Childhood Lead Testing and Poisoning Report: Pennsylvania Birth Cohort Analysis

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Executive Summary

This is a supplementary report to the Pennsylvania Department of Health's (Department) 2018 Childhood Lead Surveillance Annual Report,[1] covering data for children who were born to Pennsylvania resident mothers in 2015 and 2016 and tested for blood lead levels (BLLs) in Pennsylvania from birth to the age of 2 years. Using a cohort analytic design, this report provides more accurate estimates of the blood lead testing rates among children who were followed from birth to the age of 2 years and of the proportions of elevated blood lead levels (EBLLs) than the previous report,[1] using a cross-sectional design. Birth certificate data of children born to Pennsylvania resident mothers in 2015 and 2016 were linked to blood lead test data from the Pennsylvania National Electronic Disease Surveillance System (PA-NEDSS) using personal identifiable information.

This report is an overview of childhood blood lead tests for 2015 and 2016 birth cohorts through their first 2 years of life in Pennsylvania. The report provides information regarding variability in screening for exposure to lead and the proportion of children with EBLLs by maternal and infant demographics and neighborhood characteristics. This report can be used by the Department to 1) identify areas (counties and municipalities) with potential undertesting of children for BLLs and with higher percentages of EBLLs and 2) identify characteristics of children with potential undertesting for BLLs and with higher percentages of EBLLs. This report can also be used by federal agencies, hospitals, universities, health care providers, county/municipal health departments, and childhood lead prevention partners for further research or for planning within primary prevention programs.

Exposure to lead, even at low levels, can cause intellectual, behavioral, and academic deficits.[2,3] For this reason, in 2012, the Centers for Disease Control and Prevention (CDC) redefined an elevated blood lead level (EBLL) from "level of concern" of 10 micrograms per deciliter (µg/dL) to "blood lead reference value" of 5 µg/dL.[4] This value is also used to identify children who require case management, because low levels of blood lead have been known to negatively affect intelligence quotient, ability to pay attention, and academic achievement.

Nationally, among states with older housing stock, lead-based paint continues to be a significant source of lead exposure in young children. According to the 2018 American Community Survey estimate, Pennsylvania ranks fifth in the nation for the percentage of housing units identified as having been built before 1950, when lead was most prevalent.[5] Other sources of lead exposure include toys, ceramics, and numerous other consumer products including imported products.[4] Drinking water can also be a source of lead exposure when it flows through older lead plumbing or pipes where lead solder has been used (which can occur in newer plumbing as well).

A total of 272,887 children (137,246 from the 2015 birth cohort and 135,641 from the 2016 birth cohort) born to Pennsylvania resident mothers were included in our analysis. Of the 272,887 children, 132,738 (48.6%) children were tested for BLLs before 2 years of age. Among

132,738 children tested for BLLs before 2 years of age, 3,501 (2.6%) children had confirmed EBLLs. Among these two birth cohorts, non-Hispanic white children had the lowest percentage of children tested for BLLs (44.7%), while the highest percentage was seen among non-Hispanic black children (63.2%). Percentages of children tested for BLLs were relatively low for children whose maternal educational attainment was less than high school and for children born to mothers whose principal source of payment for delivery was "self-payment." Additionally, percentages of children tested for BLLs were relatively high for children born to mothers who were enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), who reported smoking either before or during pregnancy, and who reported having a reportable infection(s) during pregnancy. Percentages of children tested for BLLs were also higher for children living in neighborhoods with lower levels of household income, higher levels of poverty, and higher proportions of old housing.

Among children screened for BLLs before 2 years of age, 4.3% of black children had confirmed EBLLs, much higher than Asian children (3.5%) and white children (2.1%). Children born to mothers with less than high school diploma education attainment had higher percentages of confirmed EBLLs than those with high school diplomas or higher. Children born to mothers with "self-payment" as the principal source of payment for delivery had higher percentages of EBLLs than those with other payment sources. Additionally, higher percentages of confirmed EBLLs among children tested for BLLs were found among children born to mothers who were enrolled in WIC and among children whose mothers reported either smoking before or during pregnancy. Increased percentages of confirmed EBLLs were found in neighborhoods with lower levels of household income, higher levels of poverty, and higher proportions of old housing.

There was substantial variation in percentages of children tested for BLLs and in percentages of confirmed EBLLs across different counties in Pennsylvania. This report also provides data for municipalities within counties with a total number of births of 2,000 or greater during 2015 and 2016. At the sub-county level, children living in certain municipalities, which were mainly concentrated in counties in the southeastern region of Pennsylvania, had disproportionately low percentages of children tested for BLLs. Municipalities with a high proportion of children with confirmed EBLLs were also not evenly distributed throughout Pennsylvania. The majority of municipalities with a high percentage of confirmed EBLLs were similarly concentrated in counties with a high percentage of confirmed EBLLs. However, some municipalities with a high percentage of confirmed EBLLs were located in counties with low and/or moderate levels of confirmed EBLLs.

The Pennsylvania Department of Health is committed to preventing lead exposure by coordinating with other state agencies to work toward improving the outcomes of children throughout the commonwealth. In August 2019, Governor Wolf launched the Lead-Free PA Initiative, which seeks to increase access to blood lead testing for children, increase local response efforts, and plan for training of more certified lead abatement professionals. The Department and other state agencies participate in an interagency workgroup to achieve the goals of the Lead-Free PA Initiative. This report is intended to provide information that is succinct, comprehensible, and accessible to the public. Although lead surveillance should be

considered an ongoing process, the goal of the report is to provide meaningful, useful, and easy-to-access data to the commonwealth and its residents, so that the data can be better utilized for decision-making, targeting of resources, and implementing initiatives aimed at preventing exposure to lead.

Definitions

Birth cohort	A birth cohort is defined in this report as all children born to Pennsylvania resident mothers during the specific calendar year (2015 or 2016)
Age	This is the age of the child for the first time of blood lead level test. Children under the age of 1 year are 0 to <12 months, and children under the age of 2 years are 0 to <24 months.
Capillary blood test	Capillary blood tests draw blood via a child's finger prick to test for the blood lead level.
Venous blood test	Venous blood tests draw blood from a child's vein to test for the blood lead level.
Blood lead level (BLL)	This is the numeric result of a blood lead test, expressed in micrograms per deciliter (µg/dL).
Confirmed elevated blood lead level (EBLL)	This is defined as having one venous blood lead test ≥5 µg/dL or two capillary blood lead tests ≥5 µg/dL drawn within 12 weeks of each other for the same person.
Percentage of children tested for BLLs	This percentage is calculated by dividing the number of children under the age of 1 or 2 year(s) who had a BLL test by the total number of children under the age of 1 or 2 year(s) living in Pennsylvania, multiplied by 100.
Percentage of confirmed or unconfirmed EBLLs	This percentage is calculated by dividing the number of children under the age of 2 years with a confirmed or unconfirmed elevated BLL by the total number of children under the age of 2 years who had a BLL test, multiplied by 100.
Race	The race of children was classified into Hispanic, non-Hispanic white, non-Hispanic black or African American, non-Hispanic Asian, or other (all other races, unknown, or missing).
Municipality	Municipality is a political subdivision of a state where a municipal corporation is established to provide general local government for a specific population concentration in a defined area.

Introduction

Lead poisoning is a preventable environmental health hazard and, if not addressed, affects families regardless of race, ethnicity, or socioeconomic status. In recent years, there has been a national reduction in children's BLLs as sources of lead exposure for children have been reduced or eliminated. The Department continues to provide resources to families to prevent and address EBLLs through multiple strategies. Through the federally funded Childhood Lead Poisoning Prevention Program (CLPPP), the Department is working collaboratively with 6 local jurisdictions (Allegheny County, Chester County, Montgomery County, Wilkes Barre, Allentown, and city of York) to reduce lead exposure and promote childhood lead poisoning prevention. Specifically, local partners are utilizing CLPPP funding to implement strategies and activities to 1) increase blood lead testing; 2) strengthen population-based interventions; and 3) strengthen processes to identify lead-exposed children and link them to services. Additionally, the Department maintains a toll-free lead information hotline (1-800-440-LEAD) to provide information about lead poisoning prevention, testing, follow-up, and local resources for assistance.

In 2019, lead abatement efforts were continued through the federally funded Lead Hazard Control Program (LHCP), which provided funding to local partners to contract with certified lead professionals. The Department worked with partners in targeted high-risk areas across the commonwealth to identify and remove lead hazards in housing units occupied by low-income families with children 6 years of age and under. The goal of the LHCP is to protect Pennsylvania's children from the long-term effects of lead poisoning as well as evaluate the overall living conditions within the home to obtain healthier outcomes for Pennsylvania families.

The Department's community health nurses (CHNs) continue to monitor EBLLs (≥5 mg/dL) in children aged 6 and under living in Pennsylvania. The Department's CHNs cover the counties and areas of the state not covered by the 10 county and municipal health departments (CMHDs). The CMHDs include 6 counties (Allegheny, Bucks, Chester, Erie, Montgomery, and Philadelphia) and 4 municipalities (Allentown, Bethlehem, Wilkes-Barre, and York city) that have their own health departments and have their own specific case management protocols. The Department's CHNs contact families to provide education on laboratory results, potential sources of lead exposure, and actions to take to prevent or decrease the risk of exposure, as well as to help facilitate follow-up testing between clients and their pediatricians. The CHNs encourage every family of children with levels of 5 µg/dL and above to discuss the potential need for an environmental investigation with their provider; CHNs work with the pediatrician and facilitate referrals to obtain home inspections, which could identify the source of exposure as well as provide hands-on education to parents. CHNs also work to provide referrals to WIC and to early intervention programs where appropriate. In 2019, the Department also continued an ongoing collaboration with the Department of Human Services on a data match project to share data between the Medicaid claims database and the lead surveillance database. The data

match will lead to improved quality lead data and better service provision for Medicaid-enrolled children.

The Department creates an annual surveillance report to 1) help childhood lead prevention programs and partners identify populations at risk for EBLLs, 2) ensure screening services are provided to groups with a high risk of lead poisoning, 3) inform outreach activities and educational materials for parents, educators, and health professionals, and 4) ensure environmental and medical follow-up is provided to children with EBLLs. However, all previous annual surveillance reports employ cross-sectional designs that use PA-NEDSS lead testing data along with estimated population numbers for children to produce blood lead testing rates and EBLL rates. This method often underestimates the true blood lead testing rate and EBLL rate. This report improves upon the previous reports using a cohort analysis design by following children born to Pennsylvania mothers for the 2 years of life to determine their blood lead testing rates and EBLL rates, a more precise method than the previous one.

Methods

Birth Cohort

2015 and 2016 vital statistics (birth certificate) data were used for this birth cohort blood lead level analysis. Only children born to Pennsylvania resident mothers were included. A birth cohort is defined as children born to Pennsylvania resident mothers during a specific calendar year and who were followed up to their second birthday (birth up to <24 months). In this report, children born in the year 2015 and 2016 are included in the 2015 birth cohort and the 2016 birth cohort, respectively. The birth certificate dataset contains information on both newborn and maternal characteristics.

Reporting of Blood Lead Test Results and Case Investigations

In Pennsylvania, clinical laboratories are required to report all blood lead results from both venous and capillary specimens for persons under 16 years of age to the Pennsylvania Department of Health (28 Pa. Code § 27.34). In addition, clinicians are required to report cases of lead poisoning (28 Pa. Code § 27.21a). Most of the reports are submitted electronically (either through electronic laboratory reporting or online key entry) to the Department of Health through Pennsylvania's electronic reportable disease surveillance system, PA-NEDSS. Reports with a BLL ≥5 µg/dL were assigned to public health investigators for follow-up based on the location of the patients' residence. Investigators reviewed, verified, and corrected, when necessary, critical pieces of information such as date of birth, address, and specimen source.

PA-NEDSS is designed to handle duplicate reports from different entities. Several strategies are used in PA-NEDSS to ensure that all reports pertaining to a single patient are assigned to a single patient identifier. For the annual report, tests with identical specimen collection dates and identical blood lead level results from the same patient were considered as a single test. All blood lead tests for some children who had at least one BLL test from 2015 to 2018, including those collected for screening, confirmation, or follow-up purposes, were included.

Case Definition

In May 2012, the Centers for Disease Control and Prevention (CDC) accepted the recommendation from the Advisory Committee on Lead Poisoning Prevention to eliminate the term "level of concern" (associated with the level of 10 µg/dL) and to begin using a reference value of 5 µg/dL based on the 97.5 percentile of the blood lead distribution among US children. A new case definition was officially implemented by CDC in 2016 and is used in this report to identify children with a confirmed EBLL. A confirmed EBLL is defined as a venous blood lead test ≥5 µg/dL, or two capillary blood lead tests ≥5 µg/dL drawn within 84 days (12 weeks) of each other. An unconfirmed elevated BLL is defined as a capillary blood lead test ≥5 µg/dL with no other blood lead test done in the next 84 days.

To apply the CDC case definition, a number of different data elements need to be evaluated. These data elements were handled as follows in our analyses:

- If the specimen collection date was missing or illogical, the laboratory received date or result date was used instead. If all 3 were missing, the reported date was used.
- Specimens with unknown specimen sources or characterized as simply "blood" (as opposed to venous or capillary) were treated as if they were capillary specimens.
- Tests with undetectable blood lead levels were either reported as below a numeric detection limit or with a qualitative result of "negative," "not detected," or "normal." For statistical purposes, these results were given a numeric BLL value of 0.1 µg/dL.
- If an elevated capillary test was obtained on a child near the end of a year or as the child neared the limit of a particular age category, and if another elevated test result was obtained within the next 84 days, the initial elevated test was considered to be confirmed, even if the confirmatory test occurred in the following year or outside of the age category. For example, if a child had an elevated capillary test at 23 months of age in November 2018 and received a confirmatory follow-up test within 12 weeks (in 2019), this was considered an elevated BLL result in 2018 for a child "aged 0−23 months."
- For children who had multiple BLL tests performed, it was possible for them to qualify for more than one case definition category (for example, they may have had an unconfirmed elevated test and then, 6 months later, had another elevated test that was confirmed). In these situations, a child was assigned to the highest BLL case definition category for which they qualified.

Record Linkage of Children Blood Lead Level (BLL) Test Data and Birth Cohort (BC) Data

Deterministic record linkage steps were used to link maternal and infant demographics information obtained from vital records (birth certificate) to BLL records related to lead surveillance (PA-NEDSS) to form the 2015 and 2016 birth cohorts used in the analyses for this report. Steps for deterministic linkage are as follows:

Step 1.	Extract exactly matched records if subjects' first nName, last name, date of birth (DOB), gender, and residence zip code are identical in both files. If not, go to STEP 2.
Step 2.	Extract exactly matched records if subjects' first name, Soundex (last name), DOB, gender, and residence zip code are identical in both files. If not, go to STEP 3.
Step 3.	Extract exactly matched records if subjects' Soundex (first name), last name, DOB, gender, and residence zip code are identical in both files. If not, go to STEP 4.

Step 4.	Extract exactly matched records if subjects' Soundex (first name), Soundex (last name), DOB, gender, and residence zip code are identical in both files. If not, go to STEP 5.
Step 5.	Extract exactly matched records if subjects' first name in BLL data = middle name in BC data or middle name in BLL data = first name in BC data, and their last name, DOB, gender, and residence zip code are identical in both files. If not, go to STEP 6.
Step 6.	Extract exactly matched records if subjects' first name in BLL data = last name in BC data or last name in BLL data = first name in BC data, and their DOB, gender, and residence zip code are identical in both files. If not, go to STEP 7.
Step 7.	Extract exactly matched records if subjects' Soundex (first name) in BLL data = Soundex (last name) in BC data or Soundex (last name) in BLL data = Soundex (first name) in BC data, and their DOB, gender, and residence zip code are identical in both files. If not, go to STEP 8.
Step 8.	Extract exactly matched records if subjects' date of DOB in BLL data = month of DOB in BC data or month of DOB in BLL data = date of DOB in BC data, and their Soundex (first name), Soundex (last name), gender, and residence zip code are identical in both files. If not, go to STEP 9.
Step 9.	Extract exactly matched records if subjects' first name, last name, DOB, and gender are identical in both files. If not, go to STEP 10.
Step 10.	Extract exactly matched records if subjects' first name, Soundex (last name), DOB, and gender are identical in both files. If not, go to STEP 11.
Step 11.	Extract exactly matched records if subjects' Soundex (first name), last name, DOB, and gender are identical in both files. If not, go to STEP 12.
Step 12.	Extract exactly matched records if subjects' Soundex (first name), Soundex (last name), DOB, and gender are identical in both files. If not, go to STEP 13.
Step 13.	Extract exactly matched records if subjects' first name, last name, DOB, and residence zip code are identical in both files. If not, go to STEP 14.
Step 14.	Extract exactly matched records if subjects' Soundex (first name), Soundex (last name), DOB, and residence zip code are identical in both files.

A simple random sampling method was used to select a subset of potential matches after each linkage step for manual review and validation. Some potential matches that failed to be validated by the manual review were put back into the linkage process for subsequent matching. If records did not successfully match at any linkage steps, these subjects' BLL test results were assigned as "censored." After completing all these linkage steps, a child whose

multiple BLL test results might be linked to the same record in the birth certificate dataset. If the above-mentioned matching pairs were matched at the same linkage step, we only retained one matching pair, which was linked by the first of multiple test results with his/her record in the birth certificate dataset. If the above-mentioned matching pairs were matched at different linkage steps, we only retained one matching pair, which was linked at an earlier (more restrictive) linkage step. For example, a child's two BLL test results were matched to the same record in the birth certificate dataset at the linkage Step 1 and the linkage Step 9, respectively. In this case, we only retained this child's BLL test result, which was matched at the linkage Step 1 in the final linkage dataset. For a child whose multiple BLL test results were linked to different records in the birth certificate dataset, we manually reviewed these record pairs one-by-one and only retained one of them with optimal validity and reliability.

Statistical Methods

In the analyses of the percentage of children who received a BLL test, we categorized children into 2 groups: 1) age at BLL test <1 year and 2) age at BLL test <2 years. A child's age at the time of a BLL test was calculated as the time between birth date and BLL testing date. In the analyses of the percentage of tested children who were found to have EBLLs, we categorized children who received a BLL test by 2 years of age into 2 groups: 1) unconfirmed BLL ≥5 μg/dL and 2) confirmed BLL ≥5 μg/dL. A child's BLL test confirmation status was defined in the Case Definition section.

We conducted descriptive analyses to explore how percentages of children tested for BLLs and levels of EBLLs vary by maternal and infant demographics and by neighborhood characteristics among the 2015 birth cohort and the 2016 birth cohort, respectively. The following demographic information was obtained and categorized from the birth certificate dataset: gender (male or female) and race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic black or African American, non-Hispanic Asian, or other), maternal educational attainment (<high school: less than high school graduate; high school/some college: high school graduates or had attended some college but had not received a college degree; ≥college: college or higher degree; or other), principle source of payment for delivery (private insurance, medicaid, self-payment, or other), maternal smoking (yes or no: mothers reported cigarette smoking or no cigarette smoking during the 3 months before pregnancy or during pregnancy; or unknown), WIC enrollment (yes/no: mothers participated/did not participate in WIC; or unknown), maternal infection (yes: maternal infections, including gonorrhea, syphilis, herpes simplex virus, chlamydia, tocolysis, or external cephalic version, was present or treated during pregnancy; no: no maternal infection was present or treated during pregnancy), and maternal risk factors (yes or no: mother had or did not have risk factors, including pre-pregnancy diabetes, gestational diabetes, pre-pregnancy hypertension, gestational hypertension, previous pre-term birth, previous poor pregnancy outcomes, vaginal bleeding, pregnancy resulted from infertility treatment, or previous cesarean, during pregnancy).

For each child's neighborhood characteristics, census tract-level median household income (household income), the percentage of families and people whose income in the past 12

months is below the poverty level (poverty), and the percentage of housing units built before 1970 (older housing) information were obtained from the US Census Bureau 2012-2016 American Community Survey (ACS) 5-Year Estimates. Census tracts were ranked based on each neighborhood characteristic and assigned to a quartile for each characteristic, respectively. We also linked two birth cohorts' birth certificate data with census tract-level information on household income, poverty, and older housing data based on information on each child's maternal residential address.

Moreover, we conducted descriptive analyses to explore how the percentage of children tested for BLLs and the proportion of EBLLs among tested children vary by county of residence in the 2015 birth cohort and the 2016 birth cohort, respectively. For counties where the number of births were <100 in either 2015 or 2016, results were reported for both birth cohorts combined. For the sub-county analyses, descriptive analyses were presented to explore how the percentage of children tested for BLLs and the proportion of EBLLs vary by the municipality of residence within counties where the total number of births of 2 birth cohorts was ≥2,000. For the county and sub-county analyses, geocoding information of each child's residential address (longitude and latitude) reported in the blood lead test dataset was used to determine a child's county and municipality of residence. For some children who had missing or incomplete information on residential addresses in the blood lead test dataset, we used maternal residential address accompanying the birth certificate dataset to determine these children's county and municipality of residence. Finally, map visualization was used to display geographic distribution of the county- and sub-county level percentage of children tested for BLLs and percentage of confirmed EBLLs, respectively, using ArcGIS 10.4.1 (ESRI, Redlands, CA).

Findings

Percentages of children tested for BLLs by maternal and infant demographics and neighborhood characteristics

Among the 137,246 Pennsylvania children born in 2015, 66,233 children (48.26%) received a BLL test before the age of 2 years. The percentage of children who received a BLL test increased slightly in the 2016 birth cohort (49.03%).

Table 1 (page 19) provides the number and percentage of children who had a blood lead test in the 2015 birth cohort and 2016 birth cohort before the age of 1 or 2 year(s) by maternal and infant demographics and by neighborhood characteristics. There were no significant gender differences in the percentage of children tested for BLLs. We observed significant racial disparities in the percentage of children tested for BLLs in each birth cohort. Non-Hispanic black children had the highest percentage of children tested for BLLs (63.35% and 62.97% in the 2015 birth cohort and the 2016 birth cohort, respectively), while the lowest percentage was seen among non-Hispanic white children (44.11% and 45.32% in the 2015 birth cohort and the 2016 birth cohort, respectively). By maternal educational attainment, the highest percentage of children tested for BLLs was observed among children whose maternal educational attainment was "high school/some college" (54.14% and 53.91% in the 2015 birth cohort and the 2016 birth cohort, respectively). In terms of the principal source of payment for delivery, the highest percentage of children tested for BLLs was observed among children whose principal source of payment for delivery was "Medicaid" (59.70% and 59.11% in the 2015 birth cohort and the 2016 birth cohort, respectively), while the lowest percentage of BLL testing was seen among children whose principal source of payment for delivery was "self-payment" (17.03% and 13.45% in the 2015 birth cohort and the 2016 birth cohort, respectively). The percentage of children tested for BLLs was higher for children with WIC enrollment (61.39% and 60.44% in the 2015 birth cohort and the 2016 birth cohort, respectively) than among those without WIC enrollment (40.65% and 42.84% in the 2015 birth cohort and the 2016 birth cohort, respectively). Higher percentages of children tested for BLLs were also observed among children whose mothers reported cigarette smoking either during the 3 months before pregnancy or during pregnancy and among children whose mothers had at least one infection during pregnancy.

The percentage of children tested for BLLs varied significantly with respect to their neighborhood characteristics. Children living in higher-poverty neighborhoods were more likely to be tested for BLLs, as well as children living in neighborhoods with a higher proportion of older housing.

Percentages of EBLLs among children tested for BLLs by maternal and infant demographics and neighborhood characteristics

Among the 66,233 Pennsylvania children tested for BLLs before the age of 2 years in the 2015 birth cohort, 1,826 children (2.76%) had confirmed EBLLs. The number (n = 1,675) and percentage (2.52%) of confirmed EBLL cases slightly decreased in the 2016 birth cohort.

Table 2 (page 21) provides the number and percentage of confirmed EBLLs among children tested for BLLs before the age of 2 years by maternal and infant demographics and by neighborhood characteristics for each birth cohort. There were no significant gender differences in the percentage of confirmed EBLLs among children tested for BLLs. We observed significant racial disparities in the percentage of confirmed EBLLs among children tested for BLLs in each birth cohort. Non-Hispanic black children tested for BLLs had the highest percentage of confirmed EBLLs (4.41% and 4.37% in the 2015 birth cohort and the 2016 birth cohort, respectively), while the lowest percentage of confirmed EBLLs was seen among non-Hispanic white children (2.14% and 1.90% in the 2015 birth cohort and the 2016 birth cohort, respectively). By maternal educational attainment, the highest percentage of confirmed EBLLs among children tested for BLLs was observed among children whose maternal educational attainment was "<high school" (4.57% and 4.85% in the 2015 birth cohort and the 2016 birth cohort, respectively), while the lowest percentage of confirmed EBLLs was seen among children whose maternal educational attainment was "≥college" (1.84% and 1.56% in the 2015 birth cohort and the 2016 birth cohort, respectively). Children whose principal source of payment for delivery was "self-payment" had the highest percentage of confirmed EBLLs (5.49% and 4.22% in the 2015 birth cohort and the 2016 birth cohort, respectively), while the lowest percentage was observed among children whose principal source of payment for delivery was "private insurance" (1.96% and 1.75% in the 2015 birth cohort and the 2016 birth cohort, respectively). The percentage of confirmed EBLLs among children tested for BLLs was higher among children with WIC enrollment (3.29% and 3.19% in the 2015 birth cohort and the 2016 birth cohort, respectively) than those without WIC enrollment (2.28% and 2.01% in the 2015 birth cohort and the 2016 birth cohort, respectively). Additionally, higher percentages of confirmed EBLLs were observed among children whose mothers reported cigarette smoking either during the 3 months before pregnancy or during pregnancy and among children whose mothers had at least one infection during pregnancy.

The percentage of confirmed EBLLs among children tested for BLLs varied significantly with respect to their neighborhood characteristics. Children living in lower-household income neighborhoods had a higher percentage of confirmed EBLLs than those who were living in higher-household income neighborhoods. Children living in higher-poverty neighborhoods and neighborhoods with a higher proportion of older housing were associated with higher percentages of confirmed EBLLs.

Percentages of children tested for BLLs and percentages of EBLLs among children tested for BLLs by county/municipality

Table 3 (page 23) provides the number and percentage of children tested for BLLs in the 2015 birth cohort and 2016 birth cohort before the age of 1 or 2 year(s), by county. We observed that percentages of children tested for BLLs varied significantly across different counties in

Pennsylvania: ranging from 20.87% in Cumberland County to 72.65% in McKean County in the 2015 birth cohort and from 21.38% in Cumberland County to 75.51% in McKean County in the 2016 birth cohort. **Table 4** (page 25) shows that there was substantial variation in percentages of confirmed EBLLs among children tested for BLLs before the age of 2 years across different counties, ranging from 0.28% in Monroe County to 6.23% in Berks County in the 2015 birth cohort and from 0.00% in Pike County to 6.44% in Berks County in the 2016 birth.

Compared to the rest of Pennsylvania, counties with lower percentages of children who received a BLL test but had higher percentages of confirmed EBLLs among children tested for BLLs are as follows: for the 2015 birth cohort, Berks, Crawford, Lancaster, Lebanon, Venango, and Susquehanna counties [**Figure 1** (page 27) and **Figure 2** (page 28)]; for the 2016 birth cohort, Berks, Lancaster, Lebanon, Union, Venango, and York counties [**Figure 3** (page 29) and **Figure 4** (page 30)].

Figure 5 (page 31) shows data by selected municipalities and that certain municipalities had disproportionately low percentages of children who received a BLL test. Municipalities with lower percentages of children tested for BLLs, shaded in the lighter green color on the map on page 31, were mainly concentrated in counties with lower percentages of children tested for BLLs and were primarily concentrated in the southeastern region of Pennsylvania. However, there were also some municipalities where children were infrequently tested for BLLs located within counties with moderate and/or high levels of children tested for BLLs.

As seen in **Figure 6** (page 32), municipalities with a high proportion of children with confirmed EBLLs were not evenly distributed throughout Pennsylvania. The majority of municipalities with higher percentages of children with confirmed EBLLs, shaded in the darker red color on the map on page 32, were mostly concentrated in counties with higher levels of children with confirmed EBLLs. However, there were also some municipalities with a high proportion of children with confirmed EBLLs located within counties with low and/or moderate percentages of children with confirmed EBLLs.

It is worth noting that some municipalities with relatively low percentages of children tested for BLLs and high percentages of children with confirmed EBLLs were particularly concentrated in four counties: Berks, Lancaster, Lebanon, and Lehigh. In addition, there were other municipalities with this combination of characteristics sporadically distributed within other counties where the number of births ≥2,000 [**Figure 5** (page 31) and **Figure 6** (page 32)].

Discussion

This is the first childhood lead cohort report conducted in Pennsylvania in which children were followed from birth to 2 years of age. This cohort analysis improves upon previous reports in estimating blood lead testing rates and proportions of EBLLs among those who were tested by linking birth certificate data with blood lead test data and census tract-level neighborhood characteristics. The overall blood lead testing rate for children before 2 years of age is about 50%, calculated using the cohort study design in this report, compared to an approximately 30% blood testing rate estimated in the previous report using the cross-sectional study design that reported on a calendar year. This cohort analytic design not only enables us to more accurately evaluate maternal and infant demographic factors associated with undertesting of BLLs and increased EBLLs but also enables us to evaluate neighborhood characteristics associated with undertesting of BLLs and increased EBLLs.

High percentages of confirmed EBLLs among children in a population group with specific characteristics or in one geographic area may reflect a true increased risk of lead exposure in that specific group of children and in that area, or it may reflect more robust and targeted testing in that specific group of children and in that area. The burden of childhood EBLLs is best understood through a series of metrics: the percentage of children tested, the percentage of children who appropriately receive follow-up testing within the recommended time period among those with an elevated capilllary test, and the percentage of confirmed EBLLs among children tested for BLLs. This cohort analysis details numbers and percentages of children tested for BLLs before the age of 2 years and confirmed EBLLs among tested children by maternal and infant demographics and by neighborhood characteristics, as well as by county/municipality of residence.

An important implication of the report is that disparities noted in selected maternal and infant demographics, as well as in neighborhood characteristics, are associated with undertesting of childhood BLLs and with relatively high percentages of EBLLs. Results from simultaneous analyses of the proportion of children tested for BLLs and the percentage of children with EBLLs can be used to guide targeted primary prevention efforts. Maternal and infant demographics combined with neighborhood characteristics provide even more specific information for targeted efforts. In addition, looking more closely at geographic variability in the percentage of children tested for BLLs and the percentage of children with EBLLs simultaneously, particularly at a fine spatial scale such as municipal level, provides the state and local health departments with the opportunity to efficiently evaluate health care provider practices in specific geographic areas. These more granular data can guide provider decisions on priorities regarding which children should receive a follow-up test within the recommended time period and treatment if necessary.

An emerging issue is the increasing use of point-of-care testing devices for blood lead screening. A growing number of clinical practices are able to do their own capillary screening tests for children on-site. These providers are often unaccustomed to reporting results to the

Department and may be unaware of reporting requirements. This could adversely affect the number of screening test results counted and skew the proportion of children screened downwards. The Department is working with many clinics using this equipment to ensure that BLLs are reported. Furthermore, some point-of-care analyzers have been found to give falsely low BLL results when used to analyze venous blood. These devices should be used only on capillary specimens, but the Department generally does not know the type of equipment used to perform BLL tests and cannot control for this source of uncertainty. The impact of this issue cannot be assessed, as the type of testing device used is not captured in the PA-NEDSS surveillance datasets.

In addition, this report has several limitations. First, blood lead test data that were not successfully linked to birth certificate data due to inaccurate and incomplete information on identifiers would result in underestimation of testing rates. Also, some children who were born to Pennsylvania resident mothers and have moved out of state before 2 years of age were not included in this analysis. And conversely, some children who had blood lead tests in Pennsylvania and were not born to Pennsylvania resident mothers were not included in this analysis. Children who moved addresses between birth and time of testing in Pennsylvania would be presented in this report based on the address at time of testing or, if that is not present, on the maternal address from the birth certificate. Finally, since Pennsylvania does not currently have a statewide universal blood lead screening mandate, the results presented in this report should be interpreted with knowledge of local blood lead testing-related policies.

Table 1. Number and Percentage of Children Tested for BLLs Before 2 Years of Age by Maternal and Infant Demographics and Neighborhood Characteristics, 2015 and 2016 Birth Cohorts

	2015 Birth Cohort					2016 Birth Cohort				
	Total	BLL Test <1 yr		BLL Test <2 yrs		Total	BLL Test <1 yr		BLL Test <2 yrs	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Maternal and infant demographics and neighborhood characteristics										
Sex										
Female	67169	18245	27.16	32263	48.03	65969	18515	28.07	32441	49.18
Male	70076	19183	27.37	33970	48.48	69667	19399	27.85	34064	48.90
Race										
Hispanic	14748	3753	25.45	7822	53.04	15110	3835	25.38	7873	52.10
Non-Hispanic Asian	5118	1418	27.71	2633	51.45	4990	1376	27.58	2523	50.56
Non-Hispanic black	18073	5813	32.16	11450	63.35	17730	5712	32.22	11164	62.97
Non-Hispanic white	92069	24375	26.47	40613	44.11	90363	24710	27.35	40948	45.32
Other[c]	7238	2069	28.59	3715	51.33	7448	2281	30.63	3997	53.67
Maternal educational attainment										
<High school	17483	4057	23.21	7772	44.45	16661	3760	22.57	7195	43.18
High school/some college	58822	18111	30.79	31849	54.14	57583	17616	30.59	31044	53.91
≥College	60072	15062	25.07	26268	43.73	60546	16337	26.98	27874	46.04
Other[d]	869	198	22.78	344	39.59	851	201	23.62	392	46.06
Payment source for delivery										
Private insurance	79599	20151	25.32	35306	44.35	77273	20540	26.58	35597	46.07
Medicaid	44605	14763	33.10	26627	59.70	43972	14456	32.88	25991	59.11
Self-payment	6419	608	9.47	1093	17.03	6162	455	7.38	829	13.45
Other[e]	6623	1906	28.78	3207	48.42	8234	2463	29.91	4088	49.65
WIC enrollment										
Yes	49725	17278	34.75	30525	61.39	47264	16197	34.27	28565	60.44
No	84477	19412	22.98	34344	40.65	85408	20977	24.56	36586	42.84
Unknown	3044	738	24.24	1364	44.81	2969	740	24.92	1354	45.60
Maternal smoking										
Yes	23490	7342	31.26	12610	53.68	21592	6717	31.11	11662	54.01
No	111858	29610	26.47	52741	47.15	112486	30743	27.33	54035	48.04
Unknown	1898	476	25.08	882	46.47	1563	454	29.05	808	51.70
Maternal infection										
Yes	7760	2442	31.47	4438	57.19	7740	2427	31.36	4367	56.42
No	129486	34986	27.02	61795	47.72	127901	35487	27.75	62138	48.58
Maternal risk factor										
Yes	47500	12594	26.51	22596	47.57	48510	13233	27.28	23570	48.59
No	89746	24834	27.67	43637	48.62	87131	24681	28.33	42935	49.28

	2015 Birth Cohort					2016 Birth Cohort				
	Total	BLL Test <1 yr		BLL Test <2 yrs		Total	BLL Test <1 yr		BLL Test <2 yrs	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Neighborhood Characteristics										
Household income quartile										
1st	37743	11982	31.75	22607	59.90	36522	11982	32.81	21798	59.68
2nd	31718	9617	30.32	15844	49.95	31849	9617	30.20	16134	50.66
3rd	34948	8568	24.52	14720	42.12	34234	8568	25.03	14323	41.84
4th	32809	7251	22.10	13042	39.75	33030	7251	21.95	14247	43.13
Poverty quartile										
1st	31300	7288	23.28	12869	41.12	30366	7640	25.16	13258	43.66
2nd	34055	8641	25.37	14368	42.19	33086	8329	25.17	14126	42.69
3rd	31649	8882	28.06	14946	47.22	32797	9447	28.80	15672	47.78
4th	40232	12611	31.35	24041	59.76	39387	12498	31.73	23446	59.53
Older housing quartile										
1st	35406	6788	19.17	12013	33.93	35824	6994	19.52	12659	35.34
2nd	32468	8598	26.48	14479	44.59	31764	8415	26.49	14316	45.07
3rd	32299	9735	30.14	17274	53.48	32382	9990	30.85	17584	54.30
4th	37073	12307	33.20	22467	60.60	35670	12515	35.09	21946	61.53

[a]Total number of children born in 2015 and 2016 by maternal and infant demographics and neighborhood characteristics

[b]The percentage of children under the age of 1 or 2 year(s) born in 2015 and 2016 tested for BLLs by maternal and infant demographics and neighborhood characteristics

[c]Other race includes all other races, unknown, or missing.

[d]Other maternal educational attainment includes unknown or missing.

[e]Other principal source of payment for delivery includes unknown or missing.

Table 2. Number and Percentage of EBLLs Among Children Tested for BLLs Before 2 years of Age by Maternal and Infant Demographics and Neighborhood Characteristics, 2015 and 2016 Birth Cohorts

	2015 Birth Cohort					2016 Birth Cohort				
	Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL		Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Maternal and infant demographics and neighborhood characteristics										
Sex										
Female	32263	496	1.54	868	2.69	32441	392	1.21	813	2.51
Male	33970	548	1.61	958	2.82	34064	436	1.28	862	2.53
Race										
Hispanic	7822	172	2.20	279	3.57	7873	121	1.54	238	3.02
Non-Hispanic Asian	2633	53	2.01	88	3.34	2523	47	1.86	89	3.53
Non-Hispanic black	11450	223	1.95	505	4.41	11164	151	1.35	488	4.37
Non-Hispanic white	40613	554	1.36	870	2.14	40948	479	1.17	777	1.90
Other[c]	3715	42	1.13	84	2.26	3997	30	0.75	83	2.08
Maternal educational attainment										
<High school	7772	247	3.18	355	4.57	7195	192	2.67	349	4.85
High school/some college	31849	594	1.87	971	3.05	31044	445	1.43	870	2.80
≥College	26268	199	0.76	484	1.84	27874	185	0.66	436	1.56
Other[d]	344	4	1.16	16	4.65	392	6	1.53	20	5.10
Payment source for delivery										
Private insurance	35306	355	1.01	693	1.96	35597	272	0.76	623	1.75
Medicaid	26627	609	2.29	979	3.68	25991	468	1.80	919	3.54
Self-payment	1093	25	2.29	60	5.49	829	24	2.90	35	4.22
Other[e]	3207	55	1.71	94	2.93	4088	64	1.57	98	2.40
WIC enrollment										
Yes	30525	649	2.13	1003	3.29	28565	493	1.73	911	3.19
No	34344	376	1.09	782	2.28	36586	322	0.88	737	2.01
Unknown	1364	19	1.39	41	3.01	1354	13	0.96	27	1.99
Maternal smoking										
Yes	12610	297	2.36	373	2.96	11662	234	2.01	358	3.07
No	52741	732	1.39	1418	2.69	54035	586	1.08	1285	2.38
Unknown	882	15	1.70	35	3.97	808	8	0.99	32	3.96
Maternal infection										
Yes	4438	98	2.21	140	3.15	4367	74	1.69	114	2.61
No	61795	946	1.53	1686	2.73	62138	754	1.21	1561	2.51
Maternal risk factor										
Yes	22596	366	1.62	612	2.71	23570	272	1.15	645	2.74
No	43637	678	1.55	1214	2.78	42935	556	1.29	1030	2.40

	2015 Birth Cohort					2016 Birth Cohort				
	Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL		Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Neighborhood Characteristics										
Household income quartile										
1st	22607	556	2.46	1010	4.47	21798	396	1.82	924	4.24
2nd	15844	239	1.51	345	2.18	16134	211	1.31	324	2.01
3rd	14720	169	1.15	285	1.94	14323	152	1.06	270	1.89
4th	13042	80	0.61	186	1.43	14247	69	0.48	157	1.10
Poverty quartile										
1st	12869	112	0.87	183	1.42	13258	85	0.64	175	1.32
2nd	14368	162	1.13	277	1.93	14126	139	0.98	211	1.49
3rd	14946	194	1.30	326	2.18	15672	198	1.26	348	2.22
4th	24041	576	2.40	1040	4.33	23446	406	1.73	941	4.01
Older housing quartile										
1st	12013	102	0.85	196	1.63	12659	86	0.68	188	1.49
2nd	14479	170	1.17	246	1.70	14316	156	1.09	230	1.61
3rd	17274	271	1.57	478	2.77	17584	246	1.40	413	2.35
4th	22467	501	2.23	906	4.03	21946	340	1.55	844	3.85

[a]Total number of children under the age of 2 years born in 2015 and 2016 tested for BLLs by maternal and infant demographics and neighborhood characteristics

[b]The percentage of tested children under the age of 2 years born in 2015 and 2016 had unconfirmed or confirmed EBLLs by maternal and infant demographics and neighborhood characteristics.

[c]Other race includes all other races, unknown, or missing.

[d]Other maternal educational attainment includes unknown or missing.

[e]Other principal source of payment for delivery includes unknown or missing.

Table 3. Number and Percentage of Children Tested Before 2 Years of Age for BLLs by County of Residence, 2015 and 2016 Birth Cohorts

	2015 Birth Cohort					2016 Birth Cohort				
	Total	BLL Test <1 yr		BLL Test <2 yrs		Total	BLL Test <1 yr		BLL Test <2 yrs	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
County										
Adams	932	365	39.16	421	45.17	904	381	42.15	437	48.34
Allegheny	13260	4523	34.11	7650	57.69	13173	5033	38.21	8522	64.69
Armstrong	585	56	9.57	394	67.35	611	80	13.09	460	75.29
Beaver	1691	587	34.71	746	44.12	1665	579	34.77	776	46.61
Bedford	434	190	43.78	261	60.14	469	228	48.61	295	62.90
Berks	4737	386	8.15	1989	41.99	4767	368	7.72	1818	38.14
Blair	1316	478	36.32	688	52.28	1268	481	37.93	665	52.44
Bradford	618	157	25.40	301	48.71	607	193	31.80	329	54.20
Bucks	5065	1034	20.41	1766	34.87	5083	1041	20.48	1823	35.86
Butler	1850	700	37.84	930	50.27	1791	666	37.19	954	53.27
Cambria	1319	561	42.53	699	52.99	1338	597	44.62	700	52.32
Cameron	45	16	35.56	34	75.56	39	9	23.08	28	71.79
Carbon	593	160	26.98	251	42.33	592	157	26.52	242	40.88
Centre	1272	526	41.35	588	46.23	1198	477	39.82	523	43.66
Chester	5265	1279	24.29	2043	38.80	5049	1297	25.69	2012	39.85
Clarion	421	128	30.40	179	42.52	397	141	35.52	195	49.12
Clearfield	736	347	47.15	438	59.51	754	355	47.08	450	59.68
Clinton	423	172	40.66	227	53.66	406	155	38.18	199	49.01
Columbia	572	151	26.40	221	38.64	572	165	28.85	242	42.31
Crawford	931	262	28.14	353	37.92	924	291	31.49	401	43.40
Cumberland	2621	192	7.33	547	20.87	2657	184	6.93	568	21.38
Dauphin	3357	673	20.05	1095	32.62	3451	521	15.10	991	28.72
Delaware	6425	2033	31.64	3639	56.64	6445	2189	33.96	3868	60.02
Elk	295	124	42.03	170	57.63	298	92	30.87	130	43.62
Erie	3111	722	23.21	1703	54.74	3035	650	21.42	1682	55.42
Fayette	1313	460	35.03	676	51.49	1197	370	30.91	577	48.20
Forest	34	12	35.29	14	41.18	25	7	28.00	10	40.00
Franklin	1656	136	8.21	651	39.31	1688	130	7.70	662	39.22
Fulton	105	18	17.14	50	47.62	116	28	24.14	59	50.86
Greene	274	129	47.08	181	66.06	251	77	30.68	149	59.36
Huntingdon	409	197	48.17	229	55.99	374	177	47.33	201	53.74
Indiana	777	297	38.22	359	46.20	823	341	41.43	408	49.57
Jefferson	499	176	35.27	226	45.29	452	139	30.75	205	45.35
Juniata	267	90	33.71	124	46.44	287	96	33.45	126	43.90
Lackawanna	2190	512	23.38	811	37.03	2228	568	25.49	813	36.49
Lancaster	7219	943	13.06	2061	28.55	6937	681	9.82	1721	24.81
Lawrence	905	201	22.21	366	40.44	853	227	26.61	382	44.78
Lebanon	1584	216	13.64	522	32.95	1610	126	7.87	512	31.98

	2015 Birth Cohort					2016 Birth Cohort				
	Total	BLL Test <1 yr		BLL Test <2 yrs		Total	BLL Test <1 yr		BLL Test <2 yr	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Lehigh	4151	922	22.21	1617	38.95	4203	823	19.58	1601	38.09
Luzerne	3154	924	29.30	1566	49.65	3176	1074	33.82	1651	51.98
Lycoming	1198	392	32.72	601	50.17	1217	371	30.48	619	50.86
McKean	362	177	48.90	263	72.65	294	127	43.20	222	75.51
Mercer	1128	411	36.44	519	46.01	1122	374	33.33	496	44.21
Mifflin	602	250	41.53	293	48.67	554	168	30.32	235	42.42
Monroe	1330	140	10.53	360	27.07	1398	138	9.87	413	29.54
Montgomery	8832	2442	27.65	4227	47.86	8628	2516	29.16	4314	50.00
Montour	215	37	17.21	101	46.98	217	27	12.44	88	40.55
Northampton	2720	198	7.28	807	29.67	2763	214	7.75	894	32.36
Northumberland	945	317	33.54	541	57.25	934	287	30.73	489	52.36
Perry	534	135	25.28	183	34.27	531	162	30.51	206	38.79
Philadelphia	21854	7553	34.56	14846	67.93	21228	7929	37.35	14444	68.04
Pike	269	97	36.06	134	49.81	280	95	33.93	131	46.79
Potter	149	11	7.38	108	72.48	129	5	3.88	90	69.77
Schuylkill	1305	672	51.49	776	59.46	1368	675	49.34	838	61.26
Snyder	465	119	25.59	184	39.57	441	95	21.54	140	31.75
Somerset	671	245	36.51	314	46.80	655	242	36.95	303	46.26
Sullivan	41	7	17.07	20	48.78	46	12	26.09	18	39.13
Susquehanna	266	40	15.04	82	30.83	245	33	13.47	74	30.20
Tioga	330	48	14.55	144	43.64	302	36	11.92	118	39.07
Union	399	103	25.81	139	34.84	414	106	25.60	144	34.78
Venango	530	157	29.62	206	38.87	535	175	32.71	222	41.50
Warren	342	146	42.69	171	50.00	359	159	44.29	186	51.81
Washington	1919	581	30.28	931	48.51	1966	571	29.04	985	50.10
Wayne	391	124	31.71	163	41.69	422	132	31.28	179	42.42
Westmoreland	3163	1077	34.05	1546	48.88	2991	1131	37.81	1548	51.76
Wyoming	254	53	20.87	86	33.86	250	35	14.00	71	28.40
York	4621	841	18.20	1702	36.83	4648	905	19.47	1651	35.52
All counties	**137246**	**37428**	**27.27**	**66233**	**48.26**	**135641**	**37914**	**27.95**	**66505**	**49.03**

[a]Total number of children born in 2015 and 2016 by county of residence

[b]The percentage of children under the age of 1 or 2 year(s) born in 2015 and 2016 tested for BLLs by county of residence

Table 4. Number and Percentage of EBLLs Among Children Tested for BLLs Before 2 Years of Age by County of Residence, 2015 and 2016 Birth Cohorts

	2015 Birth Cohort					2016 Birth Cohort				
	Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL		Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
County										
Adams	421	5	1.19	2	0.48	437	1	0.23	7	1.60
Allegheny	7650	122	1.59	166	2.17	8522	106	1.24	160	1.88
Armstrong	394	9	2.28	10	2.54	460	3	0.65	9	1.96
Beaver	746	11	1.47	5	0.67	776	14	1.80	8	1.03
Bedford	261	1	0.38	7	2.68	295	5	1.69	11	3.73
Berks	1989	98	4.93	124	6.23	1818	35	1.93	117	6.44
Blair	688	13	1.89	18	2.62	665	5	0.75	25	3.76
Bradford	301	5	1.66	9	2.99	329	0	0.00	10	3.04
Bucks	1766	5	0.28	21	1.19	1823	4	0.22	23	1.26
Butler	930	19	2.04	7	0.75	954	7	0.73	9	0.94
Cambria	699	28	4.01	18	2.58	700	10	1.43	14	2.00
Cameron	34	0	0.00	1	2.94	28	1	3.57	1	3.57
Carbon	251	11	4.38	6	2.39	242	11	4.55	4	1.65
Centre	588	4	0.68	5	0.85	523	1	0.19	4	0.76
Chester	2043	41	2.01	42	2.06	2012	25	1.24	24	1.19
Clarion	179	0	0.00	1	0.56	195	0	0.00	6	3.08
Clearfield	438	3	0.68	3	0.68	450	6	1.33	1	0.22
Clinton	227	3	1.32	8	3.52	199	0	0.00	6	3.02
Columbia	221	1	0.45	7	3.17	242	1	0.41	5	2.07
Crawford	353	9	2.55	15	4.25	401	10	2.49	13	3.24
Cumberland	547	14	2.56	11	2.01	568	4	0.70	5	0.88
Dauphin	1095	22	2.01	33	3.01	991	16	1.61	30	3.03
Delaware	3639	40	1.10	85	2.34	3868	31	0.80	78	2.02
Elk	170	0	0.00	1	0.59	130	1	0.77	2	1.54
Erie	1703	33	1.94	46	2.70	1682	36	2.14	34	2.02
Fayette	676	3	0.44	15	2.22	577	2	0.35	12	2.08
Forest	14	1	7.14	1	7.14	10	0	0.00	0	0.00
Franklin	651	19	2.92	6	0.92	662	18	2.72	9	1.36
Fulton	50	0	0.00	0	0.00	59	0	0.00	3	5.08
Greene	181	4	2.21	6	3.31	149	5	3.36	2	1.34
Huntingdon	229	1	0.44	2	0.87	201	0	0.00	2	1.00
Indiana	359	12	3.34	5	1.39	408	8	1.96	5	1.23
Jefferson	226	2	0.88	4	1.77	205	8	3.90	5	2.44
Juniata	124	1	0.81	1	0.81	126	2	1.59	3	2.38
Lackawanna	811	28	3.45	23	2.84	813	22	2.71	24	2.95
Lancaster	2061	36	1.75	88	4.27	1721	22	1.28	90	5.23
Lawrence	366	6	1.64	7	1.91	382	7	1.83	5	1.31

	2015 Birth Cohort					2016 Birth Cohort				
	Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL		Tested children	Unconfirmed BLL ≥5 µg/dL		Confirmed BLL ≥5 µg/dL	
	N[a]	N	%[b]	N	%[b]	N[a]	N	%[b]	N	%[b]
Lebanon	522	10	1.92	21	4.02	512	12	2.34	21	4.10
Lehigh	1617	33	2.04	52	3.22	1601	39	2.44	38	2.37
Luzerne	1566	19	1.21	27	1.72	1651	32	1.94	24	1.45
Lycoming	601	7	1.16	15	2.50	619	0	0.00	15	2.42
McKean	263	5	1.90	10	3.80	222	8	3.60	4	1.80
Mercer	519	9	1.73	11	2.12	496	11	2.22	8	1.61
Mifflin	293	0	0.00	8	2.73	235	0	0.00	9	3.83
Monroe	360	1	0.28	1	0.28	413	1	0.24	2	0.48
Montgomery	4227	18	0.43	92	2.18	4314	17	0.39	62	1.44
Montour	101	0	0.00	2	1.98	88	1	1.14	2	2.27
Northampton	807	14	1.73	15	1.86	894	22	2.46	14	1.57
Northumberland	541	2	0.37	21	3.88	489	5	1.02	21	4.29
Perry	183	2	1.09	3	1.64	206	3	1.46	4	1.94
Philadelphia	14846	202	1.36	573	3.86	14444	133	0.92	525	3.63
Pike	134	0	0.00	1	0.75	131	2	1.53	0	0.00
Potter	108	2	1.85	6	5.56	90	3	3.33	1	1.11
Schuylkill	776	19	2.45	27	3.48	838	22	2.63	20	2.39
Snyder	184	1	0.54	5	2.72	140	2	1.43	4	2.86
Somerset	314	4	1.27	12	3.82	303	5	1.65	4	1.32
Sullivan	20	1	5.00	3	15.00	18	0	0.00	0	0.00
Susquehanna	82	1	1.22	3	3.66	74	1	1.35	2	2.70
Tioga	144	8	5.56	1	0.69	118	4	3.39	1	0.85
Union	139	1	0.72	3	2.16	144	6	4.17	8	5.56
Venango	206	5	2.43	12	5.83	222	2	0.90	9	4.05
Warren	171	6	3.51	4	2.34	186	9	4.84	3	1.61
Washington	931	23	2.47	16	1.72	985	24	2.44	18	1.83
Wayne	163	5	3.07	3	1.84	179	4	2.23	4	2.23
Westmoreland	1546	17	1.10	14	0.91	1548	10	0.65	22	1.42
Wyoming	86	2	2.33	2	2.33	71	0	0.00	0	0.00
York	1702	17	1.00	54	3.17	1651	23	1.39	64	3.88
All counties	66233	1044	1.58	1826	2.76	66505	828	1.25	1675	2.52

[a]Total number of children under the age of 2 years born in 2015 and 2016 tested for BLLs by county of residence

[b]The percentage of tested children under the age of 2 years born in 2015 and 2016 had unconfirmed or confirmed EBLLs by county of residence.

Figure 1. Percentage of Children Tested for BLLs Before 2 Years of Age by County of Residence, 2015 Birth Cohort

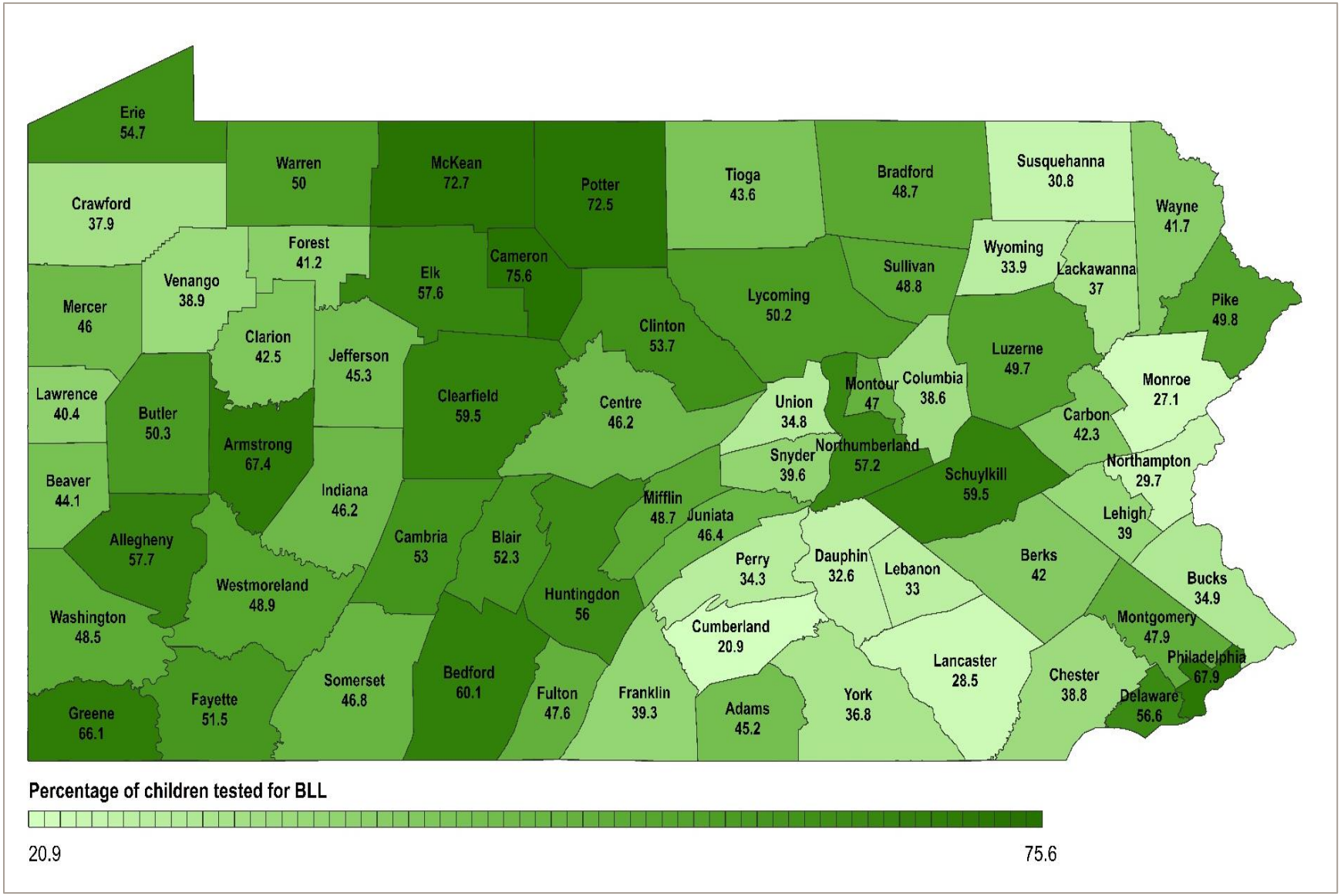


Figure 2. Percentage of Children Tested for BLLs Before 2 Years of Age by County of Residence, 2016 Birth Cohort

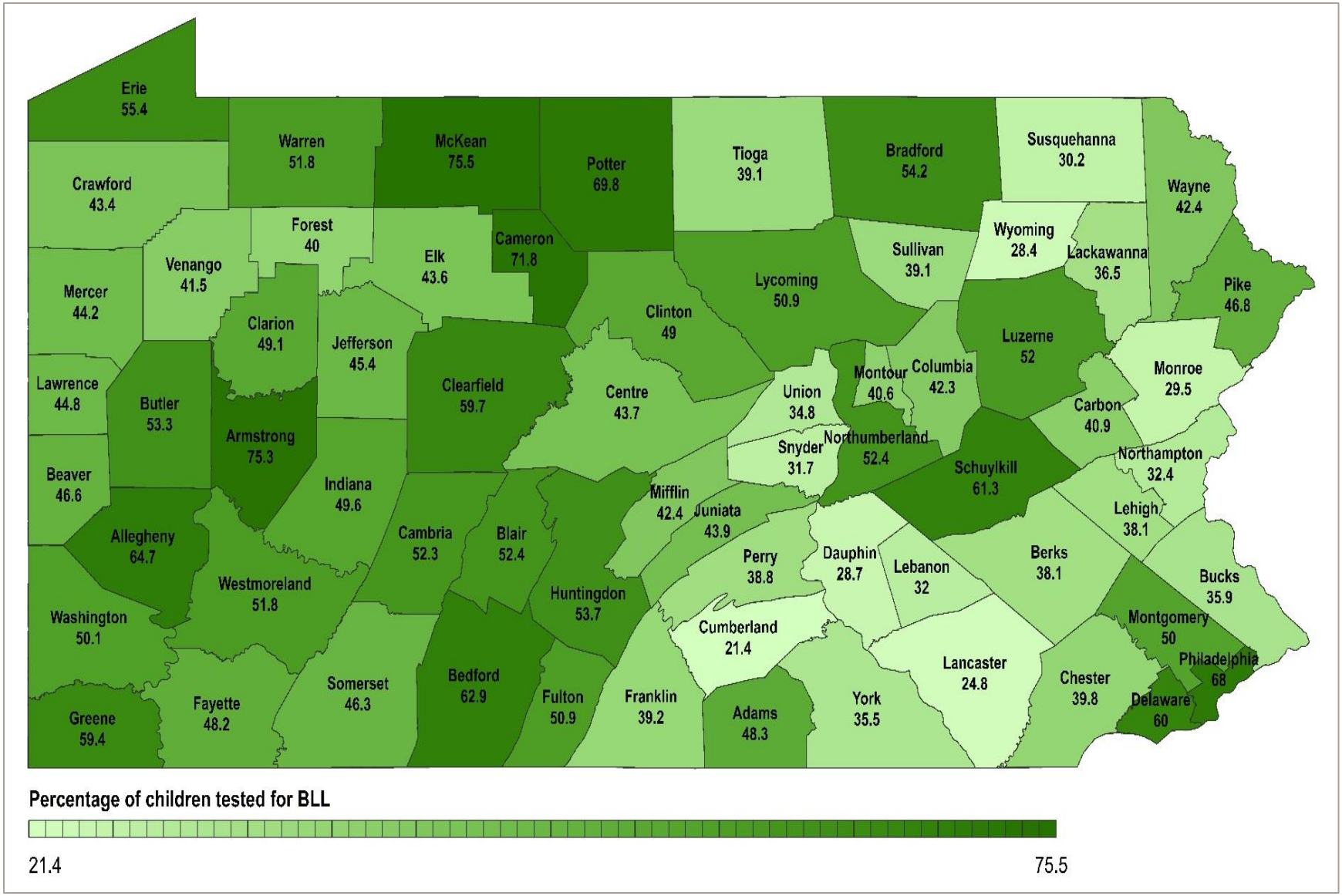


Figure 3. Percentage of Confirmed EBLLs Among Children Tested for BLLs Before 2 Years of Age by County of Residence, 2015 Birth Cohort

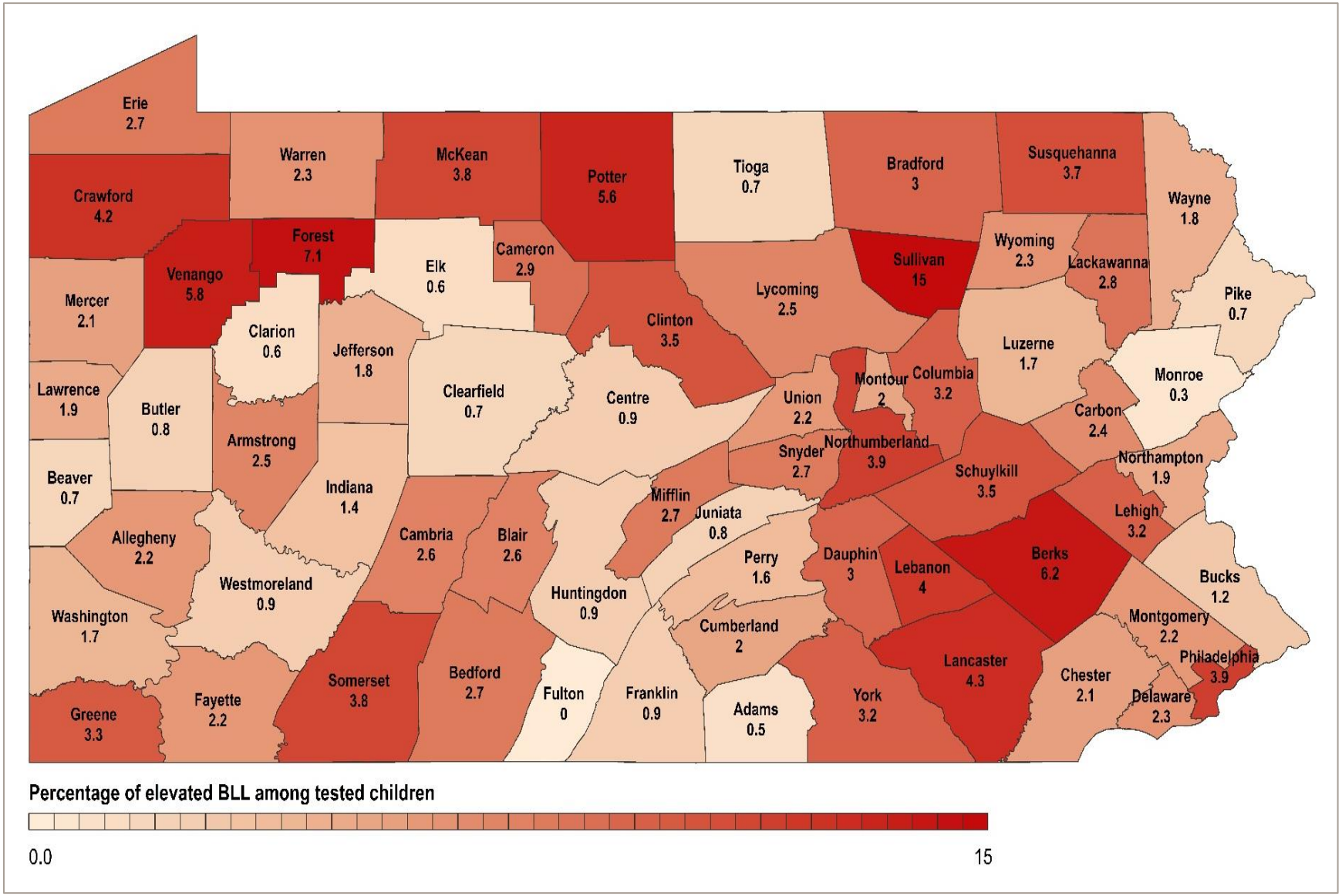


Figure 4. Percentage of Confirmed EBLLs Among Children Tested for BLLs Before 2 Years of Age by County of Residence, 2016 Birth Cohort

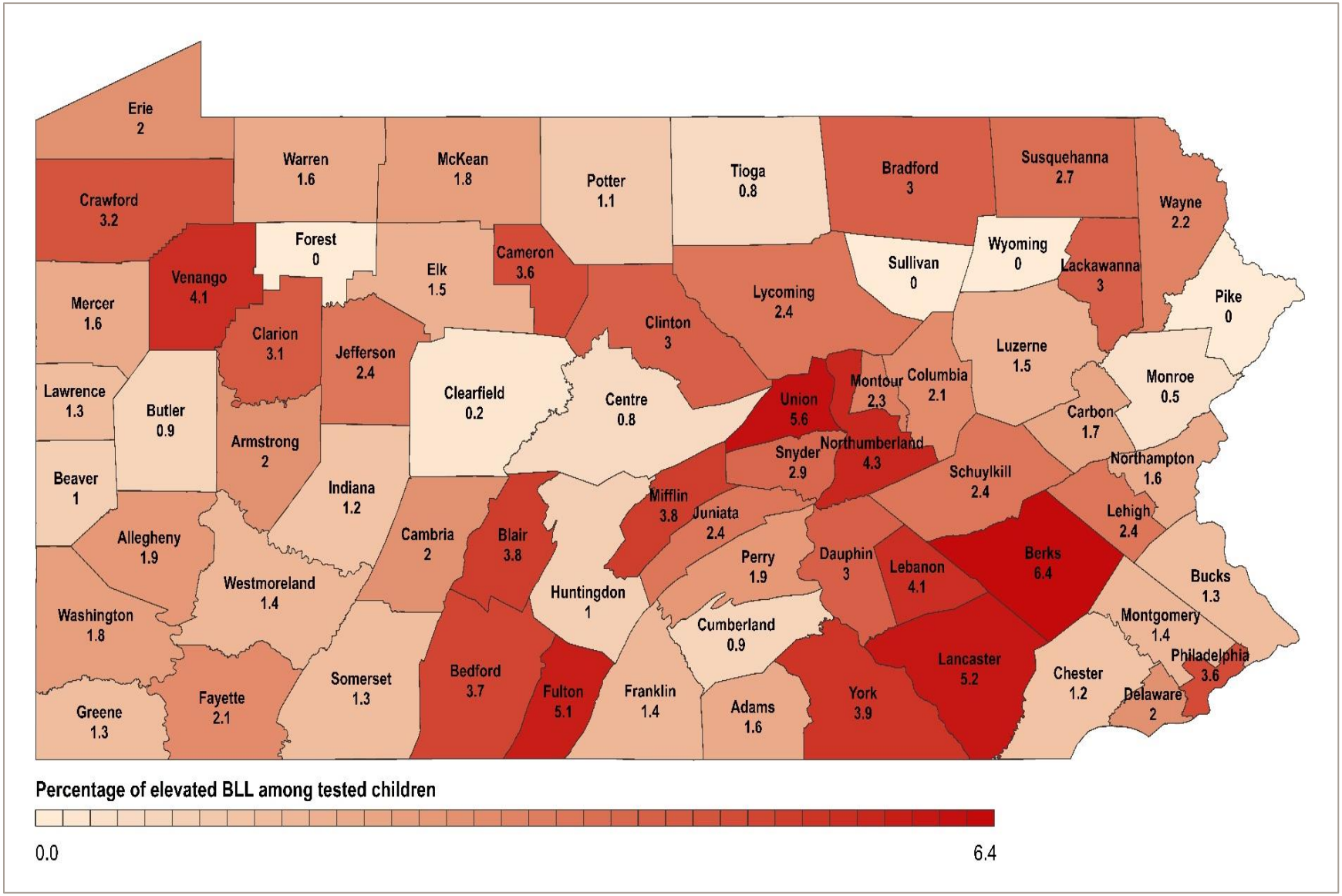


Figure 5. Percentage of Children Tested for BLLs Before 2 Years of Age by Municipality of Residence for Selected Counties with a Total of 2,000 births or Greater in 2015−2016, 2015−2016 Birth Cohort

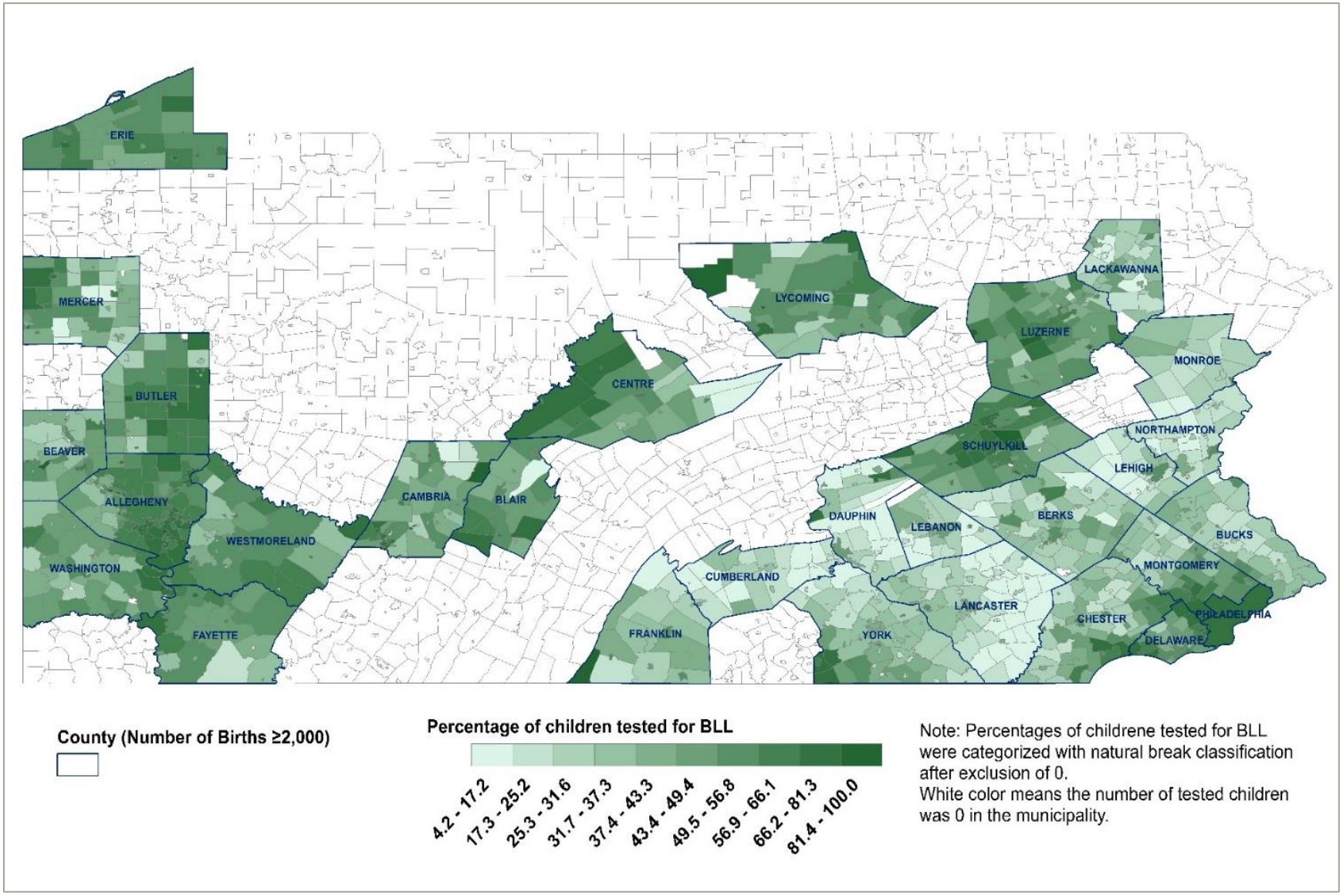
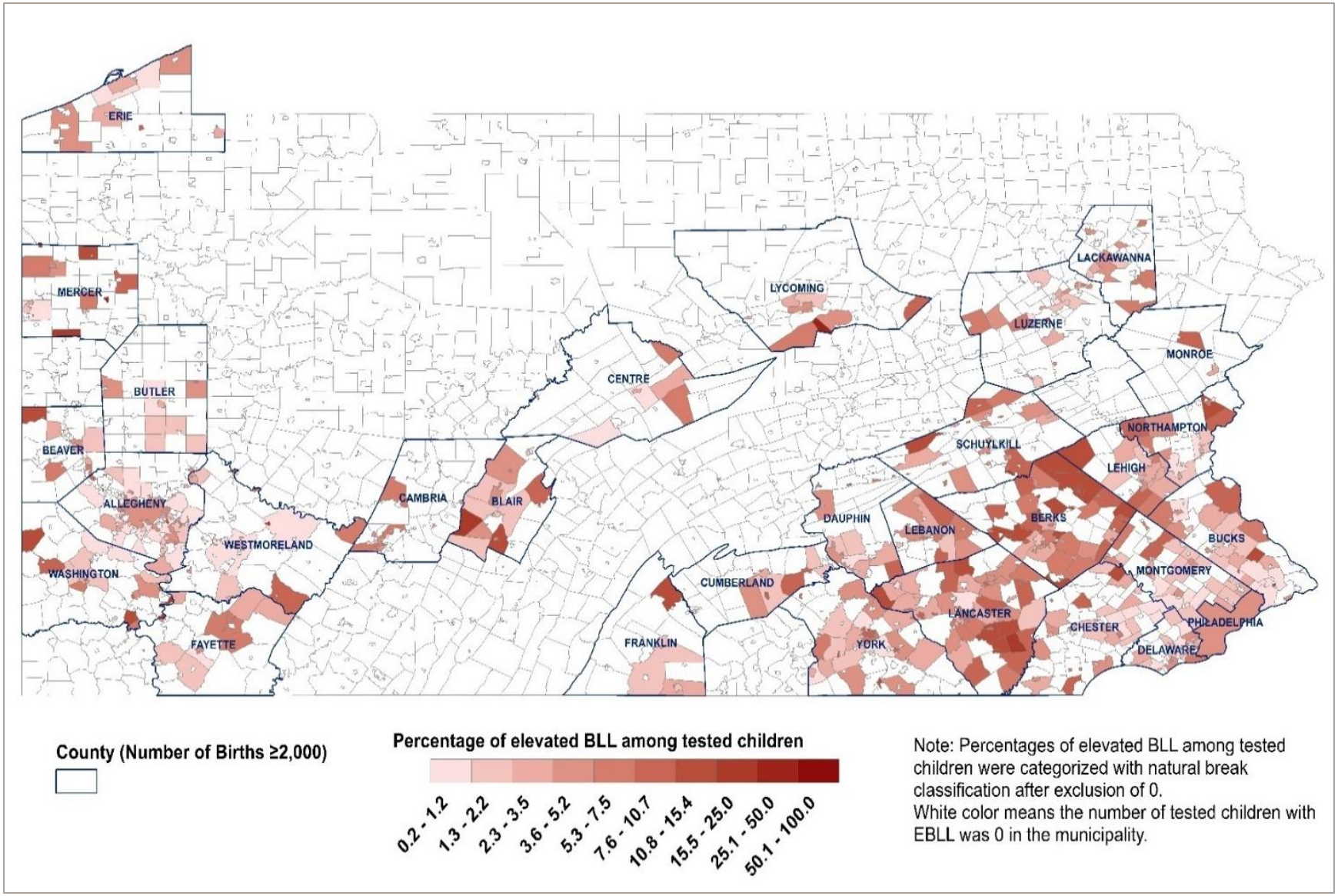


Figure 6. Percentage of Confirmed EBLLs Among Children Tested for BLLs Before 2 Years of Age by Municipality of Residence for Selected Counties with a Total of 2,000 births or Greater in 2015−2016, 2015−2016 Birth Cohort



References

1. Pennsylvania Department of Health. Childhood Lead Poisoning Prevention Program. 2018. 2018 Childhood Lead Surveillance Annual Report. Available from: https://www.health.pa.gov/topics/Documents/Environmental%20Health/2018%20Childhood%20Lead%20Surveillance%20Annual%20Report.pdf.
2. National Toxicology Program. 2012. Monograph on health effects of low-level lead. Research triangle park, NC. Available from: https://ntp.niehs.nih.gov/ntp/ohat/lead/final/monographhealtheffectslowlevellead_newissn_508.pdf.
3. Agency for Toxic Substances & Disease Registry. 2017. Environmental health and medicine education, lead toxicity, what are the possible health effects from lead exposure? Available from: https://www.atsdr.cdc.gov/csem/csem.asp?csem=34&po=10.
4. Advisory Committee for Childhood Lead Poisoning Prevention, 2012. Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. Available from: https://www.cdc.gov/nceh/lead/acclpp/blood_lead_levels.htm.
5. U.S. Census Bureau. American community survey population estimate program. 2014-2018 American Community Survey 5-Year Estimates, table B25034: year structure built.

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This report can be found at: https://www.health.pa.gov/Pages/default.aspx.