

Socioeconomic vs Health Related Factors Associated With Google Searches for Gluten-Free Diet

Monika Laszkowska,* Henna Shiwani,* Julia Belluz,[‡] Jonas F. Ludvigsson,^{*,§,||,¶} Peter H. R. Green,^{*} Daniel Sheehan,[#] Andrew Rundle,^{**} and Benjamin Lebwohl^{*,§}

*Celiac Disease Center, Department of Medicine, Columbia University College of Physicians and Surgeons, New York, New York; [‡]Vox Media, Washington, DC; [§]Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden; ^{||}Department of Pediatrics, Örebro University Hospital, Örebro, Sweden; [¶]Division of Epidemiology and Public Health, School of Medicine, University of Nottingham, Nottingham, United Kingdom; [#]Carto, Brooklyn, New York; ^{**}Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, New York

A gluten-free diet is the treatment for celiac disease (CD).¹ This diet has gained popularity in the United States out of proportion to shifts in diagnosis and incidence of CD.² Sociodemographic factors can affect food purchases and nutritional habits, and popular diets may be unrelated to recommendations from medical professionals.³ The aim of this study was to test whether sociodemographic and health data predict the popularity of Google searches for “gluten-free diet.”

Methods

Google Trends data were obtained for 9 diet-related search terms most commonly searched annually from 2005 to 2015 across 210 Nielsen designated market areas (DMAs) in the United States.⁴ Dietary terms included *Atkins diet*, *gluten-free diet*, *low-calorie diet*, *low-carbohydrate diet*, *low-fat diet*, *organic food diet*, *Paleolithic diet*, *South Beach diet*, and *veganism*. DMAs were linked to county identifiers. County data from the U.S. Census American Community Survey, the Center for Disease Control and Prevention Diabetes Interactive Atlas, and County Health Rankings National Data were aggregated to create DMA-level estimates of sociodemographic and health-related factors.

We categorized DMAs into quartiles (Q) for median household income (Q1: \$29,951–\$42,008, Q2: \$42,009–\$45,621, Q3: \$45,622–\$51,403, and Q4: \$51,404–\$81,123) and percent of non-Hispanic white residents (Q1: 4%–60%, Q2: 61%–76%, Q3: 77%–86%, and Q4: 86%–96%) using American Community Survey 2007 data. We performed Cox proportional hazards modeling to estimate hazard ratios and identify predictors of the gluten-free diet becoming the top-searched diet between 2005 and 2015. We tested the following variables, all of which we included in the multivariable model: median household income, racial-ethnic composition, prevalence of diabetes or obesity, levels of leisure-time physical inactivity, and limitations in access to healthy food. Years until

“gluten-free diet” became the most frequent dietary search was used as the time parameter in Cox modeling.

Results

“Gluten-free diet” became the most popular dietary search term for the first time in 4 of 210 DMAs (1.9%) in 2006, and in >50% of DMAs (63%) by 2011. This proportion increased annually until its peak in 2014, when it was the most popular search in 175 of 210 DMAs (83%).⁴ Once this search became the most popular in a DMA, it remained most popular in consecutive years through 2015 in 115 of 210 DMAs (55%).

On multivariate analysis, shorter time to gluten-free diet being the top search term was associated with both increasing quartiles of median household income and the proportion of the residents who were non-Hispanic white (Figure 1). Diabetes and obesity prevalence, levels of leisure-time physical inactivity, and limitations in access to healthy food were not associated with gluten-free searches. Prevalence of obesity, diabetes, and levels of leisure-time physical inactivity were all highly correlated (Pearson correlation coefficients 0.70–0.79). When the analysis was repeated excluding the 2 latter variables, the associations of gluten-free diet searches with median household and the proportion of non-Hispanic white residents were essentially unchanged.

Discussion

The prevalence of CD in the United States remained stable in recent years, approximately 0.7%.^{2,5} In contrast, adherence to a gluten-free diet among

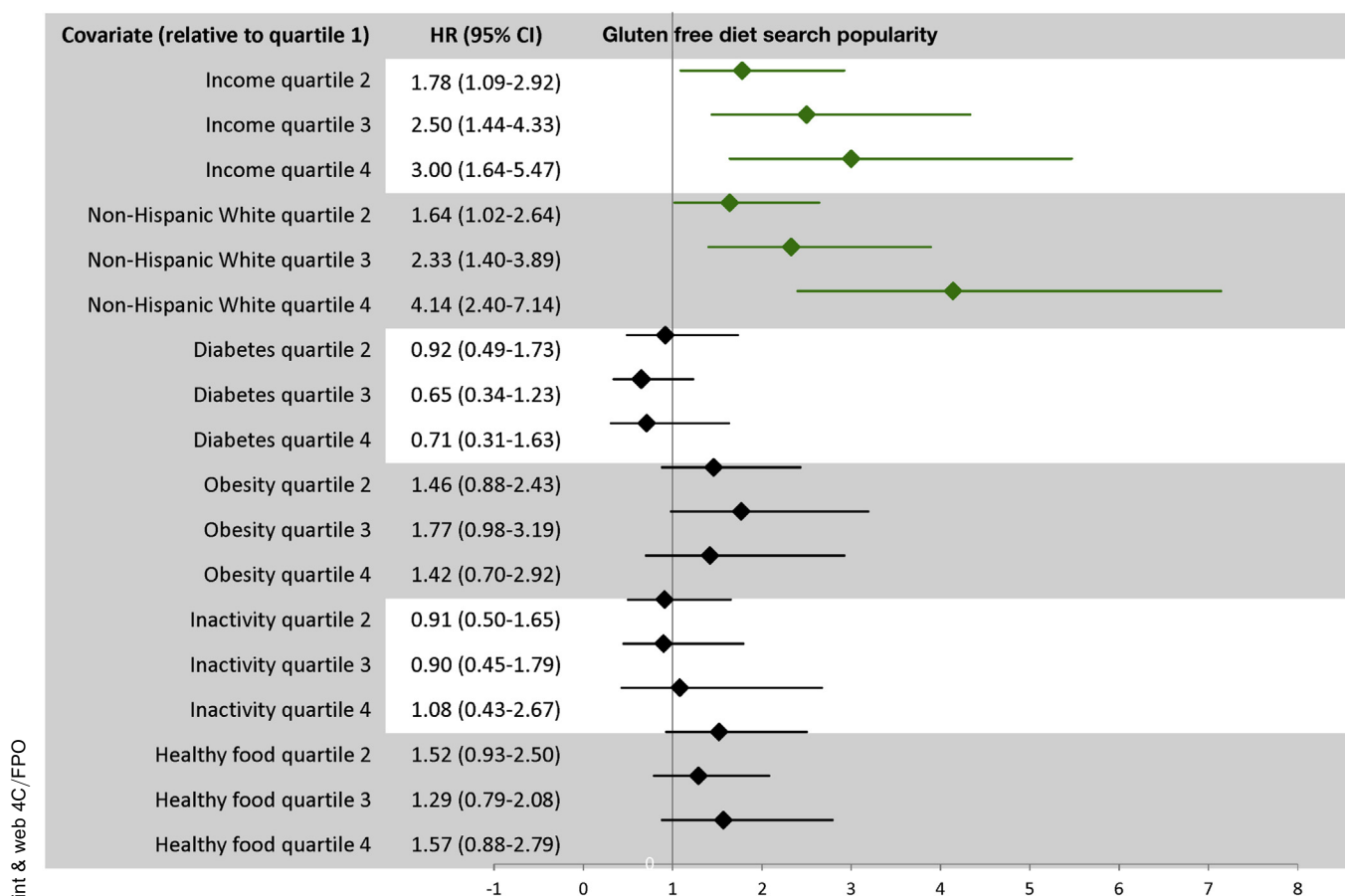


Figure 1. CI, confidence interval; HR, hazard ratio.

individuals without CD increased from 0.52% in 2009–2010 to 1.69% in 2013–2014.² Our results reflect growing interest in the gluten-free diet, which became the most popular of nine dietary search terms across 83% of the United States between 2005 and 2015.⁴

Popularity of gluten-free diet searches was significantly correlated with higher proportion of non-Hispanic white residents and higher household incomes. While the prevalence of CD in the United States is higher among the Caucasian population (approximately 1%), this modestly increased prevalence does not adequately explain these high search rates.⁵ Cost has been cited as a burden to adherence to a gluten-free diet in CD patients,⁶ which may explain why this diet among non-CD patients achieved popularity earlier in regions with higher incomes.

A third of Americans who purchase gluten-free items cite no specific reason for this dietary habit.⁷ Contrary to evidence, another third believe it is healthier or promotes weight loss.^{7,8} Nonetheless, we found that gluten-free diet searches were not correlated with health-related factors such as obesity.

Our study has several limitations. Exposures were assessed on a population level, and caution must be taken in applying them at an individual level. While we adjusted for potential confounding, there may be

unmeasured variables driving the association among income, race-ethnicity, and interest in the gluten-free diet.

In summary, the gluten-free diet has become a dominant dietary Internet search term and is more strongly associated with sociodemographic characteristics than health-related factors. Given the popularity of the gluten-free diet, future researchers should investigate the motivations of those maintaining this diet, and its consequences.

References

- Green PH, Cellier C. Celiac disease. *N Engl J Med* 2007; 357:1731–1743.
- Kim HS, Patel KG, Orosz E, et al. 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. *JAMA Intern Med* 2016;176:1716–1717.
- Choung RS, Ditah IC, Nadeau AM, et al. Trends and racial/ethnic disparities in gluten-sensitive problems in the United States: findings from the National Health and Nutrition Examination Surveys from 1988 to 2012. *Am J Gastroenterol* 2015;110:455–461.
- Belluz J. The most Googled diets in every city. 2015. Available at: <https://www.vox.com/2015/11/10/9704544/most-popular-diet>. Accessed .
- Rubio-Tapia A, Ludvigsson JF, Brantner TL, et al. The prevalence of celiac disease in the United States. *Am J Gastroenterol* 2012;107:1538–1544, quiz 1537, 1545.

6. White LE, Bannerman E, Gillett PM. Coeliac disease and the gluten-free diet: a review of the burdens; factors associated with adherence and impact on health-related quality of life, with specific focus on adolescence. *J Hum Nutr Diet* 2016;29:593–606.
7. Group TH. The Hartman Group's Health & Wellness 2015 and Organic & Natural 2014 reports. 2015. Available at: <http://www.hartman-group.com/acumenPdfs/gluten-free-2015-09-03.pdf>. Accessed .
8. Dickey W, Kearney N. Overweight in celiac disease: prevalence, clinical characteristics, and effect of a gluten-free diet. *Am J Gastroenterol* 2006;101:2356–2359.

Reprint requests

Address requests for reprints to: Benjamin Lebwohl, MD, MS, The Celiac Disease Center at Columbia University, 180 Fort Washington Avenue, Suite 936, New York, New York 10032. e-mail: BL114@columbia.edu.

Conflicts of interest

The authors disclose no conflicts.

Funding

Jonas F. Ludvigsson is supported by grants from the Swedish Society of Medicine, the Swedish Research Council – Medicine (522-2A09-195), and the Swedish Coeliac Society. Andrew Rundle would like to acknowledge support from the Columbia Population Research Center.