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RESEARCH ARTICLE

Nutrition and Other Protective Behaviors Motivated by Environmental Health Risk Awareness

Elizabeth W. Jones[1], Limin Feng[2], Jane K. Dixon[3], John P. Dixon[4], Carolyn R. Hofe[5] and Lisa M. Gaetke[1,5,*]

[1]*Department of Dietetics and Human Nutrition, University of Kentucky, 203 Funkhouser Bldg, Lexington, KY 40506-0054, USA*

[2]*Department of Statistics, University of Kentucky, 817 Patterson Office Tower, Lexington, KY 40506-0027, USA*

[3]*Yale University, School of Nursing, New Haven CT 06536-0740, USA*

[4]*Greater New Haven Green Fund, New Haven, CT 06511, USA*

[5]*Graduate Center for Nutritional Sciences, University of Kentucky, 115 Funkhouser Bldg, Lexington, KY 40506-0054, USA*

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Abstract:

Background:

Research findings have suggested that exposure to environmental pollutants contributes to increased health risks, which may be modulated by certain nutrition and other protective health behaviors. Nutrition professionals play an important role in effectively disseminating this information and in devising specific community-based nutrition education programs for audiences located in areas with environmental health issues.

Objective:

To assess awareness of environmental health problems and motivation to adopt protective health behaviors for use in planning nutrition education programs for communities exposed to environmental pollutants.

Method:

Data were collected from a modified, validated Environmental Health Engagement Profile (EHEP) survey instrument administered to adults (n=774) participating in community events in Kentucky based on location relative to hazardous waste sites.

Results:

The modified EHEP survey instrument showed good internal consistency reliability, and demographic characteristics were evaluated. Correlation analyses revealed significant positive correlations in all groups, separately and combined, between awareness of environmental pollution in an individual's surroundings and the extent of concern that pollutants cause adverse health effects ($P < 0.01$) and between concern that pollutants cause adverse health effects and taking personal actions to protect against such environmental insults ($P < 0.01$). The groups having the highest level of awareness posed by pollution are those residing near federally designated hazardous waste sites.

Conclusion:

These results suggest that determining and expanding an audience's knowledge and perceptions of environmental health risks will enhance effective nutrition education program planning.

* Address correspondence to this author at the Department of Dietetics and Human Nutrition, University of Kentucky, 119 Funkhouser Bldg, Lexington, KY 40506-0054, USA; Tel: 859-257-1031; Fax: 859-257-3707; E-mail: lgaetke@email.uky.edu

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INTRODUCTION

Exposure to environmental pollutants contributes to an increased risk for chronic diseases such as cardiovascular disease, diabetes, and cancer [1 - 4]. Most Americans, however, are not sufficiently familiar with environmental health risks and need guidance to respond with appropriate protective behaviors. Research has shown that healthy nutrition habits are essential components of strategies for helping people achieve optimum health and to modulate the severity of symptoms and disease progression for those suffering from chronic diseases [5 - 7]. As part of the National Institutes of Environmental Health Sciences (NIEHS) University of Kentucky's Superfund Research Center (UK-SRC), researchers are now finding that good nutrition may also be a defense for combating the health effects of certain environmental pollutants [2].

Persistent organic pollutants, such as polychlorinated biphenyls (PCBs), are used as the model Superfund toxicant [8] in this research. For over twenty years, these researchers have studied PCBs and other chlorinated organic compounds, diet, oxidative stress, and the increased likelihood of developing chronic diseases, such as atherosclerosis, obesity, insulin resistance/diabetes, and cancer [2 - 4]. Oxidative stress plays an important role in the development of age-related diseases [9-11], and PCBs appear to contribute to oxidative damage in the body [1 - 4, 11, 12]. Scientific evidence increasingly suggests that poor diet may increase the risk for oxidative stress and chronic diseases [1 - 4, 9 - 12]. Nutrition is known to play a significant role in the prevention and management of these same chronic diseases and has been shown to modulate the toxicity of PCBs [1 - 4, 11, 12].

Translating this science-based nutrition research to protective public health nutrition recommendations and behaviors for those exposed to environmental insults is a fairly new concept, but shows promise for those affected [11 - 13]. This nutrition message is the basis for devising community nutrition and environmental health education programs, especially for communities with proximity to federally designated hazardous waste sites. Nutrition and other health care professionals play an important role in effectively disseminating this information.

One factor impacting the success of these community programs, however, has been the apparent lack of public awareness of environmental hazards, the health risks they entail, and the range of available responses to those risks. Studies have shown that nutrition education programs are more effective when tailored to the needs and beliefs of individuals in the target population [14], and this study attempts to learn more about the knowledge and perceptions of environmental health issues by certain populations in Kentucky.

The purpose of this study was to use an environmental health survey instrument to evaluate knowledge and awareness of pollution, environmental health risks, and protective health behaviors for more effective community nutrition and health education program planning. We considered several survey instruments. Most were developed for more narrowly defined populations or more specific types of environmental problems or health issues. The Perceived Environmental Risk (PER) survey, for example, was previously used to evaluate middle and high school students and teachers participating in environmental educational subjects [15]. Other studies have used surveys developed for those suffering from asthma [16, 17], for farm workers exposed to pesticides [18], and for those in a mining region in Mexico [19]. Because the focus of this study is the environmental awareness of broader community groups, these targeted approaches were not applicable to our purpose.

Ultimately, collaboration was formed between researchers at the University of Kentucky and researchers at Yale University to create a modified version of the validated Environmental Health Engagement Profile (EHEP) survey instrument, developed by Dixon, Hendrickson, Ercolano, Quackenbush, and Dixon (2009). The EHEP was originally developed for evaluating and working with communities on environmental health issues. In the survey, statements are rated to indicate awareness of environmental pollution in the immediate surroundings, perceptions and beliefs that pollution may cause negative health effects, acceptance of pollution as unavoidable, motivation to take personal actions to protect against pollution, and motivation to work with others to reduce pollution in the community [20].

In the present study, we tested the hypothesis that knowledge and perceptions of environmental health risks are associated with increased motivation to adopt appropriate protective nutrition and other lifestyle behaviors that improve health and mitigate the effects of environmental insults. We used a modified EHEP survey instrument and assessed its reliability with added nutrition questions.

MATERIALS AND METHODS

The original validated EHEP survey instrument, published in detail elsewhere [20], was developed "for assessing the way people engage with environmental health issues." It contains five scales or subject areas defined by statements related to environmental pollution. Participants rate the statements describing their awareness of types of pollution, concerns about pollution and health, and actions taken, individually or as a community, in response to pollution by using a number scale ranging from 0 to 10 with 10 always indicating greatest magnitude (Table **1**): Scale 1, Pollution Sensitivity Scale, includes statements that ask about types of pollution in the participant's neighborhood, 0 indicates [none at all] and 10 indicates [very serious problem]; Scale 2, Pollution Causes Illness Scale, and Scale 3, Pollution Acceptance Scale, include statements regarding concerns about pollution and health, 0 indicates [disagree completely] and 10 indicates [agree completely]; Scale 4, Personal Environmental Action Scale, and Scale 5, Community Environment Action Scale, include statements about personal and community actions taken by the participant, 0 indicates [never do this] and 10 indicates [always do this when it makes sense].

Table 1. Summary of environmental health engagement profile (EHEP) kentucky nutrition version survey scales and characteristics.

Scale	Scale Name	Type of Scale	Meaning of Scale	Scoring of Scales	Number of Items	Cronbach's α
1	Pollution Sensitivity Scale	Pollution Types	Extent to which people see pollution in their immediate environment	0 = none at all 10 = very serious problem	18	.94
2	Pollution Causes Illness Scale	Concerns	Extent to which people attribute negative health effects to polluted conditions	0 = disagree completely 10 = agree completely	13	.91
3	Pollution Acceptance Scale	Concerns	Extent to which people accept pollution as unavoidable	0 = disagree completely 10 = agree completely	8	.80
4	Personal Environmental Scale	Action	Extent to which people take precautions to protect themselves from environmental health hazards	0 = never do this 10 = always do this	13	.81
5	Community Environmental Scale	Action	Extent to which people collaborate with others to reduce environmental health threats in their community	0 = never do this 10 = always do this	6	.88

We modified the original EHEP by adding fourteen statements to incorporate nutrition concepts as they relate to environmental pollution and health. Each statement was written to have content appropriate for one of the five scales, and each scale included items with nutritional issues. Examples of the added nutrition statements are provided for each of the five scales: Pollution Sensitivity Scale – "contaminants like mercury, dioxin or PCBs [may exist] in fish, meat or poultry;" Pollution Causes Illness Scale – "people may get sick because they don't eat the right foods to protect themselves from pollution;" Pollution Acceptance Scale – "many people I know don't seem to get sick, even though they don't try to keep contaminants out of their food;" Personal Environmental Action Scale – "I eat organically grown food as much as I can;" and Community Environmental Action Scale – "I talk with friends and neighbors about how we can get healthier foods in our town."

The original EHEP survey instrument was reformatted from a telephone interview tool to one completed with paper and pencil and renamed the EHEP Kentucky Nutrition Version.

Using this new survey instrument, responses were collected from a general adult population (18 yrs and older) by UK-SRC's researchers, which consisted of graduate students and faculty credentialed as registered dietitians. This was a convenience sample with no randomization of participants. We located and recruited participants from several of the University of Kentucky's (UK's) Cooperative Extension Service (CES) events and selected Kentucky community festivals between May and August, 2010. Five groups were formed based on proximity to hazardous waste sites. Kentucky has over 500 designated hazardous waste sites, which vary by state and federal designation in visibility and functioning status. Three of the four data collection events had proximity to designated U.S. Environmental Protection Agency (EPA) National Priorities List (NPL) sites. Hazardous waste sites are placed on the NPL to indicate that they are a priority due to release or possible release of hazardous contaminants and require further investigation and cleanup by the federal Superfund Program [21]. Out-of-state participants were included depending on proximity to some of the events at the state's borders, Ohio and Tennessee.

Data were collected based on the following five groups:

1. Statewide Extension Agents Group – participants were from UK's CES Family and Consumer Sciences' (FCSs') agents attending an annual meeting representing 52 out of the 120 counties in the state (n=83);
2. County Homemakers Non-NPL Group – participants were members of a nonmetropolitan county's annual meeting of the Kentucky Extension Homemakers Association homemakers. There were no nearby NPL sites (n=96);
3. Rural NPL Group - participants were attending an annual spring festival in a rural county in close proximity to a designated NPL site (n=172);
4. Metropolitan NPL Group - participants were attending the annual Kentucky State Fair in a large metropolitan area with three NPL sites (n=429); and
5. All Groups Combined and evaluated as one (n=774).

Completion of the survey was voluntary. Participants were given information about the survey with a cover letter as a waiver of consent. On completion, participants and other nonparticipating family members were offered optional free fresh fruit or granola bars and educational nutrition handouts. Review and approvals were obtained from the appropriate ethics committees. This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the University of Kentucky's Institutional Review Board.

Various demographic and lifestyle characteristics of possible impact on environmental health issues such as age, gender, education, and household members were assessed. No personal identifiers were included. Reliability analyses of each of the enhanced subscales of the EHEP were performed.

Statistical Analyses

Descriptive statistics were generated for the demographic measures. Reliability of each scale, including the added nutrition questions, was evaluated with Cronbach's alpha coefficient. Correlation analyses were used to study the relationships between continuous variables, including EHEP subscales and age. The Mann Whitney and Kruskal Wallis tests examined the associations between scales and gender, highest school grade completed, and presence of children. Multiple linear regression was also used to investigate the effect of demographic variables on each scale. The analysis included evaluation of mean scores from each of the scales and quantitative ratings of the individual statements. Because there were missing data, the actual sample sizes used in comparing individual statements and scales differed across outcome measures. Statistical Analysis Systems (SAS) statistical software package version 9.2 (SAS Institute Inc, Cary, NC, USA) and Statistical Package for the Social Sciences (SPSS) version 19 were used, and P-values less than 0.05 were considered to indicate statistical significance.

RESULTS

Reliability Statistics

Cronbach's alpha for each of the five scales was acceptable, ranging from .80 to .94. In no case would reliability improve by deletion of any one of the new nutrition statements (Table **1**).

Participant Characteristics

Overall, 853 surveys were collected (Table **2**). Only seventy nine surveys were incomplete, thus resulting in a completion rate of over 90% (n=774). Mean age of the sample population was 51 years. Ninety two percent of the participants were from Kentucky (n=713) and 8% were from neighboring states (n=61).

Means and SDs of Scale Scores

Each of the five scales was evaluated for mean score based on the survey questions. Scoring was 0 to 10 for each scale (Table **3**). Overall, the mean scores for all five scales are low, indicating that various types of pollution, environmental health issues related to pollution, and actions taken in response to pollution were new topics to most participants. In general, using means for all five groups, the mean score for the Pollution Sensitivity Scale was fairly low (M = 3.44, SD = 2.16). Participants had higher mean scores on the Personal Environmental Action Score (M = 5.58, SD = 1.80) than on the Community Environmental Action Score (M = 3.06, SD = 2.54). Participants scored higher on Pollution Causes Illness (M = 4.53, SD = 2.12) than on Pollution Acceptance Scale (M = 3.23, SD = 1.87).

Mean scores for all of the scales were similar to those previously reported in the original EHEP (20).

Table 2. Characteristics of study participants.

Participant Characteristics	n	%[a]
Gender		
Male	242	32
Female	520	68
Ethnicity		
White	728	96
Black or African American	13	2
Asian	3	0.5
American Indian or Alaskan Native	2	0.3
Native Hawaiian or other Pacific Islander	1	0.1
Latino, Hispanic or Spanish	7	1
Highest grade or level of school completed		
Never attended school or only attended kindergarten	0	
Grades 8 or less (elementary)	13	1.7
Grades 9 through 11 (some high school)	13	1.7
Grade 12 or GED (high school graduate)	188	24.7
College 1 -3 years (some college or technical school)	198	26
College 4 years or more (college graduate)	147	19.3
Post-graduate studies	199	26.1
Martial status		
Married	532	69.8
Divorced	67	8.8
Widowed	63	8.3
Separated	1	1.1
Never been married	82	10.8
Member of an unmarried couple	16	2.1
Children		
Had children	582	79

[a] Percents are calculated based on number of persons responding to each question. Some do not total to 100% due to rounding.

Table 3. Mean scores of groups for each scale.

	Pollution Sensitivity Scale			Pollution Causes Illness Scale			Pollution Acceptance Scale			Personal Environmental Action Scale			Community Environmental Action Scale		
Groups	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**
Statewide Extension Agents	82	3.76	1.65	83	4.26	1.92	83	3.24	1.52	83	5.37	1.50	83	3.33	2.30
County Homemakers Non-NPL Group	94	3.74	2.33	93	4.36	2.06	90	3.48	2.03	93	5.67	1.90	88	3.52	2.73
Rural NPL Group	164	3.41	2.32	163	4.71	2.35	162	3.31	2.06	162	5.81	1.88	160	2.92	2.55
Metropolitan Group	429	3.33	2.14	425	4.55	2.08	414	3.14	1.81	425	5.51	1.79	416	2.97	2.53
All Groups Combined	769	3.44	2.16	764	4.53	2.12	749	3.23	1.87	763	5.58	1.80	747	3.06	2.54

Note. For Scale 1, Pollution Sensitivity Scale, which asked about types of pollution in the participant's neighborhood, 0 indicates [none at all] and 10 indicates [very serious problem]. For Scales 2, Pollution Causes Illness Scale, and 3, Pollution Acceptance Scale, which included statements about concerns for pollution and health, 0 indicates [disagree completely] and 10 indicates [agree completely]. For Scales 4, Personal Environmental Action Scale, and 5, Community Environmental Action Scale, which included statements about personal and community actions taken by the participant, 0 indicates [never do this] and 10 indicates [always do this when it makes sense].

Means and standard deviations are based on non-missing data, so the actual sample sizes used in comparing individual statements and scales differed across outcome measures.

M, mean; N, number; SD, standard deviation

Correlations Between Scales

For all five groups, there was a positive correlation between Pollution Sensitivity Scale and Pollution Causes Illness Scale ($P < 0.01$) (Table **4**). Thus, participants who were more aware of pollution in their surroundings tended to think that negative health effects were caused by exposure to pollution. In all groups, except the Statewide Extension Agents

Group, the more aware the participant was of pollution in the surrounding environment, the more likely it was that the participant would take individual action to protect against pollution insults. In all groups, except the Statewide Extension Agents Group and the County Homemakers Non-NPL Group, the more aware of pollution in the surrounding environment, the more likely it was that the participant would collaborate with others to take community action to protect against pollution insults.

Table 4. Correlations between scales for groups.

Groups	Scales	Scales				
		Pollution Sensitivity Scale	Pollution Causes Illness Scale	Pollution Acceptance Scale	Personal Environmental Action Scale	Community Environmental Action Scale
Statewide Extension Agents Group (n=83)	Pollution Sensitivity Scale		.59**	-.08	.11	.20
	Pollution Cause Illness Scale			-.33**	.31**	.27*
	Pollution Acceptance Scale				-.25*	-.19
	Personal Environmental Action Scale					.47*
County Homemakers Non-NPL Group (n=96)	Pollution Sensitivity Scale		.54**	-.04	.12*	.08
	Pollution Causes Illness Scale			- .03	.32**	.11
	Pollution Acceptance Scale				.04	.10
	Personal Environmental Action Scale					.39**
Rural NPL Group (n=172)	Pollution Sensitivity Scale		.65**	.08	.23**	.33**
	Pollution Causes Illness Scale			- .01	.31**	.30**
	Pollution Acceptance Scale				- .01	- .02
	Personal Environmental Action Scale					.46**
Metropolitan NPL Group (n=429)	Pollution Sensitivity Scale		.58**	.07	.19**	.23**
	Pollution Causes Illness Scale			-.14**	.41**	.30**
	Pollution Acceptance Scale				- .17**	- .10
	Personal Environmental Action Scale					.62**
All Groups Combined (n=774)	Pollution Sensitivity Scale		.59**	.05*	.18**	.23*
	Pollution Causes Illness Scale			-.11*	.37**	.27**
	Pollution Acceptance Scale				-.11	.06
	Personal Environmental Action Scale					.54**

Note. * P < 0.05 ** P < 0.01

In all groups except the County Homemakers Non-NPL Group and the Rural NPL Group, there was a negative correlation between Pollution Causes Illness Scale and Pollution Acceptance Scale, indicating that the greater the perception of health risks from pollution the less likely the participants were to accept that pollution was unavoidable (P < 0.05 or P < 0.01). In the Statewide Extension Agents Group, the Metropolitan NPL Group, and All Groups Combined, there was a negative correlation between Pollution Acceptance Scale and Personal Environmental Action Scale (P < 0.05 or P < 0.01). Thus, these groups found that the more a person thought health risks from pollution were unavoidable, the less likely he/she would be to take personal actions to protect against pollution.

For all five groups, there was a positive correlation between Pollution Causes Illness Scale and Personal Environmental Action Scale (P < 0.01). In all groups, except the County Homemakers Non-NPL Group, there was a positive correlation between Pollution Causes Illness Scale and Community Environmental Action Scale (P < 0.05 or P < 0.01).

In all five groups, there was a positive correlation between taking Personal Environmental Action Scale and Community Environmental Action Scale (P < 0.05 or P < 0.01). Overall, if participants were willing to take individual actions, they were also more willing to participate in collective efforts to protect their community.

Correlations and Associations Between Scales and Demographic Characteristics

In examination of demographic variables, age correlated inversely with Pollution Sensitivity Scale (r = -0.08, P < 0.05) such that younger individuals had higher scores. Older persons scored higher on Personal Environmental Action Scale (r = .17, P < 0.01), and Community Environmental Action Scale (r = .13, P < 0.01). Females were more likely than males to think pollution causes health risks (Pollution Causes Illness Scale (P < 0.05) and were more likely to take personal action (Personal Environmental Action Scale) (P < 0.01) than males. Families without children were higher on

Pollution Sensitivity Scale (P < 0.01), but families with children scored higher on the Personal Environmental Action Scale (P < 0.01) and the Community Environmental Action Scale) (P < 0.01). In addition, we used multiple linear regression (Table **5**) to investigate the effect of demographic variables on each scale.

Table 5. Multiple linear regression for demographic variables on each scale.

Demographic variables	scale1 beta (p-value)	scale2 beta (p-value)	scale3 beta (p-value)	scale4 beta (p-value)	scale5 beta (p-value)
Age	-0.0071 (0.1907)	-0.0046 (0.4025)	0.0057 (0.2323)	0.0149 **(0.001)**	0.0192 **(0.0035)**
Gender	-0.1593 (0.3196)	-0.3497 **(0.0321)**	0.1711 (0.2271)	-0.6268 **(<0.001)**	-0.1133 (0.557)
Education: College 4 years or more	0.0048 (0.9828)	-0.0843 (0.7124)	0.32 (0.1079)	-0.0603 (0.7483)	-0.081 (0.7649)
Education: Grade 12 or GED	-0.1315 (0.5341)	-0.0053 (0.9803)	0.6172 **(0.001)**	-0.0529 (0.7649)	-0.4684 (0.0664)
Education: Grade 8 or less	-0.2081 (0.7229)	0.4408 (0.4608)	1.002 (0.054)	-0.1328 (0.7869)	0.5024 (0.4778)
Education: Grades 9-12	-0.5482 (0.2901)	0.5611 (0.2875)	0.0357 (0.9379)	-0.6355 (0.1429)	-1.6656 **(0.0078)**
Education: Post-graduate studies	0.2371 (0.2511)	-0.2224 (0.2901)	0.2838 (0.1207)	-0.1772 (0.3052)	-0.0205 (0.9343)
Children	-0.4308 **(0.016)**	-0.2592 (0.1539)	-0.171 (0.2791)	0.2326 (0.1196)	0.4128 (0.0553)

Individual Statements Within Scales

Individual statements in each scale were ranked by the four highest and four lowest means (Table **6**). Only data from All Groups Combined are shown. The high and low scores would help focus educational efforts for community programs depending on the audience and location. Nutrition related statements not included in the original EHEP survey instrument are marked with an *.

Table 6. Highest and lowest rankings of statements within scales for all groups combined.

Scales and Statements	Mean
Pollution Sensitivity Scale	
Highest ranked statements	
Air pollution from trucks, buses, cars	4.95
Polluted rivers, harbors, lakes, or ocean	4.68
Pesticides - insect sprays, lawn chemicals, *etc*.	4.60
Pesticides, hormones, antibiotics in our food	4.42
Lowest ranked statements	
Radiation from nuclear power plant	0.96
Toxic places like abandoned factories or dumps	2.34
Contaminated drinking water	2.37
PCBs from landfills or from discarded electrical equipment getting into our water or food*	2.76
Pollution Causes Illness Scale	
Highest ranked statements	
Asthma is made worse by pollution in the air	7.77
People should worry about toxic things in their home	6.79
People who work with chemicals often get sick from it	6.05
People may get sick because they don’t eat the right foods to protect themselves from pollution *	5.19
Lowest ranked statements	
The drinking water in my community causes health problemsn	2.28
The air in my neighborhood looks or smells polluted	2.52
The environment where I work might hurt my health	3.15
Some schools in my community are contaminated and unhealthy	3.33
Pollution Acceptance Scale	

(Table 6) contd.....

Scales and Statements	Mean
Highest ranked statements	
Many people I know don't seem to get sick, even though they don't try to keep contaminants out of their food *	4.51
I don't consider environmental problems nearly as important as other problems in my family or neighborhood	3.82
People often exaggerate the amount of sickness caused by pollution	3.58
If you want to eat a normal diet, you can't spend time worrying about contaminants in your food*	3.13
Lowest ranked statements	
People don't need to worry about toxic things, because our bodies can overcome the toxins	2.13
Pollution is just a part of modern life, so we can't do much about it	2.78
I am too busy to do anything about how the environment affects health	2.95
Eating a healthy diet will not make a difference in my health if I live near pollution *	2.97
Personal Environmental Action Scale	
Highest ranked statements	
I wash my fruits and vegetables thoroughly before using them *	8.50
I do what is necessary to make sure my home is free of toxins, like lead and radon	6.84
I avoid being around people who are smoking	6.77
I pick up trash that I see in the street or around my neighborhood	6.54
Lowest ranked statements	
I talk to my doctor or nurse about how to reduce the effects of pollution on my health	1.79
I limit how much fish I eat because fish might contain toxic chemicals	3.50
I eat organically grown food as much as I can*	3.78
I avoid using insect sprays and pesticides because they could make people sick	5.21
Community Environmental Action Scale	
Highest ranked statements	
I tell others about how the environment can affect health	4.09
I talk with my friends and neighbors about how we can get healthier foods in our town*	3.29
I join with others in trying to keep polluting businesses out of our community	3.25
Lowest ranked statements	
I attend meetings about environmental health problems in my community	2.28
When something is polluting our community, my neighbors and I get it stopped	2.57
I talk with my friends and neighbors about how we can get cleaner water in our town*	2.78

Note. Pollution Sensitivity Scale has eighteen statements with this question: "Are there any of these problems in your neighborhood?" 0 equals [none at all], 10 equals [very serious].

Pollution Causes Illness Scale has thirteen statements with this question: "Do things in the environment cause people to get sick?" 0 equals [disagree completely], 10 equals [agree completely].

Pollution Acceptance Scale has eight statements with this question: "Do people just need to live with these things?" 0 equals [disagree completely], 10 equals [agree completely].

Personal Environmental Action Scale has thirteen statements with this question: "Do you do things to help yourself with these problems?" 0 equals [never do this], 10 equals [always do this].

Community Environmental Action Scale has six statements with this question: "Do you do things with others in the community that help?" 0 equals [never do this], 10 equals [always do this].

DISCUSSION

The new EHEP Kentucky Nutrition Version survey instrument used in this study assessed awareness, beliefs, perceptions, and behaviors of Kentucky citizens pertaining to pollution and environmental health risks. Each of the five scales of the new survey instrument had Cronbach's alpha indicating acceptable internal consistency reliability. The results provide helpful findings for developing successful nutrition and health programs for individuals and communities affected by environmental pollutants.

First, the survey results confirmed that we need to know some details about the audience's level of awareness of environmental issues and the health risks they entail in designing effective nutrition and health programs for them. In reporting awareness of various pollution issues in their neighborhoods, the mean score for all five groups was low (3.44), supporting a need for education on types of pollution and the seriousness of the pollution before establishing a link to pollution causes illness and encouraging personal environmental actions. The Statewide Extension Agents Group had the highest mean score (3.76), and the County Homemakers Non-NPL Group had the second highest mean score (3.74) (Table **3**). Both of these groups were closely connected with UK's CES, which suggests that their members may have been more likely to have participated in CES educational programs, which include such topics as agriculture, food,

home, family, and the environment.

On the other hand, the Rural NPL Group was more concerned with health risks, as indicated by having the highest mean score (4.71) for Pollution Causes Illness Scale, while the Metropolitan NPL Group had the second highest mean (4.55) for that Scale. Thus, the groups having the highest level of awareness of the health risks posed by pollution are those with nearby NPL sites. This finding was not surprising, as the EPA procedure for NPL site remediation is designed to include community members through public notification, a public comment period, and ongoing consideration of community member attitudes. Further, participants in the group from the Rural NPL Group were from a smaller town and thus more likely to be aware of the history and publicity pertaining to the nearby NPL site. Some may have had family or friends who developed health problems from working at or living near the site. Conversely, the employer may have provided a lucrative source of employment in the region with subsequent loss of this revenue having a negative impact on the community. The Metropolitan NPL Group came from a much larger populated area containing three NPL sites, and participants may have been exposed to media coverage on three sites even if they were not familiar with the actual victims of the pollution.

Interestingly, however, the Statewide Extension Agents Group, which had the highest mean score for the Pollution Sensitivity Scale, as noted above, had the lowest mean score on Pollution Causes Illness Scale (Table **3**). Thus, although this group's members were aware of pollution in their neighborhoods, they were less likely to perceive the health threats involved. These participants may not have had personal experiences with living near a NPL or other polluted sites and, therefore, did not feel victimized even though they knew intellectually that pollution may cause health problems. In addition, the "neighborhood halo effect," may have contributed to this group's responses [19]. Social and geographic distancing from a hazardous waste site may imply that the environmental harms are someone else's problem, and there is less reason or ability to confront the issues in spite of environmental exposures. An effective community nutrition and health program, therefore, would need to assess the precise area of needed attention.

The second finding of importance was that all the groups in the survey showed willingness to take individual action to protect against environmental health issues, as indicated by higher mean scores (above 5.0 on 0-10 scale) for the Personal Environmental Action Scale, compared to the mean scores for the other Scales (Table **3**). The Rural NPL Group had the highest mean score (4.71) for the Personal Environmental Action Scale. When comparing scales (Table **4**), there was a statistically significant positive correlation in all groups, separately and combined, between Pollution Causes Illness Scale and Personal Environmental Action Scale. This suggests that participants were receptive to learning how to make individual protective behavior changes to address health issues. It also reinforces health behavior models that indicate that individuals must be aware of and perceive health risks to motivate them to take corrective action [22 - 25].

There was also a positive correlation between Pollution Causes Illness Scale and Community Environmental Action Scale ($P < .05$) for all groups except the County Homemakers Non-NPL Group (Table **3**). Thus, in most cases, the participants were willing to work with others in the local community on health issues. The difference in response to taking community action may also be explained by the County Homemakers Non-NPL Group not having a nearby NPL site.

Third, there was a relationship between participants' demographic characteristics and knowledge and perceptions of environmental health risks. The data showed that females were more concerned about health risks and were more likely to make protective individual behavior changes in response to environmental insults. Other researchers support this finding and report that, compared to females, males perceive fewer health risks from environmental causes and are more accepting of health risks that can occur [26, 27]. Furthermore, a younger adult was more likely to be aware of pollution, but an older person was more likely to take individual action and community action to reduce environmental insult. Younger adults may be more aware of environmental issues from science classes in school, but recent trends show young people feel less personally responsible for environment concerns than they did in the early 1990s [28]. In contrast, either as workers or through local politics and publicity [19], older age groups are more aware of the local history of hazardous waste sites and the specific environmental health issues they present.

Participants with children were more likely to take individual action and to collaborate with others in the community to reduce health threats from pollution than participants without children. The multiple linear regression analyses (Table **5**) supported these findings, which suggest that nutrition and environmental health programs will be more effective if they address such audience characteristics as age, gender, and members in the household to focus on the needed areas of attention.

Although the use of nutrition recommendations to improve health in response to exposures to environmental pollutants is relatively new, some of the rankings of individual statements within the scales show promise (Table **6**). The Personal Environmental Action Scale, for example, had the highest overall means, indicating that participants reacted more favorably to taking individual protective actions in response to environmental threats than any of the other scales. Healthy nutrition and food recommendations were included in the Personal Environmental Action Scale. While merely stating or suggesting nutritional habits is seldom sufficient to inspire a change in dietary behavior [22 - 25], nutrition programs should capitalize on this interest and motivation.

It is noteworthy that certain nutrition-related statements were ranked higher in importance by the participants in each of the scales (Table **6**). In the Pollution Sensitivity Scale, for example, All Groups Combined ranked [pesticides, hormones, antibiotics in our food], as the fourth most commonly recognized problem in their neighborhood. The same group ranked [people may get sick because they don't eat the right foods to protect themselves from pollution], fourth highest in the Pollution Causes Illness Scale. In the Personal Environmental Action Scale, the same group ranked [I wash my fruits and vegetables thoroughly before using them] as most frequent among behaviors listed. The same group ranked, [I talk with my friends and neighbors about how we can get healthier foods in our town] as the second most likely action they would take for their community. These responses reflect the importance of educating and motivating nutrition practices as a way to improve individual health habits and offer promise for those programs' success.

This study has several limitations. The sample was limited to pre-arranged events or meetings which varied in their focus in comparison to pollution issues. The data collection relied on self-reporting which may be more or less consistent with actual behavior [22 - 25]. The EHEP Kentucky Nutrition version, however, does have strong reliability. Similarity of these results to those previously reported (with the original EHEP) suggests validity, indicating that this survey provided an important tool for assessing concerns about environmental pollution and actions taken to protect health from such problems [20].

CONCLUSION

Results of this survey indicate that those developing community nutrition and environmental health programs to ameliorate the harm from environmental insults could augment their potential success by assessing and addressing a number of details regarding the audience's knowledge of environmental pollutants and related health risks. The EHEP Kentucky Nutrition Version offers a useful device for that assessment. Armed with this information, those planning such programs may influence the audience's motivation to undertake protective measures.

CONFLICT OF INTEREST

The authors, E. Jones, L. Feng, J.K. Dixon, J.P. Dixon, C. Hofe, and L. Gaetke declare they have no financial and no non-financial conflicts of interest. The authors' freedom to design, conduct, interpret and publish research is not compromised by any controlling sponsor as a condition of review or publication.

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