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AN EDUCATIONAL PILOT INTERVENTION TO INCREASE ENVIRONMENTAL HEALTH LITERACY AMONG RURAL KENTUCKY YOUTH ATTENDING SUMMER CAMP

Ashley Rose Mattingly

University of Kentucky, arma258@g.uky.edu

Author ORCID Identifier:

 <https://orcid.org/0000-0002-7510-7297>

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Ashley Rose Mattingly, Student

Dr. Dawn Brewer, Major Professor

Dr. Robin Shoemaker, Director of Graduate Studies

AN EDUCATIONAL PILOT INTERVENTION TO INCREASE ENVIRONMENTAL
HEALTH LITERACY AMONG RURAL KENTUCKY YOUTH ATTENDING
SUMMER CAMP

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in Nutrition and Food Systems in the
College of Agriculture, Food and Environment
at the University of Kentucky

By

Ashley Rose Mattingly

Lexington, Kentucky

Director: Dr. Dawn Brewer, Professor of Dietetics and Human Nutrition

Lexington, Kentucky

2020

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<https://orcid.org/0000-0002-7510-7297>

ABSTRACT OF THESIS

AN EDUCATIONAL PILOT INTERVENTION TO INCREASE ENVIRONMENTAL HEALTH LITERACY AMONG RURAL KENTUCKY YOUTH ATTENDING SUMMER CAMP

Risk factors, including exposure to environmental pollutants, poor dietary and overall health outcomes, and low environmental health literacy (EHL), place the rural Appalachian youth population at increased risk for chronic diseases. Implementation of nutrition and pollution curriculum into two week-long summer day camps for youth ages 5-12 years that focus around healthy lifestyles and environmental stewardship has the potential to increase health protective action in this community. This research utilized qualitative interviews of 30 Kids on the Creek Camp attendees to determine the efficacy of the implementation of an active learning lesson to increase EHL by explaining the link between exposure to environmental pollutants and negative human health effects and explaining nutrition's mitigating effects on environmental pollutants among rural youth.

The majority of the participants were found to achieve the recognition level of EHL but those of older age (8-11 years) and whom attended both camps showed greater understanding of the relationship between consuming a healthy diet and reduction of pollution-initiated health issues. Results suggest that further implementation of educational materials into low-EHL youth populations have the potential to provide a means by which future health protective action through healthy lifestyle strategies can result.

KEYWORDS: Environmental Health Literacy, Environmental Pollutants, Phytonutrients, Fruit and Vegetable Intake, Rural Youth, Summer Camp

Ashley Rose Mattingly

(Name of Student)

[04/19/2020]

Date

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By
Ashley Rose Mattingly

Dr. Dawn Brewer

Director of Thesis

Dr. Robin Shoemaker

Director of Graduate Studies

04/19/20

Date

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CHAPTER 1. INTRODUCTION

1.1 Background

The Commonwealth of Kentucky experiences higher than average rates of smoking and tobacco use, diabetes, heart disease, physical inactivity, and premature deaths. Kentucky leads the nation in cancer deaths and preventable hospitalizations and has the lowest health outcomes for seniors. In relation to obesity, at 38th in the nation, our youth are at great risk of becoming overweight or obese and experiencing the negative health effects that occur in conjunction with obesity (State Health Improvement Plan Committee, 2017).

Individuals in rural Appalachian Kentucky communities may be disproportionately impoverished due to many health disparities across all determinants of health. According to the Appalachian Regional Commission “Appalachia has higher mortality rates than the nation in seven of America’s leading causes of death, including heart disease, cancer, chronic obstructive pulmonary disease (COPD), injury, stroke, diabetes, and suicide.” and these numbers have steadily been increasing since 1995 (ARC, 2017). Furthermore, many of these communities are in areas where degradation of land resources over the years has created increased levels of environmental pollutants affecting both the air and water quality (Commonwealth of Kentucky Energy and Environment Cabinet, 2018). These pollutants have been found to negatively modulate human health specifically in a manner that is associated with the progression of disease. As such, individuals in these areas have a higher likelihood for prolonged exposure placing them at high risk for chronic diseases.

However, consumption of fruits and vegetables provides key phytonutrients useful for mitigating the effects of toxic exposures (Petriello et al., 2014). EHL provides a means by which vulnerable populations can perform a risk assessment of their environmental exposures and fosters critical thinking skills necessary to create action of behavior change to maintain health. Unfortunately, while almost three-fourths of rural Appalachian Kentucky report access to nutrition programs and healthy foods, less than half eat any fruits (22%) or vegetables (14%) per day (Foundations for A Healthy Kentucky, 2017). Appalachian youth consumption was found to be even less than Appalachian adults (Hoogland et al., 2019). Additionally, EHL among Kentuckians is also low (Brewer et al., 2019). Hence, there is a vital need for an education intervention that provides information to prevent or better manage chronic diseases by increasing EHL, which fosters the development of critical thinking skills to identify, analyze, and react to environmental hazards faced by vulnerable populations, including youth.

Recent studies have shown that during the summer months when school is not in session, children, especially those with lower socioeconomic status, are at a greater risk for educational losses (Sandberg & Reschly, 2013) and negative health outcomes (Baranowski et al., 2014). In regards to knowledge, education programs attended over these months have found knowledge gains greater than those lost (Johnston et al., 2017). In particular, programs focusing on increasing EHL in youth have been largely successful (Harley et al., 2016; Madrigal et al., 2020). With no studies conducted on the efficacy of a nutrition education-based summertime intervention targeting EHL in rural school-aged

children, a need exists to understand their efficacy to increase EHL among this particularly vulnerable youth population.

1.2 Problem Statement

Exposure to environmental pollution is a concern in Kentucky, which has recognized approximately 1000 contaminated sites in addition to 13 Superfund sites that are listed on the United States Environmental Protection Agency's National Priorities List (US EPA^a, 2018). Compounding this issue is that these areas are often in rural counties that have poor dietary habits and a lack of access to nutrient dense foods (Hopkins, 2016). Kentuckians are especially at risk for negative health consequences due to poor diet, lack of nutrition and environmental pollution education, and exposure to environmental hazards (ARC, 2017; Brewer et al., 2019; Commonwealth of Kentucky Energy and Environment Cabinet, 2018). Increasing EHL can help individuals and communities to take health-protective actions. EHL promotes a better understanding of the links between environmental exposures and human health (Hoover, 2020). Summer day camps are a well-known platform to provide a wide range of education opportunities for youth (Burkhart et al., 2005) and is an appropriate venue to increase EHL by educating youth about environmental pollution and nutrition.

1.3 Purpose Statement

The purpose of this study was to determine if EHL varied among youth after attending one or two different week-long day camps focused on either environmental stewardship of waterways (Headwaters Camp); or food, cooking and agriculture day camp (Farm Camp) that included a nutrition and environmental pollution focused lesson among rural Appalachian youth aged 4 -11 living in an Eastern Kentucky county located in the coalfields of Kentucky with a well-documented history of fossil fuel extraction. The

objectives of this study were (1) to assess if EHL was higher among youth that attended either Headwaters or Farm Camp or both camps; (2) to evaluate to what extent EHL differed among youth aged 5-7 and 8-11; and (3) to determine the efficacy of strategies used to incorporate and evaluate a nutrition and environmental pollution intervention in a summer day camp setting.

1.4 Research Questions

1. Will youth demonstrate at minimum the “recognition” level of EHL following either Headwaters or Farm Camps?
2. How will EHL differ among youth that attend either Headwaters Camp, Farm Camp or both summer week-long day camps?
3. Which methods of evaluation are the most successful in this community-based setting?

1.5 Research Hypotheses

1. Interviews following Headwaters and Farm Camps will demonstrate that youth have reached the EHL level of “recognition”.
2. EHL will be greater among youth attending both Headwaters and Farm Camps.
3. Both qualitative and quantitative methods are effective evaluation tools in a youth summer day camp setting.

CHAPTER 2. REVIEW OF THE LITERATURE

2.1 Kentucky Youth Health Disparities

2.1.1 Youth Health Statistics

Fifty four percent of Kentuckians ages 12-17 will have at least one reported health issue, many of them will have multiple (Data Resource Center for Child and Adolescent Health, 2018). Over half of the youth will be physically inactive and one-fourth will report asthma issues by the time they are in high school. Twenty percent of Kentucky adolescence will be found to be obese and 34% will be found to be overweight. Compounding this issue, fruit and vegetable consumption is very low with only 21% consuming fruit or fruit juice at least 2 times per day and only 9 percent consuming vegetables 3 times per day. Additionally, 28% will drink soda daily (CDC, 2018). Appalachian rural youth meeting the recommended fruit and vegetable intake (25%) were found to be significantly fewer than Appalachian adults (42%) (Hoogland et al., 2019).

2.1.2 Barriers to Youth Consumption

In a study of rural adolescents, they reported that availability of food was a primary dictator of what foods they consumed. Parents did most of the grocery shopping and youth reported consuming whatever parents or their school offered. Youth in rural Appalachia also expressed a barrier of healthy eating related to lack of school nutrition policy and programming as well as access to vending machines (Southerland et al., 2015). This accessibility factor extended to the food environment as well, as youth reported increased consumption of fast foods due to the proximity of the school to these restaurants. Other factors included the local industries and the media. Commonly cited was the desire of this generation of youth for quick and convenient products that can be obtained on the go

(Bren, 2016). Additionally, reasons offered for choosing these options over fruits and vegetables were predominately prices related, specifically that unhealthy food could be obtained at lower prices like dollar menus. Other contributors to consumption of unhealthy foods included taste, appearance and cravings (Bren, 2016; Williams, 2006, Jilcott-Pitts et al., 2015).

2.1.3 Healthy Kids Equal Healthy Adults

Studies have found that youth that are obese continue that trend into adulthood (Gordon-Larson et al., 2010) and this correlation has increased in more recent years (Deshmukh-Taskar et al., 2006). Engeland and colleagues (2004) specifically found that odds ratio of adult obesity increased to 16 for children with very high BMIs and similarly adult mortality increased by as much as 40% with highly obese children. Additionally, higher BMIs have been associated with more chronic disease and shorter life expectancies (Stenholm et al., 2017). As such it is vital that youth be given the tools necessary to attain a healthy weight during childhood and into adulthood to prevent negative health outcomes.

Early intervention in childhood focused on nutrition can result in better outcomes in adulthood. Children at 6 years and older begin to take on a functional view of food (categorize them into types) and are able to determine what is good or bad for them (Atik et al., 2011). An ideal time for changing nutrition patterns occurs from this period till the ages of 10-12. According to Hamulka and colleagues (2018) that's when youth become independent food consumers and determine pattern of eating habits that remains relatively stable into adulthood. Hence, early lifestyle interventions have the benefit of being able to set positive behaviors before unhealthy eating behaviors are engrained into a child's

lifestyle. Early exposure to fruits and vegetables has been found to increase the preference for and consumption of these foods throughout the lifespan (Hetherington et al., 2015).

2.2 Environmental Pollution and Health

2.2.1 Chronic Disease in Appalachia

The National Institute on Minority Health and Health Disparities has repeatedly identified Central Appalachia which includes a large segment of Kentucky as an area in which great health disparities are prevalent (Krometis et al., 2017). According to a report on Appalachian health disparities, declines in the rates of cancer, heart disease, stroke, and years of life lost are all less for Appalachia than the national average hence widening the gap of health disparities in this population (Foundations for a Healthy Kentucky et al., 2017; Yoa et al, 2017). These disparities cannot be explained by behavioral risk factors alone (Krometis et al., 2017). Chronic disease has long been found to be directly related to diet and the environment in which one resides, including environmental exposures to pollution sources (WHO, 2014). As such addressing these issues is vital to health maintenance of vulnerable populations.

Exposure to environmental pollution has been associated with poor health outcomes in the Appalachia Region. Air pollution has been found to affect various body systems, specifically heart disease and respiratory issues (Kurth et al, 2014). Exposure to sources of pollution common to Appalachia have been associated with dysregulated mitochondrial function of heart tissue cells leading to myocardial dysfunction (Knuckles et al., 2013; Nichols et al., 2015); significantly ($p= 0.0001$) higher incidence of chronic

obstructive pulmonary disorder, respiratory issues such as wheezing, coughing, and mucous discharge (Hendryx & Lou, 2015); and significantly greater levels of C-reactive protein (a key marker of inflammation) (Hendryx & Entwistle, 2015). Additionally, in mice models, sources of air pollution found in Appalachian mines have triggered neoplastic transformation of the cells resulting in promotion of tumor growth of lung carcinoma (Luanpitpong et al., 2014).

Many pollutants found in nature in different physical states of the environment can be classified as halogenated persistent organic pollutants (POP). Due to the lipid solubility and the ability of many of these pollutants to act as a ligand for the aryl hydrocarbon receptor, these pollutants can act as inductors of inflammation in the body correlated with chronic diseases such as diabetes, cancer, heart disease, and obesity (Petriello et al., 2014). As POPs can be stored in human tissues, slow development of damage occurs. The mechanism of action for these pollutants involves cytochrome P450 (CYP1A1)-mediated uncoupling mechanism which allows enzymes of detoxification to become leaky or uncoupled and hence produce reactive oxygenated species that create unwanted inflammation via improper oxidation in the body. This mechanism is triggered by pro-oxidative and inflammatory environmental pollutants and leads to low level oxidative stress and redox status changes that are key causes of chronic disease. Additionally, they can work through pro-inflammatory mechanisms such as triggering the release of cytokines, chemokines, and adhesion molecules in the lining of our vascular system and via the activation of transcription factors that are sensitive to oxidative stress (Petriello et al., 2014).

Susceptible populations to environmental toxin exposure may also be at increased risk due to diet related diseases already present. Poor diet can create the same inductive effect of inflammation in the same pathways as environmental toxins. As such, these individuals are at increased risk as the resulting toxicological response is greater than either of the individual responses combined. This scenario is closer to real world exposures and diets (often high in meats and saturated fats that contain both pro-inflammatory factors and pollutants) but studies examining the effect of these cases are few and much work is still needed to be done to understand the relationship between diet, pollution, and disease (Hennig et al., 2007; Hennig et al., 2018; Petriello et al., 2014).

2.2.2 Pollution in Kentucky

Kentucky is home to 13 active superfund sites (US EPA^a, 2018), ranks 15th for chemical releases per square mile, and has 421 toxic release facilities (Commonwealth of Kentucky Energy and Environment Cabinet, 2018). While as a state pollution is a major problem, Appalachia has the added burden of hydraulic fracking, abundant coal mining, and large shipping and manufacturing facilities. Appalachia's industry admissions accounted for almost half of the entire state's emissions and more exposures per manufacturing job were found. Hence the potential for exposure to human generated pollutants is high (Morrone et al., 2014).

Other environmental concerns include low water quality especially from unregulated private sources (US EPA^b, 2018; Arcipowski et al., 2017), mining contamination, poor infrastructure, and behavioral factors (improper waste disposal). Mining discharges increase concentrations of trace elements, inorganic and organic carbon

levels, pH and hardness changes, sediment contamination, and the presence of low molecular weight alkylated compounds (Boyles et al., 2017) and are responsible for the dramatic loss of aquatic life in these areas (Hendryx, 2015; Schiffman, 2017). Additionally, Hendryx and colleagues (2012) found several of these pollutants in water facilities near mining areas as well as levels of coliform and disinfectant by-products above the acceptable levels. One study found levels of hydrogen sulfide gas (H₂S) above the acceptable limit released as hydrogen sulfide compounds in the water were vaporized in Appalachian homes (Simonton, 2014). Exposure to this gas has been found by the Agency for Toxic Release and Disease Registry to create nervous system issues and neurological dysfunction (Boyles et al, 2017).

A second major concern is acidic particles, particulate matter, and sulfur compounds in the air (Spengler et al., 1996, Commonwealth of Kentucky Energy and Environment Cabinet, 2018). Specifically, particulate matter is found to be concentrated in this area from coal mining processes and the hauling of natural resources from these areas (Aneja et al., 2017). Additionally, aluminosilicate particulate matter and low molecular weight alkylated compounds were present at mining sites but not at the control sites (Kurth et al., 2015). Other pollution concerns include fracking, construction or logging, and natural gas extraction which are all common in the area (Krometis et al., 2017).

2.2.3 UK CEC Superfund

In 1980, in response to increased issues with contamination sites across the United States, Congress created the Comprehensive Environmental Response,

Compensation, and Liability Act which is now called Superfund. The purpose of the Superfund program is to address the issue of environmental toxin/chemical exposure, remediation of these contaminants, and the health risks that accompany such exposures (EPA, 2018). While the goal of the Superfund Research Centers is to completely remove toxins from a designated site, this is largely outside the capacity of a single community organization due to cost, the difficulty of the remediation process, and the likelihood of secondary toxins being created. In addition to remediation actions, biomedical interventions are needed to mediate the effects of the body following exposure to environmental toxins that are known to produce damage to the body resulting in chronic disease (Petriello, 2014).

Current research suggests that the consumption of bioactive compounds with antioxidant and anti-inflammatory capabilities may help prevent the pathogenesis of oxidation and inflammation the underlying causes of many chronic diseases (Henning, 2007; Henning, 2018). A great wealth of these bioactive compounds can be easily and cost effectively consumed via fruits and vegetables incorporated into the diet. Nutrition is being billed as part of the solution not only to addressing human toxicity due to contamination but using these diet-derived bioactive components to sense and capture environmental contaminants before human exposure as part of the remediation process (Petriello, 2014).

2.3 Phytonutrients

2.3.1 Introduction

Phytonutrients are substances produced by plants with bioactivity beneficial to human health. Types include Carotenoids, Flavonoids, Glucosinolates, Polyphenols and are found in the highest quantities in fruits, vegetables, legumes, nuts, and certain teas (Gupta & Prakash, 2014).

2.3.2 Role in Health Maintenance

Phytonutrients are hailed by scientists for their role in reducing oxidative stress and preventing the damage that oxidative compounds can have on the body. These effects have been found to be mitigated by phytonutrients' antioxidant properties including their conjugated double bond structure that allows for delocalization of harmful radical species (Lui, 2004; Gupta & Prakash, 2015). These antioxidants must be consumed in amounts greater than the number of radicals created by metabolism or exposure to (Lui, 2004).

There are various positive pharmacological properties that make phytonutrients a desirable addition to a healthy diet. Such properties include anti-microbial, anti-oxidative, anti-inflammatory, anti-allergic, anti-carcinogenic, anti-aging, hepatoprotective, neuroprotective, and immuno-modulation. Benefits of consuming phytonutrients include reduced risk of cancer, cardiovascular disease, and stroke, the three primary leading causes of death in the U.S. (Lui, 2013, Lui, 2004). Studies done in animal models and cell cultures suggest that the mechanisms for preventing chronic disease that these phytochemicals participate in may be numerous and extend beyond their known function in the antioxidant defense system. Proposed mechanisms of phytonutrients include antioxidant activity of scavenging free radicals to prevent oxidation (Petriello, 2014;

Kang et al., 2019), modulation of carcinogenesis signal transduction pathways (Kristo, 2016), regulation of the cell cycle including gene expression and enzyme activation (Katiyar, 2016), and influence immune function by hormone regulation and prevention of cell adhesion and invasion (Lui, 2013, Petriello, 2014, Kristo, 2016). Many of these mechanisms have been shown to be positively affect health outcomes in human and animal models for colon, oral, and lung cancer (Zhu, Xiang, Zhang, & Chen, 2015; Knobloch et al., 2016; Balansky, 2012; Pan et al. 2015).

Current science is yielding findings to implicate the benefits whole food consumption of fruits and vegetables as health maintenance is believed to be derived from synergistic effects of the wide range of phytochemicals and other compounds in the body (Tucker, 2007). Studies done on Vitamin C content in potatoes and orange juice have all found that there is increased antioxidant activity when whole foods are consumed (Lui, 2013; Lui, 2004; Probst et al., 2017). Lui (2004) recommended at least 4 servings of different fruits and vegetables be consumed for greatest effect (Lui, 2004).

2.4 Environmental Health Literacy (EHL)

2.4.1 Introduction to EHL

Receiving the health information does not necessarily mean that communities or individuals will take action. According to previous research, perceived risk has been found to be an important indicator of positive behavior change (Karakaya & Saracli, 2018; Jezewska-Zychowicz, 2016). As such, the need for risk communication defined as the process of developing effective methods of communication to inform the community of

potential hazards that could affect their health, environment, or financial wellbeing is vital (Brewer et al., 2020). Environmental healthy literacy (EHL) is the development of the critical thinking skills to recognize, analyze, and respond appropriately utilizing knowledge of environmental and health topics and potential health risk in order to take action to maintain optimal health (Gray, 2018). The goal of EHL is to aid the affected public in gaining the knowledge and skills to understand the link between environmental hazards and effects to human health (Hoover, 2018). For public health professionals, this means sharing evidenced based information with affected communities to increase preventative action towards reducing exposures and increasing health lifestyle habits that can mitigate disease development (Finn, 2019). Improving EHL is a process that involves information gathering, distilling this information to the public in a culturally appropriate manner, and actively engaging the public in developing skills to create behavior change on individual and community levels (Hoover, 2018; Gray, 2018).

EHL works off the principle that social determinants of health may increase the knowledge gap pertaining to health protective actions. Hence, those with initially poorer health have more vulnerability to environmental hazards. The focus of EHL is not solely to supply the affected communities with accurate scientific information on chronic disease but rather to help them engage in actively reflecting on the social and environmental determinants that influence their current health and behaviors that could be taken to reduce potential threats (Finn & O'Fallon, 2017). Hence, researchers in this area theorize that by increasing the EHL of an at-risk population, there is the potential to increase the action that communities take towards behavior change (Hoover, 2018).

Bloom's taxonomy is often preferred as the theoretical framework in EHL studies. This model can help researchers categorize levels of understanding and evaluate how these levels become greater and broader over subject material as the population progresses. Additionally, this model accounts for varying levels of understanding by specific topic. There are six stages starting with recognition (identifying something as harmful or healthy), understanding (ability to comprehend the connection between environmental factors and health), applying (exert control to reduce or mediate the risk). Then the model moves to stages that require higher levels of critical thinking: analysis (the ability to examine which claims about their environment and health have merit in reference to their unique situation), synthesis (the ability to develop a plan of action based on claims presented and skills gained), and evaluation (the ability to determine whether the proposed solution is an effective tool towards the desired end) (Adams, 2015).

2.4.2 Current EHL among Kentuckians

A recent study conducted in rural Appalachia (Whitesburg, KY) determined that community members were largely aware of the types of pollution in their community and held the belief that it was unacceptable to live in those conditions while also reporting actions to protect themselves from pollution. Participants reported a strong belief that the pollution in their environment was directly related to chronic illnesses they experienced. Regarding nutrition and environmental pollution, there were also positive correlations found between consumption of healthy foods and actions taken to prevent exposure to environmental harm such as washing fruits and vegetables and avoiding areas where the air may be contaminated (Brewer et al., 2020). A study among older adults also found that survey respondents believed that diet could help protect the body from environmental

hazards but showed low awareness of the means by which diet played this role (i.e. phytonutrients) (Dunn, 2017). Even after participation in the nine lesson Family and Consumer Sciences Extension curriculum, *Body Balance: Protect your Body from Pollution with a Healthy Lifestyle*, participants reported recognition of sources of pollutants and components of healthy foods that are beneficial and how these sources can affect the body but did not display an understanding of the relationship between how healthy dietary strategies learned could protect health and prevent harm of pollutants (Brewer et al., 2019). Hence, while rural Appalachian adults showed “recognition” level of EHL, the understanding of the mechanisms by which these factors affect human health is low. Therefore, there is a need to not only educate rural Appalachian adults as well as youth, particularly because youth were reported to have little knowledge of healthy foods along with reporting low adherence to positive dietary behaviors. Reasons for the lack of adherence, included information received from educational institutions was too elementary (pertaining to food groups and metabolism) to allow them to make proper choices about healthy dietary behaviors and weight management (Williams, 2006). To bolster EHL among Appalachian adults and youth who experience health disparities along with increased exposure to environmental pollution, youth need to be educated about nutrition’s role in protecting the body against environmental pollution to help them understand and share with their families that they are exposed to pollution and how nutrition can help protect their health.

2.4.3 Efficacy of Studies on EHL in Children

A study in Latino youth who attended a summer internship on chemicals in cosmetics and the resulting health effects concluded positive changes in EHL and self-

efficacy based on the youth's ability to engage in professional discussion and presentation of subject matter to peers at a public health forum. Additionally, youth self-reported broader understanding of environmental health topics, a foundational key in Blooms theoretical model, after participation (Harley et al., 2016). Additionally, the EHL and dietary behaviors of low socioeconomic status youth have been found to be very poor. However, after receiving over 3 hours of lessons on bee pollination and its relationship to environmental and human health, the participants responses were found to be positively modified. Specifically, questions that were unknown were answered post-lesson discussion and were able to offer a justification of their responses. For example, children responded that bee products like honey make people stronger (strengthen the immune system) when asked about how bees affect the environment and responded that you don't want to make the environment dirty when asked about pollution sources like garbage. Hence, the recognition level of EHL, the basic awareness of a topic and perhaps even greater levels of understanding were achieved (Hunter, 2016). These studies show the efficacy of EHL based intervention on both pollution and nutritional based topics. Specifically, these findings reveal that increases in the understanding of complex health related topics can be achieved. As such, programs should explore utilization of such framework to address specific health disparities in their communities.

Secondly, EHL's heightened ability to increase health behavior actions in vulnerable populations has been argued by many researchers in the health-related fields. In a recent study in California, significant increases in youth EHL was found after an education intervention on air quality. Authors examined understanding gained from the

intervention and the participants ability to take action rather than more traditional measures of knowledge, attitudes and behaviors. Not only was awareness of subject matter increased ($p= 0.01$), but significant changes were seen in understanding how to take action (p values less than 0.005) and the number of participants reporting actually taking action (p values less than 0.001 except in one case). Specifically, the statement exploring the use of the knowledge gained about air quality to protect one's health had a 50% increase in response agreements (Madrigal et al., 2020). Hence, these findings reveal that interventions focused on enhancing EHL have the potential to result in increased health protective action in at risk populations. Future research exploring the concept in more depth would greatly benefit future health promotion.

Lastly, programs servicing children have a unique benefit in that they have the ability to affect a larger population than just the recipients of the educational information and skills achievement. Specifically, children have a dramatic influence on what their parent purchases and hence what foods become accessible in the home (Caldron et al., 2016; Jeevananda & Kumar, 2012). As such, programs that gear their efforts towards children may be an effective method of reaching larger, harder to reach populations.

2.5 Current Mediums of Nutrition and Pollution Education and their Efficacy

Nutrition education is necessary as it identifies and targets determinants of health that are influencing behavior change and provides means to modify these determinants to lead to behavior change (Contendo, 2007). Foundation principles of nutritional education include sound theoretical framework for goal setting, material creation, and evaluation.

The social cognitive theory is a three-pronged theory that encompasses behavior (skills and abilities), personal factors (knowledge and beliefs), and environmental factors (built environment and social health determinants) that has had large success in educational areas (Morris et al., 2000). Secondly, program intensity (effort and enthusiasm of instructor) and duration (timing and doseage) must be adequately suited to the purpose of the program and the participating community (Contendo, 2007). Additionally, school and overall community involvement are important as the more resources and support available the more successful the program is (Morris et al., 2000).

Successful methods of nutrition implementation include utilization of the CATCH curriculum that is supported by the CDC as a multidimensional approach that involves the combination of school and home (Jakubowski et al., 2018). Secondly, peer mentored education focuses on overall wellness via three targets: the children, the youth mentors (from the neighborhood), and the caregivers, educating influencers at all levels of dietary behavior change (Hopkins et al., 2016). Direct exposure to healthy food at early stages of dietary behavior development has been found effective (Contendo, 2007; Hetherington et al., 2015; Jennings et al., 2016). Dannefer and colleagues (2015) evaluated the effectiveness of a farmer's market education program and found attending one educational class created more positive attitudes towards fruit and vegetable intake. Greater levels were seen with increased attendance as were actual increases in consumption by nearly a ½ a cup of fruits or vegetables. This is in agreement with previous studies (Powers et al., 2005; Delcampo et al., 2011). Increased preferences for fruits and vegetables have also resulted from garden-based studies (Morgan et al., 2010). Snacking was modified after an active

learning educational intervention (Grosso et al., 2013). However, two recent studies found educational interventions focusing directly on creating changes in knowledge and behavior to be unsuccessful (Jennings et al., 2016; Jakubowski et al., 2018).

Regards to pollution education, case studies and projects are a current medium of educational communication to youth. The idea behind this method is mastery of a behavior through performance. Principles vital to success include allowing the children to carry the responsibility of performing the work hence gaining self-efficacy and adherence to scientific process, resulting in critical thinking skills that can be integrated into the children's toolbox (Hugerat, 2004). Specifically, the use of developing representations of a phenomenon to investigate its function, synthesizing information followed by communication to peers, and constructing and supporting explanations of theories have all been commonly used in youth programs as were analyzing data (statistics), evaluating the validity of information, and identifying problem have all seen declines in use (Brown, 2017).

For educational strategies addressing awareness which is often the first step in the behavior change process, risk perception is vital to understand the individual's readiness to act. The key is to provide learning experience by which the individual will be able to gain a greater understanding of the actual risk without instilling panic or fear. This method is especially useful for interventions by which you want the individual to take action against future issues. This is a twostep approach, one to create awareness about the danger often accomplished through visuals, statistics, or personal anecdotes while the second step

is to provide a specific means by which the participant can reduce their risk. Understanding currently held knowledge and proving the basic information and cognitive skills needed for comprehension (understanding why the recommended technique is effective for reaching their goal) is vital to the success of the interventions. Secondly, one must stimulate higher order thinking by teaching skills that can be used to analyze a situation and evaluate and synthesize the needed levels of response (Contendo, 2007).

2.6 Free-Choice Learning Setting: Summer Camp

Free-choice learning settings (those outside of the traditional classroom setting) have been suggested to be valuable as experiences in which participants can engage in self-motivated learning (Gray, 2018). Very few validated programs that implement non-school based interventions over the summer months have been studied. However, there are a variety of positives that come out of the successful utilization of this type of setting. One, adding curriculum during the school year is difficult and can add pressure to already overwhelmed teachers, parents, and students. Two, the researchers can take advantage of the availability of an outdoor setting. Three, due to the similar structure of school, many pre-existing programs can be easily adapted to fit these settings and similar to a school setting, meals are eaten during the camp in a communal type setting which provides ideal settings for discussion (Jennings et al., 2016). Four, camps have been found to increase social cohesion, critical thinking skills (Buskirk-Cohen, 2015), self-esteem, and leadership skills. The use of experiential learning in a judgement free environment is hailed as a key principle of success for summer camp-based education (Wilson et al., 2019). Specifically, camps significantly increase exploratory behaviors in the short term. Parent's also report

that camp increases their child's environmental awareness, and this is maintained over time (Burkhart et al., 2005). Lastly, all children can experience learning loss over the summer, but this issue can more profoundly affect children facing health disparities. Recent studies found that implementation of an educational summer program can lead to positive educational outcomes that extend beyond maintenance of current knowledge (Bowers & Schwarz, 2017; Johnston et al., 2017).

In a recent intervention, twelve children attended 5 days of a recreational kids' summer camp in which they received materials from the Health Education Program for Children (HEP child). Focus was on determining differences in body composition, food intake, and physical activity before and after camp. Consumption of sugar-sweetened beverages and other sweets were found to be consumed in a more appropriate proportion. These findings were maintained at the 12-week follow-up (Campbell et al., 2018). Similarly, Faivre and colleagues (2017) examined if a Gardens to Tables Culinary Camp program was an effective method of increasing nutritional knowledge, self-efficacy, and motivation towards healthy dietary choices in youth. The camp was a weeklong and included gardening and culinary activities, physical activity, and nutrition education. Findings concluded that there was a significant ($p=0.003$) increase in all three categories. Factors of note in these interventions include multiple methods of evaluation and that physical activity and active learning techniques were incorporated into each.

2.7 Best Practices of Evaluation of Summer Camp Interventions

Pre- and post-tests were the most commonly used assessments in the above-mentioned studies. However, a wide variety of methods of evaluation were utilized including interviews conducted on site, at home, or another local site, measurements of height, weight, waist circumference, and blood pressure, paper assessments (pre and post) utilizing previously validated questions from SPAN, BRFSS, etc. (Hopkins et al., 2016), and 24-hour recalls/ 3-day food records/ food frequency questionnaires. Qualitative data has the added benefit of capturing culture specific information (Contendo, 2007) and utilized grounded theory techniques (Dannefer et al., 2015). Behavioral and psychosocial data may also be collected. Camp counselors' feedback throughout the intervention can help improve the efficacy of a program. Program evaluation can be performed by a third party when appropriate and overall community impression of the program is important (Hopkins et al., 2016). Successful evaluation tools from Faivre's study (2017) include the Let's Eat Healthy Survey, to assess differences in knowledge, and the Confidence and Motivation survey, that determines the difference in attitude towards dietary habits.

2.8 Summary

Rural youth in eastern Kentucky are a highly vulnerable population due to increased exposure to environmental hazards, poor dietary habits and health, and low environmental health literacy. The links between exposure to contaminants, negative health outcomes, and phytonutrients role in mitigating these harmful effects is complex but critical for health maintenance. As there is low understand of this complex relationship, the need for effective ways to increase EHL is urgent. Current interventions of solely nutrition or

pollution material have shown mixed results in creating positive behavior change but current research of interventions focusing on promoting environmental health literacy in youth has yielded positive results for increased understanding and action towards health maintenance. There is potential of additional benefits with utilization of summer camp setting. Hence, a study examining the efficacy of an educational intervention at a youth summer camp to increase EHL would provide both knowledge on ways to reduce health disparities in rural Appalachian youth and provide EHL materials to an at-risk population.

CHAPTER 3. METHODOLOGY

3.1 Letcher County, Rural Appalachian Youth: A Target Population

The target population for this intervention was rural Appalachian youth ages 5-12 years of age attending the Cowan County Community Center's Kids on the Creek Camps (Letcher County, KY). To be eligible for camp, youth must be 5 – 12 years and enrolled in a Letcher County school. Four different week- long day camps were offered over a period of eight weeks, June through July. The education offered at the camps provided information on a variety of topics that are pertinent to the community. During Art Camp children enjoy activities from painting and sculpting to puppet making and nature fieldtrips. The camp also includes an art lesson from a world-renowned hometown artist. Music Camp focuses on the rich history of folk art in Appalachia. The campers engage in activities such as, singing, dancing, and storytelling. Headwaters Camp provided an introduction to environmental stewardship and native Kentucky wildlife through a series of fieldtrips to local areas that highlighted different ecosystems and areas to positively interact with nature. The campers had the opportunity to explore the water cycle and use microscopes to learn about stream diversity. During Farm Camp the youth were exposed to all aspects of agriculture from gardening to cooking. These children were introduced to new foods, taught about healthy diets, and learned about food sources. Our study focused on Headwaters and Farm Camp only.

3.2 Headwaters and Farm Camp Day Camp Activities

3.2.1 Headwaters Camp

The five days of the camp were spent on fieldtrips to local areas that showcased how humans can positively interact with nature. The 2019 lessons focused around the

impact of water quality on ecosystems, specifically on how organisms in the stream are sensitive to pollution. This was done by examining the stream ecosystem under a microscope. Day two lesson was on native wildlife in Kentucky where the children got hands on with reptiles and birds and learned about how humans contribute to more interactions with larger predators. On Day 3 they went to a water quality facility and learned about how water is processed as they toured a local dam. They were taught a lesson on “enviroscape” which showed how mine drainage in the surrounding areas became runoff and ended up in the water cycle. This lesson included a handmade 3-D live action model which allowed the children to watch how this process occurred. Day 4 took place at a park where they learned about enjoying nature by engaging in outdoor activities and learning forest safety. They were also introduced to different habitats that make-up an ecosystem. Friday was Eastern Kentucky University’s garden site in Letcher County where the children learned about insects, stream biodiversity and healthy stream components, and the water cycle. They also were exposed to the history of environmental studies in Kentucky via a theatrical play. Litter as a detriment to the environment was reinforced throughout the lessons.

3.2.2 Farm Camp

This camp focused on introducing the children to all aspects of the food system. There were two fieldtrips that allowed the children the opportunity to experience how food is raised on a farm both in the garden and in the barn. Children received a hands-on experience with local agriculture that taught how foods they eat are produced. The second fieldtrip was to the local Letcher County farmers market where the children were introduced to places where they can find healthy foods and how to identify these foods.

Daily lessons included gardening in which the children got to pot their own plants, crafts where they children can made their own beehives, and culinary lessons where they learned how to make a new food each day. Physical activity sessions like yoga were conducted. The University of Kentucky sent two groups to talk about their work. Our lesson pertained to environmental health literacy. The hands-on demonstrations were used to create the connections between environmental pollutants and negative health effects on humans and then how the campers' nutrition can help counteract these effects.

3.3 Establishment of Team member and Community Partners Responsibility

The study was conducted in Letcher County, Kentucky at the Cowan County Community Center where the Kids on the Creek Camps are housed. All study procedures were approved by the University of Kentucky Office of Research Integrity's Institutional Review Board. The UK Community Engagement Core (CEC) had been partnering with the Kids on the Creek Camp program since 2017 with each year involving more lesson and evaluation involvement by the UK-CEC. The 2019 intervention and evaluation plans were determined through several emails and phone conversations between the community and research teams, as well as one in-person meeting that took place in Whitesburg. The research team was responsible for comprising and presenting an in-person lesson as well as for conducting brief interviews with the youth. Physical measurements, dermal carotenoids, height, and weight as well as consent and assent were obtained the first day of Art Camp for Kids on the Creek, the first of that series. This start date was chosen as many of the children in the area attended all of the camps and it would allow the researchers to follow a core group of kids attending all of the camps over two months time. The community team was responsible for recruiting parents from the community to

enroll their eligible children in the intervention and to encourage them to complete the parental surveys.

The Cowan Communities Action Group director was the point-of-contact for any questions the research team had and provided the research team with the needs of the community and camp staff in regard to materials and overall professionalism and engagement. The manager of the camp was responsible for arranging the facilities for the intervention as well as the scheduling and overseeing the activities the day of (this included assigning the children into groups for the lessons that day and allotting the amount of time for the lesson to be given). Follow-up measurements of dermal carotenoids, height, and weight were to be taken by the community contacts on the last day of the final camp, Farm Camp. The research team collected consent/assent, anthropometric measurements, and surveys. The graduate student researcher presented the lesson during Farm Camp and conducted interviews during both Headwaters and Farm Camps.

3.4 Recruitment of Participants

3.4.1 Youth

This longitudinal mixed methods study included a convenience sample of rural youth that participated in the Kids on the Creek Camp in Letcher County the summer of 2019. Participants were recruited for the study via in-person consultation at the beginning of the first camp as well as by Facebook sharing done by the community team. Participants were excluded if the researcher did not receive consent and assent or the participant was

not in the desired age range. The total participant numbers were 32 children for the baseline measurements, 22 participants for the qualitative interviews of Headwaters Camp, and 24 participants for the active learning nutrition lesson and qualitative evaluation during Farm Camp.

3.4.2 Parents

For this longitudinal study a convenience sample was used of children attending the Letcher County Kids on the Creek Camp. Participants' parents were recruited to sign their children up for this study as they arrived to drop their kids off at the first day of the first camp. At this time the parents were given information about the study and if they wished their child to participate. Consent and assent were taken before the beginning of camp.

3.5 Data Collection

3.5.1 Physical Measurements

Physical measurements were obtained from youth with assent and consent on the first day of Art Camp. Shoes were removed and body weight (Omron HBF-516B scale) and height (Seca 213 portable height scale) were measured. Dermal carotenoids were measured using the Veggie Meter™ (Reflection spectroscopy) to provide an estimate of fruit and vegetable intake. The participant's finger was placed inside the scanner with slight pressure to keep the finger in place for 5 seconds as it is exposed to the light before the finger is removed.

3.5.2 Qualitative Interviews of Youth and Staff

3.5.2.1 Youth Interviews

Interviews with youth were conducted during the Headwaters and Farm Camps. Interviews were conducted on the final day of each camp and were done throughout the day during free activity periods at either the community center or on field trips. All interviews were done individually by the graduate student researcher, and the participant had the ability to refuse to participate. Interviews were recorded and notes were also taken to ensure accuracy.

The Headwaters interviews were conducted face-to-face and focused on evaluating the baseline knowledge of the rural youth population attending the camp. These evaluation questions focused their knowledge of pollution, its sources, and how it affects the body (Table 1). Additionally, questions probed for the children's' understanding of how nutrition and pollution may interact in the body to maintain health. The interview guide was created by the research team and was adapted from the University of Bath Survey of Environmental Concerns and the EPA 2002 Water Pollution Survey (EPA, 2004). Each youth were asked a total of 4 open-ended questions. All interviews were between 2-5 minutes in length.

Table 3.1 Headwaters Camp Interview Guide

Questions	
1.	What was the most interesting thing that you learned over the last week during Headwaters Camp?
2.	Did you learn anything interesting about pollution? The causes or effects?
3.	Do you think that pollution ever effected or could affect the health or quality of life of you or your family and friends?
4.	How much do you think individuals, such as yourself, can prevent pollution and care for your environment?

Farm Camp interviews were conducted in the same manner. These interviews focused on establishing a baseline knowledge of healthful eating as well as the child’s perception of fruit and vegetable consumption. The focus was also placed on whether or not the children voiced an understanding of the relationship between nutrition and pollution. Additionally, these questions evaluated any material that may have been gained from the lesson presented the previous day (Table 2). Each youth were asked a total of 6 open-ended questions with interviews lasting 3-5 minutes. The nutrition questions were adapted from the USDA’s fruit and vegetable Inventory (Townsend, 2020) and the University of Texas’s SPAN (UTHealth, 2016) and CATCH (Catchglobal, 2014) curriculum. There were 22 youth with assent and consent for Headwaters interviews and 24 for Farm Camp. Interviews lasted approximately 5 minutes per child.

Table 3.2 Farm Camp Interview Guide

Questions	
1.	What was the most interesting thing that you learned over the last week during farm camp?
2.	Did you try any new foods this past week at camp? If so, which foods? Which ones would you eat again?
3.	Can you tell me about healthy foods? What makes those foods healthy?
4.	Did you learn anything interesting about pollution? How do the foods you eat effect what pollution does to your body?
5.	I feel that I am helping my body by eating more fruits and vegetables?

3.5.2.1 Staff Interviews

Staff members were interviewed to gain an understanding about future enhancements for implementation of material into the program. They were recruited via electronic mail after the completion of camp. They were selected based on having been part of the initial community partner team. Follow-up interviews were conducted with the community team in November of 2019. Five community partners were contacted via email and asked to participate in the post-intervention evaluation. These interviews focused predominantly on the UK-CEC’s role in the 2019 camp, a timeline for future involvement, changes that the community partners would like implemented, and their opinion on the lesson presented by the research team during Farm Camp and how to improve evaluation methods (Table 3). These interviews lasted 30 minutes and were conducted by the graduate student researcher. Community partners interviewed included a community volunteer instructor, the Cowan Communities Action Group and Health Communities Initiatives director, the Kids on the Creek director, the Headwaters director, and the camp counselor supervisor and teacher that assisted in the lesson presentation. All of the interviews were conducted using the telephone.

Table 3.3 Faculty of Kids on the Creek Camp Follow-up Interview Guide

Introductory Questions	
1.	To begin, could you tell me the title of your position, and years you've been involved with the camp?
2.	Can you tell me about your involvement with the camp(s)?
3.	What do your responsibilities during the planning and executing of the camp entail?
Transition Question	
1.	What was your take on UK's involvement with this years' camp?
Key Questions	
1.	What is the most important element that you would like UK to provide?
2.	What elements of UK's involvement would you like to keep?
3.	What elements of UK's involvement would you like to change?
4.	Could you please provide any feedback on elements that were frustrating? (Prompt about UK's involvement if needed)
5.	Do you have any ideas on what could be done differently in the future to make the camps an even greater success? (Prompt about UK's involvement if needed)
6.	How can the UK researchers become better involved in the planning process of the camps?
7.	What would a timeline look like for this?
8.	If UK is involved in the future, they would like to evaluate any programs they offer. What do you believe would be the most effective way to evaluate camper's change in knowledge? (probe about quantitative versus qualitative if needed)
9.	Do you feel that UK researcher's attempts at evaluation were effective at this years' camp? If so, could you explain how? Do you feel that one type of evaluation was more effective than another?
Ending Questions	
1.	Is there any advice that you would give to the UK researchers?
2.	Of all that we have discussed, what is most important to you?
3.	Are there any other comments that you would like to make?

3.6 Nutritional Intervention

3.6.1 Creation of and Delivery of Lesson Materials

A total of four counselors (including the researcher) assisted with the activities. The lesson stations were set up upon arrival and taken down after the lesson to allow for other guest lectures in the afternoon session.

3.6.1.1 Theme 1.1: Connecting Good Nutrition and Environmental Pollution

To teach youth the concepts of environmental pollution and how good nutrition, specifically phytonutrients, can help protect health, a number of engaging activities were utilized: 1) a 3- minute phytonutrient skit, 2) dermal carotenoids score for each child was measured, and 3) a tortilla chip science experiment was conducted. The adapted skit replaced the word “phytochemicals with “phytonutrients (InstructorsWeb, 2007). In brief, the skit was performed by the graduate researcher in which phytonutrients were explained by discussing what they are; sources; how a plant makes them; and the role they have in protecting cells in the body.

Following the skit, the youth then had their dermal carotenoids measured and scores provided along with an explanation of how carotenoids give color to fruits and vegetables. Paired with the carotenoid measurement were explanations pertaining to the recommended number of daily fruit and vegetable servings for their age group, and age-appropriate suggestions of how they could add fruits and vegetables to their meals or snacks in the form of either fresh, frozen, or canned.

The tortilla chip experiment followed, which demonstrated that environmental pollutants cause cell damage through oxidation and inflammation, but fruits and vegetables provide nutrients and phytonutrients that function as antioxidants to protect against cell damage.

3.6.1.2 Theme 1.2: Connecting Dosage, Environmental Exposure, and Health Problems

An adapted version of the University of Arizona lesson titled “Lemons and Onions” was used to explain the connections between the dose of environmental hazards and varying degrees of health problems experienced by people. The overall purpose of the lesson was to give the children a demonstration of how an environmental hazard and exposure to a hazard is identified. Due to time constraints the lesson was delivered in 15 minutes by removing elements regarding how scientists do research and how certain exposures do not have negative effects (Southwest Environmental Health Sciences Center University of Arizona College of Pharmacy, 2009).

3.7 Statistical Analysis

3.7.1 Pre-intervention Measurements

Data was analyzed using SPSS version 24. Descriptive statistics for demographics were calculated including frequencies, means and standard deviations. Data analysis was completed on all data from the youth that attended at least Headwaters or Farm Camp and was collected in hard copy on the day of sign-in for the camp.

3.7.2 Analysis of Qualitative Interviews

All interviews were analyzed using thematic analysis. All interviews were recorded, and field notes were taken to ensure accuracy. The graduate student researcher and the project manager transcribed the audio recorded interviews for children and the notes of phone interviews of staff. Two researchers independently coded all of the children's data, although the staff interviews were coded only by the graduate researcher. The notes of the researcher that attended the camp and presented the lesson were also coded. The coded information was compared for accuracy and themes were identified. From the final codes, themes were identified and focus coding (identifying frequency of codes) was conducted. The camper interviews were reviewed to determine knowledge retention and critical thinking skills developed from camp attendance. The staff interviews were used to identify aspects of the projects that were successful and areas which lacked proper execution. There were four broad categories of codes. Value coding would be used to designate when the child showed uncertainty or confusion even if he/she answered the question correctly. In vivo coding was used to designate thoughts or phrases verbatim as they were put by the child. Emotional coding was used to designate themes that the child expressed strong feelings toward. Descriptive coding was used to represent the information or knowledge the child was able to present to the researcher. Each question of the interview was given an anchor code and all the other codes for responses to that question were anchored under that heading.

CHAPTER 4. RESULTS

4.1 Participant Demographic Information

A total of 21 participants completed the baseline measurements, 22 youth were interviewed during Headwaters Camp and 24 were interviewed following Farm Camp. A total of 22 (69%) of the 32 Headwaters participants were evaluated after camp and 24 (63%) of the 38 Farm Camp lesson participants were interviewed.

The average age of the children was 7.75 years. They were non-Hispanic and predominantly identified as white, 89.5%, female, 60%. The average BMI percentile was normal at 79%. The average dermal carotenoid score was 96 (52.236) O.D with a range of 18-191 O.D. On average, the children had participated in the program for more than one year and sixteen of the children attended both camps.

4.2 Overarching Themes from the 2019 Qualitative Interviews: Headwaters Camp Participants

4.2.1 Theme 1.1: Predominance of Litter, Water Pollution, and Stream Biodiversity in Children's Perceptions of Pollution

There were two major recurrent themes that were found amongst the answers to all of the questions asked during the Headwaters interviews. The first was that when asked about whether they learned anything interesting about pollution, the overwhelming majority of the time the children would directly relate the question to litter despite this not having been emphasized in the questions themselves. The term litter was used 35 times

and the terms trash or garbage were used 21 times, three respondents said stuff, liquids, or plastics. In response to a question about pollution, the causes of and effects of pollution, 17 campers replied with answers that involved litter. In response to the same question, 15 campers responded with answers that pertained to water and water quality. Similarly, when asked about the most fun thing they did or learned at camp, answers pertaining to stream biodiversity was second to only an interest in wildlife with 7 responses. Answers pertaining to water (including water/stream/lake/creek/ocean) totaled 45. The same results were found in questions about caring for the environment, where responses tended to focus around preventing trash from harming the environment, specifically water sources like the ocean and the stream or lakes nearby. The idea of pollution being strongly associated with water was highly prevalent across all the interviews. Several campers reported information from a lesson on water ecosystems sensitivity earlier in the week that seemed to have a large impact on the camper and even several of the camp counselors. Hence, dominance of water in regard to pollution may have been influenced by the proximity of the other lesson or simply be prevalent amongst children of this population.

There were, however, a few students whose responses were more thorough and mentioned man-made pollutants and how the community members' behaviors might contribute to pollution. Pollutants mentioned included: ink, oil, sediment, coal, rain runoff, dumped substances, car exhaust, smoke from buildings, and algae blooms. One camper reported on pollution:

“the oil in their car leaks out and goes into the air, on the road. And that, and also how you leave your lid open and then a bear comes and then it litters all around and maybe you try to clean it and throw it in the lake.” -ID 3 (Female age:8)

Another camper reported:

“I actually kinda know quite a lot about pollution... (talks about litter and then is asked about any other causes) like the smoke from buildings and the oil from cars.”- ID 2 (Female age: 10)

4.2.2 Theme 1.2: Future Action: Environmental Restoration and Contamination Prevention

The children’s’ interviews were concluded with a question that explored the environmental health literacy of the campers. Specifically, the children were asked if they felt that exposure to environmental pollutants could affect their health. There were two primary answers as most of the children's answers were in agreement with each other. The first answer highly corresponds with the ecological concern mentioned above. The need for ecological restoration in order to create a cleaner healthier place to live was the most common answer with 19 mentions. This included themes such as picking up litter (the most common answer, n=10), protecting the ecosystem (n =7) including planting trees and not chopping them down, and cleaning up the environment (n=9) with an emphasis on water sources such as oceans and streams. Two participants suggested using better water cleaning methods to create a healthier environment. Replies in answer to the question included:

“Yeah, they could pick up garbage around the creeks and streams.”- ID 13 (Female age: 9)

“I’d actually like to go to the Gulf of Mexico like in the ocean of it so we could actual go to those two landfills of trash and pick it up”-ID 2 (Female age: 10)

“Pick up the garbage and keep the water clean” -ID 5 (Male age: 8)

“Make our water cleaning better”-ID 11 (Male age: 11)

“Definitely do not cut the trees down, then they might, then they’ll die.”- ID 27 (Male age: 8)

Additionally, there were two recurrent themes with ecological restoration. The first was legislation and was mentioned by 2 of the male interviewees. These statements voiced the opinion that community members could take action towards healthier environments by advocating for laws that protect the environment. The second was community involvement in restoring the environment (n=3). In these statements the kids showed positive attitudes towards being involved in cleaning up the environment but also voiced the idea that the community should be involved in this responsibility.

“Don't throw stuff in the water and clean up.... People could start picking up trash if it's not theirs and help people and stuff.” -ID 12 (Female age: 9)

“Me and my cousin and my sister, yesterday, were walking up and down in front of my mamaw’s yard and were were, we were picking up trash, and it was unbelievable what we found from other people.”-ID 2 (Female age: 10)

“We can throw stuff away, um litter, and we can make everybody quit throwing stuff in the water.” -ID 28 (Male age: 8)

“Probably not litter, and try to pick up trash....maybe, take all the lighters from people and throw them away, there should be a law for no lighters”. -ID 20 (Male age: 9)

The second major theme was proper handling and disposal to prevent contamination of the environment (n=12). Only two students mentioned preventing

pollution directly. Several sub-themes included: not littering (n=8), proper trash disposal (like putting trash in the trash can and don't throw things on the ground) (n=5), and recycling (n=4). This theme was emotionally coded as well as ecological and human concerns were expressed by several campers who mentioned keeping animals or people from harm (n=4). There was also a larger number of suggestions of community involvement here as many of the campers spoke in terms of we or their family/friends or neighbors.

“Make sure you don't litter, maybe if you drop a candy bar or something, make sure you notice, pick it up and throw it in the trash can.”-ID 10 (Female age:6)

“We could like recycle things and reuse them and um, use um, don't use plastic bottles, use um, use reusable ones, and you can um, like don't litter.... “- ID 4 (Female age: 9)

“You should keep your lids on, like and you should make um notes with, on, on like your purse or something, you could remind yourself to always put your trash in your trash cans and always put it in recycling bins and never just throw it down on the ground. Cause the wind could carry that and then it could drop in the lakes and water.”-ID 3 (Female age: 8)

4.2.3 Theme 1.3: Basic Understanding of Negative Pollution Outcomes in People and Wildlife

The second environmental health literacy question that dealt with pollution and its effects, asking, specifically for the child's opinion on pollution's ability to affect the body. For these EHL questions and the entirety of the interview, there was a strong statement of interest in nature, specifically wildlife, and ecological concern. Nine of the 22 children reported that their favorite part of camp was the things they had learned or participated in regarding wildlife and eight reported their favorite part being interacting with nature (including activities like fishing, catching butterflies, hunting for crawdads, etc.).

“I didn't know that um black bears, um bears, would go to different neighborhoods and dig in your trash, and like because they are so use to people giving them food so they travel to different neighborhoods and how they know that is they put this collar on them and they put a tag in their ear, and when they put the collar on, it tracks them to see which neighborhood they went to, and then they go see the tag on the thing, and then if the bear, they catch that bear and they put it in a different location and then if that same bear with that same tag number keeps doing that and doing that in that same neighborhood, they have to put it down....”-ID 3 (Female age: 8)

Concern over harm to the native wildlife of the community was reported by half the participants when asked about pollution effects (n=13). Additionally, several of the children referenced helping the animals by restoring or preventing contamination of the ecosystem when asked about caring for the environment.

“lizards can't survive if there's a lot of pollution in that area because it sinks into their um skin and it can't get out so it really irritates them....You should never cut animals out (of trees) or mess with their habitats, or like bring animals out of the rocks, and keep feeding bears, and like just let nature be.”- ID 3 (Female age: 8)

Common responses centered around pollution having a negative effect on wildlife such as making them sick, killing them, and choking them (n=13). Interestingly, many of the children showed a good depth of knowledge in this area and spoke about the pollution causing animals to leave the ecosystem and go to different areas or how the population of that species might decrease in the contaminated area. One participant mentioned that it could affect animals by affecting the plants that they ate.

“Coal and trash, they affect the water by polluting it, (asked what might that effect)... less fish and dirty water... it could affect the fish by killing them or making them flood the river or pond or something.”-ID 11 (Male age: 11)

“If the air is dirty or the water is dirty, clean water fish will die in it”- ID 1 (Female age: 6)

“If you put something on a street it will probably end up in the creek as pollution... It would probably kill the animals ‘cause they would choke on it if they drunk the water.” -ID 26 (Male age: 8)

“There is um a thing that I caught at the creek that they can only see if its non-polluted...some animals and water creatures are sensitive to pollution and it would kill them if it had pollution in there”-ID 25 (Male: age 8)

In regards to affecting people, there was a greater sense of unknown or uncertainty. While many of the campers agreed that pollution might have a negative effect on people, animals, or the environment or suggested a negative connotation towards pollution and its effects, they were unable to illustrate their reasons for this (n=4). Five participants stated that they just didn't know. Additionally, three participants reported that they believed that there was no effect on human health. Secondly, more than half reported that they believed that pollution could cause illness and other negative effects in humans (n=13), four more of the campers responded in agreement when asked if they believed pollution could affect the health of themselves, their friends, or family, and two gave personal anecdotes to support these claims.

“Well um, I got a sister that um was allergic to algae but she but she died because one time her friend was playing with her and her friend got, filled up a water bottle that was empty with it and then liked splashed it all over her and she had to go to the hospital but she died.....because my sister had a very bad allergic reaction.” - ID 1 (Female age: 6)

Common responses included: humans can develop sickness or diseases, digestive and respiratory issues, and experience reduced quality of life. One participant spoke about “substances” that were in the water but shouldn’t be there that could be negative to people’s health. Another participant spoke of how if animals were to consume contaminated plants/water this could then affect people’s ability to have proper nutrition. The graduate researcher felt the relationship between pollution and negative physical effects to humans was grasped though in a basic sense.

“It could pollute or waters.... We would have dirty water, and you, we would get sick.”-ID 11 (Male age: 11)

“It could kill the animals if they eat it and we wouldn’t be able to have the meat that we need, the protein that we need”- ID 2 (Female age: 10)

“And we drink the water and that just makes it dirty which would make the water that is in our body dirty.”-ID 26 (Male age: 8)

“It could give them like, it could make them sick”-ID 13 (Female age: 9)

“Like when the mud, like when you scoop it up, the mud could go in your mouth it could do some stuff in your stomach and stuff.”-ID 5 (Male age: 8)

A few of the participants also mentioned pollution affects the air and that it could then affect people after they have inhaled this. Several participants mentioned that a polluted environment could reduce their ability to enjoy nature, such as being unable to play in the lake, places being dirty, or experiencing foul smells. Inability to drink the water was also a popular response.

“Yes! Because the oxygen in the air will be that. If everybody cuts down trees, because trees like filter the air and gets all the yuck stuff out of it, but if everybody cuts down trees that pollution would keep going in the air and the gas from our cars would go up in the air, and then eventually we would all get really sick”-ID 3 (Female age: 8)

4.3 Overarching Themes from the 2019 Qualitative Interviews: Farm Camp

Participants

Farm Camp was the subsequent camp to Headwaters. Twenty-four campers were interviewed the day following the nutrition and environmental pollution lesson with questions pertaining to willingness to try new foods, what they knew about healthy eating, what foods or components of foods caused them to be considered healthy, their knowledge of how nutrition affected pollution in one’s body, and their opinion on increasing fruit and vegetable consumption in their diets. Interviews lasted between 3 to 5 minutes depending on the child.

4.3.1 Theme 2.1: Campers Report Interest in Culinary Creations and a Willingness to Try New Foods and Increase Fruit and Vegetable Consumption

The most popular answer for what the children learned or enjoyed during camp was their culinary activities (n=11). Culinary activities for that week were put on by the camp staff and included the children learning how to bake several different types of bread. The cooking lesson was also accompanied with a book that complemented the lesson by emphasizing a certain positive life skill. This question was also emotionally coded as many of the participants expressed strong feelings of enjoyment over having participated in their chosen activities which included: cooking, gardening, the agricultural activities done while

visiting the farm, arts and crafts done during the week, and the music session put on by the Lexington Philharmonic.

Secondly, the kids were asked if they had tried any new foods at camp. Interestingly, the vast majority (n=21) of the children responded that they had tried new foods. The most popular foods that were tried at camp were fruits and vegetables by a total of 12 campers. Of these participants, eleven cited having tried a new fruit and four tried a new vegetable. Four youth responses included applesauce, salad, and mint leaf. The second most popular type of new food tried at camp were the different types of bread they had made during the week and this was closely followed by meat (sausage, bacon, and fried chicken). Notably, foods that incorporated fruits and vegetables like spaghetti and macaroni and tomatoes were mentioned, but infrequently. Encouragingly, 18 of the campers reported they would eat these new foods again, which included 10 campers specifically referring to a fruit or vegetable. Fruits and vegetables cited by campers that they would eat again included apples, applesauce, oranges, blackberries, strawberries, seedless cherries, grapes, cabbage, salad and peppers. The foods cited by campers that they did not plan to try again were sunbread, zucchini bread, tomatoes, mint leaf, and cantaloupe. While not a new food introduced to them at camp, watermelon was an extremely popular snack for the week amongst campers that was repeatedly mentioned to the graduate researcher.

In accordance with these views, the researchers found highly positive feedback from the children regarding incorporation of more plant-based foods into the diet. After

having received the lesson on the benefits of fruits and vegetables in preventing damage or harm from pollution, the children were asked for their opinion on whether eating more fruits and vegetables would be helpful to maintaining their health. Over 87% of participants responded yes that increased fruit and vegetable consumption would help their bodies (n=21) and one responded probably. Only two reported that they did not know, and no one reported in the negative. Additionally, nine of the campers reported that they would increase consumption of plant-based foods because it made bodies healthier or stronger. Answers in the positive also included several reasons to eat more fruits and vegetables, including:

“Like to get more healthy so you can have longer life”-ID 22 (male age: 9)

“Healthier, stronger”-ID 9 (male age: 9)

4.3.2 Theme 2.2: Health Benefits and Certain Key Components of Healthful Nutrition from the Lesson Resonated with the Participants

One of the major takeaways from the nutrition and environmental pollution lesson was the emphasis on fruits and vegetables. The children’s responses to the question “what are healthy foods?” showed extremely positive perceptions of fruits and vegetables. Fruits and vegetables were mentioned a total of 20 times by 12 different campers. Several other campers simply talked directly about what healthy foods did for health. Therefore, the number of fruit and vegetable mentions is likely lower due to this issue. The kids were able to name many fruits and vegetables, which actually corresponded to those they had tried earlier in the week. Common answers included apples, bananas, strawberries, watermelon, and grapes for fruits, and green beans, corn, and carrots for veggies.

“Broccoli, carrots, lettuce, and tomatoes, and apples and grapes...”-ID 9 (male age: 9)

Other identifiers that were used to explain what made a food healthy include being natural and less processed, grown in the ground or being from trees, and coming from a seed. Colors of food such as green foods were also mentioned as healthy foods. Plant-based foods such as, dark leafy green foods and cruciferous vegetables especially red and orange colors were mentioned in the lesson, as such, these statements may have been information retained from the nutrition and environmental pollution lesson.

Phrases that were most commonly used to explain why these foods were healthy included that they increased immunity/prevented illness or damage (n=2), living longer (n=1), created better digestion (n=3), made the body stronger or healthier (n=11).

“Healthy foods they keep nitrons or something (nutrients) in there and when you eat them it helps your body digest ... it helps your body be healthy”-ID 2 (female age:8)

“(What could they do for the body) makes us stronger ...(what makes them good for us) the nutrients”-ID 22 (male age 9)

Terms that was likely retained from the lesson that surfaced during these interviews regarding the components or properties of healthy foods; nutrients (only a few remembered the whole word, phytonutrients) and vitamins (n=9). One child reported that they were healthy foods since they gave the body energy. Many of the participants remembered the benefits of the interaction of the phytonutrients with vitamins or simply the positive effects

of the vitamins themselves. Vitamins mentioned included Vitamin C that was used in the lesson, as well as Vitamin A and Vitamin B. Two campers reported the interaction of the vitamins and nutrients as being a healthy component since they could work together to protect the body against illness due to pollution. Excitingly, one child was emotionally coded in his answer that his favorite thing he learned at camp was phytonutrients. In response to questions about healthy foods and what makes them healthy:

“Like green foods, all the foods are healthy but like except for like fast food and stuff you have like that... like from, they sprout from the ground makes them healthy... vitamin C, nutrients, I know there is one more but I don't remember.”-ID 25 (female age: 8)

“Probably corn and green beans...(what makes them healthy) I know, Vitamin A, B, C”-ID 19 (female age: 6)

4.3.3 Theme 2.3: Relationship between Healthful Nutrition and Reduction of Pollution's Negative Effects on the Body Was Not Grasped by Most Campers

The children did not display confidence in their knowledge of pollution when asked if they learned anything interesting about pollution. There were eleven individuals that answered either they didn't know, or they were coded as uncertain, some of which had correct answers but were unconfident in them or unable to explain further. However, in reality their grasp of pollution was much better than expected, especially because a number of them (n= 15) did not attend both the nutrition and environmental pollution lesson or Headwaters Camp. Of the twenty-four campers, five spoke about the danger it could create in the environment with a focus on native wildlife. Five participants conveyed they had a negative connotation towards pollution. Four spoke about illness and negative effects that could be suffered by humans. Additionally, one camper specifically talked about the

relationship between nutrition and pollution and how fruits and vegetables had protective properties in this regard. One camper even responded that pollution has the ability to be in the soil and taint food and two responded that they had learned the answer about pollution from the lesson survey the day before. Another cited both air and water pollution as would be expected from previous literature.

“Um, the pollution does no harm, I think, no it does, maybe some... if they were good pollutions they won't get harmed”-ID 19 (Male age: 8)

“I learned that you can actually get sick from it if you don't take good care of the environment”-ID 15 (Female age:10)

“That it makes the environment bad and that it could harm animals”-ID 27 (male age: 8)

When asked about effects of pollution on the body and the role of nutrition, 42% (n=10) of the children responded that they did not know of any relationship between the two or that there was none. Overall, there were a total of six children who answered in agreement to the follow-up protective action of fruits and vegetables question. These statements were also coded for value, in this case a sense of uncertainty. These themes of confusion or uncertainty were found even in those that gave correct answers regarding the relationship and were documented a total of 18 times. Many campers gave answers regarding pollution and its effects but were unsure of any relationship between nutrition, pollution and health (n=3). Of the six campers that did recognize the protective relationship between fruits and vegetables and pollution, one actually talked about fruits and vegetables maintaining health (strengthening the body) but showed uncertainty about how this

happened, hence did not display full understanding of the lesson concept. Hence, 75% of the 24 campers were documented to have displayed uncertainty as to the relationship between nutrition and pollution. Campers responses to questions regarding what components of fruits and vegetables made them healthy or how these components contributed to reduced effect of pollution included:

“I don't really understand how it makes them healthy”-ID 25 (Female age: 8), “I really don't know”-ID 27 (Female age: 8)

“I don't know that; I don't know what makes ...grapes are healthy (can they help protect our bodies from harm) yes... I just think they since their healthy they make pollution go away”-ID 22 (Male age: 9)

Older children, ages 8 and older (n=16), a better understanding of the protective effects of increased plant consumption as part of a healthy diet. Several of the campers cited the protective properties of fruits and vegetables when asked about the relationship between fruits and vegetables and pollution (n=6). One camper did not know about pollution but did know that fruits, vegetables and exercise make you healthy. Additionally, several of them were able to explain that these foods had vitamins and nutrients that gave them properties to neutralize the pollutants and maintain health to prevent illness (n=5). Of the rest, four stated fruits and vegetables made them healthier or stronger, one stated healthy foods lead to longer lives, and one stated that they don't cause negative physical effects like blackened lungs or cavities. Ninety-four percent of the children believed eating more fruits and vegetables would help their body and 6% said probably. Eight participants specifically stated it would allow them to be stronger, healthier, or live longer. Likewise, they were able to recognize that these same properties were not present in other foods like

junk food. Of the 17 campers age 8 or older at Headwaters camp, 11 mentioned pollution's effect on people (n=11) as well as its effect on animals (n=11). As the lesson emphasized protective effects of fruit and vegetables, the presence of phytonutrients, vitamins, and minerals, exposure to environmental hazards, and the neutralization of pollution, these findings implicate a successful introduction and retention of some of the educational materials in the older age children only. In reference to healthy foods and their components, campers responded:

“They do keep your body from being sick and protect you from pollution ...(what about them makes them healthy) they keep your body from being affected from pollution and they have the vitamins and nutrients that you need ...(can the foods we eat protect our body from pollution) well vegetables yes but junk food not so much”- ID 15 (Female age: 10)

“Healthy foods don't have as much sugar and what makes them healthy is they used natural foods like lettuce or strawberries or yeah ...(what makes them good for us) the natural sweetness ...(do they have any other natural components that make them good for us) the vitamin C...(how could the food we eat protect us against pollution) give us more vitamins and better immune system”- ID 24 (Male age: 11)

“Like carrots and like things that are made like medicine that are healthy and vitamins that are made out of fruits and vegetables... (would eating more fruits and vegetables help your body) yeah, the other day on the scanner i only had 104 fruits and vegetables”- ID 27 (Female age: 8)

In comparison, the younger campers displayed less retention of the information. Of the ones that attended Headwaters Camp (n=5), only two spoke about pollution having a negative effect on wildlife and two answered they did not know to the question of how pollution could affect people and one answered that certain types could affect people sometimes. Of the younger campers at Farm Camp (n=8), 50% did not know what made

fruits and vegetables healthy, 25% said fruits and vegetables aid in digestion, and 25% (n=2) spoke about fruits and vegetables containing vitamins to prevent illness and strengthen the body. While 75% said that increasing fruit and vegetable consumption would aid their body, none of the campers showed an understanding of the relationship between the harmful effects of pollution and the protective role of fruits and vegetables in preventing these effects. When asked how the food you eat could affect what pollution does to your body, four campers answered they didn't know, 3 responded that they agreed fruits and vegetables could affect what pollution does to your body but were unable to explain why they believed this, and one participant simply stated that fruits and vegetables make you healthy.

There was also a noticeable difference between the participants that attended two camps rather than one. Of the 22 campers at Headwaters Camp, 7 did not return to attend Farm Camp. During the Headwaters Camp interviews, the answers from these seven children were similar to their peers with regards to an emphasis on water pollution and litter and environmental restoration. Overall, they did not show a tight grasp on pollution's ability to effect humans although, one camper did mention illness and one spoke about polluted water making your body "dirty". Of the 24 participants of Farm Camp, which all received the educational lesson on the benefits of healthy dietary habits, 8 had not attended Headwaters camp which had focused on the environment and to a certain extent pollution. Of these campers, six mentioned fruits and vegetables as being healthy, and only two mentioned vitamins or nutrients. The oldest of this group did display a solid understanding

of the relationship between fruit and vegetable consumption and the prevention of pollution's harm to the body. She stated:

“Some healthy foods can help when your body gets polluted, they can help it get like not polluted, they can help it get clean, (how do you think they can do that) the vitamin in them. (What do you think the food we eat can do about the harm pollution does to our bodies) They can help it go, like they can help make the pollution go away they can overpower with the vitamins like I said earlier.” – ID 10 (Female age: 9)

Four other campers' that attended only Headwaters Camp answers spoke about fruits and vegetables helping digestion, growth, or strengthening the body. Seventy-five percent of these campers agreed that increasing fruit and vegetable consumption would aid the body and several mentioned their body becoming healthier or stronger (n=4). However, these campers' understanding of pollution was limited. Three said they hadn't learned anything about pollution, two agreed that fruits and vegetables could help the body but could not explain why, and only two campers actually stated that exposure to pollution could affect themselves or their families.

In contrast, the sixteen participants that attended both camps showed increased understanding of both pollution and nutrition as well as a firmer grasp of the relationship between the two. One camper went to both camps but was unable to be interviewed at Headwaters Camp due to time constraints but the interview from Farm Camp was included in this analysis. Of the campers that attended both camps, 50% were able to explain that foods were healthy due to the vitamins and nutrients they contained. Additionally, it was widely understood that fruits (n=7), vegetables(n=5), and natural foods (n=3) were

considered healthy. Furthermore, of the remaining 50%, five participants stated that healthy foods provided goodness to the body (made your body stronger, healthier, provided energy, etc.) or did not cause negative physical effects and one stated that they helped you live longer. Lastly, as would be expected these were also the same campers that had displayed a good understanding of pollution and had been able to explain what foods were healthy and what made them so. Sixty-nine percent of the 15 campers stated that pollution can affect human health, four specifically mentioned the protective relationship between fruit and vegetable consumption and environmental exposures, and one mentioned fruits and vegetables making the body healthy. Moreover, four additional campers agreed that fruits and vegetables could protect humans from the harm of pollution but were unable to explain how. Of the sixteen that attended both camps, fourteen said that increasing fruit and vegetable consumption would aid their body with six citing benefits like better health, better quality of life, or increased lifespan. The other two responses were “probably”, and “I don’t know”. Pollution topics also centered around ecological concern and pollution as litter in the water.

4.4 Overarching Themes from the 2019 Qualitative Interviews: Staff Interviews

These interviews took place with five of the community members involved in the planning and implementation of this camp. Two were the directors of each camp, one was the Healthy Communities Initiative Director, and two were camp instructors as community volunteers. All were integrally involved in the creation of lesson materials or the scheduling of other organizations to come in and provide lessons.

4.4.1 Theme 1: The Necessity of Earlier Communication and Collaboration Amongst Researchers and Community Partners

The camp staff stressed the importance of how earlier the planning process started each year and that they began coordinating materials in January of each camp year. As such the need to communicate our interest in continuing research in the program and what resources we would be able to provide that year needs to happen much earlier than this past year's meeting which occurred in May. This need for increased communication during the early stages of the planning phases was expressed 10 times during the interviews. The months of January through March were specifically mentioned. In addition to this, there was strong agreement that the process of electronic email and phone conversations as the primary means of communication was insufficient. Frustration was expressed regarding the involvement of the research team during the 2018 camp that was believed to be caused in part to lack of communication. Three of the five interviewees and the graduate researcher directly mentioned face-to-face as being the preferred method of collaboration and planning while two mentioned that if nothing else skype would allow a more focus group type setting in which topics could be discussed in more length with feedback that was not delayed.

Along these lines, in order to receive feedback two other suggestions were made. First, that the communication be continuous with monthly check-ins between the teams as requested by 3 staff members. Secondly, the term total communication was brought up and the concept was mentioned seven times. The staff showed high desire to have access to the lesson and evaluation materials during the early planning stages and prior to the first day of camp. This sentiment was voiced seven times during the interviews by three of the staff

members and the graduate researcher. Specifically, the Healthy Communities Initiatives Director asked for: “An immediate debriefing in August” and to potentially share examples of other camps with similar goals that operated well to see if their model or activities would fit (Cowan) as well. One of the instructors said that it would be beneficial to give UK an example of what they are doing so we can be on the same page.

Other notable ideas that were brought out during the interviews in regard to collaboration were the appreciation of new resources that outside institutions like our research group bring to the children and that it was necessary to come to the camp prepared with materials and to present them.

4.4.2 Theme 3.2: Emphasis of Community Leaders of the Importance of Being Community Led and the Expectation of Active Engagement of the Campers

The Director of Farm Camp strongly emphasized that her main goal with the camp was the products that would be created there. She explained this means that what the students and parents get out of camp is related to how successful the staff are at aiding each child to have the best most educational and enjoyable experience. During her interview she reiterated this focus on the camper’s experience and voiced her main request of the researchers be that they learn from the children and be engaged. This theme reiterated by other staff members and was mentioned a total of nine times. The graduate researcher also found this to be a predominant key in successfully interacting in this community program. Secondly, the director of the Headwaters Camp placed emphasis on the idea that the community and specifically the kids can feel that:

“Don’t give the kids the feeling of studied upon or a test project. (You) don’t want it to feel awkward, talk about study in a way they understand early on so they can understand as much as possible about the study they are participating in before consent.” -Staff Instructor 2

Additionally, members of the community team reported that the research process at times can feel or create a feeling in the community that:

The “reward is one sided” and that the “Interviews are distracting”,” just giving people information and they go write a paper.”-Director of Headwaters Camp

Hence, there was a theme that it should be a focus of the research team to “avoid creating the feeling of a test subject”. The staff as a group were in agreement that while they wanted the partnership to continue and appreciated the work the research team was doing many of the staff vocalized that there was a need to understand that the program is “community-led” (Healthy Communities Initiative Director), and that the research team needs to work well within that group dynamic. This theme was also prevalent in the graduate researcher’s notes for future success. Suggestions for improvement within this area were increased communication and collaboration as mentioned previously but also the use of incentives, particularly in the form of something tangible that could be “taken home”- staff instructor. This idea was mentioned five times and was highly in agreement with the reflections of the primary researcher. Lastly, there was an emphasis on data collection and that the community team be privy to this information at the earliest possible opportunity as one means of reinforcing the idea that this is a partnership and information should be shared with the community and in a timely manner. This concept was mentioned five times by two of the staff members.

4.4.3 Theme 3.3: Poor Lesson Materials and Presentation, Ineffective Quantitative Evaluation of Lesson

Six of the eight questions in the main body of the interviews pertained to the presentation of the lesson and the evaluation methods used at this year's camp. Staff members were asked to provide the researchers with elements of the program that they would like to change, keep, or found frustrating. They were then asked their general opinion and their opinion in regard to the efficacy of each of the evaluation methods that were used in the 2019 camps. Three broad themes emerged.

First, there was a unanimous feeling that the written surveys to evaluate knowledge were less effective than other means of evaluation. In contrast to the positive reception of the open-ended qualitative interviews, the quantitative lesson evaluation survey was poorly received. While the understanding of the necessity of both types of evaluation was voiced, the community members raised some valid points about the drawbacks of this method. One of the largest community concerns was that due to the format of the evaluation (paper and pencil multiple choice test/survey) and one of the lessons being more passive learning in nature, that the children associated this with being at school and may have rejected the idea of having to complete “work” over the summer. Hence, they felt the children did not try as hard. This combined with the literacy difference between the ages of the children made giving the survey to a group of children and ensuring that everyone had the same ability to respond highly unlikely. Finally, two of the five staff members expressed worry over the kids feeling that due to the format of the evaluation and lesson,

the kids may have felt test anxiety and performed poorly or did not wish to participate for fear of not doing well. As such, one community team member said:

“The interviews were good, they (the campers) feel important to have that one on one.... too much like school puts pressure to feel like they need to know” and emphasized that they have “test anxiety like feelings, others just don’t want to do and mark random answers”-Staff Instructor 1

“Written test was only effective with some kids, others it’s not representative of their knowledge”, “not on their level” - Staff Instructor 2

Suggestions were made to improve the current surveys and questionnaires including differentiate by age and the use of more open-ended questions for the older children. The community team member from Headwaters also suggested that if surveys were used to keep the format in which the same questions are used at the beginning of the camp and then again at the end. The theme of one-on-one attention was mentioned 4 times and created a positive response from the community team members.

Secondly, this was coupled with an overwhelming agreement that the children were not responsive to the traditional classroom setting (n=4). Staff members emphasized the value and effectiveness of hands on activities and active learning (n=8). Specific mentions included culinary activities, the use of the carotenoid’s scanner, science projects, and technology like fit bits. The research team member’s evaluation additionally cited similar findings in regard to active learning, hands-on approaches, and the use of the carotenoid scanner. Two staff members reported poor presentation of the materials and others cited that the format of the lesson plan and evaluation methods was “imperfect”-Director of

Farm Camp. The graduate researcher was in full agreement with this, additionally citing issues with the number of participants per group, the time allotted for the lesson, and the lack of numbers of research team members that were present.

There were two mentions of having a more streamlined purpose, along the lines of one clear predominate message. This was reiterated by other members of the team that stated the importance of keeping the material simple to facilitate actual understanding by the children. There were multiple mentions along the same lines that stated the material was too advanced for the knowledge level of the age group (n=4).

Lastly, the qualitative evaluation method was conducted on the last day of each week of camp. During the Headwaters Camp this was done the day of a field trip and it was done at Cowan County Community Center during the Farm Camp. The staff and research team were highly in agreement that though this method was new, it was much more widely accepted by the campers. The staff responses included positive attitudes towards this evaluation method:

“Kids were more comfortable”, “felt better about the interview”, “more relaxed”-
Staff instructor 2

Additionally, multiple respondents reported positive attitudes towards the method of doing the interviews of the children while on field trips as long as the researchers were respectful not to interfere with the planned activities. The one-on-one method of evaluation was also very popular (n=2) and the primary researcher felt this was necessary for all

evaluation in the future due to literacy issues noticed during the 2019 camp. Overall, the interviews fared best in both overall opinion and effectiveness (n=7). Mentions of future evaluation methods that the community team is interested in learning more about included discussion-based methods, verbal evaluation, and observation.

CHAPTER 5. DISCUSSION

5.1 Discussion

The purpose of this study was to increase environmental health literacy (EHL) among rural Appalachian youth attending a summer day camp. EHL is the ability to understand potential environmental hazards and use health information to make decisions to maintain human health. This is of the utmost importance for rural Appalachian youth because they are potentially at greater risk of harm from environmental pollution due to their exposure being compounded with other health disparities, such as obesity and poor diet (Hendryx, 2015). To increase EHL among youth, we developed and delivered nutrition and environmental pollution-focused education materials into a pre-established community youth day camp program. The nutrition and environmental pollution lesson aimed to educate youth about the health benefits of fruit and vegetable consumption, specifically the potential protective properties of the synergistic effect of the phytonutrients, vitamins, and minerals found within these foods in protecting the body against the detrimental effects of environmental pollution. We also wanted to investigate differences in EHL dependent upon age and attendance of both Headwaters and Farm Camp or only attending one camp. This information has the potential to inform future models for use in rural Appalachian communities.

Following Headwater's Camp, the interview data revealed that the youth's primary understanding of pollution was that it was physical things such as litter that caused the

environment and the water to be dirty (smell or look gross) and prevented people from enjoying nature. The effects of pollution identified focused largely on ecological concerns for animals and the environment. This view of pollution was shared by the children regardless of which camp they attended. Interestingly, recent studies that included Appalachian adult lay community members, as well as environmental professionals, found similar perceptions regarding pollution (Brewer et al., 2019; Brewer et al., 2020, Morrone, 2014).

Encouragingly, following Farm Camp, participants that attend one or both camps, displayed a heightened ability to identify (“recognize”) health foods, their components, and their role in health maintenance as they were able to voice their belief that increased fruit and vegetables consumption was associated with good health.

In regards to increasing EHL among Appalachian youth, to our knowledge there is limited information available pertaining to youth, with only a minimal number of studies conducted among Appalachian adults (Brewer et al., 2019; Brewer et al., 2020). A study including primarily rural Appalachian adult females, found that following participation in a nine-lesson Family and Consumer Sciences Extension series titled *Body Balance: Protect Your Body from Pollution with a Healthy Lifestyle (Body Balance)*, participants still struggled with being able to voice that good nutrition was a preventive action they could take to help protect against the harmful health effects of environmental pollution despite their participation in the Extension series. Importantly, however, they did self-report making positive dietary changes as a result of the knowledge gained about environmental pollution and nutrition. (Brewer et al., 2019). In a separate study, similar

results of the residents being unable to voice that nutrition could help protect health from environmental pollution was also observed among Appalachian community leaders that attended a health and well-being community forum in Eastern Kentucky (Brewer et al., 2020). The purpose of the forum was to provide an opportunity for community leaders to voice their concerns about health, issues surrounding environmental pollution, and potential community solutions.

Just like our youth campers, the adults in both studies were able to associate environmental pollution with poor health outcomes, as well as being able to associate poor nutrition with poor health. Interestingly, an important difference observed between previous studies and the current study was that campers that attended both Farm and Headwaters camps reached a greater level of EHL than their counterparts attending only one of either camp and the adults of prior studies. Only among the cohort of youth that attended both camps were there participants able to identify the protective relationship between fruit and vegetable consumption and the mitigating effects of environmental hazards that could potentially protect health. Additionally, the youth that attended both camps demonstrated increased awareness and knowledge of pollution, and of the healthy components of fruits and vegetables, which likely contributed to their ability to make the connection of the protective role of nutrition against environmental pollution. Campers' interviews revealed that the children understood that by eating fruits and vegetables, they consumed phytonutrients, and these worked with the vitamins and minerals to neutralize or "make the pollution" go away. Some expressed this as cleaning the body, similar to how the ascorbic acid had "cleaned" the dirty water and chip in the experiment or making the

body healthy. Nearly all of the campers were able to emphasize that by increasing their consumption of fruits and vegetables, they were making their bodies stronger and healthier so that they didn't get sick and could have a longer lifespan. Such responses denote achievement of higher order thinking within the environmental health literacy framework and mirror those seen in similar studies with youth ages 5-10 (Hunter, 2016), in which a similar phenomenon was seen amongst older children (ages 8-11 years) compared to their younger counterparts in our study. Hence, these results provide important insight regarding EHL education targeting children in the ages ranges of 8-11 years. As well, our results also suggest that providing multiple, engaging environmental pollution-focused lessons prior to introducing the concept that good nutrition can help protect the body against environmental pollution may be a necessary step towards increasing EHL to the level of "understanding". Other important considerations effecting EHL between youth and adults could have been differences in lesson delivery between the current study and the *Body Balance* study, particularly the intensity and duration of lessons. The current study was of higher intensity and shorter duration in that more lessons were given to the campers in a shorter time frame compared to *Body Balance* participants. Delivering lessons in this manner was also found to be successful in other community settings that were educating community residents about the health benefits of balanced nutrition (Delcampo et al., 2011; Dannefer et al., 2015).

Our results also demonstrated that summer camp is a platform to provide opportunity for youth to reach the level of "understanding" of EHL, in which they can take personal protective action to protect their health from environmental pollution through

their understanding that good nutrition can help. Not only did summer camp provide the EHL education, but the opportunity to sample nutritious foods that can ultimately influence youth perceptions of fruits and vegetables and future consumption (Morgan et al., 2010; Morris, 2000; Delcampo, 2011). Encouragingly, the campers displayed a willingness to trying new foods largely new fruits and vegetables. Over half of the campers tried a new fruit or vegetable, and the majority reported they would likely eat these foods again. Such findings offer evidence in support of a summer camp setting as an effective venue by which to increase the exposure of rural youth to new fruits and vegetables and positively modify food preferences. Such findings are in agreement with previous literature that suggest nutritional interventions are successful venues to create positive perceptions of fruits and vegetables (including willingness to try new vegetables and reported likelihood to consume these foods) (Morgan et al., 2010), to enhance preferences for fruits and vegetables (Morris, 2000) and increase fruit and vegetable consumption (Delcampo, 2011).

Another important finding of our study was that the dermal carotenoids of the campers were low, 93.3 ± 2.2 O.D which indicates that in general our youth were consuming few servings of fruits and vegetables each day compared to youth studied previously. Ermakov et al. (2014) observed in his analysis of 256 fourth- and fifth-grade students that average dermal carotenoids were closer to a 29, 202 RRS signals (34% SD) and can be utilized as an effective marker of dietary intake of carotenoids in youth. These results further demonstrate the importance of summer camps to continue to offer healthy foods, particularly fruits and vegetables, as part of summer camp meals and activities.

Previous nutrition-based interventions in youth have found that both knowledge and subsequent consumption of healthy foods have been positively modified compared to controls by nutrition education programs in youth even as young as elementary school (Powers, 2005). Thus, having great potential to increase EHL to the level of “understanding” among Appalachian youth.

Feedback pertaining to program implementation from camp staff provided valuable information to inform future models of programming to enhance EHL in this population. Predominantly, the need for earlier, better communication including collaborative planning and shared materials from evaluations to lesson plans was cited as necessary for increased success. Finn & O’Fallon emphasized that good communication and collaborations are necessary actions needed to engage stakeholders more deeply in the behavior change process of a community (Finn & O’Fallon, 2017), in our case, youth campers. Our results however did show our community stakeholders to have positive feedback on the new qualitative methods we deployed in that staff reported campers seemed uncomfortable with the traditional classroom type setting and the advanced level of the materials. Hence, quantitative methods of evaluation could have resulted in inaccurate representation of their knowledge despite this methods’ effectiveness in previously done studies in this setting (Campbell et al., 2018; Jennings, 2016; Hopkins, 2016).

In conclusion, this program could be a valuable tool for increasing fruit and vegetable consumption at the community level, by increasing youth EHL. Since youth have been found to influence the decision of parents to engage in healthy behaviors,

including food purchasing decisions (Caldron et al., 2016), there is the potential that by increasing knowledge about nutrition and environmental pollution among youth it could potentially lead to requests for healthy food options in the home for household members to then consume. Future involvement of parents in such programs could also be valuable for enabling children to make health behavior changes.

5.2 Limitations and Future Direction

Issues associated with data collection occurred this year due to lack of clear communication and expectations between the community members and the research team. The scheduling and time frame of lessons, the number of participants per group, the collection of post-camp anthropometric measurements, and the parental feedback were all unable to be collected at this year's camp. Due to such constraints, areas of the lesson such as the identifying sources and types of pollution, concepts of the nutritional label, and healthy eating behaviors such as information offered from Myplate.gov (portion size, number of servings, where to find healthy foods at the grocery store, and to encourage the consumption whether the foods be fresh, frozen, or canned) were unable to be covered by all of the campers. Additionally, due to starting the actual lesson late the day of lesson-delivery the camp instructors requested to save time by not distributing the healthy snack with the lesson, which coincidentally providing healthy snacks in conjunction with the lesson mentioned in the interviews as desired to be implemented in the coming year.

For future camps, it would be beneficial to provide the camp directors with recipes so that the food preparation element could be incorporated into their current culinary

curriculum. Other issues stemmed from the larger number of campers per group than expected. The need for the ratio of children to camp counselors and instructors to be low is vital in ensuring the accuracy of the data collection and to better present the lesson to the children. This would allow the team to allot more time per student and ensure that each student's response is their own. Another purpose for this would include the ability to break the long lesson into two parts and should help keep the kids from becoming bored and disengaged. This would also be beneficial for implementing a second lesson into Headwaters Camp as they expressed interest in UK CEC increasing their involvement in this camp. As such, it is recommended for future implementation that the research team send additional assistants and that training in the methods of evaluation occur early. Additionally, a reemphasis on involving the community in the presentation of lesson materials has the potential to increase the success of the program. Lastly, this year's intervention did not include parents, so research peers have suggested an education session for parents to help these kids have the opportunities to create and sustain the suggested health behaviors in their homes. This would also be a better venue for collecting consent, as different kids attend the different camps. Additionally, reaching out to parents who pre-register would be a beneficial way to increase the number of participants.

Additionally, due to the nature of the study there could be factors that influenced the coding process which was only done by two researchers who already work with rural populations. A literacy barrier in this specific subset of the population unknown to the researchers beforehand prevented the uses of the lesson evaluations in the final results.

Lastly, as our post-evaluations were very proximal to the receipt of the materials, further research should be done into whether this knowledge achievement is retained long-term.

Future research will focus on strengthening the educational sessions that link nutrition with environmental pollution. This pilot study provided an opportunity to learn from and with the community in order to engage children in the basics of good nutrition and environmental pollution.

5.3 Conclusion

Although the average BMI percentile was normal among the subset measured, the average skin carotenoid levels were low compared to previous studies (Ermakov et al., 2014). These results highlight the need for interventions to support/encourage consumption of fruit and vegetable consumption among youth as well as the importance of such camps as the camps provide opportunities for youth to try new fruits and vegetables.

Overall, amongst all of the campers, results indicate that camp participants identified fruits and vegetables as healthy and were willing to put this belief into action by trying new fruits and vegetables at camp. The children's knowledge of pollution overwhelmingly reflected the topics presented at the Headwaters Camp – issues related to litter and water. Older children and children attending both camps displayed a higher level of understanding of both the nutrition and pollution concepts presented. Importantly, age and the number of camps attended did indeed seem to be associated with an increased

understanding of the protective relationship between fruit and vegetable consumption and pollution. This suggests that the implementing interactive education sessions in a summer camp setting summer camp is a positive venue for increasingly environmental health literacy and stewardship.

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VITA

1. University of Kentucky, Bachelor's Degree of Animal Science
2. Graduate TA/RA University of Kentucky Department of Dietetics and Human Nutrition 2019-2020, Bluegrass Barkery Associate 2019- present, Equine Worker, Kentucky Horse Park 2019, Backyard Fun Pools Associate 2014-2019
3. University of Kentucky Dean's List 2014 – 2018, Lewis Honor's College Student 2015-2018
4. Ashley Rose Mattingly