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Hunters and Non-hunters Chronic Wasting Disease Risk Perceptions over Time

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ABSTRACT

We examined risk perceptions of chronic wasting disease (CWD) over time (2004 vs. 2012), and among hunters and non-hunters. Data were obtained from two mailed surveys in 2004 that included random samples of hunters ($n = 1879$) and non-hunters ($n = 1122$). We conducted two additional mail surveys in 2012 that also included random samples of hunters ($n = 3391$) and non-hunters ($n = 1615$). Based on the psychometric paradigm, we hypothesized that CWD risk perceptions will: (1) decline over time (2004 vs. 2012, Hypothesis 1), and (2) be higher for hunters than non-hunters (Hypothesis 2). We also predicted that study year (2004 vs. 2012) and sample (hunters vs. non-hunters) will interact (Hypothesis 3). Results supported hypothesis 1; CWD risk perceptions declined over time. Hypothesis 2 was also supported as hunters reported higher risk perceptions than non-hunters. Year and sample interacted to influence perceived risk; supporting hypothesis 3.

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Chronic wasting disease; hunters; non-hunters; perceived risk

Introduction

Human dimensions (HD) research facilitates understanding the impacts of wildlife diseases on society (Otupiri et al. 2000; Decker et al. 2006). Numerous articles have explored the epidemiology of wildlife diseases, but less research has examined the HD of such diseases (Vaske 2010). Managers reluctant to make decisions without biological information should be equally hesitant to make decisions without input from relevant stakeholders. Disease risks can be potentially mitigated by understanding stakeholders, and implementing policies that incorporate their opinions (Amick et al. 2015; Schuler et al. 2016). Simonetti (1995), for example, found that understanding landowner perceived risks was helpful for Chilean park managers to address foot and mouth disease in deer.

Perceived risk is the extent to which an individual believes s/he is exposed to a specific hazard (Sjöberg 2000; Slovic 2000, 2010; Siegrist et al. 2005). Unlike actual risk, which involves objective probabilities and real consequences of hazards (Adams and Smith 2001; Breakwell 2014), perceived risks are subjective and intuitive judgments. Chronic wasting disease (CWD) is caused by a mutation in a prion protein. The disease

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is always fatal in all infected animals (Edmunds et al. 2016) and is found in several cervid species (Williams et al. 2002; Saunders et al. 2012; Haley and Hoover 2015). We examined how risk perceptions associated with CWD changed over time (i.e., 2004 vs. 2012) among hunters and non-hunters in Illinois.

Conceptual Foundation

The Psychometric Paradigm

The psychometric paradigm attempts to understand individuals' perceived risks and the determinants of such perceptions (Lion et al. 2002). Fischhoff et al. (1978) asked respondents to rate 30 hazards, activities, and technologies (e.g., nuclear power, pesticides, prescription antibiotics, x-rays) on nine semantic differential scales (e.g., voluntary – involuntary, new risk – old risk). Factor analyses identified two dimensions: (a) *dread* of the risk (i.e., how uncontrollable, potentially catastrophic, dangerous to future generations, new, involuntary), and (b) *knowledge* of the risk (i.e., how chronic, known to those exposed, old). Familiarity and self-assessed knowledge were associated with risk perceptions (Siegrist and Cvetkovich 2000; Gupta, Fischer, and Fewer 2012). Media attention and availability of information can give rise to a high degree of perceived risk, especially for low probability risks (e.g., airplane crashes) that tend to be overestimated and receive substantial attention when they occur (Boyd and Jardine 2011).

Perceptions of risk have been studied in many contexts such as healthcare (Shiloh et al. 2013), tourism and recreation (Morgan and Stevens 2008), natural disasters (Armas and Avram 2008), driving (Roche-Cerasi et al. 2013), and smoking (Oncken et al. 2005). Much of the literature, however, has focused on nuclear energy and genetic engineering (Sjöberg 2004; Gupta, Fischer, and Frewer 2012). Because wildlife and the diseases they carry can also be a hazard, risk theory can be useful for understanding and predicting how people will react to such hazards (Gore et al. 2009; Hanisch-Kirkbride et al. 2013).

Risk Perceptions over Time

Risk perceptions can vary over time, depend on the context, and can affect behavior. For example, before CWD was discovered in Wisconsin in early 2002 few people held an attitude toward the disease (Heberlein 2004). Wisconsin newspapers, however, published more than one CWD article a day during 2002 (Heberlein and Stedman 2009) and individuals who had never heard of CWD quickly developed an attitude toward the disease. That perception influenced their behavior. Wisconsin gun deer-hunting license sales for 2002 declined approximately 11% following the discovery of CWD (Vaske et al. 2004).

Over time, however, perceptions and behavior can change. Holsman and Smail (2006) compared Wisconsin residents' attitudes toward CWD over a 3-year period (i.e., 2003–05) and found people were less concerned about the disease in 2005 than they were in 2003. Two 2010 articles (Cooney and Holsman 2010; Holsman, Petchenik, and Cooney 2010) also found that although people were still slightly concerned about getting sick from eating deer infected with CWD, their perceived risks had diminished since the

discovery of the disease in Wisconsin. Time and experience with this disease may have partially alleviated the concerns identified in earlier studies (Vaske et al. 2004; Needham et al. 2004, 2006; Needham and Vaske 2006, 2008). License sales show that hunter numbers have returned to approximately where they were before the discovery of CWD (Wisconsin Department of Natural Resources 2010).

Hunters versus Non-hunters

Most CWD research has focused on hunters' risk perceptions (Vaske 2010). Hunters in eight states believed that CWD poses some risk to humans and were concerned about eating meat possibly infected with CWD (Needham and Vaske 2006; Needham et al. 2006). CWD poses no known risk to humans, but transmission to people cannot be dismissed (Belay et al. 2004, MaWhinney et al. 2006; Haley and Hoover 2015). Because of this uncertainty, some hunters have stopped hunting. As noted earlier, nine months after the discovery of CWD in Wisconsin, hunting license sales declined by over 90,000 (Heberlein 2004). Research has shown that changes in hunter behavior are influenced by risk perceptions associated with CWD (Miller 2004; Vaske et al. 2004; Needham et al. 2004, 2006; Needham and Vaske 2008; Lyon and Vaske 2010; Vaske 2010; Vaske and Lyon 2011; Harper, Miller, and Vaske 2015). Stafford et al. (2007), however, found most non-hunter landowners were not concerned about CWD, whereas most landowners who hunted expressed concern over the disease. These findings suggest that hunters may be more worried about CWD than non-hunters.

Changes in disease risk perceptions over time and participation in hunting (or not hunting) may interact. While the perceived risk among hunters declined since CWD was discovered in Wisconsin (Holsman and Smail 2006; Cooney and Holsman 2010; Holsman et al. 2010), some data suggest that CWD was never considered a serious problem among Wisconsin non-hunters (Stafford et al. 2007). Following the tenets of the psychometric paradigm, the pattern of findings for CWD in Wisconsin will likely replicate in Illinois. In Illinois, CWD was discovered in 2002 and when we collected the data in 2012, there were 372 confirmed cases, located in 10 northern Illinois counties (Miller et al. 2013).

Hypotheses

Based on the psychometric paradigm and previous literature, we advanced the following hypotheses:

- H_1 CWD risk perceptions will decline over time (2004 vs. 2012).
- H_2 Hunters will perceive more risks associated with CWD than non-hunters.
- H_3 Year (2004 vs. 2012) and sample (hunters vs. non-hunters) will interact to influence perceived risk of CWD.

Methods

Sampling and Data Collection

Data from four mailed surveys were included in this article. All surveys followed the same protocol. Each survey participant initially received a questionnaire, cover letter and

stamped return envelope. A postcard reminder was mailed 14 days after the first mailing and a second complete mailing (i.e., questionnaire, cover letter) was sent 14 days later to non-respondents. A final postcard reminder was sent to non-respondents 14 days after the second complete mailing.

The first survey in 2004 included 1500 randomly selected residents in the Chicago area, and 1500 residents from the rest of Illinois. After adjusting for undeliverable and unusable questionnaires, the response rates were 37% ($n = 482$) for Chicago-area public, and 49% ($n = 640$) for rest-of-Illinois public. Individuals who either currently hunt or had hunted previously in their life were eliminated from this sample.

The second mail survey included resident Illinois hunters selected to participate in the 2003–04 Illinois Hunter Harvest Survey. The Illinois Department of Natural Resources (IDNR) annually records harvest data on game and furbearer species in the state. A stratified random sample of hunters ($n = 3000$) was selected from residents who purchased the Habitat Stamps ($n = 1500$) and resident licenses ($n = 1500$). Of the initial 3000 surveys sent to hunters, 114 were undeliverable, and 1879 usable questionnaires were returned (response rate = 65%).

The third and fourth surveys were designed to assess attitudes toward deer management and CWD in Illinois. In 2012, a mail survey was sent to randomly selected northern Illinois deer hunters ($n = 6000$) stratified by county where their permits were issued; 3391 completed questionnaires were returned (response rate = 58%). Concurrent with the hunter study, a mail survey was sent to 5000 homeowners who resided in the 10 CWD counties. A total of 1615 usable surveys (response rate = 35%) were returned. Similar to the 2004 survey, respondents who either currently or previously hunted were eliminated from this sample.

There were two independent variables: (1) year of study (2004 vs. 2012) and (2) type of respondent (hunter vs. non-hunter). The dependent variable was "How much risk do you feel from becoming ill from chronic wasting disease?" This item was coded on a 4-point scale: (0) no risk, (1) slight risk, (2) moderate risk, and (3) high risk.

Data Analysis

Preliminary analyses compared 2004 and 2012 data sets in terms of age and sex. A two-way ANOVA was used to test the three hypotheses. A $p < .05$ was considered statistically significant. Eta (η) was used as an effect size indicator. An eta of .10 reflected a "minimal" relationship, .243 represented a "typical" relationship, and an $\eta > .371$ was considered a "substantial" relationship (Vaske 2008).

Results

The 2004 and 2012 hunter samples were statistically equivalent in terms of sex and age (Table 1). Over 95% of respondents in both years were male. The mean age of hunters in 2004 was 46.71 ($SD = 7.94$); the mean age in 2012 was 47.18 ($SD = 7.03$). The 2004 and 2012 non-hunter respondents were also statistically equivalent in terms of sex and age. Sixty-two percent were males in 2004; 63% were male in 2012. The mean age of the non-hunters in 2004 was 55.12 ($SD = 6.34$); the mean age in 2012 was 56.25 ($SD = 6.95$). None of these comparisons varied statistically.

Table 1. Demographic comparison of the four samples.

	Hunters		Non-hunters	
	2004	2012	2004	2012
Sex[a]				
Male (%)	97	96	62	63
Female (%)	3	4	48	47
Age (*M*)[b]	46.71	47.18	55.12	56.25

[a]Hunters (2004 vs. 2012) $\chi^2 = 0.24$, n.s. Non-hunters (2004 vs. 2012) $\chi^2 = 0.38$, n.s.
[b]Hunters (2004 vs. 2012) $t = 0.57$, n.s. Non-hunters (2004 vs. 2012) $t = 0.49$, n.s.

Table 2. Two-way ANOVA for perceived risk of chronic wasting disease by year (2004 vs. 2012) and sample (hunter vs. non-hunter).

Independent variables	*F*	*p*	Eta
Year	296.06	<.001	.179
Sample	21.34	<.001	.047
Year × Sample	20.12	<.001	.047

Dependent variable: Perceived risk of CWD.

Perceived risks associated with CWD declined between the two study years. In 2004, 26% reported no perceived risk from CWD to humans; in 2012, this percent nearly doubled (51%). At the other end of the continuum, 8% considered CWD a high risk to humans in 2004, while only 3% noted high risk in 2012. The two frequency distributions varied statistically, $\chi^2 = 497.10$, $p < .001$, Cramer's $V = .233$. The comparable means were 1.019 ($SE = .018$) in 2004 and 0.643 ($SE = .013$) in 2012 in the pooled sample, $F = 296.06$, $p < .001$ (Table 2). The eta was between "minimal" and "typical" at .179. These findings support Hypothesis 1; CWD risk perceptions declined over time.

Nearly half (49%) of the non-hunters reported no perceived risk to humans from CWD, compared to 44% of the hunters. Over 5% of the non-hunters indicated high-perceived risk versus <4% of the hunters, $\chi^2 = 18.38$, $p < .001$, Cramer's $V = .045$. In terms of means, hunters reported slightly more risk of CWD ($M = 0.882$, $SE = .011$) than non-hunters ($M = 0.780$, $SE = .019$). The difference was statistically significant, $F = 21.34$, $p < .001$ (Table 2), but the eta was "minimal" ($\eta = .047$). These results support hypothesis 2; hunters reported more perceived risk from CWD than non-hunters.

As noted above and as shown in Table 2, both main effects were statistically significant and in the predicted direction. Consistent with hypothesis 3, the interaction effect between year (2004 vs. 2012) and sample (hunter vs. non-hunter) was also significant, $F = 20.12$, $p < .001$, $\eta = .047$. The means for the interaction effect are shown in Table 3. Hunters in 2004 reported the highest perceived risk of CWD ($M = 1.119$, $SE = .030$), while non-hunters in 2012 had the lowest mean at 0.641 ($SE = .011$).

Discussion

We hypothesized that disease risk perceptions associated with CWD will (1) decline over time (2004 vs. 2012, Hypothesis 1), and (2) be higher for hunters compared to non-hunters (Hypothesis 2). We also predicted that study year and sample (hunters vs.

Table 3. Means for perceived risks of chronic wasting disease for the year (2004 vs. 2012) and sample (hunter vs. non-hunter) interaction[a].

Year	Hunters	Non-hunters
2004	1.119	0.920
2012	0.664	0.641

[a]Cell entries are means for perceived risk of chronic wasting disease. Perceived risk was measured on a 4-point scale: (0) no risk, (1) slight risk, (2) moderate risk, and (3) high risk.

non-hunters) will interact (Hypothesis 3) to influence risk perceptions. All three hypotheses were supported.

We based our predictions on the psychometric paradigm (Fischhoff et al. 1978; Lion et al. 2002). The public has broad, multidimensional conceptions of risk that incorporate considerations such as newness, dread, uncertainty, and controllability (Kunreuther and Slovic 1996). In many states, CWD has these elements and as such should amplify risk perception (Kasperson et al. 1988). Risks that are considered new, catastrophic, and that involve dread all tend to prompt negative reactions (Kasperson et al. 2001 in Kasperson and Kasperson 2005). Media coverage, public reaction, and the management agency's response intensified the perceived risk associated with chronic wasting disease (Heberlein and Stedman 2009; Boyd and Jardine 2011) as predicted by the psychometric paradigm.

Other research (Sjöberg 2002), however, has shown that *risk sensitivity* (i.e., an inherent predisposition to consider all risks as large) tends to explain more variation in risk perceptions than dimensions common to the psychometric model. Miller and Shelby (2009), for example, examined risk sensitivity relative to risk perceptions among Illinois hunters for CWD, mad cow disease, Lyme disease, West Nile virus, *E. coli,* and *Salmonella*. Cluster analysis of these risks revealed three clusters: no (24%), slight (57%), and moderate (19%) risk groups. The moderate risk group was either less likely to hunt in the most recent season or more likely to hunt in areas without CWD and monitor how deer were behaving before harvesting. This group was also more likely to believe that CWD could infect humans and less likely to think the threat of this disease had been exaggerated. Correlations among risk perceptions for the different diseases and illnesses suggested risk sensitivity varied among these hunters. These observations have been replicated by others (e.g., Needham et al. 2017).

Our findings may also reflect information overload theory (Miller 1956). Individuals presented with increased volumes of information about a particular topic tend to pull back cognitively. Increased messaging of risk may result in denial for protective behaviors and risk recognition (Aldoory and Van Dyke 2006). Factors associated with such retreats include socio-economic status, health, and education (Kim et al. 2007). These cognitive responses may be operating with CWD information. Since the disease was first discovered in Illinois, numerous news stories have appeared in print and broadcast media; this information may have reached the point of overload for some individuals.

Management Implications

The IDNR has aggressively combated the spread of chronic wasting disease within the state. Sharpshooting, for example, can be effective in slowing the prevalence and

distribution of CWD (Harper et al. 2015), but the management strategy is highly contentious. Unfortunately, from a management perspective, perceived risks associated with CWD declined between 2004 and 2012 for both hunters and non-hunters. With less perceived risk, management strategies such as sharpshooting may be even more contentious. The success of sharpshooting in reducing the spread and prevalence of the disease may also lead to the perception that the disease is not widespread and therefore of little risk.

Perceived risks associated with wildlife diseases are often incorporated in state agency education campaigns (Decker et al. 2012). These communication campaigns specify that CWD poses no human health risks (Eschenfelder 2006). Such messages, however, also recommend precautions (e.g., testing animals, wearing gloves when handling animals), suggesting the presence of some risk. For legal reasons, agencies are likely to continue messages with precautionary messages, but this ambiguity may influence perceptions of risk. Mixed messages suggest that wildlife agencies are uncertain about CWD, which may influence risk evaluations (Siegrist and Cvetkovich 2000; Needham and Vaske 2008; Harper et al. 2015).

Communication campaigns, however, may not be successful for educating risk-sensitive hunters. This inherent predisposition to amplify most risks makes it challenging for agencies to single out a specific hazard such as CWD and then reduce risk perceptions associated with that hazard (Sjöberg 2000, 2002; Gore et al. 2009). Communications highlighting no evidence connecting CWD and human health problems should be reiterated, emphasized, and targeted to risk sensitive groups (Needham and Vaske 2008). Differences between CWD and other hunting, wildlife, and health risks should also be clearly articulated in any information and education campaigns. Perceptions of risk from CWD and other hazards that are based on misconceptions may reduce the effectiveness of management efforts. Management agencies should measure public risk evaluations and then target groups who hold these perceptions (Miller and Shelby 2009).

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