Published in final edited form as:

*Nutrition*. 2015 May ; 31(5): 708–715. doi:10.1016/j.nut.2014.11.017.

# Dietary contributors to glycemic load in the REasons for Geographic and Racial Differences in Stroke (REGARDS) study

**James M. Shikany, Dr.P.H.**[a,*], **Suzanne E. Judd, Ph.D.**[b], **Abraham J. Letter, M.S.**[b], **Jamy D. Ard, M.D.**[c], and **P. K. Newby, Sc.D., M.P.H., M.S.**[d]

[a]Division of Preventive Medicine, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama, USA

[b]Department of Biostatistics, School of Public Health, University of Alabama at Birmingham, Birmingham, Alabama, USA

[c]Department of Epidemiology and Prevention, Wake Forest School of Medicine, Winston Salem, North Carolina, USA

[d]Program in Gastronomy, Culinary Arts, and Wine Studies, Boston University and Program in Environmental Studies, Harvard University, Boston, Massachusetts, USA

## Abstract

**Objective—**High dietary glycemic load (GL) has been associated with an increased risk of chronic diseases, including type 2 diabetes, coronary heart disease, and selected cancers. We sought to identify the main food and food group contributors to dietary GL in a representative sample of US adults to inform future interventions.

**Methods—**Participants were from the REasons for Geographic and Racial Differences in Stroke (REGARDS) study, a longitudinal cohort of 30,239 community-dwelling black and white women and men age ≥45 years across the US. Diet was assessed with a food frequency questionnaire. The amount of each carbohydrate food, and its glycemic index, were used to calculate GL values for each carbohydrate food reported. These were totaled to estimate the mean total daily GL for each participant. Individual carbohydrate foods also were collapsed into 18 carbohydrate food groups, and the portion of the total GL contributed by each carbohydrate food and food group was determined. Analyses were conducted overall, by race/sex groups, and by region.



*Corresponding author: Division of Preventive Medicine, School of Medicine, University of Alabama at Birmingham, 1720 2nd Ave. S., MT 619, Birmingham, Alabama 35294-4410; Telephone: 205-975-7989; Fax: 205-934-4262; jshikany@uabmc.edu.

JMS conceptualized and designed the study, supervised data analysis, interpreted the data, drafted the manuscript, and approved the final version of the manuscript. SEJ assembled and analyzed the data, reviewed and revised the manuscript, and approved the final version of the manuscript. AJL assembled and analyzed the data, reviewed and revised the manuscript, and approved the final version of the manuscript. JDA reviewed and revised the manuscript and approved the final version of the manuscript. PKN reviewed and revised the manuscript and approved the final version of the manuscript.

**Results—**Sweetened beverages were the main contributors to GL overall (12.14 median % of daily GL), by far the largest contributors in black men (17.79 median %) and black women (16.43 median %), and major contributors in white men (12.02 median %) and white women (11.22 median %). Other important contributors to GL overall and in all race/sex groups and regions included breads, starchy side dishes, and cereals.

**Conclusions—**In this US cohort of white and black adults, sweetened beverages were major contributors to GL overall, and especially in black participants. This information may help to inform future interventions targeting reduction in dietary GL.

### Keywords

Dietary carbohydrates; Glycemic index; Sweetened beverages; Dietary assessment; Food frequency questionnaire

## Introduction

Carbohydrates elicit a wide spectrum of blood glucose and insulin responses, influenced by both their quality and quantity. Glycemic index (GI)[1] is a ranking of carbohydrate-containing foods based on their postprandial blood glucose responses relative to a carbohydrate standard and is a measure of carbohydrate quality [1]. Generally, the lower the GI, the lower the rate of absorption of the carbohydrate and the smaller the rise in postprandial glucose and insulin concentrations [2]. In general, most refined, high-starch carbohydrates have a high GI, whereas low-starch vegetables, fruits, and legumes tend to have low GI values. Glycemic load (GL) is a measure that incorporates both the quality and quantity of dietary carbohydrates. The concept of GL was introduced to advance the notion that the overall glycemic effect of the diet, not the GI of carbohydrates or the amount of carbohydrates alone, is the more important exposure in relation to disease risk [3].

Observational studies have provided evidence that consumption of high-GL diets is associated with an increased risk of chronic diseases, including type 2 diabetes [4,5], dyslipidemia [3,6], coronary heart disease (CHD) [7–9], selected cancers [10–12], and combined chronic diseases [11]. In addition, small clinical studies have suggested that GL may play a role in overeating and obesity [13–15].

While studies investigating the association between GL and chronic diseases have increased over the past decade, there is a dearth of information in the literature on the major dietary contributors to GL in the US population. As interest in the possible role of GL in the risk of chronic disease increases, dietary interventions to reduce GL likely will become more prevalent. Determining the major food contributors to dietary GL in the typical US diet will be necessary to inform effective dietary interventions. The REasons for Geographic and Racial Differences in Stroke (REGARDS) study provided an opportunity to determine

[1]Abbreviations: ARIC, Atherosclerosis Risk in Communities; BMI, body mass index; CHD, coronary heart disease; CVD, cardiovascular disease; EPIC, European Prospective Investigation into Cancer and Nutrition; EPICOR, EPIC – Italy cohort; FFQ, food frequency questionnaire; GI, glycemic index; GL, glycemic load; MEC, Multiethnic Cohort; REGARDS, REasons for Geographic and Racial Differences in Stroke; SWAN, Study of Women's Health Across the Nation; USDA, United States Department of Agriculture.

contributors to GL in a representative sample of US white and black adults overall and also by race/sex groups and geographic region.

## Participants and Methods

### Study population

Details on the design, methods, and objectives for REGARDS have been published [16]. Briefly, REGARDS is a longitudinal cohort of 30,239 community-dwelling black and white women and men who were recruited between January 2003 and October 2007 via mail and telephone using commercially available lists of residents of the US. The sampling scheme included 30% of participants from the stroke belt (North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana), 20% from the stroke buckle (the coastal plain of North Carolina, South Carolina, and Georgia), and the remainder from elsewhere in the continental US. Within each region, the goal was to include one half white and one half black participants.

Criteria for inclusion in the sample included having a name, telephone number, and address in the commercially available nationwide database from which the sample was selected, and age ≥45 years. Exclusion criteria included race other than white or black, active treatment for cancer, chronic medical conditions precluding long-term participation, cognitive impairment, current or impending residence in a nursing home, or inability to communicate in English. An initial phone interview was used to survey participants and establish eligibility. An in-home examination was conducted among those eligible, to perform physical measurements, a resting electrocardiogram, medication inventory, phlebotomy, and urine collection. Although not the focus of this report, the cohort is being followed for incident cerebrovascular and cardiovascular diseases, and for changes in cognition. The Institutional Review Board for Human Use at the University of Alabama at Birmingham approved the study protocol, and all participants provided written informed consent.

Of the full cohort of 30,239 REGARDS participants, 8603 participants who either were missing dietary data, had more than 15% missing data on the food frequency questionnaire (FFQ), or had implausible reported energy intakes (<800 or >5000 kcal/d in men and <500 or >4500 kcal/d in women) were excluded. This resulted in a final analytic data set of 21,636 participants (71.5% of the cohort).

### Dietary assessment

During the in-home examination, various questionnaires were left with participants by study personnel, including the Block 98 FFQ, a semi-quantitative FFQ that assessed usual dietary intake of 110 food items (NutritionQuest, Berkeley, CA). This FFQ has been validated using multiple diet records [17,18]. For each item on the FFQ, participants were asked how often, on average, they consumed the food during the previous year. Participants selected from nine possible frequencies ranging from “never” to “every day.” For each item on the FFQ, the quantity of the food consumed also was recorded. For unitary items (e.g., eggs or slices of bacon), the usual number consumed each time the food was eaten was queried (1, 2, 3, or 4). For non-unitary foods, a photo was provided to participants to aid in estimating usual portions for foods served on plates (1/4, 1/2, 1, or 2 cups) and three different usual portions for foods served in bowls (1/2, 1, or 2 cups).

The FFQ was self-administered by participants and returned in self-addressed prepaid envelopes to the REGARDS Operations Center, where they were checked for completeness and scanned. In accordance with standard procedures, amounts of each food on the FFQ consumed by a participant were calculated by multiplying the frequency of consumption of that food by the usual amount consumed. NutritionQuest then processed the FFQ data for nutrient content. NutritonQuest assigned GI values to each carbohydrate food (GI reflects the quality of the carbohydrate and is independent of quantity) and estimated GL values for a standard portion size of each carbohydrate food (GL reflects the quality and quantity of the carbohydrate) on the Block 98 FFQ. Available carbohydrate – defined as the United States Department of Agriculture (USDA) National Nutrient Database for Standard Reference [19] value for grams of carbohydrate per serving minus the USDA value for grams of dietary fiber per serving – was used in calculations of GL because the intended use of GL is as an indicator of the overall glycemic effect of food, and glycemic effect is inherently a function of dietary carbohydrate which actually is digested and absorbed. Using the supplied GL values for standard portion sizes, the GL values for any amount of each carbohydrate-containing food on the FFQ reported by a given participant could be calculated. The GLs contributed by each food were totaled to estimate the mean total daily GL for each participant, as well as the portion of the total GL contributed by each carbohydrate-containing food on the FFQ.

For this analysis, 71 individual foods providing any carbohydrate for any participant from the FFQ were identified as potentially important contributors to overall dietary GL based on carbohydrate content. These foods also were collapsed into 18 carbohydrate food groups based on similarities in type of food, macronutrient content, and intended use (Table 1).

### Statistical analysis

Descriptive statistics (including means, standard deviations, and proportions) of participant characteristics at the baseline assessment according to race/sex subgroups and also by geographic region (stroke belt, buckle, non-belt) using the chi-square test (for proportions) and analysis of variance (for continuous variables) were calculated. For each participant, the GL contribution from each individual food and carbohydrate food group as a percentage of the daily total were calculated. Median percentage of daily GL for each race/sex and region subgroup were determined. Median was chosen as a better representation than mean because of inherent skewness in the diet data, and the values for foods and food groups were ranked to identify differences across subgroups. SAS version 9.2 (SAS Institute, Cary, NC) was used for data manipulation and analysis.

## Results

The analytic sample included 21,636 REGARDS participants, including 7074 white men, 2472 black men, 7287 white women, and 4803 black women (Table 2). The mean (SD) age of participants was 64.9 (9.3) y at baseline in 2003–2007, with the mean (SD) age of the four race/sex groups ranging from 63.3 (9.0) y (black women) to 66.4 (9.2) y (white men).

Participants living in the non-belt region were slightly older compared with those living in the stroke belt and buckle regions. White participants had higher levels of education than black participants, with white men having the highest proportion of college graduates (48.3%) and black women the lowest (27.4%). Participants living in the non-belt region were more educated than those living in the stroke belt and buckle. Mean body mass index (BMI) was in the obese range in black women – 31.9 (7.2) kg/$m^2$ – and was considerably higher than the other three race/sex groups, but did not vary by region. Mean GI varied only slightly among the race/sex groups (highest in black men and lowest in white women), and was slightly lower in the non-belt region. Mean (SD) daily GL was 107.1 (44.1), 115.0 (53.8), 89.9 (40.6), and 100.0 (49.6) g/d in white men, black men, white women, and black women, respectively. Mean GL was slightly higher in the belt region compared with the other two regions.

Individual carbohydrate food contributors to GL by race/sex groups are presented in Table 3. Dark breads (including whole wheat and rye) were the top contributors to GL overall and in white men, white women, and black women, accounting for 2.72, 2.70, 3.17, and 2.35 median % of daily GL, respectively. The greatest contributors to GL in black men (4.02 median % of daily GL) were regular soft drinks (ranked number 2 in white men and number 6 in black women). Other important individual food contributors to GL common to all groups included rice, biscuits/muffins, cold cereals, and bananas. Additional important contributors in whites included potatoes, not fried and bagels/English muffins. Additional important contributors in blacks included cornbread, sugar in coffee/tea, cooked cereal, and real fruit juice.

The sweetened beverage group (including regular soft drinks, Hi-C/Kool-Aid, fruit juices, and drinks with some juice) was the main carbohydrate food group contributing to GL overall and in both black men and women, accounting for 12.14, 17.79, and 16.43 median % of daily GL, respectively (Table 4). The sweetened beverages group also was an important contributor to GL in white men (ranked number 2) and white women (ranked number 3). Breads was the main carbohydrate food group contributing to GL in both white men (12.02 median % of daily GL) and white women (11.22 median % of daily GL). The breads group also was an important contributor to GL overall (ranked number 2), in black men (ranked number 2), and black women (ranked number 2). Other important food group contributors to GL overall included (in descending order of importance) starchy side dishes, cereals, fruits, breakfast baked goods, dairy, desserts, added sweeteners/spreads, and snacks.

Individual carbohydrate food contributors to GL by region are listed in Table 5. Dark breads were the top contributors to GL overall (2.72 median % of daily GL) and in the stroke belt and non-belt regions (2.52 and 3.24 median % of GL, respectively), and were the number 2 contributors in the buckle region. Rice was the number 1 contributor to GL (2.40 median % of daily GL) in the buckle region (ranked number 2 overall and number 3 in both the belt and non-belt regions). Other important individual food contributors to GL common to all regions included bananas, biscuits/muffins, cold cereals, and potatoes, not fried. Additional important contributors in the belt and buckle regions included white bread and cornbread. Soft drinks were important individual food contributors to GL in the belt and non-belt regions.

The sweetened beverage group was the main carbohydrate food group contributing to GL overall and in both the buckle and non-belt regions, and was close to the number one group contributing to GL in the belt region, accounting for 12.14, 11.43, 12.23, and 12.44 mean % of daily GL, respectively (Table 6). Other important food group contributors to GL did not differ meaningfully among the regions and included (in descending order of importance) breads, starchy side dishes, cereals, fruits, breakfast baked goods, dairy, desserts, added sweeteners/spreads, snacks, and pasta.

## Discussion

The aim of this study was to identify the main contributors to dietary GL in this sample of US white and black adults, with the goal of informing future interventions to reduce GL for possible disease prevention. Overall, sweetened beverages, starchy side dishes, breads, and cereals were the primary contributors to GL in this population. A notable finding was the particularly large contribution of sweetened beverages (including regular soft drinks, Hi-C/Kool-Aid, and fruit juices) to GL overall, and especially in black men and women.

These national results were similar to those observed in the Multiethnic Cohort (MEC) study, which included participants from Hawaii and Southern California and examined the top 10 contributors to GL by sex and ethnicity group [20]. The top three contributors in white men in the MEC were white rice, regular soda, and white bread, compared with dark bread, regular soft drinks, and rice in REGARDS; in black men: regular soda, whole wheat bread, and white rice in MEC and regular soft drinks, rice, and dark bread in REGARDS; in white women: white rice, whole wheat bread, and bananas in MEC and dark bread, rice, and bananas in REGARDS; and in black women: regular soda, whole wheat bread, and white rice/bananas in MEC and dark bread, cornbread, and rice in REGARDS. In the Study of Women's Health Across the Nation (SWAN), the top three contributors to GL in white women were bread, rice, and bagels/English muffins/buns, and in black women, bread, rice, and regular soft drinks [21].

Studies investigating contributors to dietary GL conducted internationally also tend to confirm the importance of the dietary contributors to GL identified in the present study, including bread, rice, and sweetened beverages. For example, bread was the single greatest contributor to GL in both men and women in the European Prospective Investigation into Cancer and Nutrition (EPIC), accounting for at least 40% of GL in most participating countries [22]. White breads and soft drinks were the two most important contributors to GL in both indigenous and non-indigenous children in Australia [23]. Rice and bread were the major contributors to GL in the Tehran Lipid and Glucose study [24]. Among Japanese adults, white rice has been identified in multiple studies as the single greatest contributor to GL, accounting for at least 50% of dietary GL [25–27].

Dietary GL has been positively associated with the risk of multiple chronic diseases and various risk factors in epidemiologic studies. GL was positively associated with the risk of type 2 diabetes mellitus in Chinese women [4] and in Caucasian men and all women (except Japanese Americans) in the MEC study [5]. GL was significantly associated with diabetes risk in a recent meta-analysis of 14 prospective cohort studies [28]. Higher GL has been associated with a greater risk of dyslipidemia in some observational studies [3,6], although the associations have been inconsistent in others [29]. A recent review of randomized controlled feeding trials revealed inconsistent effects of GL on multiple cardiovascular disease (CVD) risk factors [30].

A high dietary GL was associated with an increased risk of CHD and stroke in the Nurses' Health Study, although this increased risk was seen only in women with BMI >23 $kg/m^2$ and BMI >25 $kg/m^2$, respectively [7,31]. High GL-diets also were associated with higher risk of CVD (including CHD and stroke), particularly in overweight participants, in a prospective cohort of Dutch women [8]. GL was positively associated with risk of incident CHD in whites, but not in African Americans, in the Atherosclerosis Risk in Communities (ARIC) study [9], and with increased risk of stroke in the large EPIC – Italy cohort (EPICOR) study [32]. Three recent systematic reviews and meta-analyses including 8–15 prospective cohorts each concluded that high-GL diets were associated with an increased risk of CHD in women, but not in men [33–35]. A fourth meta-analysis of 14 prospective studies reported that high GL was associated with a significantly higher risk of CVD (including myocardial infarction, fatal or nonfatal CHD, stroke, and heart failure) [36]. GL has been positively associated with the risk of selected cancers (notably colorectal and endometrial), although no associations have been found for most other cancers [10–12].

In randomized controlled trials, low-GL diets have led to significantly greater reductions in body weight and fat percentage, but this effect was restricted to participants with high insulin concentrations in some studies [13,14]. This finding suggests that insulin resistance, which is increased in overweight and obesity, may be an important effect modifier of the relationship between GL and disease risk. It should be noted that a critical review of the clinical evidence addressing GL and weight loss (which included 23 clinical trials) showed that while greater weight loss on low-GI/GL diets was observed in a few trials, most showed trends favoring the low GI/GL diets that were not statistically significant [37].

Sweetened beverages were a major contributor to dietary GL in this sample of US adults, especially in blacks. Sugar-sweetened beverage consumption as related to obesity and other adverse health outcomes is a topic of intense research interest. Although the direct effects of altering sugar-sweetened beverage consumption on risk factors such as obesity is highly debated [38,39], the results of this study provide evidence that efforts to reduce sugar-sweetened beverage consumption by switching to non-sugar-sweetened beverages (e.g., water, diet sodas) may indirectly influence disease risk by reducing dietary GL.

Strengths of this study include the large sample size, the comprehensive assessment of diet, and the inclusion of both a high proportion of blacks (both men and women) and regional data, allowing us to compare results among race/sex groups and regions. The Block 98 FFQ, while state of the art when REGARDS was conceived around 2000, has now been superseded by a more current version. The Block 98 FFQ has yet to be validated in the REGARDS population, and like all FFQs, was not designed to measure absolute intakes. It also should be noted that selection bias may have resulted from using commercially available lists for recruitment, as not all persons have listed telephone numbers and/or a mailing address. Finally, the results may not be generalizable to groups other than whites and blacks in the US.

## Conclusion

In this US cohort of white and black adults, sweetened beverages, breads, starchy side dishes, and cereals were the primary contributors to dietary GL. This information may help to inform future interventions targeting reduction in GL across diverse population subgroups to reduce the risk of GL-related chronic diseases. In particular, interventions aimed at reducing sugar-sweetened beverage consumption should be considered in future interventions to reduce dietary GL.

## Acknowledgments

This research was supported by cooperative agreement U01 NS041588 from the National Institute of Neurological Disorders and Stroke, National Institutes of Health, Department of Health and Human Services. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Neurological Disorders and Stroke or the National Institutes of Health. Representatives of the funding agency have been involved in the review of the manuscript but not directly involved in the collection, management, analysis, or interpretation of the data. The authors thank the other investigators, the staff, and the participants of the REGARDS study for their valuable contributions. A full list of participating REGARDS investigators and institutions can be found at http://www.regardsstudy.org. Additional funding for scanning and analysis of the dietary questionnaires used in this study was provided by General Mills Bell Institute of Health and Nutrition. Representatives from General Mills Bell Institute of Health and Nutrition did not have any role in the design and conduct of this study; the collection, management, analysis, and interpretation of the data; or the preparation or approval of the manuscript.

## References

1. Jenkins DJ, Wolever TM, Taylor RH, Barker HM, Fielden H, Baldwin JM, et al. Glycemic index of foods: a physiological basis for carbohydrate exchange. Am J Clin Nutr. 1981; 34:362–6. [PubMed: 6259925]
2. Wolever TM. The glycaemic index. World Rev Nutr Diet. 1990; 62:120–85. [PubMed: 2180214]
3. Liu S, Manson JE, Stampfer MJ, Holmes MD, Hu FB, Hankinson SE, et al. Dietary glycemic load assessed by food-frequency questionnaire in relation to plasma high-density-lipoprotein cholesterol and fasting plasma triacylglycerols in postmenopausal women. Am J Clin Nutr. 2001; 73:560–6. [PubMed: 11237932]
4. Villegas R, Liu S, Gao YT, Yang G, Li H, Zheng W, et al. Prospective study of dietary carbohydrates, glycemic index, glycemic load, and incidence of type 2 diabetes mellitus in middle-aged Chinese women. Arch Intern Med. 2007; 167:2310–6. [PubMed: 18039989]
5. Hopping BN, Erber E, Grandinetti A, Verheus M, Kolonel LN, Maskarinec G. Dietary fiber, magnesium, and glycemic load alter risk of type 2 diabetes in a multiethnic cohort in Hawaii. J Nutr. 2010; 140:68–74. [PubMed: 19889808]
6. Shikany JM, Tinker LF, Neuhouser ML, Ma Y, Patterson RE, Liu S, et al. Association of glycemic load with cardiovascular disease risk factors: the Women's Health Initiative Observational Study. Nutrition. 2010; 26:641–7. [PubMed: 20053533]
7. Liu S, Willett WC, Stampfer MJ, Hu FB, Franz M, Sampson L, et al. A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. Am J Clin Nutr. 2000; 71:1455–61. [PubMed: 10837285]
8. Beulens JW, de Bruijne LM, Stolk RP, Peeters PH, Bots ML, Grobbee DE, et al. High dietary glycemic load and glycemic index increase risk of cardiovascular disease among middle-aged women: a population-based follow-up study. J Am Coll Cardiol. 2007; 50:14–21. [PubMed: 17601539]

9. Hardy DS, Hoelscher DM, Aragaki C, Stevens J, Steffen LM, Pankow JS, et al. Association of glycemic index and glycemic load with risk of incident coronary heart disease among Whites and African Americans with and without type 2 diabetes: the Atherosclerosis Risk in Communities study. Ann Epidemiol. 2010; 20:610–6. [PubMed: 20609341]
10. Gnagnarella P, Gandini S, La Vecchia C, Maisonneuve P. Glycemic index, glycemic load, and cancer risk: a meta-analysis. Am J Clin Nutr. 2008; 87:1793–801. [PubMed: 18541570]
11. Barclay AW, Petocz P, McMillan-Price J, Flood VM, Prvan T, Mitchell P, et al. Glycemic index, glycemic load, and chronic disease risk--a meta-analysis of observational studies. Am J Clin Nutr. 2008; 87:627–37. [PubMed: 18326601]
12. Hu J, La Vecchia C, Augustin LS, Negri E, de Groh M, Morrison H, et al. Glycemic index, glycemic load and cancer risk. Ann Oncol. 2013; 24:245–51. [PubMed: 22831983]
13. Pittas AG, Das SK, Hajduk CL, Golden J, Saltzman E, Stark PC, et al. A low-glycemic load diet facilitates greater weight loss in overweight adults with high insulin secretion but not in overweight adults with low insulin secretion in the CALERIE Trial. Diabetes Care. 2005; 28:2939–41. [PubMed: 16306558]
14. Ebbeling CB, Leidig MM, Feldman HA, Lovesky MM, Ludwig DS. Effects of a low-glycemic load vs low-fat diet in obese young adults: a randomized trial. JAMA. 2007; 297:2092–102. [PubMed: 17507345]
15. Chang KT, Lampe JW, Schwarz Y, Breymeyer KL, Noar KA, Song X, et al. Low glycemic load experimental diet more satiating than high glycemic load diet. Nutr Cancer. 2012; 64:666–73. [PubMed: 22564018]
16. Howard VJ, Cushman M, Pulley L, Gomez CR, Go RC, Prineas RJ, et al. The Reasons for Geographic and Racial Differences in Stroke study: objectives and design. Neuroepidemiology. 2005; 25:135–43. [PubMed: 15990444]
17. Mares-Perlman JA, Klein BEK, Klein R, Ritter LL, Fisher MR, Freudenheim JL. A diet history questionnaire ranks nutrient intakes in middle-aged and older men and women similarly to multiple food records. J Nutr. 1993; 123:489–501. [PubMed: 8463852]
18. Block G, Woods M, Potosky A, Clifford C. Validation of a self-administered diet history questionnaire using multiple diet records. J Clin Epidemiol. 1990; 43:1327–35. [PubMed: 2254769]
19. National Nutrient Database for Standard Reference, Release 26. Agricultural Research Service, U.S. Department of Agriculture; Version current 14 January 2014. Internet: http://www.ars.usda.gov/ba/bhnrc/ndl
20. Howarth NC, Murphy SP, Wilkens LR, Henderson BE, Kolonel LN. The association of glycemic load and carbohydrate intake with colorectal cancer risk in the Multiethnic Cohort Study. Am J Clin Nutr. 2008; 88:1074–82. [PubMed: 18842796]
21. Hu Y, Block G, Sternfeld B, Sowers M. Dietary glycemic load, glycemic index, and associated factors in a multiethnic cohort of midlife women. J Am Coll Nutr. 2009; 28:636–47. [PubMed: 20516263]
22. van Bakel MM, Kaaks R, Feskens EJ, Rohrmann S, Welch AA, Pala V, et al. Dietary glycaemic index and glycaemic load in the European Prospective Investigation into Cancer and Nutrition. Eur J Clin Nutr. 2009; 63(Suppl 4):S188–205. [PubMed: 19888274]
23. Louie JC, Gwynn J, Turner N, Cochrane J, Wiggers J, Flood V. Dietary glycemic index and glycemic load among Indigenous and non-Indigenous children aged 10–12 years. Nutrition. 2012; 28:e14–22. [PubMed: 22484006]
24. Hosseinpour-Niazi S, Sohrab G, Asghari G, Mirmiran P, Moslehi N, Azizi F. Dietary glycemic index, glycemic load, and cardiovascular disease risk factors: Tehran Lipid and Glucose Study. Arch Iranian Med. 2013; 16:401–7.
25. Murakami K, Sasaki S, Takahashi Y, Okubo H, Hosoi Y, Horiguchi H, et al. Dietary glycemic index and load in relation to metabolic risk factors in Japanese female farmers with traditional dietary habits. Am J Clin Nutr. 2006; 83:1161–9. [PubMed: 16685061]
26. Murakami K, Sasaki S, Okubo H, Takahashi Y, Hosoi Y, Itabashi M. Dietary fiber intake, dietary glycemic index and load, and body mass index: a cross-sectional study of 3931 Japanese women aged 18–20 years. Eur J Clin Nutr. 2007; 61:986–95. [PubMed: 17251928]

27. Murakami K, Sasaki S, Takahashi Y, Okubo H, Hirota N, Notsu A, et al. Reproducibility and relative validity of dietary glycaemic index and load assessed with a self-administered diet-history questionnaire in Japanese adults. Br J Nutr. 2008; 99:639–48. [PubMed: 17764595]
28. Dong JY, Zhang L, Zhang YH, Qin LQ. Dietary glycaemic index and glycaemic load in relation to the risk of type 2 diabetes: a meta-analysis of prospective cohort studies. Br J Nutr. 2011; 106:1649–54. [PubMed: 22017823]
29. Lin PH, Chen C, Young DR, Mitchell D, Elmer P, Wang Y, et al. Glycemic index and glycemic load are associated with some cardiovascular risk factors among the PREMIER study participants. Food Nutr Res. 2012; 56:9464.
30. Kristo AS, Matthan NR, Lichtenstein AH. Effect of diets differing in glycemic index and glycemic load on cardiovascular risk factors: review of randomized controlled-feeding trials. Nutrients. 2013; 5:1071–80. [PubMed: 23538939]
31. Oh K, Hu FB, Cho E, Rexrode KM, Stampfer MJ, Manson JE, et al. Carbohydrate intake, glycemic index, glycemic load, and dietary fiber in relation to risk of stroke in women. Am J Epidemiol. 2005; 161:161–9. [PubMed: 15632266]
32. Sieri S, Brighenti F, Agnoli C, Grioni S, Masala G, Bendinelli B, et al. Dietary glycemic load and glycemic index and risk of cerebrovascular disease in the EPICOR cohort. PloS One. 2013; 8:e62625. [PubMed: 23717392]
33. Mirrahimi A, de Souza RJ, Chiavaroli L, Sievenpiper JL, Beyene J, Hanley AJ, et al. Associations of glycemic index and load with coronary heart disease events: a systematic review and meta-analysis of prospective cohorts. J Am Heart Assoc. 2012; 1:e000752. [PubMed: 23316283]
34. Dong JY, Zhang YH, Wang P, Qin LQ. Meta-analysis of dietary glycemic load and glycemic index in relation to risk of coronary heart disease. Am J Cardiol. 2012; 109:1608–13. [PubMed: 22440121]
35. Fan J, Song Y, Wang Y, Hui R, Zhang W. Dietary glycemic index, glycemic load, and risk of coronary heart disease, stroke, and stroke mortality: a systematic review with meta-analysis. PloS One. 2012; 7:e52182. [PubMed: 23284926]
36. Ma XY, Liu JP, Song ZY. Glycemic load, glycemic index and risk of cardiovascular diseases: meta-analyses of prospective studies. Atherosclerosis. 2012; 223:491–6. [PubMed: 22727193]
37. Esfahani A, Wong JM, Mirrahimi A, Villa CR, Kendall CW. The application of the glycemic index and glycemic load in weight loss: a review of the clinical evidence. IUBMB Life. 2011; 63:7–13. [PubMed: 21280171]
38. Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. Obes Rev. 2013; 14:606–19. [PubMed: 23763695]
39. Kaiser KA, Shikany JM, Keating KD, Allison DB. Will reducing sugar-sweetened beverage consumption reduce obesity? Evidence supporting conjecture is strong, but evidence when testing effect is weak. Obes Rev. 2013; 14:620–33. [PubMed: 23742715]

**Table 1**

Composition of carbohydrate food groups as defined in the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires

| Carbohydrate food groups | Foods included in each group |
|---|---|
| Sweetened beverages | Soft drinks, regular; Hi-C, Kool-Aid; orange juice; orange juice with calcium; fruit juice, real; drinks with some juice |
| Breads | Bread, white; bread, dark; bagels, English muffins; cornbread; tortillas |
| Starchy side dishes | Potatoes, not fried; potatoes, French fried; rice; corn; beans, baked or pintos; potatoes, sweet |
| Cereals | Cereals, cooked; All Bran, Bran Buds; Fiber One, Fruit-n-Fiber; Raisin Bran; Total, Product 19; cereals, fiber (other); cereals, cold (other) |
| Fruits | Apples, pears; bananas; oranges; grapefruit; peaches/apricots, fresh; strawberries; cantaloupe; watermelon; other fruits in season; fruit, canned |
| Breakfast baked goods | Biscuits, muffins; doughnuts, pastries; pancakes, waffles |
| Dairy | Milk, whole; milk, 2%; milk, 1%; milk, non-fat; cream; ice cream; ice cream, low-fat; yogurt, frozen yogurt |
| Desserts | Cake, regular; cookies, regular; cookies, low-fat; pie, pumpkin; pie, other |
| Added sweeteners, spreads | Jelly, jam, syrup; sugar in coffee, tea |
| Snacks | Crackers; salty snacks, chips; salty snacks, low-fat |
| Pasta | Spaghetti, tomato sauce; pasta, pasta salad |
| Candy | Candy, chocolate; candy, not-chocolate |
| Pizza | Pizza |
| Carrots | Carrots |
| Beer | Beer, regular; beer, light; beer, non-alcoholic |
| Meal replacements | Breakfast/diet shakes; breakfast/power bars |
| Nondairy substitutes/beverages | Creamer, nondairy; milk, rice |
| Soy | Tofu, bean curd; milk, soy; meat substitutes |

## Table 2

Characteristics of the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires, overall, by race/sex groups, and by region

| Characteristics | Total (N = 21,636 | Race | | | | | Region | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | White men (n = 7074) | Black men (n = 2472) | White women (n = 7287) | Black women (n = 4803) | *P* for difference[a] | Stroke buckle[b] (n = 4728 | Stroke belt[c] (n = 7440) | Non- belt[d] (n = 9468) | *P* for difference[a] |
| Age (y), mean (SD) | 64.9 (9.3) | 66.4 (9.2) | 64.1 (9.0) | 64.6 (9.4) | 63.3 (9.0) | <0.0001 | 64.2 (9.3) | 64.4 (9.0) | 65.5 (9.4) | <0.0001 |
| Education, n (%) | | | | | | <0.0001 | | | | <0.0001 |
| < High school | 2090 (9.7) | 428 (6.1) | 395 (16.0) | 496 (6.8) | 771 (16.1) | | 523 (11.1) | 842 (11.3) | 725 (7.7) | |
| High school graduate | 5535 (25.6) | 1492 (21.1) | 678 (27.4) | 2038 (28.0) | 1327 (27.6) | | 1264 (26.7) | 1995 (26.8) | 2276 (24.0) | |
| Some college | 5932 (27.4) | 1733 (24.5) | 679 (27.5) | 2136 (29.3) | 1384 (28.8) | | 1291 (27.3) | 1987 (26.7) | 2654 (28.0) | |
| College graduate | 8069 (37.3) | 3419 (48.3) | 720 (29.1) | 2612 (35.8) | 1318 (27.4) | | 1649 (34.9) | 2613 (35.1) | 3807 (40.2) | |
| Body mass index (kg/m$^2$), mean (SD) | 29.1 (6.1) | 28.2 (4.7) | 28.9 (5.4) | 28.1 (6.2) | 31.9 (7.2) | <0.0001 | 29.3 (6.2) | 29.0 (6.1) | 29.0 (6.0) | 0.05 |
| Glycemic index, mean (SD) | 53.1 (4.3) | 53.1 (4.2) | 54.1 (4.2) | 52.5 (4.3) | 53.8 (4.0) | <0.0001 | 53.5 (4.4) | 53.5 (4.2) | 52.7 (4.2) | <0.0001 |
| Available carbohydrate (g/d), mean (SD) | 188.1 (82.7) | 200.3 (77.7) | 211.9 (96.7) | 169.9 (72.6) | 185.5 (90.1) | <0.0001 | 184.8 (83.6) | 192.0 (84.8) | 186.7 (80.4) | <0.0001 |
| Glycemic load (g/d), mean (SD) | 100.6 (46.3) | 107.1 (44.1) | 115.0 (53.8) | 89.9 (40.6) | 100.0 (49.6) | <0.0001 | 99.7 (47.4) | 103.3 (47.5) | 99.0 (44.6) | <0.0001 |

REGARDS, REasons for Geographic and Racial Differences in Stroke

[a] *P* for difference among categories of race/sex and region for each variable calculated by chi-square test (for proportions) and analysis of variance (for continuous variables).

[b] Stroke buckle includes the coastal plain of North Carolina, South Carolina, and Georgia.

[c] Stroke belt includes North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana.

[d] Non-belt includes the remainder of the continental US.

**Table 3**

Individual carbohydrate food contributors to glycemic load in the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires, overall and by race/sex groups

| | Total (N = 21,636) | | White men (n = 7074) | | Black men (n = 2472) | | White women (n = 7287) | | Black women (n = 4803) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Rank | Food | Median % of daily GL | Food | Median % of daily GL | Food | Median % of daily GL | Food | Median % of daily GL | Food | Median % of daily GL |
| 1 | Bread, dark | 2.72 | Bread, dark | 2.70 | Soft drinks, regular | 4.02 | Bread, dark | 3.17 | Bread, dark | 2.35 |
| 2 | Rice | 2.01 | Soft drinks, regular | 2.13 | Rice | 2.69 | Rice | 1.83 | Cornbread | 2.28 |
| 3 | Bananas | 1.77 | Rice | 1.96 | Bread, dark | 2.34 | Bananas | 1.80 | Rice | 2.12 |
| 4 | Biscuits, muffins | 1.62 | Biscuits, muffins | 1.88 | Cornbread | 2.22 | Potatoes, not fried | 1.60 | Sugar in coffee, tea | 2.10 |
| 5 | Cereals, cold (other) | 1.45 | Cereals, cold (other) | 1.87 | Sugar in coffee, tea | 2.18 | Biscuits, muffins | 1.53 | Bananas | 1.97 |
| 6 | Potatoes, not fried | 1.40 | Potatoes, not fried | 1.79 | Biscuits, muffins | 1.75 | Cereals, cold (other) | 1.52 | Soft drinks, regular | 1.95 |
| 7 | Soft drinks, regular | 1.35 | Bread, white | 1.76 | Bananas | 1.63 | Bagels, English muffins | 1.31 | Cereal, cooked | 1.80 |
| 8 | Bread, white | 1.20 | Bananas | 1.63 | Cereal, cooked | 1.48 | Bread, white | 1.25 | Biscuits, muffins | 1.34 |
| 9 | Bagels, English muffins | 1.10 | Bagels, English muffins | 1.42 | Cereals, cold (other) | 1.08 | Crackers | 1.20 | Fruit juice, real | 1.17 |
| 10 | Cookies, regular | 1.07 | Potatoes, French fried | 1.23 | Fruit juice, real | 1.07 | Cookies, regular | 1.11 | Cereals, cold (other) | 1.13 |
| 11 | Crackers | 1.07 | Cookies, regular | 1.22 | Potatoes, not fried | 1.04 | Cereal, cooked | 0.94 | Crackers | 0.95 |
| 12 | Cornbread | 1.06 | Crackers | 1.14 | Cookies, regular | 1.04 | Spaghetti, tomato sauce | 0.91 | Potatoes, not fried | 0.94 |
| 13 | Cereal, cooked | 1.00 | Jelly, jam, syrup | 1.10 | Pancakes, waffles | 1.02 | Pizza | 0.89 | Pancakes, waffles | 0.91 |
| 14 | Pancakes, waffles | 0.92 | Pizza | 1.01 | Bread, white | 0.89 | Pancakes, waffles | 0.84 | Cookies, regular | 0.89 |
| 15 | Potatoes, French fried | 0.86 | Pancakes, waffles | 1.00 | Orange juice | 0.89 | Jelly, jam, syrup | 0.81 | Doughnuts, pastries | 0.72 |
| 16 | Jelly, jam, syrup | 0.85 | Spaghetti, tomato sauce | 0.91 | Potatoes, French fried | 0.88 | Fruit, canned | 0.78 | Potatoes, French fried | 0.70 |
| 17 | Spaghetti, tomato sauce | 0.76 | Doughnuts, pastries | 0.66 | Doughnuts, pastries | 0.84 | Potatoes, French fried | 0.71 | Bagels, English muffins | 0.68 |
| 18 | Pizza | 0.74 | Salty snacks, chips | 0.57 | Jelly, jam, syrup | 0.84 | Apples, pears | 0.64 | Potatoes, sweet | 0.65 |
| 19 | Doughnuts, pastries | 0.66 | Cereal, cooked | 0.57 | Crackers | 0.79 | Candy, chocolate | 0.63 | Jelly, jam, syrup | 0.62 |
| 20 | Fruit, canned | 0.55 | Corn | 0.56 | Bagels, English muffins | 0.65 | Doughnuts, pastries | 0.59 | Bread, white | 0.57 |
| 21 | Pie, other | 0.53 | Pie, other | 0.56 | Pie, pumpkin | 0.54 | Cake, regular | 0.55 | Apples, pears | 0.55 |
| 22 | Cake, regular | 0.52 | Fruit, canned | 0.51 | Cake, regular | 0.54 | Pie, other | 0.55 | Pie, pumpkin | 0.55 |
| 23 | Apples, pears | 0.51 | Candy, chocolate | 0.50 | Corn | 0.50 | Potatoes, sweet | 0.53 | Spaghetti, tomato | 0.55 |
| 24 | Corn | 0.51 | Cake, regular | 0.49 | Pie, other | 0.50 | Cornbread | 0.51 | Cake, regular | 0.52 |

Author Manuscript
Author Manuscript
Author Manuscript



| | Total (N = 21,636) | | White men (n = 7074) | | Black men (n = 2472) | | White women (n = 7287) | | Black women (n = 4803) | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rank** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** |
| 25 | Salty snacks, Chips | 0.47 | Ice cream | 0.49 | Potatoes, sweet | 0.49 | Salty snacks, chips | 0.47 | Fruit, canned | 0.52 |

GL, glycemic load; REGARDS, REasons for Geographic and Racial Differences in Stroke

**Table 4**

Carbohydrate food group contributors to glycemic load in the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires, overall and by race/sex groups

| | Total (N = 21,636) | | White men (n = 7074) | | Black men (n = 2472) | | White women (n = 7287) | | Black women (n = 4803) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Rank | Food Group | Median % of daily GL | Food group | Median % of daily GL | Food Group | Median % of daily GL | Food group | Median % of daily GL | Food group | Median % of daily GL |
| 1 | Sweetened beverages | 12.14 | Breads | 12.02 | Sweetened beverages | 17.79 | Breads | 11.22 | Sweetened beverages | 16.43 |
| 2 | Breads | 11.44 | Sweetened beverages | 11.77 | Breads | 11.85 | Starchy side dishes | 8.29 | Breads | 10.69 |
| 3 | Starchy side dishes | 8.62 | Starchy side dishes | 9.11 | Starchy side dishes | 9.13 | Sweetened beverages | 8.12 | Starchy side dishes | 8.21 |
| 4 | Cereals | 7.43 | Cereals | 7.90 | Cereals | 6.24 | Cereals | 7.97 | Cereals | 6.74 |
| 5 | Fruits | 5.86 | Breakfast baked goods | 5.26 | Breakfast baked goods | 5.56 | Fruits | 7.11 | Fruits | 6.30 |
| 6 | Breakfast baked goods | 4.56 | Fruits | 5.05 | Added sweeteners, spreads | 4.72 | Dairy | 5.74 | Added sweeteners, spreads | 4.24 |
| 7 | Dairy | 4.29 | Dairy | 4.70 | Fruits | 4.61 | Breakfast baked goods | 4.03 | Breakfast baked goods | 4.16 |
| 8 | Desserts | 3.87 | Desserts | 4.09 | Desserts | 3.90 | Desserts | 3.87 | Desserts | 3.57 |
| 9 | Added sweeteners, spreads | 2.97 | Snacks | 2.78 | Dairy | 2.59 | Snacks | 2.81 | Dairy | 2.97 |
| 10 | Snacks | 2.52 | Added sweeteners, spreads | 2.76 | Snacks | 1.80 | Added sweeteners, spreads | 2.09 | Snacks | 2.11 |
| 11 | Pasta | 1.31 | Pasta | 1.51 | Pasta | 0.83 | Pasta | 1.57 | Pasta | 0.99 |
| 12 | Candy | 1.10 | Candy | 1.07 | Candy | 0.69 | Candy | 1.39 | Candy | 0.98 |
| 13 | Pizza | 0.74 | Pizza | 1.01 | Pizza | 0.44 | Pizza | 0.89 | Pizza | 0.46 |
| 14 | Carrots | 0.25 | Carrots | 0.24 | Carrots | 0.18 | Carrots | 0.30 | Carrots | 0.21 |
| 15 | Beer | 0.00 | Beer | 0.03 | Beer | 0.00 | Meal replacements | 0.16 | Beer | 0.00 |
| 16 | Meal replacements | 0.00 | Meal replacements | 0.00 | Meal replacements | 0.00 | Beer | 0.00 | Meal replacements | 0.00 |
| 17 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/beverages | 0.00 |
| 18 | Soy | 0.00 | Soy | 0.00 | Soy | 0.00 | Soy | 0.00 | Soy | 0.00 |

GL, glycemic load; REGARDS, REasons for Geographic and Racial Differences in Stroke

### Table 5

Individual carbohydrate food contributors to glycemic load in the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires, overall and by region

| | Total (N = 21,636) | | Stroke buckle[a] (n = 4728) | | Stroke belt[b] (n = 7440) | | Non-belt[c] (n = 9468) | |
|---|---|---|---|---|---|---|---|---|
| **Rank** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** | **Food** | **Median % of daily GL** |
| 1 | Bread, dark | 2.72 | Rice | 2.40 | Bread, dark | 2.52 | Bread, dark | 3.24 |
| 2 | Rice | 2.01 | Bread, dark | 1.98 | Biscuits, muffins | 2.09 | Bananas | 1.94 |
| 3 | Bananas | 1.77 | Biscuits, muffins | 1.91 | Rice | 1.98 | Rice | 1.86 |
| 4 | Biscuits, muffins | 1.62 | Bananas | 1.75 | Cornbread | 1.85 | Potatoes, not fried | 1.53 |
| 5 | Cereals, cold (other) | 1.45 | Bread, white | 1.56 | Soft drinks, regular | 1.65 | Cereals, cold (other) | 1.53 |
| 6 | Potatoes, not fried | 1.40 | Cereals, cold (other) | 1.43 | Bananas | 1.57 | Soft drinks, regular | 1.29 |
| 7 | Soft drinks, regular | 1.35 | Potatoes, not fried | 1.35 | Cereals, cold (other) | 1.36 | Biscuits, muffins | 1.20 |
| 8 | Bread, white | 1.20 | Cornbread | 1.23 | Potatoes, not fried | 1.29 | Cookies, regular | 1.11 |
| 9 | Bagels, English muffins | 1.10 | Cookies, regular | 1.14 | Bread, white | 1.26 | Bagels, English muffins | 1.10 |
| 10 | Cookies, regular | 1.07 | Bagels, English muffins | 1.13 | Crackers | 1.21 | Pancakes, waffles | 1.01 |
| 11 | Crackers | 1.07 | Crackers | 1.11 | Bagels, English muffins | 1.09 | Bread, white | 0.96 |
| 12 | Cornbread | 1.06 | Cereal, cooked | 1.07 | Cereal, cooked | 1.03 | Crackers | 0.94 |
| 13 | Cereal, cooked | 1.00 | Soft drinks, regular | 1.00 | Cookies, regular | 0.99 | Cereal, cooked | 0.92 |
| 14 | Pancakes, waffles | 0.92 | Pancakes, waffles | 0.89 | Jelly, jam, syrup | 0.86 | Potatoes, French fried | 0.88 |
| 15 | Potatoes, French fried | 0.86 | Potatoes, French fried | 0.89 | Potatoes, French fried | 0.82 | Jelly, jam, syrup | 0.87 |
| 16 | Jelly, jam, syrup | 0.85 | Jelly, jam, syrup | 0.80 | Pancakes, waffles | 0.81 | Spaghetti, tomato sauce | 0.85 |
| 17 | Spaghetti, tomato sauce | 0.76 | Pizza | 0.77 | Pizza | 0.70 | Pizza | 0.77 |
| 18 | Pizza | 0.74 | Spaghetti, tomato sauce | 0.75 | Spaghetti, tomato sauce | 0.67 | Doughnuts, pastries | 0.70 |
| 19 | Doughnuts, pastries | 0.66 | Doughnuts, pastries | 0.68 | Doughnuts, pastries | 0.60 | Fruit, canned | 0.63 |
| 20 | Fruit, canned | 0.55 | Potatoes, sweet | 0.55 | Pie, other | 0.55 | Apples, pears | 0.58 |
| 21 | Pie, other | 0.53 | Pie, other | 0.54 | Cake, regular | 0.52 | Cake, regular | 0.53 |
| 22 | Cake, regular | 0.52 | Fruit, canned | 0.53 | Corn | 0.50 | Salty snacks, chips | 0.52 |
| 23 | Apples, pears | 0.51 | Cake, regular | 0.52 | Potatoes, sweet | 0.49 | Pie, other | 0.52 |
| 24 | Corn | 0.51 | Corn | 0.51 | Fruit, canned | 0.48 | Corn | 0.51 |
| 25 | Salty snacks, chips | 0.47 | Cheese dishes | 0.51 | Salty snacks, chips | 0.45 | Fruit juice, real | 0.49 |

GL, glycemic load; REGARDS, REasons for Geographic and Racial Differences in Stroke

[a]Stroke buckle includes the coastal plain of North Carolina, South Carolina, and Georgia.

[b]Stroke belt includes North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana.

[c]Non-belt includes the remainder of the continental US.

## Table 6

Carbohydrate food group contributors to glycemic load in the REGARDS cohort of 21,636 white and black men and women with data on glycemic load from food frequency questionnaires, overall and by region

| | Total (N = 21,636) | | Stroke buckle[a] (n = 4728) | | Stroke belt[b] (n = 7440) | | Non-belt[c] (n = 9468) | |
|---|---|---|---|---|---|---|---|---|
| Rank | Food Group | Median % of daily GL | Food group | Median % of daily GL | Food group | Median % of daily GL | Food group | Median % of daily GL |
| 1 | Sweetened beverages | 12.14 | Sweetened beverages | 11.43 | Breads | 12.46 | Sweetened beverages | 12.23 |
| 2 | Breads | 11.44 | Breads | 11.06 | Sweetened beverages | 12.44 | Breads | 10.80 |
| 3 | Starchy side dishes | 8.62 | Starchy side dishes | 9.04 | Starchy side dishes | 8.42 | Starchy side dishes | 8.57 |
| 4 | Cereals | 7.43 | Cereals | 7.45 | Cereals | 7.05 | Cereals | 7.69 |
| 5 | Fruits | 5.86 | Fruits | 5.54 | Fruits | 5.24 | Fruits | 6.56 |
| 6 | Breakfast baked goods | 4.56 | Breakfast baked goods | 4.81 | Breakfast baked goods | 4.94 | Dairy | 4.57 |
| 7 | Dairy | 4.29 | Desserts | 4.02 | Dairy | 4.16 | Breakfast baked goods | 4.22 |
| 8 | Desserts | 3.87 | Dairy | 4.00 | Desserts | 3.79 | Desserts | 3.86 |
| 9 | Added sweeteners, spreads | 2.97 | Added sweeteners, spreads | 3.33 | Added sweeteners, spreads | 3.42 | Added sweeteners, spreads | 2.58 |
| 10 | Snacks | 2.52 | Snacks | 2.48 | Snacks | 2.67 | Snacks | 2.42 |
| 11 | Pasta | 1.31 | Pasta | 1.29 | Pasta | 1.12 | Pasta | 1.47 |
| 12 | Candy | 1.10 | Candy | 1.13 | Candy | 1.00 | Candy | 1.15 |
| 13 | Pizza | 0.74 | Pizza | 0.77 | Pizza | 0.70 | Pizza | 0.77 |
| 14 | Carrots | 0.25 | Carrots | 0.23 | Carrots | 0.21 | Carrots | 0.28 |
| 15 | Beer | 0.00 | Beer | 0.00 | Beer | 0.00 | Beer | 0.00 |
| 16 | Meal replacements | 0.00 | Meal replacements | 0.00 | Meal replacements | 0.00 | Meal replacements | 0.00 |
| 17 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/beverages | 0.00 | Nondairy substitutes/Beverages | 0.00 | Nondairy substitutes/beverages | 0.00 |
| 18 | Soy | 0.00 | Soy | 0.00 | Soy | 0.00 | Soy | 0.00 |

GL, glycemic load; REGARDS, REasons for Geographic and Racial Differences in Stroke

[a]Stroke buckle includes the coastal plain of North Carolina, South Carolina, and Georgia.

[b]Stroke belt includes North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana.

[c]Non-belt includes the remainder of the continental US.