HEALTH PROBLEMS OF SMOKING, LEAD, AND PREGNANCY

Pantera Rosa Team

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INTRODUCTION

In early 2005, Mrs. Glutbut, along with other mechanics on her team in Nowhere, Indiana were selected as part of a research project to determine the absorption of lead into the circulatory systems of mechanics in the National Association of Stock Car Auto Racing (NASCAR) circuit.

"NASCAR is the governing body for the largest auto sport to use lead-containing fuel. The combustion of lead-containing gasoline is associated with the emission of exhaust containing lead particles that can be inhaled, absorbed, or ingested from the environment" (O'Neil, J., Steele, G., McNair, C., Matusiak, M., & Madlem, J., 2005).

CASE BODY

Pantera Rosa, a private research team, was hired by one of the NASCAR teams to review a study involving NASCAR workers and lead toxicity. The Pantera Rosa team consists of researchers with extensive backgrounds in the areas of science, public health, medical, disabilities, environmental, and tobacco control.

A 2005 study of a NASCAR racing team found that "40.4% of workers had BLL ≥10 µg/dl. Participants exposed to exhaust gas had the highest relative risks (RR) for elevated lead followed by working on brakes and radiator repair" (O'Neil, J., Steele, G., McNair, C., Matusiak, M., & Madlem, J. 2005).

During the evaluation portion (assessment) of the review, Pantera Rosa discovered that Mrs. Glutbut, who was part of a pit crew, had a blood lead level reading of 15 ug/dl (micrograms per deciliter). CDC guidelines have established that blood lead levels of 10 ug/dl as a threshold for public health response. In addition, an examination by her personal physician revealed that she was a heavy smoker who was three months pregnant (CDC. n.d.).

As a health professional, the doctor realized that Mrs. Glutbut faced many potential problems. He discussed the risk factors of untreated lead poisoning and nicotine on her unborn fetus.

Lead can have many adverse effects for children. It can damage a child's central nervous system, kidneys, and reproductive system and, at higher levels, can cause coma, convulsions, and death. Even low levels of lead are harmful and are associated with decreased intelligence, impaired neurobehavioral development, decreased stature and growth, and impaired hearing acuity (Casey, J., 2001).

Research from the Teratology Society discusses the issues related to pregnant women and elevated blood lead levels. When a pregnant woman has an elevated blood lead level, not only is she at risk, but the unborn child is at risk for premature birth, low birth weight, neurological damage, miscarriage and still birth. "Lead is an undisputed neurotoxin; it is poisonous to the fetus's growing and developing brain" (CDC. 2005).

Research is also being conducted for women and men during child bearing years. For men, "there is scientific evidence that lead poisoning of the father before procreation may result in abnormalities in the sperm" (CDC. 2005). Sperm abnormalities and the reduction of circulation of testosterone in men can interfere with the sperm's success with egg fertilization.

The effects of elevated lead levels on the female reproductive system are well documented. "Women who have had high lead exposure as children, are three times more likely to bear low birth weight children" (CDC. 2005). More severe effects of toxic maternal exposure before conception are an abnormal fetus, miscarriage, and still birth. Toxic exposure of lead can also reduce fertility which can include unsuccessful fertilization and/or implantation of the egg. Lead is maternally transmitted by the placenta and through breastfeeding.

Another reason lead is a problem with pregnant women, is because lead's chemical makeup is similar to calcium. During pregnancy, a women's body requires more calcium. The extra calcium is often released from her bones. If your bones and/or diet are deficient in calcium then lead absorption for the fetus is increased. "Lead closely resembles calcium chemically; it can be mistakenly released into the blood with the calcium and passed to the fetus" (CDC. 2005).

Exposure to lead in utero "damages developing cells in the cerebral cortex and frontal lobes or the brain" (CDC. 2005). Lead also disrupts the performance of the majority of brain neurotransmitters. Pediatric research has reported that low levels of lead exposure can negatively affect toddlers by increasing their impulsive and hyperactive behaviors. "Attention deficit disorder is now directly linked with chronic lead toxicity" (CDC. 2005).

Although, lead exposure for children has drastically declined over the last twenty years, there is still much work to be done. This decline can be attributed to the phase-out of leaded gasoline and lead within the components of food and beverage cans along with household paint. Reducing lead in industrial emissions, hazardous waste sites, and drinking water has also assisted in the further reduction of blood lead levels of children throughout the United States. Due to the combination of efforts to eliminate and/or reduce the manmade lead in our environment, blood lead levels of children have declined 80% since the 1970s. "Despite progress, lead poisoning remains one of the top childhood environmental health problems today" (EPA.2000). "Adverse health effects caused by lead exposure include intellectual and behavioral deficits in children and hypertension and kidney disease in adults". Nationally, "310,000 children aged 1-5 years remain at risk for exposure to harmful lead levels" (CDC. 2002). Indiana is currently working on a new administrative rule concerning lead and lead abatement. The future

environmental health of Indiana's children will be further protected by the creation and enforcement of lead safety laws and regulations.

In the early 1980's, Indiana began operating a statewide Childhood Lead Poisoning Prevention Program (ISDH. 2005). Since October of 1998, all children under the age of seven that participate in Medicaid are required to be initially tested to determine blood lead levels. Testing usually occurs at 12 months and 24 months of age. This requirement resulted from the data comprised from the phase II for the third National Health and Nutrition Examination Survey (NHANES II, 1991-1994), which found that 83% children in Medicaid were diagnosed with elevated blood lead levels of 20 ug/dl and/or higher (Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards, February 2000, page 34). The Indiana State Department of Health created a Risk Assessment Questionnaire that asks parents a few questions like what is the age of the home the family resides in and does a family member have an occupation or hobby that uses lead. This mandatory questionnaire is given by a medical provider and is used to assess the risk factors for every child that is not participating in Medicaid. All children that are considered to be 'at risk' due to answers from the risk assessment questionnaire are required to be tested. Also, if the child has a sibling or playmate that had evaluated blood lead levels, the child must be tested. Since 1994 and throughout 1998, 30 % of Indiana's children under the age of six years have been screened for blood lead levels (ISDH. 2005)

Beginning in 2006, all tests concerning children's blood lead levels will be electronically reported to the ISDH central database. The electronic reporting will allow for a complete analysis of blood lead levels for the entire population of Indiana's children. For the state of Indiana,

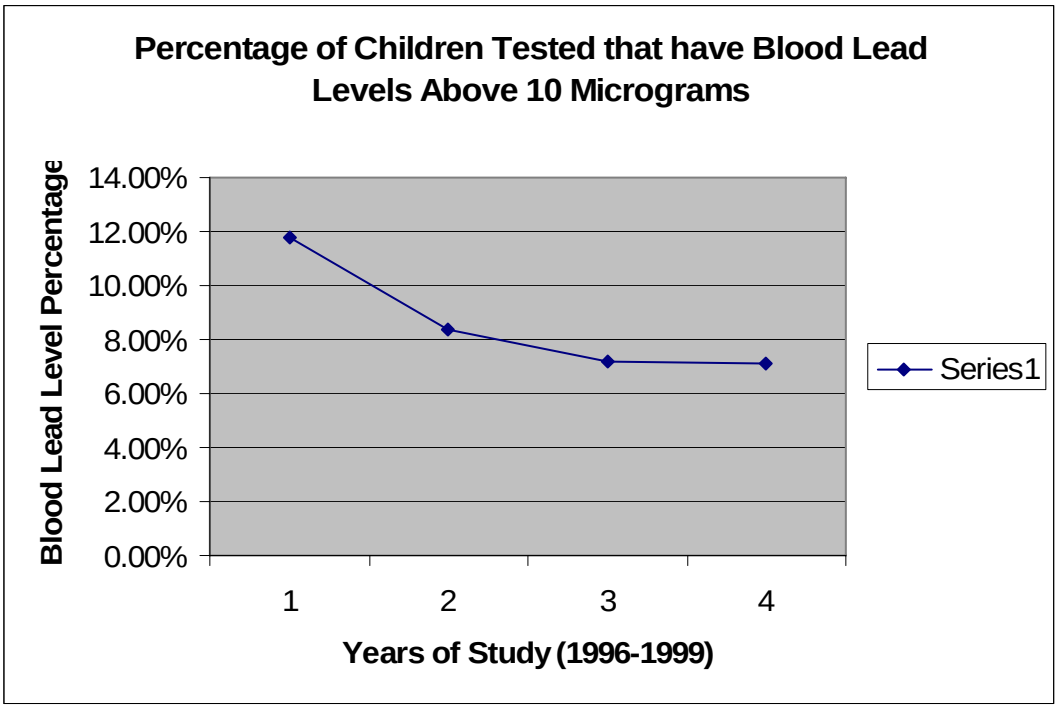
1996 11.8% of children tested had blood lead levels above 10.

1997 8.4% of children tested had blood lead levels above 10.

1998 7.2% of children tested had blood lead levels above 10.

1999 7.1% of children tested had blood lead levels above 10.

(ISDH. 2000)



Although Mrs. Glutbut and her husband live in a home built in 1998, many older homes contain lead risks. Eighty-three percent of private housing and eighty-six percent of public housing that was constructed before 1980 contains some lead based paint. This is due to the common use of lead based paint in residential housing. Lead based paint use began to drop in popularity in the 1950's. Lead based paint was banned for residential use in 1978 (EPA. 2000) Lead plumbing fixtures can also contribute to an older home's source of lead contamination. Restrictions on lead plumbing fixtures were put into effect in 1986 and 1988;

however an older home may still have these lead plumbing fixtures in use (EPA. 2000). Fortunately, Mrs. Glutbut lives in a home built after 1990, so her home does not have a residential lead contamination issue.

Since, eliminating blood lead levels (BLLs) above ten ug/dL in children is one of the national priorities for the Healthy People 2010 program, the state's central database is essential for assessing the prevalence of elevated blood lead levels throughout Indiana. The information will also assist in targeting populations with elevated blood lead levels. Once identified, programs can be initiated to best reduced children's blood lead levels.

Mrs. Glutbuts situation was complicated by the fact that she was a heavy smoker. According to 2002 Behavior Risk Factor Surveillance System (BRFSS) the smoking rate of Indiana women 25.8% (United State 19.9%) which gave our state a ranking of 48th and the pregnant smoker rate 20.2% (United States 11.4%) giving us a ranking of 47. There's significant work to do in the areas of education women and offering evidenced based cessation assistance. "Smoking cigarettes is probably the number-one cause of adverse outcomes for babies," says Robert Welch, MD, who's the chairman of the Department of Obstetrics ND Gynecology at Providence Hospital in Southfield, Michigan.

In addition to the problem associated with lead-based fuel, Mrs. Glutbut was ingesting nicotine, another toxic substance that could have lasting effects on her unborn child. Many do not realize how smoking can impair fetal development.

Cigarette smoke contains more than 4000 different chemicals, including cyanide, lead and at least 60 different cancer-causing compounds. Researchers suggest that nicotine and carbon monoxide are the two most dangerous compounds that lead to most every smoking-related complication in pregnancy. Nicotine and carbon monoxide work together to reduce the

oxygen supply by narrowing the blood vessels throughout the body of the pregnant women, including the umbilical cord. Another challenge caused by mom-to-be smoking is with the red blood cells that carry oxygen starts to pick up molecules of carbon monoxide, which reduces the amount of oxygen that can be carried (USDHHS. 2004).

Some of the most serious complications for the fetus include still birth, premature delivery, and low birth weight. The risk is doubled for still birth and low birth weight babies. Low birth weight and premature babies face an increased risk of serious health problems during the newborn period and chronic lifelong disabilities like cerebral palsy, mental retardation, learning disabilities and even death.

Smoking effects the baby's weight and size; body and lung development; and brain function. According to research, a pack-a-day will shave off a half a pound from the baby's birth weight. Since smoking stunts the growth in the womb, which could lead to negative consequences that last over the lifetime. Smaller or undersized babies tend to have underdeveloped bodies. One result could be underdeveloped lungs, which could increase the need to have the newborn hooked up to a respirator immediately after delivery. Children of mothers that smoked during pregnancy are more vulnerable to asthma and other respiratory challenges over their lifetime. Underdeveloped lungs may also double or triple the risk of sudden infant death syndrome (SIDS). The children also face an increase chance of having learning disabilities, behavioral problems and relatively low IQs. Recent studies in animals suggest that nicotine in the womb can program a baby's brain for a future addiction.

Smoking has also been associated with a number of pregnancy complications. Smoking cigarettes appear to double a woman's risk of developing placenta problems.

- Placenta previa (low-lying placenta that covers part or all of the opening of the uterus)

- Placenta abruption (the placenta peels away, partially or almost from the uterine wall prior to delivery)
- Premature rupture of the membranes (PROM) (when the sac that holds the fetus breaks before labor begins)

Mrs. Glutbut's physician relayed the good news that the health of her baby can improve whenever a woman stops smoking at any time during her pregnancy. If the women quits by the end of her first trimester of the pregnancy, she is no more likely to have a low birth weight baby as a woman who never smoked. Even if she quits during the second or third trimester she still can improve the fetus' growth opportunities.

CONCLUSION

Reducing and/or eliminating health disparities are paramount in public health. For example, one of the goals of the Centers for Disease Control is Healthy People in Healthy Places. In addition, a Healthy People 2010 goal seeks to reduce the proportion of nonsmokers exposed to environmental tobacco smoke, as well as eliminate elevated blood lead levels in children (Healthy People 2010). After reviewing (assessing) the data, Pantera Rosa team concluded that lead poisoning and the toxic effects of side stream (or secondhand) smoke, are problems for NASCAR workers, and for the general public attending NASCAR events. Indiana, as well as the rest of the country, can look to California, which has taken a leadership role in developing policy to eliminate the health hazards of lead poisoning and secondhand smoke.

Given the potential seriousness of the findings in this study, further testing (assessment) would be conducted to determine if elevated blood (lead) levels continue. In addition, there is an opportunity for Dr. Julie Louise Gerberding, Director of the Centers for Disease Control and Prevention (CDC) to take a leadership role by creating policy for NASCAR, and for appropriate

Federal and State legislative bodies to eliminate entirely the use of leaded gasoline and secondhand smoke at NASCAR functions.

Legislation and policies to eliminate lead-based fuel and secondhand smoke are a matter of respect and dignity for workers. All workers deserve a safe, healthy, and smoke free workplace. No worker should have to be subjected to the toxic affects of lead poisoning, or breathe tobacco smoke pollution to hold a job.

References

Casey, J. (2001). Lead Poisoning. Greentree Environmental Services. Chesterton, IN.

CDC. (2002). Blood Lead Levels—United States, 1999-2002 Center of Disease Control, MMWR Weekly May 27, 2005 /54 (20); 513-516

CDC. (N.D.). Third National Health and Nutrition Examination Survey (NHANES II, 1991-1994). Retrieved on December 28, 2005 from http://www.cdc.gov/nchs/products/elec_prods/subject/nhanes3.htm

CDC. (2005). Tobacco Use and Reproductive Outcomes-Fact Sheet. Retrieved on January 2, 2006 from http://www.cdc.gov/tobacco/sgr/sgr_forwomen/factsheet_outcomes.htm

Healthy People 2010. Office of Disease Prevention and Health Promotion; U.S. Department of Health and Human Services. Retrieved on January 27, 2006 from http://www.healthypeople.gov/default.htm

ISDH. (2005). Indiana Lead Program Outcomes. Retrieved on December 23, 2005 from www.in.gov/isdh/programs/lead/data_program_outcomes.htm

ISDH. (2000). Indiana Lead Program Statistical Tables. Retrieved on December 23, 2005 from www.in.gov/isdh/programs/lead/data_lead_tables.htm

ISDH. (2005). Historical Information About Lead Poisoning in Indiana. Retrieved on December 23, 2005 from www.in.gov/isdh/programs/lead/about_historical.htm).

EPA. (January 2000). Buying a Home? Here's what you need to know about lead-based paint!. 747-F-99-001 January 2000, Prevention, Pesticides, and Toxic Substances (7404)

EPA. (2000). Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards. Retrieved on December 28, 2005 from http://www.epa.gov/lead/pubs/fedstrategy2000.pdf

March of Dimes Birth Defects Foundation. Quick Reference: Smoking During Pregnancy. http://www.marchofdimes.com/printableArticles/14332_1171.asp.

Martin, J., Hamilton, B., Sutton, P., Ventura, S., Menacker, F., Munson, M. (2003). Births: Final Data for 2002. National Vital Statistics Reports, volume 52, number 10.

National Safety Council. (2004). Lead Poisoning. Retrieved from http://www.nsc.org on January 2, 2006.

O'Neil, J., Steele, G., McNair, C., Matusiak, M., & Madlem, J. (2005). Blood Lead Levels in NASCAR Nextel Cup Teams.

U.S. Department of Health and Human Services. (2004). The Health Consequences of Smoking: A Report of the Surgeon General—2004. Centers for Disease Control and Prevention, Office on Smoking and Health, Atlanta Georgia..

U.S. Department of Health and Human Services. (N.D.). Preventing Chronic Diseases: Investing Wisely in Health: Preventing Smoking During Pregnancy. Centers for Disease Control and Prevention, Chronic Disease Prevention, Atlanta Georgia.