Annual Elevated Lead Report. 2023

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Executive Summary

This report summarises findings from the surveillance of cases of elevated blood lead in children (aged 0 to 17 years) and adults over the age of 65 in Wales from 1 January to 31 December 2023, compared with the years 2017 to 2022 (excluding 2020). Carried out by Environmental Public Health (EPH), at Public Health Wales, who support clinicians with managing these cases, it outlines 2023 case data and updates on surveillance activities. Finally, it makes recommendations for next steps.

Results

There was more testing of children in 2023 compared to previous years, and subsequently more cases of elevated blood lead identified. Most tests were conducted in Betsi Cadwaladr Health Board, and fewest in Hywel Dda. Positive test rates were highest in Cwm Taf Morgannwg and lowest in Cardiff and Vale. The majority of the tests were for boys (n = 389, 69%), and the largest number of cases were in the two-to-three-year age group (n = 8, 38%). Most of the tests (n = 202, 35.7%) and cases (n = 9, 42.8%) were for children from WIMD quintile one; the most deprived. Testing of adults over the age of 65 in 2023 was in line with previous years. Unlike children, more tests were conducted for individuals from WIMD five (least deprived) than WIMD one (most deprived).

Conclusions and Recommendations

This is a first summary of the findings of blood lead testing in children and older adults in Wales. These data show that exposure to lead is still causing significant health harms to children across Wales. There are issues that EPH can investigate further, as well as work with other partners on to encourage action.

EPH should

1) Engage with clinical staff across Wales, particularly paediatric teams, to try to improve understanding of approaches to testing. This should be carried out with reference to activity in Betsi Cadwaladr to understand what their referral pathways are. It will also help to establish why testing rates vary across health boards in Wales and raise awareness of testing for elevated blood lead amongst clinicians in areas with currently low testing rates.

2) Work with NHS Wales Every Child team to develop Parent Information Resources about where lead may be found in homes and surrounding environment and how to reduce exposure.
   Given that more children affected are from WIMD 1, and aged 2-3, working to effectively communicate with these children's families and care providers to provide advice will need partnership working.
3) Aim to carry out more detailed analysis of cases managed by the EPH team to identify common sources of lead.
4) Advocate for more detail to be provided in the blood lead test data set, including NHS number and ethnicity.
5) Continue to consider approaches to developing understanding of "baseline" lead data in healthy people of all ages.

Background

Lead is a naturally occurring toxic metal, ubiquitous within the Earth's crust (WHO, 2023). Due to its historic use, lead is still present in the environment, posing a risk to the health of the people of Wales. The World Health Organization (WHO) estimated that approximately two million lives were lost globally in 2019 due to lead exposure (WHO, 2021).

Health harms

In the UK, lead related deaths are, thankfully, rare, if they occur at all. However, elevated blood lead levels can cause significant health harms. Lead exposure can result in severe toxic effects to the gastrointestinal system, nervous system, renal system, and haematopoietic system (Public Health England, 2017). Children are more vulnerable to lead poisoning than adults as they absorb four to five times as much ingested lead from a given source (WHO, 2023).

There is no safe level of lead, and health harms occur even at very low concentrations. Low level exposures to lead (≤10µg/dL in blood) can result in neurobehavioural effects in both adults and children, including reduced cognitive function such as impaired attention, learning ability and memory (United States Department of Health and Human Services Agency for Toxic Substances and Disease Registry, 2020).

Sources of lead

Exposure to lead and lead in the environment has been reduced by successful primary prevention measures to reduce lead in fuel and paints, replace lead water pipes, control of emissions from industrial sites and reduce lead in soil (UKHSA, 2023). Following the removal of lead from petrol, ingestion of lead, as opposed to inhalation, has become the most common exposure source in high income countries, primarily from lead paint dust and flakes in older houses (WHO, 2010).

In Wales, one of the two drinking water providers, Dwr Cymru Welsh Water (DCWW) is seeking to remove lead from the water supply and reduce reliance on phosphate dosing to support this. As part of the work towards a "lead-free Wales" DCWW aim to replace at least half of lead pipes and fittings they are aware of by 2050 (DCWW, 2023).

Lead exposure and health harms in Wales

Lead exposure is determined by a blood test to measure blood lead concentration. Individuals may be asymptomatic until higher levels of exposure and, even then, symptoms of lead exposure are not specific and include abdominal pain, loss of appetite, vomiting, fatigue, developmental delay and learning difficulties (NHS Inform, 2023). Therefore, it may be difficult for patients and their clinicians to identify the need for a test for lead exposure. As a result, the number of children and adults who have both a blood test taken and a result showing an elevated, or positive, blood lead level is likely to represent a significant underestimate of the size of the population exposed to lead in Wales.

In Wales, Public Health Wales has established surveillance to annually, retrospectively, analyse all NHS blood tests taken for lead in Wales. There is no routine population surveillance of blood lead levels of healthy people in Wales. The latest UK National Screening Committee (NSC) review concluded that screening the population is **not recommended** as the number of children affected is not known, the test is not reliable enough, and treatments in children with mild symptoms of lead exposure have not been proven and may be harmful (UK NSC, 2018).

This report aims to describe the epidemiology of blood lead test results, and cases of elevated blood lead, in Wales, to inform our understanding of the population exposed to lead and to target future public health actions. We characterize trends in the incidence of elevated blood lead cases in terms of age, sex, geographical distribution, and deprivation. This report is a baseline for future surveillance of elevated blood lead.

Statement of inequalities assessment

We have considered how this surveillance will affect inequalities, both in terms of describing and addressing them.

Lead exposure is particularly harmful to children and may need public health intervention and clinical management. Interventions and awareness raising around the dangers of lead should be for children and their parents or carers. In line with the Well-being of Future Generations Act (WFGA) we need to keep in mind not just actual exposure to children but the potential for other children to be exposed in the future.

In addition, engagement and preventative work should focus on children with Pica, autism spectrum disorder and other learning difficulties. Collecting "population" data on testing and cases of elevated blood lead or children with pica, autism and other additional needs would be invaluable but is not currently supported by the data that we have available to us.

It has been established that exposure to lead is more likely to occur in poorly maintained properties. People living in poorly maintained properties are more likely to be from more deprived areas. As part of our analysis, we have assessed tests and cases by WIMD quintile.

We have also assessed the data by sex to ensure there are no disparities between males and females. Unfortunately, due to lack of data, we have been unable to assess tests and cases by ethnicity. This is something we hope to include in future reporting.

We have analysed data for children and adults over the age of 65 only. Working age adults are excluded because exposures in this group tend to be occupational and tests may be carried out through the workplace or via the NHS. Actions to address these exposures therefore sit with employers and their regulators and obtaining a true picture of exposure is not possible. Including adults over the age of 65 is intended to identify situations where hobbies are leading to exposures.

Methods

The data summarised here are maintained by Digital Health and Care Wales (DHCW). They collate laboratory reports from across Wales.

Case definition

Children:

A confirmed elevated blood lead case was an individual aged 0 to 17 with a blood lead concentration ≥ 0.24µmol/L (or 5µg/dL), as detected in a laboratory. The case must also be a resident of Wales.

Adults:

A confirmed elevated blood lead case was an individual aged 65 or over with a blood lead concentration ≥ 0.48µmol/L (or 10µg/dL), as detected in a laboratory. The case must also be a resident of Wales.

Study population

Individuals were included in the study population where their Lower-layer Super Output Area (LSOA) of residence was in Wales. An individual's blood test must have been conducted between 1st January 2017 and 31st December 2023. Only initial blood tests were considered; repeat test results were excluded. A long-term average was calculated for 1st January 2017 to 31st December 2022 and compared with 1st January to 31st December 2023.

2020 was excluded due to the Covid-19 pandemic; the EPH service was aware that testing was much reduced because of altered clinical practices making interpretation of test patterns and positivity profiles very difficult.

Other Data Sources

Crude test rates for each sex, and age group, by calendar year were calculated using the mid-year population estimates for Wales produced by the Office for National Statistics (ONS).

Crude test rates by Welsh Local Authority (LA) and Health Board (HB) were calculated using the mid-term population estimates produced by StatsWales.

Deprivation was assessed by the Welsh Index of Multiple Deprivation (WIMD) which scores the 1909 Welsh Lower-layer Super Output Areas (LSOAs) by different types of deprivation. These were then ranked from

1 (most deprived) to 1,909 (least deprived) and assigned to a fifth, 1 being most deprived and 5 least deprived; it is these fifths we analysed.

The crude test rates by urban/rural divide were calculated by using ONS LSOA designations (C1/C2= urban, D1/D2 and E1/E2 = rural).

Analysis

All data cleaning and analysis (descriptive and statistical) were performed in R 4.1.3. Long-term averages were calculated as the average number of tests for each month for which data were available, so, for example, the average for all January tests from 2017 to 2022. 95% confidence intervals were calculated.

Data are correct as of the 27th November 2024.

Surveillance Findings

Children

Number and rate of initial tests

In 2023, 558 blood tests of children were submitted for initial lead testing. This is an increase of 200 (55.9%) tests compared to 2022 and the highest annual number of tests for the period for which we have data. The testing rate for 2023 was (17.6/100,000) (Figure 1).

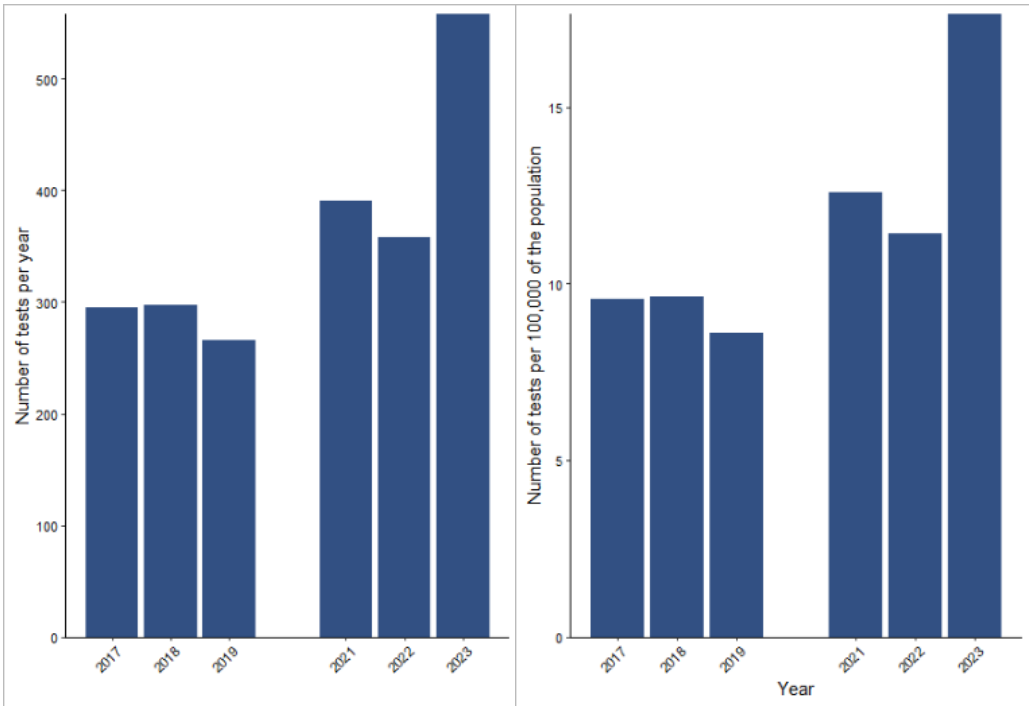

Figure 1: Number and rate of initial blood tests taken for lead, per year in children. 2017 -2023.

During 2023, the number of tests each month exceeded the monthly average for 2017 to 2022 (Figure 2) particularly from March to November.

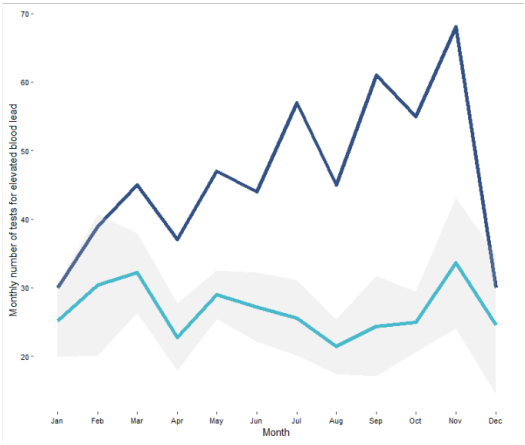

Figure 2: Monthly number of tests of children for blood lead in Wales in 2023 (dark blue line) relative to the long term average (2017 – 2022, light blue line) ± 95% CIs (grey shading).

In 2023, there were 19 new children with elevated blood lead, compared with 10 in 2022. In 2023, 3.4% of tests met the public health action level (Figure 3), compared with 2.8% in 2022 (difference not significant).

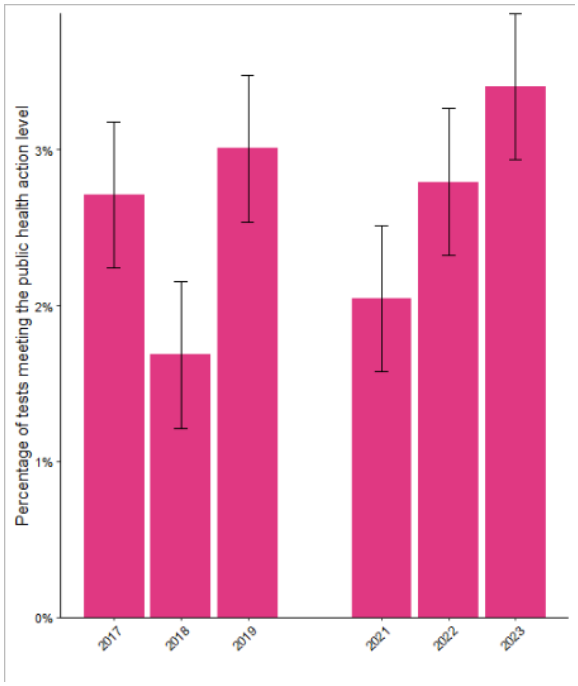

Figure 3: Proportion of tests per 100,000 of the population meeting or exceeding the threshold for elevated blood lead in children at the threshold of 0.24umol/L in Wales. 2017 - 2023.

Age and sex of children tested

Most blood lead tests in 2023 were for boys (n = 387, 69%). Most tests were for two to five year olds (n = 357, 64%) (Figure 4).

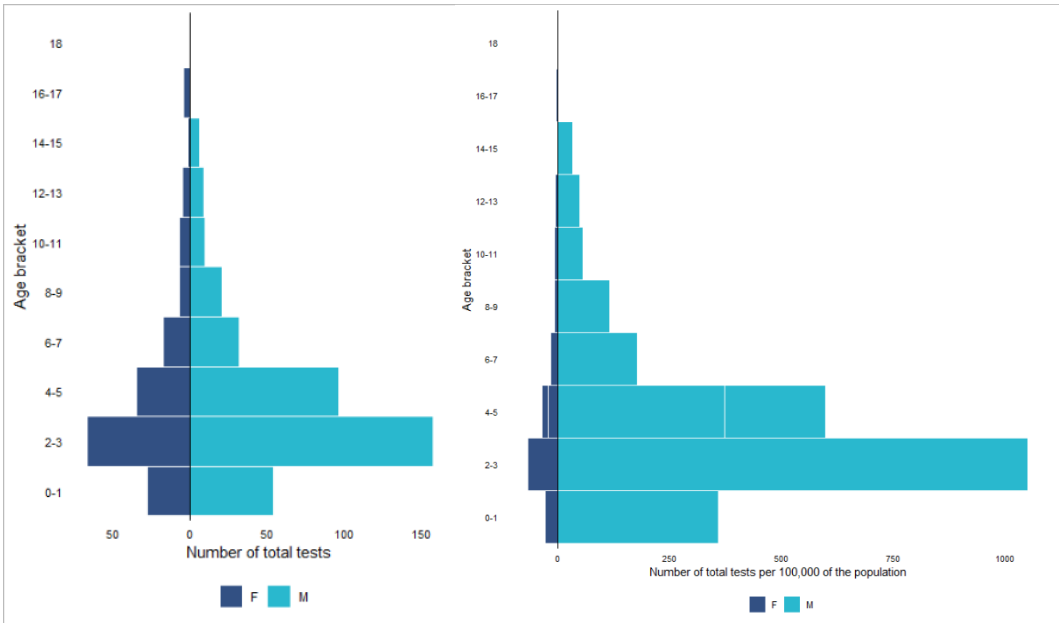

Figure 4: Number and rate of blood tests taken for lead by age and sex of child

Most children with an initial elevated blood lead test were boys (n = 14, 74%). Most children with an elevated blood lead test were in the two- to three-year old age group (n = 8, 42%). Test positivity was highest female 8 to 9 year olds (14.3%) and lowest for female two to three year olds (1.5%; Figure 5).

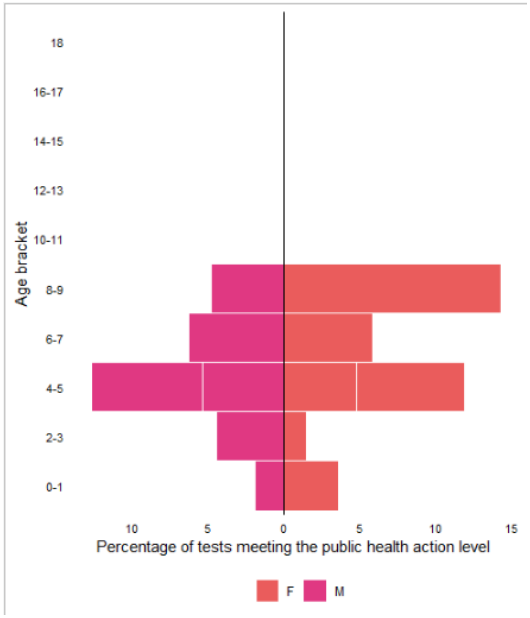

Figure 5: Proportion of tests per age and sex of the population meeting or exceeding the threshold for elevated blood lead in children at the threshold of 0.24umol/L in Wales. 2017 - 2023.

Health board trends

In 2023, the test rate was highest in Betsi Cadwaladr University HB (BCUHB; 28/100,000) and lowest in Hywel Dda University HB (HDUHB; 5.4/100,000; Figure 6).

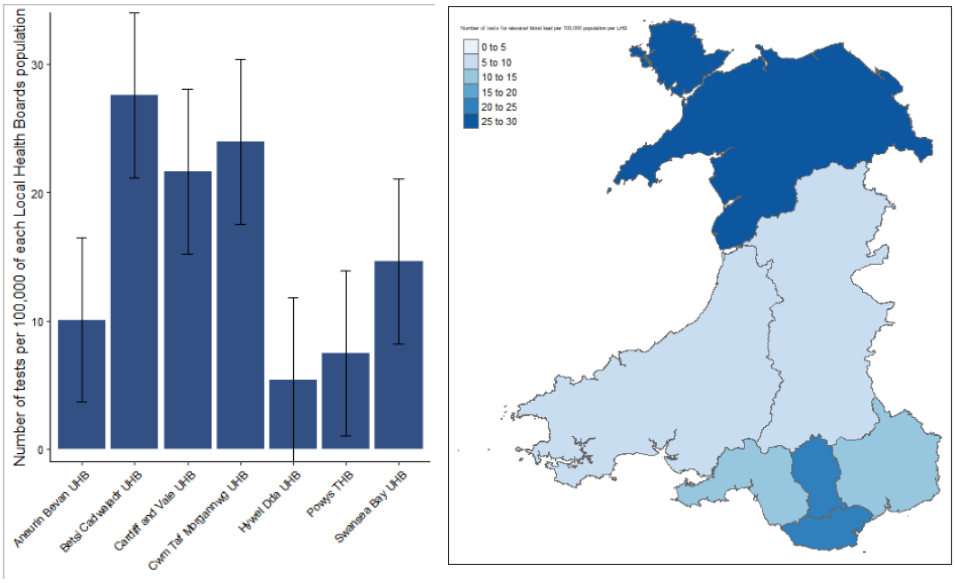

Figure 6: Initial blood lead test rate per 100,000 population by HB.

Cwm Taf (CTMUHB) had the highest rate of initial blood lead tests meeting the public health action level (0.9/100,000), with the lowest in Cardiff and Vale UHB (CVUHB; 0.2/100,000; Figure 7). Elevated blood lead rates in BCUHB, CTMUHB, HDUHB and Powys (PTHB) were all significantly higher than in CVUHB and Swansea Bay (SBUHB). But, in terms of positivity, HDUHB had a significantly higher positive test percentage than any health board except PTHB (Figure 8).

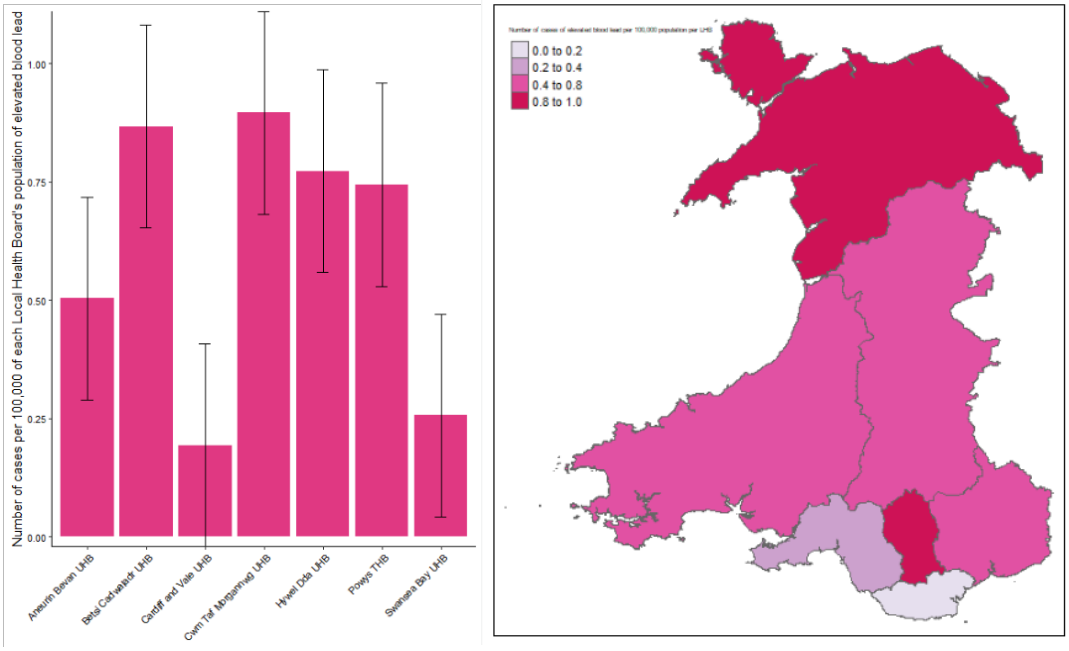

Figure 7: Rate of cases of elevated blood lead per 100,000 population by HB.

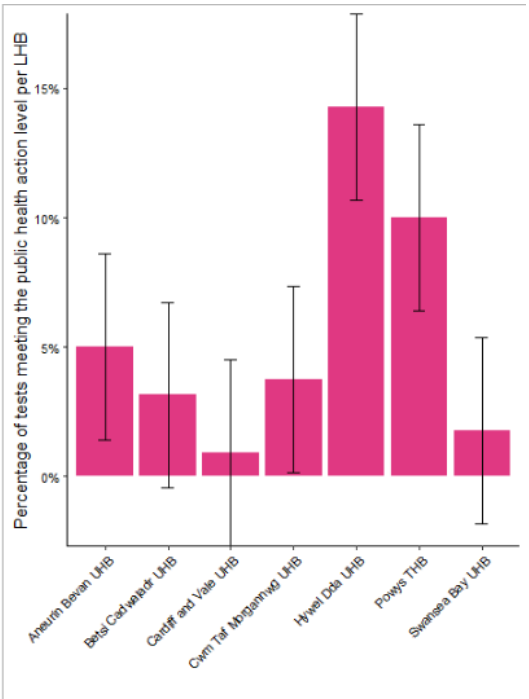

Figure 8: Percentage of tests conducted per HB meeting the public health action level.

Local authority trends

The highest rate of testing in 2023 was in Denbighshire (46.5/100,000), which, with Conwy, was significantly higher than all other LAs, the lowest in Ceredigion (2.7/100,000; Figure 9).

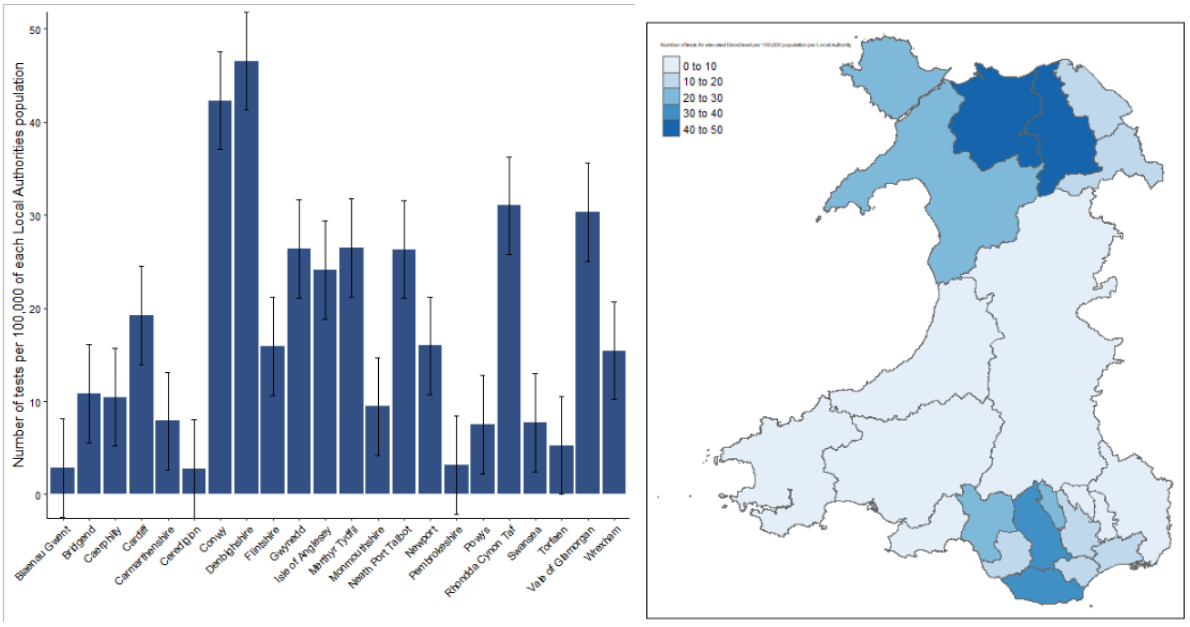

Figure 9: Rate of tests for elevated blood lead in children per 100,000 popn by LA

The highest case rate by LA was in Denbighshire (3.1/100,000), significantly higher than all other LAs in Wales. A number of LAs no children with elevated initial blood lead tests in 2023 (Figure 10).

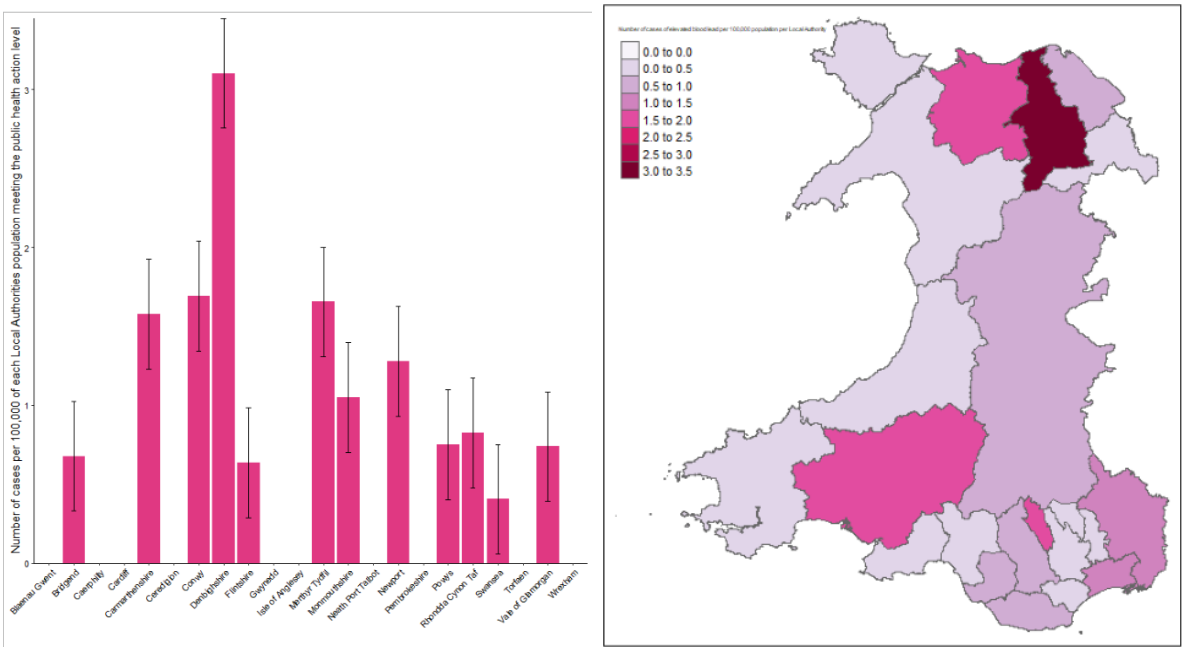

Figure 10: Rate of children with elevated initial blood lead tests per 100,000 popn by LA

Test positivity was highest in Carmarthenshire; significantly greater than any other LA in Wales (Figure 11).

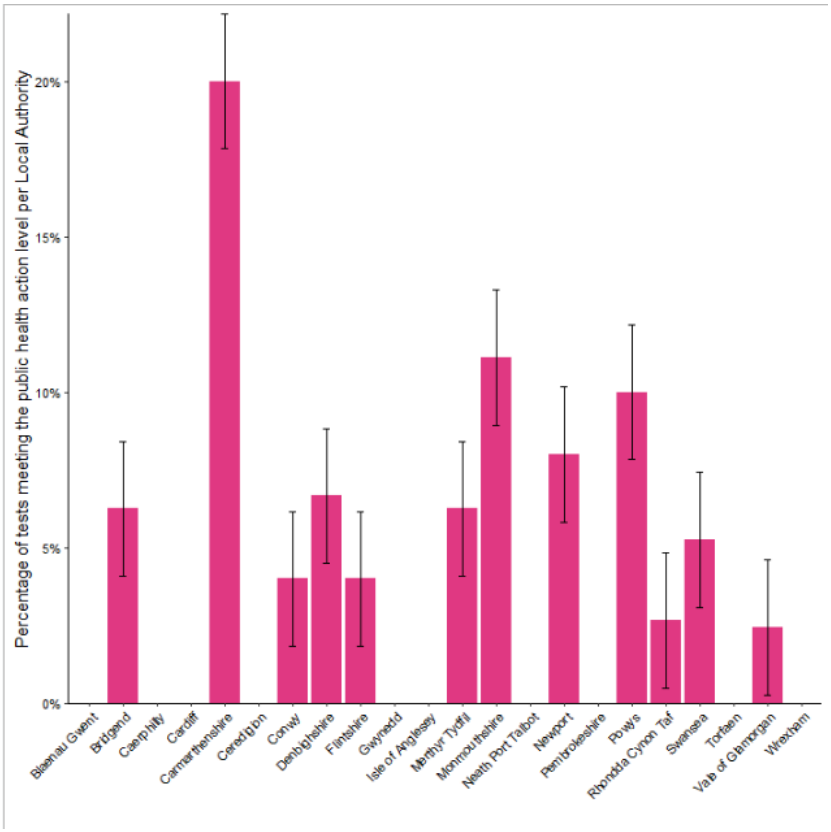

Figure 11: Percentage of tests conducted by LA meeting the public health action level

Deprivation based trends

In 2023, over a third of children with an initial blood lead test were in WIMD fifth 1, the most deprived group (n = 200, 35.8%; Figure 12); significantly more than all other fifths except the next most deprived.

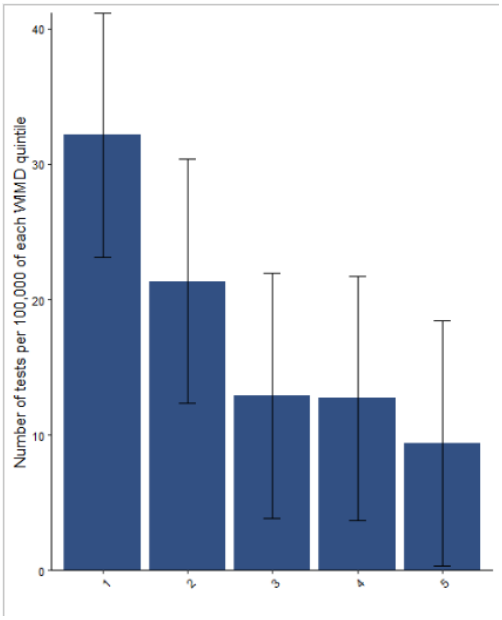

Figure 12: Rate of tests for elevated blood lead in children per 100,000 popn per WIMD quintile.

The rate of elevated blood lead was also highest in children living in WIMD one, the most deprived group (n= 7, 36.8%, 1.1/100,000; Figure 13).

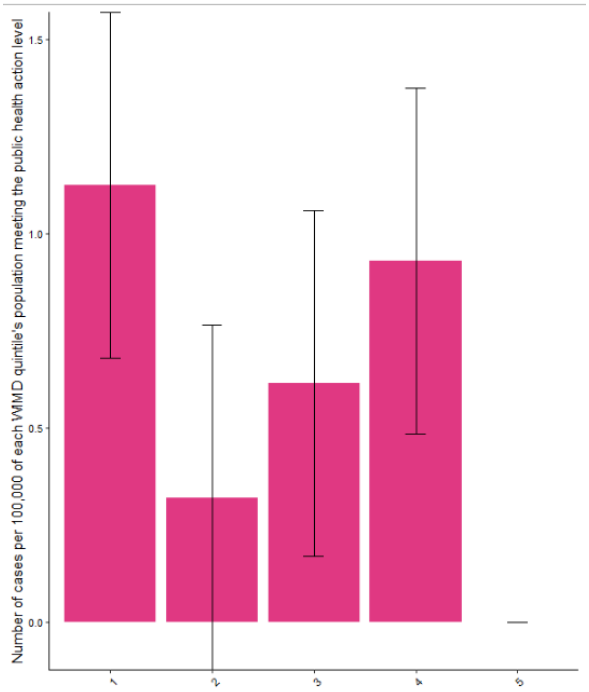

Figure 13: Rate of cases of elevated blood lead in children per 100,000 popn per WIMD quintile.

Urban: rural analysis

Most children tested in 2023 live in urban areas (n=418, 75%; Figure 14).

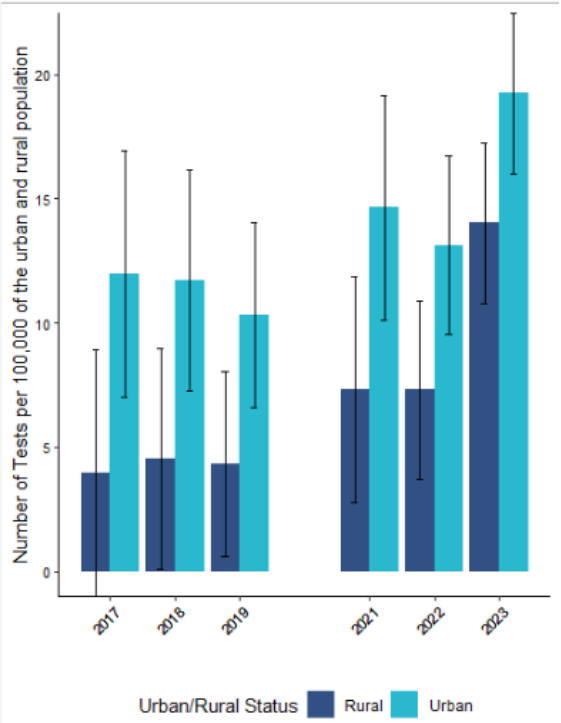

Figure 14: Tests for elevated blood lead in children per 100,000 Urban/Rural popn.

Despite fewer children from rural areas being tested, a higher rate and percentage of children residing in these areas were found to have an elevated blood lead level (Figures 15 and 16).

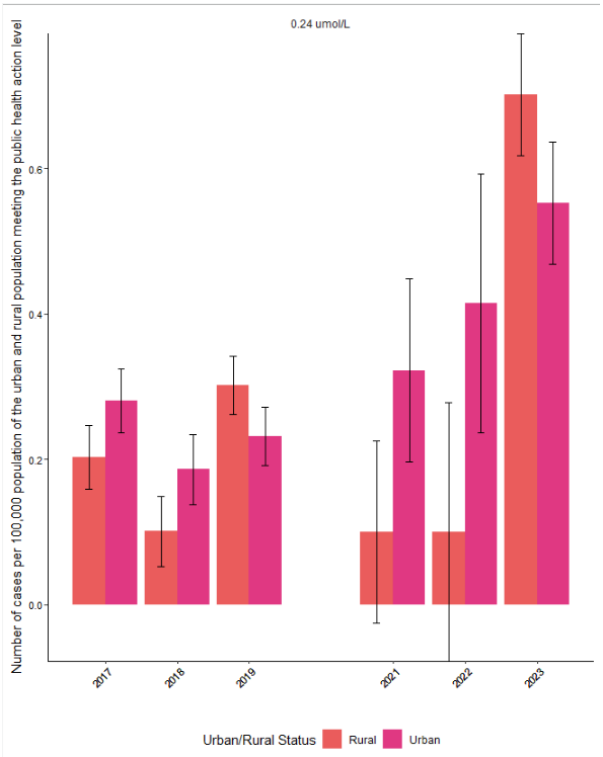

Figure 15: Rates of elevated blood lead in children per 100,000 popn per Urban/Rural popn.

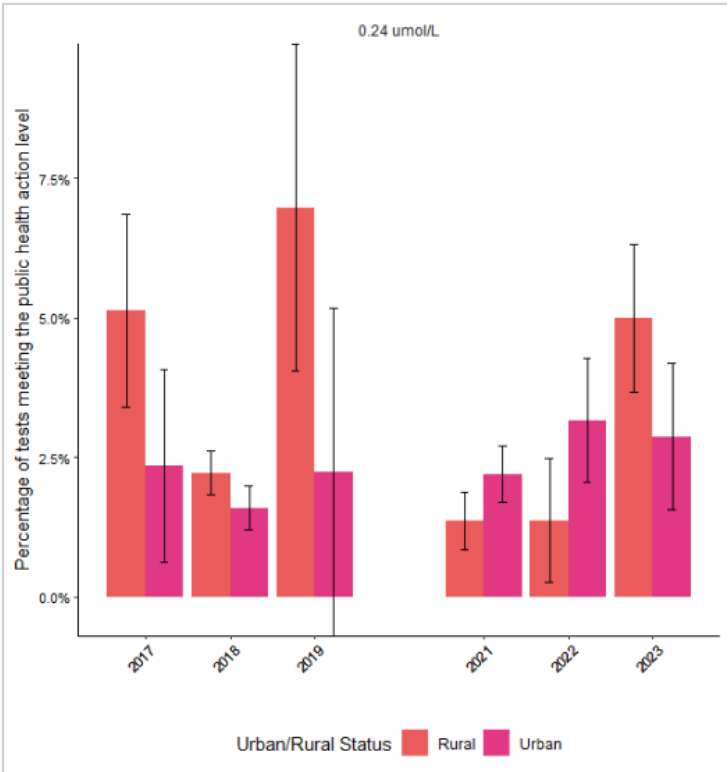

Figure 16: Percentage of tests meeting the public health action level by Urban Rural divide.

Section two: Adults over the age of 65

Number of initial tests

For 2023, 35 tests of adults over the age of 65 were submitted for initial testing (Figure 17).

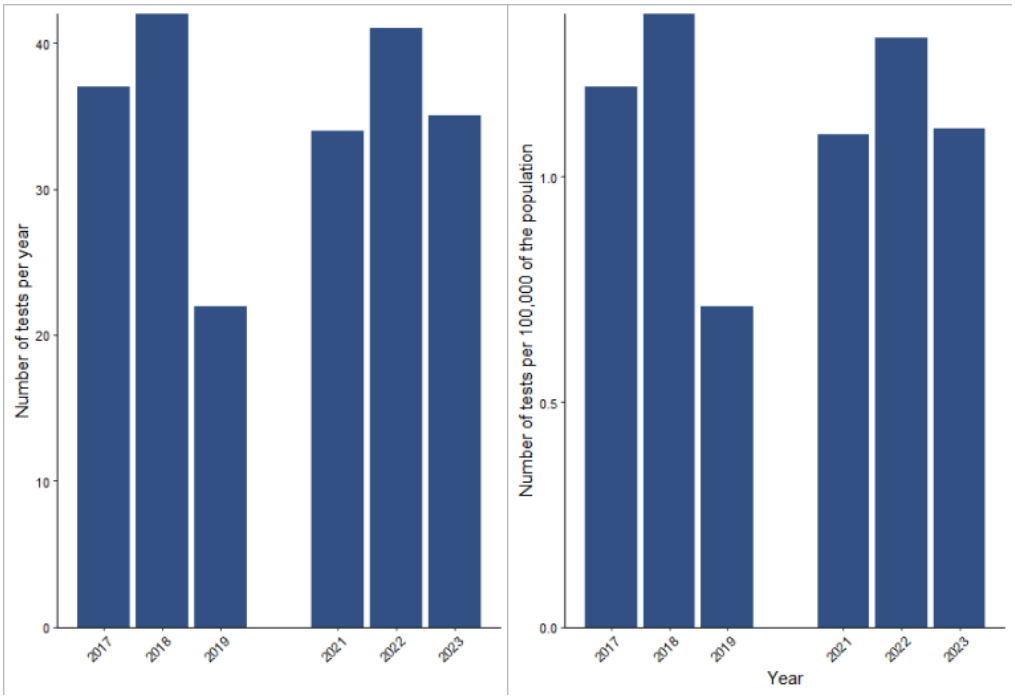

Figure 17: Number and rate of initial blood tests taken for lead, per year in adults over the age of 65. 2017 – 2023.

Age and sex of adults tested

In 2023, more men aged 65 and over were tested than women (n = 19, 54%).

Health board trends

In 2023, the test rate was highest for adults aged 65 and over in CVUHB (2/100,000), significantly higher than all HBs except HDUHB and PTHB, and lowest in BCUHB (0.6/100,000), significantly lower than CVUHB, PTHB and HDUHB (Figure 19).

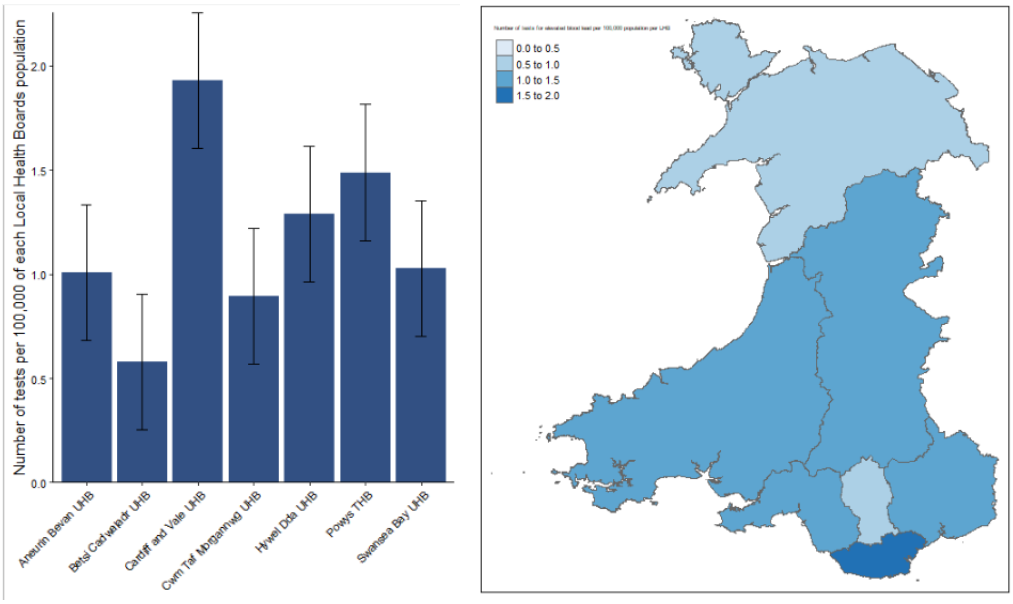

Figure 19: Initial blood lead test rate per 100,000 population by health board.

Local Authority trends

The highest rate of testing in 2023 was in Ceredigion (4.1/100,000), (Figure 20).

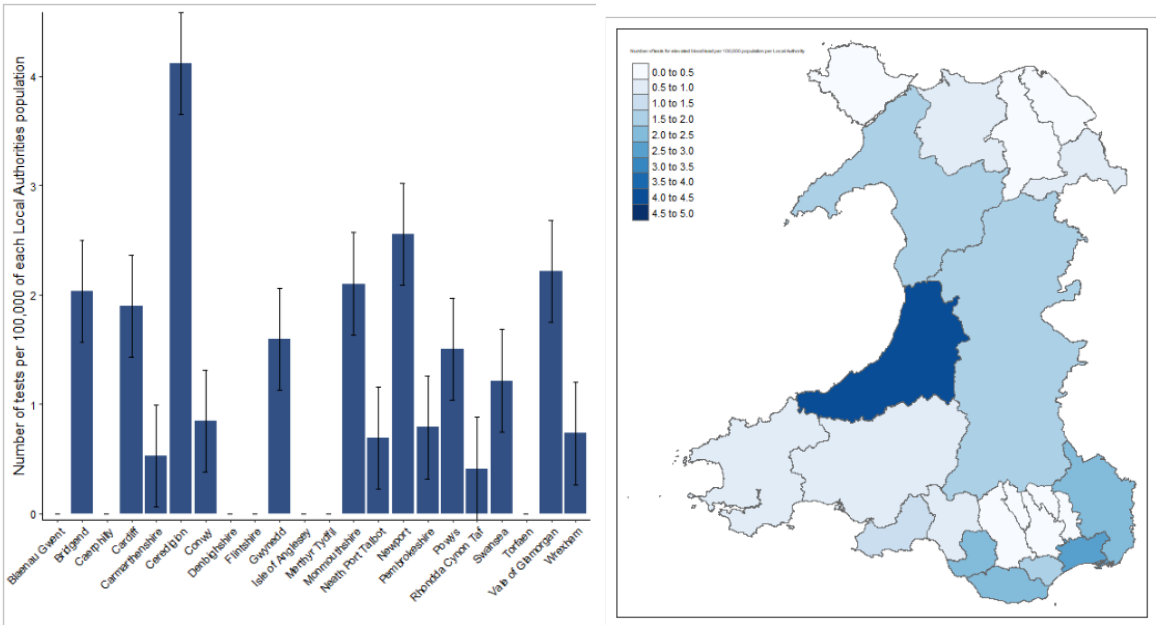

Figure 20: Test rate in adults aged 65 and over per 100,000 population by LA.

Testing for elevated blood lead by WIMD quintile

In 2023, just under a third of adults aged over 65 tested were in WIMD quintile 5, the least deprived group (n = 11, 31.4%; Figure 21).

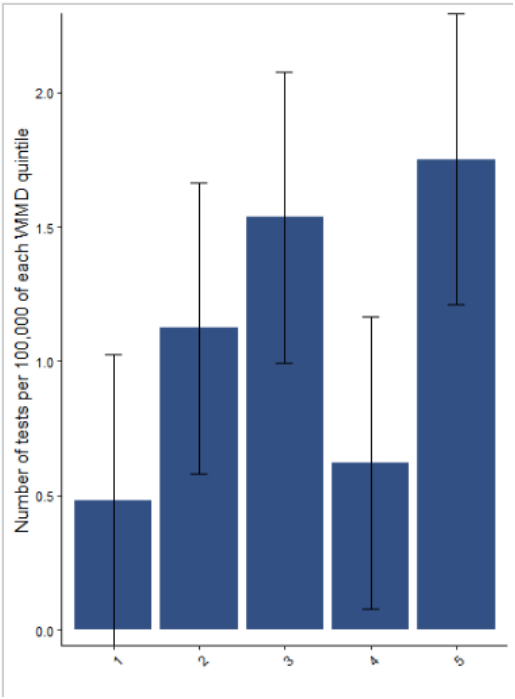

Figure 21: The number of tests for elevated blood lead in adults aged over 65 per 100,000 population per WIMD quintile.

Urban: rural analysis

Most adults aged over 65 tested live in urban areas (n = 28, 80%; Figure 22).

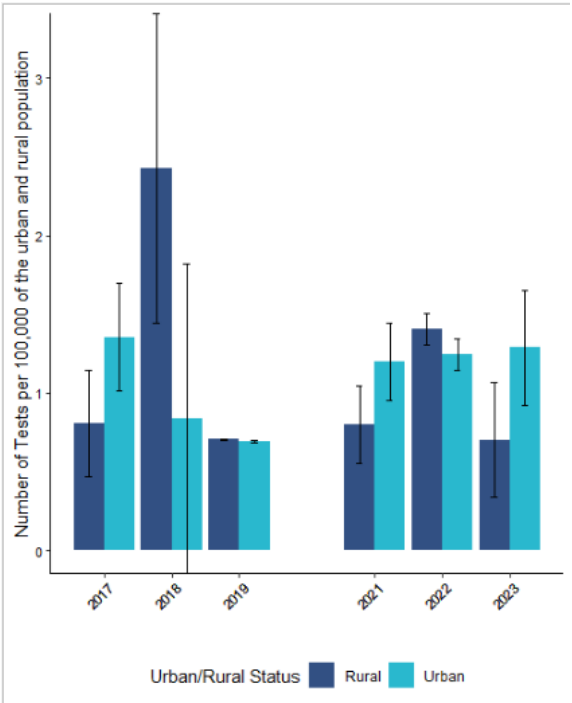

Figure 22: Rate in adults aged 65 and over per 100,000 popn per Urban/Rural popn.

Fewer than five older adults had elevated blood lead in 2023. No further analysis of these data is possible.

Limitations

These analyses are based on testing data gathered from people who clinicians suspect to have an illness that may, or may not, be caused by an environmental source. There is no routine population level analysis in Wales of lead exposures. Therefore, these people are already unwell, or have conditions meaning they may be more likely to be exposed to lead due to their behaviours. The population profiles presented here may be reflective of illness profiles in the population, rather than elevated blood lead concentrations in the population.

We used the aggregate WIMD deprivation score to create fifths and then compared outcomes between these fifths. WIMD does, of course, also include a health indicator, risking circularity between "explainer" and outcome. However, it is not currently clear to us whether another of the WIMD components could be an appropriate proxy in the way that, for example, income is used for deprivation when studying air pollution. Previous studies in the UK have established that children from Asian ethnic backgrounds have higher blood lead concentrations than children with European ethnicity (Kolev *et al.* 1996). The dataset does not contain any ethnicity data and therefore it is not possible to make any conclusions regarding ethnicity.

Conclusions and Recommendations

This is a first summary of the findings of blood lead testing in children and older adults in Wales. These data show that exposure to lead is still causing significant health harms to children across Wales. There are issues that EPH can investigate further, as well as work with other partners on to encourage action.

This report has highlighted several factors with elevated blood lead that may allow targeted approaches to reducing morbidity associated with lead exposure. Males of all ages are more likely to be tested and reach the public health action level for elevated blood lead. These demographics closely align with those observed in England (UK Health Security Agency. 2023).

Child cases were more likely to live in the most deprived areas of Wales. Deprived areas are more likely to have older properties that are poorly maintained; subsequently increasing the risk of exposure to lead via both paint and lead pipes. It is important that in future data are collected and analysed regarding potential exposure sources.

The data contained in this report likely represents a significant underestimation of the true incidence. Elevated blood lead can present insidiously with non-specific symptoms, making diagnosis difficult for clinicians (BMJ Best Practice. 2022). At present, not all health boards are testing to the same extent. As shown in the report, BCUHB testing is significantly greater than ABUHB, PTHB and HDUHB.

EPH should

1) Engage with clinical staff across Wales, particularly paediatric teams, to try to improve understanding of approaches to testing. This should be carried out with reference to activity in Betsi Cadwaladr to understand what their referral pathways are. It will also help to establish why testing rates vary across health boards in Wales and raise awareness of testing for elevated blood lead amongst clinicians in areas with currently low testing rates.
2) Work with NHS Wales Every Child team to develop Parent Information Resources about where lead may be found in homes and surrounding environment and how to reduce exposure. Given that more children affected are from WIMD 1, and aged 2-3, working to effectively communicate with these children's families and care providers to provide advice will need partnership working.
3) Aim to carry out more detailed analysis of cases managed by the EPH team to identify common sources of lead.
4) Advocate for more detail to be provided in the blood lead test data set, including NHS number and ethnicity.
5) Continue to consider approaches to developing understanding of "baseline" lead data in healthy people of all ages.

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