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HOW DOES IDENTIFYING AS GLUTEN-FREE IMPACT
INFORMATION CHOICE REGARDING THE GLUTEN-FREE DIET?

By

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HOW DOES IDENTIFYING AS GLUTEN-FREE IMPACT INFORMATION CHOICE
REGARDING THE GLUTEN-FREE DIET?

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University of Nebraska, 2019

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The market for gluten-free products is a multi-billion-dollar industry in the United States and has seen tremendous growth in the recent years. The retail sales of gluten-free foods in the United States almost tripled between 2011 and 2015, although rates of diagnosed gluten-related health problems have not risen. In addition to people who suffer from Celiac Disease, Wheat Allergy and Non-Celiac Gluten Sensitivity, there is a category of people known as PWAG (people who avoid gluten) who seem to have significantly contributed to this boom in the market for gluten-free foods. With more people choosing to adopt the gluten-free diet, there might be a negative effect for people who genuinely need to adhere to the gluten-free diet for medical reasons. An increase in the number of PWAG may be attributable in part to the bias that people have for “free-from” food labels, believing them to be healthier. Such beliefs among people arise due to selective information seeking and avoidance behaviors. Beliefs can act as self-regulatory measures to form various identities among individuals. In this study, we examine how identifying as gluten-free influences the valence of information (positive, negative, both positive and negative) about the gluten-free diet that people choose to read. We developed a survey which was administered online by the survey firm IRI. Only people who had previously tried to reduce/avoid gluten from their diets or are currently on a reduced-gluten/gluten-free diet were considered for the study. The results from a logistic

regression model indicated that if an individual identifies as gluten-free, she is more likely to read about the benefits of following a gluten-free diet, though the result is not significant at normal levels, which may be due to small sample sizes.

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CHAPTER 1: INTRODUCTION

1.1 Statement of the issue and motivation for the study

Gluten sensitivity/intolerance affects about 6 to 7 percent of the population in the United States (Fasano 2012). Gluten is a complex protein found predominantly in wheat (gliadin and glutenin), rye (secalin), barley (hordein) and oats (avenin), which are jointly referred to as prolamins (Biesiekierski 2017). While it is critical for people affected by gluten sensitivity to avoid wheat, rye and barley, some can safely consume oats (Garsed and Scott 2006). This is because the content of prolamins, the protein responsible for the sensitivity, in wheat, barley and rye is much higher—around 40 percent—than that in oats, approximately 15 percent (Haboubi et al. 2006). Eliminating gluten from their diets is critical for people suffering from autoimmune disorders like Celiac Disease (also known as celiac sprue or gluten-sensitive enteropathy) and Wheat Allergy. Non-Celiac Gluten Sensitivity (NCGS) is yet another type of gluten intolerance which has recently acknowledged by researchers and is suggested to be the most common gluten-related disorder (Barbaro et al. 2018, Niland and Cash 2018). Contrary to Celiac Disease, which can be diagnosed by medical professionals, the lack of a specific diagnostic procedure for NCGS means that most individuals with NCGS are self-diagnosed (Biesiekierski 2014). The incidence of self-diagnosis of Celiac Disease has increased among people in recent years due to the cost and time constraints associated with medical diagnosis (Copleton and Valle 2009). Multiple websites, discussion boards and support groups provide online checklists for common symptoms of gluten sensitivities and suggest remedies for individuals who feel they experience negative effects from gluten consumption. Some of

the groups providing information and promoting the gluten-free diet include Beyond Celiac (www.beyondceliac.org), and the Celiac Disease Foundation (www.celiac.org), among others. These platforms promote self-diagnosis through assessment of the abatement of symptoms after a period of gluten avoidance.

In addition to diagnosed (both self and medical) gluten sensitivities, there is also a category of people termed as people who avoid gluten (PWAG). This category of people follows the gluten-free diet without having Celiac Disease and may even be completely asymptomatic to gluten sensitivities. According to the Niland and Cash (2018), people with NCGS are also categorized as PWAG, since they have not been officially diagnosed. Data from the National Health and Nutrition Examination Survey (NHANES) showed that the prevalence of PWAG tripled between 2009 and 2014, whereas the prevalence of Celiac Disease remained stable. PWAG constituted 72 percent of the people who followed the gluten-free diet in 2014, compared to 44 percent in 2009 (Choung et al. 2016). The self-initiation of the gluten-free diet among PWAG is attributed to beliefs those individuals hold that the gluten-free version of a product is healthier than its gluten-containing counterpart. A few recent studies support this view. A study by Priven et al. (2015) found that a significant proportion of the total population considered a gluten-free product, as well as a product labeled as not containing a fictitious ingredient called MUI, to be healthier than the conventional product (25.5 and 21.9 percent respectively). Prada et al. (2019) also found similar results for both gluten-free products and the gluten-free diet. The study evaluated self-reported knowledge of the participants about gluten-free products. They found that although people did not have nutritional information about the

gluten-free products, the participants perceived gluten-free foods to be healthier. The study also tested whether people knew about the gluten content in various items and found that people were confused whether sausages, rice, seafood sticks, oats, and other foods that do not contain wheat, barley, or rye contained gluten. Some people think gluten-free foods are superior to conventional foods in promoting weight loss, avoiding carbohydrates, and improving overall health, diet, digestive health and skin complexion (Watson 2013, Dunn et al. 2014).

The increase in the number of people following the gluten-free diet has led to a rise in the market for gluten-free products. The global market for gluten-free products was valued at \$4.26 billion in 2016 and is expected to reach \$7.38 billion in 2021 (Statista Research Department 2018). Comparative market statistics in the United States show that between 2011 and 2015 the retail sales of gluten-free foods tripled from \$464 million to nearly \$1.6 billion (Watson 2016). This boom in the market may be attributable in part to the bias that people have for “free-from” food labels, considering them to be healthier (Hartmann et al. 2018).

The burgeoning demand for gluten-free foods in the market, especially by PWAG, could have a negative effect for people who need to adhere to a gluten-free diet for medical reasons (Worosz and Wilson 2012). Studies show that following a gluten-free diet also comes with an economic burden as the gluten-free products are more expensive than their gluten-containing counterparts (Lee et al. 2007). Although most PWAG buy gluten-free foods assuming them to be healthier, many gluten-free foods in reality contain higher amounts of calories, fat, sodium and sugar compared to the conventional products

and can contribute to a less healthy diet (Mansharamani 2015). In fact, studies on Celiac patients following a strict gluten-free diet have found an increase in both weight and body mass index (BMI) among the subjects over time (Dickey and Kearney 2006, Kabbani et al. 2012). Another possible explanation for this weight gain might be the decreased intestinal malabsorption and reduced gastrointestinal problems (bloating, nausea, abdominal pain) which are common symptom for Celiac patients consuming gluten. Missbach et al. (2015) concluded from their study that replacing conventional gluten-containing foods with gluten-free counterparts does not provide any additional health benefits to non-gluten-sensitive consumers and in fact only results in a more expensive diet.

Most studies on gluten-free products have primarily been directed towards improving the sensory and nutritional qualities of the products and finding better substitute ingredients to wheat, barley and rye. The motivation behind this is the fact that the gluten-free products are poor sources of minerals, vitamins and fiber (Saturni et al. 2010). Minor or pseudo-cereals like amaranth, buckwheat, quinoa, sorghum, teff, etc. serve as promising alternatives to improve intake of protein, iron, calcium and fiber in gluten-sensitive people (Lee et al. 2009). Such products are now readily available in the market with companies like BFree, Glutino, and Gluten-free Prairies, specifically producing only gluten-free items.

The research that has been conducted on consumer attitudes towards gluten-free foods so far has mostly used small samples that are not representative of the US population. For example, the study by Dunn et al. (2014) was conducted with only 97

students at University of Florida; the study by Hartmann et al. (2018) was conducted for the European countries of United Kingdom, Sweden, Poland and France. A number of studies also focus on only Celiac patients and do not account for all PWAG. While the research suggests that an important segment of consumers perceives gluten-free foods to be healthier, the research has not answered why consumers have that perception.

Testing for knowledge that people currently have about gluten, gluten-free products or the gluten-free diet may provide a better understanding of the bias that people have towards gluten-free products over conventional products. It may also be indicative of the basis for beliefs among people about the gluten-free diet in general. Consumers who are unable to accurately evaluate food labels or health information likely make biased decisions or rely on rules of thumb when making choices, as illustrated by people who preferred the fictitious MUI-free labeled food in the study by Priven et al. (2015).

1.2 Relevant Literature

Recent research in psychology and economics has illustrated how important information seeking and avoidance behavior is in shaping beliefs and behaviors. According to neoclassical microeconomic theory, information is valuable to individuals--at worst, information may provide no value (Benabou and Tirole 2016). In general, information helps in improving the consumer's decision-making abilities. In contrast to neo-classical theory, behavioral economics suggests that people might not look at a given piece of information in the same way and use heuristics to make decisions. According to Ariely (2000), using heuristics and controlling information flow can positively influence the quality of decision making as it reduces cognitive effort. The rules of thumb that drive

people in their decision-making processes also vary based on the type and source of information they expose themselves to (or are exposed to) and exposure to information can be guided by either defense or accuracy motives. Beliefs -- which are shaped by exposure to information -- fulfill both important psychological and functional needs of an individual (Benabout and Tirole 2016). Beliefs can act as self-regulatory measures to form various identities among individuals. Identity is in essence a set of beliefs that people value and defend (Benabout and Tirole 2016). Depending on the identity that one associates with, people may prefer selective exposure to information in order to defend their beliefs by avoiding information that is likely to challenge their beliefs and seeking information that supports their beliefs. Such selectivity of information is known as confirmation or congeniality bias (Hart et al. 2009).

Studies are limited in looking into information seeking and avoidance behavior based on the identity in regard to gluten-free foods and diet. Previous studies look into the dimensions of identity and decision making for food choices pertaining to veganism and organic foods, but none have been done in relation to a specific diet such as the gluten-free diet. For instance, Sneijder and Molder (2009) studied the relation between ideologically based food choice and identity in an online forum on veganism and included the notion of identity as part of a social action and Shaw and Shui (2002) studied self-identity and ethical obligations in relation to ethical consumer choice in the UK. Both the studies indicate that when an issue becomes central to an individual's identity, the behavior gets adjusted.

Studies examining individuals' decisions to access scientific information pertaining to food and health are also limited. According to Pew Internet and American Life Project about 61 percent of American adult internet users search for health information online and 60 percent said that online information affects their healthcare decisions (Fox and Jones 2009). People search online for advice and information related to conditions, symptoms and treatment options (Shuyler and Knight 2003). Xiao et al. (2014) studied people's online health information search for cancer to elucidate factors that influence search behavior. They found that perceived quality of communication with medical professionals has no impact on the frequency of information search on the internet and one's health status does not lead to a preference for using online information. Zander and Hamm (2012) studied information search behavior and its determinants in relation to ethical attributes of organic food (organic milk in particular) in four countries—Austria, Switzerland, Germany and UK—using an Information Display Matrix (IDM) where an individual could choose to read information about any of the attributes for the given varieties of organic milk. The authors state that people are more involved when confronted with ethical products and tend to carry out an extensive information search to know about such products. They go on to state that when the information is accessible, the information search is more extensive, and the information acquisition is more pronounced when the expected benefit is higher (for example when the purchase decision is felt to be important). The literature pertinent to our research question is therefore limited.

1.3 Objective of the study:

In this thesis, I examine the impact of self-identifying as gluten-free on information choice behavior related to the gluten-free diet, while assessing the knowledge an individual has with regards to the gluten-free diet and products. The hypothesis for the study will be based off the following statement by Benabout and Tirole (2016, p. 148):

“When asset-like beliefs are involved, people will tend to ignore, discount, rationalize away, or put out of mind the news that conflicts with these ideas while welcoming data that supports them.”

We hypothesize that an individual for whom being gluten-free is an important part of his/her identity will be more likely to view only the positive aspects of the information provided (i.e. potential benefits of a gluten-free diet) compared to the negative or combined aspects, in order to avoid conflicting information. The remainder of the paper will elaborate on the literature related to identity and information behavior, the model and methods used in the study and the results obtained.

CHAPTER 2: MATERIALS AND METHODS

2.1 Methodology and Data

This work derives from a broader study which attempted to elucidate the drivers of the gluten-free diet among both gluten-sensitive and gluten-tolerant individuals. We developed a survey which included 55 questions that addressed demographic characteristics (gender, age, etc.) of the respondents, their experience with various diets including the gluten-free diet, their purchase behavior pertaining to gluten-free products, their knowledge and beliefs about gluten and gluten-free products, sources of information they referred to regarding the diet and medical diagnosis of gluten-sensitivity. The survey instrument is included in Appendix I. To examine the role of identity in choice of information source, we focus on two specific questions: participants' agreement with the statement "Being gluten free is an important part of my identity," and an information choice task about the gluten-free diet. The question about identifying as gluten-free had two potential responses, yes or no, and was only presented to people who had followed or are still following the reduced-gluten/gluten-free diet. Following this question was a choice task in which participants had to choose to either read about the benefits of following a gluten-free diet, the costs of following a gluten-free diet, or both the benefits and costs of following a gluten-free diet. The information provided was summarized from the article by Cash and Niland (2018).

The survey was administered online by IRI, a leading survey firm. A total of 5,513 individuals across the United States started the survey, of which 3,051 individuals completed the survey -- IRI removed participants who were younger than 19 years of age,

who did not respond to trigger questions correctly, or who completed the survey in less than five minutes.

The variables considered in our study are listed in Table 1. The columns full sample and subset sample represents the entire population (N= 3051) and the subsample considered for analysis in our study (n=711). While most variables were collected as categorical variables, a few control variables – age, household income and level of education completed – were transformed into continuous variables for data analysis. For example, an individual whose age is in the category 25-34 years was assigned a numeric value of 29.5. Similarly, an individual whose household income is in the category \$40,000-\$59,999 was assigned a numeric value of 50 (units were in thousands of dollars) and for an individual who has an undergraduate degree, a numerical value of 16 was assigned. Appendix II has details about how each category for the concerned variables was transformed.

The questions regarding diet history of an individual involved three separate choices to indicate whether the individual had never tried the diet, had tried it previously but was not currently following it, or was currently following it. The survey included questions about eliminating gluten entirely from one's diet (gluten-free) and avoiding, but not eliminating, gluten from one's diet (reduced-gluten). For our analysis, however, the data for the two diets were combined into a single variable. This was done as regression results indicated that there was no difference in behavior between these groups. Combining the two diets also addressed concerns about small sample sizes in the intersection of the categories capturing diet type (gluten-free vs. gluten-reduced) and time

(currently following vs. followed in the past but not currently following). We maintained the distinction between those who were currently following the diet versus those who had followed the diet in the past but were no longer following it. People who had never tried either of the diets were not included in the sample.

The survey had a total of nine objective knowledge questions about gluten, gluten-free diet and gluten-free products. The objective knowledge questions were treated as a quiz. For every question an individual answered correctly, they received one point; they received zero points for a wrong answer. The percentage of correctly answered questions was then calculated (that is, an individual's score was calculated by taking the number of questions they answered correctly divided by the total number of questions and multiplied by 100) and used as a continuous variable in our analysis. On an average the objective knowledge score was 38.13 percent and 43.43 percent for the whole population and the sample respectively.

For the information choice variable, we combined the categories "Costs of following a gluten-free diet" and "Both benefits and costs of following a gluten-free diet" into a single category. Only ten percent of the respondents in our sample had chosen to look at the information that only discussed the costs of following a gluten-free diet.

For people who had never followed a gluten-free/reduced-gluten diet, it was clear that being gluten-free would not be an important part of their identity. Since the study specifically investigates the impact identity has on information choice, we limited the sample used for the analysis to only those who have been on the gluten-free/reduced-gluten diet. This was done considering the fact that the motive behind choosing to read a

particular valence of information would be different for people who have versus those who have not tried the diet. Both categories of people would also have different beliefs regarding the diet which would impact information choice. Hence, out of the total subject pool of 3,051 respondents we use a subset sample for the study of the 711 respondents who have tried the diet or are currently on it. The summary statistics for both the total population and the subset sample can be found in Table 1. The subset sample considered in our analysis is mostly representative of the total population for all the categories for each of the variables.

Table 1: Summary statistics for variables considered in the study

Key Variables	Transformed Variable Values	For full sample*		For subset sample**	
		%	Mean	%	Mean
Age			47.55		43.19
19-24 years	21.5	8.59		9.99	
25-34 years	29.5	17.20		24.19	
35-44 years	39.5	18.55		22.78	
45-54 years	49.5	19.44		19.69	
55-64 years	59.5	15.93		11.25	
65 years and older	70	20.29		12.10	
Prefer not to answer		0.00		0.00	

Table 1 (continued): Summary statistics for variables considered in the study

Gender					
Female		52.18		53.45	
Male		47.59		46.27	
Prefer not to answer		0.23		0.28	
Household Income			71.41		71.94
Less than \$20,000	20	8.72		9.28	
\$20,000 - \$39,999	30	19.01		18.42	
\$40,000 - \$59,999	50	17.80		18.14	
\$60,000 - \$79,999	70	14.68		13.22	
\$80,000 - \$99,999	90	10.98		11.53	
\$100,000 or more	125	26.74		27.70	
Prefer not to answer		2.06		1.69	
Education Completed			14.87		14.91
Less than high school	10	1.15		1.41	
High school/G.E.D.	12	19.27		19.69	

Table 1 (continued): Summary statistics for variables considered in the study

Some college/associate degree	14	37.20		34.88	
Bachelor's degree	16	26.68		27.29	
Advanced degree (M.B.A., M.D., J.D., M.S., M.A., Ph.D.)	19	15.37		16.17	
Prefer not to answer		0.33		0.56	
Objective Knowledge Score (in percent)			38.13		43.43
History of following a gluten-free or reduced-gluten diet					
Never tried		76.70		-	
Not currently following, but followed in the past		16.88		72.43	
Currently following		6.42		27.57	
Identifying as gluten-free					
Yes		5.60		24.05	
No		94.40		75.95	

Table 1 (continued): Summary statistics for variables considered in the study

Information choice about the gluten-free diet					
Benefits of following a gluten-free diet		39.82		36.71	
Costs of following a gluten-free diet		9.70		10.83	
Both the benefits and costs of following a gluten-free diet		50.48		52.46	
* N = 3051 ; ** n = 711					

2.2 Model Specification

a. Understanding determinants of identity

Since identity is our primary variable of interest in the study, we first wanted to test if any of the key variables considered in our study predicted the identity variable.

Binary logistic regression was used for this purpose. The following regression model (I) was first fitted with our sample data:

$$identity_i = \beta_0 + \beta_1 hist_i + \varepsilon_i \quad \dots\dots\dots(I)$$

Here, the variable $identity_i$ represents whether or not being gluten-free is an important part of respondent i 's identity (1 = yes; 0 = no) and $hist_i$ captures respondent i 's

diet status (1 = currently following; 0 = followed diet in the past but not currently following). The regression results and the marginal effects for the given model are presented in Table 2. Results show that $hist_i$ significantly impacts $identity_i$ and people who are currently on the gluten-free diet are 25.8 percentage points more likely to identify as gluten-free.

Next we included the variable for objective knowledge score OK_pct_i in model I to see its impact on $identity_i$:

$$identity_i = \beta_0 + \beta_1 hist_i + \beta_2 OK_pct_i + \varepsilon_i \quad \dots\dots\dots (II)$$

The regression results and the marginal effects for model (II) are presented in Table 3. The variable $hist_i$ continues to be significant; OK_pct_i is also significantly related to $identity_i$. People who have tried the gluten-free diet before but are not currently on it are 27.4 percentage points less likely to identify as gluten-free when we control for objective knowledge. For every one percent increase in the objective knowledge score, an individual is 0.3 percentage points less likely to identify as gluten-free.

Next, we looked into the impact of the demographic variables age, gender, household income and level of education completed (age_i , gen_i , inc_i and $educ_i$), along with the variables $hist_i$ and OK_pct_i , on $identity_i$:

$$identity_i = \beta_0 + \beta_1 hist_i + \beta_2 OK_pct_i + \beta_3 age_i + \beta_4 gen_i + \beta_5 inc_i + \beta_6 educ_i + \varepsilon_i \quad \dots\dots\dots (III)$$

The regression results and the marginal effects for the given model (III) are presented in Table 3. Along with $hist_i$ and OK_pct_i , gen_i also significantly impacted $identity_i$. Females are 12 percentage points less likely to identify as gluten-free.

Table 2: Regression results and marginal effects for models I, II and III to understand the determinants of identity

Independent Variable	Coefficients			Marginal Effects		
	Model I	Model II	Model III	Model I	Model II	Model III
History of following a low-gluten/gluten-free diet: Currently following	1.586*** (0.188)	1.720*** (0.196)	1.752*** (0.204)	0.258	0.274	0.269
Objective Knowledge		-0.018*** (0.005)	-0.015** (0.006)		-0.003	-0.002
Age			-0.003 (0.007)			-0.0004
Gender: Female			-0.714*** (0.200)			-0.120
Household Income			-0.002 (0.003)			-0.0004
Education			0.018 (0.047)			0.003

Table 2 (continued): Regression results and marginal effects for models I, II and III to understand the determinants of identity

Constant	-1.708*** (0.122)	-0.972*** (0.234)	-0.801 (0.678)	-0.277	-0.155	-0.123
Observations	711	711	695			
Log Likelihood	-356.197	-349.848	-331.188			
AIC	716.394	705.696	676.375			
** significant at 1 percent level of significance						
*** significant at 0.1 percent level of significance						

b. Estimating the impact of identity on information choice

We used binary logistic model again to check the impact of the key variables on the valence of information choice. Three separate regressions were run to first check the individual impacts of $identity_i$, $hist_i$ and OK_pct_i on the dependent variable— $infochoice_i$ —which represents the information chosen by respondent i . We then carried out a couple of regressions including only $identity_i$, $hist_i$ and OK_pct_i at first and then all of the independent variables to determine which model was a better fit. The models used for these five regressions are as follows:

$$infochoice_i = \beta_0 + \beta_1 identity_i + \varepsilon_i \quad \dots\dots\dots (IV)$$

$$infochoice_i = \beta_0 + \beta_1 hist_i + \varepsilon_i \quad \dots\dots\dots (V)$$

$$infochoice_i = \beta_0 + \beta_1 OK_pct_i + \varepsilon_i \quad \dots\dots\dots (VI)$$

$$infochoice_i = \beta_0 + \beta_1 identity_i + \beta_2 hist_i + \beta_3 OK_pct_i + \varepsilon_i \quad \dots\dots\dots (VII)$$

$$\begin{aligned} infochoice_i = & \beta_0 + \beta_1 identity_i + \beta_2 hist_i + \beta_3 OK_pct_i + \beta_4 age_i + \beta_5 gen_i \\ & + \beta_6 inc_i + \beta_7 educ_i + \varepsilon_i \quad \dots\dots\dots (VIII) \end{aligned}$$

Since $hist_i$ and OK_pct_i predict $identity_i$ at the one-percent level of significance (as seen in section 3.3(a)), we exclude these variables from our final model. Although gen_i is also significantly correlated with $identity_i$, we still include it in the final model as it is a key demographic variable.

A binary logistic regression model of the following form was used as the final model for this study to test and analyze the data:

$$\begin{aligned} infochoice_i = & \beta_0 + \beta_1 identity_i + \beta_2 age_i + \beta_3 gen_i \\ & + \beta_4 inc_i + \beta_5 educ_i + \varepsilon_i \quad \dots\dots\dots (IX) \end{aligned}$$

Here, for the dependent variable *infochoice*, the category “Benefits of following a gluten-free diet” was assigned a value of 1 and the combined category “Both benefits and costs of following a gluten-free diet” was assigned a value of 0. The dependent variables age_i , gen_i , inc_i , $educ_i$ and $identity_i$ represent age, gender, household income, level of education and whether an individual identifies as gluten-free (yes=1) for respondent i respectively. The value and sign of the estimated coefficients (the β s) illustrate the way in which the independent variables affect the dependent variable. The results from these models are discussed in the summarized and discussed in the next chapter.

CHAPTER 3: RESULTS

Table 3 summarizes the results for logistic regressions with *infochoice* as the dependent variable. The first three regressions IV, V and VI indicate the individual impact of *identity*, *hist* and *OK_pct* on the dependent variable *infochoice*. Out of the three variables, *identity* and *hist* positively impact *infochoice*, indicating that if an individual identifies as gluten-free (regression IV) or is currently following a gluten-free/reduced-gluten diet (regression V), then she is more likely to read about the benefits of following a gluten-free diet. *OK_pct* on the other hand negatively impacts *infochoice*, indicating the more a person knows about the gluten and the gluten-free diet, the less likely he is to read about the benefits of following a gluten-free diet. All of these three coefficients are however not significant – which means that their impacts are equivalent to zero. Regression VII considers the three variables altogether. The impact of each variable on *infochoice* is quite stable even when controlling for the effect of the other variables. Regression VIII looks into the impact of all the key variables considered on *infochoice*. Since *identity* is significantly influenced by *hist* and *OK_pct* (as shown in section 2.2(a)), we exclude them from Regression IX – which is the final model that we use for our study.

Focusing on the results of regression IX, *identity* impacts *infochoice* positively, although not significantly. The estimated coefficient for *identity* is consistent across all the regressions. Among the demographic variables, both the coefficients for age and household income are negative and significantly impact the choice of reading the benefits

of following a gluten-free diet. None of the other variables significantly impacts

infochoice_i.

Table 3: Regression results models IV - IX to understand the determinants of information choice

Independent Variable	Coefficients					
	Model IV	Model V	Model VI	Model VII	Model VIII	Model IX
Identity: Yes	0.26 (0.19)			0.23 (0.20)	0.22 (0.21)	0.27 (0.19)
Age					-0.014** (0.005)	-0.014** (0.005)
Gender: Female					0.07 (0.17)	0.08 (0.16)
Household Income					-0.004* (0.002)	-0.004* (0.002)
Education					0.06 (0.04)	0.06 (0.04)
History of following a low-gluten/gluten-free diet: Currently following		0.12 (0.18)		0.06 (0.19)	0.12 (0.19)	
Objective Knowledge			-0.003 (0.004)	-0.002 (0.004)	-0.001 (0.005)	
Constant	0.48*** (0.09)	0.51** (0.09)	0.65*** (0.20)	0.57** (0.21)	0.51 (0.56)	0.50 (0.56)
Observations	711	711	711	711	695	695

Log Likelihood	-466.39	-467.17	-467.23	-466.22	-451.96	-452.16
AIC	936.78	938.33	938.45	940.44	919.91	916.31
*** significant at 1 percent level of significance ** significant at 5 percent level of significance * significant at 10 percent level of significance						

To interpret the coefficients of the regressions in terms of probabilities, we calculated the marginal effects for all the models in Table 3, which are reported in Table 4. From the marginal effects for model IV, if an individual identifies as gluten-free, the probability for him to opt to read about the benefits of following a gluten-free diet is higher compared to an individual who does not identify as gluten-free by 11.2 percentage points. For the other models, the magnitudes of the marginal effects of all the variables are relatively small compared to *identity*. For the final model, the marginal effect for *identity* is the highest and indicates that if a person identifies as gluten-free, they are six percentage points more likely to choose to read the benefits of following the gluten-free diet. Similarly, a woman is 1.7 percentage points more likely and an individual who has one more year of education is 1.3 percentage points more likely to read about the benefits of following the gluten-free diet. All these effects are however not significantly different. On the other hand, with an increase in age by a year and an increase in income by a thousand dollars, an individual is 0.3 and 0.1 percentage points less likely to read about the benefits of the gluten-free diet.

Table 4: Marginal Effects for regressions IV – IX to understand the determinants of information choice

Independent Variable	Marginal Effects					
	IV	V	VI	VII	VIII	IX
Identity: Yes	0.061			0.054	0.051	0.061
Age					-0.003	-0.003
Gender: Female					0.017	0.017
Household Income					-0.001	-0.001
Education					0.013	0.013
History of following a low-gluten/gluten-free diet: Currently following		0.028		0.014	0.027	
Objective Knowledge			-0.0005	-0.0005	-0.0002	
Constant	0.112	0.119	0.152	0.133	0.118	0.115

CHAPTER 4: DISCUSSION AND CONCLUSION

The results obtained from this study have interesting implications for studies involving identity and information seeking behavior as well as for understanding human behavior. Looking at the impact of identity on valence of information choice, the results do not significantly support our hypothesis: an individual who identifies as gluten-free will choose to read about the benefits of following a gluten-free diet.

An observation from this study is that among the people who identified as gluten-free, there were people who just try to reduce their gluten-consumption and not completely avoid it, i.e. they followed a low-gluten diet instead of a gluten-free one. We also observed some of the people who had tried the gluten-free diet before and not currently on it also claimed that being gluten-free is an important part of their identity.

A limitation of our study is that the definition of identity studied here includes both medically and self-diagnosed identities of gluten-intolerance/sensitivity. We also did not control for subjective knowledge of an individual — how knowledgeable a person might feel he is — in our study, and this might impact the valence of information chosen to be read by an individual. Considering all these limitations, an extension of this research would be to see how reading various aspects of information influence pre-existing and mistaken beliefs among consumers about the gluten-free diet. The limitations also suggest an avenue for new research with the aim of elucidating the factors that determine the identity of a person as gluten-free. Determining the factors would give us an insight as to why the rules around identifying as gluten-free are flexible for an individual.

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APPENDIX I – SURVEY QUESTIONNAIRE

DEMOGRAPHICS

1. Age (*Please select one*)
 1. Under 19
 2. 19-24
 3. 25-34
 4. 35-44
 5. 45-54
 6. 55-64
 7. 65 and older
 8. Prefer not to answer

2. Gender (*Please select one*)
 1. Female
 2. Male
 3. Prefer not to answer

3. Ethnicity (*Please select all that apply*)
 1. White
 2. Hispanic or Latino
 3. Black or African American
 4. Native American of American Indian
 5. Asian or Pacific Islander
 6. Other
 7. Prefer not to answer

4. Household Income (*Please select one*)
 1. Less than \$20,000
 2. \$20,000 - \$39,999
 3. \$40,000 – \$59,999
 4. \$60,000 – \$79,999
 5. \$80,000 – \$99,999
 6. \$100,000 or more
 7. Prefer not to answer

5. Education completed (*Please select one*)
 1. Less than high school
 2. High school/G.E.D.
 3. Some college/associate degree
 4. Bachelor’s degree

5. Advanced degree (M.B.A., M.D., J.D., M.S., M.A., Ph.D.)
6. Prefer not to answer

5b. Please tell us which state you currently live in. (*Select one*)

6a. Height ____ feet ____ inches

6b. Weight ____ pounds

SHOPPING PRACTICES

7. How frequently do you look at the following information when purchasing a food product? (*Please select one per row*)

	Never 0	Rarely 1	Sometimes 2	Usually 3	Always 4
1. Ingredients list					
2. Nutritional Information					
3. Certification Logos (e.g. Organic, GMO-Free, Gluten-Free, etc.)					
4. Price					

8. How frequently do you consume bread, pasta, cereal, crackers, and/or bakery items? (*Please select one*)

1. Never to a few times a year
2. A few times a month
3. A few times a week
4. Once a day
5. Multiple times a day

9. How often do you **consume** gluten-free foods that have gluten and gluten-free variants? (*Please select one*)

1. Never (0 percent of the time)
2. Rarely (25 percent of the time)
3. Sometimes (50 percent of the time)
4. Usually (75 percent of the time)

5. Always (100 percent of the time)

10. Think of the most recent time you consumed a gluten-free product that has a conventional (gluten-containing) counterpart. What influenced you to choose the gluten-free version rather than the conventional version? Select all that apply.
1. I am gluten sensitive
 2. I have been diagnosed with Celiac Disease
 3. I was advised to eat gluten-free by a health professional
 4. After comparing the nutrition facts panel, the gluten-free version was healthier
 5. Gluten-free products are healthier
 6. The gluten-free version was cheaper
 7. The gluten-free version is tastier
 8. I wanted to try a new product
 97. Other (please specify _____)
 98. I do not know
 99. I have never consumed gluten free products.
11. A gluten-reduced product is a food product that is not free from gluten but does contain less gluten than its conventional, gluten-containing, version. Answer the following two questions based on your own opinion. *Select one per row.*

	Yes 1	No 2	I do not know 98
1. Would you be interested in purchasing gluten-reduced products?			
2. Do you think other consumers would be interested in purchasing gluten-reduced products?			

PERSONAL DIET HISTORY

The following questions are based on your personal diet experience. There are no right or wrong answers.

12. Select how much you agree or disagree with this statement: My eating habits are very healthy. *Select one.*

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

13. Have you ever tried the following diets? *Please select one response per row.*

	Never tried 0	Not currently following, but followed in the past 1	Currently following 2
1. Pescatarian			
2. Vegetarian, Vegan			
3. Gluten-free diet			
4. Low-gluten diet or avoid, but not completely remove, gluten			
5. Low FODMAP			
6. Ketogenic “Keto” diet (High fat, low carbohydrate diet)			
7. Atkins diet (High protein, low carbohydrate)			
8. Paleo or “caveman diet”			
9. Alkaline diet			
10. Military or Israeli Army diet			
11. Mediterranean diet			
12. Baby Food diet			
13. Whole 30 diet			

14. Liquid diet including juice fasting			
15. South Beach diet			
16. Grapefruit “Hollywood” diet			
17. DASH diet			
18. Blood type diet			
19. Cabbage soup diet			
20. KE diet or feeding tube diet			

14. <Q13 response 3 and 4 = 0>

Is there a reason you have never tried a gluten-free or low-gluten diet? *Select all that apply.*

1. I have never considered it
2. I do not feel a need to be on a diet
3. I have no gluten-related health concerns
4. I do not think that reducing gluten consumption is beneficial for my health
5. Gluten-free products are too expensive
6. I do not think gluten-free products taste as good as conventional (gluten-containing) versions
7. I do not want to avoid gluten
8. It is too inconvenient to avoid eating gluten
9. I do not know enough about the diet
10. I have never heard of the diet
97. Other (please specify _____) <SKIP TO Q18>

15. <Q13 response 3 or 4 = 1 or 2>

How many times have you followed a GF/Low-Gluten diet? *Please select one.*

<INSERT DROP DOWN WITH 1-5 AND 5+>

16. <Q13 response 3 or 4 = 1 or 2>

What was the longest period of time you followed a GF/Low-Gluten diet? *Please select one.*

1. Less than 2 weeks

2. More than 2 weeks - 1 month
3. More than 1 month - 3 months
4. More than 3 months - 6 months
5. More than 6 months - 1 year
6. More than 1 year

17. <Q13 response 3 or 4 = 1 or 2> How frequently do/did you **knowingly** consume gluten when you intend to be eating a gluten-free diet? If you are not currently on the diet but have in the past, base your answer on your most recent successful duration of the diet. This does not include accidental consumption of gluten. *Please select one.*

1. At least once a week
2. Once every two weeks
3. Once a month
4. Less than once every month - 6 months
5. Less than once every 6 months
6. I have never knowingly broken the diet
7. I do not recall

18. When you consume foods that contain gluten, what symptoms do you experience? *Select all that apply.* <RANDOMIZE>

1. Acne or facial breakout
2. Acid Reflux
3. Abdominal pain
4. Bloating or inflammation
5. Body aching (including muscle or joint discomfort)
6. Diarrhea or constipation
7. Nausea
8. Headache or migraine
9. Brain fog
10. Fatigue or lack of energy
11. Seasonal allergies
12. Painful menstrual periods
97. Other (please specify _____)
98. I do not recall or I do not know
99. I do not experience any symptoms

19. <IF Q18 response 98 or 99 selected skip to Q20>

A. How much of a gluten-containing food does it take for you to experience symptoms? *Select one.*

1. A few crumbs of a gluten-containing food
2. A cracker size amount of a gluten-containing food
3. A bread slice amount of a gluten-containing food

4. A meal entree of a gluten-containing food

B. How severe are your symptoms when you consume that amount? *Select one.*

5. Very severe
6. Somewhat severe
7. Average
8. Not severe
9. Felt no change
10. I do not recall

20. *<IF Q17 = 1, 2, 3, 4, 5, or 7, ask Q20, else skip to Q21>*

What was the reason for consuming gluten when you intended to be avoiding gluten in your diet? *Select all that apply.* *<RANDOMIZE>*

1. I was taking a “break” from the diet
2. I occasionally treat myself to a gluten-containing product
3. There were no other food options
4. I was craving something that contained gluten
5. I did not want to cause inconvenience to others
6. Religious reasons
97. Other (please specify _____)
99. I do not know

21. *<IF Q13 row 3 or 4 = 1 ask 21, else skip to text before Q22>*

What are that reasons you decided to stop avoiding gluten? *Select all that apply.*

<RANDOMIZE>

1. I saw no improvements after going on the diet
2. Gluten-free products were too expensive
3. I lost motivation or interest in avoiding gluten
4. I reached my health goal so I went off the diet
5. I no longer believed it was helpful for my health issues or desires
6. I felt that it was too inconvenient or too difficult to eat gluten-free
7. I felt that the diet was decreasing my health
8. I missed eating foods that contain gluten
9. I found out that I was not sensitive to gluten
97. Other (please specify _____)
98. I do not know

BELIEF

The following questions are about your personal beliefs about gluten and gluten-free diets. There are no right or wrong answers.

22. What percent of people in the United States do you think *are* avoiding or eliminating gluten from their diets? *Please select one.*

1. Less than 1%
2. 1%-10%
3. 11%-20%
4. 21%-30%
5. 31%-40%
6. 41%-50%
7. <include a drop down menu with 51-100%>
8. I do not know

23. What percent of people in the United States do you think *should be* avoiding or eliminating gluten from their diets? *Please select one.*

1. Less than 1%
2. 1%-10%
3. 11%-20%
4. 21%-30%
5. 31%-40%
6. 41%-50%
7. <include a drop down menu with 51-100%>
8. I do not know

24. We would like to know your opinion about the following statements. Please indicate whether you agree, disagree or do not have an opinion about the statement. *Please select one per row.*

<RANDOMIZE>	Strongly Agree 1	Agree 2	No opinion 3	Disagree 4	Strongly disagree 5
1. Wheat allergy and celiac disease are the same thing					
2. The gluten-free diet is only beneficial for people suffering from celiac disease or non-celiac gluten sensitivity.					

3. The gluten-free diet can prevent the development of celiac disease or non-celiac gluten sensitivity.					
4. Gluten can cause diseases in non-gluten sensitive people.					
5. In general, a gluten-free or gluten-reduced diet is healthier for people than a full-gluten containing diet.					
6. Gluten-free products are generally more nutritious than their gluten-containing variant.					
7. Gluten is only present in bread, bakery items, pasta, and crackers.					
8. Occasionally there will be a survey respondent who will attempt to rush through a survey by submitting answers without reading the questions. To help us ensure the accuracy of your survey, please select "No opinion" for this row.					
9. "Wheat-free" and "gluten-free" are interchangeable terms.					
10. It is deceptive for a food company to label a food gluten-free when the original product is naturally gluten-free.					
11. Gluten should be listed as an allergen on food packages.					

25. Fill in each blank below comparing whole wheat bread to gluten-free bread. *Please select one per row.*

<RANDOMIZE>	Fewer/Less	Equal	More
-------------	------------	-------	------

	1	amounts of 2	3
1. Whole wheat bread typically contains (____) calories than gluten-free bread.			
2. Whole wheat bread typically contains (____) fat than gluten-free bread.			
3. Whole wheat bread typically contains (____) sodium than gluten-free bread.			
4. Whole wheat bread typically contains (____) fiber than gluten-free bread.			
5. Whole wheat bread typically contains (____) protein than gluten-free bread.			
6. Whole wheat bread typically contains (____) vitamins and minerals than gluten-free bread.			

26. To what extent do you believe a gluten-free diet can help with the following health issues? *Please select one per row.*

<RANDOMIZE>	Disbelieve	Somewhat Disbelieve	Neutral	Somewhat Believe	Believe
1. Acne					
2. Chronic stomach pain, bloating, inflammation or acid reflux					
3. Chronic constipation or diarrhea					
4. Bone Loss (Osteoporosis or osteopenia)					
5. Fatigue or low energy					
6. Ability to lose weight					

7. Celiac Disease					
8. Tingling, numbness or pain in the hands and feet (Peripheral neuropathy)					
9. Seasonal allergies					
10. Infertility or recurrent miscarriage					
11. Painful menstrual periods					
12. High cholesterol					
13. Headaches, migraines, or brain fog					
14. Nausea					
15. Depression or anxiety					
16. Cancer					

KNOWLEDGE

Answer the following questions to the best of your ability.

26. Please mark how much you agree with the following statements. *Please select one per row.*

<RANDOMIZE>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	5	4	3	2	1
“I have a lot of knowledge about <u>nutrition.</u> ”					
“I have a lot of knowledge about <u>gluten.</u> ”					
I have a lot of knowledge about <u>grain-based products.</u>					

27. Which is the healthiest fat to consume? *Please select one.* <RANDOMIZE>
1. Saturated fat
 2. Unsaturated Fat
 3. Trans fat
 4. All fat is bad
 99. None of the above
28. Which is a good source of Vitamin D? *Please select one.* <RANDOMIZE>
1. Cheese
 2. Fatty Fish
 3. Vegetables
 4. Liver
 99. None of the above
29. What are the 3 macronutrients? *Please select one.* <RANDOMIZE>
1. Fat, Sugar, Protein
 2. Fat, Carbohydrates, Protein
 3. Fiber, Sugar, Salt
 4. Vitamin A, B, C
 99. None of the above
30. The American Heart Association suggests people should consume less than (____) mg of sodium in a day? *Please select one.*
1. 2300 mg
 2. 2500 mg
 3. 3500 mg
 4. 5000 mg
 99. None of the above
31. Which of these is not considered a nutrient? *Please select one.* <RANDOMIZE>
1. Vitamins
 2. Minerals
 3. Fiber
 4. Fats
 99. None of the above
32. All foods with carbohydrates contain gluten. *Please select one.*
1. True
 2. False
 97. I am not sure

33. Complete the sentence. Gluten is (____). *Please select one.* <RANDOMIZE>

1. a fat
2. a preservative
3. an artificial sugar
4. a protein
5. a genetically modified organism (GMO)

34. Does this product have gluten in it? *Please select one per row.*

<RANDOMIZE>	Yes 1	No 2	I am not sure 97
Ingredients: Organic Whole Grain Wheat Flour, Canola Oil, Salt, Sugar, Cornstarch, Maple Syrup, Natural Flavor, Vitamin E			
Ingredients: Beef Broth, Beans, Rice, Tomatoes, Celery, Onion, Salt			
Ingredients: Vegetable Stock, Lentils, Barley, Tomato, Carrots, Celery, Onion, Salt			
Ingredients: Quinoa, Spelt, Amaranth, Peanuts, Date, Cane Sugar, Cocoa Powder			
Ingredients: Buckwheat, Peanuts, Date, Cane Sugar, Cocoa Powder			

35. Please choose the correct definition of **celiac disease**. *Please select one.*

<RANDOMIZE>

1. A modern disease that attacks the gastrointestinal system that arises from the consumption of genetically modified foods and the use of pesticides
2. A contagious bacterial disease similar to a cold
3. An autoimmune disorder where the gastrointestinal system becomes inflamed and damaged
4. A virus transported by animals that attacks the gastrointestinal system
97. I do not know <ANCHOR >

36. What percent of people around the world have celiac disease? *Please select one.*

1. Less than 1%
2. 1%-10%
3. 11%-20%

4. 21%-30%
5. 31%-40%
6. 41%-50%
7. <include a drop down menu with 51-100%>
97. I do not know

37. In the United States, are there GMO wheat varieties? *Please select one.*

1. Yes
2. No
97. I am not sure

38. Which grain provides a complete source of protein (contains all of the essential amino acids)? *Please select one.* <RANDOMIZE>

1. Brown Rice
2. Oats
3. Sprouted wheat
4. Quinoa
99. None of the above

39. Whole grains help to reduce your risk of which disease? *Please select one.*

<RANDOMIZE>

1. Diabetes
2. Stroke
3. Heart Disease
4. Hypertension
5. All of the above

40. Which of the following is not a whole grain? *Please select one.* <RANDOMIZE>

1. Sprouted Wheat
2. Popcorn
3. Oats
4. Quinoa
5. All of the above <ANCHOR >

41. What nutrient is lost during the processing of refined wheat products before any enrichment or fortification is added? *Please select one.* <RANDOMIZE>

1. Iron
2. Vitamin D
3. Vitamin A
4. Sodium
5. All of the above <ANCHOR >

CELIAC SOURCE/DIAGNOSIS

The following questions are about your personal health experience. There are no right or wrong answers.

42. How satisfied are you with your current health status? *Please select one.*

1. Not Satisfied
2. Somewhat Unsatisfied
3. Neutral
4. Somewhat Satisfied
5. Satisfied
6. Prefer not to answer

43. Do you or have you experienced any of the following health conditions? *Please select all that apply.* <RANDOMIZE>

1. Acne
2. Acid reflux or heartburn
3. Chronic stomach pain
4. Chronic bloating or inflammation
5. Chronic diarrhea
6. Chronic constipation
7. Bone Loss (osteoporosis or osteopenia)
8. Chronic fatigue or lack of energy
9. Unexplained iron-deficiency anemia
10. Unexplained weight gain or weight loss
11. Tingling, numbness or pain in the hands and feet (peripheral neuropathy)
12. Seasonal allergies
13. Joint (arthritis)
14. Infertility or recurrent miscarriage
15. Painful menstrual periods
16. High cholesterol
17. Recurring headaches, migraines, nausea, or brain fog
18. Depression or anxiety
19. Canker sores inside the mouth
20. Itchy skin rash (dermatitis herpetiformis)
99. None of the above <ANCHOR, EXCLUSIVE >

44. <IF 99 SELECTED IN 43, SKIP TO 45, ELSE ASK 44> How much has this condition affected your wellbeing? *Please select one per row.*

	Severely for a long period of time 1	Severely for a short period of time 2	Moderately for a long period of time 3	Moderately for a short period of time 4	Lightly for a long period of time 5	Lightly for a short period of time 6
<INSERT SELECTIONS FOR 43>						

45. <IF Q13 row 3 or 4 = 1 or 2 ask 45, else skip 46>

Did limiting or avoiding gluten help you with any of the following health issues? *Please select one per row.*

	Yes 1	No 2	I am not sure 3
<INSERT SELECTIONS FOR 43>			

46. Have you been tested for celiac disease? *Please select one.*

1. Yes
2. No

47. <IF 46 = 1 ASK 47, ELSE SKIP TO 48>

What was the diagnosis? *Please select one.*

1. Celiac disease
2. Non-celiac gluten sensitivity
3. Other
4. No condition
98. I am not sure
99. Prefer not to answer

48. <IF 46 = 2 ASK 48, ELSE SKIP TO 49>

Is there a reason you have not been tested for celiac disease? *Select all that apply.*

<RANDOMIZE>

1. I am not familiar with celiac disease or non-celiac gluten-sensitivity
2. I am avoiding gluten for reasons other than celiac disease
3. I have not experienced symptoms that indicate I might have celiac disease
4. The testing would have been too expensive, time-consuming, and or invasive
5. I can determine if I feel better on a gluten-free diet without an official diagnosis from a health professional
97. Other (please specify _____) <ANCHOR>
98. I am not sure<ANCHOR, EXCLUSIVE >

<IF 14 = 1,2,3,4,5,6,7,8,9, or 97 OR if Q13_4 = 1 or 2 or if Q13_3 = 1 or 2 ask Q49
Else skip to Q50>

49. Where have you heard of the gluten-free diet? *Select all that apply.* <RANDOMIZE>

1. Healthcare center or health professional (doctor, dietitian, etc.)
2. Wellness coach, personal trainer, and or sports coach/Nutrition/Fitness shop or gym employee
3. Family member or friend
4. Blogs, video blogs, forums, social media, television talk shows
5. Published book or magazine article
6. Self (including through personal research)
97. Other (please specify _____) <ANCHOR>
98. I do not recall <ANCHOR, EXCLUSIVE >

50. Who, if anyone, has suggested that you try a gluten-free diet? *Select all that apply.*

<RANDOMIZE>

1. Healthcare center or health professional (doctor, dietitian, etc.)
2. Wellness coach, personal trainer, and or sports coach/Nutrition/Fitness shop or gym employee
3. Online checklist suggested I try it
4. Family member or friend
5. TV personality, blogger, video blogger, and or celebrity
6. Self (including through personal research)
97. Other (please specify _____)
7. No one has ever suggested that I try a gluten-free diet
98. I do not recall

51. How trustworthy do you think the following sources are for diet and nutrition information? *Select one per row.*

	Untrustworthy 1	Somewhat Untrustworthy 2	Neutral 3	Somewhat Trustworthy 4	Trustworthy 5
1. Doctors					
2. Dietitians					
3. Wellness coach, personal trainer, and or sports coach/Nutrition/Fitness shop or gym employee					
4. Food or health bloggers					
5. Food activists					
6. Family member or friend					
7. Blogs, video blogs, forums, social media, television talk shows					
8. Government organizations (ex. FDA, USDA)					
9. Large food corporations					
10. Small food corporations					
11. Public research (funded by the government or a university etc.)					

12. Private research (funded by the food industry)					
13. Diet/nutrition books					

52. What sources of information about the gluten-free diet do or would you value most?

Select all that apply. <RANDOMIZE>

1. Healthcare center or health professional (doctor, dietitian, etc.)
2. Wellness coach, personal trainer, sports coach, or nutrition/fitness shop
3. Family member or friend
4. Medical center website (eg. MayoClinic)
5. Company or organization website (eg. Celiac.org)
6. Published books or magazine articles
7. Social media, blog, video blog, or forum
8. TV Talk Shows or celebrities (e.g., The Doctors, Dr. Oz, CNN Paging Dr. Gupta, E news etc.)
9. Documentary
97. Other (please specify _____) <ANCHOR>
98. I do not recall <ANCHOR, EXCLUSIVE>

<IF Q13 response 3 or 4 = 1 or 2 ASK Q53, ELSE SKIP TO TEXT BEFORE Q54>

53. Do you agree with the following statement? “Being gluten-free is an important part of my identity.” *Select one.*

1. Yes
2. No

Next, you will have the opportunity to read a short summary of scientific evidence on the relationship between gluten and health.

54. What aspects of the relationship between the gluten free diet and health would you like to read about? *Select one.* <RANDOMIZE>

1. Benefits of following a gluten-free diet
2. Costs of following a gluten-free diet
3. Both the benefits and costs of following a gluten-free diet

<IF 1 SELECTED IN Q54, DISPLAY TEXT BELOW>

Potential benefits of the gluten-free diet:

While it is critical for individuals with celiac disease to follow a gluten-free diet (GFD), many people who do not have celiac disease have started to consume gluten-free products. There may be health benefits from a gluten-free diet for people who do not have celiac disease. Groups of individuals who do not have celiac disease but that may nonetheless benefit from following a gluten-free diet are described below. The benefits to these groups have been identified through scientific research.

- **IBS:** Individuals who suffer from irritable bowel syndrome (IBS) may experience alleviation of symptoms including abdominal pain, bloating, frequent bowel movements, and inflammation of the gut if they eliminate gluten from their diet.
- **Atopy:** Atopy is a genetic disposition to develop allergic diseases. One study has been conducted on the link between atopy and the GFD. It found that one-third of patients following a GFD experienced improvements in gastro-intestinal and atopic symptoms. These patients were not tested for wheat allergies, so it is unclear whether the improvement was due to elimination of gluten or other wheat components.
- **Non-celiac gluten sensitivity (NCGS):** A diagnosis of NCGS has often been given to individuals who do not have celiac disease but do respond to elimination of gluten from their diet. Studies have found that individuals with NCGS improve with elimination of wheat products—which cuts gluten out of the diet—though there is some question as to whether elimination of gluten or other components of wheat drives the improvement.
- **Fibromyalgia:** One study has been conducted on the GFD and symptoms of fibromyalgia, a disorder characterized by widespread musculoskeletal pain accompanied by fatigue, sleep, memory, and mood issues. Individuals were either placed on a GFD or a hypocaloric (≤ 1500 cal/day) diet. The GFD and hypocaloric diet improved symptoms of fibromyalgia and gluten sensitivity.
- **Endometriosis:** Two studies have examined the effect of a GFD on women with endometriosis and chronic pelvic pain. Both studies found an improvement in pain scores when women followed a GFD.

Reference:

Niland, B., & Cash, B. D. (2018). Health Benefits and Adverse Effects of a Gluten-Free Diet in Non-Celiac Disease Patients. *Gastroenterology & hepatology*, 14(2), 82-91.

<IF 2 SELECTED IN Q54, DISPLAY TEXT BELOW>

Potential costs of the gluten-free diet:

While it is critical for individuals with celiac disease to follow a gluten-free diet (GFD), many people who do not have celiac disease have started to consume gluten-free products. There may be drawbacks to following a gluten-free diet for individuals who do not have celiac disease. The following are potential drawbacks of following a gluten-free diet for non-celiac patients, which have been identified through scientific research.

- Under-consumption of important dietary components: Research on people following a GFD shows that that people consume lower amounts of important nutrients, such as calcium, folate, iron, and niacin; carbohydrates; and fiber than are recommended, which can have negative health consequences.
- Overconsumption of certain nutrients: Research on people following a GFD found that they consume higher amounts of fats, including saturated fats; cholesterol; and sodium than are recommended. Overconsumption of fats, cholesterol, and sodium can have negative health consequences.
- Disease risks: A study found a negative relationship between gluten consumption and two negative health outcomes: coronary artery disease and heart attacks. This means that the more gluten-containing products an individual consumed, the less likely they were to suffer from coronary artery disease or have a heart attack. Avoiding gluten may eliminate healthy whole grains from the diet; low consumption of whole grains has been linked with coronary artery disease.
- Cost: A few studies have examined the costs of GF versus gluten-containing foods. All studies found that GF foods are significantly more expensive than conventional versions of the same foods.
- Misconceptions about benefits of the GFD: Some people choose to follow a GFD under the impression that it will offer general health benefits, such as weight loss and improved athletic performance. There is no scientific evidence that suggests that the GFD leads to weight loss or improved athletic performance.
- Other complications: A few studies have found that individuals following a GFD report complications related to increased time spent finding and preparing foods that are GF, avoiding eating in restaurants, and finding appropriate foods while traveling, which may affect quality of life.

Reference:

Niland, B., & Cash, B. D. (2018). Health Benefits and Adverse Effects of a Gluten-Free Diet in Non-Celiac Disease Patients. *Gastroenterology & hepatology*, 14(2), 82-91.

<IF 3 SELECTED IN Q54, DISPLAY TEXT BELOW>

Potential benefits and costs of the gluten-free diet:

While it is critical for individuals with celiac disease to follow a gluten-free diet, many people who do not have celiac disease have started to consume gluten-free products. The gluten-free diet may have both benefits and drawbacks for people who do not suffer from celiac disease. The following information has been summarized from a scientific research article.

Potential benefits of following a gluten-free diet in non-celiac patients include:

- IBS: Individuals who suffer from irritable bowel syndrome (IBS) may experience alleviation of symptoms including abdominal pain, bloating, frequent bowel movements, and inflammation of the gut if they eliminate gluten from their diet.

- **Atopy:** Atopy is a genetic disposition to develop allergic diseases. One study has been conducted on the link between atopy and the GFD. It found that one-third of patients following a GFD experienced improvements in gastro-intestinal and atopic symptoms. These patients were not tested for wheat allergies, so it is unclear whether the improvement was due to elimination of gluten or other wheat components.
- **Non-celiac gluten sensitivity (NCGS):** A diagnosis of NCGS has often been given to individuals who do not have celiac disease but do respond to elimination of gluten from their diet. Studies have found that individuals with NCGS improve with elimination of wheat products—which cuts gluten out of the diet—though there is some question as to whether elimination of gluten or other components of wheat drives the improvement.
- **Fibromyalgia:** One study has been conducted on the GFD and symptoms of fibromyalgia, a disorder characterized by widespread musculoskeletal pain accompanied by fatigue, sleep, memory, and mood issues. Individuals were either placed on a GFD or a hypocaloric (≤ 1500 cal/day) diet. The GFD and hypocaloric diet improved symptoms of fibromyalgia and gluten sensitivity.
- **Endometriosis:** Two studies have examined the effect of a GFD on women with endometriosis and chronic pelvic pain. Both studies found an improvement in pain scores when women followed a GFD.

Potential costs of following a gluten-free diet in non-celiac patients include:

- **Under-consumption of important dietary components:** Research on people following a GFD shows that that people consume lower amounts of important nutrients, such as calcium, folate, iron, and niacin; carbohydrates; and fiber than are recommended, which can have negative health consequences.
- **Overconsumption of certain nutrients:** Research on people following a GFD found that they consume higher amounts of fats, including saturated fats; cholesterol; and sodium than are recommended. Overconsumption of fats, cholesterol, and sodium can have negative health consequences.
- **Disease risks:** A study found a negative relationship between gluten consumption and two negative health outcomes: coronary artery disease and heart attacks. This means that the more gluten-containing products an individual consumed, the less likely they were to suffer from coronary artery disease or have a heart attack. Avoiding gluten may eliminate healthy whole grains from the diet; low consumption of whole grains has been linked with coronary artery disease.
- **Cost:** A few studies have examined the costs of GF versus gluten-containing foods. All studies found that GF foods are significantly more expensive than conventional versions of the same foods.
- **Misconceptions about benefits of the GFD:** Some people choose to follow a GFD under the impression that it will offer general health benefits, such as weight loss and improved athletic performance. There is no scientific evidence that suggests that the GFD leads to weight loss or improved athletic performance.

- Other complications: A few studies have found that individuals following a GFD report complications related to increased time spent finding and preparing foods that are GF, avoiding eating in restaurants, and finding appropriate foods while traveling, which may affect quality of life.

Reference:

Niland, B., & Cash, B. D. (2018). Health Benefits and Adverse Effects of a Gluten-Free Diet in Non-Celiac Disease Patients. *Gastroenterology & hepatology*, 14(2), 82-91.

Now that you have read the information you selected, we would like to ask you one short follow-up question before we end the survey.

55. We would like to know your opinion about the following statements. Please indicate whether you agree, disagree or do not have an opinion about the statement. *Select one per row.*

<RANDOMIZE>	Strongly Agree 1	Agree 2	No opinion 3	Disagree 4	Strongly disagree 5
In general, a gluten-free or gluten-reduced diet is healthier for people than a full-gluten containing diet.					
A gluten-free diet is a good option for weight loss.					
The gluten-free diet is only beneficial for people suffering from celiac disease or non-celiac gluten sensitivity.					

RESPONDENT SATISFACTION QUESTIONS

RS1. Did you experience any problems or difficulties while taking this survey? (*Select one*)

1. Yes
2. No

<SHOW RS2 IF RS1=1>

RS2. Which of the following problems/difficulties did you experience while taking this survey? *(Select all that apply)* <RANDOMIZE>

1. Pages slow to load
2. Received 'Error 500' message
3. Typos
4. Questions are too personal
5. Difficulty answering questions (questions were not clear) (please specify_____)
6. Difficulty answering questions (technical difficulty) (please specify_____)
7. Other, please specify_____

Thank you for your time & your valuable input!

APPENDIX II - Transformation of categorical variables for data analysis

Most of the variables considered in our study were categorical variables. In order to reduce the number of categories in each variable, we chose to transform the data for some of the variables. The transformed variables were used in analyzing the data.

The variable for age was converted to a numeric variable by assigning the midpoint for each category as a respondent's age in the final analysis. For example, an individual whose age fell in ... i.e. the values 21.5, 29.5, 39.5, 49.5, 59.5 were used for the categories 19-24, 25-34, 35-44, 45-54, 55-64 years respectively and the value of 70 was used for the age category of 65 years and older.

A similar approach was adopted for the variable of household income. The numeric values of \$20000, \$30000, \$50000, \$70000, \$90000 and \$125000 were used for the corresponding categories of household incomes less than \$20000, \$20000 to \$39999, \$40000 to \$59999, \$60000 to \$79999, \$80000 to \$99999 and \$100000 and above respectively.

The variable for education was also transformed into a numeric variable by considering the minimum number of years of education required for each category. i.e. the values 10, 12, 14, 16 and 19 were used for the categories Less than high school, High school/G.E.D., Some college/associate degree, Bachelor's degree and Advanced degree (M.B.A., M.D., J.D., M.S., M.A., Ph.D.) respectively.