

Research Paper

Pesticide Residues in Food: Attitudes, Beliefs, and Misconceptions among Conventional and Organic Consumers

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ABSTRACT

Pesticide use and pesticide residues in foods have been the subject of controversial public discussions and media coverage in Germany. Against this background, a better understanding of public risk perceptions is needed to promote efficient public health communication. To this end, this study captures the German public's perception of pesticide residues in foods. A representative sample of the population aged 14 years and older ($n = 1,004$) was surveyed via computer-assisted telephone interviewing on their attitudes and knowledge with regard to pesticide residues. Based on questions regarding their typical consumer behavior, respondents were classified into conventional and organic consumers to identify differences as well as similarities between these two consumer types. As assessed with an open-ended question, both organic and conventional consumers viewed pesticides, chemicals, and toxins as the greatest threats to food quality and safety. Evaluating the risks and benefits of pesticide use, more than two-thirds of organic consumers (70%) rated the risks as greater than the benefits, compared with just over one-half of conventional consumers (53%). Concern about the detection of pesticide residues in the food chain and bodily fluids was significantly higher among organic compared with conventional consumers. Only a minority of respondents was aware that legal limits for pesticide residues (referred to as maximum residue levels) exist, with 69% of organic and 61% of conventional consumers believing that the presence of pesticide residues in foods is generally not permitted. A lack of awareness of maximum residue levels was associated with heightened levels of concern about pesticide residues. Finally, general exposure to media reporting on pesticide residues was associated with more frequent knowledge of legal limits for pesticide residues, whereas actively seeking information on pesticide residues was not. The possible mechanisms underlying these findings are discussed.

Key words: Consumer behavior; Food choice; Food safety concerns; General public; Pesticide residues; Risk perception

Despite the steadily growing market share of organic produce, the use of synthetic pesticides is a currently common agricultural practice in most European countries and internationally (15, 21). In view of the abundance of literature investigating the physiological, biochemical, and environmental effects of pesticides (3, 18), the relative scarcity of research on risk perceptions from a consumer's point of view is surprising. According to the European Food Safety Authority, almost 99% of food products originating from the European Union and European Economic Area contain either no pesticide residues at all or quantities not considered harmful to human health (7). Nevertheless, public concern about pesticide use seems to be high compared with other food-related risk factors (6), and health-related reasons tend to prevail in consumers' decisions to switch to organic produce (16).

The lower incidence of measurable concentrations of synthetic pesticide residues in organic produce is supported by various studies and meta-analyses (2, 7, 21), whereas no clear evidence of a nutritional advantage of organically

compared with conventionally produced foods has been established yet (21). It is also unclear to what extent statutory precautions for the safety of conventionally produced foods, such as legal limits for pesticide residues (referred to as maximum residue levels) (7), are known to the general public. A lack of awareness of these precautionary measures may foster the belief that any residue level is detrimental to human health and consequently give rise to heightened levels of concern about pesticide residues in foods (4).

The overall aim of this study was to capture the perception of pesticide use and pesticide residues in food among the German public. To achieve this goal, a representative sample of the German population was interviewed about their attitudes and knowledge concerning pesticide residues. Specifically, the objectives of this study were to (i) assess risk perceptions, knowledge, and levels of concern with regard to pesticide residues; (ii) relate these variables to differences in consumer characteristics; and (iii) identify potential areas for future public health communication (19) on the basis of possible misconceptions and information deficits among different consumer groups. In terms of consumer characteristics (13), the views of organic

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TABLE 1. Sex, age, and income distribution of respondents (n = 1,004)

	Total sample (%)	Conventional consumers (%) (n = 423)	Organic consumers (%) (n = 581)
Sex			
Male	49	50	50
Female	51	35	65
Age (yr)			
14–17	5	48	52
18–29	15	40	60
30–39	14	44	56
40–49	18	43	57
50–59	17	38	62
60–69	13	43	57
≥70	18	43	57
Income^a			
Under 1,000	13	45	55
1,000–1,499	11	39	61
1,500–1,999	13	39	61
2,000–2,499	11	31	69
2,500–2,999	10	42	58
3,000–3,499	5	52	48
≥3,500	17	48	52
No answer	20	42	58

^a Monthly net household income in euros.

consumers were compared with those of conventional consumers to identify similarities between, as well as any unique characteristics of, these two types of consumers. It was hypothesized that risk perceptions and levels of concern will be more pronounced among organic consumers, probably driven by the assumption that any concentration of pesticide residues in foods is against the law. In addition, common information strategies, such as active searches for information or general exposure to media reporting on pesticide residues, were assessed to relate information behavior to consumer types and differences in risk perceptions and knowledge levels. It was assumed that active searches for information are not necessarily associated with higher knowledge levels, as individuals may engage in search strategies that reinforce their preexisting views and conceptions (20).

MATERIALS AND METHODS

The survey was conducted on two consecutive weekdays at the beginning of February 2016 in Germany via computer-assisted telephone interviewing (10). A representative sample of 1,004 respondents (49% male, 51% female; mean age, 48.6 years; Table 1) was drawn from the German-speaking population aged 14 years and older. The lower age limit was chosen to include all individuals who tend to make regular food purchases and therefore qualify as consumers. To restrict the margin of error to 3% at a 95% confidence interval, a total sample size of at least 1,000 was required. The survey was conducted by a professional market research and polling agency with International Organization for Standardization–certified call centers. A computerized random sample selection procedure was used to generate a sample representative of the German population, following the standards

set by the Association of German Market Research Institutes (1) (based on the Gabler-Häder method (11)). The basic procedure is based on random digit dialing of landline and mobile phone numbers within the range of valid numbers in the German telephone network. Using this dual-frame approach, approximately 10% of mobile-only users were included in the sample (i.e., respondents who rely solely on mobile phones without a concurrent landline). Trained interviewers contacted the target households and selected the target person within each household randomly using the Kish selection grid method (14). Call attempts were scheduled between 5:00 p.m. and 9:00 p.m. on weekday evenings. The survey was administered by the interviewers via telephone as a computerized structured questionnaire. NIPO ODIN software for computer-assisted telephone interviewing research was used by all interviewers to control dialing, questionnaire administration, the customized flow of the survey (e.g., skipping of inapplicable questions), data entry, data quality checks, and data processing. The survey took between 5 and 10 min to complete and was conducted as part of a larger study on consumer topics.

Measures of safety concerns, risk perceptions, and knowledge levels. Threats to food quality and safety were assessed with an introductory open-ended question, whereas the remaining questions used a closed format (Table 2). Coding of the open-ended responses was carried out after data collection had been finalized. Responses were initially screened for similarities as well as differences with the aim of grouping responses into a smaller number of clearly defined, mutually exclusive categories. In the subsequent process of coding all responses, additional categories were created if a more fine-grained differentiation was needed or, alternatively, separate categories were combined to create categories with a broader meaning. Eventually, individual responses were coded into 18 overarching categories in total (Table 3).

The remainder of the survey contained various questions assessing consumers' food safety concerns, risk perceptions, and knowledge levels with regard to pesticide residues, including consumers' perceptions of the risk-benefit ratio of pesticides; awareness of maximum residue levels for pesticide residues; and consumers' concerns about glyphosate residues (the most commonly used active substance in pesticides) in the food chain, in breast milk, in blood, and in urine (Table 2). This last question is partly hypothetical in that refined analytical methods showed no indication of detectable levels of glyphosate residues in breast milk (22). Nevertheless, reports on alleged glyphosate residues in breast milk appeared in the media in 2014 and 2015 and unsettled the German public and breast-feeding mothers in particular (8, 22). Accordingly, the concern measure was extended to a range of bodily fluids, irrespective of scientific evidence for or against the actual transfer of glyphosate residues to these body sites.

Measures of consumer types and information behavior. In addition to sociodemographic characteristics, such as age, sex, income, education level, occupation, region, and household size, consumer types were assessed using three items targeting respondents' usual grocery shopping behavior. Respondents were asked to indicate their agreement or disagreement with the following statements: "I preferably buy organically produced foods," "I avoid foods that I know or presume to contain pesticide residues," and "I preferably buy conventionally produced foods." After reverse-coding the last item, an aggregate consumer type measure was created, with respondents divided into conventional and organic consumers by a median split. Consumers' information behavior was assessed with a single statement, which served as a

TABLE 2. Survey questions^a

	Questions	Response options
Introductory open-ended question		
Question 1.1: Threats to food quality and safety	What could most severely impair the quality and safety of food?	Open-ended question with up to three mentions per respondent
Risk perceptions, knowledge levels, and safety concerns		
Question 2.1: Risk-benefit ratio	How do you rate the risk-benefit ratio of pesticides?	1 = benefits outweigh by far 2 = benefits are slightly greater 3 = risks are slightly greater 4 = risks outweigh by far
Question 2.2: Awareness of legal limits	Do you think that pesticide residues may generally be contained in foods?	1 = yes 2 = no 3 = don't know
Question 2.3: Concern	To what extent are you personally concerned or unconcerned about the following reports on the pesticidal active substance glyphosate? (detection of glyphosate in the food chain/in breast milk/in blood/in urine) ^b	5-point scales ranging from not concerned to concerned
Consumer types	Which of the following statements apply to you or do not apply to you?	
Question 3.1	"I preferably buy organically produced foods."	1 = true 2 = false
Question 3.2	"I avoid foods that I know or presume to contain pesticide residues."	1 = true 2 = false
Question 3.3	"I preferably buy conventionally produced foods."	1 = true 2 = false
Information behavior		
Question 4.1: Active information behavior	Does the following statement apply to you or not apply to you? "I often acquire information on pesticide residues in foods."	1 = true 2 = false
Question 4.2: Exposure to media reporting	Have you heard, seen or read anything about pesticide residues in the media in the past 2 years?	1 = yes 2 = no 3 = don't know
Demographic variables	Age, sex, income, education level, occupation, region and household size	Forced-choice questions

^a Questions 3.1 to 3.3 were presented in a random order. The survey questions are grouped into thematic blocks for the sake of clarity, the actual order of questions differed slightly.

^b Question 2.3 is partly hypothetical in that refined analytical methods showed no indication of detectable levels of glyphosate residues in breast milk (22).

proxy for active forms of information seeking. In a complementary manner, general exposure to media reporting on pesticide residues in the past 2 years was measured with a forced-choice question (Table 2).

Data were analyzed using the statistical software package SPSS version 21 (IBM Corp., Armonk, NY). For all categorical variables, chi-square tests of independence were applied to test for statistically significant differences. *P* values equal to or less than 0.05 were considered statistically significant.

RESULTS

Profile of consumer types. Chi-square tests of independence were performed to examine the relations between consumer types and other respondent characteristics. Conventional consumers (*n* = 423) and organic consumers (*n* = 581) differed significantly in their reported information behavior, with higher percentages of frequent information seekers among the organic consumers (31%) relative to the conventional consumers (14%; $\chi^2(1) = 40.63$,

P < 0.000). Male respondents were evenly distributed over the two consumer type groups, whereas female respondents were significantly more often classified as organic consumers (65%; $\chi^2(1) = 24.21$, *P* < 0.001; Table 1). Consumer types were also related to household size in that a significantly higher percentage of organic consumers lived in small households of one or two persons (64%) compared with conventional consumers (56%; $\chi^2(1) = 6.06$, *P* = 0.015). No other significant differences between consumer types were found.

Perceived threats to food quality and safety. The four most frequently mentioned threats to food quality and safety across all respondents were pesticides, chemicals, toxins (17%), industrialization of agriculture (16%), mass livestock farming, use of antibiotics (13%), and climate, environmental pollution (13%). All threats mentioned by more than 5% of respondents are shown in Table 3. Lack of hygiene, a frequently underestimated health risk, was

TABLE 3. Reported threats to food quality and safety among conventional and organic consumers^a

	Conventional consumers (%) (n = 423)	Organic consumers (%) (n = 581)	Total (%)
Pesticides, chemicals, toxins	15	18	17
Industrialization of agriculture	14	16	16
Mass livestock farming, antibiotics	13	13	13
Climate, environmental pollution in general	12	13	13
Genetic engineering, genetic manipulation	9	10	10
Profit-seeking, economic interests	10	9	10
Lack of controls	12	8	10
Ingredients, additives (e.g., flavor enhancers, preservatives)	5	12	9
(Over)storage, transport over long distances	8	8	8
Too low priced, cost pressure	9	7	8
Wrong, poor declaration	7	7	7
Imports, standards in producer countries	5	8	7

^a Multiple responses allowed. Significant differences between consumer types are indicated by *** ($P < 0.001$). Additional threats mentioned by 1 to 5% of the total sample were coded into the categories contamination of soil or waters, lack of hygiene, packaging materials, consumer behavior, political interference, and careless handling of foods.

mentioned by less than 2% of respondents. The category pesticides, chemical, toxins headed the threat ranking in both consumer groups, with mention rates of 18 and 15% among organic and conventional consumers, respectively. However, a chi-square test of independence revealed that this difference in mention rates between consumer groups was not statistically significant ($P > 0.10$). Overall, the proportions of respondents nominating various threats were similar in both consumer groups. A significant difference between consumer groups was found for ingredients and additives, which were more frequently mentioned by organic consumers ($\chi^2 (1) = 12.69, P < 0.001$).

Risk-benefit ratio of pesticides. As shown in Table 4, conventional and organic consumers differed significantly in their risk-benefit assessments ($\chi^2 (4) = 34.58, P < 0.001$). More than two-thirds of organic consumers (70%) rated the risks of pesticides as greater than their benefits, nearly one-half of which found the risks to outweigh the benefits by far. By comparison, only just over one-half of the conventional consumers (53%) rated the risks as greater than the benefits, nearly one-half of which found the risks to outweigh the benefits by far.

Awareness of statutory maximum residue levels. Two-thirds of respondents reported that to their knowledge, the presence of pesticide residues in foods is generally not permitted. This tendency was more pronounced among organic (69%) compared to conventional consumers (61%), as indicated by a significant chi-square test of independence ($\chi^2 (1) = 5.76, P = 0.018$).

Concern about pesticide residues. The proportions of organic and conventional consumers reporting concern about the detection of glyphosate residues in the food chain, as well as in breast milk, blood, and urine are presented in Figure 1. Although the wording of the question ensured that it was answerable by all respondents irrespective of prior knowledge of the addressed topics, the analysis was

restricted to respondents exposed to media reporting on pesticide residues in the past 2 years ($n = 695$) to enhance the interpretability and meaningfulness of the findings. Including all respondents in the analysis showed a similar pattern of results, with significantly higher levels of concern among organic consumers on all items (P 's < 0.05).

Overall, conventional consumers showed less concern about pesticide residues than organic consumers. Comparing the proportions of consumers who were concerned about all four probed residue types (i.e., food chain, breast milk, blood, and urine), a significant difference between consumer types was found, with more than one-quarter of organic consumers (27%) indicating concern about all residue types compared with 17% among conventional consumers ($\chi^2 (1) = 13.25, P < 0.000$).

Across both consumer types, pesticide residues in breast milk were most frequently evaluated as worrying (48%), followed by residues in the food chain and blood (both 40%). The lowest levels of concern were found for pesticide residues in urine, with 34% of respondents reporting concern about this residue type. A series of chi-square tests of independence were performed to compare the levels of concern about the different residue types between consumer types. Significant differences were found for blood and urine residues (Fig. 1), with more frequent concern about these

TABLE 4. Assessments of risk-benefit ratios of pesticides among conventional and organic consumers

	Conventional consumers (%) (n = 423)	Organic consumers (%) (n = 581)
Risks outweigh by far	25	32
Risks are slightly greater	29	38
Benefits are slightly greater	26	20
Benefits outweigh by far	8	4
Don't know	14	6
Total: risks larger than benefits	53	70
Total: benefits larger than risks	33	24

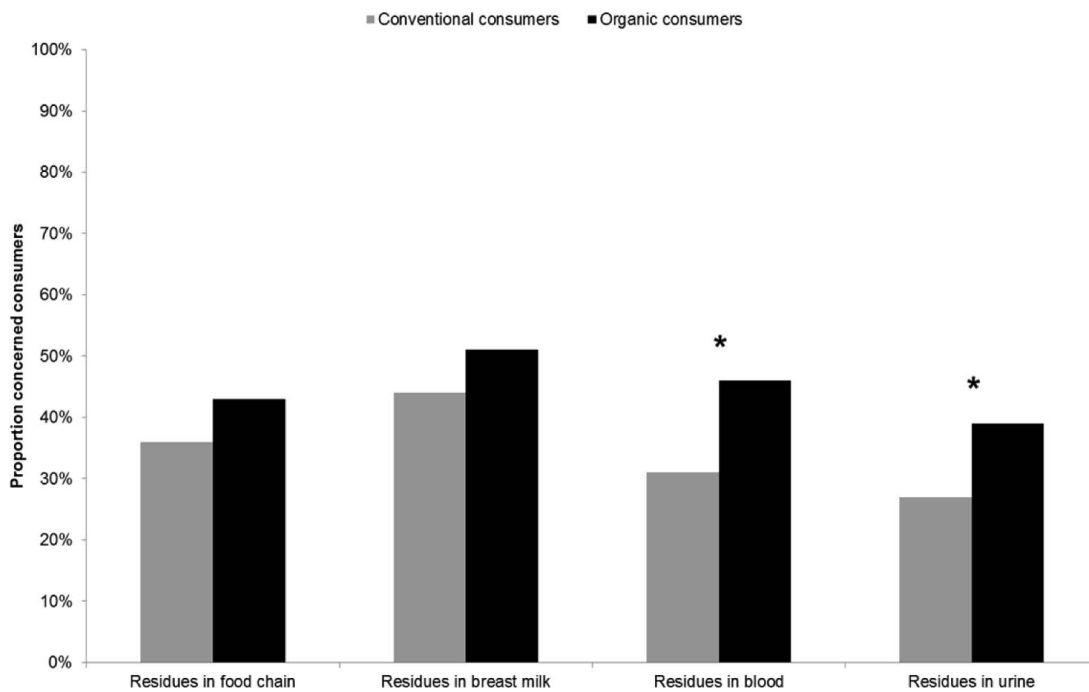


FIGURE 1. Proportions of conventional and organic consumers concerned about pesticide residues in the food chain and the human body. Proportions refer to responses above the scale midpoint (i.e., scale points 4 and 5 on the 5-point concern measure). Asterisks indicate significant differences between consumer types at $P < 0.05$.

residue types reported by organic consumers compared with conventional consumers ($\chi^2(1) = 17.34$, $P < 0.000$ for residues in blood; $\chi^2(1) = 10.19$, $P = 0.001$ for residues in urine).

Relation between awareness of statutory maximum residue levels and concern about pesticide residues. A multivariate analysis of variance was performed with awareness of statutory maximum residue levels (yes/no) as an independent variable (between-subjects factor) and levels of concern about the four residue types (i.e., food chain, breast milk, blood, and urine) as dependent variables. Results indicated that being unaware of maximum residue levels was associated with significantly higher levels of concern about pesticide residues relative to awareness of maximum residue levels ($F(4, 921) = 4.19$, $P = 0.002$; Wilk's $\lambda = 0.982$, partial $\eta^2 = 0.018$).

Relation between awareness of statutory maximum residue levels and information behavior. Respondents who identified themselves as actively acquiring information on pesticide residues in foods on a regular basis, suggesting an increased level of subject knowledge, were equally often unaware of the existence of legal limits for pesticide residues (70%) than respondents who did not report active search behavior (64%; difference in frequencies not significant). General exposure to media reporting on pesticide residues in the past 2 years, in contrast, was associated with less frequent beliefs that the presence of pesticide residues in foods is generally not permitted (62%) compared with respondents who reported no exposure to media reporting (74%; $\chi^2(1) = 18.96$, $P < 0.000$).

DISCUSSION

This study examined the perception of pesticide residues in foods among the German public, with special focus on comparisons between organic and conventional consumers. Consistent with previously observed high levels of concern about pesticide use in various countries (6), both organic and conventional consumers most frequently cited pesticides, chemicals, and toxins as the greatest threats to food quality and safety. Weighing up the risks and benefits of pesticide use, organic consumers took a more pesticide-critical stance, with more than two-thirds of organic consumers (70%) rating the risks as greater than the benefits, compared with just over one-half of conventional consumers (53%).

In terms of the legality of pesticide residues, the majority of respondents (66%) falsely believed that the presence of residues in foods is generally not permitted. Organic consumers were more frequently unaware of the existence of maximum residue levels (69%) than conventional consumers (61%). The little-known concept of maximum residue levels needs to be addressed in future public health communication, especially because unawareness of these legal limits was associated with increased levels of concern about pesticide residues in food. Specifically, it should be communicated clearly that the presence of residues per se is not associated with health risks, as long as concentrations do not exceed clearly defined thresholds (7). Highlighting the fact that threshold violations with regard to pesticide residues in foods are found in less than 2% of food samples (7) should also help to put the associated health risk into perspective.

Levels of concern about pesticide residues were highest for breast milk (48%) and lowest for urine (34%) across both

groups. As mentioned previously, pesticide residues in breast milk have been added as a hypothetical scenario owing to media coverage of this topic, although refined analytical methods showed no indication of detectable levels of pesticide residues in breast milk (22). Organic consumers more frequently voiced concerns about pesticide residues in blood and urine, and they more frequently rated all types of residues as worrying compared with conventional consumers. In combination with the above-mentioned findings, this confirms the hypothesis that risk perceptions and levels of concern are generally more pronounced among organic consumers.

In line with further predictions, exposure to media reporting on pesticide residues in the past 2 years was associated with increased knowledge levels (i.e., awareness of legal limits), whereas active information behavior was not. This is alarming because consumers who actively search for information about a particular topic may experience a stronger sense of confidence in their knowledge. In a similar vein, confirmation biases may distort Web-based searches in that individuals tend to engage in search strategies that reinforce their preexisting views and conceptions (20). However, to determine whether confirmatory search strategies played a role in the knowledge gaps regarding legal limits for pesticide residues observed in this study, additional research is needed. Conducting a study to observe and analyze the Web-based search terms participants use to acquire information on this topic may be a plausible starting point for future research.

Our findings concur with those of previous studies on risk perceptions of pesticide residues (4, 6). In Germany and various other European countries, levels of concern about pesticide residues and other chemicals in foods tend to be high. The widespread belief that the presence of any concentration of pesticide residues in foods is against the law may be related to the more general phenomenon of insensitivity to dose-response relationships often observed in laypeople. Dose-response insensitivity fosters the belief that small doses of chemicals such as pesticides are likely to cause harm (4). The current findings advance the existing literature by dividing respondents into conventional and organic consumers, so that differences as well as similarities between these consumer groups were captured. For example, whereas pesticides, chemicals, and toxins were perceived as the most serious threat to food quality and safety by both consumer types, this general perception translated into more extreme risk assessments and greater levels of concern among organic consumers. Importantly, to understand the lifestyle choices people make, the underlying knowledge base and belief-systems need to be gauged along with the factors that feed into these belief-systems, such as consumers' information behavior.

The higher proportion of females among the group of organic consumers in this survey is consistent with findings from representative surveys conducted in Germany and elsewhere (9, 23) and generally complies with the notion of greater risk aversion among women compared to men in various domains, including health-related choices (12). Previous research has also shown that women tend to be more concerned about pesticide residues than men (5), a

pattern that was also observed in this survey. Risk communication surrounding pesticide residues in foods and efforts to increase consumers' chemical risk literacy might therefore focus primarily on female consumers (4).

It should be acknowledged that the median split carried out to divide participants into organic and conventional consumers does not reflect the proportions of consumers who only buy organic or conventional foods. Consumer types should be interpreted as a measure of affinity for organic food choices rather than a categorization into strictly organic versus conventional consumers. Statistics suggest that only 3% of German consumers buy exclusively organic products, whereas more than two-thirds of consumers buy organic foods occasionally (9). Nevertheless, consumers may identify themselves more strongly as organic than as conventional consumers even if their actual grocery shopping pattern is a mix of organic and conventional foods. These mixed shopping patterns may be an indication that other purchase considerations (such as higher costs and reduced availability of organic produce) (23) keep consumers from buying organic food exclusively or more frequently.

A limitation of this study is the exclusive use of self-report measures that tend to be prone to response biases (17). Future studies need to include objective indicators to corroborate the present findings, for instance by quantifying the agreement between self-reported grocery shopping behavior and actual purchases. A further limitation concerns the cross-sectional nature of this study. To identify trends over time, it will be crucial to repeat the survey at regular intervals. Finally, although it is common practice to select nationally representative samples by means of randomized calling systems (11), combining different sample selection methods may potentially improve the quality of these samples, especially with regard to segments of the population that tend to be difficult to recruit.

In sum, this study investigates the public perception of pesticide residues in foods and compares the views of conventional to those of organic consumers. Pesticide residues are seen as a major threat to food quality and safety by both consumer types. As predicted, risk perceptions and levels of concern about pesticide residues are significantly more pronounced among organic consumers. Knowledge of statutory maximum residue levels is low, with 69% of organic consumers believing that the presence of pesticide residues in foods is generally not permitted. Active information behavior is not associated with more frequent awareness of statutory maximum residue levels, but lack of awareness of statutory maximum residue levels is associated with increased levels of concern about the presence of pesticide residues in foods.

REFERENCES

1. Arbeitskreis Deutscher Markt. 2016. The ADM sampling system for telephone surveys. Available at: <https://www.adm-ev.de/telefonbefragungen/?L=1>. Accessed 13 March 2017.
2. Baranski, M., D. Średnicka-Tober, N. Volakakis, C. Seal, R. Sanderson, G. B. Stewart, C. Benbrook, B. Biavati, E. Markellou, C. Giotis, J. Gromadzka-Ostrowska, E. Rembiałkowska, K. Skwarlo-Sonta, R. Tahvonen, D. Janovska, U. Niggli, P. Nicot, and C. Leifert. 2014. Higher antioxidant and lower cadmium concentrations and

- lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses. *Br. J. Nutr.* 112:794–811.
3. Corsini, E., M. Sokooti, C. L. Galli, A. Moretto, and C. Colosio. 2013. Pesticide induced immunotoxicity in humans: a comprehensive review of the existing evidence. *Toxicology* 307:123–135.
 4. Dickson-Spillmann, M., M. Siegrist, and C. Keller. 2011. Attitudes toward chemicals are associated with preference for natural food. *Food Qual. Prefer.* 22:149–156.
 5. Dosman, D. M., W. L. Adamowicz, and S. E. Hrudey. 2001. Socioeconomic determinants of health- and food safety-related risk perceptions. *Risk Anal.* 21:307–317.
 6. European Commission. 2010. Special Eurobarometer 354: food-related risks. Available at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_354_en.pdf. Accessed 13 March 2017.
 7. European Food Safety Authority. 2015. The 2013 European Union report on pesticide residues in food. *EFSA J.* 13:4038. doi:10.2903/j.efsa.2015.4038.
 8. Federal Institute for Risk Assessment. 2016. BfR study confirms: no glyphosate detectable in breast milk. Available at: http://www.bfr.bund.de/en/press_information/2016/08/bfr_study_confirms_no_glyphosate_detectable_in_breast_milk-196578.html. Accessed 13 March 2017.
 9. Federal Ministry of Food and Agriculture. 2016. Ökobarometer 2016. Available at: <http://www.bmel.de/SharedDocs/Downloads/Ernaehrung/Oekobarometer2016.pdf>. Accessed 13 March 2017.
 10. Groves, R. M., P. B. Biemer, L. E. Lyberg, J. T. Massey, W. L. Nicholls, and J. Waksberg. 2001. Telephone survey methodology. John Wiley & Sons, New York.
 11. Häder, S. 2016. GESIS survey guidelines: sampling in practice. GESIS Institute for the Social Sciences, Mannheim, Germany. doi:10.15465/gesis-sg_en_014.
 12. Harris, C. R., M. Jenkins, and D. Glaser. 2006. Gender differences in risk assessment: why do women take fewer risks than men? *Judgm. Decis. Mak.* 1:48–63.
 13. Hsu, C. L., and M. C. Chen. 2014. Explaining consumer attitudes and purchase intentions toward organic food: contributions from regulatory fit and consumer characteristics. *Food Qual. Prefer.* 35:6–13.
 14. Kish, L. 1949. A procedure for objective respondent selection within the household. *J. Am. Stat. Assoc.* 44:380–387.
 15. Lamichhane, J. R., S. Dachbrodt-Saaydeh, P. Kudsk, and A. Messean. 2012. Toward a reduced reliance on conventional pesticides in European agriculture. *Plant Dis.* 100:10–24.
 16. Magnusson, M. K., A. Arvola, U. K. Koivisto-Hursti, L. Åberg, and P.-O. Sjöden. 2003. Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behavior. *Appetite* 40:109–117.
 17. Nederhof, A. 1985. Methods of coping with social desirability bias: a review. *Eur. J. Soc. Psychol.* 15:263–280.
 18. Rodrigo, M. A., N. Oturan, and M. A. Oturan. 2014. Electrochemically assisted remediation of pesticides in soils and water: a review. *Chem. Rev.* 114:8720–8745.
 19. Rutsaert, P., Z. Pieniak, A. Regan, A. McConnon, and W. Verbeke. 2013. Consumer interest in receiving information through social media about the risks of pesticide residues. *Food Control* 34:386–392.
 20. Schweiger, S., A. Oeberst, and U. Cress. 2014. Confirmation bias in web-based search: a randomized online study on the effects of expert information and social tags on information search and evaluation. *J. Med. Internet Res.* 16:e94.
 21. Smith-Spangler, C., M. L. Brandeau, G. E. Hunter, J. C. Bavinger, M. Pearson, P. J. Eschbach, V. Sundaram, H. Liu, P. Schirmer, C. Stave, I. Olkin, and D. M. Bravata. 2012. Are organic foods safer or healthier than conventional alternatives? *Ann. Intern. Med.* 157:348–366.
 22. Steinborn, A., L. Alder, B. Michalski, P. Zomer, P. Bendig, S. Aleson Martinez, H. G. J. Mol, T. J. Class, and N. Costa Pinheiro. 2016. Determination of glyphosate levels in breast milk samples from Germany by LC-MS/MS and GC-MS/MS. *J. Agric. Food Chem.* 64:1414–1421.
 23. Yiridoe, E. K., S. Bonti-Ankomah, and R. C. Martin. 2005. Comparison of consumer perceptions and preference toward organic versus conventionally produced foods: a review and update of the literature. *Renew. Agric. Food Syst.* 20:193–205.