Time Trends in the Prevalence of Celiac Disease and Gluten-Free Diet in the US Population: Results From the National Health and Nutrition Examination Surveys 2009-2014

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Time Trends in the Prevalence of Celiac Disease and Gluten-Free Diet in the US Population: Results From the National Health and Nutrition Examination Surveys 2009-2014

Previous studies[1,2] have reported that the prevalence of celiac disease in the United States is increasing, although these studies were limited to narrow populations and were not nationally representative. At the same time, there is a current popular trend of people following gluten-free diets,[3] beyond what would be expected if it were solely attributable to the increasing prevalence of celiac disease. It may be in part because of a public belief that the diet is healthier. The purpose of this study was to examine the current trends in the prevalence of celiac disease and adherence to a gluten-free diet, including people without celiac disease, using nationally representative data from the National Health and Nutrition Examination Surveys (NHANESs) 2009-2014.

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Methods | From January 1, 2009, through December 31, 2014, there were 22 278 persons 6 years or older who participated in NHANESs who underwent serologic testing for celiac disease for whom information about prior diagnosis of celiac dis-

Table. Time Trends of Prevalence of Celiac Disease and People Without Celiac Disease Avoiding Gluten

Variable	2009-2010 Prevalence, % (95% CI) (n = 7798)	2011-2012 Prevalence, % (95% CI) (n = 6903)	*P* Value[a]	2013-2014 Prevalence, % (95% CI) (n = 7577)	*P* Value[b]
Celiac Disease					
Total patients with celiac disease (106 of 22 278 participants [0.69%]; 95% CI, 0.53%-0.84%)	0.70 (0.58 to 0.83)	0.77 (0.41 to 1.13)	.72	0.58 (0.30 to 0.86)	.49
Age, y					
6-19	0.49 (0.20 to 0.79)	0.95 (0.34 to 1.56)	.11	0.67 (0.24 to 1.11)	.50
20-39	0.81 (0.53 to 1.10)	0.77 (0.16 to 1.39)	.85	0.51 (0.14 to 0.89)	.23
40-59	0.75 (0.27 to 1.23)	0.76 (0.03 to 1.55)	.89	0.49 (0.26 to 0.71)	.37
≥60	0.70 (0.41 to 0.99)	0.57 (0.07 to 1.06)	.74	0.73 (−0.13 to 1.60)	.92
Sex					
Male	0.78 (0.55 to 1.01)	0.59 (0.21 to 0.96)	.36	0.22 (0.11 to 0.34)	<.001
Female	0.63 (0.44 to 0.81)	0.97 (0.35 to 1.58)	.22	0.94 (0.39 to 1.48)	.23
Race					
Non-Hispanic white	1.05 (0.80 to 1.30)	1.08 (0.56 to 1.60)	.93	0.75 (0.36 to 1.13)	.26
Non-Hispanic black	0.13 (−0.05 to 0.30)	0.28 (0.01 to 0.55)	.35	0 (0 to 0)	NA[c]
Hispanic	0.15 (−0.06 to 0.36)	0.39 (−0.02 to 0.80)	.32	0.43 (0.15 to 0.70)	.24
Other	0.14 (−0.12 to 0.40)	0.16 (−0.11 to 0.44)	.83	0.46 (−0.06 to 0.97)	.24
Asian[d]	NA	0.07 (−0.06 to 0.21)	NA	0.67 (−0.17 to 1.51)	.06[e]
People Without Celiac Disease Avoiding Gluten					
Total people without celiac disease avoiding gluten (213 of 22 277 participants [1.08%]; 95% CI, 0.80%-1.35%)[f]	0.52 (0.24 to 0.80)	0.99 (0.63 to 1.35)	.06	1.69 (1.10 to 2.31)	.001
Age, y					
6-19	0.15 (0.00 to 0.30)	0.82 (0.16 to 1.49)	.02	0.83 (0.24 to 1.43)	.01
20-39	0.37 (0.18 to 0.56)	0.89 (0.47 to 1.30)	.02	2.42 (1.32 to 3.52)	<.001
40-59	0.89 (0.10 to 1.68)	0.96 (0.12 to 1.80)	.81	2.09 (1.26 to 2.92)	.08
≥60	0.66 (0.34 to 0.97)	1.41 (0.58 to 2.23)	.07	0.87 (−0.05 to 1.80)	.64
Sex					
Male	0.45 (0.17 to 0.72)	0.77 (0.34 to 1.21)	.22	1.22 (0.82 to 1.63)	.01
Female	0.59 (0.20 to 0.98)	1.20 (0.73 to 1.66)	.08	2.15 (1.14 to 3.16)	.003
Race					
Non-Hispanic white	0.40 (0.07 to 0.73)	0.98 (0.53 to 1.44)	.08	2.04 (1.18 to 2.90)	.01
Non-Hispanic black	0.84 (0.19 to 1.50)	1.47 (0.67 to 2.27)	.27	1.08 (0.68 to 1.47)	.55
Hispanic	0.57 (0.15 to 1.00)	0.61 (0.16 to 1.05)	.94	1.21 (0.74 to 1.67)	.11
Other	1.26 (0.04 to 2.50)	0.88 (0.38 to 1.38)	.59	1.19 (0.45 to 1.92)	.96
Asian[d]	NA	1.38 (0.58 to 2.17)	NA	1.62 (0.56 to 2.68)	.61[e]

Abbreviations: NA, not applicable; NHANES, National Health and Nutrition Examination Survey.

[a] *P* values for the comparison between 2009-2010 and 2011-2012.

[b] *P* values for the comparison between 2009-2010 and 2013-2014.

[c] There were no cases in the non-Hispanic black group in 2013-2014.

[d] The Asian group is part of the other race group. Only the NHANESs 2011-2014 include information on the Asian population in the United States.

[e] *P* values for the comparison between 2011-2012 and 2013-2014.

[f] One patient was missing data on the gluten-free diet survey.

ease and use of gluten-free diet was obtained by direct interview. Celiac disease was defined as having either double-positive serologic test results on IgA tissue transglutaminase and endomysial antibody or a reported diagnosis by a health care professional coupled with being on a gluten-free diet. People on a gluten-free diet without celiac disease were identified as those adherent to a gluten-free diet without serologic test results positive for celiac disease or a physician-given diagnosis. Trends in the prevalence of celiac disease and in adherence to a gluten-free diet among people without celiac disease were estimated in the total population, as well as by age, sex, and race. Appropriate published weights and a direct standardization method were used to estimate prevalence. All analyses were conducted using R software, version 3.2.2 (R Foundation for Statistical Computing). The NHANES study was approved by the National Center for Health Statistics Research Ethics Review Board, and all participants provided written informed consent. This analysis per se was deemed exempt by the Rutgers New Jersey Medical School Institutional Review Board because the data set used in the analysis was completely deidentified.

Results | Overall, 106 (0.69%; 95% CI, 0.53%-0.84%) and 213 (1.08%; 95% CI, 0.80%-1.35%) participants were identified as having a diagnosis of celiac disease and adhering to a gluten-free diet without celiac disease, respectively, which corresponds to an estimated 1.76 million and 2.7 million people in the US population (**Table**). From 2009 through 2014, the prevalence of celiac disease remained stable over time (0.70% in 2009-2010, 0.77% in 2011-2012, and 0.58% in 2013-2014) and among population subgroups, with the exception of a decrease among men. In contrast, adherence to a gluten-free diet without celiac disease has increased significantly overall (0.52% in 2009-2010, 0.99% in 2011-2012, and 1.69% in 2013-2014) and among population subgroups, with the exception of stable trends among nonwhite participants.

Discussion | Our findings suggest that the prevalence of celiac disease has remained stable in the US population from 2009 through 2014, although increasing numbers of people are now following gluten-free diets. The two trends may be related because gluten consumption has been identified as a risk factor of celiac disease,[4] such that steady or even decreasing gluten consumption[5] may be contributing to a plateau in celiac disease.

Our study has important limitations to consider, including that small numbers of participants in the nationally representative NHANESs were identified as having a diagnosis of celiac disease and adhering to a gluten-free diet without celiac disease. Individuals who met our definition of celiac disease were not confirmed by intestinal biopsy. However, the serologic tests may be more appropriate for large epidemiologic surveys because of their simplicity and operator independence.[6]

There are many reasons, beyond celiac disease, that may account for the increasing popularity of gluten-free diets. First, the public perception is that gluten-free diets are healthier and may provide benefits to nonspecific gastrointestinal symptoms.[3] Second, gluten-free products were difficult to obtain in the past but now are more widely available at most large supermarkets and online. Third, there is also an increasing number of individuals with self-diagnosed gluten sensitivity but not the typical enteropathic or serologic features of celiac disease who have improved gastrointestinal health after avoidance of gluten-containing products.

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Study supervision: Kim, Patel, Kothari, Ahlawat.

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Invited Commentary

Maybe It's Not the Gluten

Recent consumer surveys indicate that a gluten-free diet has become one of the most popular health food trends in the United States, such that 1 in 5 individuals have eliminated or reduced gluten in their daily diet, a number that far exceeds the small subgroup that carries a diagnosis of celiac disease or IgE-mediated wheat allergy.[1] In this issue, Kim et al[2] report the results of their analysis of data from the National Health and Nutrition Examination Survey (NHANES), reporting that the prevalence of celiac

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disease has remained relatively stable from 2009 through 2014, although the prevalence of individuals reporting adherence to a gluten-free diet has more than tripled (0.52% in 2009-2010 to 1.69% in 2013-2014).

Part of what may be driving this gluten-free diet trend is simply a belief, fueled by marketing and media, that these foods are healthier. However, surveys suggest that many individuals who adhere to a gluten-free diet believe that the exclusion of gluten has resulted in subjective health benefits from weight loss to reduced symptoms of inflammation and gastrointestinal distress.[3,4] Because a gluten-free diet may have negative social, financial, and health repercussions, it is important for clinicians to understand whether, in most cases, it is the elimination of the protein gluten that is responsible for symptom improvement or whether following a gluten-free diet is simply a marker of other dietary choices that are creating positive effects.[5]

Not all research has found that individuals who adhered to a gluten-free diet resulted in subjective health benefits. A recent 2-year prospective study[6] from Italy suggests that something other than gluten itself is resulting in self-reported health benefits. Researchers enrolled all consecutive patients with gluten-related symptoms, and after those with celiac disease or wheat allergy were eliminated, only 7.5% experienced any change of symptoms with a gluten-free diet. Studies such as this raise the question of what other than gluten might explain the symptomatic improvement experienced among those following a gluten-free diet.

One explanation is that it is not the gluten but the grain itself. Researchers in Australia found that that the fermentable oligosaccharides, disaccharides, monosaccharides, and polyols (FODMAPs) and insoluble fiber that are found in gluten-containing foods may be responsible. FODMAPS and insoluble fiber increase the osmotic pressure in the large intestine and promote bacterial fermentation, which results in gas production and abdominal bloat. In a controlled, crossover study[7] of patients with irritable bowel syndrome, a diet low in FODMAPs effectively reduced these symptoms; in a related study,[8] patients who improved while following a low-FODMAP diet experienced no exacerbation of symptoms when gluten was introduced.

Another explanation is that gluten elimination may accompany other dietary trends that are associated with improved symptoms. For example, adherents to the popular Paleolithic and autoimmune protocol diets might also report being on a gluten-free diet.[9] There is a debate about whether these diets, which promote eating unprocessed foods that were available in preagricultural times while avoiding grains, oils, and legumes, offer any health advantage over other whole food diets (such as the Mediterranean diet). Nonetheless, some have argued that simply eliminating highly processed foods (including highly processed gluten-containing foods) might result in an improved sense of well-being.

Following a gluten-free diet likely means different things to different people, and a heterogeneous group of individuals are adhering to this dietary trend. Although the choice to be gluten free may be driven in part by marketing and a misperception that gluten free is healthier, it is important that this choice not be dismissed as an unfounded trend except for those with celiac disease and wheat allergy. Instead, researchers and clinicians can use this as an opportunity to understand how factors associated with this diet affect a variety of symptoms, including gastrointestinal function, cognition, and overall well-being.

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The Inclusion of Nurses in Pharmaceutical Industry–Sponsored Events: Guess Who Is Also Coming to Dinner?

The release of the Open Payments data in the United States, which detail payments from pharmaceutical and medical device companies to physicians, enables analysis of the financial relationships between physicians and industry.[1] However, the Physician Payments Sunshine Act, which mandates these disclosures, omits registered nurses. A recent qualitative study suggests nurse-industry interactions in US hospitals may be common and influential.[2] The limited prevalence data available, based on self-report, suggests that 51% to 96% of nurses have contact with industry representatives.[3]

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Australia is one of the few jurisdictions to report payments to all registered health professionals. Since 2007, member companies of the industry trade association, Medicines Australia, have voluntarily reported sponsorship of functions for health professionals.[4] This report describes the extent of inclusion of nurses in pharmaceutical company-sponsored