EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Perceived causes of sporadic cryptosporidiosis and their relation to sources of information

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Background: The importance of a person's perceptions about the causes of their disease has been emphasised by research on various diseases. Several studies have found perception may be linked to protective behaviours.

Objective: This study intends to identify the main perceived causes of sporadic cryptosporidiosis, and to analyse some of the factors that may influence respondent's perception. The role of respondents' attributions, the scientific plausibility of perceptions, and the importance of specific information sources are also explored.

Design: Quantitative and qualitative analyses of data from a case-control study.

Setting: General population in Wales and north west England.

Participants: The study is based on a sample of 411 respondents from Wales and north west of England, whose cryptosporidiosis diagnosis was confirmed by a laboratory.

Results: The results show that the most frequent perceived causes are water (by drinking it or swimming), contagion (mostly from children), and contaminated food. Perceived causes are qualitatively similar to the ones described in scientific literature, but some quantitative differences are evident. Respondents' certainty in relation to the cause of illness is directly related with plausibility. The most frequent information sources used by respondents were test stool results, environmental health officers, and doctors or nurses. Results suggest that information sources may influence the perception of the causes of cryptosporidiosis. Qualitative data provided a few clues about situations where sporadic and outbreak cases may be confused.

Conclusion: In contrast with outbreaks, various information sources in addition to the media are used by people with sporadic cryptosporidiosis that in turn affects the perception of aetiology. This has implications for the dissemination of information about control measures for cryptosporidiosis and surveillance activities.

The importance of a person's perceptions about the causes of their disease has been emphasised by research on various diseases. Several studies have found that the perceived causes of illness may be linked to protective behaviours and to the kind of treatment that people seek.^{1–5} Prior perceptions of the cause of disease may also bias the results of epidemiological studies by leading to recall bias.^{6–8}

The way people interpret their illness is probably influenced by several factors, including illness severity, demographic variables, and psychological components. Attribution theory, which focuses on the causes people attribute to events, traditionally distinguishes between two poles of locus of control: external compared with internal.⁹ In external attributions causality is assigned to an outside factor (for example, contaminated food), and in internal attributions the causes are allocated to the person themselves (for instance not being careful about the food eaten). While positive outcomes (for example, success, awards) are likely to be attributed internally (for example, ability, effort), negative ones (for example, a failure) tend to be attributed to external causes (for example, bad luck, the environment).¹⁰ Kahlor *et al* found this positive bias during a cryptosporidiosis outbreak in Milwaukee (USA), where those who became ill were likely to attribute the cause of their illness to an external factor, while those unaffected were more likely to take the merit for themselves.¹¹ Persons with a self limiting illness, where the personal impact may be mild and without the public alert generated by an outbreak, are less likely to attribute the cause of their illness to an external factor.

Several studies have found public perception of risks to be influenced by information sources, such as the media and friends.¹² Griffin *et al* emphasised the importance of the media during a cryptosporidium outbreak, noting that media

reliance was associated with anxiety about becoming ill.¹³ Hunter and Syed found that self reported cases of diarrhoea during the media coverage of an outbreak were surprisingly higher in unaffected control towns than in affected communities.¹⁴ This finding shows the potential role of the media in the perception and reporting of diarrhoeal disease. The relevance of the media as an information source during cryptosporidium outbreaks has also been highlighted in public surveys.¹⁵ Nevertheless, as the illness of isolated people with a comparatively common disease hardly attracts public attention, sporadic cases of cryptosporidiosis are unlikely to be reported by the media. In such circumstances, people have to look for information from other sources (for example, doctors, the internet).

The main aim of this study was to improve our understanding of perceived causes of sporadic cryptosporidiosis, and some of the factors that influence perception. For this purpose, the following specific objectives were considered: (1) to determine the perceived causes of cryptosporidiosis among a population of people with the illness; (2) to identify attribution differences in relation to illness severity and demographic variables; (3) to evaluate the scientific plausibility of perceived causes and to determine some of the factors that influence the reported explanation; (4) to identify the information sources that respondents use to acquire information about cryptosporidiosis; and (5) to understand the potential role of information sources on the perception of causes as stated by respondents.

METHODS

This study was done on data previously collected as part of a study of sporadic cryptosporidiosis conducted in Wales and the north west of England.¹⁶ The exact methodology is

reported in detail in our previous paper. Ethical committee approval had been obtained from the North West Multi-Centre Research Ethics Committee and the Public Health Laboratory Service Ethical Committee. In brief, participants were residents of Wales and north west of England with a laboratory confirmed diagnosis of cryptosporidiosis notified to the Communicable Disease Surveillance Centre. A questionnaire and an information leaflet, giving basic information about the study (for example, confidentiality, contact details for questions), were sent by post to 662 potential participants. If no reply was received within two weeks, the questionnaire was sent a second time. The data were collected between February 2001 and May 2002.

Of relevance to this paper, the questionnaire included an open-ended question, where respondents were asked to describe the most probable cause of their illness. After this question, participants were asked to express their certainty on the cause they provided using a 10-point scale, from "none" to "absolutely certain". The analysis of respondents' replies to the open-ended question permitted the identification of different kinds of causes, which were afterwards organised into different categories and subcategories. Several respondents mentioned multiple causes, and therefore the categories are not mutually exclusive.

Two additional variables were later estimated, one describing the kind of attribution, and the other evaluating the scientific plausibility of the perceived cause of illness. Attribution was categorised as "internal", "external", or "both" (when multiple causes contained both internal and external attributions). Plausibility was assessed by a communicable disease control physician (IA), based on current evidence from the published literature on recognised risk factors,¹⁷ and highly improbable causes from a scientific point of view (for example, inhalation) were categorised as implausible.

The data collected were analysed using different statistical approaches. Frequencies were used to describe the perceived

causes and information sources used by respondents. The influence of demographics on perceived causes and their plausibility was analysed using Pearson's χ^2 test. The relations between illness severity, the level of certainty respondents have in their perceived causes, and the number of information sources used to acquire knowledge about cryptosporidiosis were analysed using bivariate regression analyses. Logistic regression analysis was used to assess the relevance of information sources for perceived causes. Because of the sample size requirements of logistic regression,¹⁸ perceived causes were considered at the category level (for example, food—see table 2) but not at the more detailed subcategory level (for example, raw vegetables). Qualitative data, from the open-ended question, were also used to exemplify some of the quantitative findings.

The response rate was 65%, with 427 returned questionnaires. Questionnaires where respondents did not answer the open-ended part (16 people, 3.7%) were discarded. The remaining 411 cases (191 adults and 220 children) were used for this study. The mean age of the sample was 20 years (SD = 19): 37 years (SD = 16) for the adult group, and 5 years (SD = 4) for the child group. A total of 197 participants (48%) were male (one case had gender data missing) and most respondents were white (94%). The number of symptoms (fever, abdominal pain, vomiting, bloody diarrhoea, and other) and hospital admission were selected as indicators of illness severity.

RESULTS

Perceived causes

The main categories (and respective subcategories) of causes identified from the data are: water (drinking water, swimming, and other—for example, "dirty puddle"), food (raw vegetables, cooked meat, unspecified, and other—for example, prawns), contagion (from adults, from children, from cattle, from pets, and from other or multiple sources—for example, insects and rats), lack of hygiene (usually "not

Table 1 Number of respondents who mentioned a specific cause; and number of perceived causes per category and subcategory

Cause (category)	(subcategory)	Frequency (n)	Percentage
Water	(total)	136	33.1
	Drinking	66	16.1
	Swimming	43	10.5
	Other	27	6.5
Food	(total)	92	22.4
	Raw vegetables	6	1.5
	Cooked meat	13	3.2
	Unspecified	53	12.9
Place eaten	Other	20	4.9
	(total)	92	22.4
	Out	66	16.1
	Home	6	1.5
Contagion	Unspecified	20	4.8
	(total)	131	31.9
	From adults	15	3.6
	From children	45	10.9
Travel	From cattle	23	5.6
	From pets	18	4.4
	From other and multiple	30	7.3
	(total)	81	19.7
Lack of hygiene	Abroad	44	10.7
	UK	15	3.6
	Unspecified	22	5.4
	(total)	81	19.7
Uncommon causes	(total)	16	3.9
	Unspecified	16	3.9
Number of causes	0 (don't know)	28	6.8
	1	70	17.0
	2	233	56.7
	3	84	20.4
	4	23	5.6
		1	0.2

Table 2 Attribution, according to cause plausibility and age group

Plausibility		Attribution				Total
		External	Internal	Both	No data	
Child	Plausible	131	10	11	3	155
	Implausible	19	6			25
	Not enough data	6			34	40
	Total	156	16	11	37	220
Adult	Plausible	78	3	7	3	91
	Implausible	49	2	2	1	54
	Not enough data	8			38	46
	Total	135	5	9	42	191

Note that the explanation given for the children group was categorised as "internal attribution" when the respondents (usually the parents or grandparents) attributed the illness to the children's behaviour.

washing the hands"), and uncommon causes (that is, mentioned by two or fewer respondents—for example, "low immune system", "gardening"). The place where the food was eaten (at home, outside—for example, restaurant—, or unspecified) was also considered. Another category was created for those who said that the disease was caught while travelling (abroad, in the UK, or unspecified).

Table 1 gives the perceived causes of illness. The most frequently mentioned causes were eating different kinds of contaminated food (22%) especially when eaten out of home (16%), drinking water (16%), contagion from children (11%), and swimming (10%). About half (52%) of the respondents mentioned at least one of these causes. Eleven per cent of the respondents considered that they acquired the disease when travelling abroad. Regarding joint beliefs, the most frequent combination of causes were "water and travel" ($n = 27$, 6.6%), "water and contagion" ($n = 17$, 4.1%), "food and travel" ($n = 15$, 3.6%), and "water, food and travel" ($n = 10$, 2.4%).

A small proportion (17%) of respondents were not able to mention a cause for their illness. The capacity to indicate a cause was not significantly influenced by illness severity (Pearson $\chi^2 = 2.227$; $p = 0.817$), previous knowledge about the disease (Pearson $\chi^2 = 0.280$; $p = 0.596$), the number of information sources where respondents heard about the disease (Pearson $\chi^2 = 4.010$; $p = 0.675$), sex (Pearson $\chi^2 = 0.028$; $p = 0.868$), or age category (Pearson $\chi^2 = 4.843$; $p = 0.304$).

Attribution, plausibility, and age

Most respondents attributed the illness to an external cause (about 70% for adults and children; see table 2). Attribution was neither influenced by the number of symptoms (Pearson $\chi^2 = 6.047$, $p = 0.811$), hospitalisation (Pearson $\chi^2 = 0.033$, $p = 0.984$), sex (Pearson $\chi^2 = 1.608$, $p = 0.448$), age group (Pearson $\chi^2 = 11.736$, $p = 0.163$), nor the number of information sources used (Pearson $\chi^2 = 15.881$, $p = 0.197$). The differences in attribution between the adult and the child groups are not significant (Wilcoxon Mann-Whitney $Z = -1.560$, $p = 0.119$).

While most causes ($n = 246$; 59.9%) are scientifically plausible, 19.2% ($n = 79$) of the causes were considered implausible, and 20.9% ($n = 86$) of the replies did not contain enough information to permit an accurate estimation of their plausibility. Most causes given for children ($\chi^2 = 93.889$, $p < 0.001$), and adult groups are plausible ($\chi^2 = 0.972$, $p = 0.002$). However, the children group has a significantly higher number of plausible causes than the adults (Pearson $\chi^2 = 23.803$, $p < 0.001$)—that is, adults tend to give more plausible explanations for their children than for themselves. On the other hand, younger adults seem to provide a higher number of plausible causes than older respondents (16–29 years with 71% plausible causes, 30–49 years with 64%, and >50 years with 49%), but the plausibility difference between these age groups is not significant (Pearson $\chi^2 = 4.250$, $p = 0.119$). Similarly, the scientific plausibility of

Table 3 Previous knowledge about the disease, including the frequency of people that used particular information sources

		Frequency	Percentage	Plausible (%)
Heard before	Yes	223	54.3	79.0
	No	182	44.3	70.4
Information source	Missing/unsure	6	1.5	100.0
	Test stool results	142	34.5	81.2
	Environmental health officer	73	17.8	82.1
	Doctor or nurse	44	10.7	78.9
	Media	29	7.1	81.8
	Professional knowledge	26	6.3	77.3
	Friends	20	4.9	88.2
	Internet	13	3.2	84.6
	Leaflet	11	2.7	75.0
	Previous experience of cryptosporidiosis	7	1.7	100.0
	Other	6	1.5	80.0
	Information sources used per person	0	190	46.2
Information sources used per person	1	121	29.4	76.8
	2	60	14.6	79.2
	3	25	6.1	80.0
	≥4	15	3.6	92.9

Note that information sources are not mutually exclusive and that although 223 respondents said that they had heard before about cryptosporidiosis, only 221 specified an information source. The frequency of people that used a certain number of information sources (from 0 to >4) is also shown.

Table 4 Logistic regression coefficients (odds ratios) and 95% confidence intervals for odds ratios of information sources (independent variables) as predictors of perceived causes (dependent variables)

Information Source	Perceived cause			
	Water	Food	Contagion	Travel
Test stool results				
Environmental health officer		0.496 (0.243, 1.010)		
Doctor or nurse	2.134 (1.412, 7.162)			
Media			2.718 (1.208, 6.116)	0.135 (0.018, 1.006)
Professional	3.180 (1.130, 4.031)		0.196 (0.054, 0.709)	
Knowledge				
Friends			3.370 (1.298, 8.745)	

No statistically significant results were found for the least frequently mentioned information sources (that is, "internet", "leaflet", "previous experience", and "other"), being these omitted on the table. No information source was a statistically significant predictor of lack of hygiene as a perceived cause.

the explanation given by respondents was not significantly influenced by the number of symptoms (Pearson $\chi^2 = 3.390$; $p = 0.640$) or by hospital admission (Pearson $\chi^2 = 0.396$; $p = 0.529$). Plausibility is weakly but significantly related with the level of the respondents' certainty on their perceived cause ($r = 0.114$; $p = 0.045$). Respondents with previous knowledge of the disease provided a higher number of plausible causes than those who had never heard of the disease (79% v 70% of plausible causes), but this difference is not significant ($\chi^2 = 3.386$; $p = 0.066$). Moreover, the number of information sources did not significantly influence the causes' plausibility (Pearson $\chi^2 = 4.160$; $p = 0.385$), and no particular information source had an influence on plausibility (for all sources Pearson $\chi^2 < 3.0$; $p > 0.08$).

Information sources and causes

About half of the respondents had heard about cryptosporidiosis before this study (see table 3). The most common information sources are test stool results (35%), environmental health officers, (18%) and doctors or nurses (11%). About 24% of the respondents said that they had heard about the disease from more than one information source, and the number of information sources is weakly but significantly related with illness severity ($r = 0.104$; $p = 0.036$).

Table 4 shows the information sources that significantly predict perceived causes of sporadic cryptosporidiosis. Perception of water as a cause of cryptosporidiosis is directly related to information from the respondent's professional knowledge, and from doctors or nurses. Perception of food as a cause inversely depends on information from environmental health officers. Perception of contagion as a cause is directly dependent on information from the media and friends, but is inversely related to personal knowledge. Information from the media inversely predicts the perception of travel as a cause. No information source was a statistically significant predictor of lack of hygiene. Receiving information from test stool results or from the least frequently mentioned information sources (that is, "internet", "leaflet", "previous experience", and "other") do not seem to predict any particular perceived cause.

Qualitative data seem to support some of these findings. The influence of information sources on the perceived causes was clear in several replies:

"The Doctor says he [the child] will have drunk water that contained the bug."

"The Doctor suggested it was the water supply."

"I thought it was touching the bird – it was a red ear finch –, but the Environmental Officer said no, it was the water."

"I really have no idea: the Doctor said it may be the chicken, the Health Officer said water."

"Swimming pool from Tenerife. The idea was put to me by my Doctor."

DISCUSSION

The main perceived causes of sporadic cryptosporidiosis were identified, with most people (83%) mentioning at least one cause for their illness. Three main categories of perceived causes were identified from respondents' replies: water (mostly by drinking or swimming), contagion (mostly from children), and eating contaminated food. Perceived causes were qualitatively similar to the ones described in the published literature, but some quantitative differences are evident.

The case-control study based on the same population of this paper found that travel outside the United Kingdom, contact with another person with diarrhoea, and touching cattle were strongly associated with cryptosporidiosis; eating ice cream and raw vegetables were strongly negatively associated with illness.¹⁶ However, the most common causes of sporadic cryptosporidiosis (contagion from animals and people) were only mentioned by a comparatively small number of respondents; and the most common perceived causes (contaminated food, drinking water, and swimming) do not seem to be important causes of sporadic cryptosporidiosis. Other studies have reported drinking water as an important source of sporadic cryptosporidiosis.¹⁹ Also within this region drinking water was associated with several outbreaks during the 1990s.²⁰ Overall, respondents seem to underestimate the main sporadic causes and overestimate minor causes. For some causes, such as drinking water and swimming, respondents may be failing to distinguish between outbreak and sporadic causes. Travelling abroad,

What this paper adds

- This study found that only a small proportion of participants rely on the mass media for information about sporadic cryptosporidiosis.
- The sources that are more frequently used by respondents to acquire information about cryptosporidiosis are test stool results, environmental health officers, and doctors or nurses.
- The type of information source used by people influences perception about the causation of disease.

which is considered an important contributor to sporadic cases, was mentioned by about 10% of the respondents.

Most people ($n = 291$) attributed their illness to an external cause. No relation was found between the kind of causal attributions and illness severity, measured as number of symptoms and hospitalisation. However, this research considered objective indicators of illness severity, and some authors suggest that subjective measures of severity (that is, the personal relevancy ascribed by respondents to their condition) may be more relevant for the respondents' interpretation of their illness.^{21 22}

Most perceived causes (60%) were scientifically plausible. Certainty and plausibility are related, suggesting that respondents have some idea about the likelihood of their perception. Interestingly, the children group had a higher proportion of plausible answers than the adult group, perhaps because it may be easier for adults to objectively evaluate the causes of illness of their children than for themselves. No information source significantly influenced plausibility, suggesting that no particular source of information contributed more than others to credible perceptions.

About half of the respondents (54%) had heard about the disease before this study, mostly from test stool results, environmental health officers, and doctors or nurses. People who suffered from more severe forms of cryptosporidiosis heard about the disease from a larger number of information sources than those with milder severity. The search for information on multiple sources may reflect an increased effort by respondents who were more affected to better understand their illness. However, it can also be speculated that respondents who give more importance to the disease may search for additional information and also overestimate their symptoms. The number of information sources did not significantly influence plausibility or the capacity to point out a cause.

One of the most interesting findings of this study was the influence of information sources on perceived causes. Respondents who heard about the disease from a particular source were more likely to point out or to reject certain specific causes. For example, a respondent who heard about the disease from an environmental health officer may have played down the importance of food as a potential cause. The relevance of information sources for perceived causes is supported by qualitative data. Several respondents attributed their suspicions about water to a doctor. Two other cases reported that environmental health officers dissuaded them from initial thoughts about food and a wild bird.

Policy implications

- Policy makers involved in the development of communication strategies about sporadic cryptosporidiosis need to take account of variation in source of information and differences in the perception of aetiology in the population.
- Doctors and environmental health officers are particularly relevant sources of information, with the potential to influence perceptions. It is important to improve risk communication, through further research and training, with an emphasis on the differences between risk factors of epidemic and sporadic disease.
- The design of surveillance tools for the collection of information on risk factors for cryptosporidiosis should be aware of the potential bias arising from acquisition of information from various sources.

The relations found suggests that perceived causes may somewhat reflect the information sources that were used by respondents. Although it may represent a positive acquisition of knowledge, this situation may ultimately lead to the a priori rejection of potential uncommon causes or to the overestimation of some causes. This bias, if not properly considered, can eventually influence epidemiological research and health statistics. However, even if it seems unlikely, the hypothesis that the perceived cause influenced the respondent's search for a particular source of information cannot be excluded. Although most studies suggest or assume that information influences perceptions, past research has shown that the perceived controllability of the causes of illness may influence the effort to search for information.²³ Further research may substantiate the influence of information sources on perceptions, by comparing for example the relevance given by environmental health officers, doctors and nurses to the role of water and food as potential causes of cryptosporidiosis.

In addition, respondents were only asked if they had heard about the disease before answering the questionnaire, not discriminating if they heard about cryptosporidium before or after being diagnosed with the illness. Further research may differentiate between before and after illness information to better evaluate the use of information sources.

CONCLUSIONS

Three main categories of perceived causes were identified. Most respondents attributed their illness to water (by drinking or swimming), contagion (especially from children), and eating contaminated food. Although perceived causes are in general qualitatively consistent with the ones described in scientific literature, respondents seem to overestimate the importance of less frequent causes (for example, eating contaminated food) and underestimate the relevance of more frequent ones (for example, animal to person contagion). Most causes are attributed to external causes, irrespective of illness severity, and are scientifically plausible. Respondents who had a higher level of certainty in relation to their perceived cause of illness also provided a higher number of plausible answers.

The sources that are more frequently used by respondents to acquire information about cryptosporidiosis are test stool results, environmental health officers, and doctors or nurses. One of the most interesting findings was the influence of information sources on the perceived causes of cryptosporidiosis. Results show that respondents who obtained information from some specific sources tended to accentuate particular causes. This suggests that different information sources may emphasise certain causes, resulting in a potential bias of official statistics. Such suggestion may be further explored by future research.

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THE JECH GALLERY

10 teaspoons of sugar makes the waistline expand

The prevalence of childhood obesity is rising and the mechanism of obesity development is believed to be related to multiple causes including physical inactivity and overconsumption of calories. In 2002, 30.3% of boys aged 2–15 years and 30.7% of girls were at least overweight, and 16% of boys and 15.9% of girls in this age group were obese.¹ The British consume about 2.25 million tonnes of sugar each year, three quarters of it indirectly in drinks, processed foods, and confectionery. Consumption is rising and disproportionately among younger people and particularly of soft sugary drinks.

Each 330 ml soft drink container includes the equivalent of about 10 teaspoons of sugar. The intake of these added sugars contributes to 16.7% of young people's energy intake, which is well above the recommendation of 11%.² Not only does consumption of these empty calories contribute to obesity,³ more than half of 4 to 18 year olds have some dental decay, largely caused by frequent consumption of these sugar laden products.²

Awareness of the nutritional content (predominantly sugar) of soft drinks may encourage more moderate consumption. Providing healthy alternatives has also been proposed, however unless children and parents are enlightened regarding the content and consequences of consumption of soft drinks, namely obesity, diabetes, and dental decay to name a few, behaviour change may be limited even in the presence of healthy alternatives.

A simple health promotion campaign to improve awareness of the quantity of sugar in soft drinks (roughly 10 teaspoons) could provide the means of enlightening the population to the vast sugar content of soft drinks. Can you picture what 10 teaspoons of sugar looks like? Figure 1 illustrates this. The

Photograph by Richard Hewitt.

association between soft drinks and sugar needs to be highlighted. This may encourage consumption of alternative drinks to quench the thirst.

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