Eating Behaviors 29 (2018) 48–53

Contents lists available at ScienceDirect

Eating Behaviors

journal homepage: www.elsevier.com/locate/eatbeh

Associations between fiber intake and Body Mass Index (BMI) among African-American women participating in a randomized weight loss and maintenance trial

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ARTICLE INFO

Keywords:
African American
Women
Fiber
Obesity
Diet

ABSTRACT

Introduction: African-American women are at increased risk for obesity, and therefore it is important to identify dietary factors that have the potential to prevent weight gain within this population. The purpose of the current study was to examine associations between daily fiber intake and Body Mass Index (BMI) over the course of an 18-month weight loss intervention for African-American women.

Methods: Anthropometric measures and the Block Food Frequency Questionnaire were administered at baseline, 6-month, and 18-month follow-up between 2008 and 2010. A mixed-effects linear regression model with random intercept and time slope was used to model associations between fiber consumption and BMI controlling for time trend.

Results: Associations between fiber consumption and BMI were significantly different over time ($\widehat{\beta}_{Fiber*Time} = -0.07$, p-value = 0.003). There was no association between fiber intake and BMI at baseline; however, there was a significant inverse relation between fiber consumption and BMI at 6 months, and the association was even stronger at 18 months.

Conclusions: Results from this study suggest that dietary fiber consumption may be particularly important within weight loss interventions tailored for African-American women.

1. Introduction

Obesity rates have remained substantially high over the last several decades, making it a significant public health concern (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016; Ogden, Carroll, Kit, & Flegal, 2014). African-American women have the highest prevalence of obesity compared to any other subgroup, with 56.6% classified as obese, compared to 32.8% of their European-American counterparts (Ogden et al., 2014). Obesity is associated with increased risk of several leading chronic diseases disproportionately experienced by African-American women including heart disease, type 2 diabetes, and some cancers such as breast and colon cancer (Lloyd-Jones et al., 2010; Ogden et al., 2014; Robbins, Vaccarino, Zhang, & Kasl, 2001). Thus, determining factors associated with weight management is especially important for African-American women.

Numerous epidemiological studies suggest that a diet high in fiber, especially intake of whole grains or cereal fiber, can prevent excessive weight gain (Anderson et al., 2009; Anderson, Pasupuleti, & Anderson, 2008; Cho, Qi, Fahey, & Klurfeld, 2013; Howarth, Saltzman, & Roberts, 2001; Liu et al., 2003). However, these studies have been conducted in predominately European-American samples (Du et al., 2010; Slavin, 2005) and very few studies have focused exclusively on women (Liu et al., 2003). Results from an analysis of 12 years of dietary data from the Nurses' Health Study revealed that women with the greatest increase in dietary fiber intake gained 1.53 kg less on average than females with the smallest increases in dietary fiber intake ($p < 0.0001$) (Liu et al., 2003). These results were independent of age, body weight, Body Mass Index (BMI), total energy, and macronutrients at baseline, and changes in age, exercise, smoking status, hormone replacement therapy status, alcohol use, and caffeine intake. In the same study, women in the highest quintile of dietary fiber intake had a 49% lower risk of major weight gain than did women in the lowest quintile

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https://doi.org/10.1016/j.eatbeh.2018.02.005
Received 4 April 2017; Received in revised form 31 January 2018; Accepted 15 February 2018
Available online 16 February 2018

(OR = 0.51; 95% CI: 0.39, 0.67; p < 0.0001). The analyses were conducted on over 74,000 women, but no subgroup analyses were reported on associations between fiber intake and weight specifically in African-American women. Given their elevated risk for obesity and related co-morbidities, there is a need for more evidence on associations between fiber intake and weight control among African-American women.

Evidence suggests African-American women have the lowest dietary fiber intake of any racial and ethnic group (King, Mainous, & Lambourne, 2012; Kong et al., 2013). In a cross-sectional study examining dietary fiber intake by age, sex, and race, Storey and colleagues reported that, on average, non-Hispanic, black females consumed less fiber per day (12.7 g/day) compared with European-American women (15.7 g/day) and non-Hispanic, African-American males (15.0 g/day) (Storey & Anderson, 2014). In another cross-sectional study examining the dietary quality of African-American and Hispanic families in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), African-American mothers had a median fiber intake of 8.8 g/day compared to 14.5 g/day in Hispanic mothers (Kong et al., 2013). Given that fiber intake is generally low among African-American women, it is possible that increased fiber intake may impact weight status in this high-risk group.

There is limited prospective evidence supporting the role of increased fiber intake and weight loss in African-American women (Affenito et al., 2005; Krishnan et al., 2007). Krishnan and colleagues examined the association between cereal fiber intake and risk of type 2 diabetes among 59,000 participants from the Black Women's Health Study, and found an inverse association between cereal fiber intake and obesity. Although cereal fiber intake [IIR: 0.41 (95% CI, 0.24–0.72)] was protective for risk of type 2 diabetes, it was less protective in overweight women [IIR: 0.88 (95% CI, 0.74–1.04)] (Krishnan et al., 2007). Further, low dietary fiber intake was also a significant predictor of weight gain in African-American women and men (n = 1307) in the Coronary Artery Risk Development in Young Adults (CARDIA) study (Ludwig et al., 1999). Finally, in the National Heart, Lung, and Blood Institute Growth and Health Study, Affenito and colleagues found African-American girls (n = 1213) consistently consumed breakfast less often than European-American girls and consumed breakfast less frequently over the course of 9 years. Eating breakfast was significantly associated with increased fiber consumption and decreased BMI (Affenito et al., 2005). No studies to date have investigated the associations between fiber intake and weight over time specifically among African-American women and no studies to date have examined this relation in the context of a weight loss trial.

Given the limited inclusion of African-American women in randomized controlled weight loss trials, there are fewer opportunities to examine the association between fiber intake and weight in this group. Successful weight loss studies that included a significant number of African-American women such as the Diabetes Prevention Program (DPP) (Group DPPR, 2002), the PREMIER trial (Svetkey et al., 2005), and Look AHEAD (Belalcazar et al., 2014) did not report on fiber intake by race specifically. The Obesity Reduction Black Intervention Trial (ORBIT) was a randomized controlled weight loss and weight loss maintenance trial for obese African-American women (Fitzgibbon et al., 2008, 2010; Stolley et al., 2009). As part of the intervention, participants were encouraged to adopt a low-fat, high-fiber diet with increased fruit and vegetable consumption and decreased caloric intake. The purpose of the current study was to examine associations between habitual daily fiber intake and Body Mass Index (BMI) over time. The proposed study is the first to examine the association between in fiber intake and BMI during an 18 month randomized controlled trial weight loss lifestyle intervention trial for African-American women. We hypothesized that increased fiber intake would be associated with greater weight losses (lower BMI) over the course of the program. Identifying a relation between fiber intake and weight loss among this high risk group may inform the development of future weight loss interventions.

2. Methods

Data from the currently study were collected between 2008 and 2010. Methods for the IRB-approved ORBIT trial have been reported previously (Fitzgibbon et al., 2008, 2010; Stolley et al., 2009). Our analysis was restricted to women randomized to the weight loss intervention group given that the control participants did not receive any intervention related to diet. Women who provided informed consent completed anthropometric measures and the Block Food Frequency Questionnaire (Block, Woods, Potosky, & Clifford, 1990) at each time point: baseline, 6-month, and 18-month follow-up.

2.1. Measures

2.1.1. Demographics

The sociodemographic questionnaire inquired about date of birth, education, income, employment status, and relationship status.

2.1.2. Anthropometrics

Height was measured using a seca 214 portable stadiometer (seca, Hanover, MD), and weight was measured using a Tanita BWB-800 digital scale (Tanita Corporation of America, Inc., Arlington Heights, IL). Participants removed their shoes and any outer clothing for the anthropometric measurements. Height and weight were measured twice during the baseline interview, to the nearest 0.1 cm and 0.1 kg, respectively. If the two height measurements were > 0.5 cm apart or if the two weight measurements were > 0.2 kg apart, a third measurement was taken. The mean of the two closest measurements was used for analysis. BMI was then computed from height and weight (weight in kg/height in meters squared).

2.1.3. Block '98 Food Frequency Questionnaire (FFQ) (Block et al., 1990)

The Block FFQ was administered by trained interviewers and assessed frequency of dietary consumption in the past year and usual portion size for 110 different food and beverage items. Data from the Block were used to calculate nutrient intake, food group intake, and other dietary variables, including dietary fiber specifically. The food list was developed using food intake data from the National Health and Nutrition Examination Survey III (NHANES III). Reliability and validity have been established for the measure in a wide range of age, gender, income, and ethnic groups, including African American women (Block et al., 1990; Block, Thompson, Hartman, Larkin, & Guire, 1992; Hartman et al., 1996; Kennedy, Ohls, Carlson, & Fleming, 1995; Kumanyika et al., 2003; Norris et al., 1997). Data was sent to Nutrition Quest for scoring (http://nutritionquest.com/).

2.2. Weight loss intervention period (baseline to 6 months)

The development and delivery of the intervention were based on Social Cognitive Theory (SCT) (Bandura, 2001) and thus focused on changes in cognitions, behaviors, and social support related to weight loss. According to SCT, modeling or observational learning is a powerful contributor to behavioral change (Bandura, 2001). Individuals are more likely to model behavior that has a positive outcome, as well as the behavior of someone similar to themselves. The intervention provided ample opportunity for observational learning to occur, both via the interventionists and fellow participants. The intervention also presented multiple avenues to enhance self-efficacy, with curriculum focused on stimulus control, problem solving and other weight loss strategies, as well as the opportunity for monthly Motivational Interviewing (MI) sessions.

In addition to SCT, the intervention incorporated tenets related to the practice of culturally competent research (Porche-Burke, 2000). Culturally sensitive interventions require the recognition of the beliefs and practices of the particular social, ethnic and age group for whom the intervention is being developed, appreciation of the roles these