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# College Students' Perception of the Risk Factors Contributing to Childhood Lead Poisoning

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**ABSTRACT**

**Background:** Lead poisoning can cause harmful non-reversible effects on the body. Lead poisoning is known to cause damage to the nervous system, major organs, and body systems as well as have adverse effects on learning and behavioral development. The purpose of this study was to determine the college students' perceptions of the risk factors contributing to childhood lead poisoning. **Methods:** In a quantitative, non-experimental, cross-sectional design, a convenience sample of 97 college students was surveyed. The participants answered five demographic questions and 15 Likert-type statements. **Results**: Data were analyzed using descriptive statistic techniques, such as frequency, percentage, mean, and standard deviation. Half of the participants were female. Most of the participants (94%) were 18 to 22 years of age. The participants tended to agree strongly with the item related to lead poisoning having long-term medical effects ($M$ = 3.25, $SD$ = .54) and with buildings built before 1978 containing lead products (M=3.18, SD=0.54). **Conclusion:** Participants lacked knowledge of the risk factors that could prevent childhood lead poisoning. They were also not well-informed about the resource availability for prevention of childhood lead poisoning.

## INTRODUCTION

College Students' Perception of the Risk Factors Contributing to Childhood Lead Poisoning Many children are exposed to lead throughout the world while parents may be unaware of lead exposure or the sources of lead. Ossiander (2013) stated, "Childhood lead poisoning is still a problem in the United States, with an estimated 310,000 children aged 1 to 5 years having lead poisoning in 2002" (p. 21). "Lead poisoning is defined as a blood lead level of 10 μg/dL [micrograms per deciliter], which are harmful in children, suggesting the number of children with harmful exposure to lead is actually much higher" (Ossiander, 2013, p. 21). The purpose of this study was to determine the college students' perceptions of the risk factors contributing to childhood lead poisoning.

## BACKGROUND

To aid in this study, a county health department situated in northern Indiana was contacted and a gap in knowledge related to lead poisoning from the common occurrence of lead found in housing older than 1978 was identified. Nies and McEwen (2011) described that lead, in its true form, is a bluish-gray metal that is found in nature and used in manufacturing; it can contaminate soil, dust, and can be found in small particles in the air. Lead poisoning has been a problem in the United States since the 1900s and it was around that time when lead was used in paint products to make the colors brighter and last longer (Hockenberry & Wilson, 2013). At that time, lead was also added to gasoline to keep the car engines from making a knocking sound when running. In 1978, lead was banned from paint and gasoline products in the United States (Hockenberry & Wilson, 2013). Many houses and buildings built before 1977 may contain lead-based paints (Roberts, Allen, Ligon, & Reigart, 2012). Windows with paint manufactured before 1977 create paint chips that children ingest or inhale through dust particles over time from deteriorating paint (Roberts et al., 2012). Lead is still found in homes and other environments, creating a risk for poisoning, even after being banned in 1978. "The primary sources of lead for children are lead-based paint, lead contaminated dust, and contaminated soil from older homes and industrial sites. Children are also exposed to lead through lead-tainted water and consumer products such as toys, clothing, inexpensive jewelry, vinyl, brightly colored plastic products, and even pottery" (Sanders, Stolz, & Chacon-Baker, 2013, pp. 29-30). Other products may include lead, such as toys, lead water pipes, food, and cosmetics.

Hockenberry and Wilson (2013) warned that lead is most dangerous when ingested or inhaled into the body. While lead has a detrimental effect on people of all ages, children ages six and younger are most susceptible. Lead exposure causes damage to the nervous system (especially in young children's brain development) and may cause damage to the kidneys and other body systems, along with alterations in blood chemistry (Hockenberry & Wilson, 2013). Burns and Gerstenberger (2014) stated lead poisoning is a preventable condition and using techniques, such as blood lead level testing can help it be quickly identified. When blood lead levels are low, proper treatment includes prevention of further exposure to the lead source. If the blood lead levels are high, treatment is initiated to remove lead from the body and prevent any further irreversible damage (Burns & Gerstenberger, 2014).

Hockenberry and Wilson (2013) affirmed that secondary lead prevention is avoiding further lead exposure and providing treatment. Children with blood lead level results higher than 70 µg/dL would require immediate hospitalization and chelation treatment. Chelation treatment is a chemical agent therapy that removes lead from blood, organs, and tissues with calcium disodium edetate and succimer agents. A tertiary method for lead prevention is to prevent further exposure to lead by inspection of the child's environment, the removal of lead sources, and continued blood screening (Hockenberry & Wilson, 2013).

**Problem Statement**

Nies and McEwen (2011) warned that lead poisoning is a serious health threat for children ages 6 and younger. Lead poisoning can cause harmful, non-reversible effects on the human body. Lead is most dangerous when it is ingested or inhaled into the body. "Low levels of lead poisoning are associated with irreversible, deleterious effects on a child's development leading to learning and behavioral disorders, hearing impairment, decreased intelligence quotient (IQ), and diminished attention span" (Vivier et al., 2010, p. 1196). At high levels, Vivier at al. stated lead poisoning could cause seizures, coma, and possibly death. Basic awareness of exposure and sources of lead are essential to promote health awareness of this preventable condition. A gap exists between the information available and the preventive measures taken by individuals.

**Purpose Statement**

The purpose of this survey was to determine college students' perception of the risk factors contributing to childhood lead poisoning.

**Research Question**

What are college students' perceptions of the risk factors contributing to childhood lead poisoning?

## REVIEW OF THE LITERATURE

Evidence-based articles were gathered through EBSCO-host Academic Search Premier, Cumulative Index to National and Allied Health Literature (CINHAL) database, and handouts collected from the Community Health Department using the key terms "*lead*" and "*poisoning*." Nine studies and supplemental handouts dated from 2011 to 2014 were used. These sources were used to develop survey items and to understand information about blood lead levels and how they affect children.

In a study by Whitehead et al. (2014), a collection of dust samples from 583 vacuum cleaners from older homes were analyzed to discover what particles were present in the dust. Seventy-four compounds were analyzed. Findings were that older homes had increased chemicals in the settled dust particles. "In stratified analyses, the positive correlations between home age and chemical concentrations were observed in homes from all strata of income, race/ethnicity, and residence type" (Whitehead et al., p. 1323). The age of the home determined the high concentration of lead in the dust particles tested. Contaminated "construction materials, such as ceiling tiles, paint… are more likely to be present in homes built before 1980 than in more recently constructed residences" (Whitehead et al., p. 1323). Older homes were most at risk of containing high lead levels and other pollutants based on dust samples. The authors of this study were concerned with the exposure of the lead and chemicals on children. "Settled dust can be an important source of chemical exposures, especially for young children, who have frequent hand-to-mouth contact" (Whitehead et al., p. 1320). It is important to clean surfaces and to prevent children from exposure to these chemicals. Chemical exposure could be decreased by not living in a home constructed before 1980, if a high filter vacuum is used to clean, and if the house is cleaned regularly (Whitehead et al., 2014).

Liu, Hammond, and Rojas-Cheatham (2013) used a quantitative method and examined eight lipsticks and twenty-four lip glosses for high levels of harmful metals, including lead, that are consumed throughout the day from general use. To determine which lipsticks and lip-glosses should be tested because they were more likely to be used, twelve 14-19-year-old girls who lived in low- income neighborhoods were asked to list the lipsticks and lip glosses that they used. This meant that they had either the lipstick or lip gloss in their possession or at home in their bathroom. The lipstick and lip-gloss were purchased from the local store and brought to the laboratory for analysis (Liu et al., 2013). The results indicated lead in 75% of the lipstick and lip-gloss products. "Approximately half (47%) of the samples contained lead at concentrations higher than the FDA-recommended maximum level of 0.1 ppm for lead in candy likely to be consumed frequently by small children (Liu et al., 2013, p. 706). The study indicated that lead is present in most cosmetics. Child use of cosmetics could be an unknown lead exposure source. Adults who use the cosmetics in contact with a child (such as kissing a child or the child puts on the lipstick) could expose lead particles to the child or adult if directly or indirectly consumed.

Roberts et al. (2013) noticed, blood lead levels have decreased at the national level, but a significant percentage of children continue to live in housing with the presence of lead-based paint. Roberts et al. (2013) implemented a community health partnership model in their study. The authors recruited 77 children aged 9 months to 6 years of age in areas known to have high levels of lead poisoning in South Carolina. After consent was agreed, the authors gathered data from children who had test results with elevated blood lead levels. The parents were given a 3-page written questionnaire, and the child's living environment was assessed for potential lead exposure hazards. Only 64 participants had results including environmental assessments. Of the participants surveyed "39% had peeling paint in the home, 20% had peeling paint outside of the home, 31% of children played in soil near an old building" (Roberts et al., p. 127). The questionnaire given to parents revealed that "87% or more of parents were aware that lead poisoning could cause learning and/or behavior problems and that it was preventable" (Roberts et al., p. 127). The researchers concluded that the study was "the first known to the authors to examine effectiveness of questionnaire-based screening, in concert with community-based recruitment" for children with elevated blood lead levels (Roberts et al., p. 127). Screening questionnaires may be more effective in geographical locations with older households that contain lead and pose a greater potential for exposure to children.

Sanders et al. (2013) discussed the effects of lead exposure in children, in consumer products such as toys, and the investigation of lead in children's toys in moderate to high socioeconomic status daycare centers. The authors discussed how small amounts of exposure to lead in children could be absorbed and retained over time and cause behavioral and developmental changes in children. High blood levels cause potentially harmful effects on several systems on the human body. Sanders et al. (2013) conducted testing on 460 children's toys and play items that children used in daycare centers. The results indicated that 8.7% of all items tested had high lead content and 12% of all items tested had moderate levels of lead. The conclusion was that children could experience lead exposure in products used in daycare centers. The importance of lead education by healthcare professionals and stronger regulations on lead in consumer products is needed to prevent lead poisoning in children.

In a study of children at Detroit Public Schools, Zhang et al. (2013) discovered that high lead levels in this district caused some children not to perform well academically based on state standards. "Childhood lead poisoning continues to be the most important and preventable environmental problem among children and contributes significantly to the burden of childhood diseases" (Zhang et al., p. 72). The high blood lead levels can affect a child's nervous system that can cause behavioral and cognition problems, which can affect IQ scores. Blood lead levels were collected from the Detroit Department of Health and Wellness Promotion, and the education scores were collected from the educational testing data from the Detroit, Michigan public schools. Students who had high blood lead levels performed below state standards. There is also a large population of poor students and minorities in Detroit. Both of these variables are risk factors for elevated blood lead levels. The researchers were able to predict which child would perform below average on testing because of elevated blood lead levels. Children in the city were at risk for elevated blood lead levels, which contributed to having decreased test scores (Zhang et al., 2013).

In a quantitative study, Boraiko, Wright, and Ralston (2013) used a sample of residential lead-based paint remediation workers contracted by the Tennessee Lead Elimination Action Program (TNLEAP), to test 23 of these workers' vehicles for possible lead-based paint residue. Boraiko et al. (2013) hypothesized that precautionary standards were not being followed and lead-based paint was being transferred to the homes of these workers through the residue on their shoes. The vehicles were tested using a wipe sample, as it was the best indicator of recent lead residual. "The wipe samples were taken using a one-square-foot plastic template to ensure consistency in sample size. The template was wiped between each sample to prevent the transfer of lead" (Boraiko et al., 2013, p. 23). After the wipe was used in its designated area it was placed into a centrifuge tube and sent to the American Industrial

Hygiene Association laboratory accredited for lead analysis. Between each sample, the experimenter washed their hands to decrease contamination. Sampling was repeated for the passenger and driver floorboards for each of the 23 vehicles. A survey was given to the residential paint remediation workers to determine their lead exposure levels, and the training each had received on preventing transfer of the lead-based paint they were removing from old homes. They also surveyed the rate of compliance concerning the use of personal protective equipment (PPE) that would keep lead found in lead-based paint from contaminating clothes, shoes, hair, and skin. The results indicated, "Most of the employees had completed the required lead-safe worker training within the past year. Over one-half of the workers surveyed (56.25%) stated they did not always wear their PPE" (Boraiko et al., p. 24). There was no correlation between the amount of time worked in the field and compliance with wearing PPE. When testing the vehicles the standard 10 micrograms per square foot or above was used to determine a positive result for lead. "The majority of the results were below 50 micrograms per square foot of lead. Some outliers were present. The highest level of 318.6 micrograms per square foot was taken from the passenger's side floorboard" (Boraiko et al., p. 24). The research data supported the hypothesis that proper personal protective equipment was not being used and with such high levels present in the vehicles of the workers, the possibility of transferring lead into their homes was very high. The results determined that to stop the transfer of lead, stronger recommendations were given to wear the foot and leg PPE to prevent the spread of lead particles.

In a quantitative study, Liu et al. (2011) identified that eating breakfast was linked to lower blood lead levels. The study included 1,656 pre-school aged children with consent from their parents. Parents filled out a questionnaire that asked about breakfast-eating habits, demographics (gender, age, parental educations, parental occupations, and passive smoking exposure), and eating behaviors. Next, an assistant watched the children eat lunch for two weeks, and the parents filled out a three-day dietary food log for the children. Blood tests were requested from all of the children, but only 1,344 were collected. Blood samples were frozen and shipped to the Research Center for Environmental Medicine of Children for analysis of lead and micronutrient concentrations within the blood samples. Linear regression models used in the study revealed that as the nutritional intake of children decreased the lead poisoning risk increased. Each model was designed to include breakfast frequency (regular vs. irregular), demographics (children's age, gender, parental educations and occupations, grandparental educations), children's nutrient levels in blood, passive smoking, breastfeeding history, and breakfast type (rice/noodle, meat mostly, and fruit mostly). The authors explained children who ate breakfast regularly had a lower blood lead level rate compared to those who did not eat breakfast regularly. More interestingly, children who ate breakfast regularly were more likely to live in an urban or suburban area, have grandparents that were educated, have parents that were educated, and had higher zinc levels. Zinc and other micronutrients have been thought to compete with lead for absorption, which leads to lower levels of lead and higher levels of micronutrients, or zinc. Liu et al. (2011) demonstrated the usefulness of educating the general population of the importance of eating breakfast regularly to avoid high levels of lead in the blood.

In another study, Balasubramanian, Spear, Hart, and Larson (2011) discussed the use of lead-based paints in homes built before 1978. Homes built in or before 1978 had higher levels of lead migration located in dust and soil around the perimeter of the household. The authors conducted the study on 11 homes to determine if a fluorescence X-ray analyzer device was more effective in finding lead sources as surface wipe samples in older home assessments. Testing in each home included the windowsills, doors, walls, and floors. The authors concluded that all 11 homes had lead detected by the fluorescence X-ray analyzer device, however, the dust wipe samples only detected lead in 9 out of the 11 homes. They concluded that lead migration could be contained effectively by newer paint layers, the lead could migrate to the surface of objects if the object has an obvious defect, and that lead migration can be a concern in older homes with lead-based paint even if there are no visible indications of paint chipping. The study confirmed that lead is present in older homes with lead-based paint and could increase blood lead levels in children if exposed (Balasubramanian et al., 2011).

In a study, Miranda, Anthopolos, and Hastings (2011) gathered blood lead levels from the Children's Environment Health Branch within the North Carolina Department of Environment and Natural Resources, on children from 9 months to 7 years of age. Children's results were gathered within a certain mileage from the airport in North Carolina Counties. Blood lead level data were gathered from a database and was not obtained from the individuals during this study. The authors wanted to know if exposure to airplane gasoline caused blood lead levels to rise in children. "The lead in the air surrounding the airports can be inhaled directly or the lead may be ingested by children after it settles into soil or dust" (Miranda et al., p. 1513). Gasoline may be absorbed into the air or soil causing children to have increased their blood lead levels. Results were concerning because high lead levels alter children's health status. A high blood lead level "…demonstrates negative health effects, including learning disabilities and behavioral disorders, associated with lead exposures well below the action level" (Miranda et al., p. 1513). Children with even slightly elevated blood lead levels are at increased risk of developing health problems. Children who lived closer to the airport had higher blood lead levels compared to those who lived further from the airport. Minority status and the date of home construction were factors in how high the blood lead levels resulted. "Residence in poor and minority neighborhoods was also associated with elevated lead levels. In contrast, recently constructed housing units were associated with decreased mean lead levels" (Miranda et al., 2011, p. 1515). Lead in aviation gasoline can affect blood lead levels in children who live close to the airport.

In summary, the literature review focused on the harmful effects of lead poisoning on children, contact prevention, and providing information on where and how to be tested for lead poisoning. Many risk factors and sources of lead exposure exists that cause harm to children. The review highlighted that lead poisoning is still prevalent in the United States and around the world. Lead is still found in soil, homes built before 1978, paint, toys, and gasoline. Lead concentrations are detrimental and pose a current risk to children and are associated with lower grades in basic reading, writing, math, and had neurological issues. Further research seemed appropriate to investigate college students' perception of the risk factors contributing to childhood lead poisoning.

**Theoretical Framework**

The theoretical framework used to guide this study was the Neuman Systems Model. Neuman's model provided a basis for nursing care interventions at three preventative levels: primary, secondary, and tertiary, to promote wellness (Masters, 2012). This model related to the contributing risk factors as stated in the research and survey questions. In the Neuman Systems model, prevention as an intervention is linked to be of concern in potential stressors (Neuman, 2002). The three levels of prevention based on the Neuman Systems Model were applied to contributing risk factors. *Primary level* prevention is the first phase in taking precautions to prevent something from happening. Primary level prevention is usually accomplished through health prevention education to a population. The education occurs before the problem has affected the population. *Secondary level* prevention is the second phase of taking precautions to prevent further problems from happening in an individual and/or population. Secondary level prevention is usually accomplished through screening which occurs when the possibility of the problem starts to arise or certain risk factors have made a person more susceptible. An example of this phase is a blood test to screen for lead poisoning. *Tertiary level* prevention is the third phase when the population has been affected by what was trying to be prevented and now education is given to be treated for that problem or to prevent it from happening again. It also provides education on how to prevent the disease process from getting worse. All of these levels are important to consider related to the risk factors of lead poisoning (Masters, 2012).

## METHODOLOGY

A quantitative approach with descriptive design was the methodology used for this study to determine college students' perception of the risk factors contributing to childhood lead poisoning. A convenience sample of 97 students was surveyed. A Likert-type scale questionnaire was used in data collection. After the consent was signed, participants answered 5 demographic questions and 15 questions Likert-type scale responses. The scale responses ranged as a point system rating the level of agreement from one to four points: strongly disagree (1), disagree (2), agree (3), and strongly agree (4).

The survey questions were created after a thorough review of the literature on lead poisoning. The survey was conducted after approval from the Institutional Review Board (IRB). Data collection occurred on campus outside the cafeteria. Data were analyzed using descriptive statistic techniques, such as frequency, percentage, mean, and standard deviation.

### Data Collection and Analysis

Consents and the survey instrument were printed and arranged for data collection. After receiving IRB approval, a suitable time for data collection was planned and implemented. As students entered the cafeteria, they were asked if they would like to participate in the study. If the participant agreed, a consent form was given to the individual explaining the purpose of the study, stating that the survey was optional and that the participant could withdraw from the study at any time. Once the consent form was signed, the participant was given a survey. The participants were informed of their right to confidentiality and the purpose of the study. After the survey was completed, it was placed in a manila envelope. The consent was placed in another envelope to maintain anonymity. Participants were given a copy of the consent form with contact information that allowed the participants the ability to contact the research group and request to be removed from the survey if the participant decided not to be included in the research for any reason at any time. After completion of the survey, the participant was offered a piece of store-bought candy in appreciation of their participation.

Data analysis occurred after all the surveys were completed. Incomplete surveys were discarded. The frequency and percentages were calculated for each of the demographic items. The survey items were analyzed using the mean and standard deviation. Items with a higher mean are identified and described in detail in the results section.

## RESULTS

Table 1 contains the descriptive demographic data from the participants. Half of the participants were female. Most of the participants (94%) were 18 to 22 years of age. The year in school were somewhat equally distributed between 1 to 4. The most common ethnicity was White (75%), followed by Black (12%). Nearly half of the participants had a household income of US $40,000 or more.

**Table 1. Descriptive Statistics for Participant Demographics**

| Variable | *f* | % |
|---|---|---|
| **Gender** | | |
| Male | 48 | 49% |
| Female | 49 | 49% |
| **Age** | | |
| 18-22 | 91 | 94% |
| 23-27 | 4 | 4% |
| 27-31 | 1 | 1% |
| 31+ | 1 | 1% |
| **Year in College** | | |
| 1 | 34 | 35% |
| 2 | 24 | 25% |
| 3 | 21 | 22% |
| 4 | 15 | 15% |
| 5+ | 3 | 3% |
| **Ethnicity** | | |
| White | 73 | 75% |
| Black | 12 | 12% |
| Mixed Race | 9 | 9% |
| Hispanic | 2 | 2% |
| Other | 1 | 1% |
| **Range of Yearly Household Income** | | |
| $0-10,000 | 9 | 9% |
| $10,001-20,000 | 7 | 7% |
| $20,001-30,000 | 16 | 16% |
| $30,001-40,000 | 19 | 20% |
| $40,001+ | 45 | 46% |
| Unknown | 1 | 1% |

*Note. (N=97)*

Table 2 contains the descriptive statistics for answering the research question, "What are college students' perceptions of the risk factors contributing to childhood lead poisoning?" Fifteen Likert-type style survey statements focused on perceptions and knowledge of childhood lead poisoning risk factors. The participants rated each question by selecting an item on a scale of 1 (Strongly Disagree) to 4 (Strongly Agree). The mean and standard deviation for each survey question was calculated and analyzed. Fourteen of the 15 items had means greater than 2.5, the midpoint of the scale, indicating that, in general, the participants tended to agree with the statements. The item with which the participants agreed most was that lead poisoning can be prevented *(M = 3.35, SD = 0.54)*.

The participants tended to agree strongly with the item related to lead poisoning having long-term medical effects (*M* = 3.25, *SD* = .54) and with buildings built before 1978 containing lead products (M=3.18, SD=0.54). The participants also agreed that high levels of lead in the blood can affect an individual's learning ability (M=3.16, SD=0.55). In addition, participants showed relatively low levels of agreement to the items, household dust may contain lead *(M = 2.38, SD = 0.71)*, and that adults can transfer lead to children *(M = 2.14, SD 0.61)*.

**Table 2. Perceptions of the Risk Factors Contributing to Childhood Lead Poisoning**

| Variable | *M* | *SD* |
|---|---|---|
| Lead poisoning can be prevented. | 3.35 | 0.55 |
| Lead poisoning has long-term medical effects. | 3.25 | 0.54 |
| Buildings built before 1978 may contain lead. | 3.18 | 0.54 |
| High levels of lead in the blood can affect a person's learning ability. | 3.16 | 0.55 |
| Children age 6 or under are at higher risk for lead poisoning. | 3.03 | 0.62 |
| Paint on street pavement may contain lead. | 2.89 | 0.62 |
| County Health Departments are a reliable source for lead exposure resources. | 2.88 | 0.65 |
| Tap water may contain lead. | 2.80 | 0.68 |
| Cosmetics may contain lead. | 2.79 | 0.59 |
| Soil may contain lead. | 2.67 | 0.62 |
| A child who is a member of a minority group is at higher risk for lead poisoning. | 2.67 | 0.62 |
| Blood tests are the only way to tell if a child has lead poisoning. | 2.57 | 0.68 |
| Children with lead poisoning will appear sick. | 2.52 | 0.67 |
| Household dust may contain lead. | 2.38 | 0.71 |
| Adults can transfer lead to children. | 2.14 | 0.61 |

*Note.* (*N* = 97). Items were rated on a 4-point Likert-type scale ranging from 1 (*Strongly Disagree)* to 4 (*Strongly Agree*), so higher means indicate higher levels of agreement.

**DISCUSSION OF FINDINGS**

Implications from the literature were that childhood lead poisoning is a serious problem and lack of knowledge and action on the part of adults could jeopardize the health of children. According to the 97 participants surveyed in the study, lead poisoning has long-term medical effects, including learning disability. However, there was strong agreement that lead poisoning could be prevented.

A literature review by Whitehead et al. (2014) stated that older homes were most at risk of containing high lead levels. A mean of 3.35 on a 4-point Likert-type scale in this study regarding buildings built before 1968 may contain lead, indicates confirmation of previous research. Liu et al. (2013), in another study, indicated that lead is present in most cosmetics and that child use of cosmetics is an unknown lead exposure source. Participants of this study had an agreement of *(M=2.79, SD=0.59)* for the statement "cosmetics may contain lead, which is a moderate level of agreement.

Lead poisoning has been a problem in the United States since the 1900s and during that period, lead was used in paint products to make the colors brighter and last longer (Hockenberry & Wilson, 2013). Currently, the fluorescent yellow paint used on roads and sidewalks still contains lead (Indiana State Department of Health, 2014). Participants in the study had moderate agreement *(M = 2.89, SD = 0.62)* that paint on street pavement may contain lead. Lead may also be in soil and tap water. Children may be exposed to soil that contains lead and children may be exposed to lead-tainted water from older homes (Sanders et al., 2013). Participants in this research study had moderate agreement that soil *(M = 2.67, SD = 0.62)* or that tap water (*M = 2.80, SD = 0.68)* may contain lead.

Boraiko et al. (2013) conducted a study on men who worked in construction environments where they were surrounded by lead. Because of the improper use of personal protective equipment high lead level concentrations were found in the vehicles of these construction workers. Thereby Boraiko et al. concluded that there was a high likelihood that the construction workers were carrying the lead into their homes where their children could be exposed. Participants of the current study showed the lowest level of agreement that adults could transfer lead to children (M = 2.14, SD = 0.61). Participants of this research study were also not knowledgeable that children who are members of a minority group are at higher risk for lead poisoning.

The Indiana State Department of Health (2014) report indicated that children do not always appear sick when exposed to lead poisoning. In fact, by the time children show signs of being sick the lead poisoning is at critical levels. Participants of this research study tended to agree that children would physically look sick from lead poisoning. State Health Departments are responsible for community lead resource testing and tracking children with blood lead levels and are responsible. The State Health Department performs continued testing and follow-up for children with lead poisoning. Participants of this research study were not knowledgeable that County Health Departments are reliable sources for lead exposure resources.

The literature indicated that blood tests are the most valid way to test if a child has lead poisoning. In each study of the literature review, blood tests were obtained to perform their research. Participants in the current research study found that the participants were not knowledgeable that blood tests are a valid way to indicate if a child has lead poisoning.

In 1978, lead was banned from paint and gasoline products (Hockenberry & Wilson, 2013). Many houses and buildings that were built before 1977 may contain lead-based paints (Roberts et al., 2012). Windows with paint manufactured before 1977 create paint chips that children ingest or inhale through dust particles over time from deteriorating paint (Roberts et al., 2012). The literature review showed consistently that older buildings most likely contained lead. The older buildings used paint that contains lead and lead pipes that may contain lead. Participants of this research study were knowledgeable that buildings built before 1978 are more likely to contain lead.

Miranda et al. (2011) found that high lead levels alter children's health status. A high blood lead level "…demonstrates negative health effects, including learning disabilities and behavioral disorders, associated with lead exposures well below the action level" (Miranda et al., p. 1513). Participants of this research study were knowledgeable that high levels of lead in the blood could affect a person's learning ability. Sanders et al. (2013) discussed how small amounts of exposure to lead in children could be absorbed and retained over time and cause behavioral and developmental changes in children. Over time, lead affects the child. It causes medical problems that will arise over time. Participants of this research were knowledgeable that lead poisoning has long-term medical effects.

Nies and McEwen (2011) warned that lead poisoning is a serious health threat for children ages 6 and younger. Participants were knowledgeable that children 6 years old and younger are at a higher risk of lead poisoning. Each of the studies documented in the review of literature agree that lead poisoning is preventable. Participants of this research study had a strong agreement that lead poisoning is preventable.

## Implications

Understanding the students' perceptions of childhood lead poisoning and its contributing factors could help educators and healthcare providers to understand what risk factors to focus on when teaching the community about lead poisoning. This information could be used to teach the risk factors to prevent lead poisoning in children. By providing individuals with the knowledge of the potential sources of lead, and where their children can be blood tested for lead, they can help to prevent exposure to the potentially harmful effects of lead poisoning.

Information about what contains lead, lead risk factors, and general information about lead poisoning should be placed in pediatric offices so adults and parents are aware what could be harmful to children. Educations should also take place in work environments that contain lead to prevent adults from transferring lead to children in the home.

Understanding the students' knowledge of childhood lead poisoning and its contributing factors could help college students understand what to focus on their learning. More importantly, this information may be used to teach adults the risk factors to prevent lead poisoning in children. By providing adults with the knowledge of the potential sources of lead, and where their children can be blood tested for lead, the information may assist to prevent exposure to the potentially harmful effects of lead poisoning. With education, adults may be more aware of lead exposure sources in their environment to promote wellness and protect the healthy development of young children and adults. If adults had knowledge of lead and associated risk factors, they may be more inclined to use the information to prevent exposure that causes long-term health problems. Healthcare providers may use the information to develop policies that could be implemented in pediatric offices or hospitals.

## Recommendations and Conclusion

It would be best for adults to go to local Health Departments, pediatric offices, and other health facilities to learn more about lead poisoning. With education, adults will be more aware of lead exposure sources in their environment to promote wellness and protect the healthy development of young children and adults. Now that some adults have knowledge of lead and associated risk factors, they will be more inclined to use the information to prevent exposure that causes long-term health problems. They should also use this information to educate adults in the community about childhood lead poisoning. Childhood lead poisoning is preventable and people in the community need to know the risk factors related to childhood lead poisoning to prevent it and to keep children safe.

After analyzing the data, this research group developed recommendations that may be used for future research. One recommendation is to provide more education on risk factors related to lead poisoning. A billboard may be a way to communicate to the community about the risk factors of childhood lead poisoning. There also may be flyers and handouts that students may see on campus to understand the risk factors of childhood lead poisoning.

The conclusion from this study is that college students have a general knowledge of the risk factors of childhood lead poisoning. However, they lacked knowledge of the risk factors that could prevent childhood lead poisoning. The participants were also not aware that the local Health Department was a useful resource for information about childhood lead poisoning.

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