

## Diabetes & its Complications

# The Diet and Diabetes: A Focus on the Challenges and Opportunities within the Stroke Belt Dietary Pattern

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### ABSTRACT

*Diabetes mellitus, the most common type of endocrine disorder, globally affects over 400 million individuals and is steadily rising. Cultural and environmental norms that embrace or facilitate the lack of consistency in diet, lifestyle and behavioral patterns that promote health have inadvertently promoted and sustained a diabetogenic environment. Dietary patterns plentiful in processed foods, refined grains, sugar, sodium, fat and calories, coupled with modern conveniences that commission sedentary lifestyles have noticeably contributed to the diabetes epidemic as well. Like other chronic diet-related diseases, modifications of dietary intake and consumption patterns are necessary for diabetes prevention. Unfortunately, many modifiable and non-modifiable factors may hinder an individual's ability to obtain an optimal diet for disease prevention and health promotion. This includes, but is not limited to, lack of access to affordable, nutrient-dense foods, geographical location, built environment and demographic characteristics. A prime example of this can be seen in the southeastern region of the United States known as the Stroke Belt, which exhibits exceptionally higher than national average prevalence rates of cardiovascular disease, stroke, diabetes and accompanying disparities in health. Major challenges to the dietary pattern of the Stroke Belt are food consumption behaviors and preparation methods. Promising opportunities with this dietary pattern are the presence of foods, rich in antioxidants and other bioactive compounds, which may reduce the inflammation and oxidative damage associated with disease pathogenesis.*

### Keywords

Chronic disease, Diabetes mellitus, Dietary patterns, Disease prevention, Health promotion, Stroke Belt.

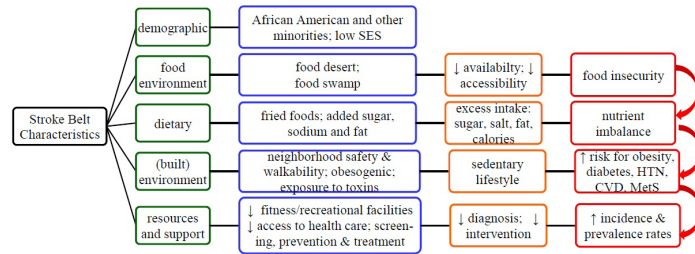
### Introduction

It is estimated that more than 29 million U.S. adults have diabetes mellitus. Not surprisingly, complications of diabetes may affect every cell, tissue, organ and system in the body, and may lead to adverse cardiovascular, renal, microvascular and macrovascular outcomes [1-3]. Racial and geographical differences in diabetes prevalence have been observed, with a greater concentration of diabetes prevalence identified among African Americans and those living in the southeastern region of the United States, also referred to as the Stroke Belt [4]. The Stroke Belt, an 11-state wide region located in the southeastern portion of the United States (Alabama,

Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia), is acknowledged as having the highest persistent prevalence rates of cerebrovascular disease (i.e. stroke) and mortality [5-7]. Further, the mortality associated with stroke is higher for African Americans living in the Stroke Belt as well as those living outside of the Stroke Belt [8]. Although much research has been conducted regarding health disparities within the Stroke Belt, there exists an immense opportunity to provide feasible and practical solutions to lessen the divide. Interventions to transform the modifiable risk factors for diabetes such as dietary intake would not only benefit individuals living in the Stroke Belt but others with similar demographic, socioeconomic and geographical risk profiles. This brief review examines the challenges and opportunities within the dietary pattern of Stroke Belt and its influence on type 2 diabetes.

## The Stroke Belt

The Stroke Belt, appropriately named due to the disproportionately greater incidence and prevalence rates of cardiovascular disease, stroke, obesity and diabetes, demonstrates a dietary pattern unique to individuals living in the southeastern region of the United States. Race, socioeconomic status and chronic disease have been suggested to elucidate the excessive prevalence of disease in the Stroke Belt [9]. It has been suggested that living in the Stroke Belt during childhood may confer an additional risk for stroke, even after relocating out of the Stroke Belt [10]. Within the Stroke Belt is the “diabetes belt”, characterized by a greater prevalence of diagnosed diabetes particularly among African Americans demonstrating modifiable risk factors such as obesity (as a result of a primarily sedentary lifestyle), as well as community -level characteristics, persistent poverty, low socioeconomic status (SES), unemployment and inadequate fitness and recreational facilities [11]. Characteristics of the Stroke Belt that may contribute to increased risk for diabetes are illustrated in Figure 1.



**Figure 1:** Select characteristics of the Stroke Belt that may contribute to diabetes risk, pathogenesis and adverse health outcomes.

## The Dietary Pattern of the Stroke Belt

The relationship between diet and disease has long been studied, with more favorable, high quality dietary patterns containing whole grains, fruits, vegetables, and other plant-based foods being associated with decreased risk for diet-related disease [12-17]. In addition to the dietary composition, meal timing and frequency and environment, may set the stage for disease risk and pathogenesis [18-21]. Unfortunately, these risk factors may span across multiple generations, with offspring of at-risk mothers being at an increased risk for disease [22]. Further, living with a lower SES may considerably contribute to risk for disease by ultimately influencing dietary intake [23,24]. These risk factors may act in synergy within the Stroke Belt to further exacerbate disease risk.

The dietary pattern of the Stroke Belt may be viewed as the “soul food” or “Southern” pattern- rich, flavorful and abundant in added sugar, fat, fried foods, processed meats, animal products, sugar-sweetened beverages and calories [25]. Standard foods include processed meats, pork, poultry, ham hocks, chitterlings, catfish, fried pork cracklings (i.e. skin), and salty snacks, greens (collards, turnip, mustard), sweet potato pie and sugar sweetened tea [26]. Common food preparation techniques include deep frying, grilling, and the addition of pork (e.g. bacon, lard), salt and sugar. Conversely, this dietary pattern is associated with lower intakes of fruits, vegetables and whole grains [27]. Further combating this disparity is the limited access to quality foods, resulting in

poorer diet quality [6,28,29]. Taken together, these characteristics labor additively and in synergy to further increase risk for diabetes mellitus, hypertension, stroke, cardiovascular disease and dyslipidemia [30]. Individuals consuming the Southern diet are at an increased risk for cardio-metabolic risks such as higher blood pressures, higher triglyceride levels, lower high-density lipoprotein (HDL) levels, abdominal visceral adiposity and metabolic syndrome [31]. In addition, the consumption of the Southern dietary pattern was associated with being African American, lower educational attainment, lower SES, higher likelihood of smoking, higher body mass index and physical inactivity [32].

Within the Stroke Belt, African Americans are likely to consume less dietary fiber, calcium, magnesium, potassium and iron and greater amounts of cholesterol and energy from carbohydrates [33,34]. In addition to African American race being an independent risk factor for diabetes, serum potassium was identified as an explanatory effect for diabetes risk [35]. Novel diabetes risk factors among African Americans include lifestyle, physiologic and environmental factors that impact African Americans more than others [35].

## Challenges within the Dietary Pattern of the Stroke Belt

Traditional dietary components of the Stroke Belt include, but are not limited, to green leafy vegetables (e.g., collard greens, turnip greens, mustard greens), starchy vegetables (e.g., corn, sweet potatoes, white potatoes), dried beans (e.g., lima, butter, kidney, navy, black-eyed), grains (rice, grits, macaroni, cornbread), breaded and fried meats and milk (whole, buttermilk) [37]. Regional variations in food preparation methods and consumption patterns within the Stroke Belt may in part offer insight to the increased prevalence of diet-related diseases within this region [38]. This becomes even more problematic as availability, accessibility and exposure to sufficient quantities and quality of more healthful food options (e.g. fresh fruit and vegetables, lean meats, whole grains, low fat dairy products, etc.) is limited in lower income neighborhoods, which have fewer supermarkets in comparison to fast food establishments [39].

Regarded as a “food desert”, this built environment promotes and sustains the consumption of processed foods rich in sodium, sugar, fat and calories, and sets the stage for disparities in dietary intake and diet-related disease prevalence [40]. This disadvantaged food environment not only directly effects food consumption, but indirectly influences disease risk by fostering the inability to maintain a dietary pattern that promotes health and prevents disease [41-43]. More recently, the term “food swamp” has been introduced to describe foodways or food systems dominated by and saturated with calorically-dense foods and beverages [44,45]. In contrast to food deserts, which lack access and availability to nutritious and affordable food, food swamps offer (few) nutritious and affordable foods. However, the accessibility and availability of healthier food options is often “swamped” or overshadowed by the presence of processed, energy-dense, less expressive foods [46].

The relationship between food, culture and diabetes has been

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exposed- with a two-edged sword revelation. Individuals within certain cultures, by default, may be at a generational disadvantage because their culture may not easily endorse the consumption of healthier, high-quality foods. This may be due in part to the learned food preference, preparation and consumption patterns and the geographical challenge of food deserts and swamps. Currently defined as a high-risk population, the African American culture (particularly in the southeastern region of the United States), has experienced a disproportionately greater risk for diabetes, obesity, hypertension and other diet-related diseases [37]. Although the cultural dietary pattern of the Stroke Belt contains many nutrient-dense foods, rich in vitamins, minerals, dietary fiber, antioxidants and other bioactive compounds, the preparation and preservation methods employed may unintentionally mitigate the potential health benefits. This in and of itself adds an additional challenge to preventing disease and promoting health in the Stroke Belt.

### **Opportunities within the Dietary Pattern of the Stroke Belt**

The colorful nature of many plant-based items included in the dietary pattern of the Stroke Belt visually represents the phytochemical and antioxidant potential of these items and their capacity to reduce the oxidative stress, inflammation and cellular injury associated with disease. Major phenolic and flavonoid compounds found in select indigenous vegetables (i.e. collard greens, mustard greens, kale, okra, sweet potato greens, green onion, butter beans, butter peas, purple hull peas, rutabagas, eggplant, and purslane) consumed in the southeastern United States include quercetin, kaempferol, isorhamnetin and ferulic acid, which have significant antioxidant potential that may be beneficial in reducing oxidative stress and inflammation associated with disease pathogenesis [47,48]. Unfortunately, certain preparation practices may lessen the intrinsic benefits offered by these foods.

Individuals living in the Stroke Belt are more likely to consume fish that has been battered and fried, which may lessen the health benefits by destroying omega-3 fatty acids, which otherwise may exert beneficial effects on blood pressure, lipid profile and endothelial function [49]. Researchers have shown that steam cooking is able to significantly increase the *in vitro* bile acid binding capacity of vegetables such as collard greens, mustard greens, cabbage and kale, which are all components of the dietary pattern in the Stroke Belt [50,51]. Kidney beans [52], okra, green beans, turnip greens, and eggplant, also included in the Stroke Belt dietary pattern, exhibit bile acid binding capacities as well [53]. The ability of these dietary components to bind bile acids demonstrate their hypolipidemic and hypocholesterolemic effects, which are critical in the prevention of diabetes and other chronic, diet-related diseases.

In addition to the root (i.e. tuber), sweet potatoes leaves, stalks and stems are exceptional sources of minerals, antioxidants, and bioactive compounds with anti-inflammatory, antidiabetic, antimicrobial, and hepatoprotective characteristics [54]. Although not readily consumed in the southeastern United States, sweet potato leaves offer cardioprotective, chemopreventive, and other health promoting benefits [55,56]. Researchers found that steam

cooking of sweet potato leaves results in an increase in total polyphenol content and antioxidant activity [57]. In this same study boiling, microwaving and frying sweet potato leaves resulted in decreased total polyphenol content; boiling and microwaving resulted in decreased antioxidant activity. Considering the before mentioned research findings, steam cooking appears to be a viable option to optimize phenolic content and antioxidant activities, while at the same time potentially reducing the amount of added fat in the diet.

Dietary modifications that encourage more optimal food preparation techniques may be extremely useful in reducing the risk for diabetes mellitus and other diet-related disease in the Stroke Belt. The Dietary Approaches to Stop Hypertension (DASH) dietary pattern, created to diminish the risks associated with hypertension, offers preparation modification that encourages the substitution of fats (i.e. animal fats → plant fats), lower fat milk and cheeses (whole milk → skim milk), using egg whites instead of whole eggs, removing skin from meats prior to cooking, baking or broiling instead of frying, lean meats, salt and sugar substitutes [58]. Although the DASH diet has been verified to reduce blood pressure and provide cardiometabolic benefits, it is not readily embraced by those with hypertension [59]. Cultural beliefs about certain nutrients, food selection and eating behaviors are all potential barriers to commencement and adherence to the DASH dietary pattern [60,61]. In addition, partnering with African American churches has been proposed as an integral component of promoting health in the African American community [62]. Disease prevention and health promotion campaigns and interventions within the Stroke Belt may consider further exploiting these established methods and practices. Potential opportunities within the Stroke Belt dietary pattern to promote health and prevent disease are presented in Table 1.

### **Conclusion**

Like most chronic, diet-related disease, the risk factors for diabetes may be characterized as non-modifiable, modifiable and manageable. The dietary composition may be viewed as the most easily modified and most variable risk factor, and conversely the least easily modified and least variable. Ironically malnutrition in terms of both excess and deficiency may increase the risk for diabetes and chronic disease. Depending upon one's stage of growth, development and physiological status along the life span nutritional needs may increase or decrease. The challenge of meeting the nutritional needs is dependent upon many economic, social, cultural and individual characteristics- which may or may not be controllable by the individual. Dietary and environmental factors characterized as diabetogenic, obesogenic, atherogenic or toxigenic may facilitate the manifestation of adverse outcomes, comorbidities and premature mortality. Disparities in the prevalence of diabetes and other chronic diet-related diseases and conditions are widespread among at-risk minorities and other individuals living in communities with lower educational attainment, lower incomes, little or no access to sufficient quantities and quality of nutrient-dense foods, health care and other services necessary to optimize health outcomes. Further, these individuals are at

	Component*	Challenge/Outcome	Opportunity/Benefit
Entrée	Fish Chicken Beef Stews and soups	<b>Preparation</b> • deep frying; smothered; grilled; barbecued; high cooking temperatures • addition of fat (e.g. butter, margarine, lard, etc.), salt and sugar  <b>Cooking at high temperatures</b> Destruction of omega-3 fatty acids and other micronutrients; greater amounts of fat, salt, sugar and calories	<b>Preparation</b> • removing skin from meats prior to cooking, baking or broiling • lean meats; salt and sugar substitutes  Greater availability of omega- fatty acids and other micronutrients; lower amounts of fat, salt, sugar and calories
Side Dishes	<b>Vegetables</b> beans/peas (green beans, butter beans, purple hull peas); greens (collard greens, turnip greens, kale, mustard greens, etc.); okra; eggplant  <b>Starchy</b> macaroni and cheese; corn bread; biscuits; potato salad; white potatoes; sweet potatoes	<b>Availability and accessibility</b> quality and quantity  <b>Preparation</b> addition of fat (e.g. margarine, butter, lard, beef and pork fat), pork (e.g. bacon), salt, sugar, whole milk, breading, eggs  <b>Extended cooking times</b> Destruction of micronutrients; lower total phenolic content; lower antioxidant activity	<b>Preparation</b> • steam cooking; roasting • substitutions: plant fats; lower fat milk and cheeses; egg whites; salt and sugar substitutes  Lower amounts of fat, salt, sugar and calories; higher total phenolic content; higher antioxidant activity
Desserts	sweet potato pie; banana pudding	<b>Preparation</b> • addition of fat (e.g. margarine, butter), eggs, sugar, whole milk  Greater amounts of fat, sugar and calories	<b>Preparation</b> • substitutions: plant fats; lower fat milk; egg whites; sugar substitutes; fresh produce in place of canned  Lower amounts of fat, sugar and calories
Snacks	salty snacks (e.g. potato chips; pork skins); sugary snacks (e.g. candies, donuts, cookies)	<b>Preparation/Composition</b> • processed snacks - refined grains, additional fat, sugars and salt  Greater amounts of fat, salt, sugar and calories; lesser amounts of dietary fiber	<b>Substitutions</b> • substitutions: raw fruits and vegetables  Lower amounts of fat, salt, sugar and calories; greater amounts of dietary fiber and antioxidants
	Beverage sweet tea; soft drinks	<b>Preparation/Composition</b> • additional sugar  Greater amounts of sugar, salt and calories	<b>Substitutions</b> • substitutions: water; 100% fruit juice  Lower amounts of sugar, salt and calories

**Table 1:** Potential opportunities within the Stroke Belt dietary pattern to promote health and prevent disease. \* Not exhaustive and does not include all of the components of the Stroke Belt dietary pattern.

an increased risk for health disparities and accompanying comorbidities and premature mortality associated with diabetes. One such community is the Stroke Belt.

The Stroke Belt, an 11-state expanse within the southeastern region of the United States, presents a unique dietary and built environment that greatly enhances the risk for diabetes, stroke, cardiovascular disease and other chronic disease. Entwined in the fabric and culture of the Stroke Belt is food- intentionally selected and prepared to “comfort the soul”. Unfortunately this “comfort” may encase the body in excessive nutrients that may interfere with optimum metabolic functioning. Although there are many dietary challenges within the Stroke Belt that may intensify diabetes risk and pathogenesis, there are available opportunities to attenuate the risks. Components of the Stroke Belt dietary pattern have demonstrated antioxidant, anti-inflammatory, hypoglycemic, hypotensive, hypocholesterolemic and cardioprotective capabilities that are critical to promoting health. Providing guidance on food intake, in addition to optimal preparation techniques, may provide cardiometabolic advantages that were previously not present. Identifying dietary challenges and opportunities within the Stroke Belt is the first of many steps in equipping individuals with scientifically-based tools and resources to significantly promote public health and prevent disease within their community.

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