Household food insecurity and dietary saturated fat in rural Appalachia

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Abstract

Purpose: To explore the relationship between food insecurity and dietary saturated fat intake in rural Central Appalachia.

Design: Cross-sectional analysis of baseline data from a longitudinal interventional study

Sample: Baseline assessment of dietary saturated fat intake and food security in volunteers who had resided in rural Central Appalachia for at least five years and were enrolled in a cooking skills class.

Method: Volunteers (n=56, 89.3% female) completed the USDA Household Food Security Survey Module (HFSSM) and Diet History Questionnaire-II. Average age was 56.5 (range 18-76) years. Average intake of saturated fat was calculated using DietCalc software. Food security was measured using the HFSSM. Descriptive and inferential statistical analyses were conducted using SAS, v. 9.3 with an alpha level of .05.

Findings: High or marginal food security was experienced by 75% with 25% of participants experiencing low/very low food security. Average daily saturated fat was 26 grams. Significant findings included greater saturated fat consumption in men; lower saturated fat consumption with older age; older age being associated with lower food insecurity; and no association between food insecurity and saturated fat intake. Average daily saturated fat gram intake was significantly lower for females than males; the group means were 23.6 (SD = 12.4) and 49.6 (SD = 15.0) for these two groups, respectively ($t = 4.8$, $P < .001$). For every 10-year increase in age, there was a 2.7 gram decrease in daily saturated fat intake.

Conclusions: Historical food traditions and method of food preparation likely contribute to the lack of an association between high food security and saturated fat intake in rural Appalachia. Food insecurity was not associated with saturated fat intake in our sample. Additional research is needed to determine to the full impact of food insecurity on dietary fat intake in Appalachia.

Keywords: Food Insecurity, Appalachian Region, Fatty Acids Saturated, Poverty

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Dietary saturated fat intake and household food insecurity (i.e., the condition of being unable to consistently have physical, social and economic access to sufficient safe and nutritious food that meets dietary needs and food preferences for a healthy life) are both independently associated with higher risk of cardiovascular disease (CVD) and other chronic illnesses (Abdurahman, Chaka, Nedjat, Dorosty, & Majdzadeh, 2018; Ford, 2013; Cascio, Schiera, & Liegro, 2012). In rural Central Appalachia (i.e., Kentucky Appalachian counties with Rural-Urban Continuum Codes of 8[completely rural or less than 2,500 urban population, adjacent to a metropolitan area] or 9 [completely rural or less than 2,500 urban population, not adjacent to a metropolitan area]) (U.S.

Department of Agriculture, Economic Research Services [USDA, ERS], n.d.), an area with disproportionately higher rates of CVD, metabolic syndrome, and type 2 diabetes, household food insecurity is higher than in most other areas of the United States (Coleman-Jensen, Rabbit, Gregory, & Singh, 2017). In this study, we analyzed the relationship between household food insecurity and dietary saturated fat intake in individuals living in rural Central Appalachia.

Background

Dietary Saturated Fat

Many factors influence individuals' dietary habits, including the type and amount of fats typically consumed. Higher dietary saturated fat intake is associated with increased CVD risk, particularly when it replaces polyunsaturated fats or whole grain carbohydrates (Tapsell, Neale, Satija, & Hu, 2016). While the human body does use saturated fats for physiological and structural functions, it is able to produce what it requires without dietary intake (U.S. Department of Health and Human Services, U.S. Department of Agriculture, [USHHS, USDA], 2015). Current nutritional recommendations are to limit dietary saturated fat intake to less than 10% of total calories daily. For the average person consuming 1800-2200 daily calories, saturated fat intake should be limited to less than 18-22 grams each day. However, over 70% of Americans consume more than the recommended daily limit of saturated fats (USHHS, USDA, 2015).

Saturated fats are dietary fats that are solid (e.g., lard, shortening, butter, and margarine) or semi-solid (e.g., coconut, palm kernel, palm oils) at room temperature (USHHS, USDA, 2015). Solid/semi-solid fats are abundant in the U.S. diet and reducing dietary solid/semi-solid fat is an important way to reduce saturated fat and excess calories (USHHS, USDA, 2015). Saturated fat is associated with higher low density lipoprotein (LDL) cholesterol and serum triglycerides, and

subsequently, greater risk of atherosclerosis (Sacks et al., 2018). Replacement of 5% of calories from saturated fats with polyunsaturated fats or monounsaturated fats reduces LDL cholesterol and triglycerides, decreases atherosclerosis risk, and is associated with 15-25% overall CVD risk reduction (Li et al., 2015).

Processed food (i.e., food altered from the harvested state in order to lengthen preservation) high in saturated fats is a major source of energy in the United States (Floros et al., 2010). Processed food is often less expensive than non- or minimally processed food and is consumed more frequently in food insecure households (Eicher-Miller, Fulgoni, & Keast, 2015). Individuals participating in food assistance programs are likely to purchase most of their monthly food during the earlier days of the month, resulting in a higher likelihood of purchasing processed foods with longer shelf lives (Oliveria, 2018). While processed food improves food security, it also contributes 52% of the saturated fat in the American diet (Weaver, et al., 2014). Therefore, individuals at high risk of food insecurity are likely to be at risk of a socioeconomic-related higher intake of saturated fats from processed foods. Conversely, high food security is associated with a higher intake of polyunsaturated fatty acids, which is related to lower CVD risk (Mazidi & Vatanparast, 2018; Coleman-Jensen, et al., 2017).

Household Food Insecurity

In 2016, 15.6 million (12.3%) U.S. households experienced high food insecurity (Coleman-Jensen et al., 2017). Nearly 5% of these food insecure households had very high food insecurity (i.e., eating patterns of at least one household member disrupted and food intake reduced because of insufficient money or resources for food). Approximately 18% of these food insecure U.S. households are located in rural counties (Rabbitt, Coleman-Jensen, & Gregory, 2017). The typical

food insecure household spends 29% less for food (including federal/state nutritional supplemental funds) than the food secure household of the same size and composition (Coleman-Jensen et al., 2017).

Nearly all individuals experiencing food insecurity report worrying that their food will run out before they could afford to buy more (98% of respondents) and that they are unable to afford to eat balanced meals (95% of respondents) (Coleman-Jensen et al., 2017). More than 17% of Kentucky households reported high or very high food insecurity in 2016. Rural Central Appalachia, the majority of which is located in Kentucky, has disproportionately higher rates of food insecurity than the state's non-Appalachian counties (average rates: 17.85% vs. 13.97%; ranges 13.3-23.9 vs. 8.0 – 21.6; respectively) (Gundersen, Dewey, Crumbaugh, Kato, & Engelhard, 2018). In addition to higher rates of CVD, metabolic syndrome and type 2 diabetes, food insecurity in Appalachia is also associated with higher rates of obesity, poor management of health conditions, and depression (Bengle et al., 2011; Johnson, Sharley, & Dean, 2011; Porter & Johnson, 2011).

Objective

The purpose of this study was to assess the relationship between food insecurity and saturated fat intake among individuals living in rural Appalachia, controlling for age and sex.

Methods

This cross-sectional, exploratory analysis was conducted from baseline data of a longitudinal trial in six rural Central Appalachian counties with similar demographics. Participants who were ≥ 16 years old and lived in rural eastern Kentucky for a minimum of five years were eligible for the study. Children under the age of 16 were excluded because it is unlikely that this age group would

include the primary household grocery shoppers. Individuals who were unable to make decisions about food choices and those with malabsorptive disorders or procedures were also excluded.

Research Ethics

Medical Institutional Review Board approval was obtained for this study (14-002-P2H). The study was registered with Clinical Trials.Gov: NCT02924051.

Procedure

We recruited study volunteers (N=56) via advertisements in county cooperative extension office newsletters printed in local newspapers. Informed consent was obtained by a member of the research team at the start of an informational group meeting held at each county extension office. During this meeting, the purpose and protocol of the study were explained to volunteers. To ensure all data collection forms were of appropriate literacy, participants' literacy levels were assessed using the Newest Vital Sign screening tool prior to data collection. Literacy screening was performed by a registered nurse trained in health literacy assessment. Scores on the NVS range from 0-6. Individuals who score > 4 on the NVS are considered to have adequate literacy (i.e., the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions) when measured by the Test of Functional Health Literacy in Adults (Weiss et al, 2005).

Following literacy screening, participants completed the USDA Household Food Security Survey Module (HFSSM) and demographic questionnaires during the informational meeting. Participants then received a packet that included print instructions on completion of the web-based National Cancer Institute's (NCI) Diet History Questionnaire-II (DHQ-II), including individualized access codes. Participants were instructed in the completion of the DHQ-II by a

registered nurse trained by a doctorally-prepared dietitian. Participants were also provided print illustrations of serving sizes of commonly eaten foods paired with comparably sized objects (eg, 3 ounces of meat is approximately the size of a deck of playing cards). Participants who did not have Internet or computer access received a paper version of the DHQ-II, identical to the web-based version and a large postage-paid, pre-addressed envelope to return the completed DHQ-II. Data specialists entered the responses into the electronic DHQ-II using the participant access codes. The Diet*Calc Analysis Program 1.5.0 was used to determine the average daily grams of saturated fat (NCI, 2012).

Measures

Demographic variables included age (in years) and sex (male/female).

Saturated Fat (Average Daily Intake). The DHQ-II measures intake frequency of 124 foods over the previous month. The questionnaire includes portion size and supplement questions (NCI, 2012). The DHQ-II has higher correlations (0.63–0.65) with multiple-pass 24-hr recalls obtained seasonally over 12 months than the Block (0.54–0.58) and Willett (0.58–0.63) questionnaires (Subar et al., 2001). The Diet*Calc software calculates average daily intake of saturated fats from reported frequency of the 124 foods in the DHQ-II.

Food Security. The 18-item USDA Household Food Security Survey Module (HFSSM) ranks household food security (i.e., having consistent and reliable access to sufficient amount of nutritious food). The HFSSM is a valid measure and considered the most authoritative method for differentiating level of food security. Responses of “yes,” “often,” “sometimes,” “almost every month,” and “some months but not every month” are coded as affirmative for each item. The sum of affirmative responses to the 10 questions in the scale is the raw score on the scale. The raw

score is then combined into categories to form the scored version of the HFSSM. The resulting ordinal variable ranges from 1 to 4, with higher scores indicting lower food security. A raw score of zero corresponds to a scaled score of 1 ('high food security'); raw scores of 1-2 are coded as a scaled score of 2 ('marginal food security'); raw scores of 3-5 correspond to a scaled score of 3 ('low food security'); and raw scores of 6-10 are coded as a scaled score of 4 ('very low food security'). Given the ordering of these ranks from the greatest security to the least, the interpretation of this variable is actually a food insecurity ranking as the score increases.

Analysis

We summarized study variables using means and standard deviations or frequency distributions. Bivariate associations among study variables were assessed using Pearson's product moment correlation or the two-sample t-test. The multivariable association between food security and saturated fat intake, controlling for age and sex, was assessed using multiple linear regression; variance inflation factors were used to assess whether multicollinearity influenced regression parameters. Data analysis was conducted using SAS, v. 9.3; an alpha level of .05 was used.

Results

All participants recruited for the study tested at literacy levels ≥5 on the NVS, demonstrating adequate literacy for comprehension of the HFFSM and DHQ-II. Average age of those in the study was 56.5 years (SD = 13.5); the range was from 18 to 76 years. Most participants were female (89.3%). The majority of those in the study were either in the high food security (35.7%) or marginal food security (39.3%) categories; 12.5% of participants were in each of the low and very low food security groups. The average saturated fat consumption per day was 26.4 grams (SD = 19.2); the range was from 6.2 to 74.9 grams.

The correlation of age with food security ranking was significant (Table 1). This relationship was negative, suggesting that increased age was associated with decreased food insecurity. The other correlations in the bivariate analysis were not significant, as shown in the table. In particular, saturated fat intake was not associated with age or with food security in this sample. The comparisons of study variables between males and females via the two-sample t-test revealed that there was no difference by sex in age ($t = 0.10$, $p = .92$) or food security ranking ($t < 0.10$, $p = .96$). The average daily saturated fat gram intake was significantly lower for females than males; the group means were 23.6 (SD = 12.4) and 49.6 (SD = 15.0) for these two groups, respectively ($t = 4.8$, $p < .001$).

Table 1

C*orrelations among Study Variables* (N = 56)

Variables	*Age* ***r (p-value)***	*Food insecurity* ***r (p-value)***
Food insecurity	-0.35 (.0081)	--
Saturated fat	-0.19 (.17)	-.097 (.48)

The multiple regression of saturated fat intake on age, sex, and food insecurity was significant overall ($F = 9.5$, $p < .001$); the R^2 for this model was 0.36. Age and sex were significantly associated with saturated fat intake in this multivariate analysis (Table 2). In particular, for every 10-year increase in age, the model predicted a 2.7 gram decrease in daily saturated fat intake. Consistent with the bivariate analysis, the model indicated lower saturated fat consumption among women, with 25.7 fewer grams per day in this subgroup, compared with men. Food security was not predictive of saturated fat grams in this model, though the p-value was smaller in this multivariable analysis relative to the bivariate correlation between these two

variables. All variance inflation factors were < 1.5, suggesting multicollinearity was not likely distorting any regression parameters.

Table 2

Multiple Regression Model to Assess Predictors of Daily Saturated Fat Grams (*N* = 56)

Variable	*Parameter estimate*	|*t*|	*p-value*	*Variance inflation factor*
Age	-0.27	2.0	.047	1.14
Female	-25.74	4.8	<.001	1.00
Food insecurity	-2.67	1.5	.14	1.14

Discussion

Significant findings in this study include greater saturated fat consumption in men than in women; lower saturated fat consumption with older age; older age being associated with lower food insecurity; and the lack of an association between food insecurity and saturated fat intake, even when adjusting for age and sex. Average daily saturated fat intake in the United States is 31.3 grams in men and 23.3 grams in women (USDA, ARS, 2019). Reduction in dietary saturated fat intake has a greater response in total cholesterol and low-density lipoprotein cholesterol in males than in females (Weggeman, Zock, Urgert, & Katan, 1999). In this study, average daily saturated fat intake was significantly greater for males than females at 49.6 g/day and 23.6 g/day, respectively. The greater impact of LDL-cholesterol reduction in males indicates strategies aimed at reduction of saturated fat intake would likely be effective in reducing CVD risk in males within this population.

Older age was associated with lower dietary saturated fat in our study. Aging is associated with an increased concentration of inflammatory markers and the concentration is influenced by dietary saturated fat (Calder et al., 2017). Additional research is needed to determine factors that

contribute to dietary saturated fat intake in older adults. Older age was also associated with greater food security in this cohort. In older adults, food insecurity both contributes to and is a consequence of poor health outcomes including mobility limitations, chronic disease burden, limitations in activities of daily living, medication under-use, and depression (Afulani, Herman, Coleman-Jense, & Harrison, 2015; Bishop & Wang, 2018; Darmon & Drewnowski, 2015; Ganhao-Arranhado, Paul, Ramalho, & Pereira, 2018; Jih, et al., 2018; Jung, Kim, Bishop, & Hermann, 2018).

While poverty and subsequently, food insecurity, contribute significantly to unhealthy diets, it is likely that other factors contribute to the lack of a significant association between dietary saturated fat and food insecurity in this group of rural Central Appalachian residents. In 2013, we conducted and reported results of focus groups related to barriers to consuming healthy foods in Central Appalachian (Hardin-Fanning, 2013). Participants reported difficulties in changing personal habits, limited access to a variety of healthy food, difficulty in preparing healthy foods, limited knowledge of the health benefits of foods, family attitudes toward food, and difficulty determining how to incorporate healthy foods into meals as barriers to healthy eating unrelated to economics. Potential strategies to address these barriers have been discussed earlier (Hardin-Fanning, 2013). An additional factor that is likely to influence the high dietary saturated fat in this group of Appalachian residents is historical food tradition.

Historical Food Tradition

The combination of saturated fats being a historical part of Appalachian cooking and food serving as a means of celebrating family and community contributes to a diet highly conducive to nutrition-related chronic disease. The typical diet of Appalachia consists primarily of calorie-dense

meats, starches, and fats. A principal historic and current source of protein in rural Appalachia is pork (Miller, 2009; Sohn, 2005). Pork is used as a primary food, a seasoning for legumes and vegetables, and a source of cooking fat. Climate variations in Central Appalachia necessitated food preservation that included brining or curing pork (Sohn 2005). These preserved pork products (i.e., ham, bacon, sausage, cold cuts) are still principal foods in rural Appalachia.

Frying is a common method of food preparation in rural Appalachia (Sohn, 2005). Frying or adding animal fats (e.g., salt pork added to dried legumes), results in even greater amounts of saturated fats than prior to food preparation. The top ten foods identified as important to Appalachians are bacon, biscuits and gravy, chicken and dumplings, cornbread, coffee, fried potatoes, green beans, soup beans, stack cakes and vegetable soup (Sohn, 2005). Several of these foods are high in saturated fats but have cultural foundations that have endured over generations. While the Appalachian diet does have a reasonable variety of foods, particularly during summer when produce is available, most meals include gravies, sauces, and foods fried in fat (Sohn, 2005).

Family, including extended kin, is the cornerstone of community life in Appalachia. In rural Appalachian communities, food has long been a means of celebration and hospitality (USDA, USHHS, 1987). Celebration dinners (e.g., weddings, homecomings) usually include several different meats, vegetables, breads, and desserts. Family reunions, funeral food preparation, dinners on the ground (i.e., pot luck dinners at community churches), and food-related festivals continue to be very common in rural Appalachia (Miller, 2009). Since these events are opportunities to showcase favorite recipes, the foods served are often fried or have fatty meats added for seasoning. The high saturated fat content in rural Appalachia's historical diet persists in the region.

Strengths and Limitations

The primary strength of this study is the measurement of saturated fat intake and food security in an at-risk population using validated instruments. These findings add to the understanding of how food choices and food availability may be related to demographic factors, and this is crucial information given the strong links between diet and disease. The main limitation of this exploratory study is sample size, but the results underscore the need for further research in this area.

Conclusion

Factors unrelated to socioeconomic status, including demographic characteristics and tradition, influence food choice. Food insecurity was not associated with saturated fat intake in our sample. Additional research is needed to determine the full impact of food insecurity on saturated fat intake in rural Appalachia.

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