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ASSESSING THE PERCEPTIONS OF ENVIRONMENTAL POLLUTANTS, HEALTH AND NUTRITION BEHAVIOR TO IMPROVE RISK COMMUNICATIONS IN KENTUCKY

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ABSTRACT OF THESIS

ASSESSING THE PERCEPTIONS OF ENVIRONMENTAL POLLUTANTS, HEALTH AND NUTRITION BEHAVIOR TO IMPROVE RISK COMMUNICATIONS IN KENTUCKY

Nutrition interventions are an effective way to improve the dietary habits and lifestyle choices and reduce the risk of chronic disease. The Researchers in the UK-SRP Community Engagement Core develop nutrition programs for communities affected by environmental pollutants. Risk communication is a discipline that can be used to develop targeted nutrition interventions that will yield positive behavior change. The purpose of this study was to examine knowledge, risk perception, and actions concerning environmental pollutants and nutrition behavior. Data was collected using a modified survey instrument based on the validated Environmental Health Engagement Profile (EHEP). Survey participants from diverse regions of the state included 1) health educators; *2*) residents from a nonmetropolitan-non-Appalachian area; 3) a nonmetropolitan-Appalachian area; and 4) a metropolitan area. Results indicated a significant, positive correlation in all four groups between perception of environmental pollutants in a person's surroundings and the extent of concern that pollutants cause adverse health effects ($p < 0.01$). Recognizing that participants see a link between environmental pollutants and their health allows nutrition researchers to develop targeted, effective nutrition interventions. This information will be useful in the development of future nutrition programs to improve the health of Superfund communities.

KEYWORDS: Environmental pollutants, Nutrition, Superfund, Risk communication, Risk perception

Elizabeth V. Willett

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THESIS

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The Graduate School

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ASSESSING THE PERCEPTIONS OF ENVIRONMENTAL POLLUTANTS, HEALTH AND NUTRITION BEHAVIOR TO IMPROVE RISK COMMUNICATIONS IN KENTUCKY

Thesis

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Sciences
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By

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Lexington, KY

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Chapter One

The first *Healthy People* report in 1979 stated "…there is virtually no major chronic disease to which environmental factors do not contribute, either directly or indirectly" (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). According to the World Health Organization, globally one quarter of all deaths can be attributed to environmental conditions and are responsible for one third of all child deaths. In the U.S. about 13% of total deaths can be attributed to the environment, specifically cardiovascular disease, neuropsychiatric disorders, cancers, asthma, and musculoskeletal diseases (Organization, 2006).

The Centers for Disease Control reported in 2009 that the U.S. population has widespread exposure to chemicals commonly used in industry. The most prevalent pollutants found in the U.S. population's blood and urine are polybrominated diphenyl ethers (PBDEs), bisphenol A (BPA), perfluorinated chemicals (PFCs), mercury, and acrylaminde. People are exposed everyday to these common pollutants and chemicals through consuming food, breathing contaminated air, using products containing these pollutants and storing food in containers made with these pollutants. (Control, 2009) Research findings are supporting the belief that environmental factors, such as pollutant and chemical exposure, play a role in the development of chronic disease (Butterfield, 2002).

Environmental health is defined as the "freedom from illness or injury related to exposure to toxic agents and other environmental conditions that are potentially detrimental to human health" (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). Environmental health engagement is defined as any thoughts or experiences

related to environmental concerns and any actions or behaviors taken to mitigate or reduce harmful effects (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). Effective risk communication is a "two-way interactive dialogue" that can be enhanced with research examining how individuals and communities can reduce their risk (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). Risk communication techniques can be used to build trust, plan effective health interventions, build source credibility, and ultimately help people make informed decisions about health behavior (Weinstein, What does it mean to understand a risk? Evaluating risk comprehension, 1999). This may be an effective tool for communicating about environmental pollution and the subsequent health risks to the general public.

The University of Kentucky (UK) Superfund Research Program (SRP) is part of a national grant program challenged to conduct research to explore the health effects of environmental pollutants. UK's program is unique because it focuses on chlorinated pollutants, such as polychlorinated biphenyls (PCBs), and on the strategy that nutrition can have a positive impact on the health of those most impacted by pollutant exposure. The SRP Community Engagement Core (CEC) develops lessons on various nutrition, health and pollution topics to be used for nutrition programs in communities with hazardous waste sites and for educating the general public on environmental pollution. These lessons can be viewed as environmental nutrition risk communication, which are intended to educate citizens in Kentucky (KY) on the risks and harmful effects of pollutants while offering nutrition strategies to positively impact their health. The CEC plans these lessons with the objective that behavior will change and more healthful habits will be adopted.

Background

Superfund is the program designed by the federal government to clean up and manage the nation's worst uncontrolled hazardous waste sites. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 established this federal program in response to the growing number of abandoned hazardous waste sites causing environmental and health problems, such as Love Canal and Times Beach (Superfund, 2010).

Superfund sites are widespread and most counties in KY are impacted in some way. There are 14 sites in KY on the National Priority List (NPL) (Agency, 2009). The NPL is a national register of the worst pollutant sites in the U.S. and these sites receive priority for cleanup and impact assessments from the federal and state governments. These and other waste sites can leak environmental pollutants into the air, water, and soils. These pollutants may eventually find their way into our bodies and food supply and may play a role in the development of chronic diseases (Butterfield, 2002).

Certain pollutants, once entering our body and bloodstream, will cause damage to arterial walls, increase oxidative stress and contribute to an increased risk of chronic diseases (Gaetke, Gaetke, & Bowen, 2008). PCBs have been found to be neurotoxicants, associated with thyroid toxicity, and can affect the immune, reproductive, endocrine, and nervous systems (Hopf, Ruder, & Succop, 2009). Dietary antioxidants can help protect cells from damage by free radicals. Nutrition strategies to increase antioxidants such as vitamins C and E, carotenoids, and other plant compounds may be useful against harmful effects from pollutant exposure (Antioxidants, 2009).

The dialogue on health, pollution and nutrition with individuals and communities should be a two-way exchange and can be considered risk communication. The goal of any risk communication message is to influence a person's perception of risk and to change behaviors. There are many factors that will influence the receipt of a message and whether or not it leads to the intended behavior change. As senders of risk communication messages, the CEC planned to assess the characteristics of their target populations and health educators. These characteristics include current beliefs, concerns, and actions about pollutants and demographic information such as education level, gender, having children or no children, and where they live. A greater understanding of the CEC's target audiences may lead to improved risk communication through more targeted messages that will impact pollution risk perception and health behaviors.

UK Cooperative Extension Service (CES) agents lead many health and nutrition programs in their respective communities and are well trusted sources of information for individuals and families. Agents utilize educational publications from the CEC for planning programs on environmental health and nutrition topics. Assessing the characteristics of these health educators will also aid in the writing of the lesson plans. Understanding the beliefs and attitudes of these health educators is vital for effective risk communication since they can impact the message delivery and receipt by the audience. It is important for health educators to be informed of the risks associated with common pollutants in the United States, but also know how to properly educate about those risks to the citizens in their community.

Statement of Problem

There is a known relationship between pollution exposure and health outcomes, and therefore it is necessary for people living near NPL sites and other hazardous waste sites to protect themselves with lifestyle changes, particularly healthy food and dietary behavior choices. People are exposed to a wide array of environmental pollutants through air, water, and food. These toxins can bio-accumulate in the body and increase oxidative stress, leading to decreased immune functioning and an increased risk of several chronic diseases. There is a need for effective health and nutrition communication as it relates to pollutant exposure for the average individual and those living in communities with Superfund hazardous waste sites.

The problem exists in the fact that individuals may not realize the long-term negative health effects from environmental pollution, nor understand the link between pollutants, nutrition, and disease state. Researchers and health educators may perceive some level of increased health risk from exposure to environmental pollutants, but does the average person living in a community with a NPL Superfund site perceive any risk? What about those living near multiple federal and state designated hazardous waste sites? If individuals understand environmental health issues, do they have better dietary behaviors and actions because of their concern about exposure to environmental pollutants?

Individuals living near one or several hazardous waste sites may not be aware of common pollutants in their surrounding environment. As developers of environmental nutrition lessons, the CEC should be informed of the current knowledge, risk perception, and health behaviors of the individuals living in KY.

Statement of Purpose

The purpose of the current study is to assess participant knowledge, concerns and actions of environmental pollutants, environmental health and nutrition issues using the Environmental Health Engagement Profile (EHEP) KY nutrition version. This assessment will gather data useful for improving environmental nutrition risk communication techniques used in NPL communities and for development of future environmental health and nutrition lessons. Environmental nutrition risk communication is defined as interactive dialogue with individuals and communities on the topics of environmental pollution and the subsequent health effects, coupled with positive nutrition strategies useful in lowering risks to chronic disease.

Environmental nutrition risk communication is an effective way to intervene in the communities most impacted with environmental pollution. Successful interventions will help individuals understand the relationship between pollution exposure and adverse health risks, while at the same time suggest nutrition strategies to lower these health risks and increase their protective health behaviors against pollution effects.

In this study, both KY citizens and health educators will be assessed. Knowing the current level of pollutant knowledge, concerns related to pollution, and the protective health actions of community members will guide future environmental nutrition lesson planning by identifying areas of focus and hopefully improving the overall quality of CEC environmental nutrition education.

A group of health professionals will also be assessed because this information will be useful for planning environmental pollution and nutrition lessons designed to be used by health professionals in Kentucky communities. Environmental education is becoming more prevalent and it is necessary to evaluate the knowledge and attitudes of health educators on the topics they are teaching, since these may impact the message delivery (Weber, Hair, & Fowler, 2000).

Justification

The U.S. Healthy People 2010 Objectives have declared that health communications "…can contribute to all aspects of disease prevention and health promotion" (U.S. Department of Health and Human Services, 2000). This objective is especially important with the prevalence of chronic, life-style related diseases facing Kentucky and the U.S. Heart disease is the number one cause of death in the United States and is a preventable disease through dietary and lifestyle choices. Other leading causes of death for the U.S. and KY that have dietary factors associated with them are cancer, stroke, and Type 2 Diabetes Mellitus (Leading Causes of Death, 2009). Researchers are finding connections between pollutant exposure and these chronic diseases. Thus, communication of these findings to the public is necessary for impacting health behavior change.

Education about exposure to pollutants is necessary because most are toxic, resilient, and bioaccumulate in humans over time and may increase the risks for chronic disease. The average citizen may not understand the risks to exposure to common pollutants, or think they are exposed at all. Risk communication on the topic of

environmental pollution, health and nutrition is necessary due to the known relationship between pollution and chronic disease.

Without risk communication on the toxic effects from pollution exposure, an individual living near these areas may not know about the associated adverse health effects and may not take protective health actions. In KY, many lakes and rivers are under advisory for one or more toxins. There are locations under a no fish consumption advisory due to PCBs or mercury levels in the fish tissues and water (Fish Consumption Advisories in Kentucky, 2009) . All waters in KY are under advisory for mercury and women of childbearing age and young children are under advisement for consuming local fish. Currently none of the Ohio River banks on the KY border can fully support recreation and fishing uses. Of the other rivers in KY, 21% cannot support any uses, and 12% can only support partial uses. Of the lakes in KY, 23% can only support partial uses and 5% cannot support any uses by the public. The sources of impairment to the bodies of water in KY are agricultural runoff, municipal point sources, improper waste disposal and urban runoff. (Health, 2010) These statistics show the importance of educating communities on the state fish and water advisories through effective environmental nutrition risk communication. Many people may not have internet access to read these advisories and may eat local freshwater fish in higher amounts than is considered safe for their health.

A difference exists between the level of risk perception to a hazard for the general public and health researchers. The general public tends to underestimate their current risk to health problems, while researchers believe that a correction in misinterpretations or education on the risk will lead to motivation to change behaviors (Brewer, Weinstein,

Cuite, & Herrington, 2004). Assessing the current state of knowledge, concern, and action of community members through data collection may identify knowledge gaps that can be addressed through future research and education efforts. Effective environmental nutrition communication designed specifically for communities living with past and current hazardous waste sites may improve health behaviors among individuals by influencing knowledge and concern about pollution.

Objectives

The following objectives guided the research design of the assessment of Kentucky citizens:

1. Examination of the level of risk perception (knowledge and concerns) of environmental pollution by using the EHEP KY nutrition version in 1) average citizens in communities with and without NPL hazardous waste sites, and 2) in health professionals living in counties with and without NPL sites.
2. Evaluation of the demographic characteristics and the level of risk perception of the individuals and health professionals completing the EHEP KY nutrition version.

Research questions

The EHEP KY nutrition version examined responses according to five scales. The scales in this survey are the Pollution Sensitivity, Pollution-Causes-Illness, Pollution Acceptance, Community Environmental Action and the Personal Environmental Action. The following research questions were examined by analyzing responses from individuals and health professionals on their knowledge and understanding of pollution in

their community, their perception of risk from environmental pollutants, food behaviors and intentions to take action against environmental pollution.

1. What types of pollution do people believe are the most abundant in their immediate environment?
2. Do average individuals perceive health risk from pollution in the environment?
3. Will the average individual living near a NPL hazardous waste site perceive health risk from pollution in the environment and thus take personal protective health action?
4. Does a health professional take more personal protective health action than an individual living with a NPL hazardous waste site?
5. How will gender affect the level of perceived risk and action in response to their perceived risk of environmental pollution?

Hypothesis

1. There is an association between level of risk perception and the protective health actions taken in response to perceived risk from environmental pollution for health professionals.
2. There is an association between the level of risk perception and protective health actions taken in response to perceived risk from environmental pollution for individuals living near a hazardous waste site.
3. Health professionals will take more protective health actions against environmental pollution than individuals living near a NPL hazardous waste site.
4. Gender does affect the level of concern that pollution causes adverse health effects

Limitations

The research data was gathered using funds provided by a National Institute of Environmental Health Science SRP grant. This grant specifies only adults be used for research purposes and no invasive or clinical measures can be taken from participants. The research team was not able to include community members living directly next to the hazardous waste sites to complete a survey. The county festivals where some surveys were performed had visitors from other counties and possibly other states.

Assumptions

The research design relied on volunteer samples and assumed the community members took time to fill out a survey on environmental pollution in its entirety with honest and reliable answers.

Chapter Two

Review of Literature

Exposure to environmental pollutants may cause adverse human health effects and increase risk to chronic diseases. There are many affected communities in the U.S. due to spills, leakage, and dumping of pollution into the soil, water, and air. It is necessary for health educators to be aware of the negative health effects from pollution and the strategies advisable for lessening one's exposure to pollutants and decreasing risks of chronic disease. This review of literature will discuss pollutants and the associated health risks. This chapter will also discuss risk communication in relation to environmental pollution and health protective behavior.

Environmental Pollutants

Environmental pollutants are widespread in the environment and many are stored in animal fat cells and bioaccumulate in the food chain. Inhalation, ingestion, and physical contact are the three main routes of exposure to pollutants in our environment.

PCBs are a common industrial pollutant used heavily prior to 1979 when they were banned from U.S. production. PCBs have been found to have several adverse health effects on the immune system, reproductive system, nervous system and the pollutant may also increase certain types of cancer and oxidative stress. (Polychlorinated biphenyls (PCBs), 2010) According to research by Choi et al. on cord serum PCBs levels of those living near a Superfund site, there are several impacting factors. An earlier birth year correlates with a higher serum PCB level; consuming local dairy products, organ meats, and red meat were also found to be significant contributors to PCB body burden (Choi, Levy, Dockery, Ryan, Tolbert, & Altshul, 2006).

Mercury is a common pollutant that is naturally occurring in the environment and is found in air, water and soil. Mercury exposure affects the nervous system and may cause harm to the brain, heart, kidneys, and immune system. The U.S. population is mainly exposed through dietary habits of eating fish or shellfish containing mercury (Mercury, 2010).

Risk Communication

Risk communication is an exchange of information between a sender and a receiver (or target audience) to discuss health and environmental risks and strategies to deal with the risk (U.S. Department of Health and Human Services, 2000). The purpose of risk communication is "…building trust and consensus, creating awareness, educating, influencing perceptions, attitudes and beliefs, promoting action and changing behavior" (McGloin, Delaney, Hudson, & Wall, 2009) Risk communication will be most effective if it alerts the target audience to the risk, is realistic about the extent of danger, and addresses what can be done to protect oneself and ways to mitigate damage from the risk (Breakwell, 2000). It is important for health professionals to be informed of the risks associated with common pollutants in the U.S., but also know how to properly educate about those risks to the citizens in their community.

When evaluating an individual's response to a risk or level of risk perception it is important to understand the decision-making factors that may affect risk perception. These factors or characteristics include previous knowledge, values, social pressures, environmental barriers, financial constraints and psychological factors. (Weinstein, What does it mean to understand a risk? Evaluating risk comprehension, 1999) The psychological factor to most likely impact health and food behaviors is called optimistic

bias. This cognitive bias addresses the commonly held belief by any individual that they are less likely to experience harm from a behavior than someone else doing the same behavior. Other biases include anchoring, which is about the first initial impression of a risk by an individual, and availability, which addresses the fact that an individual may have already experienced the effects of a particular risk or been exposed to it through the media (McGloin, Delaney, Hudson, & Wall, 2009).

Sender and receiver characteristics.

There are many factors to consider when thinking about environmental nutrition risk communication. Characteristics of the affected community, target audience and the information sender will impact how well a message is received. The characteristics of the target community are important to consider when planning nutrition risk communication programs. Literacy rate, cultural norms and socio-economic status must be taken into account when designing written materials and preparing presentations. (McGloin, Delaney, Hudson, & Wall, 2009)

Understanding receiver characteristics is important according to the "mental model" approach which seeks to identify accurate and inaccurate beliefs on a particular hazard held by a target audience (Breakwell, 2000). The information gathered from environmental health engagement surveys can be useful for correcting misunderstandings on environmental health topics. This may lead to getting individuals and communities to a better position to make more informed decisions about health and food choices.

Consideration of audience characteristics, such as age, income, activity level and education level, is essential for effective interventions concerning nutrition and health risk. Research has found that gender plays a role in risk perception. For example, males

usually will view risks as less of a threat than females. A more predominant male audience may need more dramatic messages or images to increase risk perception and change behavior. Women with children or stay at home mothers may believe risks to be higher. Older adults have been found to perceive risks to be higher and avoid risk more than others. Interestingly, higher education level has been equated with less aversion to risk and feeling less confident about the effectiveness of protective measures against a risk. Consideration of the audience is very important to successful message planning and audience segmentation may be ideal in specific communities (McGloin, Delaney, Hudson, & Wall, 2009).

Environmental risk perception.

Risk perception can be summarized by three steps: the acquisition of information, interpretation and synthesis of different pieces of information, and the understanding of that information in light of previous knowledge, perceptions and attitudes (Burger, Greenberg, Gochfield, Shukla, Lowrie, & Keren, 2008) The interactive exchange of information between a source and the receiver will hopefully lead to better risk management and behavior changes. "Knowledge acquisition is essential to understanding hazards and risks" (Burger, Greenberg, Gochfield, Shukla, Lowrie, & Keren, 2008) and should be a central belief for the planning of effective risk communication and messages.

A person's level of risk perception to environmental hazards can be impacted by society and social media (Weber, Hair, & Fowler, 2000). The harm from environmental pollution exposure may not be seen firsthand, so many people's perception of risk may be greatly influenced by mass media exposure. The perception of risk when related to food choices is a barrier to nutrition interventions. The health effects from food and pollution

are not usually short-term effects, but rather effects that may compound with other risk factors and influence a person's health for the long-term. This may play a role in the level of risk perception to pollutants in a person's immediate area. When negative effects are not seen quickly or firsthand, it can be easily dismissed or viewed as not relevant to health behavior choices.

Assessing a community's knowledge of pollutants and their level of concern that those pollutants cause illness may be viewed as a measure of "environmental literacy" (Weber, Hair, & Fowler, 2000). This may help educators understand why certain behaviors are taken or not taken by individuals living in that community. This research survey addressed nutrition behaviors associated with pollutant risk perception. The results gathered may be viewed as a nutrition literacy score for the participants, which may be useful for the CEC purposes of increasing knowledge and changing health and nutrition behaviors. The need exists to measure the nutrition and environmental literacy from educators involved in disseminating health information because teaching may be influenced by the teacher's personal views and beliefs (Weber, Hair, & Fowler, 2000).

Personal relevance will also impact the message receipt by an individual. In the case of Harlan County, KY the community has been exposed to media exposure and litigation because of the National Electric Coil/Cooper Industries contamination that took place in Dayhoit, KY from 1951 to 1987 (Agency, 2009). The media exposure may have impacted many community members perception of risk to pollution and trust in industry and government health agencies that responded to the situation. These factors of personal experience are relevant when considering health lessons and risk message planning for this community.

Environmental survey instruments.

There are existing survey instruments designed to measure a person's environmental knowledge and concern about pollution. Survey designers must check scales prior to data collection for reliability so the results gathered can be attributed to the data and not poor scale design. Many past studies have used homogenous samples in similar geographic regions or with similar characteristics and this study design does not reflect the true variability and diversity that may exist in people's attitudes and knowledge about environmental pollution. (Weber, Hair, & Fowler, 2000) It is argued that a person's thoughts about pollution are more perceptions than factual knowledge. A person's level of pollution risk perception is regarded in terms of a person's prior experience with issues such as air pollution, waste disposal, agriculture runoff, toxic chemicals or land development.

The Perceived Environmental Risk (PER) survey instrument was designed to evaluate environmental perceptions of students and environmental education teachers (Weber, Hair, & Fowler, 2000). The survey started out with 75 items developed by a literature review and interviews with industry and education professionals. After review 45 items were selected for inclusion in the data collection used for reliability and validity of the instrument. The authors designed a 0-5 Likert-type scale that was pretested on middle and high school students and their teachers. After exploratory factor analysis revealed good scores of internal reliability and validity, 38 items were kept in the survey (Weber, Hair, & Fowler, 2000).

The PER instrument did not include any nutrition or food related statements and was developed intended for use in a school setting. The statements would not be considered suitable for low-literacy populations and when surveying the general public. These criteria are important considerations for survey instrument design and selection.

The Environmental Health Engagement Profile (EHEP) survey was designed for use in the general public as a tool for educators and researchers to use to assess a person's level of environmental health knowledge, concerns and mitigating actions against environmental pollution. The authors have deemed this measure to be a person's level of environmental health engagement (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). This instrument was designed after careful review of existing environmental perception instruments, including the PER. This instrument was designed with the intent for use by professionals who make risk communication on environmental pollution a focus of their work with individuals and communities (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009).

The EHEP was built on a stage model of progression from environmental risk perception to action (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). The survey was developed using three phases. The first phase included interviewing a group of urban residents on their thoughts on illness and pollution, cleanliness of their environment, and actions taken personally and with the community to impact environmental pollution exposure. These interviews were transcribed and coded for similar thoughts and topics. From this coding, 399 potential items were identified and 56 were retained for inclusion in the survey instrument. The second phase consisted of environmental health experts reviewing the 56 items and classifying them into categories

of knowledge, concern or action. After this review 46 items remained and were tested in Phase three of the project. Phase three was a field test by telephone survey to determine internal structure, reliability and validity of the items and instrument. (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009)

The EHEP was found to have good internal reliability and validity scores. Five scales were developed through this process. These scales addressed the three original categories of knowledge, concern and action. The authors found significant correlations between the knowledge and concern scales, as well as the concern and personal action scales. There were associations found between demographics and the scales. Age and knowledge were inversely correlated, and women were found to have higher scores than men for personal protective actions.

The EHEP instrument is a good instrument to use for the general public because it addresses a wide range of environmental threats, and a wide range of precautionary actions a person may take to lower risks from environmental pollution. The correlation between the scales showed good validity and supports the stage model of risk perception to action. The survey is low-literacy and adaptable to a paper-and-pencil version.

These environmental risk perception instruments allow a researcher to obtain a summed-average of each item in each scale for the groups that can be used as a single index explaining the beliefs, concerns, and actions of that group (Weber, Hair, & Fowler, 2000). Comparisons can be made between the groups for significant differences and similarities. These results may be indicative of future topics for environmental nutrition lessons intended to increase knowledge of pollutants and concern about health.

Health Protective Behavior

The Social Cognitive Theory states that behavior is dependent on a multitude of personal, environmental, and behavioral factors. The adoption of a behavior or a change in behavior can be facilitated by strengthening cognitive, behavioral, and efficacy skills and providing environmental supports specific to the behavior. (Derrick, Miller, & Andrews, 2008) Many common health behavior theories, including health belief model, theory of reasoned action, and protection motivation theory, include risk perception but they are not clear on the severity this may play in a person's health behaviors. (Brewer, Chapman, Gibbons, Gerrard, McCaul, & Weinstein, 2007) This supports using environmental nutrition risk communication to impact health behaviors through interactive dialogue on pollution and health effects even if the extent of impact is unknown.

The health belief model predicts health behaviors based on perceived probability that an outcome will occur, severity of the negative outcome, perceived effectiveness of the precaution, and cost to adopt the precautionary action. The theories all differ by the number and kind of variables used in the prediction of health behaviors. Some account for present behaviors, like the health belief model, while others look more at future behaviors and their impact to risk. (Weinstein, 1993) The environmental risk perception surveys generally looks at present levels of knowledge, concern and actions. The accuracy hypothesis of behavior assumes that one's perception of risk at a given time will predict the risk behaviors at the same point in time. The data gathered in this study will be analyzed for simple correlations and associations at a given point in time, which was the point at which the participant took the survey.

Most theories agree that a higher perceived risk of harm from a hazard should encourage action to reduce risk (Brewer, Weinstein, Cuite, & Herrington, 2004). The motivation for health protective behavior is believed to arise from the anticipation of a negative health outcome and desire to avoid this harm (Weinstein, 1993). The motivation to act is also dependant on the person's belief that the negative outcome will actually happen to them rather than someone else, commonly referred to as optimistic bias. Another important factor is the consideration that the intended behavior change or action will reduce the likelihood of harm from a risk (Weinstein, 1993).

Risk perception in most health behavior models is described as a person's likelihood, susceptibility, or vulnerability to an adverse health effect from a hazard. Susceptibility and likelihood describe an individual's probability of harm from a hazard under certain situations. (Brewer, Chapman, Gibbons, Gerrard, McCaul, & Weinstein, 2007) Everyone's susceptibility and likelihood to adverse health effects from pollution are different and based on many factors, such as genetics, current health status, environment, and health behaviors. The environmental risk perception survey instruments do not quantify an individual's probability to harm from pollution, rather they attempt to examine a person's knowledge and thoughts on pollution issues, concern that the hazard will cause harm and the resulting health behaviors.

Environmental Nutrition Interventions

In research it is important to ensure that the results will benefit the community or target population (Goldberg-Freeman, Kass, & Tracey, 2007). Researching a population's views and attitudes on pollution and nutrition will benefit communities living near hazardous waste sites by helping to guide researchers in the planning of

lessons intended to impact nutrition behaviors and attitudes towards pollution. Bridging the gap between what the communities are doing and what the researchers want the community to be doing is important for decreasing risks to chronic diseases. Environmental nutrition interventions are designed to communicate on the topic of pollution and how it interacts in the body, while at the same time proposing healthful dietary strategies to decrease risk of disease.

Environmental nutrition interventions are also intended to serve the needs of the general public, because environmental pollutants can travel far from the source. Current research from air sampling stations in Beijing, China and across the Pacific Ocean show that air pollution generated during the 2008 Olympics travelled to the U.S. west coast in under a week (Simonich S. P., 2009). Particulate matter from coal combustion in urban areas and large forest fires can have long range transport. China, India, and the U.S. are the largest emitters of particulate matter into the global environment and these pollutants can cause adverse health effects in populations far from the source of emission. Pollutants have an atmospheric fate and a metabolic fate and both will have health effects to the human population. Simonich & Harris (2010) suggests that everyone who is exposed to environmental pollution would be a benefit from educational programming to improve health. CEC research supports the need for offering environmental nutrition information to affected community members.

Research from the UK SRP indicate that nutrition may be an effective strategy against the damaging effects from common pollutants found in the U.S., such as PCBs. Increasing antioxidant consumption will help to decrease oxidative stress, which is linked to many chronic diseases. Vitamin C and E, zinc, omega-3 fatty acids, and phenolic

compounds such as quercetin and resveratrol have been found to have positive effects on decreasing pollutant induced oxidative stress (Majkova, 2010). A low saturated fat diet rich in fruits, vegetables, whole grains, legumes, nuts and seeds will provide vitamins and minerals necessary for proper immune functioning (Hennig, et al., 2008).

Summary

The review of literature supported using risk communication techniques when educating about environmental pollutants, health and nutrition. The review also helped to define environmental nutrition risk communication as a tool to incorporate into the CEC nutrition lessons. These environmental nutrition programs need to be planned with an understanding of the target audience's prior knowledge, cultural beliefs, values, current behaviors and demographics to achieve optimal results of influencing dietary and health behavior change. Using a trusted community member to deliver environmental nutrition risk interventions may help build community confidence in their ability to perform dietary changes needed in communities living with a Superfund site. Affected individuals and the general public may not realize the negative health effects from common environmental pollutants and how their food choices play a role in mitigating health risks. Using a validated environmental risk perception instrument to assess KY citizens' knowledge of environmental pollutants, concern about adverse health effects and protective actions taken will provide a deeper understanding of the UK SRP CEC target audiences. The results of this study will lead to more effective programming for those communities suffering from chronic pollutant exposure.

Chapter Three

Methodology

This methodology will describe the project, sample population, instrument of measurement, data collection methods and how the data was analyzed.

Research Design

A quantitative design explored the levels of environmental health engagement in individuals living in counties with and without NPL sites. The Environmental Health Engagement Profile (EHEP) which was adapted to include nutrition statements to evaluate attitudes towards environmental pollution and nutrition behaviors was used as the validated survey instrument. The survey was adapted from an oral-interview instrument to a pencil-and-paper instrument by the original authors from Yale University.

The survey was written at a low-literacy level and evaluated knowledge, risk perception, and environmental actions taken in response to pollution. The survey was administered at a UK CES Family and Consumer Science (FCS) health professional seminar and at selected KY festival events.

Differences in perception of risk to environmental hazards have been found to vary significantly according to socioeconomic status (SES), education level and geographic locality (Weber, Hair, & Fowler, 2000). Survey results were from three different geographic locations in KY and included for basic demographic information from its participants. SES was not included in the original survey instrument provided by Dixon et al.

Sample

A convenience or opportunity sampling technique was utilized at the four events held throughout the state of KY. Data collection began in May 2010 and ended during August 2010. The sampling technique was chosen for its timely design and inexpensive cost to collect basic. The surveys were anonymous and collected without any personal identifiers.

The U.S. Office of Management and Budget (OMB) is responsible for the classification system used to define metropolitan and nonmetropolitan areas in the U.S. The sample populations chosen to be studied in the EHEP Kentucky Nutrition version profile are described below. According to the 2000 U.S. Census Bureau information, KY is 90.1% Caucasian and 7.3% black or African American. The counties surveyed in this data collection process will be of a similar demographic characteristic.

Health educators.

UK CES FCS agents are very involved in nutrition programs and educating their communities on current health topics. The agents are well-respected and seen as credible sources of information, as well as, living in and accepted as members of the community. Agents have used environmental programs and lesson plans developed by the SRP CEC. Understanding the population's characteristics, including their current level of knowledge on pollution topics, will help the SRP CEC as lesson planners in the development of tools for these KY health educators. The sample will be considered a purposive or authoritative based on their credibility in the community and status as a health professional and educator. The instrument was administered at a CES FCS conference held on May 20th, 2010 in Lexington, KY.

Nonmetropolitan Area, non-Appalachia.

Mason County is located along the Ohio River in northeastern Kentucky and has no hazardous waste sites listed as NPL. According to the USDA Economic Research Service, this county is classified as a nonmetropolitan county and defined as having an urban population of 2,500 to 19,999 and is adjacent to a metropolitan area (Kassel, 2010). The sample was chosen for comparison with metropolitan, nonmetropolitan-Appalachian and health educators samples.

Mason county has an active Kentucky Extension Homemakers Association (KEHA), which is a volunteer organization represented in every county of KY. The members are dedicated to improving the quality of life for their families and communities through education and service. The KEHA clubs and members host meetings and programs on a variety of subjects, including health and nutrition. The club leaders are seen as credible sources of information in their family and community, and are trusted members of the community (KEHA, 2010). The instrument was administered at a KEHA Annual Meeting held on May 24th, 2010 in Maysville, KY.

Nonmetropolitan Area, Appalachia.

Harlan County is located in the Appalachian Mountains along the KY-Virginia southeast border. Harlan County contains one hazardous waste site listed as a NPL site and is classified as a nonmetropolitan statistical area with an urban population of 2,500 to 19,999 and is not adjacent to a metropolitan area (Kassel, 2010). This sample was chosen for its comparison with the metropolitan, nonmetropolitan-non-Appalachia, and health educator samples.

The National Electric Coil/Cooper Industries NPL hazardous waste site in Dayhoit, KY is located in Harlan County. This site was discovered to be contaminated with volatile organic compounds in February 1989 when private drinking wells on adjacent private home properties were found to be contaminated. Investigations showed that waste sludge and PCBs flowed on the land and were dumped into the Cumberland River. The U.S. Environmental Protection Agency (EPA) has overseen the cleanup and remediation of the property and conducts site reviews every five years. (Agency, 2009)

The community has been involved in ligation with the liable company and monetary restitutions were rewarded by the company to the affected community members. Environmental pollution and nutrition education on this sensitive topic has been limited in the past due to litigation. The lawsuits have been settled and it is a good time to assess the knowledge and risk perceptions of this impacted community.

The Poke Sallet Festival is an annual festival held in Harlan, KY attracting thousands of visitors from the county as well as surrounding counties and states. The instrument was administered at the Festival from June 4-5, 2010 in Harlan, KY.

Metropolitan Area.

Jefferson County is located along the Ohio River and the northwest border with Indiana. This county has two hazardous waste sites listed as NPL sites and is classified as a metropolitan area with a population of 1 million or more (Kassel, 2010). Included in this metropolitan area are two counties, Bullitt and Oldham, which also contain hazardous waste sites listed as NPL. In total there are six KY NPL sites in this area. (Superfund, 2010) This sample was chosen for its comparison with the nonmetropolitan-Appalachia, nonmetropolitan-non-Appalachia, and health educator samples.

The six NPL sites in and adjacent to Jefferson County have included groundwater, surface water, soil, and air pollution by a wide variety of contaminants. Three of the six NPL sites were deleted from the list, but still continue to be reviewed every five years by the EPA or are monitored by the state Superfund department and/or responsible parties. All sites had pollution from heavy metals, such as lead and chromium. Some sites had PCB contamination and volatile organic compounds such as ketones, toluene, and benzene. (Superfund, 2010)

The Kentucky State Fair is held annually in Jefferson County, KY and sees visitors from all across the state and neighboring states. Surveys were available at a table displayed as part of the UK College of Agriculture booth held in the West Hall of the Exposition Center. Visitors to the West Hall were asked to complete the EHEP KY Nutrition version on a volunteer basis. Participants were informed of the confidentiality and anonymity of the instrument prior to taking the survey. This sample will be compared to the other three samples. The instrument was administered at the Kentucky State Fair from August 20-22, 2010 in Louisville, KY.

Instrument

The EHEP is an instrument designed to measure environmental health engagement, meaning the "way that people think and behave in relation to environmental health issues" (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). The authors have collaborated with the UK SRP CEC team and revised the survey into a Kentucky version entitled the EHEP KY nutrition version. The revised version contains several new statements concerning nutrition and pollution beliefs. All individuals were asked to evaluate a statement using a number scale ranging from 0 to 10. For scale 1: 0

indicates “none at all” and 10 indicates “very serious” when asked about pollutants in the participant’s neighborhood. For scales 2 and 3: 0 indicates “disagree completely” and 10 indicates “agree completely” with statements dealing with concern for pollution and health. For scales 4 and 5: 0 indicates “never do this” and 10 indicates “always do this” for personal and community actions taken by the participant.

The survey authors’ identified five scales: pollution sensitivity, pollution-causes-illness, pollution acceptance, personal environmental action, and community environmental action. These scales are summarized below (Table 3.1).

Table 3.1, Summary of EHEP KY nutrition version survey scales

Scale	Meaning of scale
Scale One: Pollution Sensitivity	Knowledge or belief of pollutants in one’s neighborhood.
Scale Two: Pollution-Causes-Illness	Extent to which a person attributes adverse health effects to pollutants.
Scale Three: Pollution Acceptance	Extent to which a person believes pollution is unavoidable.
Scale Four: Personal Environmental Action	Extent to which a person takes protective actions from environmental pollutants or hazards.
Scale Five: Community Environmental Action	Extent to which a person joins with others to help reduce harm from pollution in their community.

The five scales have been validated by the Yale University School of Nursing through a series of factor analyses intended to examine internal reliability (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). The pollution sensitivity scale was found to have a Cronbach's α of .91, which is a high value indicating strong internal reliability. The pollution-causes-illness scale's Cronbach's α was .84, also a high score indicating internal reliability of the statements in the scale. The pollution acceptance scale's score was .67, which is slightly below the accepted standard of .70. The personal environmental action scale's score was .63 and the community environmental action scale's score was .79. Three of the five scales reflect a strong Cronbach's α score for internal consistency reliability. Further validation work on this instrument is expected from the original authors and the new nutrition statements added to the KY nutrition version may have internal reliability and validation work conducted by a UK SRP statistician at a later date.

Use of the EHEP KY Nutrition version survey and cover letter, as a waiver of documentation of informed consent, have been approved by the University of Kentucky Institutional Review Board.

Procedure

The survey was administered to UK CES agents at an annual seminar event held in Lexington, KY and KEHA members in Maysville, KY. The agents and KEHA members received no compensation or incentive for completing the survey, and were not required to complete the survey as part of the seminar or meeting.

The survey was administered to volunteering attendees at the Annual Poke Sallet Festival held in Harlan County, KY. The CEC team members hosted a nutrition education booth at the festival on selected topics and gathered completed surveys for data collection. The design of the booth and visible materials did not include any environmental pollution topics, so not to bias participants. The participants learned of the survey topic once they read the waiver of consent and completed the survey. A Registered Dietitian(s) and/or Dietetic Master's student were available for all nutrition questions and concerns that arose from completing the survey. Fresh fruit and healthy snacks were distributed to volunteers completing the survey.

The survey was also administered to volunteering attendees of the KY State Fair in Jefferson County, KY. The same procedures were used as described for the Harlan County festival booth except there was no nutrition information displayed due to space constraints. Registered dietitians were always available for nutrition questions and concerns that arose from completing the survey or for general nutrition questions.

Data Analysis

Linear regression and nonparametric tests were used to test for correlations between the scales and with the continuous demographic variable of age. Linear regression examined the relationships between scales of knowledge, concern, and action with the demographics of gender, highest school grade completed and whether or not the respondents have children. The analysis also included evaluation of mean scores from individual statements and whole scales between the four sample groups. SAS version 9.2 was used and p-values less than or equal to 0.05 were considered significant.

Chapter Four

Results

The following chapter will discuss the survey data and results collected using the EHEP KY nutrition version. The data was examined looking at each group separately and combined as one population for significant correlations and associations. Mathematical means and percentages were calculated for the individual statements and scales.

When analyzing individual statements or scales, if data were missing the participant was omitted from that particular statistical model, but included in all the other models for which data was provided. Out-of-state participants were included because several groups included participants from states on the KY border. All states have NPL sites and other hazardous waste sites and out-of-state participants are exposed to similar pollutants.

Overall, there were 774 surveys collected from four events throughout the state of Kentucky. There were 79 incomplete surveys due to omission of a scale, partial incompletion of a scale, or missing demographic information. The percent of completed surveys was approximately 90%. The high completion rate may be due in part to the presence of the study personal on hand to answer questions about the survey as they arose. Mean scale scores are all four groups combined are summarized below (Table 4.1).

The mean age of the sample population was 51 years. The gender breakdown was 525 female (68.45%) and 242 male (31.55%). There were 686 in-state participants (91.83%) and 61 out-of-state participants (8.17%). 582 participants had children (78.86%), while 156 participants had no children (21.14%).

The interpretation of the scoring for each statement within a particular scale is as follows. Scale 1 had eighteen statements concerning this question: "Are there any of these problems in your neighborhood?" 0 equals "none at all", 10 equals "very serious". Scale 2 had thirteen statements concerning this question: "Do things in the environment cause people to get sick?" 0 equals "disagree completely", 10 equals "agree completely". Scale 3 had eight statements concerning this question: "Do people just need to live with these things?" Rating 0 equals "disagree completely", 10 equals "agree completely". Scale 4 had thirteen statements concerning this question: "Do you do things to help yourself with these problems?" Rating 0 equals "never do this", 10 equals "always do this". Scale 5 had six statements concerning this question: "Do you do things with others in the community that help?" Rating 0 equals "never do this", 10 equals "always do this".

Table 4.1, Mean scale scores for all four groups

Variable	N	Mean	Std Dev	Minimum	Maximum
Scale 1: Knowledge	769	3.44	2.16	0	9.78
Scale 2: Concern	764	4.53	2.12	0	10.00
Scale 3: Concern	749	3.23	1.87	0	10.00
Scale 4: Personal Action	763	5.58	1.80	0	10.00
Scale 5: Community Action	747	3.06	2.54	0	10.00

Health Educators Group

The group included 83 total participants with 14 incomplete surveys to equal an 83% completion rate. Mean scale scores are summarized below (Table 4.2). The participants represented 52 out 120 Kentucky counties, one participant was from Cincinnati, Ohio, and 15 participants declined to give town, county, or zip code information. This group was all female with an average age of 44 years. The education breakdown for this group is as follows: 69.88% indicated post-graduate work, 25.30% indicated being a college graduate, 2.41% indicated attending college for at least one to three years and 2.41% did not provide any education demographic information. When asked about children, 61.45% of the participants indicated they have children and 33.73% have no children, and 4 participants declined to provide this information.

Table 4.2, Mean scale scores for health educators group

Variable	N	Mean	Std Dev	Minimum	Maximum
Scale 1: Knowledge	82	3.76	1.65	0	7.00
Scale 2: Concern	83	4.26	1.92	0	7.77
Scale 3: Concern	83	3.24	1.52	0	5.50
Scale 4: Personal Action	83	5.37	1.50	1.38	8.62
Scale 5: Community Action	83	3.33	2.30	0	9.00

Nonmetropolitan, non-Appalachian Area Group

The group had a total of 96 participants with 20 surveys being incomplete, equaling a 79% completion rate. Mean scale scores are summarized below (Table 4.3). The majority (91%) of the participants were from Mason County, KY, 2 were from other KY counties, 3 were from out-of-state, and 4 declined to give town, county or zip code

information. Most of the participants in this group were female, representing 91% of the group. The average age for this group was 67 years. The education breakdown is as follows: 37.5% completed high school or received a GED, 26.04% attended college for one to three years, 16.67% received post-graduate education, 12.5% were college graduates, 4.17% provided no education information, and 3.13% completed grade eight or less. When asked about children, 83.33% of the participants indicated they have children, 11.46% have no children and 5.21% declined to provide this information.

Table 4.3, Mean scale scores for nonmetropolitan, non-Appalachian group

Variable	N	Mean	Std Dev	Minimum	Maximum
Scale 1: Knowledge	94	3.74	2.33	0	9.33
Scale 2: Concern	93	4.36	2.06	0.38	9.54
Scale 3: Concern	90	3.48	2.03	0	9.50
Scale 4: Personal Action	93	5.67	1.90	0	10.00
Scale 5: Community Action	88	3.52	2.73	0	10.00

Nonmetropolitan, Appalachian Area Group

The group had a total of 166 participants with 18 surveys being incomplete, equaling an 89% completion rate. Mean scale scores are summarized below (Table 4.4). There were 14 KY counties and 5 additional states represented in this group. The majority (75.90%) of respondents were from Harlan County, KY. This group was 72.29% female and 26.51% male, and the average age was 51years. The education breakdown is as follows: 36.75% completed high school or received a GED, 25.30% attended college for one to three years, 12.65% received post-graduate education, 12.05% were college graduates, 6.02% completed at least grade nine through eleven, 5.42%

completed grade eight or less and 1.20% provided no education information. When asked about children, 76.51% of the participants indicated they have children, 19.28% have no children and 4.22% declined to provide this information.

Table 4.4, Mean scale scores for nonmetropolitan, Appalachia group

Variable	N	Mean	Std Dev	Minimum	Maximum
Scale 1: Knowledge	164	3.41	2.32	0	9.44
Scale 2: Concern	163	4.71	2.35	0	10.00
Scale 3: Concern	162	3.31	2.06	0	9.25
Scale 4: Personal Action	162	5.81	1.88	0	10.00
Scale 5: Community Action	160	2.92	2.55	0	10.00

Metropolitan Group

The group had a total of 429 surveys collected with 27 surveys being incomplete, equaling a 94% completion rate within this group. Mean scale scores are summarized below (Table 4.5).The majority (89.23%) of respondents were from KY, and an additional nine states being represented by 40 participants (9.32%). This group was the most gender diverse with 54.78% being female and 44.06% being male. The average age of participants was 48.71 years. The education breakdown is as follows: 29.84% attended college for one to three years, 24.24% received post-graduate education, 21.68% were college graduates, 21.21% completed high school or received a GED, 1.63% completed at least grade nine through eleven, 0.93% provided no education information, and 0.23% completed grade eight or less. When asked about children, 75.52% indicate they have children, 19.81% have no children, and 4.66% declined to provide this information.

Table 4.5, Mean scale scores for metropolitan group

Variable	N	Mean	Std Dev	Minimum	Maximum
Scale 1: Knowledge	429	3.33	2.14	0	9.78
Scale 2: Concern	425	4.55	2.08	0	10.00
Scale 3: Concern	414	3.14	1.81	0	10.00
Scale 4: Personal Action	425	5.51	1.79	0	10.00
Scale 5: Community Action	416	2.97	2.53	0	10.00

Research Question 1: What types of pollution do people believe are the most abundant in their immediate environment?

The first scale in this survey, entitled pollution sensitivity, measured the participants' knowledge of different pollutant types in their neighborhood. The three pollutant types, in descending order, receiving the highest mean scores based on knowledge in the health educators group were pesticides (insect sprays and lawn chemicals), molds, and air pollution from vehicles. For the nonmetropolitan, non-Appalachian group the highest mean scores were air pollution from factories and power plants, air pollution from vehicles and pollution found in rivers and other bodies of water. For the nonmetropolitan, Appalachian group the highest mean scores were for pollution found in rivers and other bodies of water, air pollution from vehicles, and pollutants (pesticides, hormones, antibiotics) in food. For the metropolitan group the highest mean scores were for air pollution from vehicles, pesticides, and pollutants in food. The mean

scores ranked highest and lowest for the statements for all the surveys combined are listed in Table 4.6.

Table 4.6, Mean statement scores for scale one: pollution sensitivity

Scale statement	Mean score	Scale statement	Mean score
Air pollution form trucks, buses, cars.	4.95	Radiation from nuclear power plants.	0.96
Polluted rivers, harbors, lakes or ocean.	4.68	Toxic places like abandoned factories or dumps.	2.34
Pesticides, i.e. insect sprays, lawn chemicals.	4.60	Contaminated drinking water.	2.34
Pesticides, hormones, antibiotics in our food.	4.42	PCBs from landfills or from discarded electrical equipment getting into our water or food.	2.76

Within the nonmetropolitan, non-Appalachian group a significant association was identified between the scale 1: pollution sensitivity and gender (female) (p-value<0.01). The females surveyed ranked pollutants types in their neighborhoods higher than the males in this sample.

Within the metropolitan group there were two significant relationships discovered. There is an inverse correlation between scores in scale 1: pollution sensitivity and age (p-value=0.04). Meaning as age increases there was a decrease in the knowledge of pollutant types in a person's neighborhood. There was a positive association between rankings for scale 1: pollution sensitivity and the participant not having any children (p-value<0.01). Those without children ranked the statements higher in this scale than those with children, indicating they believed there to be more pollutant types in their neighborhood.

Within the nonmetropolitan, Appalachian group there was a positive association found between scores for scale 1: pollution sensitivity and gender (p-value=0.05). Males tended to rank pollution statements in this scale higher than females, indicating an increased belief of pollutant types in their neighborhood.

When the data from all four samples was combined, there was an inverse correlation between the ages of the participants and the scores for scale 1: pollution sensitivity (p-value=0.04). As age increased, the scores decreased, implying that awareness of pollutants in their surroundings decreased.

Research Question 2: Does the average individual perceive health risk from pollution in the environment?

Table 4.7 summarizes statements from scale 2 receiving the highest and lowest mean scores for all surveys. These results show the average person does have a moderate level of concern that some pollutants are harmful to human health. Air pollution is believed to make asthma worse by those surveyed in this study. The participants believe they should be concerned about harmful substances in their home. Participants have a

moderate belief that nutrition habits, such as eating the right foods, may protect them from harmful pollution effects. Most participants do not believe their drinking water or air in their neighborhood to be polluted. For the most part, participants do not believe their work environment or neighborhood schools are harmful to their health or their family's health.

Table 4.7, Mean statement scores for scale two: pollution-causes-illness

Scale statements	**Mean score**	**Scale statements**	**Mean score**
Asthma is made worse by pollution in the air.	7.77	The drinking water in my community causes health problems.	2.28
People should worry about toxic things in their home.	6.79	The air in my neighborhood looks or smells polluted.	2.52
People who work with chemicals often get sick from it.	6.05	The environment where I work might hurt my health.	3.15
People may get sick because they don't eat the right foods to protect themselves from pollution.	5.19	Some schools in my community are contaminated and unhealthy.	3.33

There was a significant association (p-value=0.03) for increasing mean scores to statements in scale 2: pollution-causes-illness and females for the nonmetropolitan, non-Appalachia group. Within the metropolitan group, a significant association was identified between increasing scores to statements in scale 2: pollution-causes-illness and females (p-value<0.01). The same positive association was found when the data was analyzed together with all four groups (p-value=0.01). The highest overall mean score for the scale 2: pollution-causes-illness was 4.71 for the nonmetropolitan, Appalachia group.

A correlation was discovered between responses to scale 1: pollution sensitivity and scale 2: pollution-causes-illness scales for all groups separately and combined. For all groups individually there was a positive correlation with a p-value < 0.01. In the health educators group the estimate of coefficient was 0.69 (Figure 4.1); meaning for every increase by one in the ranking for scale one, there will be an increase in response ranking in scale two by 0.69. The nonmetropolitan, non-Appalachian area group's estimate of coefficient was 0.52(Figure 4.2); the nonmetropolitan, Appalachian area group's coefficient was 0.64 (Figure 4 3), and the metropolitan area group's coefficient was 0.56 (Figure 4.4). Figure 4.5 below represents the positive relationship for all data combined. The x-axis represents the pollution sensitivity scale and the y-axis represents the pollution-causes-illness scale. The straight line sloping from the bottom left to the upper right indicates a positive correlation between the two scales. As scores in scale one, measuring pollutant knowledge increased, so did the scores for scale two measuring concern or risk perception for pollutants.

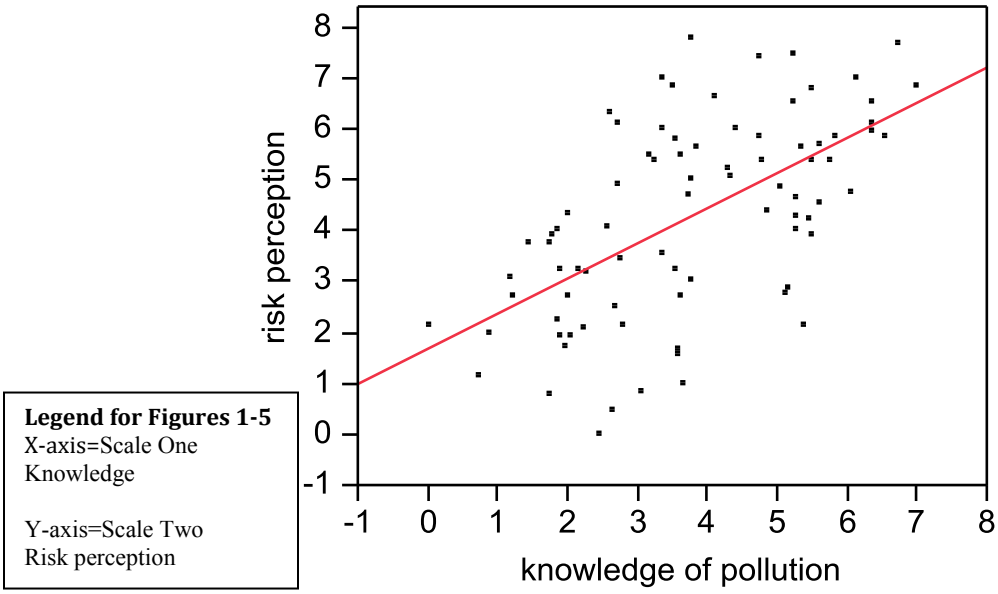

Figure 4.1, Correlation between scale one and scale two: Health educators

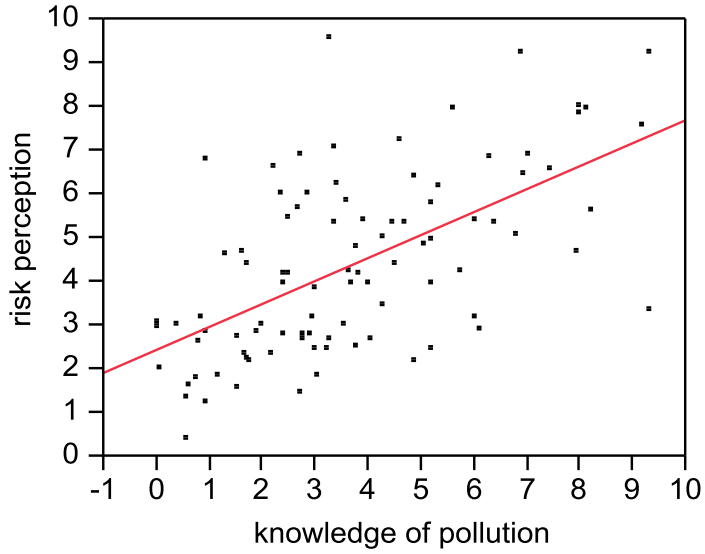

Figure 4.2, Correlation between scale one and scale two: Nonmetropolitan, non-Appalachia

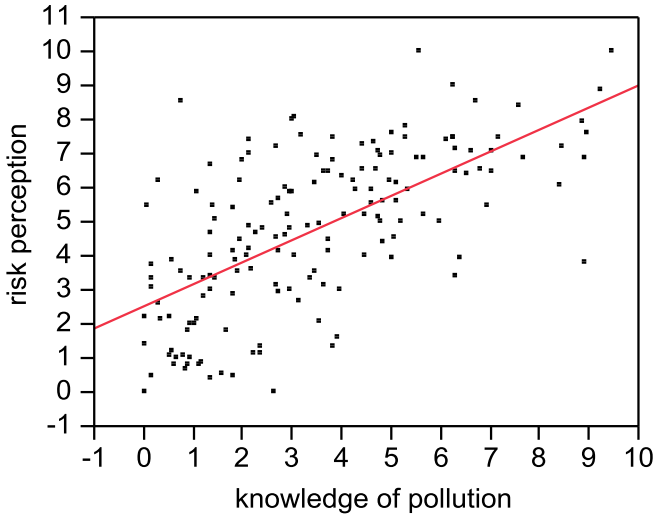

Figure 4 3, Correlation between scale one and scale two: Nonmetropolitan, Appalachia group

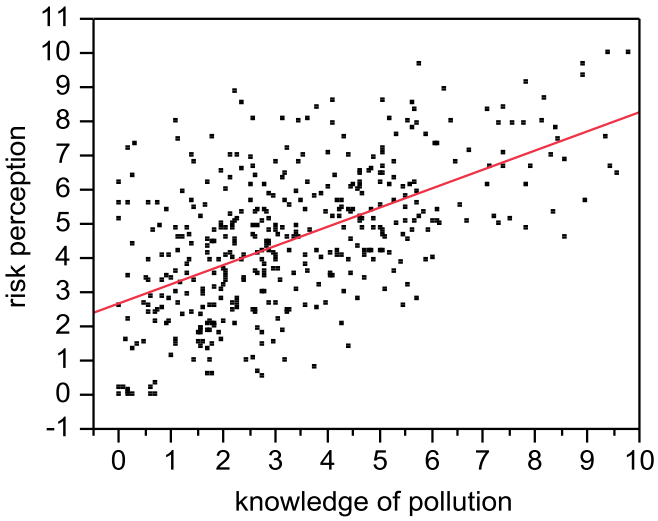

Figure 4.4, Correlation between scale one and scale two: Metropolitan area group

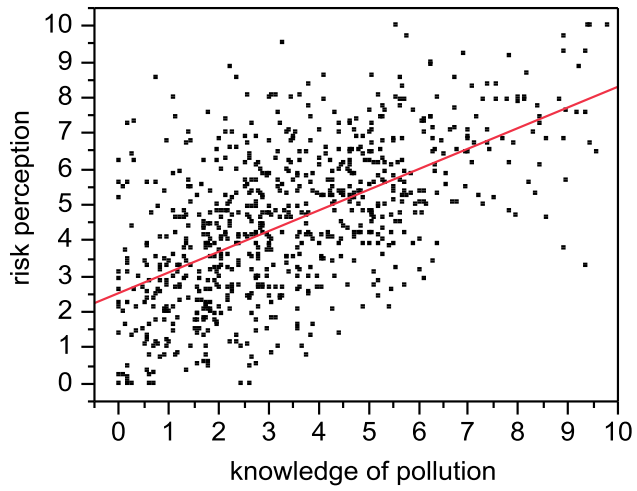

Figure 4.5, Correlation between scale one and scale two: all groups

Research Question 3: Does the average individual living near a NPL hazardous waste site perceive health risk from pollution in the environment and thus take personal protective health action?

This was an examination of scale 2: pollution-causes-illness and scale 4 and 5: personal and community environmental action for the metropolitan group and the nonmetropolitan, Appalachian group. Both of these groups' sampling locations were in counties with NPL sites and previous mass media exposure to pollution issues in the respective counties. Table 4.8 and Table 4.9 summarize the highest and lowest mean scores for statements in the two action scales for all data combined.

Within the metropolitan group, there was a positive correlation between scale 2: pollution-causes-illness and scale 4: personal environmental action (p-value<0.01) with an estimate of coefficient of 0.35. There was also a positive correlation between scale 2: pollution-causes-illness and scale 5: community environmental action ($p<0.01$). Within the nonmetropolitan, Appalachian group there was a positive correlation between the

scale 2: pollution-causes-illness and scale 4: personal environmental action (p-value<0.01), with an estimate of coefficient of 0.25. A positive correlation was identified between scale 2: pollution-causes-illness and scale 5: community environmental action (p-value<0.01).

Pollution acceptance has been defined as the feelings or concern that pollution is unavoidable (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009). An inverse correlation exists between scale 3: pollution acceptance and scale 4: personal environmental action for the metropolitan group (p-value <0.01). The estimate of coefficient for this relationship was found to be -0.17. Meaning, as the extent to which someone accepts pollution as unavoidable increases, their personal protective actions will decrease. This same relationship was observed within the health educators group (p-value = -0.03, estimate of coefficient = -0.23) and for all the survey data combined (p-value =0.03, estimate of coefficient = -0.08). Table 4.10 summarizes the results for scale 3.

Table 4.8, Mean statement scores for scale four: personal environmental actions

Scale statements	Mean scores	Scale statements	Mean scores
I wash my fruits and vegetables thoroughly before using them.	8.50	I talk to my doctor or nurse about how to reduce the effects of pollution on my health.	1.79
I do what is necessary to make sure my home is free of toxins, like lead and radon.	6.84	I limit how much fish I eat because fish might contain toxic chemicals.	3.50
I avoid being around people who are smoking.	6.77	I eat organically grown food as much as I can.	3.78
I pick up trash that I see in the street or around my neighborhood.	6.54	I avoid using insect sprays and pesticides because they could make people sick.	5.21

Table 4.9, Mean statement scores for scale five: community environmental actions

Survey statement	Mean Score	Lowest mean score for community actions	Mean Score
I tell others about how the environment can affect health.	4.09	I attend meetings about environmental health problems in my community.	2.28
I talk with my friends and neighbors about how we can get healthier foods in our town.	3.29	When something is polluting our community, my neighbors and I get it stopped.	2.57
I join others in trying to keep polluting businesses out of our community.	3.25	I talk with my friends and neighbors about how we can get cleaner water in our town.	2.78

Research Question 4: Does a health educator take more personal protective health action than an individual living with an NPL hazardous waste site?

The overall mean score for the scale 3: pollution sensitivity was highest for health educators, but the difference was very small when compared to the other samples. The mean score was close to the nonmetropolitan, non-Appalachian group's overall mean score and this could be due to the participants in both groups being involved to some degree with health education in their communities.

The nonmetropolitan, Appalachian area group was chosen for comparison with the health educators because it has one NPL site in its county with a long history of mass media exposure and litigation concerning this hazardous waste site. A nonparametric test, Mann-Whitney, was used to compare the scores for the two groups because neither group of scores was normally distributed. The one-sided p-value was 0.03 which indicates that health educators had significant increased scores on statements concerning the pollutants found in their neighborhood.

When comparing the actions scales for the health educators group and the nonmetropolitan, Appalachian group a nonparametric test was again used and the one-sided p-value for the two sample t-test was 0.75. This means the health educators do not take more personal protective health action against exposure to environmental pollution than the average individual surveyed in the nonmetropolitan, Appalachian group.

Research Question 5: Does gender affect the level of perceived risk and action in response to their perceived risk of environmental pollution?

There were several significant relationships between gender and perceived risk and gender and action. Within the nonmetropolitan, non-Appalachian group females had increased concern about pollution causing adverse health effects when compared to males (p-value=0.03). For the nonmetropolitan, Appalachian group males scored pollutant types in their neighborhood higher than females (p-value=0.05). Within this same group, males participated in more community environmental action than females (p-value=0.02).

Within the metropolitan group, females had more concern about pollution and adverse health effects when compared to males (p-value<0.01). In addition, females take more personal protective actions against pollution effects than males (p-value<0.01). Males had a higher level of pollution acceptance than females (p-value=0.04) which has been interpreted to mean a higher amount of indifference or thoughts that pollution and its health effects are unavoidable. Table 4.10 below summarizes the highest and lowest mean scores for statements in scale three.

When the data was combined as a whole group, some of the same trends were still significant. Females had more concern that pollution could cause harmful health effects (p-value=0.01) and took more personal protective health actions than males (p-value<0.01).

Table 4.10, Mean statement scores for scale three: pollution acceptance

Scale statement	Mean score	Scale statement	Mean score
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	People don't need to worry about toxic things, because our bodies can overcome the toxins.	2.13
I don't consider environmental problems nearly as important as other problems in my family or neighborhood.	3.82	Pollution is just a part of modern life, so we can't do much about it.	2.78
People often exaggerate the amount of sickness caused by pollution.	3.58	I am too busy to do anything about how the environment affects health.	2.95

Chapter Five

Discussion

The UK SRP CEC develops environmental pollutant education lessons to deliver as health programs to any impacted community in the state and for use by UK CES agents. The results indicated that the most common pollutant types believed to be in people's neighborhoods were air pollution from vehicles, pollutants in bodies of water, pesticides from lawn applications and chemicals in food. These ranked mean scores indentify topics for future environmental nutrition lesson plans to be developed by the CEC.

Based on the knowledge results from scale one, environmental nutrition risk communication programs focused on hormones, antibiotics, and pesticides in food would be beneficial. Interestingly, pollutants in fish, such as mercury or PCBs received low rankings in each group, which indicates that people do not view this as a problem in their neighborhood. The participants may not have been thinking of the fish served in restaurants or sold in their neighborhood grocers when ranking this statement. There are pollutants in the fish available for consumption in the U.S., so much in fact that the EPA and the U.S. Food and Drug Administration have an advisory on consumption for sensitive populations.

Education on fishing from local waters could also be useful since people believe polluted waters to be in their neighborhoods. All states have water and fish consumption advisories for impacted waters and post this information on websites and places where someone buys a fishing license. These advisories should be included in health programs concerning water pollution and fish consumption because not everyone has access to the internet or knows to check for these advisories. Another important reason to educate on

this topic is because in KY, as previously mentioned, there are many bodies of water under advisories. This may indicate an area of focus for future lesson planning and environmental nutrition programs from the SRP CEC.

Scale 2: pollution-causes-illness attempts to quantify the degree to which people believe that pollution causes adverse health effects in themselves, family and community. This can be described as the perceived likelihood that different illness or health effects in their neighborhood can be attributed to pollutants being present. The survey does not quantify this as a percentage, but rather on a numerical scale measuring a person's agreeability with different statements concerning pollution and health. A person's risk perception to a hazard is impacted by many factors, including the amount of exposure to the hazard and previously held beliefs and attitudes. The influence of each region's history with hazardous waste sites, industry pollution, and the mass media exposure may have played a role in the community members' knowledge and level of risk perception to pollutants.

The metropolitan group surveyed was in Jefferson County, KY, which has a total of six NPL sites in this region. Some of these sites have received a great deal of mass media exposure and community activist groups have formed because of these sites. This exposure may have influenced the understanding and knowledge of pollutant types within this group. The same can be said for the nonmetropolitan, Appalachian group which had exposure to one NPL site and the long history of the coal mining industry in the region. This was the group with the highest overall mean score for statements in scale two, which indicates a higher concern that pollution causes adverse health effects. These media exposures may play a role in the values and attitudes held by community members and

thus impact the belief about pollutants in their surroundings and the accompanying health concerns.

The nonmetropolitan, non-Appalachian group is adjacent to a large metropolitan area and is located on the Ohio River. There is much industry in this adjacent area along the river and there are NPL sites in the adjacent metropolitan area that community members may have heard of because of television and newspaper coverage. The health educators surveyed came from counties all over KY. Each county will have had different impacts and exposures to pollution that affected the knowledge and beliefs on pollution held by these health educators.

The mean results for scale 2: pollution-causes-illness may also be useful to the CEC for identification of areas of focus for lesson development. The UK SRP is unique for using nutrition strategies as a tool for addressing the adverse health effects caused by pollutant exposure. The statements receiving scores between 0 and 5 on the numerical scale, meaning an inclination to disagree with the health concern statement, are important areas to focus on for environmental nutrition risk communication. These statements include thoughts about the drinking water, air pollution, the mental development of children being harmed by pollutants, the belief that many people have health problems because of pollution, and thoughts about pollution being bad for one's health.

There was a significant positive correlation found between knowledge or belief that pollutants were in one's neighborhood and concern that pollution exposure may cause adverse health effects for all groups. The estimate of coefficient is a determination of how much one variable will change with a change in an associated variable. The estimates of coefficients were all in a similar range, but the health educator and the

nonmetropolitan, Appalachian groups' were higher than the other two groups. This may be attributed to the education level of the CES agents and those surveyed had job roles that include health education to the community. They may stay more aware and educated on these issues for program planning and because their community members are requesting health information to be given at programs. When considering the participants from the nonmetropolitan, Appalachian group, most live in Harlan County, KY. This county's exposure to an NPL site with a history of media exposure and litigation may influence their knowledge and risk perception to pollution.

CES county agents lead many programs in their counties that are meant to educate, inform, and impact health behaviors of citizens in their community. Further environmental education geared toward the agents may have a trickledown effect to the community members. If the SRP CEC can further educate CES agents on pollutant types and increase their awareness, then concern will rise and this effect may be passed on through program selection and environmental nutrition education lessons used with their community members. This may be especially important and useful in counties with the NPL hazardous waste sites, where citizens have had long-term exposure to pollutants.

There was a positive significant correlation found between belief about pollutants in one's neighborhood and personal protective actions taken for three of the four samples, and for all data combined. These positive relationships between knowledge and protective health actions intensify the need for environmental nutrition and health lessons to be delivered to individuals and communities exposed to chronic pollution exposure. The health educators group was the only one without this significant relationship. Health educators were found to have more knowledge about pollutants but did not take more

action than the average citizen. This finding rejected the hypothesis stating health educators would take more personal protective actions against environmental pollution than those living near a NPL hazardous waste site.

For all four groups a significant positive relationship was found between the level of concern that pollution causes illness and the personal protective health actions taken by an individual. This finding supported the hypothesis that stated there will be an association between risk perception and actions taken by health educators and those living near an NPL hazardous waste site. The personal actions inquired about in this survey included closing windows, making sure the home is free of lead and radon, washing produce, eating 5 or more servings of fruits and vegetables every day, and limiting the amount of fish eaten. These are all actions that can reduce a person's exposure to pollution and lessen harmful health effects from pollution in the environment. Health educators would ultimately want to increase these behaviors by increasing a person's risk perception towards pollution. This can be achieved through environmental nutrition lessons designed to educate on the adverse health effects from pollution and the healthy nutrition strategies to lower risks to chronic diseases.

The personal protective actions identified through this data collection with the lowest scores, indicating that people rarely do these actions, are behaviors to focus on in environmental nutrition lessons. Most participants indicated they do not often limit the amount of fish eaten due to toxic chemical exposure. As nutrition educators, it is important to stress the beneficial aspects of fish consumption to human health. It is also important to educate on pollutant exposure from fish consumption and highlight the types of fish that can be safely eaten. The fish consumption advisory from the federal

government is intended for sensitive populations, but all life stages could benefit from fish and pollutant education. Eating a variety of fish types and avoiding the larger fish types known to the most contaminated is good nutrition advice for all, and should be included in environmental nutrition lessons.

The data was examined for significant associations between the scales and gender. Females were found to have higher levels of concern that pollution causes adverse health effects. This fits with previous research that has found males perceive less risk from a hazard. This may be due to a female's role as a mother or nurturer of the family unit. Females also took more protective personal health actions than males. This may be attributed to females more often being the family member buying and preparing meals and performing the daily household chores. Within the metropolitan group, males had higher scores on the scale 3: pollution acceptance, indicating a greater belief that pollution is unavoidable. This fits with the earlier mention of males usually viewing less risk from a hazard. In one group males were found to have a higher level of community environmental action, but this association was not found when looking at the data combined as one population. These associations support the hypothesis stating that gender will affect the level of risk perception to environmental pollutants.

There were several limitations in this data collection process. The original survey was designed as a telephone interview format and was converted by the original authors to a pencil-and-paper format for use in KY. Deciphering handwriting for data entry was sometimes difficult.

The most common question asked during the survey completion process was about the word "neighborhood" in the first scale. The pollution sensitivity scale is

introduced with the statement "Are there any of these problems in your neighborhood?" Many participants did not feel they lived in a neighborhood and were confused about what to consider when ranking these statements. In certain regions of KY there are not typical neighborhoods; instead there are hollers or houses along highways with neighboring houses at a great distance away. The study personnel instructed the participants to come to their own conclusion on what to consider their community. There is no way to interpret each individual participant's survey for this information. A definition of neighborhood or a different word choice depending on the region being surveyed may be an appropriate solution to the limitation.

Pollutant exposure is not the sole reason for someone becoming sick, but it may be a contributing factor that someone does not think about or have control over. Environmental nutrition risk communication can teach communities about what they do have control over, such as nutrition and lifestyle behaviors. Increasing KY citizens' concern for pollutant exposure and the adverse health effects may help to improve the health status of individuals and families. Raising awareness of environmental health issues may give people another reason to adopt healthy nutrition behaviors.

It may not be easily to generalize the results to other areas due to the use of convenience sampling for all the sample groups. The majority of participants were selected from counties with one or multiple NPL hazardous waste sites in the area. This may have affected the amount of media exposure to pollutants and lead to an increased knowledge of pollutant types in their environment.

Chapter Six

Conclusion

The purpose of this study was to assess KY citizens' knowledge, concerns and protective actions toward environmental pollution. This was accomplished through the collaborative design of the EHEP KY nutrition version survey instrument and its use in KY. The data collection and results revealed characteristics about the CEC's target audiences that were previously unknown. Prior to this study, environmental nutrition lessons were used in counties with the worst hazardous waste sites in KY and mainly were focused on chronic disease reduction strategies. With the results from the surveys collected, the CEC can focus on other topics of interest to the community members concerning pollution. The results indicate that lessons on chemicals in food, fish, water and air pollution in relation to health and nutrition are of interest to the communities in KY.

This study supports previous findings that increasing knowledge and concern towards environmental pollution can affect an individual's risk perception and ultimately lead to behavior changes. The CEC focuses on nutrition and health behaviors to lessen oxidative stress caused by pollution exposure. Understanding the relationship between knowledge, concern and action is important as environmental nutrition educators. If we can increase the knowledge of pollution and make the connection between environment and health in community members' minds, we may see healthy nutrition behavior changes.

This study supports using environmental nutrition risk communication as a tool for dialogue in communities affected by pollution. The results indicate that people do think about pollution and there is some concern existing that it is harmful to health.

Using these results, the CEC can continue the interactive dialogue with communities and health educators and hopefully continue to make beneficial strides toward more healthy nutrition behaviors in the face of environmental pollution. Helping individuals to better understand the relationship between pollution exposure and health will ultimately lead to more protective health and nutrition behaviors.

Future research studies could be designed to test health behavior hypothesis such as the behavior motivation hypothesis, which assumes that elevated risk will lead to future changes in behaviors. This could be tested by administering the survey at Time 1, conducting an environmental nutrition risk communication program, and then administering the survey at Time 2 to evaluate for behavior change with increased knowledge of risk to pollution.

Self-efficacy was not examined in this survey. Future survey questions could be added measuring the participant's belief in their ability to carry out healthy behavior changes for dealing with pollution exposure. Further work could be done on the nutrition statements in this survey, including validation of these statements. Some of the statements could be elaborated to include more specific nutrition behaviors, such as asking which types of fish are most often consumed or limited.

Appendix

Definition of Terms

Antioxidant- a substance (as beta-carotene or vitamin C) that inhibits oxidation or reactions promoted by oxygen, peroxides, or free radicals (antioxidant, 2009).

Community Engagement Core- provides support and guidance through critical information on nutrition and health-related issues to meet the needs of individuals and communities in KY affected by environmental contaminants (Core D: Community Outreach Core, 2009).

Environmental health- freedom from illness or injury related to exposure to toxic agents and other environmental conditions that are potentially detrimental to human health (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009).

Environmental health engagement- the variety of methods for mitigating or reducing what a person sees as potentially harmful effects from exposure to toxic agents (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009).

Environmental Health Engagement Profile- an instrument for assessing the way people engage with environmental health issues, including people's experience of environmental health hazards, the assumptions concerning the risks involved, and the actions taken either individually or collectively in their communities (Dixon, Hendrickson, Ercolano, Quackenbush, & Dixon, 2009).

Environmental Health Engagement Profile KY nutrition version- a pencil-and-paper format of the original EHEP with added nutrition statements in each scale.

Health communication: The art and technique of informing, influencing, and motivating individual, institutional, and public audiences about important health issues. The scope of

health communication includes disease prevention, health promotion, health care policy, and the business of health care as well as enhancement of the quality of life and health of individuals within the community. (U.S. Department of Health and Human Services, 2000)

Kentucky Extension Homemakers Association- a volunteer organization that works to improve the quality of life for families and communities through leadership development, volunteer service and education (Kentucky Extension Homemakers Association, 2009).

Lipophilic- having an affinity for lipids (lipophilic, 2009).

Mercury- a naturally occurring metal; combines with carbon to form methylmercury in water and soil (Mercury, 2009).

National Priority List- is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation. (National Priorities List (NPL), 2009)

Optimistic bias- person considering themselves less likely to suffer from any particular hazard than other similar people (Breakwell, 2000).

Pollution: the action of polluting especially by environmental contamination with man-made waste, the condition of being polluted (pollution, 2009)

Polychlorinated biphenyls- mixtures of up to 209 individual chlorinated compounds (known as congeners). (Polychlorinated Biphenyls (PCBS), 2009)

Risk communication- Engaging communities in discussions about environmental and other health risks and about approaches to deal with them.

(U.S. Department of Health and Human Services, 2000)

Social Cognitive Theory- contends that behavior is dependent on a multitude of personal, environmental, and behavioral factors. The adoption of the a behavior or a change in behavior can be facilitated by strengthening cognitive, behavioral, and efficacy skills and providing environmental supports specific to the behavior. (Derrick, Miller, & Andrews, 2008)

Superfund- the name given to the environmental program established to address abandoned hazardous waste sites. It is also the name of the fund established by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA statute, CERCLA overview). This law was enacted in the wake of the discovery of toxic waste dumps such as Love Canal and Times Beach in the 1970s. It allows the EPA to clean up such sites and to compel responsible parties to perform cleanups or reimburse the government for EPA-lead cleanups. (Basic Information, 2009)

Superfund Research Program- the Superfund Research Program (SRP) is a network of university grants that are designed to seek solutions to the complex health and environmental issues associated with the nation's hazardous waste sites. The research conducted by the SRP is a coordinated effort with the Environmental Protection Agency, which is the federal entity charged with cleaning up the worst hazardous waste sites in the country. (Superfund Research Program, 2009)

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Webber K, Willett E. *A behavioral weight loss intervention uses journal writing to enhance weight loss*(Poster Presentation). American Dietetics Association Annual Meeting; Boston MA, November 2010.

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