

Tainted?

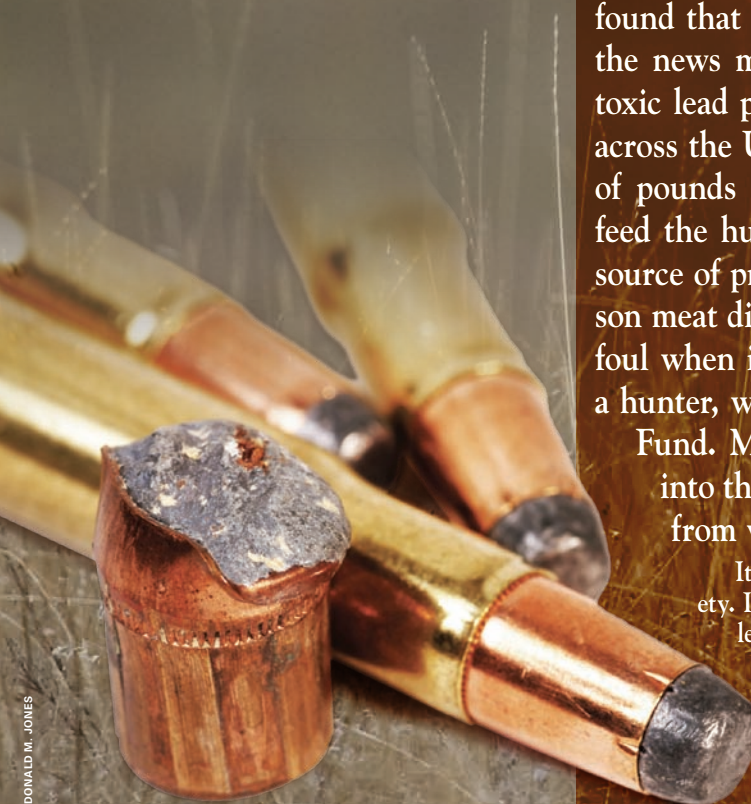
A Look at the Controversy Surrounding Lead Contamination of Venison from Bullet Fragments and the Potential for Human Exposure. What's the Science behind it?

By Howard P. Monsour, Jr., M.D.
B&C Regular Member

Sarah Livesay
RN, MSN, APRNC

Early in 2008, a firestorm of news articles appeared concerning possible toxic exposure from lead bullets used by hunters. This began with the initial publication of a study performed by a Bismarek, North Dakota, dermatologist. Utilizing x-rays, he found that metal was present in 53 of 95 packages of ground venison to be donated to food pantries. Assuming this was lead, he brought this to the attention of the Department of Health of North Dakota, who subsequently took five samples targeting the metal pieces and found that all five tested strongly for lead. This information took the news media by storm. Headlines outlining the possibility of toxic lead poisoning in hunters and hunter's families appeared all across the United States. Concern was raised about the thousands of pounds of venison donated each year in many states to help feed the hungry. One deer could provide 100 people with a rich source of protein. Some states issued immediate recalls of all venison meat distributed in such pantries. Many hunting groups called foul when it was learned that this physician, who professed to be a hunter, was actually on the Board of Directors of the Peregrine Fund. Most importantly however, this launched investigations into the possibility of lead contamination and lead intoxication from venison.

It is important to understand the historical perspective of lead in our society. In the United States, adults and children have generally been exposed to lead to some degree throughout their lives. Elevated blood levels can occur in numerous settings. Adults who work in manufacturing and construction are at risk for occupational exposure. Lead was added to gasoline in the 1920s. It is estimated that 90 percent of atmospheric lead originated from automobile exhaust and accounted for the main increase in environmental lead concentration observed between the





1930s and 1960s. Lead-free gasoline was introduced in the 1970s and has contributed considerably to the decrease in lead levels when monitored in the United States and around the world.

Lead paint has also been shown to be a major cause of elevated lead levels in children and in adults, which led to regulation of lead content in paint in 1978. In some parts of the United States, illegally distilled alcohol (moonshine) is also a source of lead exposure. Lead exposure is particularly toxic in children. Those younger than age six years of age are more susceptible than adults to the toxic effects of lead because children have an incomplete blood brain barrier that permits entry of lead into the developing nervous system. Also, young children have a

greater prevalence of iron deficiency, which causes increased absorption of lead from the gastrointestinal tract.

The regulation of lead in the United States has resulted in a significant reduction in lead levels in the past several decades. In 1991, the Centers for Disease Control (CDC) in the United States established 10mcg/dL (micrograms per deciliter) as the threshold for lead toxicity. This decrease from 60 mcg/dL was prompted by evidence of cognitive and behavioral effects of low-lead toxicity. Baseline lead levels across the United States have shown consistent and significant reductions in children and adults.

Humans absorb lead primarily through the lungs and the gastrointestinal tract. Once absorbed, lead is distributed to

the blood, soft tissues, and skeleton. Lead in the blood is excreted via the kidneys with a mean half-life of 30 days if renal function is normal. Lead in the skeleton (bones) has a half-life of decades and contains approximately 95 percent of the body's pertinent lead. Lead can be released from the body's bone reservoir during times of bone turnover. This occurs during pregnancy which then exposes the fetus to lead and with mother's breastfeeding. It is for this reason, that lead exposure is particularly concerning with women of childbearing age.

Clinical manifestations of lead toxicity can be divided into acute exposure and chronic exposure. Acute exposure would be defined as "lead poisoning." Symptoms are often nonspecific such as muscle pains, fatigue, irritability, insomnia, anorexia, impaired short-term memory, and difficulty concentrating. Chronic low levels of lead exposure can increase risks of kidney damage, high blood pressure, anxiety, and hostility. High lead levels in children can lead to developmental delay and decreased language and motor skills. Population-based studies have consistently shown that lead levels greater than 10 mcg/dL in children affect cognitive and behavioral development. Though it has been stated widely in the lay literature that there is no "safe lead level," it is virtually impossible to assume that a zero lead level is attainable in our environmental situation.

Lead has served as a basic ingredient in ammunition for hundreds of years. The first reports regarding lead ingestion appeared in the medical literature in the 1960s. Most of these reports are related to inadvertent ingestion and retention of lead shot resulting in increased lead absorption. Most of these patients presented with chronic complaints of abdominal pain and other manifestations of lead toxicity. With removal of the lead objects, it has been shown that lead levels decreased significantly or returned to normal. From the pre- and post-lead level measurements, it was well documented that consumption of lead in these individual circumstances led to lead toxicity.

It is not surprising that animals shot with lead projectiles which do not succumb have an increased incidence of lead exposure. Animals that eat lead also are at risk of intoxication. This led to the banning of lead shot in migratory game birds. In the late 1990s and early part of this decade, several studies evaluated the potential risk of lead exposure to humans who consume birds that succumb to lead shot. The best of these studies was performed in Greenland's indigenous (Inuit) adult population. These

"I recognize the right and duty of this generation to develop and use the natural resources of our land; but I do not recognize the right to waste them, or to rob, by wasteful use, the generations that come after us."

Theodore Roosevelt

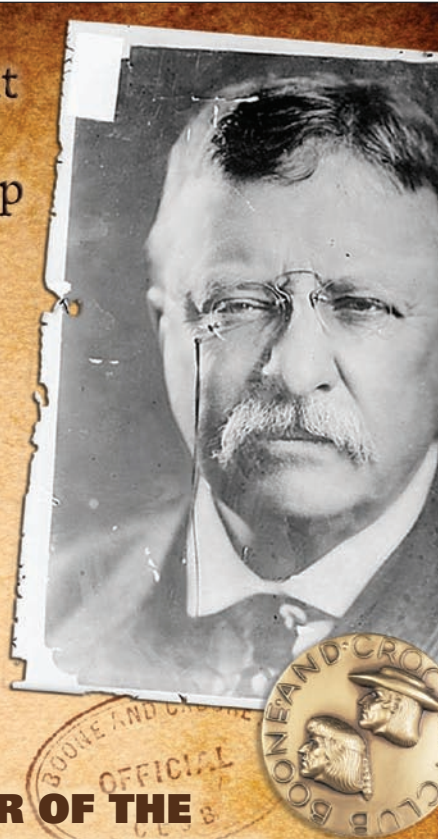
BECOME A MEMBER OF THE ROUGHRIDERS SOCIETY TODAY

You can help the Boone and Crockett Club ensure the future of the "natural resources of our land" for our children and grandchildren by joining the Roughriders Society.

Members of this prestigious group include the Boone and Crockett Club in their financial and estate plans. Careful planning often allows Roughriders Society members to enjoy substantial tax advantages, while supporting the Boone and Crockett Club's vital conservation work.

Roughriders Society members proudly wear distinctive lapel pins and are acknowledged in the Boone and Crockett Club Visitors Gallery and in the annual report each year.

Please call 406-542-1888 ext. 212 for more information.



Tainted?

studies were performed after it was noted that this isolated population contained similar or higher lead levels than the rest of the Western population despite the removal of leaded gasoline and the reduction in lead levels in Western populations. Previous studies had demonstrated that certain sea birds contained increased lead which was isotopically matched to the lead in ammunition. Participants in this population study who ate a daily intake of these sea birds had lead concentrations more than double those who

reported less than weekly intake of sea birds. In those who ate sea birds several times a week, the concentrations were mid range. These studies supported previously reported studies from Canada in 1995 that demonstrated elevated blood lead levels in children related to the consumption of birds containing lead shot. Earlier this decade, studies were also completed in Greenland concluding that the most important source of lead in the diet of many of the indigenous populations in Greenland came from lead shot that contaminated the sea bird meat. It was with these studies concerning birds and lead toxicity that introduced the first concept of pulverized or microscopic lead, sometimes referred to as lead dust, as a potential source of lead poisoning. It was noted that most people will pick out the lead shot and not consume it. Regardless, residual lead dust may be present in the meat particularly if the lead hits hard structures such as bone.

Until 2008, almost no studies had been performed looking at the potential of lead toxicity from projectiles in big game animals and the possible effects on humans. With the alarm raised in North Dakota, multiple state agencies were mobilized to evaluate the problem. In October 2008, a North Dakota lead-exposure study was completed. This was a retrospective study that involved the CDC and the various epidemiologic and environmental departments. It was performed to assess the human health risk from consumption of wild game and possible lead contamination among residents of six North Dakota cities. Exposure to wild game was defined as self-reported consumption of wild game meat including venison, other wild game, and birds excluding waterfowl. Blood samples from 736 persons were analyzed.

Almost all of the participants (98.8 percent) reported eating venison, and 64.5 percent and 84.4 percent reported consuming other game and birds, respectively. Almost

all of the participants primarily hunted the wild game they consumed. Eighty-two percent reported processing their own meat. Ninety-two percent of the participants reported cleaning the meat around the wound channel. Thirty-one percent had the meat processed by meat packers/lockers; 9.2 percent by local butchers. Most of the participants consumed the venison throughout the year, half reported consuming other game or birds occasionally

summary, this excellent study demonstrated that individuals who eat game shot with lead projectiles do demonstrate higher lead levels most likely related to the consumption of that game type. However, there is no evidence that this led to significant health hazard or toxicity in this population. It was

noted that adults over 65 tended to have higher lead levels and reported eating wild game for a decade or more. However, these patients were also more exposed to environmental lead, especially leaded gasoline over the previous decades, which may account for some of the high lead levels. Higher lead levels were also noted in males and females who participated in lead-related hobbies including target shooting, home remodeling and painting, and reloading.

Another study conducted at Washington State

University evaluated the effect of feeding pigs, which have a digestive absorption similar to humans, ground meat of 30 deer with lead fragments. Blood lead levels were measured immediately after the ingestion and several days thereafter. The mean blood level concentration of the pigs peaked to 2.29 mcg/dL (maximum 3.8 mcg/dL) two days following ingestion of venison containing lead fragments. The deer in this study were killed using a 7mm Remington Magnum 150-grain bullet. The bullets consisted of a lead core (68 percent of mass) and copper jacket (32 percent) with lead exposed at the tip, commonly classified as rapidly expanding bullets. The average shot distance was 116 meters (range 25 to 172 meters). Eighty-seven percent of the deer were shot in the thorax and in 92 percent of the shots, some portion of the projectile exited in the animal. The collected blood samples were performed one hour prior to feeding the venison on day zero, and then on days one, two, three, four, seven, and nine. Mean blood lead level concentrations in the pigs fed venison with lead fragments were significantly elevated above those in the control pig on post-exposure days one, two, and three only. This study supports the previous study from North Dakota that eating lead meat will result in absorption of lead. However, the scope of the study cannot draw any conclusion as to the potential toxicity of the lead ingestion, only

■ **The current scientific studies show an increase in lead levels related to the ingestion of game animals harvested using lead projectiles, but no evidence that significant levels of exposure have occurred in the live population of venison eaters studied thus far.**

INTERESTED IN REDUCING RISK

- **Use copper or non-exposed, lead-core bullets, muzzleloader bullets, or shotgun slugs, which have the potential to substantially reduce the fragmentation**
- **Properly process the meat by removing the meat around the wound channel**
- **Bullet placement resulting in a good clean harvest of the animal is paramount**

and only during the hunting season. Results showed that older individuals tended to have higher lead levels and males tended to have higher lead levels than females. Participants who lived in homes built between 1950 and 1977 also tended to have higher lead levels.

This study did show that participants who consumed wild game had a 0.30 mcg/dL higher lead level in comparison with people who do not consume wild game. Participants who did not consume wild game within a month before the data collection had significantly lower lead levels, likely because of the half life and excretion of lead. Among those participants who reported eating other game, a 0.40 mcg/dL increase in lead was associated with having an average serving size greater than two ounces compared to those who consume less meat.

From a scientific perspective, this study showed that people who consume wild game have increased lead levels directly related to the consumption of wild game. Those participants who consumed all game types had the highest lead levels. Participants who consumed a larger than average serving size (greater or equal to two ounces) had higher lead levels. No participant in the study had a higher lead level than the CDC recommended threshold of 10 mcg/dL. In fact, the geometric mean lead level (1.17 mcg/dL) of the study population was lower than the overall population geometric mean lead levels in the United States (1.60 mcg/dL). In

the fact that lead from these shot deer was eventually absorbed. These pigs were fed significantly larger portions of venison than that reported as the average meal size in the North Dakota study.

Preliminary results of a study performed at the Minnesota Department of Natural Resources were recently published. This study examined the variability associated with bullet fragmentation and deposition in whitetail deer and domestic sheep killed by bullets. This study evaluated samples of both ground and muscle cuts of deer utilized for a donation program to feed the hungry. They found that 27 percent of ground venison and two percent of whole muscle cuts had detectable metal fragments. Laboratory testing of these metal fragments proved that the metal fragments were lead. They decided to take things a step further and perform a study to improve the understanding of bullet fragmentation patterns in carcasses. They performed this study using a center fire rifle (.308) with 150-grain bullets of three types: rapid expansion, controlled expansion and non-lead (copper) bullets. Also used was a .50 caliber muzzleloader with 100 grains of powder and two different bullet designs. A 12-gauge one ounce Foster-style slug shotgun was utilized. In this study, eight deer were also included, killed by a sharpshooter at less than 100 meters using Ballistic Tip bullets as part of a deer reduction project. Seventy-two euthanized domestic sheep were shot in the thoracic cavity at 50 meters (54 yards). Bullet fragments were counted in both animals and analyzed using radiography at the University of Minnesota. Muscle tissue samples were collected at two, 10, and 18 inches from the exit wounds. The researchers also washed the sheep shot with both types of rapid expansion bullets and took a second radiograph to determine the effect washing had on fragmentation distribution.

Animals shot from bullets with no exposed lead (copper case surrounding the lead core) or pure copper bullets were found to have significantly reduced or no lead exposure. The non-exposed lead core bullets averaged nine copper fragments in the animal with an average maximal distance from the wound channel of seven inches. The pure copper bullets obviously had no lead fragments and the few fragments that were seen were less than an inch from the exit wound. The ballistic tip bullet exhibited the highest fragmentation rate with an average 141 fragments per carcass and an average maximum distance of 11 inches from the wound channel. Soft point bullets averaged 86 fragments per carcass with a maximum distance also at 11 inches from the wound channel. Interestingly, bonded lead core bullets performed almost identically to the soft-core bullets with an average of 82 fragments and an average maximum distance of nine inches from the wound channel. Shotgun slugs averaged 28 fragments at an average maximum distance of five inches from the wound channel. Muzzleloader bullets (245 and 300 grain) left an average of three and 34 fragments, respectively with distances of one and six inches respectively.

Rinsing of the carcass produced less lead around the wound channel but was also found to scatter some lead away from the wound potentially contaminating areas previously not affected. In summary, those bullets that retained the most of their weight were the least to cause lead fragment contamination. Copper bullets retained almost 95% of their weight with minimal fragmentation and had no lead contamination. Cleaning of the wound channel will remove most but not all of the lead fragments and rinsing is not a safeguard for removing all lead fragments.

The researchers also shot three animals in the hindquarters which showed extensive fragmentation. The hunter would not want to use this meat. In other words, shot placement is an important additional variable in reducing potential lead fragmentation.

Finally, a health consultation report was released in November 2008 by the Wisconsin Department of Health and Family Services (DHFS). They collected one pound ground venison samples from freezer stocks of five food pantries and six meat processors throughout the state and additionally from whole and cut venison from Wisconsin

Department of Natural Resources employees (hunter samples). These were grouped into commercially or hunter-processed venison. The prevalence of lead in the samples was 15 percent in the commercial samples and eight percent in the hunter sample groups. They then took the mean concentrations of lead found in the contaminated samples and used a biokinetic model to compare lead concentrations to the FDA's provisional tolerable intake levels for lead in adults and children. This simulated analysis showed that there was a significant possible lead-ingestion threat to children if they ate the contaminated samples. The modeled exposure estimates demonstrated that 100% of children who would eat from the maximum detected lead level samples percent would exceed a lead level of 10mcg/dL. Of the children who ate from the low lead level samples, four percent would exceed 10mcg/dL concentration. They concluded that because elevated blood lead has not been confirmed among consumers of venison and because measured lead content in venison varies greatly "there is an indeterminate public health hazard among those consumers." This study shows that in the presence of lead in the venison a theoretical exposure pathway exists for the ingestion of contaminated meat. However, 85 percent of the commercially processed venison and 92 percent of the hunter-processed venison did not contain lead. The modeled exposure assumed that the children would eat the contaminated venison 100 percent of the time.

In conclusion, state agencies should be commended for acting appropriately to concern regarding lead ingestion. They limited possible exposure by stopping the distribution of potentially lead-contaminated venison and then conducted studies to assess the risk. The current scientific studies show an increase in lead levels related to the ingestion of game animals harvested using lead projectiles, but no evidence that significant levels of exposure have occurred in the live population of venison eaters studied thus far. Modeled experiments show that a theoretical risk can occur in children who ingest the highest and moderately high levels of lead-contaminated venison. The use of copper or non-exposed, lead-core bullets, muzzleloader bullets, or shotgun slugs have the potential to substantially reduce the fragmentation and thus, the possible contamination from lead. The proper processing of the meat with removal of the meat around the wound channel is another good suggestion. And finally, as always, bullet placement resulting in a good clean harvest of the animal is paramount. ■

