A Section 508–conformant HTML version of this article is available at https://doi.org/10.1289/EHP2582.

Examining Lead Exposures in California through State-Issued Health Alerts for Food Contamination and an Exposure-Based Candy Testing Program

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Summary: In California, the annual number of children under age 6 y of age with blood lead levels (BLL) ≥10 μg/dL is estimated at over 1,000 cases, and up to 10,000 cases when BLL between 4.5 and 9.5 μg/dL are included. State-issued health alerts for food contamination provide one strategy for tracking sources of food-related lead exposures. As well, California passed legislation in 2006 for the Food and Drug Branch (FDB) of the state health department to test and identify lead in candy. This report presents health alert data from California over a 14-y period, compares data before and after the candy testing program began, and examines country of origin, ZIP code data, and time from candy testing to release of health alerts for lead-contaminated candies for 2011–2012. After 2007, health alerts issued for lead in candy and food increased significantly. Analysis of candy-testing data indicated that multiple counties and ZIP codes were affected. Seventeen candies with high lead concentrations were identified, resulting in rapid dissemination (<2 wk) of health alerts to local health departments and community clinicians and to the public. Surveillance of lead exposures from state-based food and candy testing programs provides an opportunity to identify and immediately act to remove nonpaint sources of lead affecting children. https://doi.org/10.1289/EHP2582

Introduction

In 2011, California ranked fifth in the United States for the number of children under 5 y of age with blood lead levels (BLLs) ≥10 μg/dL, with approximately 950 cases a year between 2007 and 2011 (Raymond and Brown 2015). In 2012, more than 11,000 cases of elevated lead levels (ELLs), defined as levels >4.5 μg/dL, were reported for children under 6 y of age in California (CLPPB 2017).

Lead poisoning prevention in the United States has focused on the removal of lead from industrial sources, including paint and gasoline. Other sources of lead, such as tainted tap water and contaminated foods, warrant more thorough assessment. Case reports from local and state lead poisoning prevention programs suggest that up to 30% of pediatric lead poisoning cases investigated (with cases defined as BLLs ≥10 μg/dL), did not identify an immediate lead paint hazard (Brown and Margolis 2012). Many childhood lead poisoning case investigations have identified nonpaint related exposures, including tap water, food, candy, home remedy products, take-home contamination from workplace exposures, or hobby-related contamination (Brown and Margolis 2012; FDA 2006).

Field investigation data also suggest that nonpaint lead exposures are often insufficiently characterized and their importance thus underestimated. For example, a 2012 report from the Centers for Disease Control and Prevention (CDC) indicated that lead program inspections primarily focus on looking for lead paint hazards in the physical structures where children with BLLs ≥10 μg/dL spend time, and that nonpaint sources are sought only when no paint hazards are found (Brown and Margolis 2012).

In this Brief Communication we report the benefits of active surveillance of health alerts in identifying nonpaint sources of lead and preventing future lead exposure in children. In particular, we focused on health alerts stemming from a program of the Food and Drug Branch (FDB) of the California Department of Public Health (CDPH), in which a specific food type, candy, is tested for lead contamination.

Discussion

Background

The current permissible tolerable lead level in food likely to be consumed by small children (such as candy) was lowered by the U.S. Food and Drug Administration (FDA) to 0.10 parts per million (ppm) following several case reports of lead-contaminated candy resulting from field investigations across the United States (FDA 2006). In California alone, several reports have been published about lead poisoning cases associated with candy and food. Among these were a case-series investigation into childhood lead poisoning associated with imported candy (CDC 2002); an outbreak investigation that identified food-related sources of lead exposure among pregnant women and children in Seaside, Monterey County (Handley et al. 2007); and a series of investigative reports focusing on candy imported from other countries, especially Mexico (Orange County Register 2004). In a case investigated in Seaside, some food and candy samples tested had lead levels as high as 2,300 ppm (Handley et al. 2007; CDHS 2003), and case investigations in Orange and Stanislaus counties identified candy with over 21,000 ppm (CDHS 2001).

In a 2002 report from the California Childhood Lead Poisoning and Prevention program, the authors wrote that candy produced in Mexico was identified as a possible exposure source in approximately 15% of about 1,000 cases of (which was at the time defined as ≥10 μg/dL) that were reported to the California Department of Health Services over a period of 9 mo (CDC

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The authors declare they have no actual or potential competing financial interests.

Received 28 July 2017; Revised 6 September 2017; Accepted 7 September 2017; Published 26 October 2017.

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2002). The number and severity of many of these reports in California resulted in legislation being passed in 2006 requiring increased surveillance of lead in candy and public reporting. Currently, the state FDB is responsible for collection of candy samples, and the Food and Drug Lab Branch conducts testing. Extensive candy testing began in 2007.

As in many other states, health officials in the CDPH and the FDB prepare and disseminate health alerts to regional and county public health programs, practicing community clinicians, and the general public. In the context of food, health alerts warn of potential toxic food exposures identified by public health and food safety program, including recalls, seafood-related quarantines, and episodes of contamination that have potential widespread public health impact. California also disseminates health alerts across the state to warn health care providers and the public health community about potential lead hazards. Health alerts related to pediatric lead poisoning cases can provide information about nonindustrial lead exposures such as candy and other foods. The CDPH issues health alerts through its newsroom to notify the public about emerging health threats and to encourage voluntary recalls of contaminated products.

Data Sources

We obtained CDPH health alerts from the department's website for the years 2007 to 2014, and from the California Department of Health Services newsroom for alerts issued between January 2001 and June 2007. Health alerts issued between 2001 and 2014 were reviewed by four independent reviewers (M.A.H., K.N., C.C., E.S.) to determine whether *a*) health alerts were considered warnings, which focus on higher-level concerns, compared with less serious advisories and announcements also included in news releases, and *b*) health alerts involved food contamination. For the purposes of this report, we excluded warnings that focused on fishing restrictions—including shellfish quarantines—and on harvesting wild mushrooms, as well as warnings that focused on products identified as home remedies or alternative medicines.

Warnings about food contamination were then data-abstracted into a spreadsheet and coded by the biological or chemical name of the contaminant; the year; the food product contaminated; country of origin for the food; and, for alerts involving lead, the level reported in parts per million or micrograms per serving (ppm or μg/serving). Using criteria established by the CDC (Gould et al. 2013), foods were assigned to one of 17 commodity groups: fish, crustaceans, mollusks, dairy, eggs, beef, game, pork, poultry, grains/beans, oils/sugars, fruits/nuts, fungi, leafy vegetables, root vegetables, sprouts, and vegetables from a vine or stalk. Additionally, semi-prepared foods, such as hummus, dips, spreads, and cookie dough, were classified as prepared foods. Herbal teas or supplements, spices, and drinks were each given a separate category.

We obtained data on candies tested in 2011 and in 2012 from the CDPH FDB, Food Safety Section (P. Kennelly, written communication, May 2014). We reviewed lab slip requisition forms, abstracted data on country of origin, lead levels detected, sample submission dates, and ZIP codes for sites where samples were collected. We focused on two years, 2011 and 2012, the most recent years for which there were available candy data at the time of the analysis. For candies that were tested multiple times, only one observation was selected and the highest tested lead level included.

The sampling strategy for candies attempted to include a wide range of retail stores and candy distributors across the state. The data were reviewed to *a*) determine how many of the candies tested had high levels of lead exceeding the established limit of 0.10 ppm; *b*) determine how many individual candies that were tested subsequently resulted in a health alert being issued, as well as the time frame from testing to health alert release; *c*) describe the levels of lead among those candies with amounts exceeding the FDA limit; *d*) identify the country of origin of lead-contaminated candies; and *e*) determine which ZIP codes and counties the contaminated candies included in the sample represented.

Findings

A total of 164 health alerts were issued for food contamination in California between 2001 and 2014 [California Department of Health Services, written communication, June–July 2012; California Department of Health Services online archive (archive taken off line 6 October 2017; accessed 15 June 2015)]. Of these, the largest percentage (36.6%) was issued for lead contamination in foods (Figure 1).

Of the 60 lead-related health alerts issued over this period, 55 (91.6%) were for imported foods, and the remaining 5 were for food products manufactured in the United States. Almost all of the health alerts for lead-contaminated imported foods (96.3%) were for candy products. Of the two noncandy related health alerts focusing on imported food products, one was for *chapuline* (a toasted grasshopper snack food), and one was for spices/herbs. Lead-contaminated imported candies came primarily from Mexico (34%), China (24%), and India (20%).

There was a substantial increase in the total number of health alerts issued after 2006, primarily for lead in candy. Between 2001 and 2007, before the candy testing program was widespread, 22% of the 48 total health alerts issued related to lead contamination. In the 7 y after the candy testing program was in effect, between 2008 and 2014, lead-related health alerts made up approximately 42% of the total of 116 issued ($p < 0.05$).

Over the time period 2011–2012, 1,346 candies were tested for lead, and 65 unique products were identified as having lead levels >0.05 ppm (4.8%). Close to two-thirds ($n = 40$) had lead levels ≥0.10 ppm; the highest level of lead was 2.4 ppm. These test results prompted 17 health alerts for lead-contaminated candies.

The median length of time between the date of the test results and the date of health alert issuance was 6 d. All but one was issued within 2 wk of the time that the test results were reported. The most frequent countries of origin for the 65 candies identified over the 2-y period were India (35%), Taiwan (12%), China (11%), the United States (11%), Mexico (9%), Pakistan (6%), Hong Kong (4%), United Kingdom (3%), with 1 candy each for Germany, Indonesia, Thailand, Turkey, and Spain. ZIP codes were not identified for 6 of the 65 candies (9.2%). The ZIP codes for the 17 candies for which health alerts were issued represented 11 counties across the state.

Conclusions

Based on these observations, lead-contaminated candies represent an important contribution to lead exposures in California. The fact that a large number of unique products were identified among the contaminated candies presents an ongoing challenge for exposure-based testing programs, as does the large number of candies tested for which no lead was detected. After legislation was passed requiring more widespread testing of candies for lead, many imported candies were identified as containing lead, suggesting that imported candy might be considered a public health risk for lead poisoning in California. However, this approach does not convey the magnitude of that risk, because the sampling methods are not currently population-based. More work is needed to determine the best approaches to sampling in order to determine the magnitude of the problem.

We do not know whether other food sources (besides candy) that are not tested through the candy testing program, or candies not included in the sampling, also contribute to lead exposures in

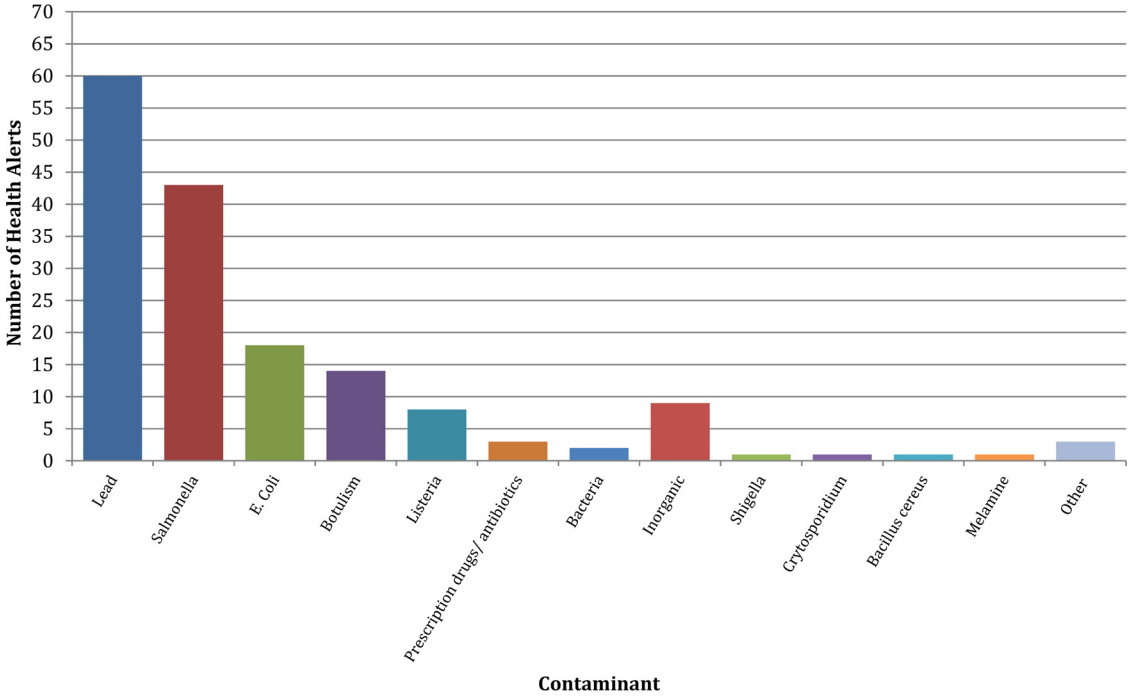

Figure 1. Food-related health alerts issued in California by contaminant type, 2001–2014 ($n = 164$).

California. Furthermore, these data do not represent prevalence estimates of lead risks at the county and ZIP code level. Nevertheless, the candy testing program does provide a means of proactively detecting sources of lead, and the health alerts may help prevent lead poisoning cases in vulnerable populations, particularly children.

We know that consumption of contaminated foods, such as lead-contaminated candies, can immediately result in ELLs, especially in children. A recent study of lead in candy in Mexico identified a significant association between the previous week's lead intake through the consumption of candy and the proportion of children with BLLs above the CDC action level of 4.5 μg/dL (Tamayo y Ortiz et al. 2016). In that study, lead levels in candy consumed the previous week ranged between 0.13 and 0.70 ppm—which are similar levels to those found in California candies, as reported above—and exceeded 0.10 ppm, the FDA reporting threshold.

Although there have been few exposure-based programs to track lead exposures in foods, we believe that the California program to test candies and rapidly translate these results into health alerts and recall programs is a useful model. The availability of new technologies to screen foods for lead, such as XRF (X-ray fluorescence) screening tools (Reames and Charlton 2013), can allow for local programs to increase exposure-based surveillance activities. These screening results can, in turn, help prioritize which food and candy samples should be sent to local and state laboratory testing programs. Multiple strategies, including the one presented in this report, along with case-based investigations, are needed to assist health departments and clinicians in practice to translate health alert data into implementation strategies and clinician practice.

Acknowledgments

The authors acknowledge funding from the National Institute on Minority Health and Health Disparities, National Institutes of Health (grant P60MD006902).

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