University of Cincinnati

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I, Kathleen Ash, hereby submit this original work as part of the requirements for the degree of Master of Science in Nutrition.

It is entitled:
The relationship between family history of disease and adherence to a DASH dietary pattern by adolescents with high blood pressure

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This work and its defense approved by:

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Committee member: Sarah Couch, Ph.D.
The relationship between family history of disease and adherence to a DASH dietary pattern by adolescents with high blood pressure

A thesis submitted to the
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Of the University of Cincinnati
In partial fulfillment of the
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In the Department of Nutrition
College of Allied Health

By

Kathleen Ash
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Committee Chair: Abigail Peairs, PhD
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ABSTRACT

Purpose: To investigate the relationship between family history of cardiovascular disease (inclusive of heart disease, high blood pressure and stroke) and adherence to a Dietary Approaches to Stop Hypertension (DASH) type dietary pattern by adolescents with high blood pressure.

Subjects: 111 adolescents ages 11-18 diagnosed with either pre-hypertension or stage I hypertension, who voluntarily participated in a nutrition intervention program promoting a DASH type dietary plan were included in this study.

Methods: All participants were recruited from Cincinnati Children’s Hypertension Center (CCHC) located at Cincinnati Children’s Hospital Medical Center (CCHMC). Subjects were randomly selected to be in one of two groups: the DASH-4-Teens intervention group or usual care group. Both groups received dietary counseling focusing on the development of a DASH type dietary pattern, rich in fruits, vegetables, and low fat dairy products and low in sodium and fat. Only those participants who completed both the baseline and 6 month follow up visit were included in these analyses. Multiple regression mixed models were used to evaluate the association between family history of diseases and change in DASH score which represented adherence. Statistical significance was defined as P<0.05. Data analysis was conducted using SAS version 9.2 (SAS Inc., Daly, NC, USA).

Results: A family history of heart attack was significantly associated with a positive change in DASH score, and change in DASH fruit component score. There were no significant relationships between family history of high blood pressure and stroke and change in DASH score or independent DASH component scores.
Conclusion: Based on these findings, family history of heart attack predicted a positive change in adolescent DASH score and DASH fruit score. Additional research is needed to confirm these relationships and determine why these relationships exist. If family history of heart disease proves to be a predictor of adolescent adherence to a therapeutic diet to lower blood pressure, it may be useful to emphasize the familial relationships between high blood pressure and heart disease to positively influence adherence to the DASH dietary pattern.
ACKNOWLEDGEMENTS

I would like to thank my advisor Dr. Abigail Peairs for her continued support and help in completing my thesis. I would also like to thank Dr. Sarah Couch for giving me the opportunity to work on this project and guiding me through the process. I am grateful for all who have put time and effort into helping me complete my thesis.
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LITERATURE REVIEW

I. Introduction

The presence of hypertension in the adolescent population has increased substantially in recent years. Considerably less research has been conducted regarding the treatment of hypertension in children as compared to adults. Effective treatment is necessary for the health and future of our youth. The following literature review will describe the significance and prevalence of hypertension in the adolescent population and treatment options, specifically focusing on the DASH diet known to effectively lower blood pressure. However, the effectiveness of treatment is only as good as the adherence to the proposed diet. Therefore this review will discuss known predictors of adolescent adherence to health regimens in order to explore the possible relationship between family history of certain cardiovascular/metabolic disease/risk factors and compliance to health recommendations.

II. Adolescent Hypertension

In recent years, the prevalence of overweight and obesity in the United States has increased substantially among all age groups. Along with the rise in obesity has come a subsequent rise in hypertension, affecting all age groups, including teenagers. The method of diagnosis for adolescent hypertension is different than for the adult population. Rather than using specific cut points as in adults, in children and adolescents, hypertension is defined as a systolic and/or diastolic blood pressure greater than or equal to the 95th percentile for age, gender, and height measured on three separate occasions. Depending on the severity of the disease, individuals are diagnosed with having either stage I or stage II hypertension. In youth, stage I hypertension includes those individuals with blood pressure readings between the 95th and 99th
percentile for both their age and sex, while stage II hypertension includes any individual who falls above the 99th percentile.

Hypertension in the adolescent population is of great concern, primarily due to the long term negative health consequences associated with high blood pressure. Notably, hypertension is directly related to an increase in the risk of multiple cardiovascular and renovascular diseases, including congestive heart failure, myocardial infarction, renal disease and stroke. Even a mild case of hypertension can result in harmful effects on both the heart and blood vessels.

Numerous metabolic complications can be related to high blood pressure, such as dyslipidemia, type 2 diabetes and cardiovascular diseases. Thus, it is clear that early identification, diagnosis, and treatment of hypertension is crucial in the prevention of life-long health issues.

III. Hypertension Risk Factors

There are several factors that put individuals at greater risk for hypertension. Many of these risk factors are related to lifestyle and are modifiable including: overweight/obesity, lack of physical activity, and poor diet. As previously mentioned, overweight and obesity puts an individual at greater risk for hypertension. Weight gain stimulates sympathetic activity which is thought to subsequently cause blood pressure elevation. A poor diet consisting of a high amount of sodium and/or a low amount of potassium can also increase the likelihood of developing hypertension. Consideration should also be given to the fact that high blood pressure is often a secondary factor as a result of some other underlying chronic disease such as kidney disease, high cholesterol or diabetes.

Other risk factors are predetermined, and therefore non modifiable. They include age, race and family history. For example, individuals with parents or other close relatives who have been diagnosed with hypertension are at an increased risk for the development of the disease.
themselves. Age and race also play a part in the development of the disease. More than 50% of Americans ages 60-69 and more than ¾ of those ages 70 or older are affected by high blood pressure. Hypertension is also more common in the African American population. Patients who are more susceptible to developing high blood pressure must be aware of common signs and symptoms. If an individual does develop high blood pressure, effective treatment is needed in order to minimize the risk of potentially lifelong cardiovascular consequences.

IV. Treatment for Hypertension

There are several effective methods to reduce blood pressure if necessary. Pharmacological treatment of hypertension has proven benefits; however blood pressure lowering medications are costly and have potential for adverse effects. Also, much is still unknown regarding the long term effectiveness and safety of these medications, particularly when used in youth. A more common first line of treatment includes lifestyle modifications, such as improving diet and/or increasing physical activity. Weight management is often the focus of treatment for obesity-related hypertension to prevent further increases in blood pressure. Specific diet modifications have proven to be effective and comprise a central part of the treatment strategy for those diagnosed with hypertension. One such dietary plan developed for the purpose of lowering blood pressure is the Dietary Approaches to Stop Hypertension (DASH) diet.

V. The DASH Diet

The DASH dietary pattern was formulated by researchers from Johns Hopkins University in an effort to optimize daily food group servings containing nutrients that have been shown to lower blood pressure. This dietary pattern focuses on the consumption of fruits, vegetables, and
low-fat dairy products for the purpose of lowering blood pressure\textsuperscript{15}. The diet ensures a rich
consumption of essential nutrients such as potassium, calcium, magnesium and dietary fiber,
while limiting sodium intake\textsuperscript{16}. The DASH plan was not created specifically as a weight loss
diet however, a reduction in dietary fat is emphasized by the DASH eating plan because of the
ability of dietary fat to negatively alter blood lipid levels\textsuperscript{17}. The most important aspects of the
diet include the consumption of 7-10 servings of fruits and vegetables each day, three servings of
low fat dairy foods each day, and choosing to consume mostly low fat and low sodium foods.

VI. \textit{The DASH Dietary Pattern and Hypertension}

DASH like eating has proven successful in lowering blood pressure in the adult
population, compared to a diet focusing solely on lowering sodium consumption\textsuperscript{15}. The DASH
dietary approach positively alters blood pressure by effectively lowering both systolic and
diastolic blood pressure in hypertensive adults\textsuperscript{15}, suggesting that it may be a useful tool to
control high blood pressure. In addition, following the DASH eating pattern was shown to
positively affect other health indicators such as blood lipids\textsuperscript{18}. Numerous observational studies
have confirmed that adherence to a DASH like eating pattern is related to better cardiovascular
health and associated with lower prevalence of hypertension\textsuperscript{15,18,19}. Adults have experienced the
beneficial effect of the diet on blood pressure in as little as two weeks\textsuperscript{20}. Health experts suggest
the same effect will be seen in the teenage population if the diet is followed properly. In fact, it
has been shown that consuming a DASH-type diet was associated with lower prevalence of
hypertension in youth with type 1 diabetes mellitus\textsuperscript{21}. Also, Moore and colleagues suggest that
increased consumption of fruits, vegetables, and dairy is associated with lower blood pressure in
healthy children\textsuperscript{19}. Additional studies investigating this trend in children are needed to confirm
these findings.
The observed beneficial effects of the DASH dietary pattern on blood pressure can be attributed to the nutrients consumed in high amounts as part of the dietary plan. The DASH dietary pattern places emphasize on fruits and vegetables which are high in potassium. Potassium may lower blood pressure through a direct vasodilatory role, alterations in the rennin-angiotensin system, and/or renal sodium handling. Low fat dairy foods, also emphasized in the diet, increase levels of calcium in the body. Ca²⁺ is known to activate the endothelial potassium channels. Decreased levels of calcium in the body may cause smooth muscles to vasoconstrict, resulting in a rise in blood pressure. In addition, lowering total saturated fat in the diet has been shown to reduce blood pressure. It is proposed that these nutrients have an additive or interactive effect when provided together in whole foods. Thus, adhering to each aspect of the DASH dietary pattern is essential to effectively lower blood pressure.

VII. Adherence to Health Interventions

Adherence to prescribed health recommendations is a primary determinant of treatment success. Not surprisingly, poor adherence is associated with a reduction in the effectiveness of health care programs and interventions. Adherence can be defined as “the extent to which a person’s behavior, in terms of taking medications, following diets, or executing lifestyle change coincides with medical or health advice.” Patient adherence is important for any treatment plan or regimen to succeed. In fact, patients who are adherent to treatment have a three times greater chance of a positive treatment outcome compared to patients with poor adherence. Even so, only an estimated 50% of those affected by chronic diseases adhere to treatment recommendations. This calls to attention the importance of identifying factors that contribute to adherence in order to help individuals improve their health status.
VIII. Adolescent Adherence

Although issues with adherence can be seen within all populations, adolescents appear to have particularly low compliance to dietary treatment of disease. A wide range of adherence levels to treatment has been seen within the adolescent population, ranging from 10%-89% for different chronic illnesses. Rates of compliance to treatment are often difficult to measure, requiring a broad range of methods to evaluate. Some measures include biological measures such as markers of drugs in body fluid, patient reports, medication counts or measures of treatment outcomes such as medical assessments. Each measurement method has both strengths and weaknesses. Among the most widely used assessments include measures of treatment outcomes related to specific disease state.

Understanding which factors influence compliance among adolescents is an important step in designing effective treatment approaches for this population. Adolescence is a time in which the individual goes through tremendous changes, both physically and cognitively. During the teenage years, an individual is developing his/her own identity and a sense of self. Research has shown that during this time, teens may fail to recognize the seriousness of a disease or the long term consequences of low adherence to the recommended treatment approach. Delivery of superior health care is dependent on the willingness of patients to follow prescribed instructions. Many factors can potentially contribute to an individual’s level of compliance to a given health recommendation. Much research has been done on compliance to various health recommendations in adults, but fewer in the adolescent population. For adolescents, factors such as psychosocial, family dynamic, family history of hypertension, home food environment and other health/metabolic risk factors (insulin and lipid levels) may all play a role in adherence. It is clear that “adherence” to the DASH eating pattern is necessary in order to experience any
beneficial effects. This holds true for all health interventions, as compliance is a key component of effective management of chronic disease\textsuperscript{4}.

\textbf{IX. Predictors of Adherence}

\textit{Family Environment}

Family factors have been extensively studied as potential motivators of compliance to health recommendations by adolescents. It has been shown that parents who are more supportive, more flexible, less critical, and good at problem solving tend to have children with better adherence to health regimens\textsuperscript{33}. For example, it was found that adolescents with type 1 diabetes who experienced an authoritative parenting style had better glycemic control and higher adherence to treatment for their condition\textsuperscript{34}. On the other hand, marital conflict and single parent households have been shown to impede adherence, presumably because family cohesion may help individuals cope with the demands of treatment\textsuperscript{35}.

\textit{Family History}

Family history of a disease appears to predict adherence to treatment for disease in adults, but has been less studied in adolescents. With respect to the hypertension literature, family history of hypertension refers to a blood relative, such as a parent or sibling, who has or had high blood pressure\textsuperscript{36}. There are a few reasons to explain why high blood pressure tends to run in families. First, family members share genes that may predispose a person to developing hypertension. Second, families tend to have similar diets and exercise routines which are known to influence the likelihood of the disease. Having one or more family members with high blood pressure before the age of 60 puts an individual at two times the risk of developing high blood pressure themselves\textsuperscript{36}. Having three or more relatives with hypertension at any point in life is
considered a strong family history, which also increases susceptibility to developing the disease.  

While little is known about the specific link between hypertension, family history of disease and compliance to treatment, there is research to support associations between family history of cardiovascular disease (CVD), knowledge of CVD risk factors, and health behaviors in adults. A family history of CVD is associated with an adult being better able to interpret a blood pressure of 130/85 as a risk factor for CVD. This suggests that a family history of a disease has the potential to make family members more knowledgeable and aware of personal health issues, particularly those related to heart health. Zazpe and colleagues also reported that a family history of CVD was a predictor of adults having a better response to a health intervention. These studies support the idea that having a family history in CVD positively influences knowledge and predicts adherence to health recommendations.

In other health conditions, Gierisch and colleagues examined factors specifically associated with women complying to the health recommendation of receiving annual mammograms. It was found that women who had a family history of breast cancer were more likely to adhere to mammography screening recommendations. Results of this study support the findings of Walter and Emery regarding the association of family history and health compliance.

Family history is a predictor of the development of multiple chronic diseases (including hypertension). It has been found that tailoring preventive health recommendations according to an individual’s family history in chronic diseases can increase the likelihood of a patient complying with health recommendations. This suggests that collecting data on an adult patient’s family history is an integral step in the treatment of chronic disease. Walter and
Emery found family history to be a motivator of compliance to preventative treatment. Individuals in the study felt personally vulnerable if they had an immediate family member diagnosed with cancer, diabetes or heart disease. Patients viewed the consequences of chronic diseases as more life threatening, driving their adherence to treatment. It is unknown if adolescents would respond similarly to a family member diagnosed with one of these diseases, however the evidence in adults is encouraging.

X. Rationale for Current Study and Purpose

Several studies have examined family history of a disease and its effects on the knowledge and awareness of family members regarding the disease. However, few have studied the association between family history of disease and adherence to a specific health intervention. Further, family history of disease has not been studied as a predictor of a teen’s adherence to dietary treatment for hypertension. This study assessed the association between family history of cardiovascular disease and compliance to a therapeutic diet emphasizing the DASH dietary pattern in teenagers with high blood pressure.

XI. Purpose and Hypothesis

The purpose of this study was to investigate the relationship between family history of CVD (inclusive of heart attack, high blood pressure and stroke) and adherence to the DASH diet in adolescents with elevated blood pressure following a 6-month nutrition intervention emphasizing the DASH dietary pattern for blood pressure management. The hypothesis was that adolescents with a family history of CVD would have greater adherence to the DASH diet for managing their blood pressure than those with no family history of CVD.
METHODS

Participants

A subset of participant data from the ongoing DASH-4-Teens clinical trial conducted by Couch et al. was accessed to investigate this research question. Study participants were recruited from the Cincinnati Children’s Hypertension Center (CCHC) located at Cincinnati Children’s Hospital Medical Center (CCHMC). Participants were 11-18 years of age and diagnosed with either pre-hypertension or stage I hypertension. Physician approval was required prior to participation in the study and informed consent was collected. All participants under 18 years of age were also required to have informed consent for participation from a parent/guardian prior to enrollment.

Participant exclusion criteria included being diagnosed with either normal blood pressure or stage II hypertension, taking medications known to alter blood pressure, inability to speak English, having a known eating disorder or previously receiving diet counseling to improve blood pressure. Participants were also excluded if the development of hypertension was determined to be secondary to another cause (i.e. kidney disease).

All enrolled participants were randomly selected to be in either the DASH-4-Teens intervention group or usual care group. Study groups were matched for age, sex, race and hypertension status. Study participants were assessed at baseline, 6 months and 18 months for dietary intake and health status. For this study, only data from those participants who completed both their baseline and 6 month follow up visit were considered. This included a total of 57 DASH completers and 54 usual care completers.
**Intervention**

The primary goals of the study were to modify adolescent blood pressure by changing their dietary intake to include a greater number of servings of fruits, vegetables and low fat dairy products, and a lower amount of total fat and sodium; in other words, to eat a more DASH-like dietary pattern. The diet plan implemented in this study was a slight modification of the adult DASH diet in order to meet adolescent nutritional needs. All participants were randomized to either the DASH-4-Teens group or the usual care group. Participants in both groups were counseled by a registered dietitian to develop a DASH like dietary pattern consisting of 8 or more servings per day of fruits and vegetables, 3 or more servings per day of low fat dairy and 2 servings per day or less of foods high in fat or sodium (>3 g fat and/or 480 mg of sodium). This food plan is consistent with the Dietary Guidelines for Americans and is individualized dependent on age, gender and activity level. All study participants participated in a 60 minute face-to-face diet education in the clinic to gain knowledge of the DASH dietary pattern.

The main differences between the two intervention groups were that during the diet education visit, the dietitian gave the DASH-4-Teens participants a 10 module, illustrated manual containing individualized instruction on the DASH dietary pattern. The usual care participants received a pamphlet summarizing the DASH diet without individualized information. Also, following the diet education in the clinic, the DASH-4-Teens intervention participants were telephoned by a registered dietitian weekly for 8 weeks, followed by 7 biweekly phone calls. These phone calls were designed to provide dietary advice and help with goal setting and action planning toward reaching DASH dietary goals. Other behavioral strategies, such as meal planning, self-rewarding, and handling high risk situations were also addressed on the calls, and participants received written summary materials in the mail after each
call. Dietary goal attainment was assessed via self-monitoring dietary booklets (trackers) provided only to DASH-4-Teens participants. Participants were awarded monetary incentive based on level of compliance to the dietary goals. The usual care participants received no phone calls, thus they were not required to keep food trackers. Since usual care essentially promotes a “DASH type diet,” with the same dietary goals, all participants have been combined for the purpose of this research. Taking into account that there may be differences in the level of DASH adherence dependent on group assignment, intervention group was included as a covariate in all analyses.

Measures

Blood Pressure

To determine eligibility, patient blood pressure measurements were taken on three separate occasions prior to enrollment in the study. Blood pressure readings were taken by a member of the trained nursing staff at Cincinnati Children’s Hypertension Clinic using a standard clinical sphygmomanometer. Patients were instructed to rest their right arm for 5 minutes prior to their blood pressure being taken. Patients were diagnosed as having pre-hypertension if blood pressure readings were \( \geq 90^{\text{th}} \) percentile and below the \( 95^{\text{th}} \) percentile for their sex, age and height on at least 3 separate occasions. If blood pressure readings were \( \geq 95^{\text{th}} \) percentile but less than the \( 99^{\text{th}} \) percentile + 5 mm Hg for the participant’s sex, age and height on at least 3 separate occasions the patient was diagnosed as having stage 1 hypertension.

Anthropometrics

Body mass index was calculated by weight in kilometers divided by height in meters squared. BMI z-scores were then calculated from Centers for Disease Control growth charts.
Participant weight was measured through the use of a calibrated triple-beam balance scale located at the clinic. Height was then measured through the use of a wall mounted stadiometer.

*Family History*

Family history was collected as part of routine care in the Preventive Cardiology clinic at CCHMC. Family history information was obtained from the parents of all patients during their initial appointment at the clinic using a standardized questionnaire. The questionnaire included inquiry related to family history of high blood pressure, high blood pressure during pregnancy, high cholesterol, heart attack, stroke, kidney disease, thyroid disease, diabetes and/or overweight. A numbering system was used to quantify the strength of the family history for each individual. A value of 1 was given to a patient who had a father, mother or sibling (first degree relative) with the disease/risk factor. A value of 0.5 was given to a patient who had a grandparent, aunt or uncle (second degree relative) with the disease/risk factor. For the purposes of this research, a summary of values for family history of high blood pressure, heart attack and stroke were computed and used to assess the relationship with DASH adherence.

*Dietary Intake Assessment*

Dietary intake for each participant was assessed via three random 24-hr dietary recalls, 2 of which occurred on weekdays and 1 on a weekend day. Diet recalls were collected through a telephone interview administrated by a trained registered dietitian at Cincinnati Children’s Hospital Medical Center who was blinded to participant intervention group. Prior to the telephone interview, adolescents were instructed on the use of a food portion size model to better able themselves to accurately report food intake on the telephone. Recalls were then analyzed to determine adolescent average caloric intake, nutrient content and number of servings of fruits,
vegetables, low fat dairy products and DASH unfriendly foods. All records were then coded in order to determine DASH score for each participant.

Adherence was measured by change in DASH score index as calculated by Gunther et al 14 (with a few modifications). DASH score was comprised of 10 components which assessed the adolescent’s dietary intake against the DASH dietary pattern serving recommendations for total grains, whole grains, fruits, vegetables, total dairy, low fat dairy, meat/poultry/fish/eggs, nuts/seeds/legumes, fats/oils and sweets. Each food group had a maximum score of 10 which was achieved when a participant met the full recommendations for that particular food group, whereas lower intakes were scored proportionately. Since grains and dairy were divided into sub components, these groups had a maximum score of 5. For the purpose of this study, a DASH sodium component was added to the score and the adolescent’s sodium intake was assessed against the recommendations set forth in the Fourth Pediatric Report for Blood Pressure Management 41. Each food group and sodium score were then added to give an overall DASH score ranging between a value of 0 and 90.

Statistical Analysis

Only completers of both baseline and 6 month follow up visit were included in these analyses. Means and standard deviation were used to summarize continuous variables and frequencies used to summarize categorical variables. Multiple continuous regression models were used to evaluate the association between predictor variables (i.e., family history of disease/risk factors) and change in DASH score and DASH component scores. All models were adjusted for race, gender, age, intervention group, parent income, child BMI z-score, hypertension status, and baseline DASH score. Statistical significance was defined as P<0.05. Data analysis was conducted using SAS version 9.2 (SAS Inc., Daly, NC , USA).
RESULTS

I. Participant Characteristics

Table 1 describes baseline characteristics for all DASH study participants. Among the 111 participants, the majority of subjects were white males. Over 42% of the subjects recruited to participate in the study were diagnosed with stage 1 hypertension at baseline. The frequency of family history of disease can also be seen in Table 1. A positive family history of high blood pressure was the most commonly observed (77.5%), followed by a family history of heart attack (36.9%) and family history of stroke (18.9%). Table 1 also includes the baseline and post-treatment values for each of the scores considered in this research (total DASH score, and the individual Fruit, Vegetable, and Sodium Component scores).

Table 1. DASH-4-Teens Participant Characteristics at Baseline

<table>
<thead>
<tr>
<th>Participant Characteristic</th>
<th>“n” or Mean value (% or SD as indicated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, n(%)</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>69 (62.2)</td>
</tr>
<tr>
<td>Females</td>
<td>42 (37.8)</td>
</tr>
<tr>
<td>Group, n(%)</td>
<td></td>
</tr>
<tr>
<td>DASH</td>
<td>57 (51.4)</td>
</tr>
<tr>
<td>UC</td>
<td>54 (48.6)</td>
</tr>
<tr>
<td>Race, n(%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>67 (60.4)</td>
</tr>
<tr>
<td>Other</td>
<td>44 (39.6)</td>
</tr>
<tr>
<td>HTN Status, n(%)</td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>63 (56.8)</td>
</tr>
<tr>
<td>Stage 1</td>
<td>47 (42.3)</td>
</tr>
<tr>
<td>Income, n(%)</td>
<td></td>
</tr>
<tr>
<td>&lt;$20,000</td>
<td>25 (22.73)</td>
</tr>
<tr>
<td>$20,000-&lt;$50,000</td>
<td>41 (37.27)</td>
</tr>
<tr>
<td>$50,000-$80,000</td>
<td>21 (19.09)</td>
</tr>
<tr>
<td>&gt;$80,000</td>
<td>23 (20.91)</td>
</tr>
<tr>
<td>Age, years (SD)</td>
<td>14.55 (1.98)</td>
</tr>
<tr>
<td>BMI z-score (SD)</td>
<td>1.83 (0.82)</td>
</tr>
<tr>
<td>FH High Blood Pressure n(%)</td>
<td>86 (77.5)</td>
</tr>
<tr>
<td>FH Heart Attack n(%)</td>
<td>41 (36.9)</td>
</tr>
<tr>
<td>Calculated DASH Scores</td>
<td>Baseline</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>DASH Score (Total) (SD)</td>
<td>40.02(9.30)</td>
</tr>
<tr>
<td>Fruit Component Score (SD)</td>
<td>2.10(2.46)</td>
</tr>
<tr>
<td>Vegetable Component Score (SD)</td>
<td>4.55(2.74)</td>
</tr>
<tr>
<td>Sodium Component Score (SD)</td>
<td>4.78(4.33)</td>
</tr>
</tbody>
</table>

DASH=Dietary Approaches to Stop Hypertension Intervention. UC= Usual Care Intervention. HTN= Hypertension. BMI= Body Mass Index. FH= Family History

Total DASH Score Range= 0-90. Fruit Component Range= 0-10. Vegetable Component Range=0-10 Sodium Component Range= 0-10

II. Family History of Disease and DASH Score

The results of the regression analyses examining the relationship between family history of disease and change in DASH score can be seen in Table 2. Table 2 presents the estimate and the significance level (P value) for the relationship between family history of high blood pressure, heart attack, and stroke, and change in participant DASH score. As seen from these results, a positive family history of heart attack was associated with a significant positive change in overall DASH score (P=0.03) as compared to those individuals with no family history in heart attack.

There was no significant relationship detected between a positive family history of blood pressure or stroke and change in participant DASH score.

Table 2. Family History and Change in DASH Score

<table>
<thead>
<tr>
<th>Effect</th>
<th>Estimate (SE)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH High Blood Pressure</td>
<td>0.19 (2.62)</td>
<td>0.94</td>
</tr>
<tr>
<td>FH Heart Attack</td>
<td>4.75 (2.22)</td>
<td>0.03*</td>
</tr>
<tr>
<td>FH Stroke</td>
<td>2.4 (2.82)</td>
<td>0.397</td>
</tr>
</tbody>
</table>

* Indicative of significant difference between groups (p<0.05). FH= Family History
III. Family History of Disease and DASH components

The relationship between a positive family history of disease and change in the DASH component scores are presented separately in Tables 3, 4, & 5. As shown in Table 3, a positive family history of heart attack was associated with a statistically significant positive change in fruit component score (P=0.017). Neither a positive family history of high blood pressure nor stroke was associated with a change in fruit component score from baseline to 6 months post treatment.

Table 3. Family History and Change in Fruit Component Score

<table>
<thead>
<tr>
<th>Effect</th>
<th>Estimate (SE)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH High Blood Pressure</td>
<td>0.01 (0.69)</td>
<td>0.98</td>
</tr>
<tr>
<td>FH Heart Attack</td>
<td>1.39 (0.57)</td>
<td>0.017*</td>
</tr>
<tr>
<td>FH Stroke</td>
<td>-0.18 (0.76)</td>
<td>0.82</td>
</tr>
</tbody>
</table>

* Indicative of significant difference between groups (p<0.05).
FH= Family History

The relationship between a positive family history of disease and change in vegetable component score is presented in Table 4. There was no relationship between a positive family history of high blood pressure, heart attack or stroke and change in participant vegetable component score.

Table 4. Family History and Change in Vegetable Component Score

<table>
<thead>
<tr>
<th>Effect</th>
<th>Estimate (SE)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH High Blood Pressure</td>
<td>0.56 (0.68)</td>
<td>0.42</td>
</tr>
<tr>
<td>FH Heart Attack</td>
<td>0.30 (0.59)</td>
<td>0.61</td>
</tr>
<tr>
<td>FH Stroke</td>
<td>0.74 (0.75)</td>
<td>0.32</td>
</tr>
</tbody>
</table>

FH= Family History
The relationship between a positive family history of disease and change in sodium component score are presented in Table 5. There was no relationship between a positive family history of high blood pressure, heart attack or stroke and change in participant sodium component score.

Table 5. Family History and Change in Sodium Component Score

<table>
<thead>
<tr>
<th>Effect</th>
<th>Estimate (SE)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FH High Blood Pressure</td>
<td>0.098 (0.91)</td>
<td>0.91</td>
</tr>
<tr>
<td>FH Heart Attack</td>
<td>0.82 (0.77)</td>
<td>0.29</td>
</tr>
<tr>
<td>FH Stroke</td>
<td>0.78 (0.98)</td>
<td>0.43</td>
</tr>
</tbody>
</table>

FH= Family History

DISCUSSION

This study is unique in examining the relationship between family history of CVD and the adherence of adolescents with elevated blood pressure to a therapeutic diet emphasizing the DASH dietary pattern to lower blood pressure. The findings from this study add to previous research investigating predictors of patient adherence to various dietary regimens. The results indicate that having a family history of heart attack was positively related to adolescent adherence (defined as change in DASH score) to the DASH diet for lowering blood pressure. In other words, adolescents with high blood pressure who had a first or second degree relative who had suffered from a heart attack were more likely to follow the DASH dietary pattern presented during dietary counseling to lower their own blood pressure. This supports previous research in adults that shows a positive family history of heart disease influences their own decisions regarding health related issues. Further, results showed that having a positive family history of heart attack was related to a change in DASH fruit component score as compared to those patients with no family history of heart attack. This indicates that patients
were most likely to better meet their fruit goals as opposed to other goals set out by the diet. Neither a positive family history of high blood pressure or stroke had any relation to change in overall DASH score or individual DASH component scores.

There are several reasons why a family history of heart attack may contribute to greater dietary adherence to a therapeutic diet for blood pressure management among teenagers. First, a heart attack is a very dramatic, often frightening event in a family. An adolescent may be more impacted (and therefore more motivated to make lifestyle changes) by an intense experience such as a relative’s heart attack, as compared to a more silent disease and/or event, such as high blood pressure. Greater meaning is placed on more visible risk factors, such as heart attack, than hidden ones such as simply knowing that one has high blood pressure. Second, it is possible that in a family who has suffered from such a dramatic event, there would be more importance placed on health in general. If high significance is placed on health in a family, this could positively influence an adolescent’s adherence to health recommendations such as the DASH diet for lowering blood pressure. Having a supportive family who emphasizes health was shown to significantly influence adherence to health regimens in the adolescent population. Third, those adolescents that have experienced such a dramatic health event may have a better understanding of the connection between good lifestyle choices and prevention (or management) of chronic disease. This understanding may have moved them into the “readiness” phase of the stages of behavioral change, where they were more motivated to make changes to a diet that can prevent chronic disease.

However, there was no relationship between a family history of high blood pressure and change in adolescent DASH score or component scores. It is possible that the often more silent effects of high blood pressure cause the disease to be perceived as less of a health threat by
family members compared to a family history of something with more dramatic consequences, such as a heart attack. In fact, it has been shown that adults perceive hypertension as less of an actual disease and more as a risk factor for causing dramatic events. The majority of patients defined hypertension as a limitation, but not an actual disease because one can still feel “healthy.” Another explanation to this finding could be that if the parent of the adolescent is the family member who carries a history of high blood pressure, they may be more inclined to be lenient when it comes to their child’s adherence to the DASH diet. The parent may feel guilty for the child’s development of high blood pressure. Support for this explanation can be found in the chronic disease state of obesity where parents who are obese themselves are more lenient toward bad eating habits in their children. It is possible this same connection can be seen in the hypertension population. If the parent has high blood pressure themselves, they may be lenient with treatment for high blood pressure, making it unlikely the teen will comply with the diet.

There was also no relationship between a family history of stroke and change in adolescent DASH score or independent component scores. Although this can also be a major occurrence, only approximately 20 percent of the participants in this study had a family history of stroke compared to the almost 40 percent for heart attack. With fewer cases within this study population, it is speculated that an association between family history of stroke and adherence to the DASH diet may not have been detected. It would be interesting to see whether the findings would hold true for a population that had a greater occurrence of stroke in their family history.

For the adolescent population, adherence to any health recommendation presents many complex and difficult challenges. Adherence is a behavioral process that can be strongly influenced by the delivery of education by healthcare providers. For example, knowing that family history of disease may motivate adolescent adherence to a dietary intervention encourages
administrators of the intervention to emphasize the relationship between the participants’ family history and their own health status. Informing patients about their genetic susceptibility to disease may motivate them to better adhere to the dietary recommendations provided \(^{48}\).

Research has shown that family history of disease has an impact on an individual’s perception of their own risk \(^{48}\). These perceptions should be used to motivate preventive health behaviors, such as the DASH diet \(^{40}\). Providing messages tailored to an individual’s personal risk for disease have been shown to increase physical activity and fruit and vegetable intake in teens \(^{9}\). More research is needed in the teenage population to determine the best way to deliver and utilize family history information in the clinic setting.

*Limitations and Future Research*

This study had a few limitations. First, it is possible that family history of the patient was skewed depending on the individual completing the family history questionnaire. The questionnaire inquired about both the mother’s and father’s side of the family, however it is possible that if only one parent participated in the completion of the questionnaire, the family history data of the other parent may not be entirely accurate. In the future if there is uncertainty regarding previously collected family history information, families should be recontacted to clarify missing data and to ensure that the most accurate and up to date family histories are obtained. Second, family dynamics were not taken into account as a predictor when examining the proposed relationship between family history and dietary adherence. It is possible that adolescents would be more influenced by family history of disease if they are living with the family member who had the disease. Previous research has shown that an individual’s belief about consequences is influenced by witnessing the effects of painful and/or lingering disease \(^{40}\).
Thus, in the future it may be interesting to take into account the family environment, and who lives in the home with the adolescent participating in the study.

Last, the self reporting aspect of the study was a limitation. Adolescents self reported dietary intake was used to calculate DASH score and therefore adherence to the diet. A major problem of self reported intakes is that values tend to be underestimates of true energy intake. Individuals have a tendency to report energy intakes closer to perceived norms than actual. Underreporting of energy and macronutrients impedes the ability to see true relationships between diet and health. It is possible that participants in this study did not accurately report all that was consumed, thus affecting the calculation of their DASH score as well as the independent component scores.

Future research regarding the relationship between family history and adolescent adherence should take into account some of the limitations of this study. Incorporating family environment, such as whether a child lives in a single parent home, as a covariate could help further investigate the role of this factor in adolescent adherence to the DASH intervention. Family environment has been shown to largely impact adolescent compliance to various health interventions, it would be interesting to examine the effect of environment specifically in relation to adherence of adolescents to a DASH dietary pattern. Another consideration would be to require both parents of the child to participate in providing their side of the family history. This would ensure that the most accurate information is obtained regarding family history of health conditions.

Future research is extremely important to confirm the findings of our study and expand on the effects of family history of disease on adherence of adolescents to a DASH dietary intervention. It is evident that family history of disease may play a crucial role in adolescent
adherence to treatment for high blood pressure. Identifying additional aspects of family history that affect adherence can help to predict the likelihood of a participant achieving dietary goals presented during DASH diet education. If family history of disease proves to be a predictor of adherence, it is possible one could emphasize this relationship between high blood pressure and the various diseases to try and positively influence adolescent adherence. Knowing the effects of family history on adolescent adherence can be used to motivate adolescents to develop a DASH like dietary plan to lower blood pressure.

Conclusion

A family history of heart attack predicted a positive change in DASH score and fruit score by adolescents with high blood pressure, however further research is necessary. These findings can help researchers to better understand motivators of adherence to treatment in the adolescent population. Future research will allow us to better understand how strongly family history of disease influences the adherence of adolescents to health recommendations and treatment.
REFERENCES


