Information sources and consumer attitudes toward genetically modified food in China

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Abstract

Purpose – The purpose of this paper is to analyze the impact of different information source on consumer attitudes toward genetically modified food.

Design/methodology/approach – The data used in this study are obtained from a large-scale nationwide consumers' survey in urban China conducted by the China Center for Agricultural Policy, Peking University, in 2020. A descriptive analysis between information sources and consumer attitudes toward GM food was conducted. Based on the collected data, an econometric model on the determinants of consumer attitudes was constructed and used for analysis.

Findings – This study shows that the impact of new media is currently no different than that of traditional media, indicating that the media campaign successfully reduced the spread of rumors and misinformation regarding GM food. Moreover, this study also shows that consumers whose main information source regarding GM foods is school hold more positive feelings toward such food.

Originality/value – This study contributes to the existing literature by examining the impact of information source on consumer attitudes toward GM food. To reverse consumers' negative attitudes, China has launched a widespread media campaign since the first decade of the 2000s. Results of this study show that authorities' efforts to manage and surveil new media have yielded the desired outcome.

Keywords Genetically modified food, New media, Traditional media, Consumer attitudes, China

Paper type Research paper

1. Introduction

Information sources play an important role in consumers' attitudes toward genetically modified (GM) food (Bredahl *et al.*, 1998; Frewer *et al.*, 2003; Rousu *et al.*, 2004; Miles *et al.*, 2005; Costa-Font *et al.*, 2008; Wunderlich and Gatto, 2015), and this determination has been confirmed in the context of China (Hu *et al.*, 2006). For instance, based on data collected in China, studies have shown that consumers who obtain GM information from traditional media, such as TV, radio and newspapers, are more likely to approve of GM food (He *et al.*, 2015; Zhang and Sun, 2018). Analyzing 50 news articles published between 2011 and 2020 in two major Chinese Communist Party newspapers, People's Daily and Guangming Daily, Du and Rachul (2012) reported that 48% of these articles predominantly supported GM technology, while the remaining 52% maintained a neutral stance. Conversely, those who rely on the internet for information were more prone to harbor negative attitudes toward GM food as indicated by He *et al.* (2015), Zhu *et al.* (2017) and

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Zhang and Sun (2018). This pessimistic trend is exemplified by the Baidu Search Index, China's primary online search engine, which showed a growing negativity in opinions regarding GM food from 2011 to 2017 (Zhou *et al.*, 2019). Furthermore, on Sina Weibo, the highest leader advocating positive views of GM food, Zhouzi Fang, commanded significantly fewer followers compared to Yongyuan Cui, the highest leader with a negative stance on GM food (Zhou *et al.*, 2019).

This difference in impact might result from the different attitudes of the reports made by traditional media and new media (i.e. personal websites and social media). Although there is no solid scientific research showing that GM food itself has caused any adverse health issues (National Academies of Sciences, Engineering and Medicine, 2016), reports on GM foods in Chinese media vary significantly. On the one hand, traditional media are state owned and report on GM food positively based on scientific research (Du and Rachul, 2012; Zhao *et al.*, 2019). On the other hand, negative reports on GM food, which are based on unverified research and anecdotes, are widespread in new media, such as Sina Weibo, which is the Chinese equivalent of Twitter, and Tencent's WeChat, which is the Chinese equivalent of Facebook (Wunderlich and Gatto, 2015; Zhang and Sun, 2018; Zhou *et al.*, 2019).

Due to the widespread rumors and misinformation regarding GM food, a negative attitude toward such food has become predominant in China since the first decade of the 2000s (Cui and Shoemaker, 2018). Studies based on data collected two decades ago showed that more than half of Chinese consumers had positive attitudes toward GM food (Li *et al.*, 2002; Zhou and Liu, 2009). However, data collected in the last ten years showed that the majority of Chinese consumers had a negative attitude toward GM food (Li *et al.*, 2015; Cui and Shoemaker, 2018). For example, Cui and Shoemaker (2018) showed that 12% of consumers had a positive view of GM food, while the percentage of those with a negative view was 47%. That is, the majority of Chinese consumers' attitudes toward GM food have changed from positive to negative since the first decade of the 2000s.

To reverse consumers' negative attitudes, China launched a media campaign to combat misinformation and build support for GM food over the last ten years (China Central Television (CCTV), 2014; Ministry of Agriculture (MOA), 2015). According to new requirements regarding media, misleading information about GM technology is prohibited in all media (People's Daily Online, 2014; CCTV, 2014; MOA, 2015). Specifically, in cyberspace, management and surveillance programs that allow jail terms for spreading rumors were implemented (Shan, 2011; Lin and Chin, 2017). In addition, scientists and experts have been encouraged to educate the public on genetic modification technology and promote rational perceptions of genetic modification technology in media, especially in new media (Wang, 2015).

However, to our knowledge, there is no systematic estimate of the impact of these efforts, even though these measures have been in place for years. That is, whether these efforts are effective remains unclear. Specifically, do traditional media and new media have the same impact on consumers' attitudes toward GM food in China today? How do other information sources, such as relatives/friends and schools, affect consumers' attitudes? In addition, should authorities adjust their management and surveillance of media?

The objective of this study is to quantitatively measure the impact of different information sources on consumers' attitudes toward GM food recently, especially after the media campaign in China. By doing so, we can test whether the impact of traditional media is different from that of new media. The results of this study will answer whether the management and surveillance of genetic modification technology in the media is effective. Hence, it will provide useful information for policy-makers to formulate and implement optimal strategies to educate the public on genetic modification technology. This study has important implications, as China has the world's largest internet population, and more than two thirds of this population uses social media (China Internet Network Information Center, 2018a, b).

The rest of this paper is as follows: In the next section, the data and empirical models used in this study are discussed. The estimation results are discussed in the third section. The final section concludes the paper.

2. Data

In this section, we first discuss the consumer survey data used in this study. Then, we try to link consumers' information sources to their attitudes toward GM food. Even though the results based on the descriptive analysis are conditional, they shed light on the impact of information sources on consumers' attitudes toward GM food.

2.1 Data collection and sampling

To examine the current trends of consumer attitudes toward GM food in China, this study uses data collected by the China Center for Agricultural Policy, Peking University, in November 2020. The survey was conducted in nine cities in six provinces across China: Harbin (a medium-sized city) in Heilongjiang Province (Northeast China); Beijing (a large city, North China), Jinhua (a small city) and Ningbo (a medium-sized city) in Zhejiang Province; Nanjing (a medium-sized city) and Yancheng (a small city) in Jiangsu Province (East China); Guangzhou (a large city) and Zhongshan (a small city) in Guangdong Province (South China); and Lanzhou (a medium-sized city) in Gansu Province (Northwest China). These nine cities were selected from the Urban Household Income and Expenditure Surveys (UHIES) conducted by the National Bureau of Statistics of China (NBSC) (Huang and Peng, 2015). After excluding 173 respondents who had never heard of GM products, the in-person interviews conducted in respondents' homes covered 2030 consumers who were randomly selected from the UHIES samples in these nine cities (last row, Table 1).

	Mean	Standard deviation
Individual characteristics		
Male	0.44	0.50
Age	38.70	14.79
Primary school	0.05	0.23
Middle school	0.20	0.40
High school	0.22	0.42
College	0.45	0.50
Graduate school	0.08	0.27
Government or state-owned firm employee	0.10	0.30
Private company employee	0.53	0.50
Student	0.12	0.32
Other job	0.26	0.44
Agriculture-related job	0.06	0.24
Years of knowing about GM food	7.77	4.17
Grocery shopping	0.49	0.50
Household characteristics		
Family size	3.49	1.35
Low income[a]	0.43	0.49
Middle income[a]	0.28	0.45
High income[a]	0.29	0.46
Family experienced food allergy	0.14	0.35
Large city	0.32	0.47
Medium-sized city	0.47	0.50
Small city	0.21	0.41
Total observations	2030	

Note(s): [a] "Low-income" families are those with a per capita income less than 50,000 yuan per year; high-income families are those with a per capita income more than 100,000 yuan per year; and middle-income families are those with a per capita income more than 50,000 but less than 100,000 yuan per year
Source(s): Authors' work

Table 1. Characteristics of individuals and households

During the field survey, several measures were taken to improve the quality of the data collected. For example, to avoid potential selection bias regarding the individuals interviewed in each household, the interviewers were asked to interview the first adult (ages 16–70) they met upon their arrival at the interviewee's apartment. In addition, to reduce potential estimation bias due to measurement errors, the survey was conducted by trained graduate students and professional researchers, while the questionnaire used was taken from previous studies (e.g. Huang and Peng, 2015).

The questionnaire included several sections. First, there was a section on basic household characteristics, such as family size and income, and it inquired into whether any of the family members had experienced food allergies. The second section recorded demographic information about the respondent (e.g. gender, age, education, job category, whether she or he was in charge of grocery shopping). The information on household characteristics and individual characteristics is summarized in Table 1.

Finally, the questionnaire included two long sections to record consumers' attitudes toward GM food and their information sources, which were the key variables in this study. Following previous studies, the respondents were asked to specify their attitude toward GM food according to five choices: (1) strongly oppose, (2) oppose, (3) neutral, (4) approve and (5) strongly approve. For simplicity, respondents who stated "no idea" were also classified into the neutral group.

Another long section in the questionnaire provided detailed information about the sources from which the respondents had obtained information about genetic modification technology. The information sources were classified into five categories: traditional media, new media, relatives and friends, school and other (such as colleagues and salespeople). Traditional media include TV, radio, newspapers and magazines. The official websites of government agencies are also classified as traditional media, as information on GM food on these websites is very similar to that on TV and in newspapers. New media include personal websites and social media, such as Tencent WeChat, QQ and Weibo.

2.2 Characteristics of households and individuals

The characteristics of respondents show that the sample represents a wide range of consumers (upper panel, Table 1). As shown in row 1, we interviewed more women than men (the percentage of male respondents was 44%). This is expected, as women stay at home more often than men do in China. The percentage of male in our study is similar to previous studies (e.g. Zhu *et al.*, 2018; Xu *et al.*, 2020). The mean and standard deviation of the respondents' ages were 38.7 and 14.8, respectively, which means our survey included both younger and older consumers (row 2). Furthermore, the mean age of the respondents closely aligns with the findings of the 7th National Population Census of China conducted in 2020 (with the average age of China's population being 38.8), underscoring the representativeness of our study sample (China News Network, 2021). As shown in rows 3–7, a wide range of education levels of the respondents was also covered, ranging from those with less than a junior high school education (25%) to those with a college education and above (53%). This is generally consistent with Xu *et al.* (2020), where approximately 50% of the sample had a college education or above. Respondents were employed in government organizations, private enterprises and other areas (rows 8–11).

The wide range of household characteristics is also found in Table 1. As shown in the lower panel, the average household size was 3.5, which is consistent with national statistics (NBSC, 2021). The percentage of households with a per capita income below 50 thousand yuan per year, between 50 and 100 thousand yuan per year, and more than 100 thousand yuan per year was 43%, 28% and 29%, respectively [1]. The data from the National Bureau of Statistics of China indicate that the per capita income of urban residents in 2020 was around

44,000 yuan, consistent with our survey results (NBSC, 2021). On average, 14% of the families interviewed had experienced food allergies. This information helped us examine whether there was a relationship between food allergy experiences and attitudes toward GM food as other studies have done (e.g. Huang and Peng, 2015). The percentages of consumers in large, medium-sized and small cities were 32%, 47% and 21%, respectively (rows 2–4 from the bottom, Table 1).

2.3 Consumers' attitudes toward GM food and their information sources

The upper panel of Table 2 shows consumers' attitudes toward GM food [2]. On the one hand, 43% of consumers strongly opposed (18%) or somewhat opposed (25%) GM food. On the other hand, 25% of consumers either approved of (21%) or strongly approved of (4%) GM food. Finally, 33% of consumers neither opposed nor approved of GM food. These findings are consistent with other studies based on recent survey data that showed that the percentage of consumers who opposed GM food was higher than the percentage who approved of GM food (e.g. Cui and Shoemaker, 2018).

The consumers' sources of information about GM food are shown in the lower panel of Table 2. During the survey, each respondent was asked to provide up to three information sources from which they had learned about GM food. This study used two scenarios to measure consumers' information sources. The first scenario was based on respondents' choices of information sources, while the second scenario was based on their first choice. In each scenario, different types of information sources were classified into five categories: traditional media, new media, friends and relatives, school and other.

As expected, the data show that traditional media were the consumers' most common information source. As shown in Table 2, the percentage of consumers who had heard about GM food from traditional media was 69% (row 6). New media were the second largest information source, with a percentage of 48% (row 7). The percentage of those who received information from relatives and friends was 20%, while 5% of respondents had heard about genetic modification technology in school (rows 8 and 9). Similar results were obtained when

	Mean	Standard deviation
Attitude toward GM food		
Strongly oppose	0.18	0.39
Oppose	0.25	0.43
Neutral	0.33	0.47
Support	0.21	0.41
Strongly support	0.04	0.19
Information source dummies		
Any choice[a]: Traditional media	0.69	0.46
New media	0.48	0.50
Relatives and friends	0.20	0.40
School	0.05	0.23
Other information source	0.04	0.19
First choice[b]: Traditional media	0.56	0.50
New media	0.27	0.45
Relatives and friends	0.10	0.30
School	0.04	0.20
Other information source	0.03	0.17

Note(s): [a] Each respondent could choose up to three information sources regarding GM food
[b] Respondent's first choice of information source of GM food
Source(s): Authors' work

Table 2. Consumers' attitudes toward GM food and their information sources

we remeasured the information sources based on the respondents' first choices. As shown in the last five rows, the percentages of traditional media, new media, friends and relatives, school and other information sources were 56%, 27%, 10%, 4% and 3%, respectively.

Finally, we tried to link consumers' attitudes and their information sources. However, we will first discuss the reclassification of consumers' attitudes. For simplicity, consumers' attitudes were reclassified into three groups: oppose (including strongly oppose and somewhat oppose), neutral and approve (including somewhat approve and strongly approve). The conditional relationship between the information source and consumer attitudes toward GM food is shown in Figure 1.

As shown in Panel A of Figure 1, if the information source was traditional media, the percentages of respondents who opposed were neutral toward and approved of GM food were 44.9%, 31.5% and 23.7%, respectively. These percentages are very similar to those of consumers whose information source was new media (42.4%, 32.9% and 24.7% for consumers who opposed were neutral toward and approved of GM food). That is, it seems that traditional media had no difference in impact from new media. Replacing all information sources with the respondents' first choice of information source yielded very similar results (Panel B of Figure 1).

Figure 1 also shows that compared to consumers whose information source was traditional media (or new media), consumers who obtained GM food information from school were more likely to approve of GM food, and those who received information from relatives and friends were more likely to oppose GM food. As shown in Panel A, among consumers whose information source was relatives and friends, 55.6% opposed GM food, while only 18.2% approved of GM food. On the other hand, among those whose information source was school, only 14.4% opposed GM food, while 47.7% approved of GM food. Similar results are shown in Panel B of Figure 1, where we replaced all information sources with respondents' first information choice.

3. Econometric model and estimation results

The descriptive analysis reveals an apparent correlation between information sources and consumers' attitudes toward GM food (Figure 1). However, the conditional correlation might be misleading as there are other factors affecting consumers' attitudes toward GM food. In this section, we develop an econometric model to isolate the impact of information sources.

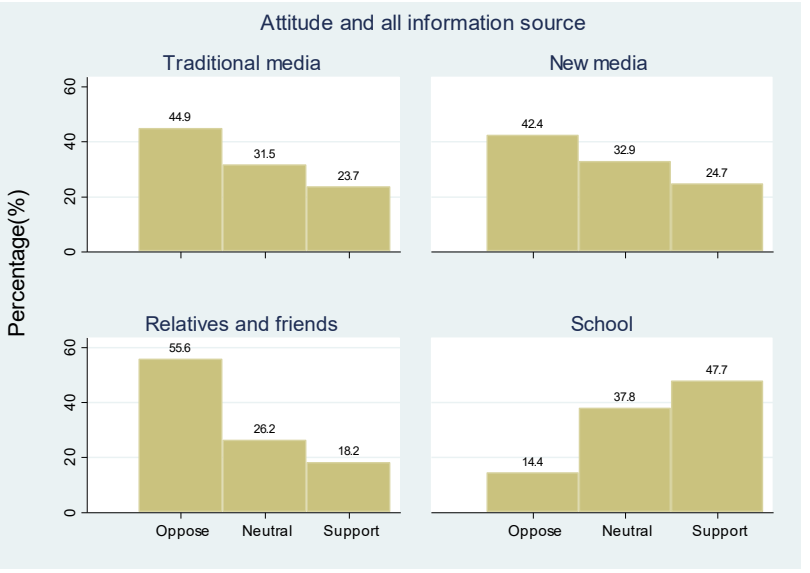
3.1 Econometric model

Following similar previous studies (e.g. Huang and Peng, 2015), this study models consumers' attitudes toward GM food as follows:

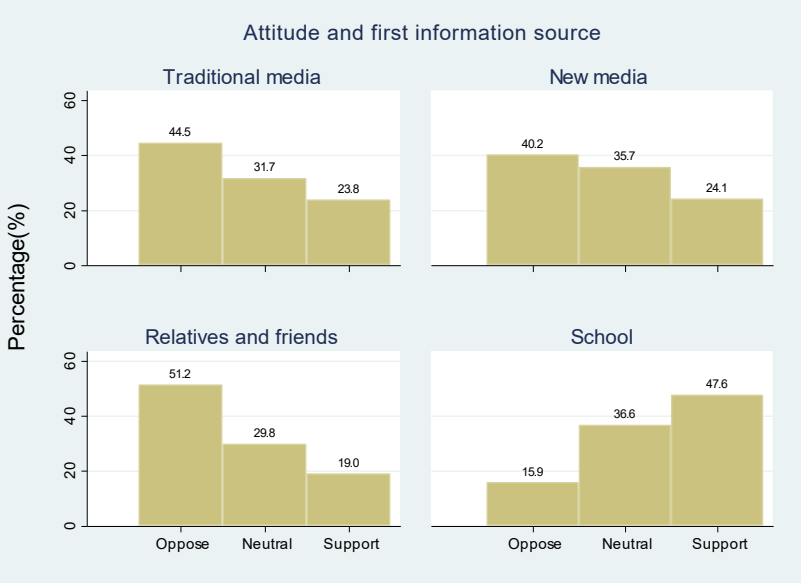
$$Attitude_i = \alpha_0 + \alpha_1 Information_i + \alpha_2 Individual_i + \alpha_3 Household_i + \alpha_4 Other_i + e_i \quad (1)$$

In Equation (1), the dependent variable, *Attitude,* is consumers' attitude toward GM food. As discussed earlier, this variable has three possible values: oppose (*Attitude = 1*), neutral (*Attitude = 2*) and approve (*Attitude = 3*). Subscript i is the ith consumer, and α is the coefficient to be estimated. Finally, *e* is the stochastic error term.

The first dependent variable, *Information*, is a vector. We created a dummy variable for each of the five categories of information sources: traditional media, new media, friends and relatives, school and other. The estimated coefficients of these dummy variables indicate the impact of the information source on consumers' attitudes toward GM food. When the consumers' first choice was used, traditional media were used as the default value. That is, the estimated coefficients of the other four information sources show the difference between their impact and the impact of traditional media.



Panel A



Panel B

Source(s): Authors' work

Figure 1.
Consumers' attitudes toward GM food and information sources

Both *individual* and *household* are vector variables. Age and length of time aware of GM food are two continuous variables. All the other individual characteristic variables were measured as dummy variables. For example, males were assigned a value of 1, and females were assigned a value of 0. For education, there were four dummy variables: middle school dummy,

high school dummy, college dummy and graduate school dummy. These were compared to those who had primary school and lower education levels. Occupation comprised the following three dummy variables: working in a government organization or state-owned enterprise, working in a private enterprise and student. The group for comparison included individuals working in other institutions. Finally, whether the respondent was in charge of grocery shopping for the family was also included in the *individual* vector.

Similarly, household size and family income were included in the *household* vector variables. To consider the impact of food safety, we also included one dummy variable on whether any family members had experienced food allergies. This variable was assigned a value of 1 if any of the family numbers had experienced food allergies and 0 otherwise.

Finally, the *other* vector variable was added to consider the impact of other factors that affect consumers' attitudes toward GM food. For example, consumers' attitudes might be affected by city size. To capture the impact of city size, we included two dummy variables, one for medium-sized cities (taking a value of 1 if it was a medium-sized city and 0 otherwise) and the other for large cities (taking a value of 1 if it was a large city and 0 otherwise).

Given the nature of the dependent variable (i.e. consumers' attitudes toward GM food), Equation (1) was estimated using an ordered logit (Ologit) regression model. The sign of the estimated parameter represents the nature of the impact (Zhang and Kai, 1998). However, these estimated coefficients did not show the quantitative impact of these independent variables on consumers' attitudes toward GM food. Hence, we estimated the marginal effects for all independent variables after the estimation of the ordered logit model.

3.2 Estimation results

The estimation result of Equation (1) is shown in Table 3, while the marginal effects of all independent variables are shown in Table 4. Overall, the estimation results of Equation (1) were reasonable. Most estimated coefficients had the expected signs and were statistically significant. For example, the estimate results showed that males were more likely to approve of GM food. In addition, both age and education had a negative impact on consumers' attitudes toward GM food. All these findings are consistent with those of previous studies (such as Cui and Shoemaker, 2018). In the following, we focus on a discussion of the estimated coefficients of the information source.

First, the estimation results showed that traditional media have an impact similar to that of new media. As shown in Table 3, both the estimated coefficients of traditional media and new media were positive but not significant (rows 1 and 2). That is, none of them had a significant impact on consumers' attitudes toward GM food. More importantly, we tested whether these two estimated coefficients were significantly different. The test result shows that the chi-squared statistic was 0.05 with a P value of 0.82. That is, the impact of traditional media was similar to that of new media in terms of affecting consumers' attitudes toward GM food.

To test the robustness of this finding, we then reran the model using consumers' first choice of information source. As shown in the second column of Table 3, the estimated coefficient of new media was still insignificant (row 6). As discussed earlier, under this scenario, the default value was traditional media. Hence, the insignificant estimated coefficient of new media implies that its impact on consumer attitudes was similar to that of traditional media. That is, rerunning the model using consumers' first choice on an information source yielded the same result as that using consumers' overall choices for information sources.

To show the impact of the order of consumer choice regarding information sources, we then reran the model by adding both the information source of all choices and their first choice. As shown in the third column of Table 3, the estimated coefficients of traditional

	Attitude: 1 = oppose, 2 = neutral, 3 = support		
	Any choice (1)	First choice (2)	Both (3)
Any information source			
Traditional media	0.0495		−0.0100
	(0.46)		(−0.07)
New media	0.0176		0.0657
	(0.18)		(0.57)
Relatives and friends	−0.2449**		−0.3733**
	(−2.01)		(−2.33)
School	0.7677***		0.8874**
	(3.71)		(2.52)
Other information source	0.5980**		1.0515**
	(2.54)		(2.49)
First information source (baseline = traditional media)			
New media		−0.0660	−0.1177
		(−0.66)	(−0.72)
Relatives and friends		−0.1368	0.1745
		(−0.89)	(0.76)
School		0.6385***	−0.2166
		(2.83)	(−0.51)
Other information source		0.3740	−0.6756
		(1.44)	(−1.34)
Individual characteristics			
Years of knowing about GM food	−0.0343***	−0.0320***	−0.0356***
	(−2.96)	(−2.80)	(−3.06)
Male	0.2088**	0.2186**	0.2008**
	(2.31)	(2.43)	(2.22)
Age (year)	−0.0475***	−0.0490***	−0.0471***
	(−10.91)	(−11.32)	(−10.82)
Education (baseline = primary school)			
Middle school	−0.2232	−0.1794	−0.2317
	(−1.00)	(−0.81)	(−1.04)
High school	−0.4360*	−0.3820*	−0.4465**
	(−1.92)	(−1.69)	(−1.97)
College	−0.4337*	−0.3683	−0.4323*
	(−1.88)	(−1.61)	(−1.87)
Graduate school	−0.2136	−0.1758	−0.2086
	(−0.77)	(−0.63)	(−0.75)
Job type (baseline = other)			
Government or state-owned firms	−0.2678*	−0.2852*	−0.2663*
	(−1.75)	(−1.86)	(−1.73)
Private firms	−0.1493	−0.1477	−0.1501
	(−0.78)	(−0.77)	(−0.78)
Student	−0.1181	−0.1464	−0.1196
	(−0.67)	(−0.84)	(−0.68)
Agriculture-related work	0.6078***	0.6097***	0.6092***
	(3.24)	(3.25)	(3.24)

(*continued*)

Table 3.
Estimation results of the ordered logit model

	Attitude: 1 = oppose, 2 = neutral, 3 = support		
	Any choice (1)	First choice (2)	Both (3)
Grocery shopping	−0.1074	−0.0923	−0.1077
	(−1.16)	(−1.00)	(−1.16)
Family characteristics			
Family size	−0.0089	−0.0101	−0.0073
	(−0.27)	(−0.30)	(−0.22)
Family member with food allergy	−0.1503	−0.1602	−0.1435
	(−1.17)	(−1.25)	(−1.12)
Family income (baseline = low-income group)			
Middle-income group (50 k∼100 k)	0.1436	0.1259	0.1441
	(1.35)	(1.19)	(1.36)
High-income group (>100 k)	0.0625	0.0555	0.0616
	(0.58)	(0.51)	(0.57)
First cutoff point	−2.8030***	−2.8609***	−2.8613***
	(−7.44)	(−7.87)	(−7.32)
Second cutoff point	−1.1809***	−1.2483***	−1.2372***
	(−3.17)	(−3.47)	(−3.20)
Total observations	2,030	2,030	2,030

Note(s): Z-statistics are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' work

Table 3.

	Oppose		Neutral		Support	
	ME	T Value	ME	T Value	ME	T Value
Traditional media	−0.0106	−0.46	0.0024	0.46	0.0081	0.46
New media	−0.0038	−0.18	0.0009	0.18	0.0029	0.18
Relatives and friends	0.0522**	2.01	−0.0119**	−1.99	−0.0403**	−2.01
School	−0.1637***	−3.72	0.0374***	3.37	0.1263***	3.75
Other information source	−0.1275**	−2.56	0.0292**	2.49	0.0984**	2.55
Years of knowing about GM food	0.0073***	2.98	−0.0017***	−2.87	−0.0056***	−2.97
Male	−0.0445**	−2.32	0.0102**	2.27	0.0344**	2.32
Age (year)	0.0101***	12.11	−0.0023***	−8.72	−0.0078***	−11.03
Middle school	0.0476	1.00	−0.0109	−1.00	−0.0367	−1.00
High school	0.0930*	1.93	−0.0213*	−1.91	−0.0717*	−1.92
College	0.0925*	1.88	−0.0212*	−1.87	−0.0714*	−1.88
Graduate school	0.0456	0.77	−0.0104	−0.77	−0.0351	−0.77
Government or state-owned firms	0.0571*	1.75	−0.0131*	−1.73	−0.0441*	−1.75
Private firms	0.0318	0.78	−0.0073	−0.78	−0.0246	−0.78
Student	0.0252	0.67	−0.0058	−0.67	−0.0194	−0.67
Agriculture-related job	−0.1296***	−3.26	0.0296***	3.15	0.1000***	3.24
Grocery shopping	0.0229	1.16	−0.0052	−1.15	−0.0177	−1.16
Family size	0.0019	0.27	−0.0004	−0.27	−0.0015	−0.27
Family experience with food allergies	0.0321	1.17	−0.0073	−1.17	−0.0247	−1.17
Middle-income family	−0.0306	−1.35	0.0070	1.34	0.0236	1.35
High-income family	−0.0133	−0.58	0.0030	0.58	0.0103	0.58

Note(s): Based on the estimation results shown in the first column of Table 3
Source(s): Authors' work

Table 4.
Marginal effect on consumers' attitudes toward GM food

media and new media were still insignificant (rows 1 and 2). In addition, the estimated coefficient of the first choice on new media was insignificant (row 6). That is, the estimation results show that the impact of traditional media was similar to that of new media in terms of affecting consumers' attitudes toward GM food. Their impact was not affected by the order of the respondents' information source preferences.

This finding is as expected. As discussed in the second section of this paper, government agencies have made significant efforts over the past decade in media monitoring and regulation to counteract consumers' negative attitudes. Especially in cyberspace, strict management and surveillance were firmly implemented to stop the spread of misinformation and rumors on genetic modification technology. That is, reports should now be based on the opinions of scientists and/or experts. The results of this study show that these efforts led to the expected outcome. Based on data collected in 2020, the estimation results of this study show that new media currently have no different impact from traditional media.

The second interesting finding is that consumers who receive information from relatives and friends are more negative about GM food. As shown in the third row, the estimated coefficient of relatives and friends as information sources were negative and statistically significant (Table 3). We further tested whether the estimated coefficient of traditional media was different from that of relatives and friends. The chi-squared statistic was 4.29, with a P value of 0.04. Rerunning the model using consumers' first choice in information sources yielded similar results (row 7). As shown in the third row of Table 4, consumers who received information from relatives and friends were 5.2% more likely to oppose GM food than those who had other information sources. On the other hand, the reduction in the percentage who had neutral and supportive attitudes was 1.2% and 4.0%, respectively.

The negative attitude of consumers who received GM food information from relatives and friends is consistent with previous studies. Previous studies have shown that consumers might have a high level of confidence in and trust information from their relatives and friends; however, the information might not be correct (Simon-Friedt *et al.*, 2016). Consistent with these studies, our data show that respondents whose primary information sources were relatives and friends know less about GM food science than others (Figure 1). Further studies discussed in the next subsection confirm that there is a negative relationship between attitude toward and knowledge of GM food.

The final interesting finding is that consumers who receive genetic modification technology information from school are more likely to approve of GM food than those with other information sources. As shown in row 4 of Table 3, the estimated coefficient of school information sources is significantly positive. We further tested whether the estimated coefficient of traditional media is equal to the estimated coefficient of school. The chi-squared statistic was 13.14, with a P value of 0.00. Replacing all information sources with the first information source and rerunning the model, we obtained similar results (row 7). Row 4 of Table 4 shows that school information sources lead to a reduction in negative attitudes toward GM food of 16.4% and increase the percentage of neutral and positive attitudes by 3.7% and 12.6%, respectively.

The positive impact of school on consumers' attitudes has also been discussed in other studies. For example, Cheng *et al.* (2021) showed that the percentage of those approving of GM food among those who learned about genetic modification technology in school was more than two times higher than that among those who had never learned about such technology in school. On the other hand, learning about genetic modification technology in school reduced the percentage of negative attitudes by 30% (Cheng *et al.*, 2021). Similarly, according to Shen *et al.* (2021), consumers whose information source is school have the highest level of knowledge of GM food among all who are aware of GM food.

	Attitude: 3 categories		Attitude: 5 categories
	Any choice	First choice	Any choice
	(1)	(2)	(3)
Any information source			
Traditional media	0.2068		−0.2775
	(0.33)		(−0.29)
New media	−0.7383		−1.1112
	(−0.88)		(−0.88)
Relatives and friends	−0.1751		−1.8122
	(−0.15)		(−1.06)
School	2.3348***		3.2484**
	(2.63)		(2.43)
Other information source	1.0279		−0.3790
	(0.60)		(−0.15)
First information source (baseline = traditional media)			
New media		−1.1855	
		(−1.15)	
Relatives and friends		1.4124	
		(0.71)	
School		2.0817*	
		(1.74)	
Other information source		1.7182	
		(1.23)	
Individual characteristics			
Years of knowing about GM food	−0.0239**	−0.0287**	−0.0270*
	(−2.38)	(−2.54)	(−1.79)
Male	0.0698	0.1731*	−0.0571
	(0.57)	(1.94)	(−0.31)
Age (year)	−0.0128*	−0.0170***	−0.0117
	(−1.91)	(−3.03)	(−1.16)
Education (baseline = primary school)			
Middle school	−0.0617	0.0732	−0.2438
	(−0.38)	(0.40)	(−1.00)
High school	−0.0227	0.2366	−0.3800
	(−0.07)	(0.68)	(−0.83)
College	−0.1010	0.2759	−0.6156
	(−0.27)	(0.66)	(−1.09)
Graduate school	0.1415	0.5084	−0.2355
	(0.38)	(1.14)	(−0.42)
Job type (baseline = other)			
Government or state-owned firms	−0.1757*	−0.2645**	−0.1693
	(−1.69)	(−2.07)	(−1.08)
Private firms	−0.3416*	−0.3106*	−0.4991
	(−1.68)	(−1.73)	(−1.63)
Student	−0.1654	−0.2683	−0.2997
	(−1.05)	(−1.56)	(−1.26)
Agriculture-related work	0.1940	0.2881*	0.1506
	(1.49)	(1.94)	(0.77)

Table 5.
Estimation results of the effect of information sources on consumers' attitudes considering the endogeneity of information sources

(*continued*)

	Attitude: 3 categories		Attitude: 5 categories
	Any choice	First choice	Any choice
	(1)	(2)	(3)
Grocery shopping	−0.0837	0.0027	−0.1661
	(−1.22)	(0.03)	(−1.61)
Family characteristics			
Family size	−0.0218	−0.0195	−0.0210
	(−0.87)	(−0.75)	(−0.56)
Family member with a food allergy	−0.0225	−0.0539	−0.0776
	(−0.34)	(−0.73)	(−0.79)
Family income (baseline = low-income group)			
Middle-income group (50 k~100 k)	0.0705	0.0446	0.1062
	(1.21)	(0.70)	(1.21)
High-income group (>100 k)	0.0338	0.0280	0.0581
	(0.59)	(0.43)	(0.68)
Constant	2.8517***	2.7217***	5.0330***
	(4.83)	(7.57)	(5.67)
Total observations	2,030	2,030	2,030

Note(s): Z-statistics are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' work

Table 5.

3.3 Endogeneity problem

This study uses two methods to consider the potential estimation bias due to endogeneity problems. There is no reason to believe that respondents' attitudes toward GM food affect their choice of information source. That is, there is no mutual causation problem, which is one of the two major reasons for endogeneity (Wooldridge, 2002). Hence, these two methods are used to consider the potential impact of omitted variables, such as an individual's risk preference. First, we added new variables to measure consumers' risk preference in Equation (1) and reran the model (see Appendix Table 1 for details). Specifically, we used the change in consumers' attitudes toward GM food before and after COVID-19 to measure their risk preference. To test the robustness, we then replaced that variable with two dummy variables: risk aversion (equal to 1 if her or his attitude became more negative) and risk acceptance (equal to 1 if her or his attitude became more positive). These changes all led to similar estimation results. More importantly, the estimated coefficients of our key variables (i.e. information source), as shown in rows 1 to 5 of Appendix Table 1, in all these scenarios are very similar to those shown in Table 3.

Second, we used some instrumental variables to address the endogeneity problem of information sources. Specifically, the official information source is instrumented by the number of papers published in academic journals, TV coverage, and broadcast coverage, while the new media information source is instrumented by the number of Internet users and Baidu search index. Information on the number of papers published in academic journals comes from the China National Knowledge Infrastructure (CNKI), while the Baidu search index is from the Baidu website. Information on the number of Internet users, TV coverage, and broadcast coverage comes from the provincial statistical yearbooks. In China, genetic modification technology was first included in textbooks for sophomore students in high schools in 2003. Hence, we added an interaction term of 34 years of age (those who were sophomore students in 2003) or younger and with a high school degree or above to instrument school information sources. Finally, we used a large city dummy to instrument the information source from relatives and friends. That is, we assumed that consumers who lived in large cities had fewer relatives and friends than those who lived in medium-sized and small

cities. In addition, considering the fact that consumers might be affected by the maximum, we used the maximums of these IV variables since consumers had heard of genetic modification technology. Using the flow and stock values of these IV variables yields similar results [3].

The estimation results of the main equation are shown in Table 5, while the estimation results of the information source are shown in Appendix Table 2. As shown in Appendix Table 2, the estimated coefficients of the number of papers published in academic journals, the interaction of a high school or above education and 34 years of age or younger, and the large city dummy are statistically significant in the official, school and relatives and friends information source equations. Even though the estimated coefficients of internet users and the Baidu search index are insignificant in the new media equation, further studies show that the F value of excluding all the instrumental variables is 1.77 with a p value of less than 10%, indicating that they are useful. More importantly, the estimation results of Table 5 are consistent with those of Table 3. As shown in Table 5, both the estimated coefficients of official and new media information sources are insignificant (rows 1 and 2). Rerunning the model using consumers' first choice of information source yielded similar results (row 6, column 2). Replacing consumers' attitudes from three choices to five choices, we still obtained similar results (column 3). The results of these tests (i.e. columns 2 and 3) indicate that the estimation results are robust. That is, the estimation results of Table 5 confirm that the impact of the official information source is not different from that of new media. Finally, as shown in the fourth and eighth rows of Table 5, consumers who received information from school were more likely to support GM food than those who had other information sources [4].

3.4 Information sources affect consumers' attitudes by affecting their knowledge

How do information sources affect consumers' attitudes toward GM food? Previous studies have shown that different information sources have different impacts on consumers knowledge, which can further affect their attitudes toward GM food (e.g. Fernbach *et al.*, 2019). To test this hypothesis, we rewrote Equation (1) as follows:

$$Knowledge_i = \beta_0 + \beta_1 Information_i + \beta_2 Individual_i + \beta_3 Household_i + \beta_4 Other_i + \varepsilon_i \quad (2)$$

$$Attitude_i = \gamma_0 + \gamma_1 Knowledge_i + \gamma_2 Information_i + \gamma_3 Individual_i + \gamma_4 Household_i + \gamma_5 Other_i + \tau_i$$

In Equation (2), βs and γs are parameters to be estimated, while τ and ε are error terms. The new variable, *Knowledge*, measures consumers' knowledge of genetic modification technology. To measure consumers' knowledge, we included five questions in the questionnaire. All five questions are from the website of the Ministry of Agriculture (http://www.moa.gov.cn/ztzl/zjyqwgz/kpxc/). We first recorded respondents' answers to each question. Then, we told them the correct answers to these five questions. *Knowledge* is the total number of questions that respondents answered correctly. Because *Knowledge* is nonnegative, we use the Poisson model for the *Knowledge* function.

The estimation results of Equation (2) are shown in Table 6. As shown in the first column, neither traditional media nor new media had a significant impact on consumers' knowledge (rows 2 and 3). On the other hand, the estimated coefficient of relatives and friends was significantly negative (row 4), while the estimated coefficient of school was significantly positive (row 5). In other words, the estimation results show that consumers whose information source includes relatives and friends know less about genetic modification technology than other consumers, while consumers who had learned about genetic modification technology from school had a higher level of genetic modification knowledge than other consumers.

The last column of Table 6 shows that *Knowledge* had a significant impact on consumers' attitudes toward GM food. As shown in the first row, the estimated coefficient of knowledge

	Dependent variables	
	No. of right answers Poisson	Attitude Ologit
No. of right answers		0.4214*** (15.28)
Traditional media	0.0004 (0.01)	0.0543 (0.49)
New media	0.0344 (0.96)	−0.0245 (−0.25)
Relatives and friends	−0.0935* (−1.94)	−0.2056* (−1.65)
School	0.1185* (1.77)	0.6884*** (3.23)
Other information source	0.1530* (1.71)	0.5331** (2.21)
Individual characteristics		
Years of knowing about GM food	−0.0000 (−0.00)	−0.0388*** (−3.26)
Male	−0.0427 (−1.26)	0.2589*** (2.79)
Age (year)	−0.0218*** (−12.61)	−0.0360*** (−8.03)
Education (baseline = primary school)		
Middle school	−0.0385 (−0.37)	−0.2103 (−0.93)
High school	0.0437 (0.42)	−0.4941** (−2.13)
College	0.2442** (2.35)	−0.6490*** (−2.74)
Graduate school	0.2910** (2.52)	−0.4299 (−1.51)
Job type (baseline = other)		
Government or state-owned firms	−0.1006* (−1.82)	−0.1930 (−1.22)
Private firms	−0.0004 (−0.01)	−0.2582 (−1.30)
Student	−0.0592 (−0.90)	−0.0827 (−0.46)
Agriculture-related work	−0.0565 (−0.68)	0.6929*** (3.61)
Grocery shopping	−0.0253 (−0.72)	−0.1007 (−1.06)
Family characteristics		
Family size	0.0186 (1.46)	−0.0264 (−0.77)
Family experience with food allergies	−0.0145 (−0.31)	−0.1319 (−1.00)
Income (baseline = low-income group)		
Middle-income group (50 k~100 k)	0.0360 (0.89)	0.1506 (1.38)
High-income group (>100 k)	0.0693* (1.75)	0.0108 (0.10)

(*continued*)

Table 6.
Information source, knowledge and consumer attitudes toward GM food

	Dependent variables	
	No. of right answers Poisson	Attitude Ologit
City size (base = large city)		
Medium-sized city	−0.0358	0.0392
	(−0.81)	(0.32)
Small city	−0.0137	0.0981
	(−0.32)	(0.82)
First cutoff point		−1.7843***
		(−4.57)
Second cutoff point		0.0165
		(0.04)
Constant	1.2716***	
	(8.31)	
Total observations	2,030	2,030

Note(s): Z-statistics are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
Source(s): Authors' work

Table 6.

was positive and statistically significant. That is, the estimation results showed that the greater the number of questions that a respondent answered correctly, the more likely he or she was to have a positive attitude toward GM food. This finding confirmed that influencing consumers' knowledge is one of the major channels through which information sources can affect consumers' attitudes toward GM food.

4. Discussion

Data collected a decade ago showed that traditional media have a positive attitude toward GM food, while new media have a negative attitude toward it (Du and Rachul, 2012; Tian, 2017; Zhou *et al.*, 2019). Consequently, consumers who obtain genetic modification information from traditional media are likely to approve of GM food, while those who obtain genetic modification information from new media are likely to oppose GM food (e.g. He *et al.*, 2015; Zhu *et al.*, 2017; Zhang and Sun, 2018). However, based on data collected in 2020, this study shows that the impact of new media is similar to that of traditional media. That is, compared to traditional media, new media did not lead to a more negative attitude toward GM food. In addition, this study shows that consumers who obtain genetic modification information from school are likely to have a positive attitude toward GM food. On the contrary, individuals who acquire genetic modification information from their relatives and friends tend to exhibit lower knowledge scores and a more negative attitude toward GM food.

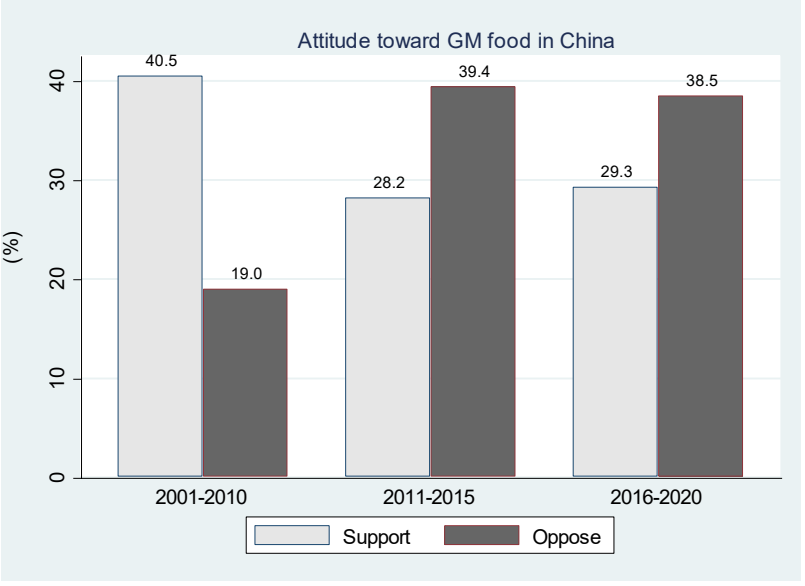
The results of this study have important policy implications. First, government authorities should make a greater effort to educate the public about genetic modification technology. Approximately a decade ago, China initiated a media campaign aimed at countering misinformation and fostering support for GM food to counteract consumers' negative perceptions. Based on data collected in 2020, our study demonstrates that consumers whose primary information source is new media exhibit similar attitudes toward GM food as those relying on traditional media. This empirical evidence indicates that the Chinese government's initiatives to manage and oversee media have achieved their intended outcomes. Consequently, government authorities should allocate more resources to public education endeavors, including fostering increased collaboration between scientists, experts and both traditional and new media outlets.

Second, schools might be another crucial information source for government authorities should prioritize. As illustrated in this study, consumers who obtain genetic modification technology information from school tend to achieve higher scores on knowledge assessments

and are more inclined to maintain a positive attitude toward GM food. Unlike information from other sources, educational content in schools is predominantly sourced from experts and scientists, rendering students less susceptible to the widespread misinformation and rumors prevalent in the media, particularly in new media platforms. Based on the insights gained from this study, it is imperative to reinforce the role of schools in public education efforts. It is worth noting that as more students graduate from school and become active participants in the food market, we can anticipate a further enhancement of public attitudes toward genetic modification technology in the future.

Finally, it may be prudent for Chinese authorities to expedite the commercialization of GM feed and food crops. Owing to the increasing resistance to GM technology since 2010, the commercialization of GM crops, including GM soybeans, maize and rice, has been postponed indefinitely in China (Qiao, 2015). Nonetheless, China continues to import a significant quantity of GM soybeans and maize annually (Xie *et al.*, 2017). In line with prior research findings (e.g. Wu and Qiao, 2023), our study reveals that Chinese consumers' attitudes toward GM food are rebounding (Figure 2). To mitigate the risk of further agricultural yield losses and reduce reliance on the international market for GM grain crop imports, it is advisable for the Chinese government to expedite the commercialization of GM feed and food crops.

While this study provides solid empirical evidence that the impact of new media is currently no different than that of traditional media, indicating that the media campaign successfully reduced the spread of rumors and misinformation regarding GM food in China, it is not without its limitations. First, future research should investigate the mechanisms through which the media campaign affects consumers' attitudes. Nonetheless, this may pose challenges given the limited precise information available regarding the media campaign, including its time frame and comprehensive content, and the potential presence of social desirability bias (Grimm, 2010). Second, it's essential to acknowledge that this study primarily reflects the impact of the media campaign in the current period. The dynamics of this impact and the potential for change should be subjects of investigation in future research.



Source(s): Authors' work

Figure 2.
Consumer attitudes toward GM food in China based on 65 observations (there is more than one observation in some papers)

Notes

1. 1 US dollar = 6.9 yuan in 2019 (NBSC, 2021).
2. Three GM foods were included in the questionnaire: soybean oil, tofu and papaya. For two reasons, the analysis in this study is based on consumers' attitudes toward soybean oil. First, consumer attitudes toward tofu and papaya are very similar to those toward soybean oil. Second, soybean oil has been widely used in previous studies.
3. Considering all the information source variables are discrete endogenous regressors, we also reran the model using Lewbel and Dong's special regressor method (Dong and Lewbel, 2015). Based on consumers' attitudes toward GM food, we created two dummy variables: consumers whose attitudes toward GM food are positive and consumers whose attitudes toward GM food are negative. The estimation results confirmed that the impact of official information source is not different from that of new media; however, the impact of other information sources (i.e. school and relatives and friends) is insignificant. The estimation results are available upon request.
4. The estimated coefficient of relatives and friends is insignificant (Table 5), even though the estimated coefficient of the large city dummy is as expected (Appendix Table 2).

References

Bredahl, L., Grunert, K.G. and Frewer, L.J. (1998), "Consumer attitudes and decision-making with regard to genetically engineered food products–a review of the literature and a presentation of models for future research", *Journal of Consumer Policy*, Vol. 21 No. 3, pp. 251-277, doi: 10.1023/a:1006940724167.

Cheng, W., Liu, K., He, S. and Liao, Y. (2021), "Perception and suggestions on science popularization and industrialization of genetically modified organisms based on the cognition of university students in China", *Journal of Agricultural Biotechnology*, Vol. 29 No. 1, pp. 137-145.

China Central Television (CCTV) (2014), "Notice on surveillance on 'Non-GMO products' advertisement", available at: http://1118.cctv.com/2014/10/10/ARTI1412911094790531.shtml

China Internet Network Information Center (2018a), "The 41st statistical report on internet development in China", available at: http://www.cac.gov.cn/2018-01/31/c_1122347026.htm

China Internet Network Information Center (2018b), "The 41st China statistical report on internet development", January 2018, available at: http://cnnic.cn/hlwfzyj/hlwxzbg/hlwtjbg/201803/P020180305409870339136

China News Network (2021), "Result of the 7th Population Census: the average age of China's population is 38.8 years old", May 11, 2021, available at: https://m.gmw.cn/baijia/2021-05/11/1302286020.html

Costa-Font, M., Gil, J.M. and Traill, W.B. (2008), "Consumer acceptance, valuation of and attitudes towards genetically modified food: review and implications for food policy", *Food Policy*, Vol. 33 No. 2, pp. 99-111, doi: 10.1016/j.foodpol.2007.07.002.

Cui, K. and Shoemaker, S.P. (2018), "Public perception of genetically-modifified (GM) food: a nationwide Chinese consumer study", *NPJ Science of Food*, Vol. 2 No. 1, 10, doi: 10.1038/s41538-018-0018-4.

Dong, Y. and Lewbel, A. (2015), "A simple estimator for binary choice models with endogenous regressors", *Econometric Reviews*, Vol. 34 Nos 1-2, pp. 82-105, doi: 10.1080/07474938.2014.944470.

Du, L. and Rachul, C. (2012), "Chinese newspaper coverage of genetically modified organisms", *BMC Public Health*, Vol. 12 No. 1, p. 326, doi: 10.1186/1471-2458-12-326.

Fernbach, P.M., Light, N., Scott, S.E., Inbar, Y. and Rozin, P. (2019), "Extreme opponents of genetically modified foods know the least but think they know the most", *Nature Human Behaviour*, Vol. 3 No. 3, pp. 251-256, doi: 10.1038/s41562-018-0520-3.

Frewer, L.J., Scholderer, J. and Bredahl, L. (2003), "Communicating about the risk and benefits of genetically modified foods: the mediating role of trust", *Society of Risk Analysis*, Vol. 23 No. 6, pp. 1117-1133, doi: 10.1111/j.0272-4332.2003.00385.x.

Grimm, P. (2010), "Social desirability bias", in Sheth, J. and Malhotra, N. (Eds), *Wiley International Encyclopedia of Marketing*, John Wiley & Sons, Hoboken, NJ.

He, G., Zhao, Y., Zhang, W. and Xue, P. (2015), "A sociological analysis on the public acceptance of GM crops in China: based on a sampling survey in 6 cities", *Chinese Journal of Sociology*, Vol. 35 No. 1, pp. 121-142.

Hu, W., Zhong, F. and Ding, Y. (2006), "Actual media reports on GM foods and Chinese consumers' willingness to pay for GM soybean oil", *Journal of Agricultural and Resource Economics*, Vol. 31 No. 2, pp. 376-390.

Huang, J. and Peng, B. (2015), "Consumers' perceptions on GM food safety in urban China", *Journal of Integrative Agriculture*, Vol. 14 No. 11, pp. 2391-2400, doi: 10.1016/s2095-3119(15)61125-x.

Li, Q., Curtis, K.R., McCluskey, J.J. and Wahl, T.I. (2002), "Consumer attitudes toward genetically modified foods in Beijing, China", *AgBioForum*, Vol. 5 No. 4, pp. 145-152.

Li, R., Wang, Q. and McHughen, A. (2015), "Chinese government reaffirms backing for GM products", *Natural Biotechnology*, Vol. 33 No. 10, p. 1029, doi: 10.1038/nbt.3362.

Lin, L. and Chin, J. (2017), "China's tech giants have a second job: helping Beijing spy on its people", *The Wall Street Journal*, available at: https://www.wsj.com/articles/chinas-tech-giants-have-a-second-job-helping-the-government-see-everything-1512056284

Miles, S., Ueland, Ø. and Frewer, L.J. (2005), "Public attitudes towards genetically-modified food", *British Food Journal*, Vol. 107 No. 4, pp. 246-262, doi: 10.1108/00070700510589521.

Ministry of Agriculture (MOA) (2015), "Notice on genetically modified advertisements", available at: http://www.moa.gov.cn/ztzl/zjyqwgz/zcfg/201501/t20150122_4346780.htm

National Academies of Sciences (2016), "Engineering, and medicine", *Genetically Engineered Crops: Experiences and Prospects*, The National Academies Press, Washington, DC, doi: 10.17226/23395.

National Bureau of Statistics of China (NBSC) (2021), *China Statistics Yearbook*, China Statistics Press, Beijing.

People's People's Daily Online (2014), "Xi Jinping: dominate the high points of GM techniques", available at: http://world.people.com.cn/n/2014/0928/c157278-25754424.html

Qiao, F. (2015), "Fifteen years of Bt cotton in China: the economic impact and its dynamics", *World Development*, Vol. 70 No. C, pp. 177-185, doi: 10.1016/j.worlddev.2015.01.011.

Rousu, M., Huffman, W.E., Shogren, J.F. and Tegene, A. (2004), "Estimating the public value of conflicting information: the case of genetically modified food", *Land Economics*, Vol. 80 No. 1, pp. 125-135, doi: 10.2307/3147148.

Shan, J. (2011), "Government plans to improve fading public confidence in food safety", *China Daily*, available at: https://www.chinadaily.com.cn/bizchina/2011-01/04/content_11793068.htm

Shen, L., Cheng, J. and Li, L. (2021), "Cognition on and consumption intention of genetically modified food among consumers in Shanxi province", *China Journal of Public Health*, Vol. 37 No. 2, pp. 286-289.

Simon-Friedt, B.R., Howard, J.L., Wilson, M.J., Gauthe, D., Bogen, D., Nguyen, D., Frahm, E. and Wickliffe, J.K. (2016), "Louisiana residents' self-reported lack of information following the Deepwater Horizon oil spill: effects on seafood consumption and risk perception", *Journal of Environmental Management*, Vol. 180, pp. 526-537, doi: 10.1016/j.jenvman.2016.05.030.

Tian, L., Guo, M., Xu, W. and Huang, K. (2017), "Analysis of the status quo of public opinion and new type of popularization mode on genetically modified food", *Journal of China Agricultural University*, Vol. 22 No. 4, pp. 179-187.

Wang, Q. (2015), "China's scientists must engage the public on GM", *Nature*, Vol. 519 No. 7541, p. 7, doi: 10.1038/519007a.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, The MIT Press, Cambridge.

Wu, M. and Qiao, F. (2023), "Is Chinese consumers' attitude toward genetically modified foods bouncing back?", *British Food Journal*, Vol. 125 No. 11, pp. 4199-4213, doi: 10.1108/BFJ-01-2023-0042.

Wunderlich, S. and Gatto, K.A. (2015), "Consumer perception of genetically modified organisms and sources of information", *Advance in Nutrition*, Vol. 6, pp. 842-851, doi: 10.3945/an.115.008870.

Xie, W., Ali, T., Cui, Q. and Huang, J. (2017), "Economic impacts of commercializing insect-resistant GM maize in China", *China Agricultural Economics Review*, Vol. 9 No. 3, pp. 340-354, doi: 10.1108/caer-06-2017-0126.

Xu, R., Wu, Y. and Luan, J. (2020), "Consumer-perceived risks of genetically modified food in China", *Appetite*, Vol. 147, 104520, doi: 10.1016/j.appet.2019.104520.

Zhang, J. and Kai, F.Y. (1998), "What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes", *JAMA*, Vol. 280 No. 19, pp. 1690-1691, doi: 10.1001/jama.280.19.1690.

Zhang, Y. and Sun, Y. (2018), "The effect of ideology on attitudes toward GM food safety among Chinese internet users", *Sustainability*, Vol. 10 No. 11, p. 4326, doi: 10.3390/su10114326.

Zhao, Y., Deng, H., Yu, C. and Hu, R. (2019), "The Chinese public's awareness and attitudes toward genetically modified foods with different labeling", *NPJ Science of Food*, Vol. 3, pp. 1-7, doi: 10.1038/s41538-019-0049-5.

Zhou, M. and Liu, Q. (2009), "Investigation for Changsha consumers' recognition and attitude to genetically modified food", *Consumer Economics*, Vol. 3, pp. 51-53.

Zhou, R., Wang, D., Siddiquei, A.N., Anwar, M.A., Hammad, A., Asmi, F., Ye, Q. and Nawaz, M.A. (2019), "GMO/GMF on social media in China: jagged landscape of information seeking and sharing behavior through a valence view", *International Journal of Environmental Research and Public Health*, Vol. 16 No. 23, p. 4838, doi: 10.3390/ijerph16234838.

Zhu, H., Jackson, P. and Wang, W. (2017), "Consumer anxieties about food grain safety in China", *Food Control*, Vol. 73 No. B, pp. 1256-1264, doi: 10.1016/j.foodcont.2016.10.045.

Zhu, W., Yao, N., Ma, B. and Wang, F. (2018), "Consumers' risk perception, information seeking, and intention to purchase genetically modified food: an empirical study in China", *British Food Journal*, Vol. 120 No. 9, pp. 2182-2194, doi: 10.1108/bfj-11-2017-0622.

Further reading

Chen, R. (2013), "The scandal of 007/008 maize in Dika, Guangxi", available at: http://www.moa.gov.cn/ztzl/zjyqwgz/sjzx/201303/t20130306_3247724.htm

Ministry of Agriculture (MOA) (2021), "Information on genetically modified technology", available at: http://www.moa.gov.cn/ztzl/zjyqwgz/zjyxwbd/

Zhang, L. and Zhong, N. (2013), "Eating event adds spice to GM food debate", *China Daily*, available at: https://www.chinadaily.com.cn/life/2013-10/23/content_17052494.htm

Zhong, F., Marchant, M., Ding, Y. and Lu, K. (2002), "GM foods: a Nanjing case study of Chinese consumers' awareness and potential attitudes", *AgBioForum*, Vol. 5 No. 4, pp. 136-144.

Appendix

The supplementary material for this article can be found online.

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