ABSTRACT

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BEHAVIORS, PERCEIVED HEALTH
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DISEASE RISK FACTORS IN ADOLESCENT
GIRLS

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Poor physical fitness and diet contribute to increases in cardiovascular disease (CVD) risk factors including BMI, waist circumference (WC), systolic and diastolic blood pressure (SBP and DBP), and HDL-C levels. These behaviors are also associated with positive perceptions of health status. It was hypothesized that the associations between positive health behaviors and CVD risk factors would be mediated by perceived health status in adolescent girls. Regression models were used to test for independent effects and mediation. 185 girls were analyzed, 83% were African American and 50% were overweight. Perceived health status predicted WC, BMI, and SBP. Fat consumption predicted WC and SBP. There were no associations between health behaviors and perceived health status. Adolescent girls are able to accurately assess their overall health status regardless of fitness or dietary behaviors. Interventions should encourage girls to consider these healthy behaviors when assessing health status to increase participation in these behaviors.

RELATIONSHIPS BETWEEN HEALTH BEHAVIORS, PERCEIVED HEALTH STATUS, AND CARDIOVASCULAR DISEASE RISK FACTORS IN ADOLESCENT GIRLS.

By

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Chapter I: Introduction

Background

   Cardiovascular disease (CVD) is the leading cause of death in the United States, accounting for one-third of all deaths in 2004. It is the number one killer of women, regardless of ethnic or racial background, but has a higher prevalence in African American women (44.7%) when compared to Caucasian women (32.4%). (American Heart Association, 2006) While the signs and symptoms of the disease may go unnoticed until middle age, the development of CVD begins in childhood and early adolescence. (Biddle, Gorely, & Stensel, 2004) With the progression of CVD beginning early in life, it is important to identify and understand modifiable risk factors that can be altered during adolescence to reduce the likelihood of disease later in life.

   Several risk factors contribute to morbidity and mortality, including physical inactivity and poor fitness, a poor diet, elevated blood pressure, decreased HDL cholesterol levels, and a higher body mass index (BMI) and waist circumference. (Jessor, Turbin, & Costa, 1998) However, these risk factors are modifiable and participation in health behaviors including exercise and the consumption of a diet low in fat but high in fruits and vegetables is associated with a reduction in the likelihood of developing CVD. (Croll, Neumark-Sztainer, & Story, 2001)

   National physical activity recommendations have been established to promote participation in healthy behaviors. Physical activity recommendations suggest participating in 30 minutes of moderate to vigorous on activity most, if not all, days of the week. (Pate, Pratt, Blair, Haskell, Macera, Bouchard, & et al., 1995) Current

food guidelines recommend eating at least five servings of fruits and vegetables per day and minimizing dietary fat intake. (King, Appel, Caballero, Clydesdale, Kris-Etherton, Nicklas, & et al., 2005) These recommendations have been made to increase awareness of the importance of these positive health indicators and to encourage people to adopt the corresponding behaviors. (Harris, Gordon-Larsen, Chantala, & Udry, 2006; Young, Phillips, Yu, & Haythornthwaite, 2006) However, according to the 2005 Youth Risk Behavior Survey, 64% of adolescents in the United States did not meet the currently recommended levels of physical activity and 10% reported that they did not participate in any moderate or vigorous physical activity. (Center for Disease Control and Prevention, 2007) This decline in physical activity has ultimately led to a decline in aerobic fitness. (Eisenmann, 2003) According to data from the National Health and Nutrition Examination Survey (NHANES), 34.4% of adolescent females had low fitness, and the prevalence of low fitness was greater in non-Hispanic blacks than non-Hispanic whites. (Carnethon, Gulati, & Greenland, 2005) The Centers for Disease Control and Prevention (CDC) also reported that less than 40% of youth meet Dietary Guidelines for saturated fat and 80% do not eat the recommended five servings of fruits and vegetables per day. (Cugnetto et al., 2005) In adolescent girls, only 21.3% ate sufficient amounts of fruits and vegetables. (Lowry, Lee, McKenna, Galuska, & Kann, 2008) Evidence such as this suggests that most adolescents do not partake in health related behaviors, demonstrating the importance of identifying health indicators associated with behavioral decisions in high-risk adolescents.

Health Belief Model

According to the Health Belief Model (HBM), individuals have a desire to avoid illness and will take action to prevent or control poor health if they believe it will be beneficial in reducing their susceptibility to the illness or disease. (Glanz et al., 2002) One component of the HBM is "perceived benefits", such that a particular course of action or participation in heath actions depends on the individual's beliefs regarding the effectiveness and importance of the actions for reducing the threat of disease. Those who participate in health-action behaviors are more likely to perceive their quality of health and well-being to be better than those who do not. (Glanz et al., 2002) When using the HBM to understand health behaviors in relation to the development of cardiovascular disease, an individual's participation in disease reducing behaviors will affect their perception of health and may reduce the susceptibility of CVD.

It is important to understand the relationship between healthy behaviors and perceived health, as high fitness and eating a nutritious diet have been associated with more positive perceptions of health status. In turn, positive perceived health status may be inversely related to morbidity and mortality. Therefore, this study sought to examine the relationships between health behaviors and CVD risk factors, while examining the effects of perceived health status as a potential mediator, in a sample of predominantly high-risk African American adolescent girls. This is important because identifying these relationships in a youth population will be beneficial in the development of appropriate interventions that encourage lifestyle changes that can be continued through adulthood. Adolescence represents a good time to detect and

monitor risk factors for disease as these risk factors track through adulthood and those

who choose to make the appropriate lifestyle changes will greatly reduce their risk of

disease later in life. (Rodrigues, Moyses, Bissoli, Pires, & Abreu, 2006)

Review of the Literature

Perceived health status is an indication of an individual's total sense of well-being

and is thought to be affected by positive health practices, such as participation in

physical activity that may lead to improvements in fitness and the consumption of a

proper diet. (Fonseca & Matos, 2005; Jessor et al., 1998; Kaplan et al., 1996; Mahon,

1994; Piko, 2000) Although it is a subjective measure, self-perceived health has been

shown to be related to more objective measures of health status and mortality from all

causes. (Kaplan et al., 1996; Manderbacka et al., 1999; Piko, 2000) Previous studies

examining the relationships between health behaviors, perceptions of health status,

and CVD risk factors have looked primarily at adults. However, because health

behaviors and the progression of disease begin early in life, it is also important to

study this relationship in adolescents.

An early study conducted by Belloc and Breslow (1972) found that physical

activity and good eating habits were associated with positive perceptions of health in

a sample of nearly 7,000 adults. Further analysis of health questionnaires revealed an

inverse association between these health practices and actual health status, as

determined by objective measures. Similarly, cross-sectional analysis of data from the

1979 National Survey of Personal Health Practices and Consequences revealed that

the more health behaviors respondents practiced, the less likely they were to report

health problems. Subjects included 3,025 adults between the ages of 20 and 64 years.

Of the behaviors subjects were asked about, which included participating in physical activity, eating breakfast, and weight control, physical activity had the highest correlation with positive health status. No correlation was observed between dietary practices and health status. (Wilson & Elinson, 1981) These early findings demonstrate inconsistencies in the research examining the positive effect that fitness and diet have on both perceived and actual health status in adults. The association is less clear regarding dietary practices and actual fitness levels, but physical activity seems to be a strong predictor of current and future risk of disease in an adult population.

More recent studies have found similar results. Mahon (1994) examined the relationship between positive health practices and perceived health status in 211 adolescents between the ages of 15 and 21 years. Using the Personal Lifestyle Questionnaire (PLQ) to assess health practices and the General Health Rating Index (GHRI) to measure perceived health status, a positive correlation was observed between exercise and nutrition and perceived health status. However, this study did not examine how these health behaviors affected future risk of morbidity and mortality. Similarly, Jessor et al. (1998) examined dietary and physical activity behaviors in adolescents in grades 7 through 9. Students completed questionnaires that assessed psychosocial factors, such as perception of health, and their physical activity and dietary patterns. Results from this study indicated that value on health and beliefs about the harmful effects of behaviors such as eating a high-fat diet and physical inactivity, related positively to health-enhancing behaviors. Although this study examined these variables in a different manner compared to the previously

mentioned studies, these findings suggest a reciprocal nature of the relationship between health behaviors and perceptions of health.

Several studies have examined the relationship between physical activity and perceived health status. When students between the ages of 18 and 31 years completed questionnaires regarding their physical activity behaviors during the previous 12 months and their perceptions of their health, physical activity was shown to a be a predictor of perceived health status (r=0.20). Researchers concluded that participation in physical activity was used as a "frame of reference" for rating health status. The effects of fitness on perceived health status were not assessed in this study. (Piko, 2000) Similarly, middle-aged men from the Kuopio Ischaemic Heart Disease Risk Factor Study who participated in physical activity and had higher levels of fitness were more likely to perceive their health as being good. After being followed over a period of five years, those who perceived their health as being "bad" had a higher prevalence of morbidity and mortality compared to those who perceived their health as being "good". (Kaplan et al., 1996) These findings relate primarily to older individuals but are important in demonstrating that perceived health status is a predictor of morbidity and mortality.

Racial differences in the associations between perceptions of health and physical activity status and fitness have also been observed. (Kohl & Hobbs, 1998; Piko, 2006; Fonseca & Matos, 2005; Ward et al., 2006) In a recent study, greater participation in physical activity and higher fitness were positively associated with perceptions of health only in 14-year old white girls. This relationship was not observed in their African American counterparts. (Ward et al., 2006) Similarly, Kimm et al. (2002)

found that African American girls seem to be at a greater risk for physical inactivity than other population groups. Between the ages of 9-10 and 16-17 years, leisure time physical activity declined by 100% in African American girls, compared with 64% for white girls. These findings suggest the need for further research in high-risk African American adolescents to determine if participation in health behaviors affects perceptions of health, and if these perceptions of health are related to the risk of disease later in life. With inconsistencies in the research and the age-related decline in physical activity and fitness from adolescence into young adulthood, it is critical to understand the predictors and determinants of this behavior.

Although the benefits of physical activity and fitness on a number of diseases have been well-established in middle-aged populations, the importance of and the relationship between these risk factors and the development of disease is less well understood in adolescents. (Andersen & Haraldsdottir, 1994) Adolescent health behaviors have both immediate and long-term benefits for health, as they may contribute to the delay or prevention of CVD and premature mortality. (Jessor et al., 1998) Those who are more aware of the consequences of health behaviors and incorporate physical activity and proper nutrition into their daily routines are more likely to continue those behaviors into adulthood, ultimately leading to a more favorable health profile. (Evans et al., 1994)

The association between diet and perceived health has also been studied. It has been established that consuming nutritious foods is critical for physical development and health and that nutritional intake can have long-term effects on health. (Croll et al., 2002) When examining the perceptions of adolescents regarding healthy eating,

Croll et al. (2001) found that students in grades 7 through 12 had an adequate knowledge of healthy eating recommendations and the importance of a good diet. However, a majority of students indicated that healthy eating was not important to them, which is consistent with findings from other qualitative studies. (Croll et al., 2001; Goodwin, Knol, Eddy, Fitqhugh, Kendrick, & Donahue, 2006) Similarly, analysis of data from the youth section of the 1990 California Tobacco Survey and Teenage Attitudes and Practices Survey indicated that only 8.5% of adolescents were concerned with healthy eating. (Evans et al., 1995) Cross-sectional studies have found that fruit and vegetable intake were positively associated with a positive ranking of self-assessed quality of health. Conversely, increased dietary fat intake associated with a negative ranking. (Goodwin et al., 2006; Manderbacka, Lundberg, & Martikainen, 1999) Unfortunately, limited focus has been placed on African American adolescents who are at a higher risk for eating unhealthy and developing disease, suggesting the importance of further research regarding the importance of diet as a potential predictor of the development of disease in this group.

Once an individual's health behaviors have been identified, it can be determined how those behaviors relate to the overall risk for developing disease. As previously mentioned, positive health practices are associated with positive perceived health status and perceived health status has been shown to be a strong predictor of morbidity and mortality. (Kaplan et al., 1996) Because CVD is the leading cause of death among men and women of all ethnicities, it is beneficial to determine how health behaviors and perceived health status affect an individual's risk for the development of CVD.

The benefit of physical fitness and dietary practices on disease risk is not well understood in adolescents and few data are available on CVD risk in adolescents because the development of disease occurs over several decades. (Andersen, 1996) However, the process of heart disease begins early in life and risk factors, when detected in children and adolescents, are predictive of CVD later in life. In a study conducted in 280 Brazilian schoolchildren between the ages of 10 and 14 years, 3.4% of girls were identified as having hypertension, approximately 20% had increased cholesterol levels, and almost 50% had decreased HDL-C levels. These values have been shown to be comparable to American adolescents. (Rodrigues et al., 2006) The girls in the study were also significantly less fit than their male counterparts, suggesting the importance of increasing physical activity and fitness in this group. (Rodrigues et al., 2006) Findings from this study demonstrate that risk factors for CVD develop early in life.

Numerous studies have found that increased fitness and participation in physical activity is associated with lower blood pressure, increased HDL-C levels, and a more favorable body composition. (Borehman, Twisk, van Mechelen, Savage, Strain, & Cran, 1999) Analysis of NHANES data suggested a strong inverse association between fitness and BMI and waist circumference in adolescents and adults. The association in adolescents is less clear. There was no association between SBP or HDL-C and fitness in adolescent females despite significant findings in adolescent males suggesting the need for further analysis in this age group. (Carenethon, Gulati, & Greenland, 2005)

Andersen (1996) examined the effects of physical activity and dietary practices on risk factors in a randomly selected group of 15 to 19 year olds. The relationship between physical activity and blood pressure and lipid profiles was not significant but risk factors and physical activity levels did track from adolescence into young adulthood. (Andersen, 1996; Andersen et al., 1994) The relationship was weaker in female participants as compared to their male counterparts, which may have been due to insufficient statistical power or the potential of examining a population that is more fit than the general population. It was also observed that a healthy diet low in fat and sugar intake was associated with being more fit and higher HDL -C levels. Although fitness, rather than diet, may have been responsible for the more favorable lipid profile, it is evident that risk factors track from adolescence over time.

The idea that risk factors in adolescence track into adulthood was also observed in the Bogalusa Heart Study. The Bogalusa Heart Study was a long-term epidemiological study examined cardiovascular risk factors over time to determine the predictive effects of childhood risk factor levels on future risk. Researchers found that adverse levels of risk factors, including blood pressure and cholesterol levels, persisted into later life and were significant predictors of the development of CVD. (Myers, Coughlin, Webber, Srinvasan, & Berenson, 1995; Webber, Srinivasan, Wattigney, & Berenson, 1991) These findings were consistent with those from the Muscatine Study, which found a correlation between childhood and adult blood pressure. (Lauer & Clarke, 1989)

Similarly, there is a positive association between fat consumption and CVD risk factors, such that increased fat consumption increases the risk of certain risk factors,

specifically blood pressure. (Appel et al., 1997; Puska et al., 1983) The association between dietary fat intake and body composition in adolescents is less clear. (Berkey, Rockett, Field, Gillman, Frazier, Camargo, & et al., 2000) In women, total fat intake was not associated with overall CVD risk. (Hu, Stampfer, Manson, Rimm, Colditz, Rosner, & et al., 1997) An inverse association between fruit and vegetable consumption and disease risk has also been observed such that consuming more fruits and vegetables had positive effects on blood pressure. These findings have been observed extensively in adults but are less clear in younger populations.

The aforementioned studies suggest that lifestyle behaviors and risk factors established in adolescence track into adulthood, highlighting the importance of examining these health behaviors during adolescence. They also suggest the practicality of using adolescent risk factors to predict the future risk of disease development.

Purpose and Hypotheses

As previously stated, it is important to identify the determinants of health behaviors in adolescents, as they have implications for future health status. The research examining physical fitness and dietary patterns in adolescent girls is limited and there are no previous studies that have looked at perceived health status as a potential mediator between these variables and CVD risk factors. Therefore, the purpose of this study was to examine the relationship between fitness and dietary behaviors and CVD risk factors, and determine if an individual's perceived health status mediated this relationship.

It was hypothesized that adolescent girls who have higher levels of fitness and consume less fat and more fruits and vegetables in their diet will be more likely to have positive self-perceptions of health. It was also predicted that a more positive view of health status would be inversely associated with CVD risk factors, such that high levels of fitness and fruit and vegetable consumption, along with a positive perception of health, would result in a lower risk for hypertension, dyslipidemia, and unfavorable body composition.

Ho$_1$: Increased physical fitness is associated with lower CVD risk factors. (Refer to C in Fig.1)

Ho$_2$: Increased fruit and vegetable consumption and low dietary fat intake are associated with lower CVD risk factors. (Refer to C in Fig.1)

Ho$_3$: The relationship between physical Fitness, Fat Score, and Fruit and Vegetable Score and CVD risk factors is mediated by an individual's perceived health status. (Refer to A and B in Fig.1)

Chapter II: Methods

Project Heart Summary

Project Heart was a randomized controlled trial conducted in a Baltimore magnet high school. Participants were randomized to an 8-month physical activity intervention conducted in physical education (PE) classes or a standard PE class (control). The purpose of this comprehensive physical activity intervention was to evaluate the effects of a school based physical activity intervention for increasing overall physical activity in high-school girls. (Young, Phillips, Yu, & Haythornthwaite, 2006) Because measures of physical activity, fruit and vegetable consumption and dietary fat intake, blood pressure and cholesterol levels were not all collected during follow-up sessions, for the present study, only data collected at baseline was analyzed. As a result, this study was cross-sectional.

Participants

Subjects included participants from the Project Heart: CAP study, which began in 2000 and ended in 2006. This physical activity intervention was conducted in 9th grade girls who attended an all-girls school in Baltimore City, Maryland. Students came from varying economic levels and different regions of the city. Inclusion criteria were 9th grade status, willingness to participate, and enrollment in two consecutive semesters of physical education (PE) classes. Exclusion criteria were medical conditions that would prevent participation in PE, pregnant or breastfeeding, planning to leave the local area, or enrollment of a sister in the program. Parental and student consent was obtained prior to participation. Of the 442 adolescents assessed

for eligibility, 221 were randomized into study, 83.0% of whom were African American. Baseline data was collected on participating subjects. (Young et al., 2006)

Study Overview

Physical activity that leads to increased fitness and consuming a healthy diet are lifestyle choices that greatly impact one's risk of developing disease in the future. Therefore, physical fitness and healthy eating were considered the independent variables in this analysis. The individual's perception of her health was the mediating variable between fitness and dietary behaviors and CVD risk factors. The mediator accounts for the relation between the predictors or behaviors and the outcome. (Baron & Kenny, 1989) It was hypothesized that the individual's perception of health would be directly related to her health behaviors, which, in turn, relates to her future risk of disease. The main outcomes, or dependent variables, are risk factors for CVD, including hypertension, low HDL-C levels, a high BMI, and a high waist circumference. (See Figure 1) Using the Baron and Kenny model to examine the relationship between variables, it was assumed that variations in levels of the independent variable significantly account for variations in the presumed mediator (a), variations in the mediator significantly account for variations in the dependent variable (b), and when these paths (a and b) are controlled for, the previously significant relation between the independent and dependent variables is no longer significant. (Baron & Kenny, 1986)
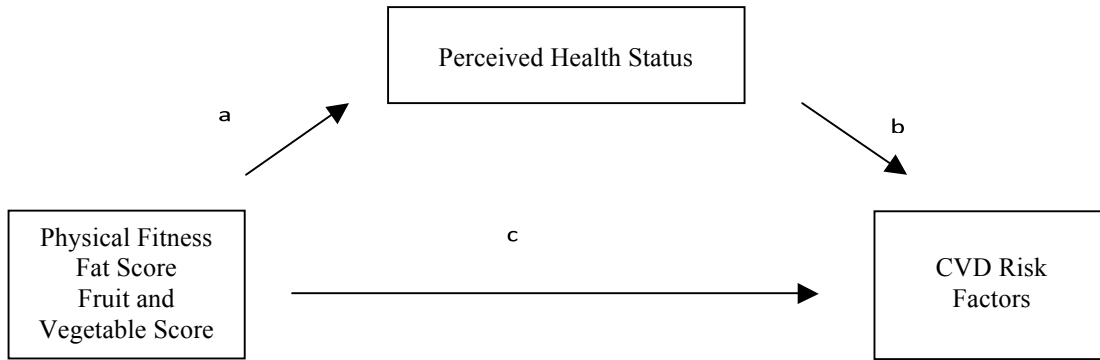
Figure 1. Baron and Kenny model for the mediator effect between the independent and dependent variables. Physical Fitness and Dietary Behaviors = IV; Perceived importance of health = mediator variables (MV); Cardiovascular Risk Score = DV. (a) is the relation between IV and MV; (b) is the relation between MV and DV; (c) is the relation between IV and DV.

Adapted from Baron, R.M. & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Independent Variables

Physical Fitness: Fitness was determined using a sub-maximal 3-stage step test designed for adolescents. (Ewart et al., 1995) Participants exercised at 50%, 59%, and 70% of their estimated maximal heart rate reserve by stepping up and down on 3 progressive step heights to meet the required energy expenditure. Participants continued to step at the varying step heights until the test was completed or she reached the target heart rate, which was 70% of estimated heart rate reserve.

Heart rate was recorded at 2:30, 2:45, and 3:00 of each 3-minute stage. If the participant did not exceed the target heart rate, she proceeded to the next stage. If the participant reached the target heart rate, the test was terminated.

Because all participants completed at least the first stage of the sub-maximal test, heart rate at the end of stage 1 was used to evaluate fitness. A lower heart rate at the end of stage 1 indicated better fitness.

Dietary Behaviors: Fruit and vegetable consumption (Fruit and Vegetable Score) and fat intake (Fat Score) were assessed using a modified version of the Berkeley Nutrition Services Fat Screener and the Berkeley Nutrition Services Food Screener. These are self-report instruments in which individuals indicated how many times per week they ate a variety of foods considered to by healthy and unhealthy. Seven food items were listed as fruits and vegetables and 17 items were listed as high-fat foods. (Block, Gillespie, Rosenbaum, & Jenson, 2000) Participants responded on a scale from 1=Did Not Eat through 5=Ate Three or More Times a Day. Individual responses for the seven fruit and vegetable items were summed and participants were given a score ranging from 1 to 35. A higher Fruit and Vegetable Score indicated greater consumption of fruits and vegetables and was considered better than a lower score. Similarly, individual items for dietary fat assessment were summed and given a score ranging from 1 to 85. A higher fat score indicated a greater dietary fat consumption and was considered worse for overall health compared to a lower score.

A study that examined the effectiveness of this survey found that, when compared to the "gold standard" 1995 Block 100 Item Food Frequency Questionnaire, there was a high correlation between total fat and fruit/vegetable consumption (criterion-related validity r=0.69 and r=0.71). (Block et al., 2000) The intraclass correlation coefficient for this instrument in overweight African American adolescent females (r= 0.87) indicated a high reliability for 3 days of recall. (Resnicow et al., 2000) It was therefore determined that this measure would accurately assess fruit, vegetable, and fat consumption in the study population.

Mediating Variable

Perceived Health Status: The individual's perception of health was assessed by having the adolescent rank their self-assessed health status using the question, "How do you consider your current health status?" Participants were asked to circle 1 for excellent, 2 for good, 3 for fair, and 4 for poor. This question was taken from the SF-36 health survey questionnaire, which has been found to have good test-retest reliability (r=0.80) and internal consistency (Chronbach's $\alpha = 0.95$) in subjects between 16 and 74 years of age. (Brazier, Harper, Jones, O'Cathain, Thomas, Usherwood, et al., 1992) This measure also has concurrent validity in relation to more complex, multi-item summary measures of general health. (Manderbacka et al., 1999)

Dependent Variables

Systolic and Diastolic Blood Pressure: Blood pressure was taken on the non-dominant arm, while the subject was seated and resting for 5 minutes, by a trained technician using a Dinamap automated blood pressure cuff. Three measurements were taken with one minute rest between measures. The three measures were averaged to determine resting blood pressure and recorded. (Young et al., 2006)

HDL-C: Lipid levels were obtained from a venous blood sample after a 12-hour fast to determine HDL-C. Samples were analyzed at Quest Diagnostics laboratory and results were recorded on the subject's data sheet. (Young, et al., 2006)

Body Mass Index (BMI): Height, weight, and waist circumference were determined using standard measures. Height was measured to the nearest 0.1 cm and weight to the nearest 0.11 kg. Body mass index (BMI) was calculated by dividing the height in square meters by the weight in kilograms.

Waist Circumference: Waist circumference was measured in a horizontal plane 1 cm above the umbilicus. (Young et al., 2006)

Statistical Analysis

Participants were excluded if they were missing information on any of the study variables. Means and variances of the independent, mediating, and dependent variables were calculated for demographic information, including age and ethnicity. A series of regression models were used to test for independent effects and mediation. To test Ho_1 and Ho_2 and determine if there was a significant relationship between the independent and dependent variables (Refer to Figure 1, part C), separate regression models were run for each CVD risk factor on each of the independent variables. Each model controlled for age and ethnicity because a majority of the sample was the same age and African American. Perceived health status was regressed on Fitness, Fat Score, and Fruit and Vegetable Score in separate models to test the association between the independent and mediating variables (Refer to Figure 1, part A). Each risk factors was then regressed on the proposed mediator, perceived health status, to determine if there were significant associations between the mediating and dependent variables (Refer to Figure 1, part B). Lastly, separate regression models were run for each CVD risk factor on each dependent variable with perceived health status as the mediating variable also included in the model. This model would test Ho_3 and allow for the determination of the significance, or non-significance, of the mediating variable. All statistics were analyzed using SPSS v.14. The level of significance for analysis was $p<.05$.

Chapter III: Results

Participant Characteristics

Of the 221 girls randomized into the Project Heart: CAP study, only 185 were

included in the present analysis due to missing information. Participant characteristics

are shown in Table 1. Approximately 83% of participants were African American,

with an average age of 14 years. The average heart rate obtained after the first stage

of the sub-maximal fitness step test was approximately 146bpm ($SD = 18.23$) but

ranged from 67 to 191bpm. Dietary behavior analysis revealed mean scores of 35

($SD = 9.12$) and 18 ($SD = 5.15$) respectively for fat and fruit and vegetable

consumption. The average score for participants' evaluation of their perceived health

status was approximately 2, indicating a "good" perception of health. Perceived

health status scores ranged from 1 to 4.

Cardiovascular risk factors included HDL-C, body composition measures (WC

and BMI), and blood pressure. Participants had an average HDL-C level of 52 mg/dL

($SD = 11.38$), which is considered slightly above what would be considered high–risk

for this age group. Body composition measures included waist circumference ($77 \pm$

14.51) and BMI (25 ± 6.87). The average blood pressure was 109/60mmHg (Table 1).

Pearson correlations are shown in Table 2. Analysis revealed significant

correlations between the Fat Score and Fruit and Vegetable Score ($r = .448$). Dietary

fat intake was inversely correlated with WC ($r = -.171$), BMI ($r = -.143$), and SBP ($r =$

$-.194$). Fitness was unrelated to any of the CVD risk factors. Perceived health status

was moderately correlated with WC ($r = .408$), BMI ($r = .411$), and SBP ($r = .218$).

Systolic blood pressure was inversely correlated with HDL-C ($r = -.239$) and

positively correlated with WC (r = .514). There was also a moderate correlation between systolic and diastolic blood pressure (r = .508).

To determine if perceived health status mediated the effects between fitness and dietary behaviors and CVD risk factors, the Baron and Kenny steps to determine mediation were applied.

1. Variations in Levels of the Independent Variable Significantly Account for Variations in the Presumed Mediator

Regression analysis was first used to determine the independent associations between Fitness, Fat Score, and Fruit and Vegetable Score (independent variables) and each of the CVD risk factors (dependent variables). There was no significant association between Fitness and HDL-C, BMI, WC, SBP or DBP (Table 3).

Regression of CVD risk factors on dietary fat intake indicated significant inverse associations between Fat Score and WC (p = .02) and SBP (p = .01), as shown in Table 4. Greater dietary fat consumption, as indicated by a higher Fat Score, was associated with a small but significant decrease in WC and SBP. These findings appear to be in the opposite direction of what would be expected. There were no significant associations with Fat Score and HDL-C, BMI, or DBP.

Regression analysis revealed no significant associations between the Fruit and Vegetable Score and any of the CVD risk factors. Increased fruit and vegetable consumption did not predict HDL-C, WC, BMI, SBP or DBP (Table 5).

There were no significant associations between Fitness, Fat Score, or Fruit and Vegetable Score and perceived health status. Because step 1 was not met, there was

no need for further mediation analysis. However, regression analysis was used to examine the relationship between the mediator and each dependent variable.

2. Variations in the Mediator Significantly Account for Variations in the Dependent Variables

The associations between perceived health status and each of the CVD risk factors are shown in Table 7. Regression analysis revealed significant associations between perceived health and WC (p=.000), BMI (p=.000), and SBP (p=.003). For every unit increase in perceived health status, which indicated a poorer rating of health status, there was an 8cm increase in WC and a 4kg/m^2 increase in BMI. For every unit increase in perceived health (poorer health rating), there was also approximately a 4mmHg increase in systolic blood pressure. There were no significant associations between perceived health status and HDL-C or DBP.

Summary of Results

As noted earlier, no significant associations were found when perceived health status was regressed on each independent variable (Fig. 2, part a). Only Fat Score was significantly associated with a few CVD risk factors. Fitness and the Fruit and Vegetable Score did not predict any of the CVD risk factors (top portion of Fig. 2). There were significant findings for some CVD risk factors when regressed on perceived health status (Fig, 2, part b). However, because there was no association between the independent and mediating variables, it was unnecessary to proceed with further analysis to the third step (when these paths are controlled for, the previously significant relations between the independent and dependent variables are no longer significant).

Chapter IV: Discussion

The purpose of this study was to determine if the relationship between Fitness, Fat Score, Fruit and Vegetable Score and CVD risk factors is mediated by perceived health status. The main findings of this study were that no associations were found between Fitness, Fat Score, Fruit and Vegetable Score and perceived health status and only Fat Score was associated with some of the CVD risk factors. Although perceived health status was not a mediating variable, it independently predicted several CVD risk factors.

The hypothesized model that suggested perceived health status would mediate the relationship between fitness, fat intake, fruit and vegetable consumption and CVD risk factors did not work for the current study population. It was hypothesized that those who participated in healthy lifestyle behaviors would perceive their health as being better than those who did not. This in turn would lead to a decreased risk for CVD risk factors. A potential reason for this model not working is the young age of the participants, which ultimately gave them lower risk for disease and CVD risk factors. However this was a high-risk youth population and research has shown that risk factors in adolescence track into adulthood. (Andersen et al., 1996; Myers et al., 1995; Webber et al., 1991)

Another possible reason is that the study population may have considered factors other than fitness and diet when assessing their health status. Despite being young, the average BMI of participants indicated that approximately half of the girls were overweight according to BMI cut-points for adolescent girls. (Cole, Bellezzi, Flegal, & Dietz, 2000) Previous research regarding BMI has consistently suggested that BMI

is associated with individual and a clustering of CVD risk factors including hypertension and dyslipidemia, suggesting that participants would also have these other risk factors. (Cugnetto et al., 2008)It is possible that a high BMI may not contribute to other risk factors in this population. It has been suggested that there are cultural differences in body size perceptions such that African American girls are more likely to be comfortable with a larger body size. (Kelly, Eisenberg, Story, & Neumark-Sztainer, 2005) It is possible that African American girls may be less likely to view their overweight status as negative factor compared to other ethnicities. Additionally, poor lifestyle factors such as poor fitness and eating unhealthy foods are thought to account for increases in BMI. (Goran, 2001; Hill & Melanson, 1999) Thus, it was expected that a high BMI would be associated with lower fitness, poor diet, and ultimately unfavorable lipid levels and blood pressure.

Similarly, the health belief model was chosen to provide the underlying theoretical framework for this study. It was hypothesized that lifestyle behaviors would affect perceptions of health and those who viewed their health as being important were more likely to participate in healthy behaviors. This theory may have been inappropriate for this population. If African American girls regard their health as being "good" despite their overweight status, they may be less likely to view physical fitness and consuming a healthy diet as being important factors in positively affecting one's health. It has been suggested that women tend to use other factors, such as frequency of illness or injury, to assess their overall quality of health. (Piko, 2006) These other factors may outweigh participation in exercise and proper dietary habits. If participants in this study were rarely sick or did not miss school days due to injury

or illness, they may be more likely to view their health as being "good" compared to those who were often sick. If these factors are given more consideration when assessing overall health than fitness and diet, this could lead to less participation in these healthy behaviors.

Importance of Perceived Health Status

Self-perceived health is a subjective measure of assessing how one views' her health based on various components. It was thought that participation in healthy behaviors would positively affect perceived health status. However, there was no association between Fitness, Fat Score, or Fruit and Vegetable Score and perceived health status, which was a requirement for testing for mediation. Our findings differ from previous research that has suggested that adolescents tend to use health behaviors as a frame of reference for assessing their current health status. (Piko, 2006) Specifically, earlier research has found that dietary behaviors and perceived fitness have been related to perceived health status although much of this work has looked at adults. (Milligan, Burke, Beilin, Richards, Dunbar, Spencer, & et al., 1997; Pastor, Balaguer, Pons, & Garcia-Merita, 2003; Piko, 2006; Tremblay, Dahinten, & Kohen, 2003) Perceived health status did predict WC, BMI, and SBP. This association also indicates that African American adolescent girls in this sample were able to accurately assess their overall health status, as determined by objective measures of health status.

It is possible that those who perceive their health as being "good" have greater self-efficacy and self-esteem, which meta-analysis has shown to have a moderate effect size. (Yarcheski, Mahon, Yarcheski, & Cannella, 2004) Adolescent girls who

feel more capable of participating in physical activity to increase fitness or eating a healthy diet may be more willing to try these healthy behaviors. This would lead to decreased risk of disease later in life. Also, those girls who have greater self-esteem may be more comfortable with their overall body image and health. Increased self-esteem may also increase the likelihood of participation in healthy behaviors.

Fat Intake and CVD Risk Factors

Increased dietary fat consumption was inversely associated with BMI and SBP, such that for every unit increase in fat score, indicating poorer diet choices, there was a decrease in BMI and blood pressure. Although these changes in risk factors were small, they were in an unexpected direction and are inconsistent with previous research. In adolescents, dietary fat intake was not associated with BMI (Berkey, Rockett, Field, Gillman, Frazier, Camargo, & et al., 2000) but was associated with systolic and diastolic blood pressures in adults. (Appel et al., 1997; Puska et al., 1983) In women, total fat intake was not associated with overall CVD risk. (Hu, Stampfer, Manson, Rimm, Colditz, Rosner, & et al., 1997) When assessing total fat intake, the proportions of the types of fats being consumed may be a greater indicator of health behaviors than total fat intake. The negative effects of saturated and trans fats may be balanced by the benefits of mono- and poly-unsaturated fats. (Cugnetto et al., 2008; Dholpuria, Raja, Chahar, Gupta, & Purohit, 2007) Because the tool used to assess diet in this study was not specific in determining the types of fats being consumed, it may be that girls were consuming more healthy fats, which would lessen their risk for disease.

There were no associations between fitness, fat score, or fruit and vegetable score and perceived health status. Earlier findings suggested that fitness and perceived health status were only significantly associated in adolescent white girls but not their African American counterparts, which is consistent with our findings. (Ward et al., 2006) However, our findings regarding fat and fruit and vegetable consumption are unexpected and inconsistent with previous research that has shown that dietary behaviors are predictors of perceived health status. (Goodwin et al., 2006; Manderbacka et al., 1999) Our findings suggest that African American adolescent girls use factors other than fitness and diet, such as sickness and self-esteem, when assessing their overall quality of health.

Fitness and CVD Risk Factors

The lack of associations between fitness and CVD risk factors was unexpected and inconsistent with previous research where fitness was inversely associated with cholesterol levels, body fatness, and blood pressure. (Borehman, Twisk, van Mechelen, Savage, Strain, & Cran, 1999) Analysis of NHANES data suggested a strong inverse association between fitness and BMI and waist circumference in adults. The association in adolescents is less clear. In one study on adolescents, there was no association between SBP or HDL-C and fitness in adolescent females despite significant findings in adolescent males, which is consistent with our findings. (Carenethon, Gulati, & Greenland, 2005) However, other studies have found cardiorespiratory fitness to be a strong predictor of individual risk factors as well as the clustering of risk factors in adolescents. (Anderssen, Cooper, Riddoch, Sardinha, Harro, Brage, & et al., 2007) It may be that the benefits of fitness may not be evident

in younger adolescents, especially young girls. It is important to note that many studies that have found these relationships have used a maximal aerobic test to determine fitness. It may be possible that the sub-maximal test used to estimate aerobic fitness was not able to accurately assess fitness. This tool was developed specifically for overweight adolescents in this study but had not been validated prior to the study. Similar to fitness, when testing the association between physical activity and CVD risk factors, participation in physical activity was unable to predict any risk factor. While also inconsistent with previous research, this is not surprising due to the high association between physical activity status and fitness.

Fruit and Vegetable Consumption and CVD Risk Factors

Fruit and vegetable consumption was also not associated with any CVD risk factors. This was unexpected due to the significant correlation between the Fat Score and Fruit and Vegetable Score. It is also inconsistent with previous research, which has demonstrated an inverse association between fruit and vegetable consumption and systolic and diastolic blood pressure. (Appel et al., 1997) Again it is possible that the instrument used to assess fruit and vegetable consumption did not include foods that are commonly eaten by this population, which may underestimate total fruit and vegetable consumption. Participants may have also overestimated their dietary behaviors if they wanted to appear healthier than they actually were.

Importance and Significance

Despite finding no associations between fitness or vegetable consumption and CVD risk factors, dietary fat consumption and perceived health predicted several risk factors in a predominantly African American sample of adolescent girls. This

population is at an increased risk for the development of CVD and CVD risk factors but they seem to be able to accurately assess their overall health status. Determining the predictors of CVD risk factors in adolescence may help in the development of appropriate interventions to promote healthy behaviors that target this population.

Limitations

There are several limitations with this study. Because this study was cross-sectional, causal relationships between perceived health status and CVD risk factors could not be determined. Similarly, if participants had been followed over time, potential improvements in fitness or changes in dietary habits may have shown significant associations with CVD risk factors.

There are also limitations with generalizability. Participants were all female and from a single urban school. A majority of participants were African American, which makes it difficult to extend our findings in this group to other ethnic populations. However, it was important to study this population due to the increased risk for the development of CVD associated with this ethnic group.

Lastly, methods used to assess the fitness and dietary components of participants may not have been appropriate. The submaximal test is not a direct measure of fitness so there may be errors associated with estimating fitness using the current fitness test. For example, energy expenditure was determined based on heart rate reserve. This formula uses an age-predicted equation to estimate maximal heart rate. Despite its convenience, this equation often underestimates an individual's actual maximal heart rate. Similarly, resting heart rate is also included in the heart rate reserve formula. Resting heart rate was taken while participants were seated but may not represent

actual resting heart rate if participants were anxious for the test or had been active

prior to taking heart rate. Lastly, participants had to keep cadence throughout the test.

If they were unable to do so and began stepping too fast or slow, this would change

their heart rate and either under- or over-estimate their fitness.

The Berkley Nutrition Services Food Screener may not have been sensitive to

actual dietary habits in this age group. Many commonly eaten foods may not have

been included on the questionnaire, thus greatly underestimating total fat intake or

fruit and vegetable consumption. Only seven food items were used to assess fruit and

vegetable consumption. Three of these items included drinks or soups and two

questions asked if any fruit and vegetables were eaten with few to no examples that

may have help adolescents recall foods eaten. Portion sizes were also not accounted

for which can also over- or underestimate actual food consumption. The gold-

standard 24-hour Dietary Recall may have been more representative of the actual

eating behaviors in this population. (Cugnetto et al., 2008) However, the Dietary

Recall method is much more expensive. It is important to note, however, that fitness

and diet were not main outcomes for the Project Heart study. The chosen methods for

assessing these variables were more cost-effective and timely.

Despite these limitations, this study can provide beneficial information regarding

physical activity and dietary patterns and health status in a high-risk population.

Determining the indicators that are related to health behaviors can be useful in

developing appropriate and effective interventions that aim to increase health-

promoting behaviors in African American adolescents. These interventions could then

lead to a more favorable CVD risk profile by reducing the risk factors associated with the disease.

Conclusion

In a predominantly African American sample of adolescent girls, perceived health status, regardless of fitness and dietary behaviors, seemed to be a strong predictor of BMI, WC, and SBP. It is possible that interventions that encourage girls to consider their fitness and diet when assessing their health status may be an important strategy to encourage girls to participate in these behaviors that positively affect their health.

Table 1.

Participant Characteristics (n = 185)

Variables	Mean	SD[a]	Range
Age	13.7	0.454	(13.7 – 15.0)
Fitness [b]	145.8	18.23	(56.6 - 190.6)
Fat Score [b]	35.0	9.12	(17.0 – 71.0)
Fruit and Vegetable Score [b]	17.8	5.15	(10.0 – 35.0)
Perceived Health Status[c]	2.0	0.70	(1.0 – 4.0)
$Cholesterol_{total}$ (mg/dL)[d]	157.7	26.70	(85.0 – 256.0)
HDL-C (mg/dL)[d]	52.4	11.39	(30.0 – 98.0)
WC_{avg} (cm) [d]	77.9	14.51	(54.0 - 123.0)
BMI (kg/m^2)[d]	25.3	6.87	(14.8 - 46.7)
SBP_{avg} (mm Hg)[d]	109.1	11.91	(81.0 – 163.0)
DBP_{avg} (mm Hg)[d]	59.6	6.68	(42.3 - 82.7)
Ethnicity (%)			
African American	83.0		
BMI (kg/m^2) (%)			
Normal	52.3		
Overweight	21.6		
Obese	26.1		

Note. Fitness represents the average heart rate during a submaximal fitness test such that a lower value indicates greater fitness. Values for Fat Score are the mean of reported scores on a 85-point scale such that a higher score indicates greater fat consumption. Values for the FV Score are the mean reported scores on a 35-point scale; a higher score indicates higher fruit and vegetable consumption. Values for perceived health are the mean reported on a 4-point scale (*1 = excellent, 4 = poor*). HDL-C = high-density lipoprotein cholesterol; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure.
[a]Standard deviation.
[b]Independent Variables.
[c]Mediating Variable.
[d]Dependent Variables.

Table 2

Pearson Correlations of Physical Fitness, Fat Score, Fruit and Vegetable Score, Perceived Health Status and Cardiovascular Disease Risk Factors

	Age	Ethnicity	Fitness	Fat Score	FV[a] Score	PHS	HDL-C	WCavg	BMI	SBPavg
Ethnicity	-.054	-								
Fitness	-.031	.092	-							
Fat Score	-.105	.101	.117	-						
FV[a] Score	-.048	.018	-.004	.448**	-					
PHS	.020	.070	.079	-.069	-.012	-				
HDL-C	.038	-.058	.064	.041	-.037	-.070	-			
WC$_{avg}$	.098	-.010	.032	-.171*	-.033	.408**	-.103	-		
BMI	.065	-.004	.024	-.143*	-.014	.411**	-.104	.928**	-	
SBP$_{avg}$	.090	-.063	.072	-.194**	-.036	.218**	-.239**	.514**	.553**	-
DBP$_{avg}$	.073	-.100	-.048	-.140	.016	.121	.061	.160*	.148*	.508**

Note. Fitness represents the average heart rate during a submaximal fitness test such that a lower value indicates greater fitness. Values for Fat Score are the mean of reported scores on a 85-point scale such that a higher score indicates greater fat consumption. Values for the FV Score are the mean reported scores on a 35-point scale; a higher score indicates higher fruit and vegetable consumption. Values for perceived health are the mean reported on a 4-point scale (*1 = excellent, 4 = poor*). FV Score = Fruit and Vegetable Score; PHS = Perceived Health Status; HDL-C = high-density lipoprotein lipase (mg/dL); WC = waist circumference (cm); BMI = body mass index (kg/m^2); SBP = systolic blood pressure (mm Hg); DBP = diastolic blood pressure (mm Hg).
[a] FV Score = Fruit and Vegetable Score
*p < .05.
**p < .01.

Table 3.

Summary of Regression Analysis of Fitness on CVD Risk Factors, Controlling for Age and Ethnicity

	CVD Risk Factors			
	B	*SEB*	*t value*	*p*
Fitness	*HDL-C (mg/dL)*			
	.001	.001	1.262	.208
	WC (cm)			
	.017	.058	.295	.768
	BMI (kg/m^2)			
	.002	.028	.078	.938
	SBP (mm Hg)			
	.045	.047	.954	.341
	DBP (mm Hg)			
	-.019	.027	-.719	.473

Note. Controlling for age and ethnicity. Fitness represents the average heart rate during a submaximal fitness test such that a lower value indicates greater fitness. Separate linear regression models run for each CVD risk factor. HDL-C = high-density lipoprotein cholesterol; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Table 4.

Summary of Regression Analysis of Fat Score on CVD Risk Factors, Controlling for Age and Ethnicity

	CVD Risk Factors			
	B	*SEB*	*t value*	*p*
Fat Score	*HDL-C (mg/dL)*			
	.001	.002	.618	.537
	WC (cm)			
	-.258	.113	-2.272	.024*
	BMI (kg/m^2)			
	-.103	.055	-1.889	.060
	SBP (mm Hg)			
	-.243	.093	-2.617	.010**
	DBP (mm Hg)			
	-.097	.053	-1.850	.066

Note. Controls are age and ethnicity. Values for Fat Score are the mean of reported scores on a 85-point scale such that a higher score indicates greater fat consumption. Separate linear regression models run for each CVD risk factor. HDL-C = high-density lipoprotein cholesterol; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure.
*p < .05.
**p < .01.

Table 5.

Summary of Regression Analysis of Fruit and Vegetable Score on CVD Risk Factors, Controlling for Age and Ethnicity

	CVD Risk Factors			
	B	*SEB*	*t value*	*p*
Fruit and Vegetable Score	*HDL-C (mg/dL)*			
	.005	.003	1.508	.133
	WC (cm)			
	-.081	.204	-.398	.691
	BMI (kg/m^2)			
	-.018	.099	-.185	.854
	SBP (mm Hg)			
	-.073	.168	-.437	.663
	DBP (mm Hg)			
	.026	.094	.273	.785

Note. Controlling for age and ethnicity. Values for the Fruit and Vegetable Score are the mean reported scores on a 35-point scale; a higher score indicates higher fruit and vegetable consumption. Separate linear regression models run for each CVD risk factor. HDL-C = high-density lipoprotein cholesterol; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Table 6.

Multiple Regression Analysis of Fitness, Fat Score and Fruit and Vegetable Score on Predicting Perceived Health Status

| | Perceived Health Status | | | |
	B	*SEB*	*t value*	*p*
Fitness	.003	.003	1.243	.215
Fat Score	-.007	-.006	-1.087	.278
Fruit and Vegetable Score	.004	.011	.358	.721

Note. Controlling for age and ethnicity. Fitness represents the average heart rate during a submaximal fitness test such that a lower value indicates greater fitness. Values for Fat Score are the mean of reported scores on a 85-point scale such that a higher score indicates greater fat consumption. Values for the FV Score are the mean reported scores on a 35-point scale; a higher score indicates higher fruit and vegetable consumption. Values for perceived health are the mean reported on a 4-point scale (*1 = excellent, 4 = poor*).
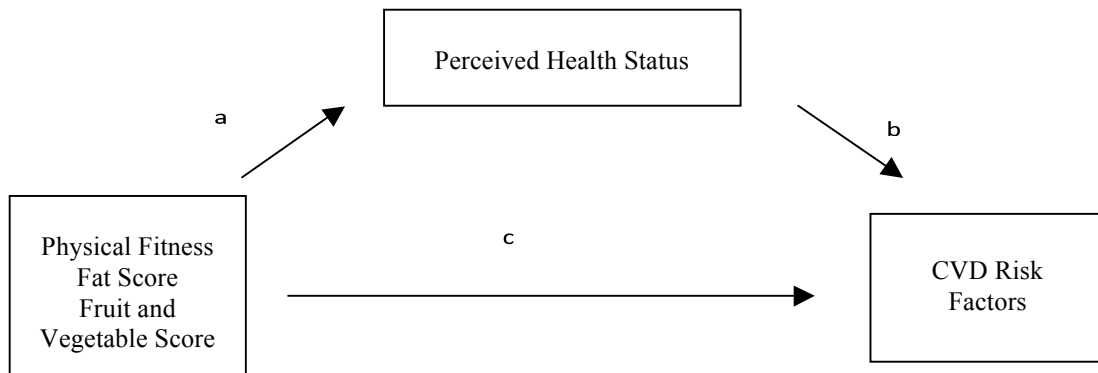
Table 7.

Summary of Regression Analysis of Perceived Health Status on CVD Risk Factors, Controlling for Age and Ethnicity

	Cardiovascular Risk Factors			
	B	*SEB*	*t value*	*p*
Perceived Health Status	*HDL-C (mg/dL)*			
	-.003	024	-.121	.904
	WC (cm)			
	8.477	1.375	6.166	.000**
	BMI (kg/m²)			
	4.079	.656	6.214	.000**
	SBP (mm Hg)			
	3.702	1.120	3.059	.003**
	DBP (mm Hg)			
	1.147	.691	1.661	.098

Note: Controls are age and ethnicity. Values for perceived health are the mean reported on a 4-point scale (*1 = excellent, 4 = poor*). Separate linear regression models run for each CVD risk factor. HDL-C = high-density lipoprotein cholesterol; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure.
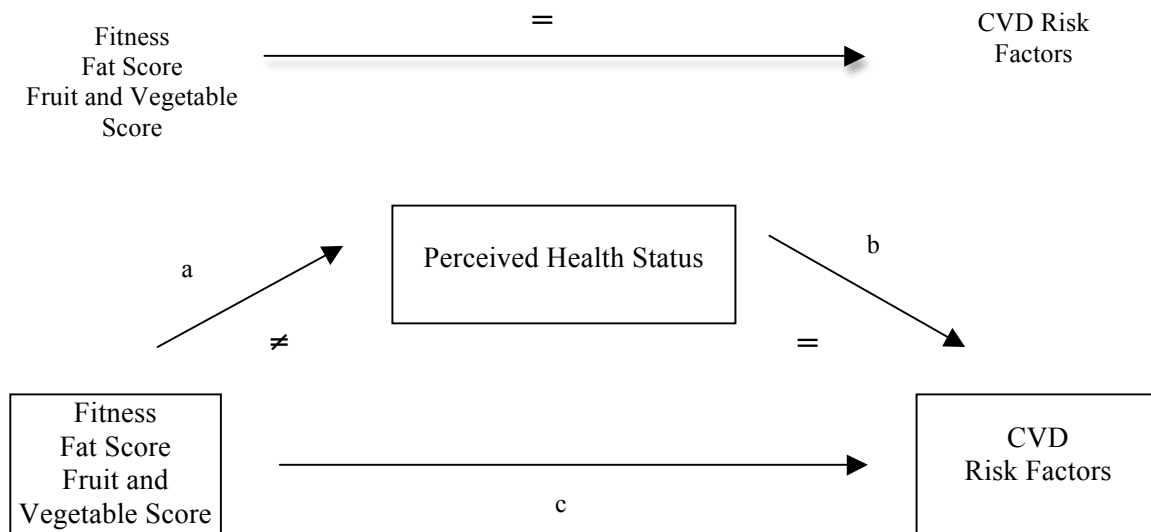*p < .05.
**P < .01.

Figure 1. Baron and Kenny model for the mediator effect between the independent and dependent variables. Physical Fitness and Dietary Behaviors = IV; Perceived importance of health = mediator variables (MV); Cardiovascular Risk Score = DV. (a) is the relation between IV and MV; (b) is the relation between MV and DV; (c) is the relation between IV and DV.

Adapted from Baron, R.M. & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Fitness
Fat Score
Fruit and Vegetable
Score

=

CVD Risk
Factors

a

Perceived Health Status

b

≠

=

Fitness
Fat Score
Fruit and
Vegetable Score

c

CVD
Risk Factors

Figure 2. Baron and Kenny model for the mediator effect between the independent and dependent variables after regression analysis. Physical Activity and Dietary Behaviors = IV; Perceived importance of health = mediator variables (MV); CVD Risk Factors = DV. (a) is the relation between IV and MV; (b) is the relation between MV and DV; (c) is the relation between IV, MV, and DV. Top portion of figure is the relation between IV and DV without MV.

Adapted from Baron, R.M. & Kenny, D.A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

*Fat score was only significantly associated with WC and BMI. There were no significant associations between Fitness or FV score and any of the CVD risk factors.

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