as glucose becomes unavailable through fasting, the body adjusts by utilizing its stored fat for energy. Fasting also reduces high blood pressure, high cholesterol, and fat deposit in the arteries.

Tavares (2014) stated that there is a general believe that individuals who exercise also eat a healthy diet; the study showed that there is no clear-cut relationship between a person's decision to exercise and to eat healthy diet, if the choice is free and not influenced by external policy considerations. The research found that factors such as marriage led to a decision to eat healthy and exercise; and factors such as smoking, private health insurance, living alone, aging or unemployment prevented some people from making positive choices about diet and exercise.

Recent researchers, since the Covid-19 pandemic, have examined some of the variables included in this study. Nakamura, Watanabe, Tanaka, Yasui, Nishihira, and Murayama (2020) looked at the effect of increased daily water intake and hydration on Health in Japanese adults. They concluded that increased water intake could provide several health benefits, such as lowering blood pressure, increasing body temperature, diluting blood waste materials, and protecting kidney function.

Ababei, C., Ababei R, Loredana I, and Ababei, A. (2020) examined the influence of exercise and diet on the improvement of health during the Coronavirus pandemic. The research concluded that the training sessions and individualized nutrition plan had a profound effect on health by reducing their cholesterol and triglycerides levels and their body mass.

Patel and Kuofie (2021) showed in their study that physical activity promotes good health. They recommended further research into how 1) regular adequate sleep, 2) well-balanced diet, 3) physical activity, 4) intermittent fasting, and 5) water hydration each contributes to health.

While we have referenced several studies showing how different combinations of the five above-mentioned variables affect health, this study build on these studies by examining all five independent variables together and establishing their contribution to good health by a measure of their effect on Body Mass Index. Gutin (2018) stated that BMI is a measure of the reality of health.

BMI = (weight in pounds multiplied by 703) and divided by height in inches squared (National Institutes of Health [NIH], n. d.). NIH (n. d.) classified BMI as:

Underweight = <18.5; Normal weight = 18.5–24.9; Overweight = 25–29.9; Obesity = BMI of 30 or greater.

Methodology and Results

Methodology

The methodology used in this study was mixed methodology. Qualitative descriptive research design was used; quantitative correlational-predictive research design was also used.

In this study, 30 participants were randomly selected and surveyed using SurveyMonkey for collection of responses. See the SurveyMonkey questionnaire (Appendix A). The questionnaire was administered over a period of one week; the entire responses is in Appendix B. Excel software was used for the data analysis. Descriptive data analysis was used. Multiple regression analysis was also used. The study also looked for multicollinearity; when two independent variables are correlated; that correlated independent variables make it very difficult to make inferences about the individual coefficients and their effects on the dependent variable (Lind, Marchal & Wathen, 2018).

Results

Descriptive Data Analysis

Table 1: The collected data/responses

Body Mass Index(BMI)	Exercise (hrs. per day)	Diet(Daily Calories)	Daily sleep (hrs.)	Hydration(glasses of water daily)	Daily fasting (hrs)
28.1	3	1600	6	4	8
31	2	1300	6	2	4
26.6	2	1300	8	4	4
19.8	2	1300	8	2	4
28.1	6	1300	6	2	6
24.3	1.25	1600	8	4	6
45.2	6	1800	6	8	6
38.3	0	1300	8	10	4
36.9	1.5	1800	6	4	6
24.7	0.5	1800	8	6	4
27.5	0.67	1300	8	8	4
24	1	1600	8	10	2
23.2	4	1300	6	4	4
25.7	0.5	1800	6	2	4
33.3	0.5	1300	6	4	4
27.1	1	1300	6	2	6
29	6	1600	8	4	6
27.5	12	1600	6	4	10
23.3	2	1800	6	2	6
43.5	8	1600	8	6	6
25.5	2	1300	8	6	8
25.5	2	1300	6	2	4
24.9	6	1800	6	6	4
34.5	3	1300	6	6	4
25.8	8	1800	6	2	2
24.7	0.25	1300	8	6	4
24.4	4	1800	4	8	4
26.4	0.5	1600	4	4	4
22.9	4	1600	8	8	8
25.8	2	1600	6	4	2

Table 1 shows the collected data/responses.

The maximum number of hours of exercise was 10 hours per day and the least was 2 hours.

None of the 30 participants was underweight. Ten of the participants had normal weight. Thirteen

participants were overweight. Seven participants were obese. One participant had a 43.5 BMI; this participant was very obese.

Figure 1: Bar chart of weight of responders.

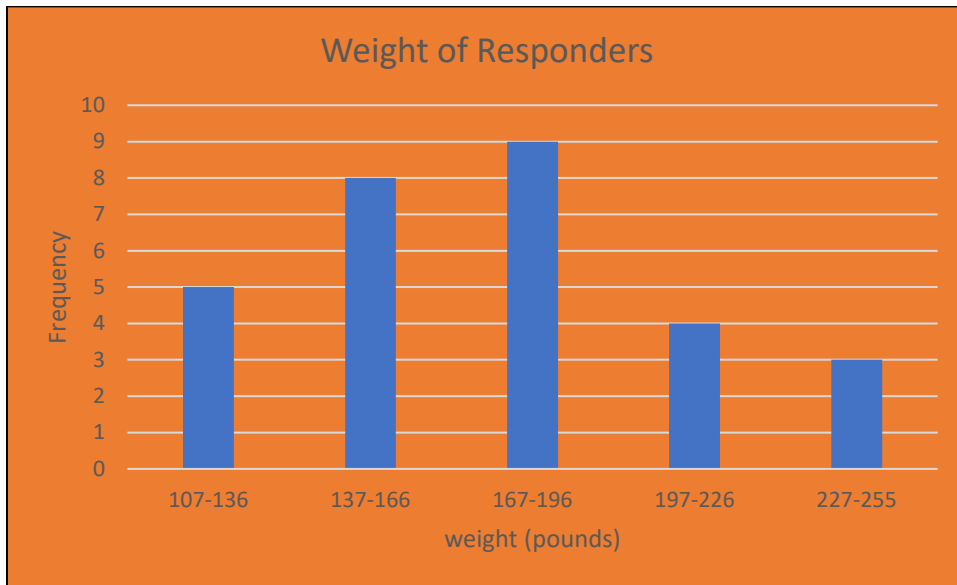


Figure 1 shows that 9 of the participants weighed 167-196 pounds, and 3 participants weighed 227-255 pounds.

Figure 2: Bar chart of hydration of responders.

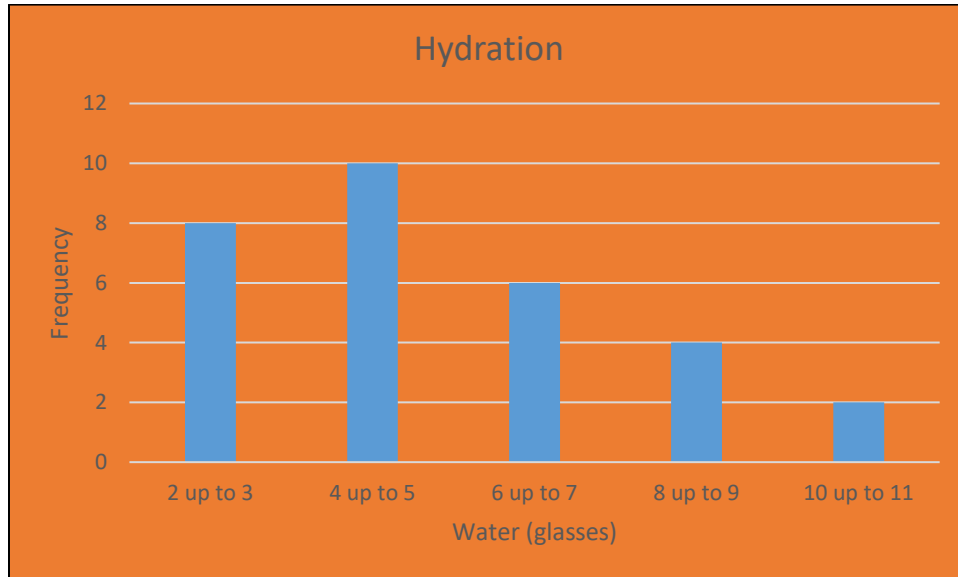


Figure 2 shows that 10 participants hydrate by drinking 4 to 5 glasses of water a day. And 2 participants drink 10 to 11 glasses of water a day.

Figure 3: Bar chart of hydration of responders

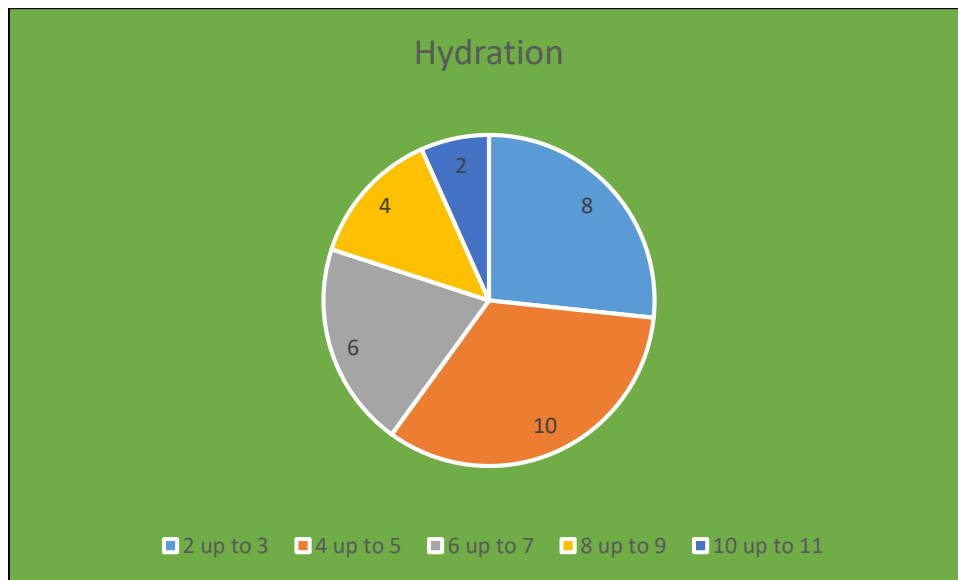


Figure 3 shows that 6 participants hydrate by drinking 6 to 7 glasses of water a day. Four participants drink 8 to 9 glasses of water a day.

Table 2: Exercise

<i>Exercise (hrs Daily)</i>	
Mean	3.05566667
Standard Error	0.52216496
Median	2
Mode	2
Standard Deviation	2.86001529
Sample Variance	8.17968747
Kurtosis	1.93219681
Skewness	1.41456445
Range	12
Minimum	0
Maximum	12
Sum	91.67
Count	30

Table 2 shows that the participants exercise an average of 3.05 hours a day.

Table 3: Fasting

<i>Fasting (daily)</i>	
Mean	4.933333333
Standard Error	0.342181418
Median	4
Mode	4
Standard Deviation	1.874204812
Sample Variance	3.512643678
Kurtosis	0.678817153
Skewness	0.776594624
Range	8
Minimum	2
Maximum	10
Sum	148
Count	30

Table 3 shows that the participants fast an average of 4.9 hours a day.

Multiple Regression Analysis

Applying multiple regression analysis to determine the correlation between the independent variables, diet, fasting, hydration, exercise and sleep and the dependent variable health/BMI.

Step 1. Computing the correlation matrix.

Table 4: Correlation matrix

	Body Mass Index(BMI	Exercise	Diet	Sleep	Hydration	Fasting
Body Mass Index(BMI	1					
Exercise (hrs. per day)	0.199183	1				
Diet(Daily Calories)	0.043846	0.289024	1			
Daily sleep (hrs.)	-0.02367	-0.14685	-0.27605	1		
Hydration(glasses of water daily)	0.279488	-0.0798	0.082301	0.326093	1	
Daily fasting (hrs.)	0.133595	0.411337	0.047257	0.080898	-0.04824	1

Table 4 shows the second column shows the correlations between each of the independent variables and the dependent variable health/Body Mass Index. All the independent variables show some linear correlation to the dependent variable. The strongest correlation is hydration, followed by exercise, then fasting, diet, and sleep. None of the correlations between the independent variables exceeds an absolute value of .700, so we assume that multicollinearity should not be an issue.

Step 2. Compute The Multiple Regression Equation Using All Five Independent Variables.

Table 5: Multiple Regression; Regression Statistics and Analysis of Variance (ANOVA)

SUMMARY OUTPUT					
<i>Regression Statistics</i>					
Multiple R	0.385176404				
R Square	0.148360862				
Adjusted R Square	0.029063958				
Standard Error	6.091215068				
Observations	30				
ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	5	155.1253759	31.02507519	0.836190011	0.537049253
Residual	24	890.4696241	37.102901		
Total	29	1045.595			
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>
Intercept	29.73155549	12.3283458	2.411641917	0.023892473	4.287100339
Exercise (hrs. per day)	0.411641162	0.458536177	0.897728865	0.37824809	-0.534730994
Diet(Daily Calories)	0.002380704	0.005856704	-0.406492133	0.68798312	-0.014468346
Daily sleep (hrs.)	0.691951277	1.055091084	-0.655821367	0.518177315	-2.869552248
Hydration(glasses of water daily)	0.865302894	0.502203131	1.723013738	0.097748773	-0.171193426
Daily fasting (hrs)	0.272993247	0.672460546	0.405961731	0.688367555	-1.114897106

Table 5 shows that in the ANOVA, the computed F value of 0.836 is greater than the Significant (critical) F value of 0.537, therefore at least one of the independent variables contribute to the dependent variable of good health/BMI. Based on the t-stat, hydration is the most contributor (1.72) to BMI, followed by exercise (0.89); fasting (0.40); diet (-0.4); and sleep (-.65). Based on p-value, none of the independent variables is less than 0.05); therefore, none of the independent

variables statistically significantly contribute to BMI at 5% significant level based on the collected sample data from 30 participants.

Initial Regression Equation:

The coefficients of determination that is the R squared in the Regression Statistics is 0.148. Therefore, the five independent variables contribute 14.8% to good health/BMI.

The initial multiple regression equation is: $Y=29.73 + 0.41(\text{exercise}) -0.002(\text{diet}) - 69(\text{sleep}) + 0.85(\text{Hydration}) +0.27(\text{fasting})$. A unit/one hour daily increase in exercise improves the health/BMI of the person by 0.41 unit, holding the four other independent variables constant. A unit /one daily increase in water hydration improves the health/BMI of the person by 0.85 unit, holding the four other independent variables constant.

The multiple regression equation is used to estimate the health/BMI of a black or African America given the values of his or her five independent variables.

Step 3. Apply the Global Test.

The inputs can be accessed from the ANOVA section of the multiple regression table. The decision rule is that if the computed F is less than or greater than 2.62, we reject the null hypothesis that all the β 's (coefficients of the independent variables) are zero. The alternate hypothesis is that not all β 's (coefficients of the independent variables) are zero. That is, at 0.05 (5%) significant level. Table 6 shows that the F statistic of 0.836 is less than the critical value of 2.62 therefore we reject the null hypothesis that all the coefficients are zero. At least one of the independent variables has the capacity to explain the variation in health/Body Mass Index.

Table 6: Coefficients of Independent Variables

Stating the null & alternate Hypotheses.	
	1=exercise, 2= diet, 3= sleep, 4 =Hydration and 5=Fasting
$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$	
H_1 : not all the B's are equal	
Global test formula	
$F = SSR/k$	31.04
$SSE/[n-(k+1)]$	37.10291667
F-statistic	0.836657682
Critical value	2.62
Significance	0.05

Step 4. Next, we need to evaluate the individual regression coefficients. The t-stat can be obtained from the regression table.

Exercise	Diet	Sleep	Hydration	Fasting
$H_0: \beta_1 = 0$	$H_0: \beta_2 = 0$	$H_0: \beta_3 = 0$	$H_0: \beta_4 = 0$	$H_0: \beta_5 = 0$
$H_1: \beta_1 \neq 0$	$H_1: \beta_2 \neq 0$	$H_1: \beta_3 \neq 0$	$H_1: \beta_4 \neq 0$	$H_1: \beta_5 \neq 0$
0.897	-0.4	0.655	1.72	0.4
Individual coefficient test formula.				
$t = b_i - 0$				
S_{b_i}				
Significance level				
0.05				

From the results, we conclude that all the independent variables contribute to body mass index at 5% significant level.

Discussions and Recommendations

None of the 30 participants was underweight. Ten of the participants had normal weight. Thirteen participants were overweight. Seven participants were obese. One participant had a 43.5 BMI; this participant was very obese. The maximum number of hours of exercise was 10 hours

per day and the least was 2 hours. The multiple regression equation is: $Y=29.73 + 0.41(\text{exercise}) - 0.002(\text{diet}) - 69(\text{sleep}) + 0.85(\text{Hydration}) + 0.27(\text{fasting})$.

The findings showed the 1) sleep, 2) diet, 3) exercise, 4) water hydration, and 5) fasting each contributes to good health, as defined by body mass index (BMI).

The study recommended that medical doctors should stress to their patients that 1) sleep, 2) diet, 3) exercise, 4) water hydration, and 5) fasting each contributes to good health. That medical doctors use the multiple regression equation to estimate the health/BMI of a patient and advise the patient according to the inadequate independent variable. The study also recommended that the World Health Organization and governments around the world should stress likewise to people.

Conclusion

People who undertake moderate physical activity are at exceptionally low risk of several chronic illnesses, which include but are not limited to - Type II diabetes, some types of cancers, and cardiovascular disorders (Stanton, Happell, & Reaburn, 2014). However, the corona virus disease 2019 (COVID-19) global pandemic period drastically affected everyone worldwide (World Health Organization, 2020) resulting in social distancing, stay at home, and inactivity. Since the Covid-19 pandemic, researchers have examined some of the variables included in this study. Ababei, C., Ababei R, Loredana I, and Ababei, A. (2020) examined the influence of exercise and diet on the improvement of health during the Coronavirus pandemic.

This study concluded from the multiple regression analysis that the five independent variables diet, sleep, exercise, fasting, and hydration each contributes to good health/BMI.

However, the study recommended that further research be carried out with a much larger sample size and among a more varied ethnicities and age groups.

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Appendix A

Survey Questionnaire

1. Select the best match to your race or ethnicity.

Black or African American

Hispanic or Latino

White or Caucasian

Asian or Asian American

American Indian or Alaska Native

2. What is your marital status?

Married Widowed Divorced Separated Single, never married.

3. What is your height in feet and inches? For example, if you are five feet four inches, write 5'4".

Enter your answer. _____

4. In which of the following age groups do you belong?

20-30 31-40 41-50 51-60 61-70 70+

5. What is your current weight in pounds?

Enter your answer. _____

6. On a typical day, roughly how many hours of physical activity or exercise do you do? If your work includes heavy activity, please include it.

Enter your answer. _____

7. On a typical day, how many calories of food do you consume? The average daily calorie consumption is: Breakfast 300-400, Lunch 500-700, and dinner 500-700. Indicate the choice of total daily calories that best fit your profile. 1300 1600 1800.

8. On a typical night, roughly how many hours of sleep do you get? If you work during the night and sleep during the day, please include it. 4 6 8 10 12.

9. On a typical day, roughly how many glasses of water do you consume?

2 4 6 8 10.

10. On a typical day, roughly how many hours do you go without food? Consider the hours in between meals. If you take daily additional fasting times, please add this. Please select the best

fit. 2 4 6 8 10.

Appendix B

Entire responses

Ethnicity	Marital Status	Age (Year groups)	Body Mass Index	Exercise (hrs. per day)	Diet(Daily Calories)	Daily sleep(hrs.)	Hydration(g of water c
Black or African American	Married	61-70	28.1	3	1600	6	4
Amer. Indian/ Alaska Native	Widowed	51-60	31	2	1300	6	2
Black or African American	Married	51-60	26.6	2	1300	8	4
Black or African American	Married	31-40	19.8	2	1300	8	2
Black or African American	Single, never married	51-60	28.1	6	1300	6	2
Black or African American	Married	61-70	24.3	1.25	1600	8	4
Black or African American	Single, never married	31-40	45.2	6	1800	6	8
Black or African American	Single, never married	31-40	38.3	0	1300	8	10
Black or African American	Married	61-70	36.9	1.5	1800	6	4
Black or African American	Single, never married	31-40	24.7	0.5	1800	8	6
Black or African American	Single, never married	61-70	27.5	0.67	1300	8	8
Black or African American	Married	31-40	24	1	1600	8	10
Black or African American	Married	31-40	23.2	4	1300	6	4
Black or African American	Single, never married	51-60	25.7	0.5	1800	6	2
Black or African American	Divorced	70+	33.3	0.5	1300	6	4
Black or African American	Married	61-70	27.1	1	1300	6	2
Black or African American	Married	61-70	29	6	1600	8	4
Black or African American	Married	70+	27.5	12	1600	6	4
Black or African American	Single, never married	20-30	23.3	2	1800	6	2
Black or African American	Single, never married	61-70	43.5	8	1600	8	6
Black or African American	Married	61-70	25.5	2	1300	8	6
Black or African American	Married	41-50	25.5	2	1300	6	2
Black or African American	Married	61-70	24.9	6	1800	6	6
Black or African American	Widowed	61-70	34.5	3	1300	6	6
Black or African American	Married	61-70	25.8	8	1800	6	2
Black or African American	Single, never married	51-60	24.7	0.25	1300	8	6
Black or African American	Married	51-60	24.4	4	1800	4	8

Black or African American	Married	51-60	26.4	0.5	1600	4	4
	Single, never						
Black or African American	married	51-60	22.9	4	1600	8	8
Black or African American	Married	31-40	25.8	2	1600	6	4