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Predicting Public Concern Regarding Toxic Substances in the Environment

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The purpose of this research was to identify the variables that increase concern about the health, environmental contamination, and economic consequences of toxic substances in the environment. A mail survey was sent to a New York State sample, and a 66% response was obtained. Seven indices were developed from specific concerns about toxic substances in the environment including, among others, exposure, health effects, pollution, and economic consequences. Stepwise regression analysis was conducted for each concern index. The results suggest that the number of information sources regarding environmental issues was a strong predictor of concern in nearly all models. Other variables that were repeatedly found to be important contributors to the models were years of education, attitudes about government involvement in private industry, knowledge of epidemiology and the scientific method, and the perceived proximity to sources of potential contamination. Unlike other research, women and mothers of sick children did not make large contributions to the model.

Introduction

The effects of chronic chemical pollution on human populations presents a difficult problem of definition and understanding. Toxicology is a relatively young science. Highly specific and sensitive methods have been developed to measure toxic substances in the environment. Interpretation of low-level exposures and their relationship to human health is difficult. Furthermore, safe exposure levels for humans are, for the most part, unknown and the evaluation of adequate containment and/or possible modes of transmission of these substances is a formidable task at the present time (*1–8*).

Despite the ambiguity of the hazards of chronic chemical pollution, individuals are concerned about their exposure and the subsequent effects of chronic chemical pollutants on their health, as evidenced by the growing numbers of petitions to federal, state, and local governments for health studies. The purpose of this research is to identify the variables that shape the concern of the public regarding toxic substances in the environment.

Methods

Sample

A list for sampling was obtained in 1985 from the New York State Department of Motor Vehicles. This sample included both male and female residents of New York State, excluding New York City, aged 25 to 74, who had obtained a new license or who had renewed their driver's license within the previous year. The list included the residents' names, addresses, and birth dates. Among New York State residents, excluding New York City, over 84% of persons ages 25 and older had a license to drive in 1982. The desired sample was based upon a maximum allowable standard error of 10% of the sample values as low as 20% in subgroups of 400 respondents and an overall response rate of 70%.

In the spring of 1986, a questionnaire was mailed to each person with a cover letter and a self-addressed permit return envelope. The follow-up procedures included a postcard reminder, a second mailing of the questionnaire, and a final mailing of the questionnaire by certified mail. Data from the 1980 Census were used to assess the representativeness of sample respondents.

After the three follow-up attempts, 66% of the sample completed and returned the questionnaire. The distributions of all respondents by age, sex, and region of residence were compared to the sampling frame, the 1980 U.S. Census, and the group of nonrespondents and known refusals. The sample characteristics are summarized in Table 1. Within several percentage points, most of these distributions were similar among the response categories, except that persons with less than 9 years of education were underrepresented and persons with 13 or more years were overrepresented. The proportion of white respondents was also somewhat higher than in the general population of New York State, excluding New York City, which was about 88% in 1980.

Measurement

Data were collected for a variety of categories as shown in Table 2. Under geographic location, the region

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Table 1. Characteristics of sample respondents (n = 2196).

Characteristic	Percent	Number
Sex		
Male	45.6	975
Female	54.4	1162
Anonymous respondent	—	59
Education, years		
8 or less	4.5	97
9–11	8.4	182
12	31.0	669
13+	56.1	1210
Unknown	—	38
Race		
White	96.1	2069
Black	2.3	50
Other	1.5	33
Unknown	—	44
Religion		
Protestant	34.4	736
Catholic	47.1	1008
Jewish	7.7	165
None/Other	10.8	232
Unknown	—	55
Age, years		
< 34	23.0	506
35–44	24.0	528
45–54	17.3	379
55–64	19.0	418
65+	16.6	365
Region of residence		
Western NY	11.3	248
Long Island	22.7	499
Other Upstate NY	60.0	1449
Marital status		
Married	77.5	1683
Divorced	6.3	136
Separated	2.1	45
Widowed	5.9	128
Never married	8.3	181
Unknown	—	23
Homeownership		
Own	79.1	1708
Rent	20.9	452
Unknown	—	36

Table 2. List of independent variables.

Sociodemographic characteristics
Age
Race
Education
Occupation
Marital status
Religion
Ethnicity
Geographic location
New York region of residence
Proximity to toxic waste disposal site
Proximity to commercial pesticide use
Proximity to residential pesticide use
Homeownership
Length of residence
Knowledge
Epidemiology
Toxicology
Scientific method
Sources for information (media types)
Attitude
Locus of control
Responsibility for environmental costs (government level, industry, individuals)
Government involvement in private industry
Health status
Personal
Children

of residence was included because two regions in New York State have unique characteristics with regard to the threat potential for environmental contamination by toxic substances. In 1983, nearly 900 inactive toxic disposal sites had been located in New York State (*9*). Western New York (Erie and Niagara Counties) has a high density of these sites because of the concentration of chemical industries that have been in operation in this area for many years (*9*). The geologic composition of Long Island poses a substantial risk for groundwater contamination by industrial chemicals and agricultural pesticides since it has a large and shallow groundwater aquifier (*10*).

Correlation coefficients were used to identify collinear variables and to define a factor analysis for scale development. The individual questions are listed in the appendix. The values from each of the individual variables were summed and five scales were constructed and are as follows: *a*) perceived proximity to three sources of environmental contamination: toxic waste disposal sites, commercial pesticide use, and residential pesticide use; *b*) knowledge about epidemiology and the scientific method used in the conduct of environmental health studies; *c*) beliefs about human and animal exposure to chemicals and the extent to which toxicology can measure and answer questions about health effects; *d*) the number and variety of media sources used for information regarding environmental pollution by hazardous waste; and *e*) a "laissez-faire" attitude regarding government intervention in private industry.

The locus of control is a variable that measures the extent to which one believes he or she has control over events. An internal locus of control refers to a person's belief that he or she maintains control, while an external locus of control indicates a more passive belief that others control the events. Locus of control was assessed using Rotter's 17-item index (*11*). The scores ranged from 1 to 4, with lower ratings indicating a more external locus of control.

The health status of the respondent was assessed using the Physical Health Spectrum index by Belloc et al. (*12*). On a seven-point scale, this index measures health from having severely disabling chronic conditions at the one extreme of the poorest health status, to having a high energy level and no health problems at the opposite extreme. Two additional measures were employed to ascertain whether any children who were under age 18 had one or more chronic diseases or had one or more serious symptoms during the last month prior to the survey. The chronic diseases included diabetes, epilepsy, asthma, bronchitis, and a variety of heart or circulatory problems. The serious symptoms included

unexplained rashes; back pain; swelling; stomach pain; and muscle and joint aches, stiffness, or cramps.

The Concerns Indices

Thirty-nine specific concerns were included in the survey. The questions were modified from a measure prepared by White et al. (*8*).

Each question included a five-point scale from being "very concerned" to "not concerned at all" (Appendix). Correlation coefficients were used to identify collinear variables and to define a factor analysis for index development. Seven indices emerged that included the following concerns: one's own exposure to toxic substances in environment; the spouse's exposure; children's exposure; environmental pollution; personal health consequences; health effects to the family; and the economic consequences of toxic substances in the environment. The values of the individual items were summed for each issue, with a higher value indicating greater concern. A stepwise regression analysis was employed for each dependent variable.

Results

Predictive variables were consistent across the seven regression models. Table 3 summarizes the variables in the model predicting concern about one's personal exposure to toxic substances in the environment. This model explained 19% of the variance, with most of it contributed by four variables: the number of information sources, a belief that government should be involved in private industry, being more knowledgeable about epidemiology and the scientific method, and a closer proximity to sources of potential environmental toxic materials.

Table 4 describes the model of concern for a spouse's exposure to toxic substances in the environment. In the first model, marital status was included. It was the strongest predictor, explaining 41% of the variance. In the second model, all unmarried respondents were omitted. The major contributors to this model were number of information sources, people having more knowledge about epidemiology and the scientific method, stronger government involvement in private industry, and a closer proximity to environment sources of toxic materials.

Table 3. Regression model of concern about personal exposure to toxic substances in the environment.

Most important predictors		Other variables included in model
Variable	Partial R^{2a}	
More information sources	0.08	Younger age
More government involvement	0.04	Poorer health status
More epidemiologic knowledge	0.03	Industry clean-up costs not passed to consumer
Closer proximity	0.01	External locus of control
		Married
		Longer length of residence
		Nonwhite
		Catholic
		Local government responsible for environmental issues
		Less education

[a] Model $R^2 = 0.19$.

The third model, which showed concern about children's exposure, was examined for all respondents and also for only those respondents with children still living at home (Table 5). The model with all respondents had 19% of the variance explained with the variables married, divorced, and the number of information sources as the major predictors. The concern model for parents with children at home had 12% of the variance explained. The major contributors to this model were stronger government involvement in private industry, more information sources, closer proximity to potential environmental toxic materials, and a poorer health status of the respondent.

Concern about environmental effects was associated with many of the same variables. The model, as shown in Table 6, predicted 17% of the variance. The number of information sources was the most important contributor to the model, with government intervention, less years of education, more knowledge of epidemiology and the scientific method and a closer proximity among the largest contributors to the model.

The concern for health effects associated with exposures to toxic substances in the environment were examined in two models. One focused on personal health effects and the second, on those affecting family members. These two models are summarized in Table 7. Personal health concerns were associated with being younger, Catholic, and having more information sources and less education. Family health concerns, on the other hand, were related to government intervention, more information sources, being younger and Catholic, having less education, an external locus of control, and being nonwhite. Both models explained 17% of the variance.

Finally, Table 8 summarized the concern model for the economic consequences of toxic substances in the environment. Concern is higher among Western New York residents in persons with less education and with more information sources. This model explains 14% of the variance.

Discussion

Several methodological issues need to be considered. First, the sample was biased in that it underrepresented persons with less than 9 years of education. Since this group had the highest level of concern in the sample, any bias would tend to result in an underestimate of the true concern level of the population.

Secondly, item nonresponse resulted in an omission of 10% of the respondents from the multivariate model. However, the missing values did not adversely affect the statistical power of the model. Also, the regression effect of missing values indicated they occurred randomly.

Table 4. Regression model of concern about spouse's exposure to toxic substances in the environment.

Most important predictors		Other variables included in model	Most important predictors		Other variables included in model
Variable	Partial R^2 [a]		Variable	Partial R^2 [b]	
Married	0.41	More government involvement	For married respondents only:		
More information sources	0.02	Government not raise taxes for clean-ups	More information sources	0.06	Poorer health status
More epidemiologic knowledge	0.01	Closer proximity	More epidemiologic knowledge	0.03	Younger age
		Younger age	More government involvement	0.02	Longer length of residence
		Poorer health status	Closer proximity	0.01	Nonwhite
		Less education			Industry cleanup costs not passed to consumer
		Long Island residence			Long Island residence
		Homeowner			

[a] Model R^2 = 0.45.
[b] Model R^2 = 0.15.

Table 5. Regression model of concern about children's exposure to toxic substances in the environment.

Most important predictors		Other variables included in model	Most important predictors		Other variables included in model
Variable	Partial R^2 [a]		Variable	Partial R^2 [b]	
Married	0.09	Female	For respondents with young children only:		More epidemiologic knowledge
More information sources	0.03	More epidemiologic knowledge	More government intervention	0.04	Married
Divorced	0.02	External locus of control	More information sources	0.02	Divorced
		Homeowner	Closer proximity	0.02	
		Nonwhite	Poorer health status	0.01	
		More government intervention			
		Closer proximity			
		Chronic illness in family			
		Less education			
		Acute symptomatology in family			

[a] Model R^2 = 0.19.
[b] Model R^2 = 0.12.

Table 6. Regression model of concern about environmental sources and consequences of toxic substances in the environment.

Most important predictors		Other variables included in model
Variable	Partial R^2 [a]	
More information sources	0.06	Poorer health status
More government intervention	0.03	Local government responsible for environmental issues
Less education	0.02	Industry clean-up costs not passed to consumer
More epidemiologic knowledge	0.01	External locus of control
Closer proximity	0.01	Less knowledge of toxicology
		Female
		Catholic

[a] Model R^2 = 0.17.

And finally, perceived proximity to sources of potential environmental contamination was the only variable of distance available for this study. Actual proximity was used in other studies, for instance the Love Canal and the Memphis Phantom Dumpsite studies (*1,4*). Perception of closeness to potential contamination sources was a significant predictor of concern in this study. A study comparing the actual distance and perceived proximity to inactive toxic waste disposal sites is reported in another paper where actual distance was not related to concern level, while perceived proximity was significantly related (*14*).

In summary, the results suggested that the number of information sources regarding environmental issues was the most predictive variable of concern with more sources associated with greater concern. These data would suggest that increasing awareness and information contributes more to an emotional response of heightened concern than increasing accurate information and improving understanding of toxic substances in the environment.

Education was the second most common predictor of concern levels. Fewer years of education were indicative of higher levels of concern. The attitude that the government should be involved in the affairs of private industry as they relate to environmental issues was also a common predictive variable. The attitude suggested that the government should protect its citizens from environmental toxic substances.

Knowledge of epidemiology and the scientific method was negatively associated with concerns. The understanding of the epidemiologic method did not have the desired effect of reassurance, but rather it also heightened the emotional reaction to toxic substances in the environment.

Table 7. Regression model of concern about personal and family health effects related to toxic substances in the environment.

Most important predictors		Other variables included in model	Most important predictors		Other variables included in model
Variable	Partial R^2 [a]		Variable	Partial R^2 [b]	
For personal health effects:			For family health effects:		
Younger age	0.08	Married	More government intervention	0.04	Married
Catholic	0.02	More government intervention	More information sources	0.02	Female
More information sources	0.02	External locus of control	Younger age	0.02	Closer proximity
Less education	0.02	Nonwhite	Less education	0.02	Poorer health status
		More epidemiologic knowledge	Catholic	0.01	Local government responsible for environmental issues
		Closer proximity	External locus of control	0.01	Divorced
		Long Island residence	Nonwhite	0.01	Industry clean-up costs not passed to consumer
		Individuals affected pay for environmental clean-up			State government not responsible for environmental issues
		Local government responsible for environmental issues			Individuals affected pay for environmental clean-ups
		Industry not responsible for environmental issues			Longer length residence
		Longer length of residence			Less knowledge of toxicology

[a] Model $R^2 = 0.17$.
[b] Model $R^2 = 0.17$.

Table 8. Regression model of concern about economic consequences of toxic substances in the environment.

Most important predictors		Other variables included in model
Variable	Partial R^2 [a]	
Western New York residence	0.04	Other upstate residence
Less education	0.03	Catholic
More information sources	0.02	External locus of control
		Homeowner
		Government not raise taxes for clean-ups
		Less knowledge of toxicology
		Nonwhite
		More government intervention
		Individuals affected pay for environmental clean-ups
		No acute symptomatology in family
		Interaction female/acute symptoms in family
		Government reallocate resources to pay for clean-ups
		Industry cleanup costs not passed on to consumer
		Industry not responsible for pollution issues

[a] Model $R^2 = 0.14$.

In other studies, women, particularly those with children or with sickly children, had greater concerns about exposures to toxic materials in the environment (*1–4*). While these variables were included in several of the models, their contributions were negligible. In the univariate analysis (not presented here), sex was associated with all concerns except environmental. This would suggest that sex, per se, has a spurious relationship with these concerns and that the acquired attributes associated with sex are more accurately associated with concern. When sex was forced into the regression models it became a nonsignificant contributor when the variables, education, government intervention, and locus of control were added.

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Appendix

Concerns Index Items

1. Here is a list of concerns some people have regarding toxic materials in our environment. On a 5-point scale, how would you describe the level of your concern regarding:
   - Your past exposure
   - Your present exposure
   - Your future exposure
   - Your spouse's past exposure
   - Your spouse's present exposure
   - Your spouse's future exposure
   - Your children's past exposure
   - Your children's present exposure
   - Your children's future exposure
   - Your uncertainty of exposure
   - Build-up of poison in your body
   - Health problems in your pets
   - Uncertainty of health effects
2. How concerned or unconcerned are you about the effects on the environment of:
   - Air pollution
   - Drinking water pollution
   - Food contamination
   - Plant life and tree damage
   - Fish contamination
   - Municipal landfills
   - Toxic disposal sites
   - Nuclear plant emissions

3. How concerned or unconcerned are you about health concerns related to toxic materials in the environment?
   Getting cancer
   Birth defects in my children
   Genetic disease in my children
   A spontaneous abortion
   Damage to my reproductive system
   Damage to my nervous system
   Damage to my urinary system
   Dental problems in family members
   Headaches in family members
   Rashes in family members
   Fatigue in family members
   Weakness in family members
   Family stress
4. How about economic concerns?
   Industry leaving your town
   Loss of jobs in the town or city
   Inability to attract industry to your area
   Decline of your property value
   Harm to your community's economy

Proximity Items

1. How close or far do you think you are
   From the nearest toxic-chemical disposal site?
   From chronic agricultural commercial pesticide use?
   From chronic residential pesticide use?

Score: 1-very close; 2-close; 3-far; 4-very far

Toxicology Beliefs

1. How many or how few chemicals do you think
   Are known to be harmful to man?
   Are known to be harmful to animals?
   Can be measured in the environment?
   Can be detected in the body?

Score: 1-very few or few; 0-many or very many

Epidemiologic Knowledge

1. How easy or difficult do you believe it is to detect most toxic chemicals in the body?

Score: 1-very easy; 2-easy; 3-difficult; 4-very difficult

2. In some health studies, scientists try to measure symptoms, diseases, and medical care of particular high risk groups. How important or unimportant do you think it is for them to also measure these things for a group other than the group at risk?

Score: 1-not important at all; 2-not very important; 3-important; 4-very important

3. We often see or hear reports of results of important health studies. How do you interpret these results?

Score: 1-probably not true at all; 2-probably not true; 3-probably true; 4-absolutely true

Government "Laissez-faire" Attitude

1. How strongly do you agree or disagree that in general, the government should stay out of the affairs of private industry?
   The government should stay out of the affairs of private industry even when the issue is public health and/or safety?

Score: 1-strongly agree; 2-agree; 3-disagree; 4-strongly disagree

Public Responsible for Costs

1. Who do you believe should bear the expense of cleaning up environmental problems
   Industry, by passing on the costs to consumers?
   Government, by increasing taxes?

Score: 1-agree; 2-disagree;

Information Sources

1. What sources have you used for information regarding environmental pollution by hazardous wastes?
   Local television news
   National television news
   Newspapers
   Magazines
   Books
   Newsletters or papers from organizations for the protection of the environment
   Personal experience
   Word of mouth
   Format training/knowledge
   Reading scientific articles in journals
   Official declarations by private industry
   Official declarations by government

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