mount isa community

[LEAD SCREENING PROGRAM 2010]

A report into the results of a blood lead screening program of 1-4 year old children in Mount Isa, Queensland.

Queensland Government

This report was prepared by Tropical Regional Services, Division of the Chief Health Officer, Queensland Health. This report should be read in conjunction with the 2006-2007 Lead Screening Program Report.

Copies of this report will be made available on the Queensland Health website www.health.qld.gov.au or may be obtained by contacting Mount Isa Public Health Unit on (07) 4744 9100.

The previous Mount Isa Community Lead Screening Program 2006-2007 Report is available at: http://www.health.qld.gov.au/ph/documents/tphn/mtisa_leadrpt.pdf

Date: March 2011

Executive summary

In 2007, Queensland Health completed a study in Mount Isa of children between one and four years old in order to determine blood lead levels in this age group. Results of the study indicated that the average blood lead level (geometric mean) for the group sampled was 4.97µg/dl (micrograms per decilitre). This study of 400 children identified that 45 children (11.3 per cent of those in the study group) had blood lead levels greater than or equal to 10µg/dl. Of these, two had blood lead levels greater than 20µg/dl.

In 2010, Queensland Health commenced a second study in Mount Isa of children aged one to four years in order to continue to monitor blood lead levels in this age group. Results of this study indicate that the average blood lead level (geometric mean) for the group sampled was 4.27µg/dl. This study of 167 children identified that eight children (4.8 per cent of those in the study group) had blood lead levels greater than or equal to 10µg/dl. Of these, one had a blood lead level greater than 20µg/dl.

Statistical analyses revealed a significant decline between this survey and the 2007 survey in both the geometric mean blood lead levels and the percentage of children's blood lead levels at or above 10 micrograms per decilitre (µg/dl). While care should be taken in interpreting such declines, the results do however indicate a step in the right direction.

However, the study demonstrated a declining but continuing significant association between elevated blood lead levels and Indigenous status.

Measurement of haemoglobin levels, as an indicator of iron status, was included in this survey to explore any possible links between haemoglobin levels and elevated blood lead levels. Iron has been identified as an important nutritional factor due to its relationship with lead absorption. This component of the survey was voluntary and therefore elicited fewer results (136/167) making statistical analysis more challenging. There was however no statistically significant association between haemoglobin and blood lead levels shown in this study.

Due to the small number of environmental audits performed, it is not reasonable to make any significant conclusions or identify any specific trends from the data collected during the audits, however it seemed noticeable that the ownership of pets and the amount of exposed dirt in yards in six of the seven households were important factors. These factors have been consistently reported to be associated with elevated blood lead levels in children in studies at other locations.

On the basis of these results, and those of the 2007 study, Queensland Health will continue to focus on a range of individual follow-up activities in addition to continued population-focused strategies for improving awareness and encouraging personal protective behaviours for the Mount Isa community. For those households where children had elevated blood lead levels, individual follow-up activities will continue to focus on:

- auditing of environments and the collection of soil, dust and paint samples from the home and other relevant places where the child spends significant time
- advice with modifying the home environment, and identifying child hand-mouth behaviours and practices that may lead to exposure
- dietary investigation and advice
- additional blood testing to determine if exposure prevention strategies are reducing blood lead levels
- referral to a paediatric specialist where blood lead level results are above 20µg/dl.

Queensland Health continues to encourage all Mount Isa residents to be aware of their blood lead levels particularly for young children, and to access the free blood lead testing service at QML Pathology Services. Queensland Health will continue to closely monitor the results of any testing and will also continue to work with key partners through the Living with Lead Alliance to strengthen lead management in Mount Isa.

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1.0 Introduction

In 2006 and 2007, responding to concerns about community exposure to lead, Queensland Health undertook a blood lead screening program of one to four year old Mount Isa children. The results of this program were presented to a community meeting in Mount Isa in May 2008 with the report made available on the Queensland Health website: www.health.qld.gov.au/ph/documents/tphn/mtisa_leadrpt.pdf

The recommendations from the screening program were:

1. Queensland Health will continue to monitor the results of routinely collected blood lead levels in Mount Isa, and actively manage elevated blood lead levels at 10 micrograms per decilitre (µg/dl) and above
2. Queensland Health will undertake a follow-up study of the blood lead levels of children in Mount Isa in 2012
3. Queensland Health will continue to promote health messages through education and improved parental and child awareness of how to live safely with lead
4. Queensland Health will continue to work with the Living with Lead Alliance. This work will include the development of more comprehensive mitigation strategies, including dust-control measures.

Recommendation two provided for a follow-up study of the blood lead levels of the children in Mount Isa in 2012. Due to continued community concerns and the recognised need to more closely monitor Mount Isa children's blood lead levels, this survey was brought forward to 2010.

Accordingly, on 20 February 2010, Tropical Regional Services of Queensland Health commenced a survey of blood lead levels of one to four year old Mount Isa children which concluded on 8 October 2010.

2.0 Study aims

As with the 2006-2007 screening program, the primary aim of this survey was to determine the blood lead levels of a representative number of one to four year old children from the Mount Isa community.

The survey aims were for Queensland Health to:

- measure the blood lead levels of a representative sample of children aged one to four years in the Mount Isa community
- identify risk factors for lead exposure in children with blood lead levels at or above the health goal level of 10µg/dl
- assist affected families in reducing their lead exposures through advice and information
- expand on the existing evidence-base to guide further action to manage lead exposure in the Mount Isa community
- measure the level of blood haemoglobin in children to assess iron and provide an indicator of nutritional status.

3.0 Study methods

3.1 DESIRED SAMPLE AND INCLUSION CRITERIA

A sample size of 144 children was required for this survey to ensure sufficient statistical power to provide reliable information on the blood lead levels that were representative of the targeted population. The sample size required for this survey was less than the 2006-2007 screening program target of 400, as a baseline prevalence of elevated blood lead levels was now known.

Larger sample sizes reduce the width of the confidence intervals in the results. However, it should be noted that taking blood samples from small children is a difficult, painful and distressing experience for children and their parents or guardians. The sample size of 144 children was chosen to balance the need to accurately estimate community lead levels with the impact this testing would have on the community, in line with contemporary ethical guidelines.

In an effort to ensure appropriate representation from all age groups, genders and the Indigenous community, 167 children were ultimately tested.

As with the previous program, children aged one to four years were chosen as the target group due to their potentially higher exposures from their hand-to-mouth activity and the weight of evidence that identifies important health effects from lead for this age group and their general vulnerability. Carrying out a survey that targeted children also provided Queensland Health with an opportunity to identify and work closely with the families of young children at risk of important developmental health effects from lead exposure. By intervening at such a critical stage of development, long-term population health benefits can be realised.

3.2 COMMUNITY ENGAGEMENT AND RECRUITING METHODS

Awareness of the survey and opportunities to have children's blood lead sampled was undertaken through the use of media releases via the local newspaper and local radio stations, a Fun Day at the Mount Isa Hospital, and the distribution of posters and informative brochures. The survey was also actively promoted by the Living with Lead Alliance, other key stakeholders and local organisations.

Blood lead sampling occurred at either QML Pathology Services or Mount Isa Hospital (Queensland Health Pathology services). To supplement these pathways, trained staff also provided an after-hours opportunity for sampling at the Fun Day held in the Mount Isa Hospital grounds.

Children were not randomly selected but were invited to participate and therefore were 'self-selected'. However recruiters ensured that the age, sex and Indigenous distribution of the sample population was as similar as possible to the age, sex and Indigenous distribution of the Mount Isa population aged one to four years based on data from the Office of Economic Statistics and Research, Queensland Treasury.

3.3 SAMPLE COLLECTION AND ANALYSIS

Blood sampling from venepuncture remains the most reliable method for blood lead testing and this was again used as the method for blood collection for analysis.

Informed written consent was obtained from all the parents or guardians for testing to be done and inclusion in to this survey. At this time information on age, sex, Indigenous status and length of time lived in Mount Isa was recorded.

Measurement of haemoglobin levels was added to the 2010 survey so that an accurate account of haemoglobin levels and any possible links with lead could be drawn. Iron was identified as an important nutritional factor due to its relationship with lead absorption. In addition, iron deficiency

is one of the most prevalent nutritional problems among children worldwide, particularly prevalent in children with a low socioeconomic status and so was opportune to gather this data (Wright, Shannon, Wright, Hu 1999). This component of the survey was voluntary and therefore elicited fewer results, making statistical analysis more challenging.

Haemoglobin was used as the measure of iron status in this survey. More comprehensive tests were considered; however, full iron studies would have required an additional 5mls of blood, while no additional blood was required to measure haemoglobin. The team involved in this program felt that taking additional blood from young children was not acceptable and measuring haemoglobin was the preferred option.

In addition, measuring haemoglobin was consistent with Queensland Health standard practice. Routine Child Health Checks conducted by Queensland Health include haemoglobin only for screening and full iron studies are then done if the screening shows low haemoglobin.

3.4 FOLLOW-UP PROTOCOLS

3.4.1 To determine consistent and appropriate follow up for blood lead levels, Queensland Health adopted the blood lead management criteria as recommended by the American Academy of Paediatrics (2005). Parents/guardians were advised of the results by a Public Health Nurse as soon as possible after testing. The nurse described what the results meant and provided any further information if requested. At this time, the nurse also advised the parent/guardian of children with blood lead levels at or above 10µg/dl that they would be contacted by environmental health staff to request a survey of their home environment and to discuss how lead exposures could be minimised. Results were also forwarded to a nominated family General Practitioner, if requested.

3.4.2 This survey used the standard Queensland Health criteria to assess and recommend follow up services according to haemoglobin level, adapted from the Queensland Health Primary Clinical Care Manual 6th Edition (2009). Children with haemoglobin levels below 110g/l were referred to a medical officer for further clinical consideration.

3.4.2 Environmental audit

As with the previous program, a household audit was undertaken for those children with elevated blood lead levels at or above 10µg/dl. The primary purpose of the household audit was to assist Queensland Health to identify household environmental factors that may be influencing the blood lead levels for those in the elevated group for the survey.

Households were generally visited within two weeks of notification of the blood lead level results. Household surveys were undertaken by Queensland Health Environmental Health Officers when a parent or guardian was home, following verbal consent being obtained from the child's parent or guardian. While at the child's home, the officer discussed the child's blood lead level with the parent or guardian and completed the household audit by asking questions and making observations. On the basis of responses to the audit questions and observations, samples of soil, dust and/or paint were also obtained. Additional audits were also conducted if the child spent significant time in other environments such as child care.

The audit tool consisted of four parts including:

- general details of the household
- child behaviour (e.g. time at address, thumb sucking etc)
- occupant information (e.g. occupations of residents, hobbies)
- home environment (e.g. exterior, interior, pets and food growing).

The audit questions were based on risk factors for lead exposure reported in the literature. A copy of the audit tool used for this survey is included as Appendix 1.

All samples were collected using standard methods and analysed by Queensland Health Forensic and Scientific Services. The results assisted environmental health staff in identifying potential exposures and targeting personal strategies to minimise risk.

3.5 DATA CODING AND ANALYSIS

Data analysis was undertaken using Stata version 10 (StataCorp LP, College Station, Texas, USA).

Blood lead levels (µg/dl) were analysed as both a continuous variable and as a categorical variable for the elevated blood lead group (blood lead levels ≥10µg/dl). Age was also described as both a continuous variable (age in months) and as a categorical variable (age in single year age groups).

Blood lead levels were tested by Queensland Health Pathology and Scientific Services and a private laboratory. One of the testing mechanisms available for blood lead levels report all levels that are lower than 2.1µg/dl as "<2.1µg/dl". In order to take the most conservative possible approach, these results were recoded as 2.0µg/dl for the purposes of numerical analysis.

Continuous variables were compared using one way ANOVA and categorical variables using chi squared test and fishers exact test. ANOVAs were performed on the log transformed blood lead levels. A relationship was considered to be statistically significant if $p<0.05$, i.e. the probability incorrectly rejecting the null hypothesis (stating that there is a relationship when in fact there is none) is less than 5 per cent. All proportions and means were calculated discounting missing values.

A geometric mean is a type of average.

- The term 'mean' is generally thought of as an average – the individual results are added together and the total divided by the number of measures (n)
- In a geometric mean – the numbers are all multiplied together and the n^{th} root found.

Geometric means are commonly used to summarise and compare data collected from clinical measures like blood lead levels where these results tend to be extremely clustered at one end of the scale.

4.0 Study results

4.1 PARTICIPANT CHARACTERISTICS

Table 1: Demographic characteristics of the sample population and the Mount Isa population aged 1 to 4 years

	Sample population		Mount Isa population*	
	Number (n=167)	Percentage of population	Number (n=1577)	Percentage of population
Indigenous status				
Indigenous	37	22.2	486	30.8
Non Indigenous	130	77.8	1091	69.2
Sex				
Male	92	55.1	809	51.2
Female	75	44.9	786	49.8
Age (years)				
12-23 months (1 year)	49	29.3	254	16.1
24-35 months (2 years)	59	35.3	232	14.7
36-47 months (3 years)	30	18.0	514	32.6
48-59 months (4 years)	23	17.4	577	36.6

** The Mount Isa population was derived from the Office of Economic Statistics and Research, Estimated Residential Population 2007*

Table 2 provides a summary of the ages of the children who participated in the study as well as the time they had spent in Mount Isa. The table includes a breakdown by age, sex, Indigenous status and time spent in Mount Isa. The mean age of the sample population was 32 months, while the average length of time that children had resided in Mount Isa was 26 months.

Table 2: Description of the study samples' age, sex, Indigenous status and time spent in Mount Isa

	Number (n=167)	**Mean age in months (standard deviation)**	**Min – Max values**
Age (months)			
All	167	32.2 (12.9)	12.2-59.5
Male	92	30.6 (12.9)	12.4-58.9
Female	75	34.3 (12.8)	12.2-59.5
Indigenous	37	34.3 (12.5)	13.9-59.5
Non Indigenous	130	31.7 (13.1)	12.2-59.5
Months in Mount Isa		Mean time in months	
All	166*	26.5 (13.2)	0.25-59
Male	91	24.2 (13.4)	0.25-54
Female	75	29.2 (13.9)	0.5-59
Indigenous	36	28.0 (15.9)	0.5-53
Non Indigenous	130	26.5 (13.5)	0.25-59

** Please note that numbers and percentages in the sample population do not add up to 167 due to a missing data item.*

Figure 2 (page 14) shows a map of Mount Isa illustrating where children who participated in the study lived at the time of their blood test.

4.2 BLOOD LEAD LEVELS FOR PARTICIPATING MOUNT ISA CHILDREN

Table 3 shows the geometric mean blood lead levels for the study group with breakdowns by age group, sex and Indigenous status. The geometric mean for the entire group was 4.27µg/dl (with a minimum value of 1.9µg/dl and maximum value of 22.4µg/dl). The geometric mean blood lead for males was 4.17µg/dl, not significantly lower compared to 4.39µg/dl for females. The geometric mean blood lead for Indigenous children was 5.44µg/dl, significantly higher compared to 3.98µg/dl for non-Indigenous children. The youngest age group (12-23 months) had a geometric mean blood lead level of 4.35µg/dl compared to 3.75µg/dl for the oldest age group (48-59 months), and there was not a statistically significant difference in blood levels between age groups.

Table 3: Summary of geometric mean blood lead levels by sex and Indigenous status

	Number	Geometric mean blood lead level (95% confidence intervals)	Highest and lowest
All	167	4.27 (3.96,4.61)	1.9-22.4
Indigenous status			
Indigenous	37	5.44 (4.53, 6.53)	2.0-22.4
Non Indigenous	130	3.98 (3.68, 4.32)	1.9-16.6
Sex			
Male	92	4.17 (3.79, 4.58)	1.9-16.6
Female	75	4.39 (3.88, 4.98)	1.9-22.4
Age (years)			
12-23 months (1 year)	49	4.35 (3.82, 4.96)	2.0-16.6
24-35 months (2 years)	59	4.72 (4.15, 5.37)	1.9-12.0
36-47 months (3 years)	30	3.85 (3.10, 4.77)	1.9-22.4
48-59 months (4 years)	29	3.75 (3.14, 4.49)	2.0-11.6

Of the 167 children who had blood lead level tests, 4.8 per cent (eight children) had blood lead levels greater than or equal to 10µg/dl. Of these, only one had a blood lead level above 20µg/dl (this is the level at which children were referred to a paediatrician for examination and assistance with factors such as diet). The distribution of blood lead levels is shown in Figure 1.

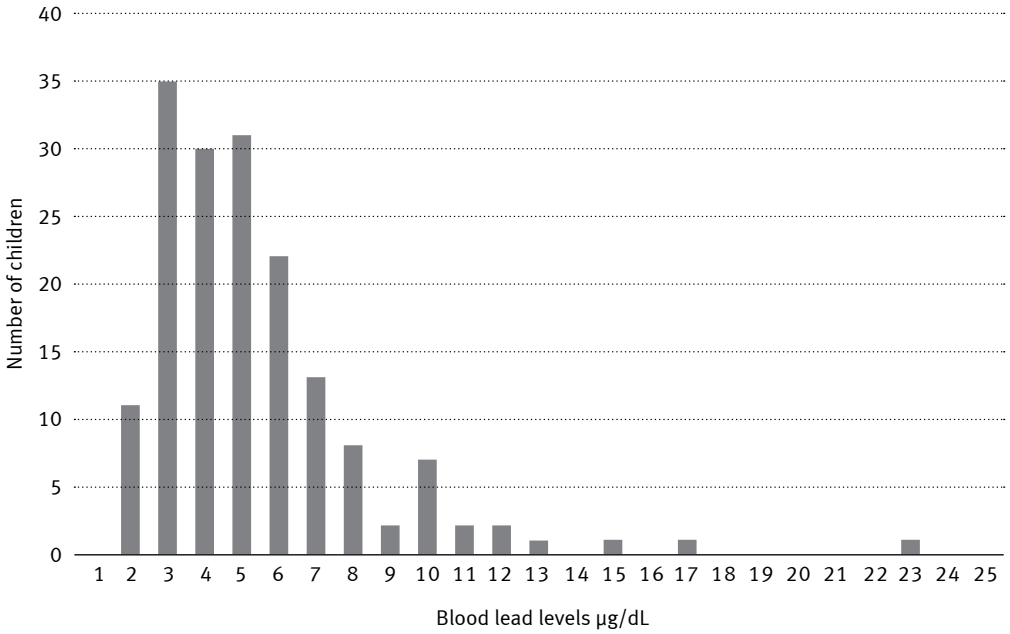


Figure 1. Distribution of blood lead levels (µg/dL) for the survey

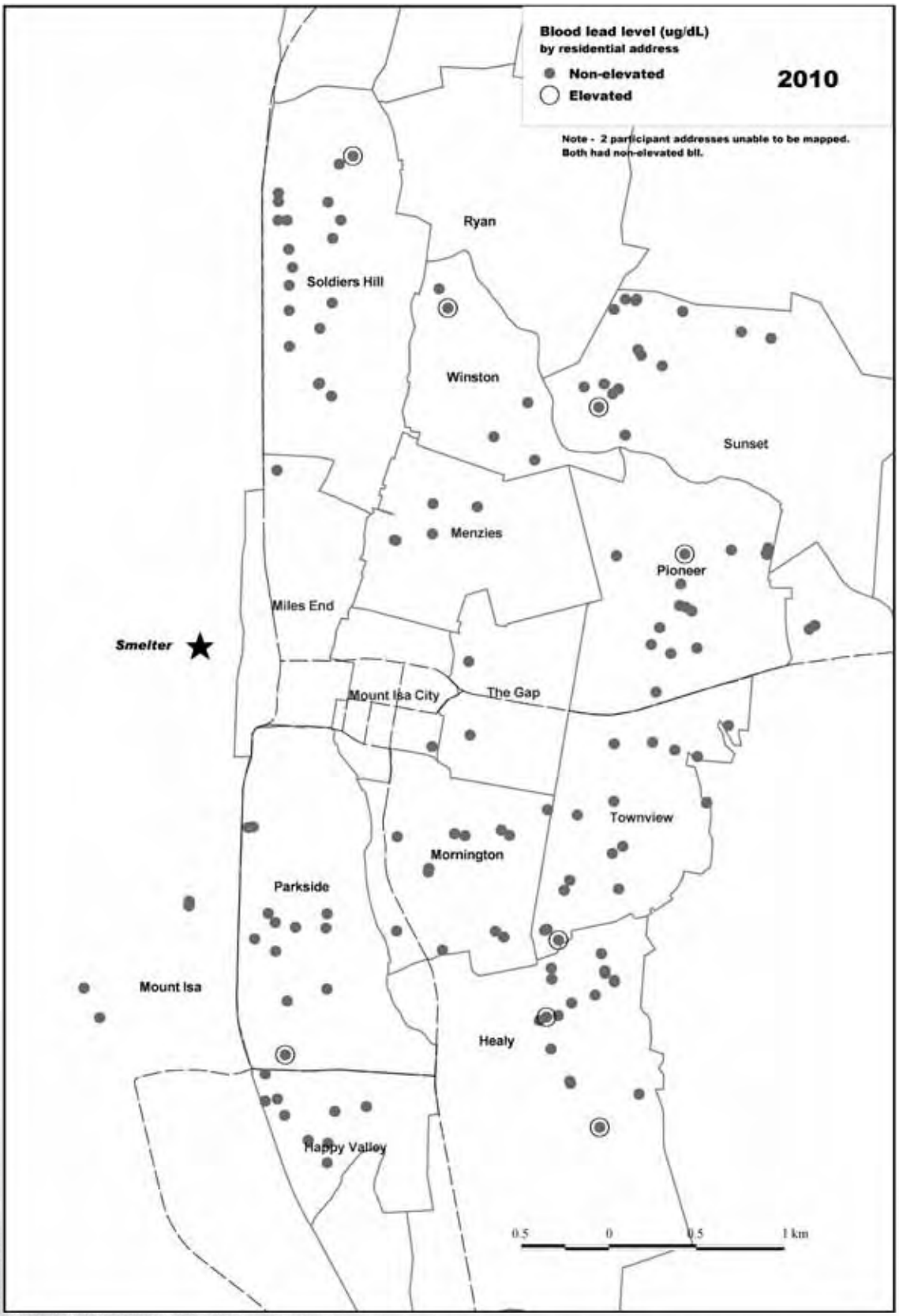
Table 4 indicates the numbers and percentages of the study population of children with elevated blood lead levels ≥10µg/dl by Indigenous status, sex and age group.

Table 4: Numbers and percentages of children with elevated blood lead levels ≥10µg/dl by Indigenous status, sex and age group

	Number (n=8)	Percentage*
Indigenous status		
Indigenous	3	8.1
Non Indigenous	5	3.9
Sex		
Male	4	4.4
Female	4	5.3
Age (years)		
12-23 months (1 year)	2	4.1
24-35 months (2 years)	3	5.1
36-47 months (3 years)	2	6.7
48-59 months (4 years)	1	3.5

** Percentage relates to the proportion of the study population with elevated blood lead levels.*

Figure 2: Domestic locations in Mount Isa of children in the 2010 study with blood lead levels of less than 10µg/dl and those with blood lead levels equal to or greater than 10µg/dl



4.3 BLOOD HAEMOGLOBIN LEVELS FOR PARTICIPATING MOUNT ISA CHILDREN

The total sample of children tested was 167 and there were haemoglobin results for 136. Of those 136, nine children (6.62%) had low haemoglobin levels (for the threshold 110g/l and below). Four of these nine children identified as Aboriginal or Torres Strait Islander. There were no children that were below the 80g/l threshold requiring immediate referral to a medical officer.

None of the children with low haemoglobin levels had an elevated blood lead level equal to or greater than 10µg/dl.

Statistical analysis (output of the chi2, fishers and ANOVAs) demonstrated that:

- The association between low haemoglobin and high lead results (using geometric means) was not statistically significant.
- The association between low haemoglobin and Aboriginal and Torres Strait Islander status was not statistically significant.
- Any relationship between low haemoglobin and gender was not statistically significant with low haemoglobin as a categorical variable, however was statistically significant (p=0.0179) with males having a lower mean haemoglobin compared to females.
- Any relationship between low haemoglobin and age was not statistically significant.

There is no statistically significant association between haemoglobin and blood lead levels or haemoglobin and Indigenous status, p values of 0.9920 and p=0.2975 respectively.

Table 5: Number and percentage of children below the 110g/l threshold

Haemoglobin level	Number	Percentage
Normal haemoglobin ≥110g/l	127	93.38
Below 110 threshold	9	6.62
Total	136	100

Table 6: Number of children below the 110g/l threshold by Indigenous status, sex and age group

	Number
All	9
Indigenous status	
Indigenous	4
Non Indigenous	5
Sex	
Male	6
Female	3
Age (years)	
12-23 months (1 year)	2
24-35 months (2 years)	3
36-47 months (3 years)	1
48-59 months (4 years)	3

4.4 HOUSEHOLD FACTORS

The homes of seven out of the eight children with a blood lead level greater than or equal to 10µ/dl were audited using the audit tool attached in Appendix 1. This was due to one family declining the offer of a household audit for personal reasons. A child care centre and a playgroup premises where children spent significant time were also audited.

The aim of the audits was to identify potential risk factors for elevated blood lead levels in these children. Behaviours or other factors that seemed relevant in spite of the small sample size, included residing at a property with bare soil (six/seven), pet ownership (six/seven), sucking of non-food items (three/seven) and nutrition factors (two/seven).

Thirty-one soil samples were collected from external areas (including vegetable gardens, sandpits and other bare soil areas where children played) and thirty-three dust samples were taken from nine premises, including a child care centre and a playgroup. A paint sample was also obtained from one premise.

All soil, dust and paint samples complied with relevant standards with the exception of three soil samples from two premises that were in excess of the health investigation level of 300mg/kg lead National Environment Protection (Assessment of Site Contamination) Measure 1999. Further advice with modifying the home and yard environment, and identifying child hand-mouth behaviours and practices that may lead to exposure have been made to these occupants to reduce the ongoing public health risk of exposure to this soil.

As indicated by the Environmental Audit Tool (Appendix 1), additional variables were measured in the audit. However they have not been included in this report as they were collected for the purpose of individual follow-up and personalised interventions.

5.0 Comparison of results to the 2006-2007 lead screening program

While it is appropriate to explore differences in lead levels between the similar 2007 and 2010 surveys, care should be taken making direct comparisons, due to possible self-selection biases.

Table 7 shows the geometric mean blood lead levels for the 2007 and 2010 study groups with breakdowns by age group, sex and Indigenous status.

Table 7. Summary of geometric mean blood lead levels by sex, Indigenous status and age for the 2007 and 2010 surveys

	2010		2007	
	Number	Geometric mean blood lead level (95% confidence intervals)	Number	Geometric mean blood lead level (95% confidence intervals)
All*	167	4.27 (3.96,4.61)	400	4.97 (4.69, 5.24)
Indigenous status				
Indigenous*	37	5.44 (4.53 6.53)	83	7.05 (6.25, 7.95)
Non Indigenous*	130	3.98 (3.68, 4.32)	315	4.54 (4.28, 4.82)
Sex				
Male*	92	4.17 (3.79, 4.58)	214	5.13 (4.75, 5.52)
Female	75	4.39 (3.88, 4.98)	184	4.77 (4.39, 5.18)
Age (years)				
12-23 months (1 year)	49	4.35 (3.82, 4.96)	84	5.39 (4.80, 6.07)
24-35 months (2 years)	59	4.72 (4.15, 5.37)	114	5.50 (4.93, 6.14)
36-47 months (3 years)	30	3.85 (3.10, 4.77)	106	4.48 (4.01, 4.99)
48-59 months (4 years)	23	3.75 (3.14, 4.49)	95	4.56 (4.11, 5.06)

** Comparison of 2010 and 2007 results was statistically significant ($p \leq 0.05$)*

All comparisons (overall, Indigenous, non-Indigenous, sex, and age groups) showed reductions in the geometric mean blood lead levels from 2007 to 2010. These differences reached statistical significance for the overall participants, both the Indigenous and non-Indigenous participants, and males.

Table 8 lists the numbers and percentages of children with elevated blood lead levels ≥10µg/dl by Indigenous status, sex and age group in the 2007 and 2010 surveys.

Table 8. Numbers and percentages of children with elevated blood lead levels ≥10µg/dl by Indigenous status, sex and age group

	2010		2007	
	Number	Percentage	Number	Percentage
All*	8	4.8	45	11.3
Indigenous status				
Indigenous*	3	8.1	22	26.5
Non Indigenous	5	3.9	23	7.3
Sex				
Male*	4	4.4	26	12.1
Female	4	5.3	18	9.8
Age (years)				
12-23 months (1 year)	2	4.1	9	10.7
24-35 months (2 years)	3	5.1	19	16.7
36-47 months (3 years)	2	6.7	9	8.5
48-59 months (4 years)	1	3.5	8	8.4

** Comparison of 2010 with 2007 results was statistically significant (p≤0.05)*

All comparisons (overall, Indigenous, non-Indigenous, sex, and age groups) showed reductions in the percentage greater than or equal to 10µg/dl from 2007 to 2010. These differences reached statistical difference for the overall participants, the Indigenous participants, and males.

Figure 3:Domestic locations in Mount Isa of children in the 2007 and 2010 studies with blood lead levels of less than 10µg/dl and those with blood lead levels equal to or greater than 10µg/dl

6.0 Discussion

The geometric mean blood lead level for the whole group was 4.27µg/dl with a minimum of 1.9µg/dl and maximum of 22.4µg/dl. This is significantly lower that the geometric mean from the 2007 program which was 4.97µg/dl. One child with a blood lead level of 22.4µg/dl was referred to a paediatrician.

The geometric mean for Indigenous children was 5.44µg/dl, significantly higher compared to 3.98µg/dl for non-Indigenous/s children. In the 2007 survey the geometric mean for Indigenous children was 7.0µg/dl compared to 4.5µg/dl for non-Indigenous children. While these results show a decline between surveys they continue to identify that Indigenous children, on average, have higher blood lead levels.

In this survey, 167 Mount Isa children were tested with eight children (4.8 per cent) having blood lead levels greater than or equal to 10µg/dl. This is significantly lower that the results from the 2007 program which was 11.3 per cent.

The percentage of Indigenous children in 2010 that had blood lead levels equal or greater than 10µg/dl was 8.1 per cent which was significantly lower than the 26.5 per cent of Indigenous children in 2007 that had blood lead levels equal or greater than 10µg/dl.

In this survey the only significant relationship identified was Indigenous status. In the previous 2007 study both age and indigenous status were significant factors.

The geometric mean blood lead level for children with normal haemoglobin was 4.19µg/dl and the geometric mean for children with low haemoglobin was 4.18µg/dl. No children registered a haemoglobin level of less than 80g/l. None of the nine children with low haemoglobin had an elevated blood lead level (10µg/dl and above). Of the nine children whose haemoglobin levels were below the 110g/l threshold, five were non-Indigenous and four were Indigenous.

Research does, however, indicate that inadequate dietary intake of iron as well as long-term marginal nutritional status for iron, increases absorption and tissue concentrations of lead. Whether iron status modifies the influence of lead on intellectual or cognitive development remains to be determined. From a review of research surrounding iron deficiency and lead absorption, it can be concluded that an increased intake of iron in line with recommended daily intakes for sex and age, along with sufficient iron stores, may reduce the risk of lead absorption and toxicity. Whether an association between iron deficiency and blood lead levels is causal cannot be determined from the data available and future research would need to be performed to produce evidence regarding iron intake and lead (Adam, Chapman, Daly, Heneka, Groves, Leonard, and Moon 2010).

From a nutritional point of view, the dietary strategies suggested to safeguard at risk groups (infants, children, pregnant mothers, Aboriginal and Torres Straight Islander people) as well as the general public from at risk blood lead levels, are consistent with recommendations for a healthy diet. This includes the consumption of a diet in line with the 'Australian Guide to Healthy Eating' with emphasis on adequate intakes of calcium, iron and zinc, a moderate fat intake particularly saturated fat, regular meal patterns and promotion of general food safety and hygiene.

As there were only seven environmental audits performed, it is not reasonable to make any significant conclusions or identify any specific trends from the data collected during the audits. It seemed noticeable however that the ownership of pets (as a conduit of soil into a house) and the amount of exposed dirt in yards in six of the seven households were important factors. One premise had a level of lead in soil that warranted a health-based investigation (for a standard residential area) as proposed in the National Environment Protection (Assessment of Site Contamination) Measure 1999. Recommendations, based on site specific issues, were made to modify the environment to reduce the potential for exposure.

Those who participated in the study were evenly distributed across the Mount Isa community with no distinct spatial patterns of elevated blood lead levels.

For the children in this study with elevated blood lead levels, the continuing priority for Queensland Health has been to work with the families to identify and then modify any risk factors thought to relate to lead exposure and absorption. For some children who were identified early in the study, blood lead retesting has indicated that modifying risk factors (such as monitoring child hand-mouth behaviour, minimising dust around the home and restricting access to bare soil in house surroundings) has reduced blood lead levels.

We should be cautious when interpreting this drop in the overall percentage of the study group with elevated blood lead levels. These results indicate a step in the right direction. We do, however, need to continue to drive these figures down to as low a level as possible.

Queensland Health continues to encourage all Mount Isa residents to be aware of their blood lead levels particularly for young children, and to access the free blood lead testing service at QML Pathology Services. Queensland Health will continue to closely monitor the results of any testing and will also continue to work with key partners through the Living with Lead Alliance to strengthen lead management in Mount Isa.

7.0 References

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Appendix 1
Environmental audit tool used for the survey

ENVIRONMENTAL AUDIT TOOL			
Officer:		**Inspection Date:**	
Population Health Unit:	**Mount Isa and Gulf**	**Time:**	

1.0 DETAILS		
1.1 Name	Surname:	Given Names:
1.2 Date of Birth		Male Female
1.3 Residential address		
1.4 Guardian/Parents Name	Surname:	Given Names:
	Relationship with child:	
	Surname:	Given Names:
	Relationship with child:	

1.5 Telephone number	Home:	Mobile:

2.0 CHILD	
2.1 Does the child suck their thumb?	☐ Yes ☐ No ☐
2.2 Does the child mouth, chew or eat non-food items?	☐ Yes ☐ No ☐ Sometimes
2.3 Are the toys, blankets and dummies cleaned regularly?	☐ Yes ☐ No How often?
2.4 Does the child eat regular nutritional meals and snacks?	☐ Yes ☐ No ☐ Sometimes
2.5 Does the child have any favourite places to play?	☐ Yes ☐ No Details:
2.6 How long has the child been living at this address?	
2.6.1 Previous address	
2.7 Does the child regularly visit another home/place?	☐ Yes ☐ No

2.7.1 Associated address(s)	
3.0 OCCUPANTS	
3.1 What are the occupations of the residents? (abrasive blasters, mechanic, construction workers, landscapers, painters) *Note name & relationship with child	1
	2
	3
3.1.1 If a resident is exposed to lead in their occupation, do they return home without showering?	☐ Yes ☐ No ☐ Sometimes
3.1.2 If so, where are dirty work clothes stored?	
3.1.3 Is the washing machine water reused on the garden?	☐ Yes ☐ No Where?
3.1.4 Are contaminated work tools, boots or vehicles brought home?	☐ Yes ☐ No ☐ Sometimes
3.2 Do residents engage in hobbies involving lead at home? (eg car/boat building, antique restoration, casting lead fishing sinkers)	☐ Yes ☐ No Details:
3.2.1 If so, does the child play in this area or with any associated equipment?	☐ Yes ☐ No ☐ Sometimes
3.3 Do residents use any alternative medicines, herbal preparations, tonics or traditional cosmetics?	☐ Yes ☐ No Details:

Comments

4.0 HOME ENVIRONMENT	
4.1 Exterior	
4.1.1 Is there a sand pit near the home?	☐ Yes ☐ No Details:
4.1.2 Are there areas of bare soil in the yard?	☐ Yes ☐ No Percentage: Details:
4.1.3 Was the land ever used for industrial purposes?	☐ Yes ☐ No ☐ Unsure
4.1.4 Has fill been brought to the property?	☐ Yes ☐ No ☐ Unsure
4.2 Interior	
4.2.1 Do interior surfaces have a high level of surface dust?	☐ Yes ☐ No Description of floor surface material:
4.2.2 Has any interior construction been undertaken in the recent past?	☐ Yes ☐ No ☐ Unsure
4.3 Paint	
4.3.1 How old is the dwelling?	☐ Unsure
4.3.2 What is the condition of the paintwork? (including sheds)	Exterior ☐ Good ☐ Flaking ☐ Not painted/other
	Interior ☐ Good ☐ Flaking ☐ Not painted/other
4.3.3 Has the home/furniture recently been renovated, paint stripped or disturbed?	☐ Yes ☐ No ☐ Unsure Details:

4.3.4 Have any neighbouring properties recently been renovated, paint stripped or disturbed?	☐ Yes ☐ No ☐ Unsure Details:
4.3.5 Does the property or near by properties use an incinerator?	☐ Yes ☐ No Details:
4.4 Pets	
4.4.1 Are there pets?	☐ Yes ☐ No Details:
4.4.2 Are the pets allowed indoors?	☐ Yes ☐ No
4.4.3 Are the pets and bedding regularly washed?	☐ Yes ☐ No How often?
4.4.4 Does the child play with the pets?	☐ Yes ☐ No
4.5 Food	
4.5.1 Are homegrown fruit and vegetables washed before being eaten?	☐ Yes ☐ No ☐ Sometimes
4.5.2 Is water, other than the reticulated system, used for drinking?	☐ Yes ☐ No ☐ Sometimes

Comments

5.0 POSSIBLE RISKS IDENTIFIED	
Concern	**Action**
2.0 Child	
3.0 Occupants	
4.0 Home Environment	

Map of Property

Details of samples taken (Also indicate on map)
1
2

3

4

Officer Signature:	**Date:**


Queensland Government