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The Impact of Nutritional Changes on Dietary Inflammatory Index: NEW Soul Study

Callie McLean

University of South Carolina - Columbia, cmclean@email.sc.edu

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THE IMPACT OF NUTRITIONAL CHANGES ON DIETARY INFLAMMATORY INDEX:
NEW SOUL STUDY

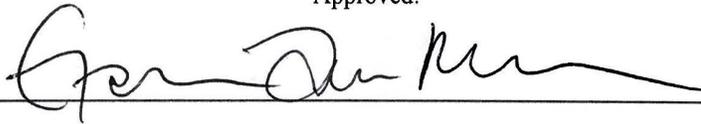
By

Callie McLean

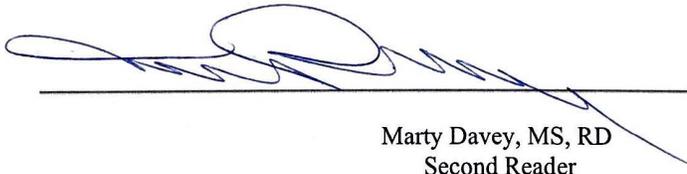
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Approved:



Gabrielle Turner-McGrievy, PhD, MS, RD
Director of Thesis



Marty Davey, MS, RD
Second Reader

Steve Lynn, Dean
For South Carolina Honors College

The Impact of Nutritional Changes on Dietary Inflammatory Index: NEW Soul Study

By: Callie McLean

University of South Carolina, Honors College

Gabrielle Turner-McGrievy, PhD, MS, RD; Michael Wirth, PhD; Anthony Crimarco, MS; Marty Davey, MS, RD



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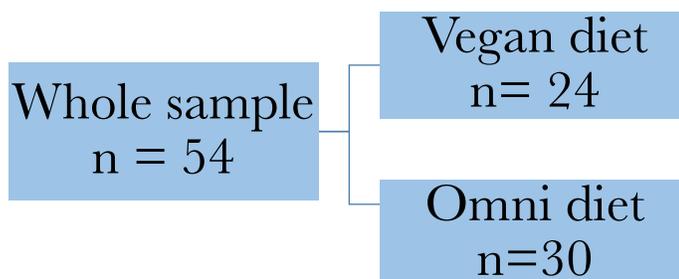
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Thesis Summary:

Background: Historically, a soul food diet consisted of mainly plant-based foods in West Africa and evolved to a mostly meat-based diet in the Southeastern United States. As a result, many soul foods today often exceed the recommended dietary guidelines for saturated fats and cholesterol. This is important to consider for dietary interventions focusing on African American populations, since they are at a greater risk for cardiovascular disease and chronic illness compared to all other ethnic groups. One way to examine the impact of diet on overall health is to assess changes in the inflammatory potential from diet. The Dietary Inflammatory Index (DII) is a valid instrument that researchers developed to measure the inflammatory potential of a diet. Previous research on the DII has indicated diets with high inflammatory potential to be positively correlated with higher levels of inflammatory biomarkers in the body.

Objective: To investigate how changes in diet at six months can impact DII scores and how changes in DII scores are related to changes in body weight among participants in the Nutritious Eating with Soul (NEW Soul) study.

Design: Six month, randomized 2-arm intervention



Methods: A total of 54 participants were randomized to either a plant-based vegan diet (n=24) or a low-fat omnivorous diet (n=30) in a culturally-tailored dietary intervention focused on modifying traditional soul foods into healthier recipes. Diets were supplemented by weekly

classes of the Oldways African Heritage and Health program and A Taste of African Heritage (ATAH), a food pyramid guide, to ensure cultural competency. Participants had diet (three 24-hour dietary recalls) and body weight (digital scale) assessed at baseline and six months. Six-month changes in weight and DII were assessed. DII calculation is related to a global database based on data from 11 different populations. This study used different food parameters (micro- and macronutrients and individual food items) to calculate DII scores. Independent sample t tests were used to examine differences in DII change scores between groups and a Pearson correlation was conducted to examine the relationship between change in DII and weight loss.

Results: At the six months, the DII score of the entire sample significantly decreased (i.e. indicating a more anti-inflammatory diet) by -1.7 ± 2.1 points ($p < 0.001$). The differences between the changes in DII scores between the omnivorous (-1.6 ± 2.5) and vegan (-1.9 ± 1.7) groups was not significant ($p = 0.69$). The correlation between changes in DII score and change in body weight also was not significant ($r = 0.19$ and $p = 0.17$).

Sample	DII Score	P-value	95% CI	Weight loss change	P-value	95% CI
Baseline	-1.7	-	-2.3 – 1.2	-6.0	-	-8.6 – 3.4
6-months	-1.9	-	-2.6 – 1.2	-7.1	-	-10.5 – -3.64
Difference	-1.6	$P < 0.001$	-2.6 – -0.7	-5.2	$P < 0.001$	9.2 – 1.21

Conclusion: These results suggest that both intervention diets have a higher anti-inflammatory potential than the typical soul food diet participants consumed before the intervention. The DII score change was slightly greater in the vegan diet group than the omnivorous diet group, however the difference in change scores was not statistically significant. The correlation between the changes in body weight and the changes in DII scores was not statistically significant, suggesting that there was not a strong correlation between the two. The DII score data do not appear to favor one diet over the other, but do indicate that consuming more plant-based foods, which both diets recommended, could potentially have positive impacts on health. Future research should examine if health-related outcomes, other than weight loss, are associated with improvements in the DII among this population.

Conflict of Interest: None

Funding: The NEW Soul study is funded by a grant from the National Institutes of Health/NHLBI R01HL135220.

Introduction:

The soul food that people associate with the southeastern African American diet has undergone an evolution since its inception in Africa. Today, it is associated with hearty, comfort food that has a connection to culture. Historically, the soul food diet consisted of mainly plant-based foods in West Africa. Africans relied heavily on agriculture and crops they grew themselves. Many of these crops were high in important minerals and nutritional markers like iron and protein. These crops included yams, black-eyed peas, spinach, kale, and cabbage, among others. When the Spanish and Portuguese arrived in West Africa for the slave trade in the late 15th to mid 17th centuries, they introduced new foods and patterns in the diet of Africans. Europeans incorporated many grains into their diet, something Africans had not placed a large emphasis on in their cuisine. Europeans also changed the way that Africans seasoned and flavored their food. Spices and herbs like garlic, turmeric, and cumin were introduced into dishes. Africans used these spices to enhance the flavors of their food. The spices and herbs they used were fresh and organic, keeping their meals healthy and nutritionally balanced. When the Atlantic Slave Trade grew towards the end of the 15th century, West Africans were shipped to America in large quantities. It was while they were enslaved in the Americas that Africans started adopting many of the diet habits that led to health problems today. The slave trade facilitated exchanges between African, Arabian, European, and Asian cultures. Africans were introduced to new crops and animals they did not previously have access to, while having to do without many of the crops and spices that they were accustomed to in Africa. Corn and sweet potatoes were two crops in particular that became very prominent in the African diet during foreign invasions and the slave trade. These two crops in particular helped contribute to the increase of grains and bread in their diet. The introduction of pork, chicken, and other fowl

greatly changed the composition of the African diet, shifting from a mainly plant-based diet to a more carnivorous one. Meat started becoming a larger part of the diet, with fruits and vegetables starting to get pushed to the wayside. When fruits and vegetables were included in a meal, they were usually incorporated into a dessert or stew, diminishing their nutritional value. Oftentimes, slaves would receive the worst parts of animals that were left over from plantation family meals and had very little nutritional value. These parts were often extremely fatty and had either a bland or unpleasant taste.¹ They would try to make the food they had access to taste better by using copious amounts of salt and animal lard. The practice of over salting has evolved over time to lead to the high prevalence of hypertension in African Americans today. The practice of using lard and frying food has led to a high prevalence of cardiovascular disease in African Americans as well.²

African Americans have a much higher risk of developing hypertension and cardiovascular disease than the general population. African Americans develop hypertension at younger ages than in other races and have much more severe cases on average than other races, with African Americans experiencing a 320% higher rate of end-stage renal disease than other races. African Americans are at least 40% more likely to develop hypertension than whites and will develop hypertension around 10 years younger.³ South Carolina, two in five African Americans have hypertension. The higher risk of hypertension also leads to an increase in risks for cardiovascular disease. African Americans suffering from hypertension are three to four times more likely to develop some form of cardiovascular disease. Cardiovascular disease is the second leading cause of death in South Carolina. African Americans in South Carolina are more likely to develop ischemic heart disease than their Caucasian counterparts, resulting in an average loss of life of 10 years. African Americans in South Carolina also have a stroke

mortality rate that is 27% higher than the national rate for African Americans. This is the fifth highest stroke rate in the US and accounts for the third leading cause of death among African Americans in South Carolina. African Americans in South Carolina are also 48% more likely to die of a stroke or related complications than their Caucasian counterparts.⁴

Plant-based diets have risen in popularity in recent years due to their reported health benefits. Plant-based diets include a wide range of diets but all have a focus on vegetables, fruits, legumes, and other non-meat food components. Vegetarian diets involve the absence of meat while vegan diets involve the absence of any animal-derived products. Several studies have found that maintaining any kind of plant-based diet in comparison to other diets results in numerous health benefits and reduced cardiovascular risk. The majority of the studies done to analyze the diets have been of a cohort and cross-sectional design. A systematic review of interventions using vegetarian and vegan diets found several positive health benefits. Some of these health benefits include reduced glucose levels, reduced LDL cholesterol, and reduced body mass index. These measurements have been linked to chronic disease in the past. The review also found that plant-based diets were correlated to a reduction in mortality from ischemic heart disease by 25%. Plant-based diets are starting to be accepted by the medical field as a supplemental treatment for various chronic health problems, many of which are of the utmost concern to African Americans.⁵

A new program designed to tackle the health issues threatening African Americans in the South is the Nutritious Eating With Soul (NEW Soul) study. This nutrition study is being conducted by the BRIE Lab in the Arnold School of Public Health at the University of South Carolina. The goal is to find a diet that can best address the health needs of this specific population. There are disproportionately high incidence rates and risks for cardiovascular disease

and hypertension among African Americans living in South Carolina, and the NEW Soul study hopes to lower these with their program. The program builds off of previous research that supports the health benefits of plant-based diets by randomizing participants to either a vegan diet or a low-fat omnivorous diet. Participants receive guidance through weekly classes from culturally competent programs like the Oldways African Heritage and Health program and receive support from their fellow participants during group sessions. Progress is measured by changes in different health and biomarkers throughout the program.⁶

The inflammatory potential of food is starting to get more attention from both the scientific community and the consumer as chronic disease diagnoses are increasing. The Dietary Inflammatory Index (DII) was developed in 2014 at the University of South Carolina. The purpose of the DII is to be able to use a 24-hour diet recall to assign a score that accurately predicts the inflammatory potential of a diet. The DII was developed using global data from 11 different populations. These populations cover diverse regions, ethnicities, and diet types. The DII can be applied in any population where dietary recall data is available. An individual or group's DII score is expressed relative to the standard global mean. A negative DII score indicates that the diet is more anti-inflammatory, which is associated with a protective effect and less chronic disease. A positive DII score suggests a more pro-inflammatory diet, which can lead to higher levels of chronic disease.⁷

Methods:

The Nutritious Eating with Soul (NEW Soul) study is a program that aims to use tailored nutrition interventions to reduce body weight and prevent heart disease in African Americans living in South Carolina. The study's goal is to assess what diet can best meet and address the health needs of African Americans, starting with those living in South Carolina. The study was advertised in the African American community and interested individuals could apply to the program by taking a screening survey. Eligible participants were African American individuals between the ages of 18 and 65 living in the Midlands region of Columbia, South Carolina and falling within the BMI range of 25-49.9kg/m². Participants meeting the requirements for the study were randomized to two arms of the intervention. A total of 54 participants were randomized to either a plant-based vegan diet (n=24) or a low-fat omnivorous diet (n=30) in a culturally-tailored dietary intervention focused on modifying traditional soul foods into healthier recipes. Both intervention arms were supplemented by the Oldways African Heritage and Health program and the food pyramid guide, A Taste of African Heritage (ATAH) to ensure cultural competency. Participants in both groups attended one class per week for the six months of the intervention. These classes included cooking demonstrations, group activities, and educational lectures. Participants had diet (three 24-hour dietary recalls) and various measurements assessed at baseline and at six months. The main trial is collecting data on changes in lipids, blood pressure, cholesterol, and other related health markers. The current study specifically examined changes in body weight (digital scale), and DII scores. Participants scheduled appointments at the Arnold School of Public Health to have their measurements assessed. Measurement coordinators took each measurement at least two times, averaging the results. If the measurements differed beyond the accepted range, the measurement was taken a third time to

ensure accuracy. Blood work was drawn by phlebotomists within the Arnold School of Public Health at these appointments as well. Participants had to fast for 12 hours prior to their appointment to be eligible for the blood draw. If the phlebotomists failed to find a usable vein or draw blood, participants were sent to an independent lab that would send results to the intervention staff. Six-month changes in weight and DII were assessed using the measurement results. This study used different food parameters (micro- and macronutrients and individual food items) to calculate DII scores. Participants completed their dietary recall and the value they reported was subtracted by the standard global mean derived from the DII database. This number was then divided by the standard deviation. The result was then expressed as a z-score relative to the standard global mean. Researchers then converted the z-score to a percentile to avoid having right-skewed results. In an effort to further center the results, researchers doubled the percentiles and subtracted 1. This kept values within the range of -1 (maximum anti-inflammatory potential) and +1 (maximum pro-inflammatory potential). To calculate food parameter-specific DII scores, researchers multiplies the new percentile by each food parameter-specific inflammatory effect score. The overall DII score was calculated by adding together all food-parameter specific inflammatory effect scores. Scores were then averaged within each group. Independent sample t-tests were used to examine differences in DII change scores between groups and a Pearson correlation was conducted to examine the relationship between change in DII and weight loss. Changes in measurements were examined for the sample as a whole as well as within each arm of the intervention.⁷

Results:

DII scores were calculated using paired t-tests at the beginning of the intervention to establish a baseline and again at six months to evaluate for any changes. There were a total of 54 participants in the intervention who had complete data at both baseline and six months and were used in the analysis. At the beginning of the intervention, the DII score for the whole sample was calculated to be -0.19. At the six-month benchmark, the DII score for the whole sample was calculated to be -1.93. This resulted in a DII score change of -1.74 points ($p < 0.001$) for the sample as a whole.

Paired t-test for group level difference in DII scores at 6-months and baseline:

Variable	# Observed	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	54	-0.19	0.26	1.88	-0.70 --- 0.32
6 months	54	-1.93	0.29	2.13	-2.51 --- 1.35
Difference	54	-1.74	0.29	2.14	-2.32 --- 1.15

DII scores were calculated within the two arms of the intervention as well. At the beginning of the intervention, the DII score for the vegan group was calculated to be -0.21. After six months of the vegan diet, the DII score was calculated to be -2.07. This group saw a DII score change of -1.86 points ($P < 0.001$). There were 24 participants within the vegan arm of the intervention.

Vegan Group DII Score Change

Variable	# Observed	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	24	-0.21	0.39	1.93	-1.02 --- 0.61
6 months	24	-2.07	0.42	2.06	-2.94 --- 1.20
Difference	24	-1.86	0.35	1.70	-2.58 --- 1.15

Within the omnivorous group, the DII score at the beginning of the intervention was calculated to be -0.18. At the end of six months, the DII score was calculated to be -1.81. Those following an omnivorous diet experienced a change in DII score of -1.63 points (P=0.0011).

There were 30 participants within the omnivorous arm of the intervention.

Omnivorous Group DII Score Change

Variable	# Observed	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	30	-0.18	0.34	1.88	-0.88 --- 0.52
6 months	30	-1.81	0.40	2.21	-2.63 -- -0.99
Difference	30	-1.63	0.45	2.46	-2.55 -- -0.72

The changes in DII scores for the samples indicate a higher anti-inflammatory potential in the diets. There was, however, no significant difference between the diets in relation to DII score change (P=0.69).

The intervention also looked at changes in weight among the participants. Weight was measured using a digital scale at the beginning of the intervention and at six months. The average weight for the sample as a whole at the beginning of the intervention was calculated to be 226.17 lbs. The average weight of the sample after six months was found to be 220.14 lbs. The difference in weight for the sample after six months was found to be -6.03 lbs. ($P < 0.001$).

Paired t-test for group level difference in weight at 6-months and baseline:

Variable	# Observed	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	59	226.17	6.52	50.07	206.55 --- 233.71
6 months	59	220.14	6.79	52.12	213.12 --- 239.22
Difference	59	-6.03	1.30	9.96	-8.63 -- -3.44

The intervention also looked at changes in weight within each group. Within the vegan group, the average weight assessed at baseline was 215.96 lbs. After six months on the vegan diet, the average weight of the group was 208.91. There was a weight change of -7.05 lbs. in this group ($P = 0.0002$).

Vegan Group Weight Loss Change

Variable	# Obs	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	27	215.96	9.28	48.21	196.89 --- 235.03
6 months	27	208.91	9.41	48.88	189.58 --- 228.25
Difference	27	-7.05	1.66	8.62	-10.45 - -3.64

Within the omnivorous group, the average weight recorded at the beginning of the intervention was 234.79 lbs. After six months on the omnivorous diet, the average weight of the group was 229.60 lbs. This group had an average weight loss of -5.12 lbs. (P=0.00123).

Omnivorous Group Weight Loss Change

Variable	# Observed	Mean	Standard Error	Standard Deviation	95% Confidence Interval
Baseline	32	234.79	8.97	50.73	210.27 --- 248.94
6 months	32	229.60	9.48	53.63	216.50 --- 253.08
Difference	32	-5.19	1.95	11.03	-9.16 --- 1.21

The intervention looked at the relationship between DII score change and weight change to determine if there is a correlation. The correlation between the two variables was found to be not significant ($r=0.19$, $P=0.17$).

Discussion:

The diets assigned to the two arms of the intervention were designed to be culturally competent and a natural transition for participants from their previous diets to a more plant-based diet. The intervention utilized the Oldways African Heritage and Health program to facilitate cooking classes and to correctly utilize their food pyramid, A Taste of American Heritage. This program teaches participants how to cook nutritionally balanced meals while also honoring their heritage and culture.⁶ The NEW Soul study hoped that including these cultural considerations and working closely with the participants would result in encouraging improvements in health markers. The two health markers that this part of the study looked at specifically were changes in DII score and changes in body weight.

Changes in weight and DII scores were calculated for the sample as a whole as well as within each arm of the intervention. Researchers took measurements at the beginning of the intervention to establish a baseline and then again at six-months. They calculated weight change, DII score change, mean, standard error, standard deviation, and a 95% Confidence Interval.

Within the whole sample ($n = 54$), the group as a whole decreased their DII score by an average of -1.74 points ($p < 0.001$). The standard error for this calculation was 0.29 while the standard deviation was 2.14 . This means that most participants were around the same score change and there was very little error in calculating these score changes. This consistency suggests the intervention was successfully implemented. The vegan arm of the intervention ($n = 24$) also decreased their DII score, lowering it by an average of -1.86 points ($P < 0.001$). The standard error was 0.35 while the standard deviation was 1.70 , suggesting even less deviation among participants in this group. The omnivorous arm followed this same trend, decreasing their score by an average of -1.63 points. Their standard error was calculated to be 0.45 and their

standard deviation was calculated to be 2.46. The vegan group had the largest decrease in DII score, but the difference between diets was not statistically significant ($P = 0.69$).

The DII was designed to measure and predict the inflammatory potential of a diet, which has been shown to be associated with chronic diseases. The score changes resulting from this intervention indicate that the groups changed their diets to more anti-inflammatory ones. This can create a protective effect against inflammation in the digestive system and can help prevent chronic diseases. Chronic low-grade inflammation of intestinal tissues is dangerous long-term and puts stress on the body and its immune system. This sustained stress makes the immune system vulnerable to both acute and chronic diseases. Anti-inflammatory diets have been proven to be associated with lower levels of inflammatory biomarkers, reducing both inflammation and risk for chronic diseases. In the African American population, a decrease in inflammation can help protect against cardiovascular disease and hypertension, two of the top three leading causes of death among African Americans in South Carolina.⁷

The differences in body weight among the groups were also encouraging. The sample as a whole that had their weight data available ($n = 59$) reduced their average weight by -6.03 lbs. ($P < 0.001$). The standard error for the whole sample was 1.30 while the standard deviation was 9.96 lbs., suggesting some fluctuation among participants and calculations. Those in the vegan group that had weight data available ($n = 27$) decreased their average weight by -7.05 lbs. ($P = 0.0002$). The standard error for this group was 1.66 while the standard deviation was 8.62 lbs., suggesting some deviation as well. The participants in the omnivorous group that had weight data available ($n=32$) decreased their average weight by -5.19 lbs. ($P = 0.00123$). The standard error for this group was 1.95 and the standard deviation was 11.03 lbs., indicating more deviation among these participants. Researchers analyzed the relationship between DII score change and

weight change to determine the existence of a correlation, but found the correlation between the two variables to be not significant ($r = 0.19$, $P = 0.17$).

The data collected during the intervention do not favor one diet over the other, but do indicate that a plant-based diet is more anti-inflammatory than the diets participants were on before the intervention. This suggests that it could be beneficial for African Americans living in South Carolina to adopt a plant-based diet more similar to the original soul food diet in terms of preventing and managing chronic conditions like cardiovascular disease and hypertension. Reducing refined grains, sugars, and meats while emphasizing fruits, vegetables, and legumes could translate to very positive health benefits.

The results of this study are consistent with the results of other studies examining plant-based diets. A comprehensive literature review conducted by the University of South Carolina studied the use of plant-based diets in overweight and obesity prevention and treatment. This review included all types of plant-based diets, various program designs, and different demographic profiles of participants, but the general goal of the studies was similar to the NEW Soul study. Their review found that plant-based diets both promoted weight loss and prevented obesity, corroborated by the results of the NEW Soul study. The combination of these two reports suggest that more research into the effects of plant-based diets on weight loss could be very helpful in combating the obesity crisis in the South, especially among African Americans. As previously recorded, obesity increases the risk for many chronic diseases, including cardiovascular disease. Helping African Americans prevent obesity could lower their risk of cardiovascular disease and other chronic illnesses.⁸ Another study that analyzed the relationship between DII and cardiovascular disease found a direct, positive association between DII and cardiovascular disease. The study highlighted the Mediterranean diet, which is similar in nature

to the NEW Soul diets in that it reduces refined grains and meats while placing an emphasis on fruits and vegetables. This study found that diets that are more pro-inflammatory in nature put consumers at a higher risk for cardiovascular disease and complications. The NEW Soul study aims to reduce the incidence of cardiovascular disease in African Americans living in South Carolina. The shift in participants' DII scores to more anti-inflammatory results after switching to plant-based diets and this previous research about the relationship between DII and cardiovascular disease suggests that researchers were right about plant-based diets being a diet that can meet the health needs of African Americans in the South.⁹

Conclusion:

The main goals of the NEW Soul study were to investigate which diets could improve body mass index and cardiovascular risk rates in African Americans in South Carolina. The results of the study suggest that both intervention diets have a higher anti-inflammatory potential than the typical soul food diet participants consumed before the intervention. Diets with higher anti-inflammatory potential result in lower levels of inflammation and less stress placed on the immune system. This can help protect against inflammation and help prevent or reduce chronic diseases. The DII score change was slightly greater in the vegan diet group than the omnivorous diet group, however the difference in change scores was not statistically significant. The correlation between the changes in body weight and the changes in DII scores was not statistically significant, suggesting that there was not a strong correlation between the two. The DII score data do not appear to favor one diet over the other, but do indicate that consuming more plant-based foods, which both diets recommended, could potentially have positive impacts on health.

Historically, the soul food diet was plant-based in nature. Using culturally competent programs like the Oldways African Heritage and Health program in conjunction with an intervention like NEW Soul appears to result in high adherence rates as well as successful outcomes in both DII score and body weight measurements. One limitation that exists in this intervention are the geographic restrictions. The study is currently only available to African Americans in the Columbia/Midlands area. Once the program is able to expand geographically, it will be better able to assess the impact of these diet changes on African Americans living in the Southeastern United States. Another limitation that exists is the requirement to be able to attend

weekly classes in person. If participants were not able to commit to meeting times, they were not eligible for the intervention.

The results of the intervention were very encouraging and suggest that New Soul researchers are on the right track with their goal to find a diet that will result in positive health benefits for African Americans and reduce their incidence of cardiovascular disease and hypertension. Future research should examine if health-related outcomes, other than weight loss, are associated with improvements in the DII among this population.

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