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Total dietary fiber intakes in the US population are related to whole grain consumption: results from the National Health and Nutrition Examination Survey 2009 to 2010[☆]

Marla Reicks^{a,*}, Satya Jonnalagadda^b, Ann M. Albertson^b, Nandan Joshi^c

^a Department of Food Science and Nutrition, University of Minnesota, St Paul, MN

^b General Mills Bell Institute of Health and Nutrition, Minneapolis, MN

^c General Mills Inc, Mumbai, India

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ABSTRACT

Whole grain (WG) foods have been shown to reduce chronic disease risk and overweight. Total dietary fiber is associated with WG and its health benefits. The purpose was to determine whether associations exist between WG intake (no-WG intake, 0 ounce equivalent [oz eq]; low, >0–<3 oz eq; high, ≥ 3 oz eq) and total dietary fiber intake among Americans 2 years and older. One-day food intake data from the US National Health and Nutrition Examination Survey 2009 to 2010 ($n = 9042$) showed that only 2.9% and 7.7% of children/adolescents (2–18 years) and adults (≥ 19 years) consumed at least 3 WG oz eq/d, respectively. For children/adolescents and adults, individuals in the high WG intake group were 59 and 76 times more likely to fall in the third fiber tertile, respectively, compared with those with no-WG intake. Total dietary fiber intake from food sources varied by WG intake group for children/adolescents and adults with more total dietary fiber consumed from ready-to-eat (RTE) and hot cereals and yeast breads/rolls in the high WG intake group compared with the no-WG intake group. Major WG sources for children/adolescents and adults included yeast bread/rolls (24% and 27%, respectively), RTE cereals (25% and 20%, respectively), and oatmeal (12% and 21%, respectively). Among those with the highest WG intake, WG RTE cereal with no added bran was the greatest contributor to total dietary fiber compared with other RTE cereal types. Whole grain foods make a substantial contribution to total dietary fiber intake and should be promoted to meet recommendations.

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1. Introduction

Evidence from a meta-analysis of longitudinal studies among adults indicated an association between whole grain (WG)

intake and reduced risk of type 2 diabetes, cardiovascular disease, and overweight [1]. Whole grain intake among school-aged children (third–sixth grades) and female adolescents was associated with lower body mass index z-scores and

Abbreviations: NCHS, National Center for Health Statistics; NHANES, National Health and Nutrition Examination Survey; NSLP, National School Lunch Program; oz eq, ounce equivalent; RTE, ready-to-eat; USDA, US Department of Agriculture; WG, whole grain.

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* Corresponding author: Department of Food Science and Nutrition, University of Minnesota, 1334 Eckles Ave, St Paul, MN 55108. Tel.: +1 612 624 4735.

E-mail address: mreicks@umn.edu (M. Reicks).

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lower risk of overweight in young adulthood, respectively [2,3]. The protective health benefits of WG have been attributed to numerous components including total dietary fiber and bioactive compounds in bran and germ such as vitamins, minerals, trace elements, polyphenols, alkylresorcinols, and carotenoids [4-7].

US Dietary Guideline recommendations indicate that at least half of all grains be consumed as WGs [8], which typically includes at least 3 ounce equivalents (oz eq)/d for adults and 1.5 to 4 oz eq/d for children/adolescents, depending on age, sex, and energy needs [8]. However, US National Health and Nutrition Examination Survey (NHANES) 1999 to 2004 data showed that only 1.5% to 4.3% of children/adolescents, 4.8% of adults aged 19 to 50 years, and 6.6% of adults aged 51+ years consumed at least 3 WG oz eq/d [9,10]. Most children/adolescents and adults also do not consume the recommended grams/day of total dietary fiber [11]. Adequate Intake (AI) values of 19 to 25 g/d were established for children aged 1 to 8 years, 31 to 38 g/d for boys aged 9 to 18 years, 26 g/d for girls aged 9 to 13 years, and 21 to 38 g/d for women and men 19 years or older from Dietary Reference Intakes [12]. Based on data from NHANES 2003 to 2006, less than 3% of children/adolescents had a usual fiber intake that was greater than the AI [11]. Dietary fiber intakes for adults were also less than the AI, with mean intakes of 13.7 g/d and 17.6 g/d for women and men (age, ≥ 19 years), respectively [11].

The top food sources of WG based on NHANES 2001 to 2002 data for all persons 2 years and older included ready-to-eat (RTE) cereals (28.7%), yeast breads (25.3%), hot cereal (13.7%), and popcorn (12.4%) [13]. However, the release of the 2005 Dietary Guidelines and accompanying media attention has increased consumer demand for WG foods [14] and resulted in greater WG food availability [15]. Results from a US national survey in 2012 [16] indicated that WG and fiber content were top considerations when buying packaged foods for 67% and 62% of consumers, respectively. Given the greater visibility of WG recommendations since 2005 and increased consumer demand, an updated assessment of WG sources, intake, and relationship to total dietary fiber is needed.

The 2010 Dietary Guidelines for Americans recommended an increased intake of WG and total dietary fiber [8] based on low current intakes, reported associations with lower chronic disease risk, risk indicators and overweight [1,17-20], and higher overall diet quality [9,10,21]. Cooked dry beans and peas, other vegetables, fruit, and WG were recommended as food sources to meet total dietary fiber recommendations [8]. Previous studies have suggested that consumers associate WG foods with fiber and may be confused regarding the difference between WG and total dietary fiber [22-24].

Clarification of the contribution that WG foods make to total dietary fiber based on the most recent dietary intake data will allow educators to promote WG foods for the array of nutritional benefits that are provided, including total dietary fiber. The purpose of this study was to test the hypothesis that associations exist between WG intake and total dietary fiber intake of Americans 2 years and older. In addition, the contribution of various food sources to WG intake was identified. Specific research objectives were to (1) determine whether associations exist between WG intake group (no-WG intake, 0 oz eq; low, >0 - <3 oz eq; high, ≥ 3 oz eq) and total

dietary fiber intake among children and adolescents (age, 2-18 years) and adults (age, ≥ 19 years) by examining the odds of falling into a specific WG intake group by total dietary fiber intake tertile, (2) to determine if total dietary fiber intake from various food sources differs by WG intake, (3) to determine if the percentage of total dietary fiber contributed by types of RTE cereal varies by WG intake, and (4) to identify the contribution of different food sources to WG intake.

2. Methods and materials

2.1. Study population

Data from NHANES 2009 to 2010 were used for the present analysis [25]. The continuous NHANES is a cross-sectional survey that collects data about the nutrition and health status of the US population using a complex, multistage, probability sampling design [25]. National Health and Nutrition Examination Survey is conducted in a noninstitutionalized, civilian US population by the National Center for Health Statistics (NCHS). Participants of NHANES completed a comprehensive questionnaire assessing dietary behaviors, health history, socioeconomic status, and demographic information at NHANES Mobile Examination Centers and in participant's homes. The NCHS Research Ethics Review Board reviewed and approved all study protocols for NHANES 2009 to 2010. Owing to the nature of the analysis (secondary data analysis) and the lack of personal identifiers, this study was exempted by the University of Minnesota Institutional Review Board.

2.2. Dietary intake assessment

Trained interviewers conducted in-person 24-hour dietary recalls using the US Department of Agriculture's (USDA's) Automated Multiple-Pass Method 5-step data collection [25]. Dietary data included detailed descriptions of all food and quantities eaten. Detailed descriptions of the dietary interview methods are provided in the NHANES Dietary Interviewer's Training Manual, which includes pictures of the Computer-Assisted Dietary Interview system screens, measurement guides, and charts used to collect dietary information [25].

Two days of dietary intake were collected from participants. Dietary intake data for the first day were collected through in-person interview and used for analysis in this study. Participants with complete and reliable dietary data were included, as determined by the NCHS. US Department of Agriculture's Food and Nutrient Database for Dietary Studies was used to code and estimate the nutrient content of reported food and beverages [26].

2.3. Whole grain and fiber content

The MyPyramid Equivalents Database for USDA Survey Food Codes, version 2.0A, was used in NHANES 2009 to 2010 to calculate WG intake [27]. A Center for Nutrition Policy and Promotion addendum to MyPyramid Equivalents Database 2.0A was used to estimate WG intake from 117 new food codes from NHANES 2005 to 2006 and 2007 to 2008 [28]. Whole grain values were imputed for 96 new food codes from NHANES 2009 to 2010 based on the reported content of similar foods.

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