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COMMENT

Consumption of wild-harvested meat from New Zealand feral animals provides a unique opportunity to study the health effects of lead exposure in hunters

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There are numerous reasons for countries to transition to non-lead ammunition as highlighted by Kanstrup et al. (2016). When wild game animals are killed with lead projectiles, hundreds of lead fragments are dispersed throughout the carcass and packages of processed wild game are reported to contain lead fragments (Hunt et al. 2009). There is also a correlation between subsistence hunters using lead projectiles and elevated levels of lead in the blood (Tsuji et al. 2008; Iqbal et al. 2009; Fachehoun et al. 2015). Since there is no safe level of lead exposure (Canfield et al. 2003; WHO 2009), this lead exposure through hunting may be a significant public health concern and one that is avoidable (Buenz 2016). Furthermore, many hunters are unaware of the potential risks of lead in wild-game meat or hold unyielding opinions that lead projectiles do not pose a health risk. However, we are all aware that a correlation does not imply causality, and there has yet to be a conclusive interventional study establishing if there are increased levels of lead exposure due to eating wild game harvested with lead bullets or shot.

We hypothesize that eating wild game harvested with lead bullets results in increased blood lead levels for hunters and their family members. This hypothesis can be tested through an interventional trial in New Zealand by providing hunters with lead-free or standard lead projectiles and measuring blood lead levels after hunters and their families eat wild game. New Zealand is the ideal location for this study because all wild game species are feral, without a restricted hunting season.

When Captain Cook arrived in New Zealand in 1773, his crew released the first pigs and goats into an environment that previously had supported only a limited range of highly endemic fauna, almost exclusively birds. Multiple subsequent animal liberations also occurred throughout the islands of New Zealand to provide a food source for potential castaways. Additionally, other species, specifically multiple types of deer, tahr, and chamois, were introduced to foster game hunting. As a result of these introductions, New Zealand has at least 14 species of feral ungulates. The modern New Zealand Department of Conservation is tasked with either managing or exterminating these feral species: this effort goes as far as aerially deploying more of the pesticide sodium fluoroacetate (i.e., 1080) than anywhere else in the world. In a similar effort, New Zealand is the only place in the world with license-free, year round, wild game hunting (Kerr and Abell 2014). In contrast, in the United States and Europe, the hunting season lasts for only weeks or months. This unique hunting situation allows hunters in New Zealand to harvest more wild game, more regularly, for food.

We propose a two-year blinded study randomizing hunters to groups harvesting animals with lead projectiles and lead-free projectiles. Specifically, after a run-in period and baseline blood lead-level assessment, hunters would be given lead or lead-free bullets and asked to harvest and process their deer. Within the lead pharmacokinetic peak of 2–4 days after ingesting lead (Hunt et al. 2009), hunters and their families would be asked to provide blood and urine samples for lead-level measurement and report the location where the game eaten was harvested. Since individual hunters tend to harvest game from a specific geographic area, a crossover study design would be possible, with hunters switching to the other projectile type after 1 year. Since following exposure to lead there is a temporal

Fig. 1 Intergenerational hunting. For many individuals, hunting wild game for meat is part of an intergenerational bonding experience. Unfortunately, this experience may be exposing family members to lead through eating meat harvested with the use of lead projectiles. A blinded crossover study providing hunters with lead or lead-free projectiles would determine if this lead exposure through lead projectile fragments in the meat resulted in raised lead levels

peak with a subsequent sequestering into bone (Ahamed and Siddiqui 2007), these acute measurements allow determination of dietary lead exposure. Additionally, it would be possible to use isotope analysis to identify if the lead levels in the blood of participants were primarily from the environment, or from the lead bullets (Tsuji et al. 2008; Thomas et al. 2009). Fortunately, baseline blood lead levels in New Zealand are similar to levels in other developed countries (Silva et al. 1988), and thus, allow a broad extrapolation of the data generated. This simple design would take into account any environmental phenology of the wild game.

Importantly, the results from this study are easily implemented: a significant increase in blood lead levels when lead bullets are used would support the conversion to lead-free ammunition; conversely, if it were to be determined that lead levels in hunters consuming wild-harvested game harvested with lead bullets were not elevated, continuing the use of lead bullets would be possible with little potential health concern. If elevated lead levels are observed in individuals eating meat harvested with lead bullets, these findings can be further expanded to animals consuming the carrion of lead-shot game (Hunt et al. 2006)—these carrion-eating animals would likely be experiencing increased lead levels as well.

For many people, the intergenerational primal experience of hunting wild game (Fig. 1) is an important part of their family culture (Peterson et al. 2011). If it is shown that the lead fragments in the meat they harvest results in increased blood lead levels, switching to non-lead projectiles would offer a suitable alternative to continue the cultural hunting experience. Thus, regardless of the outcome, the data resulting from testing this hypothesis will have an important impact on the health of individuals consuming wild-harvested game and provide data addressing the most significant data deficiency in the implementation of policy that Kanstrup et al. have described.

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