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Association between childhood demographics and blood lead screening—-Nevada Kindergarten Health Survey 2010

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ASSOCIATION BETWEEN CHILDHOOOD DEMOGRAPHICS AND BLOOD LEAD SCREENING – NEVADA KINDERGARTEN HEALTH SURVEY 2010

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ABSTRACT

Association between childhood demographics and blood lead screening – Nevada Kindergarten Health Survey 2010

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Lead, as a toxic substance, invades the human body, and gradually damages the organs. Oftentimes, elevated blood lead levels are not recognized until serious health issues are found. In the United States, approximately 250,000 children aged 1–5 years have elevated blood lead levels greater than 10 micrograms of lead per deciliter of blood (Centers for Disease Control and Prevention, 2004).

However, there is no effective treatment for lead poisoning. Chelation can merely decrease the blood lead levels but cannot reverse the existing damage. To prevent and control childhood lead poisoning, many studies have been conducted to investigate the sources of lead and analyze effective prevention strategies. Blood lead screening tests, as preventive methods for childhood lead poisoning, have been implemented by several states for years. However, some still question the effectiveness of blood lead screening tests, and the cost of these tests creates another barrier. These factors largely hinder the progress of eliminating childhood lead poisoning. To institute blood lead screening tests among different populations, some crucial factors must be considered, such as the children's demographic information and the barriers of accessing health care.

The data used in this study was provided by the Nevada Kindergarten Health Survey conducted in 2010. This study aims to analyze the association between the likelihood of obtaining blood lead screening tests and childhood demographic characteristics, namely annual household income, race/ethnicity, home zip code, and barriers to accessing to healthcare. The study results signal the barriers for children's blood lead screening tests and provide recommendations for public health professionals and policy makers to implement effective preventive methods for childhood lead poisoning.

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CHAPTER 1

INTRODUCTION

Lead can cause irreversible damage for the human body, and it significantly influences children's mental and physical development (CDC, 2004). According to the present study, children with lead poisoning show lower academic performance than non-lead poisoned children (CDC, 2004). There is an old saying that children are the future of a country. Therefore, protecting children from lead poisoning is the responsibility of Public Health officials. However, it is a complicated issue for Public Health professionals to eliminate lead sources and control childhood lead poisoning. Many studies have been conducted to investigate the source of lead exposure and the strategies of lead poisoning prevention. Researchers and scientists have put forward their assumptions and proposals regarding childhood lead poisoning, and the study results indicate that prevention is the key for lead poisoning (CDC, 2009).

Children's immune systems are different from adults; children are more vulnerable to lead poisoning than adults (Southern Nevada Health District, 2009). Especially, children younger than 7 years old are more susceptible to lead poisoning than older children (Reagan and Silbergeld, 1989). In the United States, almost 1 million children's blood lead levels are high enough to cause irreversible damage to their health. Based on a CDC report, approximately 250,000 children, who reside in the United States, ranging from 1 – 5 years old, have elevated blood lead levels that are greater than 10 micrograms of lead per deciliter of blood (CDC, 2004).

Lead enters the body mainly via ingestion, which can cause irreversible damage. Furthermore, lead gradually invades and accumulates in the human body; so many children with lead poisoning usually do not show any clinical symptoms until it leads to severe health issues (Gracia, 2007). There is no effective method to cure lead poisoning. Chelation therapy can only decrease the blood lead levels and will not repair the damage already done. Moreover, chelation therapy is only used when blood lead reach a high level.

Almost every system in the body can be affected by lead poisoning, although lead poisoning usually shows no symptoms and goes frequently unrecognized. Lead can cause hearing loss, vision illness, and neurological disorders; even worse, lead poisoning can lead to death at very high levels (Gracia, 2007). Reports in 2006 indicated that out of 15 children tested with elevated blood lead in Clark County, 13 of the cases occurred in children aged 6 or younger. NICRP (Nevada Institute of Children Research and Policy) conducted a survey on kindergarten children's health and insurance status. This paper aims to analyze whether there is an association between the likelihood of obtaining blood lead screening tests and children's demographic characteristics (annual household income, race/ethnicity, home zip code, and barriers to health care), and to provide recommendations for health care personnel and policy makers.

Significance in the Public Health Arena

It is the mission of Public Health professionals to protect children's welfare and improve children's health status. Although childhood lead poisoning has been addressed by the researchers for decades, many existing factors have influenced and prohibited Public Health professionals from accomplishing these goals, such as environmental pollution, poisonous food additives, and poor medical resources, etc.

To eliminate lead poisoning in the United States, the CDC initiated the Childhood Lead Poisoning Prevention Programs (CLPPP). Many preventive strategies have been implemented, including regular blood lead screening tests for children and removal of lead sources from houses, food, toys, and consumer products. However, there are still some potential lead sources that have not been recognized. Additionally, because of the medical cost and limited medical facilities, blood lead screening tests have not been prevalent in the United States. Luckily, lead poisoning is preventable. Thus, implementation of effective strategies to protect children is necessary and important for Public Health.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Although environmental lead exposure and poisoning are preventable, they remain a serious public health risk, particularly for young children. Lead exposure leads to many health problems, including intellectual and behavioral deficits in children and hypertension and kidney disease in adults (Agency for Toxic Substances and Disease Registry, 1999). Moreover, children aged 9 months to 6 years are most vulnerable and at greatest risk of lead exposure (National Center for Health Statistics, 2010). One of the national health objectives for 2010 aims to eliminate blood lead levels (BLL) ≥ 10 ug/dl in children (U.S. Department of Health and Human Services, 2000).

Due to screening and the aggressive use of chelating agents, the mortality of lead poisoning is low, but the morbidity is still significant. As a common environmental contaminant, lead is associated with impaired cognitive, motor, developmental, and behavior skills in children. Usually, lead poisoning is insidious and asymptomatic, and it often goes unrecognized. Nevertheless, the lead existing in blood is still damaging to the immune system, nervous system, and other bodily organs. Many scientists argue that blood lead levels lower than 10ug/dl still cause diseases, so no safe threshold has been determined for the potentially harmful effects on children.

Lead Toxicity

Lead has been used extensively in industry and in household products for centuries, and the history of lead poisoning is as ancient as Roman history. Lead is a main-group element with symbol Pb, so lead toxicity is also named plumbism. All lead compounds are toxic, but the organic lead compounds must be metabolized in the liver into their active forms. There are three primary routes of lead distribution: blood, soft tissue, and mineralizing tissue. Lead is the most detrimental substance for the pediatric central nervous system (Erickson & Thompson, 2005). Lead damages the nervous system and causes brain disorders.

The new research on lead toxicity has been stimulated by advances in toxicology and epidemiology, as well as by a shift of emphasis in toxicology away from binary outcome (life/death; 50 percent lethal dose) to grades of function, such as neuropsychological performance, indices of behavior, blood pressure, and kidney function. Lead affects every organ and system in the body, but it mainly targets the nervous system both in adults and children. Lead exposure leads to cognitive deficits in children, which are also linked to learning disabilities (U.S. Department of Health and Human Services, 2000). Due to various individual nutritional statuses, and health and age, people have different absorption levels and biological fates of lead.

The most common routes of lead absorption in adults and children are inhalation and ingestion, and children are 5-10 times more likely to absorb lead than adults (Gracia, 2007). Also several other factors influence the lead absorption, such as dietary deficiencies of iron, calcium, zinc, and ascorbic acid, which can increase gastrointestinal absorption of lead (Alexander, 1974). The amount of lead stored in bones and teeth increases with age, and lead interferes with bone formation, maturation, and absorption. Younger children are more vulnerable to the toxic effects of lead because their blood-brain barrier and skeletal systems are still developing (Mahaffey, 1990). The research results indicate that elevated blood lead levels are negatively associated with IQ. With the blood lead levels increasing, IQ decreases. The following table demonstrates that various blood lead levels are associated with different clinical symptoms.

Table 1. Clinical Presentation of Lead Toxicity Based on Blood Lead Levels (Hu, 1991)

Level of Toxicity	Blood Lead concentration (ug/dl)	Children Clinical Presentation
Asymptomatic or impaired abilities	<10	Decreased learning and memory, decreased verbal ability, impaired fine motor coordination, signs of ADHD or hyperactivity, lower IQ, impaired speech, and hearing
Mild	10-39	Myalgia or parasthesia, irritability, mild fatigue/lethargy, occasional abdominal discomfort
Moderate	>40-50	Arthralgia, difficulty concentrating, general fatigue, headache, muscular exhaustibility, tremor, weight loss, vomiting, constipation, diffuse abdominal pain
Severe	>70-80	Lead lines (blueish black appearance on gingival tissue), colic (intermittent, severe cramps), parasthesia or paralysis, encephalophathy
Severe, acute	>100-150	Encephalopathy, seizures, anemia, nephropathy

ADHD = attention-deficit/hyperactivity disorder, IQ = intelligence quotient, CNS = central nervous system.

Although lead poisoning is irreversible, it is preventable. Children can inhale and ingest lead through various ways, such as dust, food, and consumer products. Therefore, it is crucial to know the sources of lead to prevent childhood lead poisoning.

Sources of Lead

Lead compounds were applied everywhere, all of which constitute potential exposure sources (Goldstein, 1992). In the United States, elevated blood lead levels in children are primarily caused by deteriorating lead paint and contaminated dust and soil. Other than those, there are various sources of lead contribute to exposure in children. However, the non-paint lead exposure sources are underestimated and insufficiently characterized. Thus, investigators should look for all possible sources instead of only focusing on lead paint in places where the child spends time. Generally, there are three routes of lead: absorbed from gastrointestinal tract into bloodstream, absorbed into blood stream through alveoli, and absorbed from mother into fetus through placenta. Specifically, the sources of lead exposure are listed as following.

1. **Lead in housing and artificial turf**

This is the most common way and dangerous high-dose source of lead exposure for young children. There were approximately 38 million homes that had lead-based paint (LBP) in 2000, and about 24 million units had deteriorated lead paint, dust lead, or bare soil contaminated with lead (Erickson & Thompson, 2005). Of those homes that had LBP hazards, 1.2 million units housed low-income families with children age younger than 6 years old. The majority of the children with elevated blood lead levels reside in the relatively small number of properties (Jacob &Nevin, 2006). Housing units with LBP hazards are not evenly distributed, and Northeast and Midwest housing has twice the prevalence of LBP hazards compared with South and West (Erickson & Thompson, 2005). Children in units with LBP are almost 10 times more likely to have elevated blood lead levels than children in similar housing without lead paint (Korfmacher&Kuholski, 2007).

Housing built before the 1978 ban on lead paint is a significant risk factor for exposure. 42 percent of children living in housing built before 1946, and 39% of children in housing built between 1946 and 1973 had BLLs ≥ 5 ug/dl versus 14% children in housing built after 1973 (National Center for Healthy Housing and the University of Cincinnati Department of Environmental Health, 2004). Addressing lead paint hazards significantly reduces the risk of identifying another child with an EBL in a unit where one was previously identifies (Schwartz & Levin, 1991). Mean BLLs if children whose housing was abated show a 38% decrease over a 2-year period after lead hazard control (Brown, Gardner, Sargent, & etc., 2001).

Currently, artificial turf is used on about 3500 playing fields throughout the United States (Bernard & McGeehin, 2003). The rubber filled in the turf and the crumbs made from recycled tires contain lead. The new artificial turfs are less likely to be harmful than the old artificial turf because lead is released in dust with the turf ages and weathers. This dust could be ingested and inhaled, and the risk for harmful exposure increases (Claudio, 2008).

2. Lead in the environment

The United States produced about 450,000 tons of lead in 2003, and it is the third largest lead producer in the world (CDC, 2009). Facilities containing lead can increase the risk of lead exposure for the adjacent populations. However, not all sources are obvious, and many potential risks are neglected and many users are exempt from reporting.

- **Air:** According to EPA (the United States Environmental Protections Agency) report in 2001, industrial emissions accounted for the major part of air lead, which produced 78% of air lead. The transportation sector accounted for 12%, and fuel consumption accounted for 10% (U.S. Geological Service, 2004). Besides these sources of lead that are listed by EPA, other sources can still contaminate the surrounding communities, such as municipal incinerators, off-road vehicles, propeller aircraft using aviation gasoline, auto repair shops, etc., though the lead emission of these operations are fall below reporting quantities. In addition, demolition of old buildings also contributes to local air lead levels and can increase BLLs in children (U.S. Geological Service, 2004).

- **Dust:** The typical route of lead exposure for children is dust particles ingestion, especially the lead paint dust (Farfel, Orlova, & Lees, 2003). Lead in this form is much easily absorbed. Dust particles are composed of soil, paint, and industrial or automotive emissions. The threshold of a lead hazard in dust sample is 40ug/ft^2, but dust samples as low as 10ug/ft^2 can be associated with significant increases in blood lead levels. Lead concentrations in dust samples collected from windowsills must exceed 250ug/ft^2 to be considered hazardous due to a disproportionate amount of dust collects on horizontal surfaces (U.S. EPA, 2009).
- **Soil:** Soil is bound tightly with lead, and it is contaminated with lead due to the breakdown of lead-based paint on buildings and playground equipment. Also, the lead tire weights that fall off are quickly abraded and ground into tiny pieces by traffic, resulting in high dust-loading rates, especially in urban areas (ATSDR, 1999). Lead also can be deposited in the soil from industries using lead, and children living near mining and smelting sites are at risk of EBL. According to the report of Oregon government, soil samples taken from play areas in a yard have a stronger relationships to children's BLLs than samples taken from other locations, so outside play areas and food gardens should be located away from

homes and buildings and areas that could be contaminated by heavy traffic (CDC, 2004).

3. **Lead in the diet**

The Public Health has been aware for some time that certain kinds of food and drink are contaminated by lead. The food contaminated with lead can be natural or anthropogenic, and the lead can also contaminate the food during processing through contact with metal implements, solder, pigments, glazers, or packaging. In addition to that, lead can also enter into human body by drink water.

- **Food:** The food and packaging from outside of the United States can contain high lead levels. Candy imported from Mexico has been reported with high lead levels repeatedly. Also EBL cases have been reported in California, New York, North Dakota, Oklahoma, and Texas (Root, 2007). This prompted FDA to issue warnings on the availability of lead contaminated candy and to develop candy tighter guidelines for manufacturers, importers, and distributors of imported candy. In addition, chocolate contains more lead than other food. In the 2004 TDS (the market basket Total Diet Study) revealed that chocolate bars had the highest lead levels of the 280 items surveyed (Root, 2007).
- **Lead in drinking water**: Drinking water contaminated with lead usually occurred due to the corrosion of plumbing materials containing lead. When water goes through the lead pipes, the water is contaminated. Older homes are more likely to have the lead pipes than new homes. Based on the 2006 EPA report, the largest sources of lead in water are brass or chrome-plated fixtures and illegal use of lead solder (Farfel, Orlova, Lees, &etc, 2003). In 2006, Chien reported that breast milk

also can be contaminated with lead because of maternal exposure to lead and past exposure mobilized from lead stored in bones (FDA, 2006). Even low levels of lead in breast milk still strongly influence the infant's BLL. Calcium supplementation can reduce lead in breast milk.

Nonetheless, the benefits of breastfeeding outweigh concern for lead at BLLs common among the U. S. women (Chien, Yeh, Lee, & etc, 2006). Some dietary supplements were found containing lead that exceeds the tolerable dietary lead intake level. The food and drink contains lead, such as crystal decanters, crystal glassware, ceramic pottery, and other dinnerware. In 2006, the U.S. FDA advised manufacturers and suppliers that lead in vinyl lunchboxes may transfer to food.

4. **Lead in consumer goods**

Toys, Polyvinyl chloride (PVC), and candle wicks were found containing lead levels sufficiently high to cause elevated BLL in children. A study of toy jewelry found that lead concentrations are greater than 50% in forty percent of samples; when wiped, 70% of these samples released at 1.0ug lead that can lead to high risk of lead poisoning for children. Therefore, the regulatory approach and policies regarding children's product should be stressed and strengthened. PVC is composed of lead salts that are used to stabilize polymers to avoid degradation from heat, sunlight, and wear. It is prevalently used to make window frame, rain gutters, wall paneling, doors, wallpapers, flooring, garden furniture, binders, and pens. Candle wicks cause lead exposure from air and hand to mouth activity. However, it has not been found that children with EBLs caused by candle wick. In 2002, the CPSC banned candlewicks containing > 0.06% lead (CPSC, 2003).

There are still potential risks of lead exposure for children that have not been recognized by the public, but are still threatening children's health. Further research is necessary. In addition to controlling and eliminating lead exposure, it is important to know the other prevention strategies for lead poisoning.

Lead prevention strategies

Lead poisoning arise a tough issue for Public Health professionals, but it is entirely preventable. According to the epidemiological perspective, the prevention strategies are divided into three levels: primary prevention, secondary prevention, and tertiary prevention.

1. **Primary prevention strategies**

Public Health should educate parents how to avoid lead exposure, inspect the home at risk, and remove any potential lead exposure sources. This is an ongoing strategy for children at risk for lead poisoning. The organization, GLO (Get the Lead Out), is helping people to be aware of the various sources of lead (Goldstein, 1992). This project is working on the children who were at risk for elevated BLLs, but their BLLs are lower than 10ug/dl. The project aims to prevent increasing incidences of lead poisoning by education and inspection of at-risk home (O'Fallon, 2004).

Also the relevant policies and legislation should be implemented by state and local departments to eliminate childhood lead poisoning, such as policies on managing food and toys imported from outside of the United States. In addition, Medicare and Medicaid require that children be screened for lead exposures at ages 12 and 24 months. The principles of the primary prevention include identifying sources, eliminating and controlling sources, and monitoring environmental exposures and hazards.

2. Secondary Prevention

The secondary prevention is also important in preventing children lead poisoning, which includes blood lead screening test and chelating therapy. The CDC recommends universal screening for all children from 1 to 5 years of age as a preventative measure (CPSC, 2007). Through the CDC Childhood Lead Poisoning Prevention Program, 42 states and 6 metropolitan areas provides this free BLL testing service. In 2003, the CDC awarded $31.7 million to the states' departments of health to develop and implement comprehensive lead poisoning prevention efforts that would include follow-up care after initial elevated BLLs, and especially hospitalizations. The recommendations along with CDC's grant programs to states and localities lead to a substantial increase in the number of children who were tested. Many children with lead poisoning who may previously have gone unrecognized were identified and received appropriate follow-up care.

If BLLs are greater than 45ug/dl, chelation therapy is used for reversal of lead poisoning. Chelation therapy detoxifies the body of noxious substance and destructive metals. There are three main drugs used for chelation: succimer (Chemet), ethylenediaminetetraacetic acid (EDTA), and British Antilewisite (BAL). These drugs bind to metals in the body and prevent them from binding to other agents. Then they can be excreted from the body. Succimer is the only oral chelating drug, and it can be administered in an outpatient setting. But most children are observed for adverse effects in an inpatient setting when beginning therapy (Henretig, 1998). EDTA is insoluble in water so it is given in the form of calcium chelate, also known as calcium disodium edentate. This form is also beneficial because it does not cause a net loss of calcium through the solobilization and excretion of the lead (Manahan, 1991). BAL is another drug used for chelation therapy in pediatrics. Before beginning treatment with BAL, a glucose-6-phasphatase dehydrogenase (G6PD) screen should be carried out because of adverse effects when a G6PD deficiency occurs in concurrence with BAL treatments (Feingold & Anderson, 2004).

In secondary prevention, the major responsibility is universal blood lead level screening and chelation therapy - treating the children with elevated blood lead levels.

3. **Tertiary prevention**

If a child with elevated blood lead levels is found, the follow-up care should be free offered by local health departments. Local health departments may provide free removal of contaminated homes and also continual follow-up care for these affected children. All diagnosed children as lead poisoning should be provided with adequate follow-up care, and it will prevent the occurrence of lead toxicity. Children should not be discharged from hospitals until a fully documented lead removal plan is in place to remove the source of lead exposure. Also the children diagnosed as lead toxicity should not be discharged back to the original environment in which previous exposure occurred (Ford, Delaney, Ling, & Erickson, 2001). CDC tracks BLLs in the U.S. population using National Health and Nutrition Examination Survey (NHANES), an ongoing series of national examinations of the health and nutritional status of the civilian non-institutional population. During the period from the late 1970s to the early 1990s, the prevalence if BLLs≥10ug/dl among young children in the United States dropped dramatically decreased from 88.2% to 4.4% (CDC, 1997). In a word, the essence of the tertiary prevention is follow-up care and removal of lead sources.

The irreversible and permanent damage to children health argue that the truly effective public health response to lead poisoning is primary prevention. The difficult challenge of primary prevention is if a nation's government can make efforts to establish and implement protective legislation, effective enforcement, judicious application of scarce resources, and cooperation among environmental health, public health, and private health care system (Meyer, Brown, & Falk, 2003). The following table demonstrates the guideline of managing the elevated BLL.

Table 2. Management guideline for elevated BLL (American Academy of Pediatric Committee, 2009)

BLL<10ug/dl	No action is required
BLL 10-14ug/dl	Obtain confirmatory test within 1mo. If still in this range, provide lead education and repeat test in 3mo.
BLL 15-19ug/dl	Same as for BLL 10-14ug/dl, but repeat within 2 mo, if the level increases or is still in this range after 3 mo, proceed according to protocol for BLL 20-44ug/dl.
BLL 20-44ug/dl	Obtain confirmatory BLL within 1 wk to 1mo (sooner with higher levels). If still in this range, undertake comprehensive medical (history, physical examination for neurodevelopment monitoring, and laboratory evaluation (hemoglobin or hematocrit and iron level), nutritional, and environmental assessment. Lead hazard reduction is implemented with the assistance of the local health department.
BLL 45-69ug/dl	Obtain a confirmatory BLL within 2 d. If still in this range, perform assessment and take actions as indicated for BLL 20-44 ug/dl; also obtain EP level. Chelation therapy is recommended at this level. If unable to do this in a lead-free environment, hospitalization is indicated. Monitor CBC, electrolytes, and liver function.
BLL >70 ug/dl	Hospitalize and obtain confirmatory BLL, initiate chelation therapy, and implement actions as for BLL 45-69 ug/dl.

Key: EP, erythrocyte protoporphrin,

Barriers of access to blood lead screening tests for children

Blood lead screening tests are the effective strategy in preventing childhood lead poisoning. However, due to several reasons, blood lead screening tests for children have not been implemented universally in the United States. Based on Arthur's report in 2005, there are three main barriers, including patient failure, physician failure, and patient and physician failure. Patient failure refers to the patients did not report for a test that was ordered or if they obtained all their care in the Emergency Department or Health and Human Services. Physician failure means the physicians did not remember to order the test. Patient and physician failure is attributed to both of the parties (office visits, but with no well-child examination) (Fernberg, 2005).

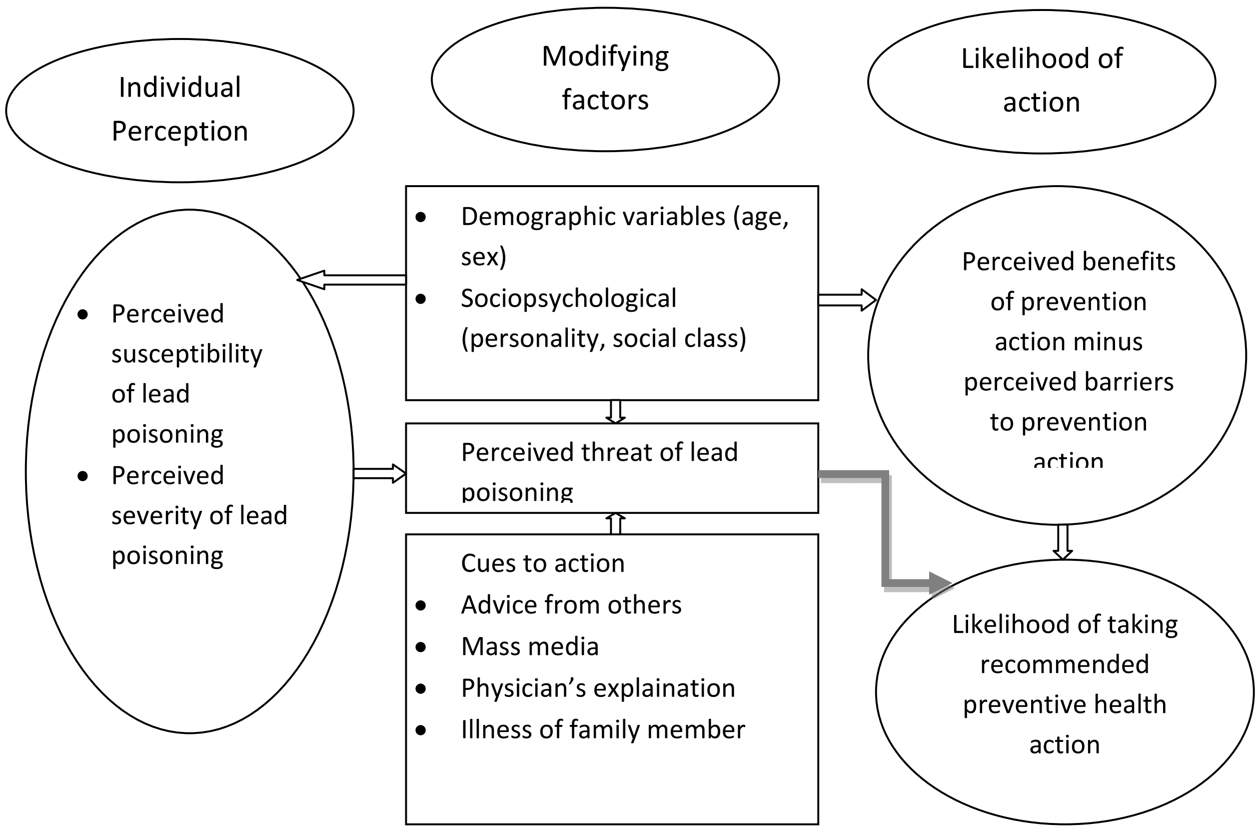
Moreover, many parents of very young children are misinformed and uninformed about the hazards of lead exposure, the most common environmental toxin affecting children. Parents expect pediatric professionals to alert them to preventable cause of hard to their children and to provide healthcare that reflects the standards of care established by governmental bodies and professional association (Polivka, 2005). Parental perception of severity of lead poisoning and benefits of blood lead screening tests is a key factor in popularizing the blood lead screening tests among different population regardless of race/ethnicity and socioeconomic status. Furthermore, people preferred to learn about lead poisoning from low-literacy brochures, videos, and television ads (Polivka, 2005).

The literature also mentioned that the children enrolling in the Medicaid program nationwide are 3 times more likely than non-Medicaid children to have elevated blood lead levels, and the Medicaid-enrolled children with lead levels greater than 10ug/dl was

>8% higher than the general population. (Rosenman, 2007) Generally, people enrolled in Medicaid program have lower annual household income and live in inadequate housing conditions. They are at high risk of lead poisoning and face difficulties to access to qualified heath care and good health providers.

Meanwhile, according to the Health Belief Model theory, the following concepts can explain the barriers, which are perceived severity, perceived susceptibility, perceived cost, perceived benefits, and motivation. Also it can be exemplified by the following figure.

Figure 1. Health Belief Model application for blood lead screening tests



Children lead poisoning and prevention in Nevada, USA

Due to several reasons including short of funding, minimal blood lead testing, and the lack of mandatory reporting, there is no adequate information regarding Nevada lead poisoning. Nevada is one of the only four states that did not report blood lead levels to the CDC. Based on the NHANES reports, the prevalence of elevated blood lead level was decreased dramatically from 1976 to 2000 due to the ban of lead paint (NHANES, 2009).

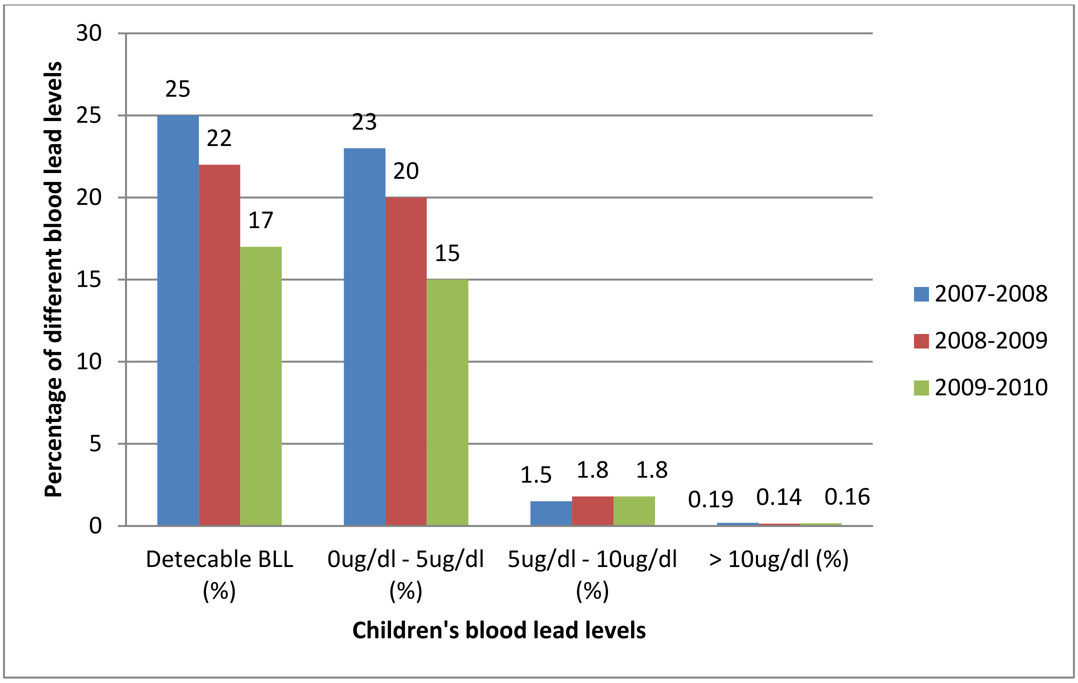
Correspondently, the Southern Nevada Health district annual reports indicated that the prevalence of elevated blood lead level (EBLL) in Southern Nevada was decreased gradually. From 2007 to 2008, total number of children age from 72 months and younger screened by blood lead tests were 9630, and 2358 cases (24.49%) had detectable blood lead levels. Among these cases, 2196 cases (22.80%) were with BLL between 0ug/dl to 5ug/dl, 144 (1.5%) cases were with EBLL between 5ug/dl to 10ug/dl, and 18 (0.19%) cases were with EBLL more than 10ug/dl (SNHD, 2008). From 2008 to 2009, total screened by blood lead tests were 10,595. 2314 (21.84%) cases had positive results of blood lead screening tests. Among these cases, 2107 (19.89%) cases blood lead levels were under 5ug/dl, and 192 (1.81%) cases' blood lead levels ranged from 5ug/dl to 10ug/dl. 15 (0.14%) cases were over 10ug/dl. (SNHD, 2009) From 2009 to 2010, 11,041 were tested blood lead levels. 17% had detectable BLL (>0ug/dl); 15% had blood lead levels greater than 0ug/dl and less than 5ug/dl; 1.8% had blood lead levels greater than 5ug/dl and less than 10ug/dl; and (0.16%). (SNHD, 2010)

Southern Nevada Health District cooperated with Nevada Institute for Children's Research and Policy implemented Childhood lead poisoning prevention program (CLPPP) that was awarded by the Centers for Disease Control and Prevention (CDC). The goal of this program is to eliminate childhood lead poisoning as a public health concern in Nevada. Several reasons complicated the implementation of blood lead screening tests, including the population growth in Nevada, immigration, poverty, and health insurance. To overcome these obstacles, CLPPP made several strategies and strove to eliminate lead poisoning. Based on the above data, the incidence of childhood blood lead poisoning is decreased. (See Table 3 and Figure 1)

Table 3. Blood lead screening tests result in Southern Nevada Health District from 1997 to 2000.

Year	Screened cases	Detectable BLL (%)	0ug/dl – 5ug/dl (%)	5ug/dl – 10ug/dl (%)	>10ug/dl (%)
2007-2008	9630	2358 (25)	2196 (23)	144 (1.5)	18 (0.19)
2008-2009	10595	2314 (22)	2107 (20)	192 (1.8)	15 (0.14)
2009-2010	11041	1877 (17)	1656 (15)	199 (1.8)	18 (0.16)

Figure 2. Trends of elevated blood lead levels in Southern Nevada Health from 1997 to 2000.



The preventive strategies for lead poisoning are essential for protecting children from lead poisoning, but it is time-consuming and costly. Nevertheless, the healthy development of future generation of the world's children deserves no less. Thus blood lead screening test, the major method of preventive method is addressed in this paper.

CHAPTER 3

RESEARCH DESGIGN AND METHODOLOGY

Research Objectives

To determine if there is an association between children's demographic characteristics and the likelihood of getting blood lead screening tests, including annual household income, race/ethnicity, home zip code, and health insurance.

Hypotheses

H_1: Annual household income is associated with getting a blood lead screening test.

Ha. Those of lower income levels are less likely to be screened.

H_2: Race/ethnicity and home zip code are associated with getting a blood lead screening test.

H_3: Ability to access Medical insurance is associated with getting a blood lead screening test.

Data Collection and Study Population

This survey was initiated in the fall of 2008. The NICRP (Nevada Institute of Children Research Policy) cooperated with the Clark County School District (CCSD) and the Southern Nevada Health District (SNHD) to create a healthy survey designed for parents of children entering kindergarten. These questionnaires were finished by the parents of kindergarten children residing Nevada. This survey aimed to provide a general understanding of the overall health status of children when they enter school. Due to the substantial Hispanic population, the questionnaire was created in both English and Spanish, and contained 22 questions.

Based on analysis of the first year's survey responses, NICRP revised the health survey in the fall of 2009. To obtain the second-year data on the state's kindergartens, the questionnaires were distributed to kindergarten teachers in all public elementary schools in the state, except of schools in Esmeralda and Clark counties. Five kindergartens in the rural county, Esmeralda County, chose not to participate in the survey. The Clark County School District requested that only a sample of their schools be included in the survey due to reduce burden on school staff. Thus, surveys were sent to a randomly selected sample of schools (n=140) in Clark County to obtain a 5 percent margin of error in survey results. Schools were chosen based on their Title I status, as provided by the Clark County School District, to ensure that a representative sample was achieved. It was determined that 71 of the 213 elementary schools in the district (33.3%) were Title I schools. Among Title I schools, forty-five schools (32.1 % of the target 140 schools in the sample) were randomly selected using SPSS. The remaining 95 schools (67.1% of the needed sample of 140) were randomly selected from a list of non-Title I schools using SPSS.

For all districts, teachers distributed the surveys to parents during the first part of the school year. After finishing the questionnaires, the parents turned them into either the school office or their child's teacher. Then, the surveys were returned to NICRP via mail. Each questionnaire had a unique ID number that was assigned by the NICRP staff for tracking survey. All information was entered into the statistical analysis software SPSS 17.0. The surveys in Spanish were entered into the English database by a bilingual staff at NICRP. No identifying information was included on any of the surveys.

Due to an oversight when translating the survey from English to Spanish, two questions on the Spanish version of the survey differed from their English counterparts. Specifically, in the question asking respondents about barriers to accessing health care, the choice “lack of money” was not available to Spanish-speaking respondents to select. Likewise, in the question asking respondents about the type of pre-school setting their child had attended in the past year, the choice “home-base” (care) was not available to Spanish-speaking respondents. However, both of these questions included an “other” choice to select with a blank space to fill in any additional detail.

Each school district provided the number of kindergarten students enrolling that Fall 2009. There were approximately 24,261 kindergarteners enrolling in that fall of 2009 for the entire state. At the end of the data collection, the overall response rate was 39.2% for the state, and 9,504 surveys were received and entered. NICRP also calculated the individual response rate of each school district. These rates ranged from 18.2% participation in Mineral to 80.1% participation in Humboldt County (see figure 1 and table 3). In Clark County the response rate for the schools samples to participate was 34.7% (NICRP, 2009). Among all the school districts, Clark County comprised the vast majority (59.0%) of the respondents for this survey, and the schools in rural counties Washoe County accounted for 23.4% and 17.6% separately. (See figure1)

Figure 3. Survey Participation by School district of Nevada Kindergarten Health Survey 2010

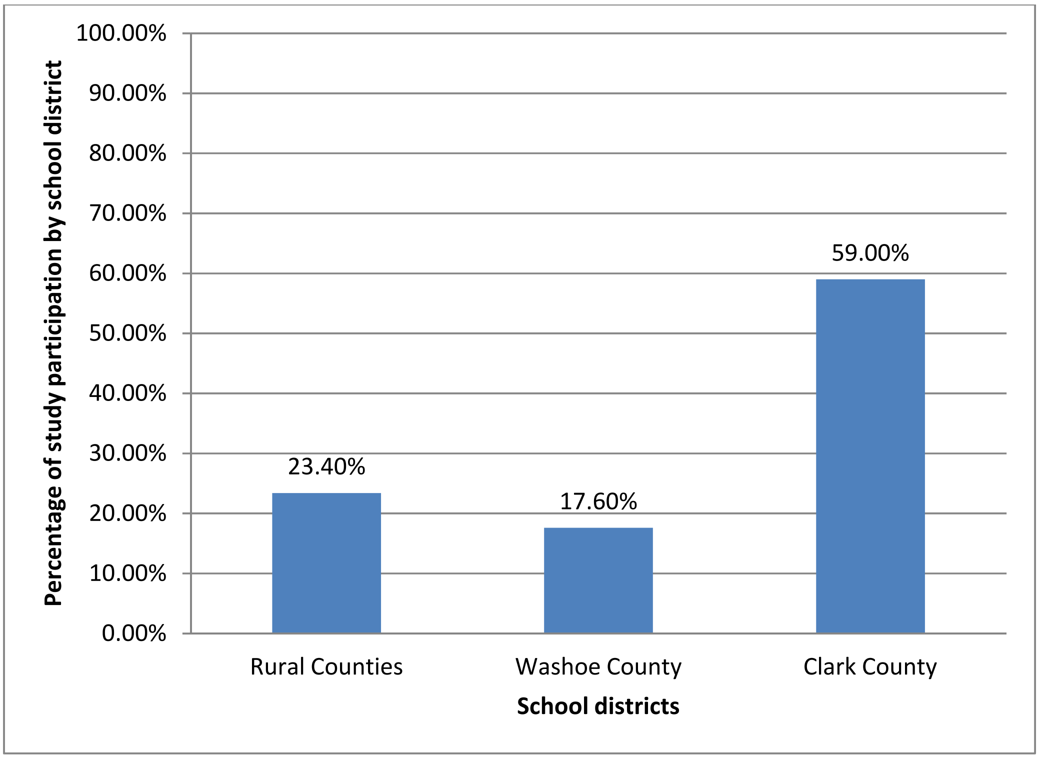


Table 4. Survey Response Rate by School District of Nevada Kindergarten Health Survey 2010 (NICRP, 2010)

School District	Number of Surveys Sent out	Number of Surveys Received	Survey Response Rate
Carson City	568	432	76.1
Churchill County	326	110	33.7
Clark County	16,161	5,610	34.7
Douglas County	419	302	72.1
Elko County	763	529	69.3
Eureka County	16	11	68.8

Humboldt County	271	217	80.1
Lander County	76	47	61.8
Lincoln County	68	49	72.1
Lyon County	647	283	43.7
Mineral County	44	8	18.2
Nye County	420	157	37.4
Pershining County	46	15	32.6
Storey County	21	12	57.1
Washoe County	4,321	1,670	38.6
White Pine County	94	52	55.3
All Districts	*24,261*	*9,504*	*39.2*

Note: Esmeralda County, with 5 kindergarteners enrolled in 2009-2010 school year, did not participate in the survey.

Strengths of the Study

The study results will demonstrate that if children's demographic characteristics are associated with blood lead screening tests. Furthermore, the results will provide recommendations for Public Health professionals and policy makers on implementing effective strategies to prevent and control childhood lead poisoning.

Limitation of the Study

This is a cross-sectional study design and self-reported data from parents was utilized. All the information relies on recall of the survey respondents. Therefore, the results may be subject to recall bias. Also several questions of the surveys were left blank when collected. NICRP kept all surveys in the database for analysis, but it is important to note when reading percentages presented in tables that not all respondents answered all questions. Therefore, some tables may have total of 9,504 (all participants responded to the question) while others may have a lesser number of total cases because several people left the question blank (NICRP, 2010).

Inclusion Criterion

All participants are residing in Nevada and attending kindergarten.

Exclusion Criterion

Children are not attending kindergarten and residing outside of Nevada.

Primary Predictor Variables

Annual household income, children's home zip code, race/ethnicity, and barriers to accessing healthcare.

Primary Outcome Variables

Blood lead screening tests – Has your child ever been tested for lead poisoning? – Yes/No

Statistical Analysis

All analyses will be conducted using SPSS 18.0. The association between blood lead testing and the socio-demographic variable will be analyzed using log linear model, chi-squire tests, and multiple logistic regression to quantify comparative disease risk. Descriptive statistics will be performed to assess the study population.

Institutional Review Board Approval

To protect the privacy and confidentiality of all participants, identifying information was coded into a de-identified numeric ID and maintained during all stages of data retrieval and analysis. The data were managed by NICRP staff, and any data release required the NICRP director’s consent and agreement. Access to such documents and data will be gained only by IRB-approved personnel.

CHAPTER 4

FINDINGS OF THE STUDY

Description of study participants

The school districts involved provided the number of kindergarten students enrolled for the 2009-2010 school year. Using this information, 24,261 surveys were sent out to participating schools. At the end of the data collection period (December 2010), 9,504 surveys were received and entered, resulting in a 39.2% response rate for the 15 districts in the state and the schools selected to participate in Clark County.

1. Children's gender and age

The total is 9504 participants, including 4503 male (47.4%), 4536 female (47.7%), and 465 cases with gender identification missing (4.9%). 737 (16.79%) male participants took the BLST, and 3652 (83.21%) male participants did not take the BLST. 741 (16.69%) female participants took the BLST, and 3699 (83.31%) female participants did not take the BLST.

The participants' ages range from 4 years old to 10 years old, and most of the participants' age were 5.5 years old. According to NSST 392.040, if a child is under 5 on or before September 30, the child must not be admitted to kindergarten. Also, if the child is not 6 years of age on or before September 30 of a school year, the child must not be admitted to the 1st grade (ECS, 2011). This statute creates a bottleneck that causes the pool of children aged 5 years to be larger than the normal population. Therefore, 88.6% of the participants are 5 years old due to the cutoff age of children entering kindergarten in Nevada. (See Table 1) Log Linear regression is applied to investigate the relationship between children's gender and the BLST ($p>0.05$). The results indicate that gender is not statistically associated with the BLST. Because all the participants are young and the gender is not statistically associated with the BLST, the final results were not adjusted for age or gender.

Table 5. Nevada kindergartners' gender and age

		Total (N=9504)	Blood lead screening test	
Child's age (in years)	Mean (5.5 years old)		Yes	No
	4 years old	482	96	386
	4.5 years old	36	6	30
	5 years old	8237	1371	6866
	5.5 years old	160	28	132
	6 years old	309	47	262
	6.5 years old	1	0	1
	7 years old	2	0	2
	10 years old	1	0	1
	Missing	55	9	43
Child's gender n (%)				
	Male	4389	737	3652
	Female	4440	741	3699
	Missing	453	79	374

Figure 4. **Children's gender, Nevada kindergarten Health Survey 2010**

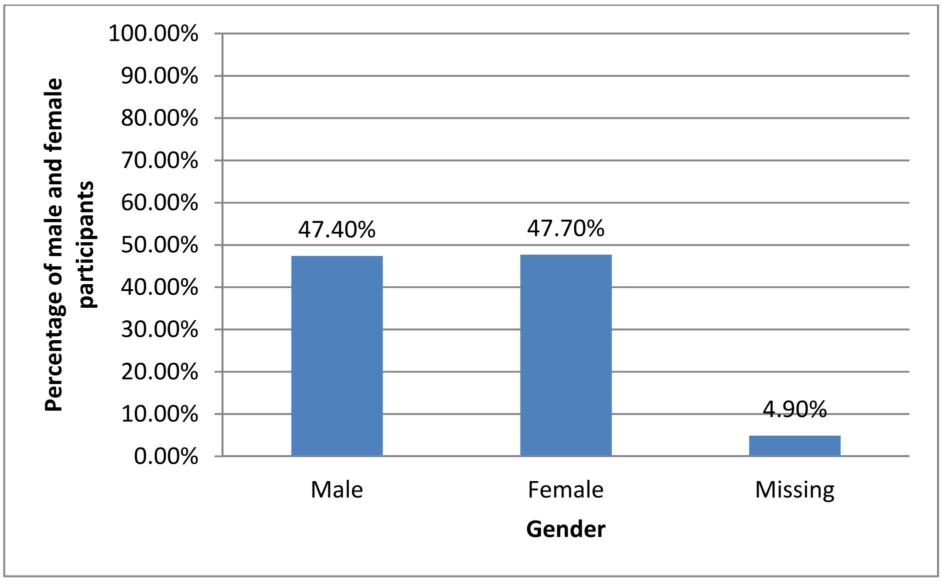
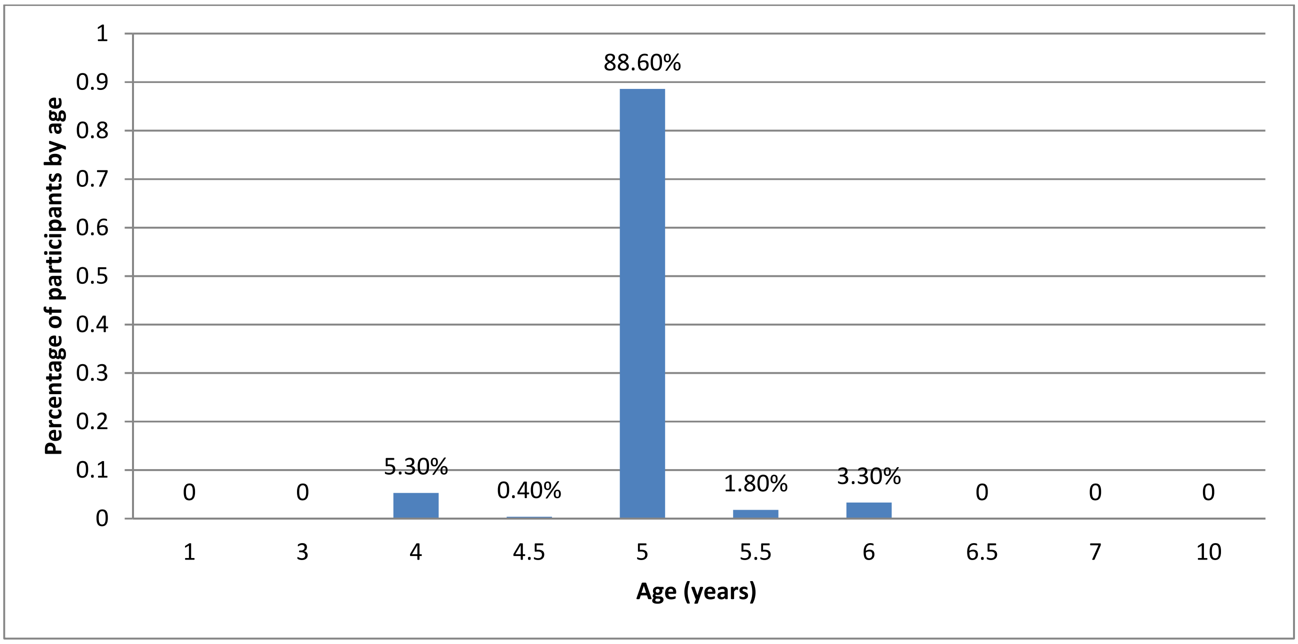


Figure 5. **Children's age, Nevada Kindergarten Health Survey 2010**

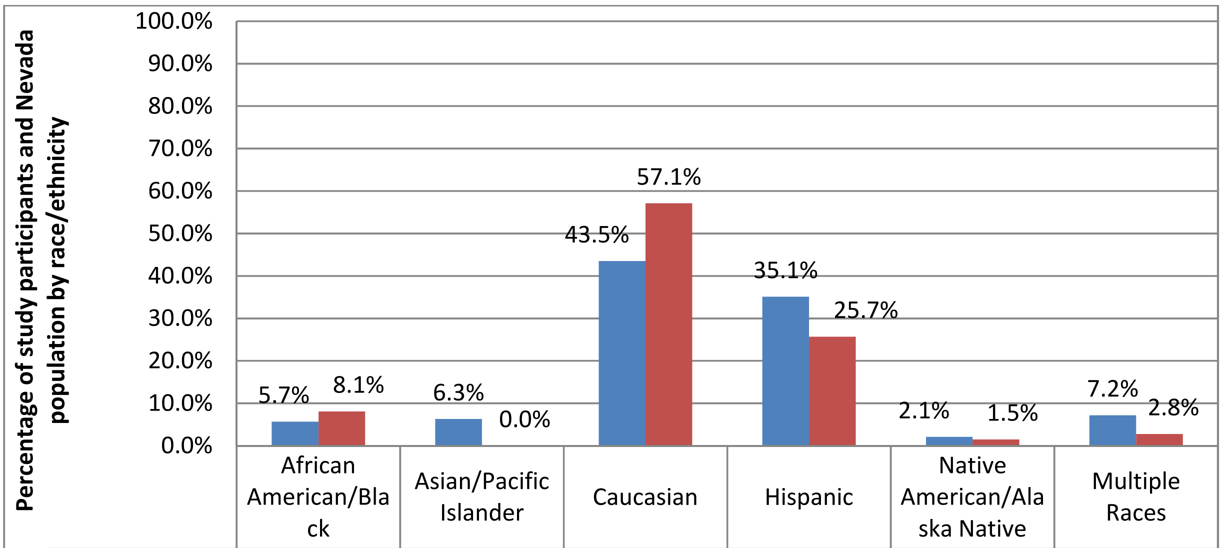


2. Children's race/ethnicity

Based on 2010 survey responses, the race/ethnicity of the Nevada kindergarten is roughly similar with the race/ethnicity percentages most recently estimated by the U.S. Census Bureau for the entire population in Nevada. Nevertheless, there are proportionally fewer Caucasians and more Hispanics responding to the survey than Nevada's Census estimates. (See Figure 3) (NICRP, 2010)

To analyze the relationship between racial groups and the blood lead screening test, log linear regression was applied. The results indicate that race is a significant predictor for the BLST. In this survey, there are 503 African American participants. Of whom, 145 (29.4%) of African American kindergartners participated the BLST and 348 (70.6%) did not. African American children are 1.48 times more likely to take the BLST than Caucasian children. 558 Asian/Pacific Islander Nevada Kindergarteners responded to the survey. 63 Asian participants (11.6%) were screened by the BLST and 481 (88.4%) were not. The results show Asian/Pacific Islander kindergartners are 79.8% less likely to take the BLST than are Caucasian kindergarteners. Among the total 3032 Hispanic children from Nevada Kindergartners, 739 (24.4%) took the test, while 2284 (75.6%) did not. Hispanic children are 2.47 times more likely to take the test than Caucasian children. Among the total 190 Native American participants, 55 Native American children (30.1%) in this survey chose to take the test, and 128 (69.9%) did not. The results reflect that the Native American group is not significantly associated with the BLST. For the mixed racial group, 633 participated in this study. Among whom, 97 (15.3%) took the test, and 536 (84.7%) did not. They are 1.38 time more likely to take the BLST than are Caucasian children. (See Table 3) The following figure compares the racial/ethnic percentage of the survey sample to the racial/ethnic percentage of the Nevada population.

Figure 6. **Percentages of Nevada population and study participants by Race/Ethnicity of Nevada Kindergarten 2010 (NICRP, 2010)**



	African American/Black	Asian/Pacific Islander	Caucasian	Hispanic	Native American/Alaska Native	Multiple Races
Survey Sample	5.7%	6.3%	43.5%	35.1%	2.1%	7.2%
Nevada	8.1%	0.0%	57.1%	25.7%	1.5%	2.8%

3. Annual household income

According to the 2010 Nevada Kindergarten Health survey, more than 50% of the participants came from annual families whose annual household income less than $45,000, and children from families with a lower household income have higher uninsured rates than do the children from higher-income families. The results indicate that annual household income is a predictor for the BLST. To analyze the association between annual household income and the blood lead screening tests, annual household incomes ranging from $0 to $95,000 were divided into 10 categories. (See Figure 4)

1276 (13.8 %*) of the children were from families with annual household incomes less than $15,000, whereas this group accounts for 13.5% of uninsured Nevada Kindergartners. Among this group, 368 (28.8%) took the test, and 908 (71.2%) did not. They are 5.53 times more likely to take the test than the children from families with annual household income higher than $95,000. Among 1188 participants (12.8 %*) from families with annual household income ranging from $15,000 to $24,999, 300 (25.3%) took the test, and 888 (74.7%) did not. The children from this group are 5.81 times more likely to take the test than the children from the highest-income families. Among 1070 participants (11.6 %*) from families with annual household income ranging from $25,000 to $34,999, 214 (20%) took the test and 856 (80%) did not. This group is 4.3 times more likely to take the test than the group with the highest household income. 760 participants (8.0 %*) are from families with $35,000 – $44,999 annual household income. In this group, 120 (15.8%) took the test and 640 (84.2%) did not. This group is 3.2 times more likely to take the test than the group with the highest annual household income. The group with annual household incomes ranging from $45,000 - $54,999 has

672 participants, and the participating and the non-participating cases are 94 (14.0%) and 578 (86.0%), respectively. They are 2.8 times more likely to take the test than the last group.

The group with incomes ranging from $55,000 to $64,999 has 566 participants. In this group, 58 (10.2%) took the test, and 508 (89.8%) did not. The next group with income ranging from $65,000 to $74,999 has 598 participants. The participants and non-participants cases are 48 (8%) and 550 (92%), respectively. Then, the group with incomes ranging from $75,000 to $84,999 has 529 participants. 53 (10%) participants took the test, and 476 (90%) did not. The results reveal that the groups with annual household incomes ranging from $55,000 to $84,999 are not statistically associated with the BLST.

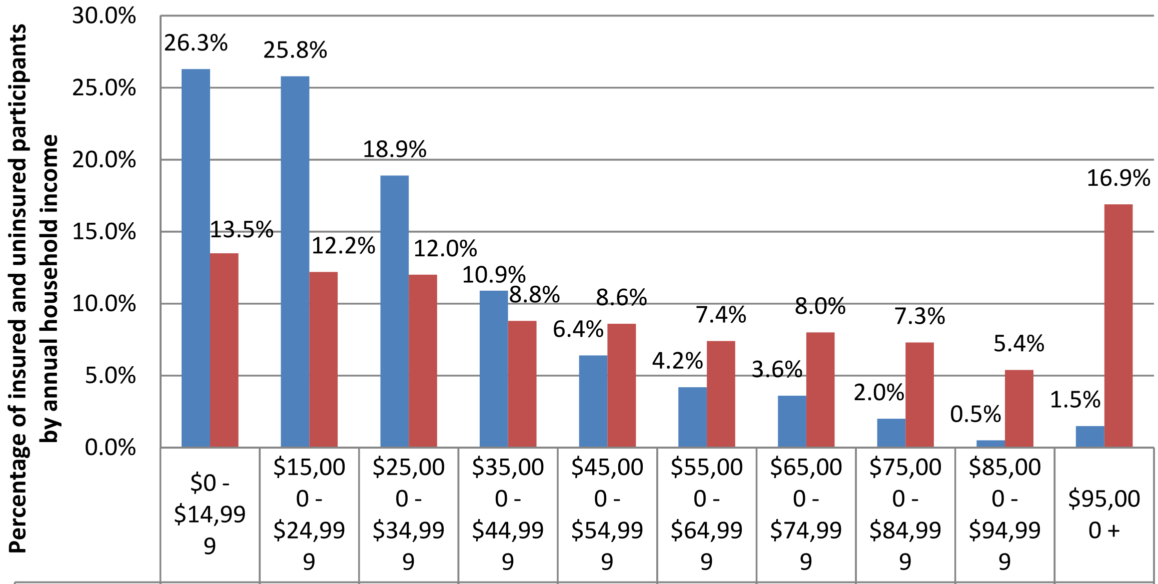
The group with annual household income ranging from $85,000 to $94,999 has 381 participants (4 %*). In this group, 27 (7.1%) took the test, and 354 (92.9%) did not. This group is 1.3 times more likely to take the test than the group with the highest annual household incomes. The last group with annual household income ranging above $95,000 has 1187 participants (12.5%). In this group, 65 (5.5%) took the test, and 1118 (94.2%) did not.

It is noteworthy that the likelihood of children taking the BLST decreases as annual household income increases. Meanwhile, the uninsured rate decreases with the increase of annual household incomes. In addition, the correlation between income and insurance status reflects both the lack of access to, and affordability of, private health insurance options for lower- and middle-income families. This is the same as the Kaiser Family (2009) study results that found that of those lower- and middle-income families that had access to private health insurance coverage, only 19% could afford the premiums (NICRP, 2010).

*refers to the percentage of each individual annual household income based on the total cases (N=9504)

*the reference group of the annual household income is the last group with income greater than $95,000 per year.

Figure 7. Percentages of insured and uninsured participants by annual household income of Nevada Kindergarten Health Survey 2010 (NICRP, 2010)



	$0 - $14,999	$15,000 - $24,999	$25,000 - $34,999	$35,000 - $44,999	$45,000 - $54,999	$55,000 - $64,999	$65,000 - $74,999	$75,000 - $84,999	$85,000 - $94,999	$95,000 +
Uninsured	26.3%	25.8%	18.9%	10.9%	6.4%	4.2%	3.6%	2.0%	0.5%	1.5%
Insured	13.5%	12.2%	12.0%	8.8%	8.6%	7.4%	8.0%	7.3%	5.4%	16.9%

4. Zip codes

In this survey, the participants came from 189 zip-code areas in Nevada; only 33 zip-code areas have more than 1 participant. Zip code, 89442, which is in Washoe County, has the highest participant rate (40.91%) in the study, and zip code, 89001, which is in Lincoln County, has the lowest participant rate (0%). In order to analyze the association between zip codes and blood lead screening tests, the zip codes were categorized into 12 groups according to the school district. There are 16 school districts in Nevada excluding Esmeralda did not participate in the survey. Due to the inadequate number of cases of some school districts, several school districts were combined as following, Churchill and Mineral Counties, Lander and Eureka Counties, Humboldt and Pershing Counties, and Lyon and Storey Counties. Thus, there are twelve groups in this survey, and we compared the likelihoods of children taking the BLST among these twelve school groups. (See Table 1)

Although the majority of participants are from Clark County, the rate of blood lead screening tests (BLST) is 19.1%. White Pine County has the highest participant rate (32.0%) of BLST, but the total is only 50 cases. The lowest participant rate (4.1%) of BLST is Lincoln County. The Log linear model was conducted to analyze the association between school districts and the BLST. The results indicate that school district is a predictor of the BLST ($p<0.001$). Furthermore, we compared the participating rate of each school district to the rate of Clark County participant. Douglas County and the combined Churchill and Mineral Counties had higher possibilities to take the test than Clark County (OR >1), and the rest of the school districts were less likely to take the BLST compared to Clark County. ($p<0.05$) (See Table 1)

Table 6. Differences of the likelihood of children taking Blood lead screening tests among the twelve school districts

County Name	Total Participants	Blood Lead Screening Tests		OR	P value
		Yes	No		
Carson City	420	54 (12.9%)	366 (87.1%)	.627	.001
Churchill and Mineral Counties	114	28 (24.6%)	86 (75.4%)	1.383	.001
Douglas County	298	46 (15.4%)	252 (84.6%)	1.999	.001
Elko County	520	64 (12.3 %)	456 (87.7%)	.775	.001
Lander and Eureka Counties	47	4 (8.5%)	43 (91.5%)	.596	.001

Humboldt and Pershing Counties	226	26 (11.5%)	200 (88.5%)	.395	.001
Lincoln County	49	2 (4.1%)	47 (95.9%)	.552	.001
Lyon and Storey Counties	288	35 (12.2%)	253 (87.8%)	.181	.001
Nye County	155	22 (14.2%)	133 (85.8%)	.588	.001
Washoe County	1621	215 (13.3%)	1406 (83.7%)	.702	.001
White Pine County	50	16 (32%)	34 (68%)	.649	.001
Clark County	5483	1045 (19.1%)	4428 (80.9%)		

*reference group is Clark County

5. Barriers to accessing health care

This paper also analyzes whether the potential barriers of access to healthcare for the kindergarteners' parents are associated with blood lead screening tests. (See Table 2) Among these barriers, "lack of insurance", "lack of transportation", and "other reasons" are statistically associated with the BLST ($p<0.05$). "Lack of money" and "Lack of good medical provider" are not statistically related with the BLST ($p>0.05$).

1208 participants considered "Lack of health insurance" as the main barrier for healthcare access. In this group, 246 cases (20.4%) took the test, and 962 (79.6%) did not. Those with insurance are 1.3 times more likely to take the test than those without insurance. 197 participants selected "Transportation" as the main barrier. Under this category, 44 (22.3%) participated the test, and 153 (77.7%) did not. The people with transportation are 1.4 times more likely to take the test than the people without transportation. In addition, 115 marked "Other reasons" as barrier. Under "other reasons", 9 (7.8%) cases took the test, and 106 cases (92.2%) did not. The people considering "other barriers" are 42% less likely to take the BLST.

915 cases (9.6%) chose “Lack of money”. In this group, 146 (16.0%) took the test, and 769 (84.0%) did not. 274 participants considered “Lack of good medical providers” as their main barrier. In this group, 42 (15.3%) took the test, and 232 (84.7%) did not. (See Table 2)

Table 7. Frequencies of Children’s demographic characteristics and blood lead screening test

		Total (N=9504)	Blood lead screening test			
Child’s race, n (%)					OR	P<0.05
	African American	493	145	348	3.181	.001
	Asian/Pacific Islander	544	63	481	.798	.001
	Caucasian	3804	360	3444		
	Hispanic	3023	739	2284	2.470	.001
	Native American	183	55	128	3.281	.464
	Multiple Categories	633	97	536	1.382	.008
	Missing	602	98	504		
Annual Household Income, n (%)					OR	P<0.05
	$ 0 - $ 14,999	1276	368	908	6.971	.001
	$ 15,000 - $ 24,999	1188	300	888	5.811	.001
	$ 25,000 - $ 34,999	1070	214	856	4.300	.001
	$ 35,000 - $ 44,999	760	120	640	3.225	.001
	$ 45,000 - $ 54,999	672	94	578	2.797	.023
	$ 55,000 - $ 64,999	566	58	508	1.964	.530
	$ 65,000 - $ 74,999	598	48	550	1.501	.113
	$ 75,000 - $ 84,999	529	53	476	1.915	.272
	$ 85,000 - $ 94,999	381	27	354	1.312	.001
	$ 95,000 +	1183	65	1118		
	Missing	1059	210	849		
Barriers to accessing to health care					OR	P
	No barriers	8402	1178	7224	.853	.020
	Lack of transportation	197	44	153	1.439	.044
	Lack of insurance	1208	246	962	1.320	.001
	Lack of good medical providers	274	42	232	1.320	.570
	Lack of money	915	146	769	.936	.514
	Other	115	9	106	.418	.014

*reference group for race is Caucasian
*reference group for annual household income is $95,000 +

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

The study results are consistent with the literature. Health disparities remain an issue for Nevada. Most minority children and children from low household income families face difficulties in accessing and acquiring equal healthcare service. The study results reveal the persisting issue in Nevada healthcare system. There is need for improvement, standardization, and unification of lead screening guidelines. Understanding barriers to blood lead testing is also necessary to develop credible data to promote shifts in public policy regarding lead abatement. (Feinberg, 2011)

Discussion

According to the data, annual household income is a predictor for the BLST. The children from families with lower household incomes are more likely to, and tend to, take the BLST than the children from families with higher household incomes. Furthermore, the results demonstrate that the odds ratio of annual household income versus the blood lead screening tests gradually decreases with the increase of annual household income. In terms of housing age, low-income buyers are found to be more likely to purchase homes that were built in 1970 or earlier, with 49.7 percent residing in homes of this age, compared to 47.7 percent of moderate-income buyers and 40.2 percent of high-income buyers (Bates, 2011). Lead was widely used in both interior and exterior house paint until 1978 and was banned after 1978 (National Center for Healthy Housing and the University of Cincinnati Department of Environmental Health, 2004). The proportion of children with BLLs $\geq$ 5 ug/dl living in older houses is higher compared to the children living in houses built after 1978. Therefore, people who live in older house are more self-conscious of their children's blood lead levels than people living in newer houses, and they are motivated to take the BLST.

In this survey, the proportion of Hispanic kindergartners is higher proportionate than Caucasian kindergartens compared to the Nevada population. Figure 3 reflects the extent to which higher birth rates and immigration are leading to a change in the make-up of the American people. By 2042, minorities will outnumber whites across the entire population, for both adults and children (Bates, 2011). In addition, the data results demonstrate that race is a predictor for blood lead screening tests. Among racial groups, African Americans, Hispanic Americans, and Native Americans are more likely to take the BLST than Caucasians, whereas, Asians are less likely to take the BLST than Caucasians. According to the National census, a higher proportion of African Americans and Hispanic Americans live in older houses and fall into the low-income categories than Caucasians and Asians. (Bates, 2011) Because Hispanics and Blacks have lower levels of education on average than Caucasians and Asians, and receive lower earnings on average for comparable levels of education, the problems confronting low-income homebuyers and owners disproportionately affect these groups. According to the Health Belief Model, people at high risk subconsciously tend to take preventive strategies from diseases and potential dangers. Thus, in our study, minority parents except Asians are more likely to get their children screened by blood lead screening tests than Caucasian parents based on the study results.

Because the majority of the participants were from Clark County, the other districts were compared to Clark County. The results indicated that the children from other school districts were less likely to get screened than the children from Clark County except

Churchill County, Mineral Counties, and Douglas County. These counties contain major cities, so the transportation and healthcare facilities may be more accessible for the residents than other school districts.

To investigate the parents' difficulties in obtaining blood lead screening tests, the questionnaire listed an item, "Have you ever experienced any barrier to accessing health care for your child?". 2.2 percent of participants considered "transportation" as the barrier for them, 13.3 percent considered "lack of insurance" as the barrier, 3 percent considered "lack of good healthcare provider" as the barrier, 10 percent chose "lack of money", and 1.3 percent selected "other reasons". 79.6 percent of participants experienced no barriers to accessing healthcare for their children. The results indicated that "lack of transportation" and "lack of insurance" are statistically related with blood lead screening tests.

Based on our survey, 197 participants considered "lack of transportation" as the barrier to healthcare access for their children. People who live in rural areas and have no transportation have difficulties to accessing heath care and good medical providers, so their children face barriers to get the BLST. According to Figure 4, the groups with lower annual household incomes have a higher proportion of uninsured people, and the groups with higher annual household incomes have a lower percentage of uninsured people. Interestingly, the results reflect that "lack of money" is not significantly associated with BLST, but "lack of insurance" is statistically associated with BLST. According to the Health Belief Model – perceived benefits, if people perceive there are potential benefits of a certain action, they have a stronger tendency to do it. Thus, in this case, people assume the items covered by health insurance and recommended by healthcare providers are more necessary and deserve more efforts than the items not covered and not mentioned, like BLST.

Because Hispanics and Blacks have sharply lower average living conditions than Whites of comparable incomes, and because low-income households have sharply lower average wealth than higher income households, the neighborhood and housing options of low-income individuals and minorities is further restricted, their vulnerability to income and budget shocks is greater, and the speed at which they can achieve homeownership thereby slower. Hispanics have the highest share of older housing at 49.9 percent, compared with 46.4 percent of White first-time, and 45.3 percent of Blacks. However, the share of all households living in these older housing units is higher still at 53.4 percent, which is essentially the same as the share of recent-mover low-income renters in older units. (Herbert, 2006)

Regardless of income or race-ethnicity, homebuyers tend to occupy somewhat newer units than renters. Minority homebuyers are more likely to live in inadequate housing than Whites, with 4.5 percent of Blacks and 6.3 percent of Hispanics in moderately inadequate housing, compared to 2.9 percent of Whites. In addition, the level of structural inadequacy is higher among recent-mover low-income renters, with 7.9 percent living in moderately inadequate and 3.0 percent in severely inadequate housing. Urban areas also tend to have lower homeownership rates than suburban areas, and so owners in these areas may be less likely to realize benefits from higher concentrations of owner-occupants. As shown, low-income buyers are less likely to live in suburban areas than either moderate- or high- income buyers (46 percent versus 55 to 56 percent). (Herbert, 2006)

Conclusion and recommendation

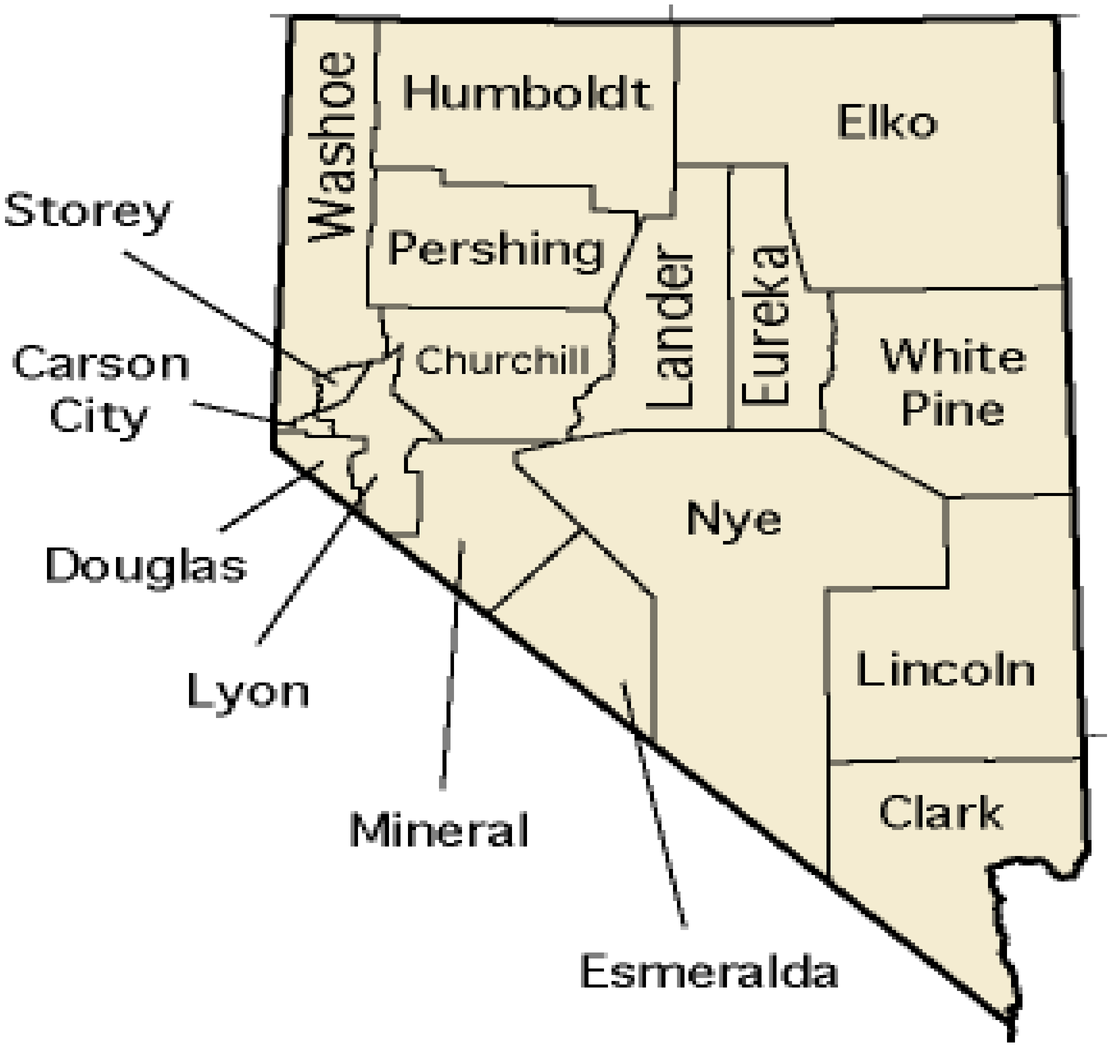
The results demonstrate that minority parents, except Asians and those from families with lower annual household incomes request the BLST more strongly than Caucasian and children from families with higher annual household incomes. Furthermore, the parents with lower household incomes are more self-conscious and motivated to get their children screened by the BLST. Also, the results indicate that children from lower annual household incomes are more likely to face difficulties regarding lack of transportation, lack of insurance and financial hardship, etc. These groups of children are more likely to live in older houses and are at high risk of lead poisoning. Thus, healthcare professionals in Department of Public Health and policy makers should put more emphasis on these groups to supply help and protect them from lead poisoning.

Children's welfare deserves more, rather than less attention, and it is necessary to further the research to investigate the barriers to the BLST, and to implement the BLST for children universally. Our study findings suggest that the public health professionals should expand more resources on African Americans, Hispanic Americans, Native Americans, and low-income families. The more effort we dedicate, the more success we will achieve.

Lead poisoning caused damage in several of the organ systems of children including the nervous system and the kidney, and influences their physical and mental development. Identifying elevated blood lead levels in the most vulnerable young children of Nevada is a critical way to make a difference in their lives and is more than worth the time, effort, and money to provide them an opportunity for a good future. It is our social responsibility to eliminate health disparities and supply equal and sufficient, qualified healthcare to all our children regardless of socioeconomic and racial differences.

APPENDIX 1

Nevada School District Map



APPENDIX 2

Survey instruments

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Kindergarten Health Survey

DEAR PARENT OR GUARDIAN: *This survey has been designed by the Nevada Institute for Children's Research and Policy at the University of Nevada Las Vegas, in partnership with the State of Nevada, Department of Health and Human Services and the local County School District. The information from this survey will be used to help understand the health of children entering kindergarten this year. You have been asked to participate because you will have a child in kindergarten. All information from this survey will be used to discuss children's health on a group level. Your child's name will* ***never*** *be connected to your responses in any way or known by the researchers.* ***All information in this survey is confidential.***

Child's Age ________

Elementary School Name: ______________

Child's Gender: Male Female

Weight of Child: ________lbs.

Child's Height: ______ft. _______in. (12in = 1ft)

Total number of **children** in your household: (ages 0-17) ________

Total number of **adults** in your household: (ages 18+)__________

Annual Household Income (check one)
- ☐ $0 -$14,999
- ☐ $15,000 -$24,999
- ☐ $25,000 -$34,999
- ☐ $35,000 -$44,999
- ☐ $45,000 -$54,999
- ☐ $55,000 -$64,999
- ☐ $65,000 -$74,999
- ☐ $75,000 -$84,999
- ☐ $85,000 -$94,999
- ☐ $95,000 +

Your HOME zip code: ___________

Child's Race / Ethnicity (check one)
- ☐ African American
- ☐ Asian / Pacific Islander
- ☐ Caucasian
- ☐ Hispanic
- ☐ Native American
- ☐ Other (please specify) ________________________

Please answer the following questions for the child that is enrolled in kindergarten this year.

1. Is your child currently covered by medical insurance?
☐ Yes ☐ No
If "Yes", what type of insurance? ☐ Private, ☐ Medicaid, ☐ Nevada Check Up, ☐ Other______________________

2. Has your child been seen by a medical provider for a routine check-up (not an illness) in the *past 12 months*?
☐ Yes ☐ No

3. Does your child have a primary care provider (regular doctor, nurse practitioner or physician's assistant)?
☐ Yes ☐ No

4. Has your child seen a dentist in the past 12 months?
☐ Yes ☐ No

5. Has your child ever had a cavity?
☐ Yes ☐ No

6. Within the last 12 months how many times have you taken your child to the Emergency Room (not Urgent Care) for an illness or injury that was not life-threatening?
☐ None (0) ☐ 1-2 ☐ 3-5 ☐ 6-9 ☐ 10 or more

7. Please check all medical conditions listed below that your child has
☐Asthma/Airway Disorder ☐ Glasses/Contacts
☐Diabetes ☐ Hearing Aid/Impairment
☐Seizures ☐ Physical Disability
☐Mental Health Condition ☐ ADD/ADHD
☐Cancer ☐ None
☐ Other (specify)______________________________

8. Do you think your child may have a medical problem that he/she has not seen a doctor for?
☐ Yes ☐ No
If yes, what is it? ____________________________

9. If immunizations were not required for school, would you still have your child immunized?
☐ Yes ☐ No

10. Where do you take your child for immunization (shots)? If you have used more than one of these, please check the last one:
☐ Primary Care Provider (Child's regular doctor) ☐ Health District ☐ School-Based Clinic
☐ Community Health Clinic ☐ Other (specify): ______________________

11. Has your child ever been tested for lead poisoning?
☐ Yes ☐ No

12. Have you experienced any barriers to accessing health care for your child? **(check all that apply)**
☐ None ☐ Lack of transportation
☐ Lack of insurance ☐ Lack of good medical providers
☐ Lack of money ☐ Other (please specify): __________

13. Have you ever tried to get mental or behavioral services for your child?
☐ Yes ☐ No
If "Yes", have you had trouble getting services?
☐ Yes (explain)_________________________ ☐ No

14. In general, are you able to follow your doctor's recommendations for medications and/or follow up visits?
☐All of the time ☐Some of the time
☐Most of the time ☐None of the time
If you did not say "All of the time", please explain why not:
____

15. In general, how many times a week does your child do at least 30 minutes of physical activity? (circle one)
0 1 2 3 4 5 6 7

16. What type of pre-school did your child attend most often in the past 12 months? **(check one)**
☐Head start ☐ Private ☐ Home Based ☐ Home Based
☐School/University Campus ☐ None/Stayed Home
☐ Other______________________________

PLEASE RETURN THIS SURVEY TO YOUR CHILD'S TEACHER BY TUESDAY SEPTEMBER 8, 2009

Thank you for your participation. If you are interested in participating in future research please contact the Nevada Institute for Children's Research and Policy at (702) 895-1040 or via email at nicrp@unlv.nevada.edu.

TEACHERS: Please return the survey to your school's front office or mail to **NICRP, Kindergarten Health Survey, 4505 Maryland Parkway, Box 453030, Las Vegas, NV 89154**

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