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Potential Health Consequences of the El Paso Smelter

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Abstract

The city of El Paso, Texas previously had a smelter that employed a lot of individuals in surrounding areas. The smelter eventually closed, which led to public health officials investigating the health and environmental factors that the smelter had on the community. Testing has found that there were neurological, behavior, and blood lead levels elevated within children that were in the vicinity of the smelter. The smelter has created a lasting impact on the community, environment, and health of the individuals within that area.

Keywords: Statistical analysis**.**

1. Introduction

El Paso is a town in the state of Texas that runs along the Mexican American border. El Paso has a rich history with a lot of hard-working individuals settling down there. Within geography, it is important to note that El Paso lies between Texas, New Mexico, and Mexico. This area is largely desert, which means it was a common route for travelers. In 1887, a smelter was built and became operational [2]. A smelter is a factory for extracting metal from ores. This process is done by heating up and applying chemicals to an ore. This may produce metals such as copper, iron, silver, etc. When this process is happening, there are a lot of particles and chemicals that get thrown into the air [7]. This allows tiny fragments of this lead or arsenic to be distributed into the air and into the lungs of workers, which could potentially cause cancer [5].This has drawn studies and discussions on the environmental and health safety of the community within the El Paso population. There are many discussions to this point because this smelting facility was a huge economic source for the city of El Paso. The smelter employed more than 25,000 people in about 110 years and producing about $15 million in its prime [6]. This is a key point in different considerations because there is a low-income, Latino community that lives in the city less than two miles from the plant [4]. The issue of American work vs environment comes into play, which means there must be studies and data to support the environment and health collapse. Public participation in decision-making is important, only when the correct research and understanding is adequate [1]. In order to effectively measure the health effects of the smelter, participants had IQ tests, blood tests, neurological tests, and behavioral tests done.

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2. Methods

1.1 Data Source

Data for this paper was pulled from an article published in Lancet in 1975. This article describes the neurological and psychological effects of chronic low blood-lead levels from the El Paso smelter plant. There were 124 children in the dataset, which included a range of ages and miles from the factory. The data was pulled from children from 1972 to 1974.

1.2 Outcome and other variables

The outcome measures were the blood analysis and the neurological/behavior of the children tested. Patient demographics in the dataset included age, gender, socioeconomic status, language spoken at home, and duration of residence in the study area. All of these factors influence the primary outcome measures.

When it comes to neurological and behavioral tests, there were different measures for each. For neurological testing, auditory reaction, visual reaction, tapping, tandem walking, and standing on each foot were recorded. All of these measurements were taken individually in order to assess neurologic functioning. For behavior testing, the Werry-Weiss-Peters Activity Scale (WWPS) was used to assess disturbance. This scale is a questionnaire that has categories and responses to those questions. Different symptoms that could be related to lead were asking in the form of yes or no question. Lastly, blood lead levels were taken over the course of two years. This was measured in micrograms/100 mL.

1.3 Statistical analysis

Data analysis was performed using data from Microsoft Excel that was imported and analyzed in IBM SPSS for Mac. The descriptive statistics were evaluated for this dataset, which included the number of participants, minimum, maximum, mean, and standard deviation.

3. Results

The general descriptive statistics for each individual category discussed above is depicted in tables 1.1-1.4. When it comes to IQ, the mean for full IQ was 91.08 with a standard deviation of 14.404 stated in Table 1 IQ performance had a minimum of 51 and a maximum 149. This is important because it allows us a range of the children that were within the study. In Table 2, it depicts the numerous neurological tests that were performed on participants. Auditory, visual, and finger taps were all used as a test for neurological performance. They were also done on both sides (right and left). For auditory taps, the left had a mean of 39.90 with a standard deviation 30.709. On the right, the mean was 39.98 with a standard deviation 30.865. The right and left auditory taps had a comparable mean and standard deviation. The visual neurological tests on the right had a mean of 41.87 and 41.77 on the left. The visual tests also had very similar results when comparing sides. When it comes to symptoms, the participants were given two options, 1 was yes and 2 was no. When it comes to the mean in Table 3 for all the symptoms, they were closer to 2 than 1, which meant there were more participants without the symptoms than with. Irritability

had the closest mean to yes with a mean of 1.69. Lastly, the blood lead levels of the individuals were tested in two years, 1972 and 1973 in Table 4. The blood lead levels from 1972 had a mean of 36.16 with a standard deviation of 16.516. The blood lead levels from 1973 had a mean of 31.71 with a standard deviation of 9.931. The blood lead levels decreased in individuals from 1972 to 1973 in micrograms/100 mL.When the interferential statistics were assessed, a clear difference was made between children who grew up around the smelter and those who didn't. There was a statistical difference between the children who grew up within one mile of the smelter and those who didn't within the first two years of life. This was assessed by a 95% confidence interval with specific statistics provided below, such as t-values, standard estimates, and p-values. This is displayed in Figures 3 and 4. The children who were raised within one mile of the smelter within the first two years of life had significantly higher levels of lead in 1972 and then more in 1973. There was also a significant difference of the children who were screened in 1972 compared to those assessed in 1973, according to Figures 3 and 4. This data was evaluated with a 95% confidence interval and one-sample t-test methodology of analysis. Lastly, there was a statistical significance in data when the children's low blood lead levels were compared with the CDC threshold of lead exposure, according to Figure 1 and Figure 2. This was also used using a 95% confidence interval with a one-sample t-test. The p-values in all three of these tests were less than .05, which leads us to the conclusion that all of these tests were statistically significant.

4. Discussion

There were limitations to the study presented in this paper. The study presented individuals who were only children. Children have different bodies, immune systems, and physiological processes compared to adults. The study was geared towards minors but didn't include any perspective from adults. Given the seriousness of the issue, it is so important to have data across the range. The response to the smelter could different amongst a diversity of ages. It is an important consideration when applying this health problem to different populations. The importance of acquiring data in order to assess adult reactions to the smelter is imperative. Applying this concept to adults with similar variables would be a great start to make an inference within different communities and populations. Children are affected heavily by lead poisoning, which is an idea to consider. In order to properly assess the complete effect of this smelter, it is important to have comprehensive data to support this. Another limitation that was found was the sample size. 124 children is a great start for a sample size for the initial idea, but it is nowhere near the data that needs to be collected to make strong inferences and hypotheses. Sample sizes are important to consider when applying this concept to a bigger population. The need for more testing across the geographical region is an important comparison that is yet to be made. The low sample size with specific results could be explained through an alternative method. In order to make conclusions on causation instead of correlation, a bigger sample size is necessary. Previous studies that include different geographic need to be included when making assessments on the danger of a smelter within a community.

5. Conclusion

The El Paso Smelter was a smelter located in El Paso, TX that operated for over 110 years. This smelter was closed and then had the possibility of re-opening. The re-opening of the smelter came under speculation when studies were published about the possible health implications of living near or next to the smelter. Lead and other

metals were expelled from the smelter, which meant that the environment and safety of individuals around were compromised. Data collected from 124 children in 1972 and 1973 was comprised within the study. This data and showed that these 124 children had altered neurological testing, behavior, symptoms, and blood lead levels. Previous data published from smelters around the United States have had similar results with decrease neurological conductive and elevated blood metal levels [3]. This study and its results need to be further investigated in order to make a comprehensive public health alert about smelters all around the world. Limitations include sample size and diversity of the individuals chosen within the study. The results of this study need to be evaluated when it comes to the safety of living around a smelter for possible health effects.

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6. Appendix

Table 1: IQ

	N	Minimum	Maximum	Mean	Std. Deviation
IQ_Performance	124	51	149	99.82	15.993
IQ_Full	124	46	141	91.08	14.404
IQ_Verbal	124	51	126	84.66	13.578
IQ_Type	124	1	2	1.22	.414
Valid N (listwise)	124				

Table 2: Neurological tests

	N	Minimum	Maximum	Mean	Std. Deviation
Taps_finger_right	124	11	99	61.02	22.435
Taps_auditory_left	124	13	99	39.80	30.709
Taps_visual_left	124	15	99	41.77	30.158
Taps_finger_left	124	7	99	55.10	24.400
Taps_visual_right	124	16	99	41.87	29.928
Taps_auditory_right	124	12	99	39.98	30.865
Taps_left	124	5	99	31.78	34.265
Taps_right	124	6	99	32.64	33.829
Valid N (listwise)	124				

Table 3: Symptoms

	N	Minimum	Maximum	Mean	Std. Deviation
Colic	124	1	2	1.81	.390
Irritability	124	1	2	1.69	.466
Convulsions	124	1	2	1.95	.215
Clumsiness	124	1	2	1.91	.285
Pica	124	1	2	1.91	.285
Valid N (listwise)	124				

Table 4: Blood Lead Levels

	N	Minimum	Maximum	Mean	Std. Deviation
Lead_73	124	15	58	31.71	9.931
Lead_72	124	1	99	36.16	16.516
Valid N (listwise)	124				

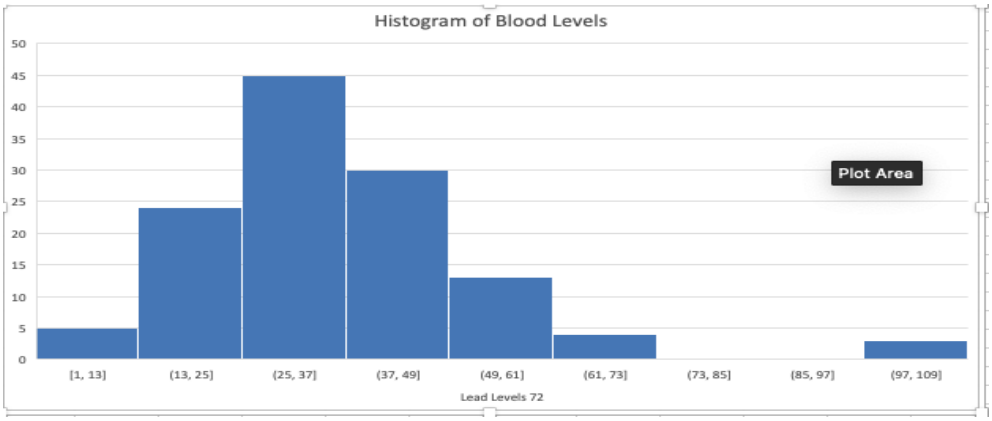


Figure 1: Histogram of Blood Levels 1972

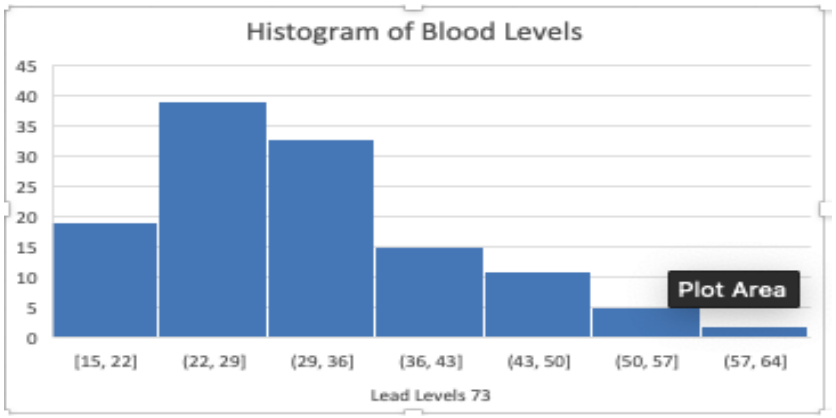


Figure 2: Histogram of Blood Lead Levels 1973

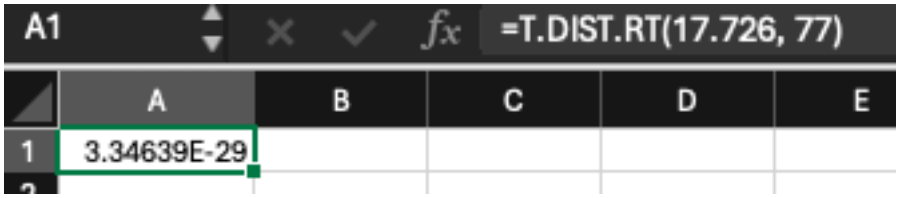
1a) Hypothesis

Null hypothesis H_0: $u_o \leq 10$ ug/100 ml

Alternate hypothesis Ha: $u_o > 10$ ug/100 ml

1c) If p-value is ≤ alpha value which is 0.05 in this problem, then reject the null Hypothesis

1d) SE= .9518**,** CI= (24.9768, 28.7668)**,** T= 17.726



1e) p<.05, reject the null hypothesis, sufficient evidence that blood lead levels are dangerous and way beyond the threshold. Blood lead levels in 1973 were higher, so the null hypothesis is rejected for this year also.

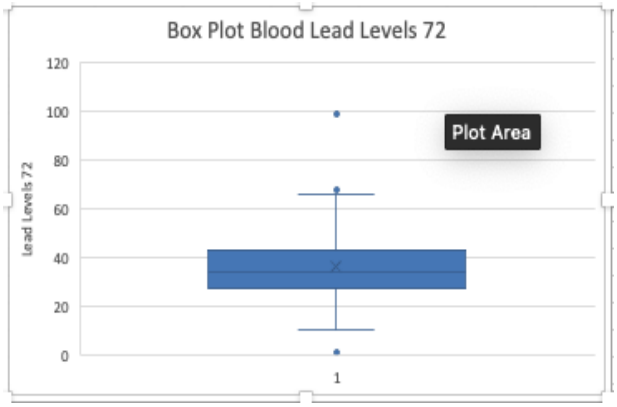


Figure 3: Box Plot of Blood Lead Levels 1972

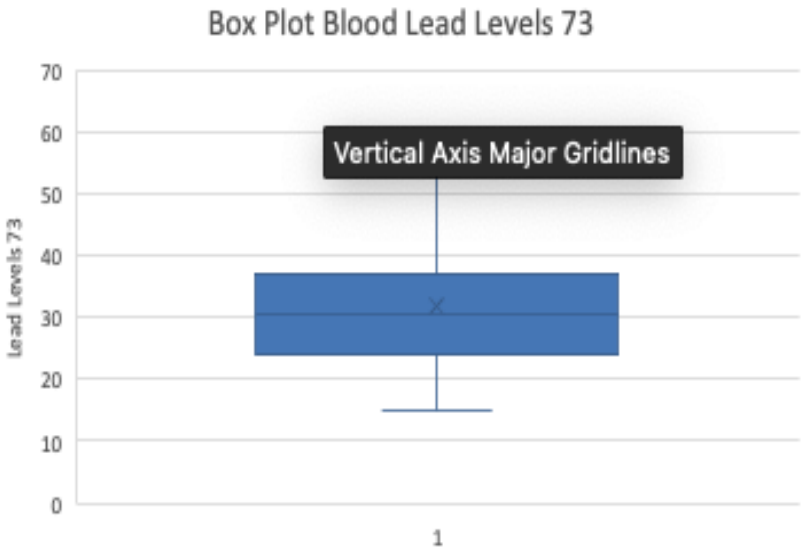


Figure 4: Box Plot of Blood Lead Levels 1973

2a) Hypothesis-

Null- blood levels between children screened within 1 mile of the smelter are not statistically different from those not raised within 1 mile

Alternative- blood levels between children screened within 1 mile of the smelter are statistically different from

those not raised within 1 mile

2c) If p <a (.05), we reject null hypothesis

If p >a (.05), we fail to reject null hypothesis

2d) Mean x- 35.51429 Mean y- 30.21348

T= 2.285, Df=45.551, P=.02702

P= .02702< a(.05)

2e) Reject null hypothesis, there is a statistical difference in the children that were screened within 1 mile and those were not raised within 1 mile

3a) Null- blood levels between children screened from 1972 to 1973 are not statistically different

Alternative- blood levels between children screened from 1972 to 1973 are statistically different

3c) If p <a (.05), we reject null hypothesis

If p >a (.05), we fail to reject null hypothesis

3d) Mean x- 36.16129 Mean y- 31.70967

T= 4.155, Df=123, P=.000006

P= .000006< a(.05)

3e) Reject null hypothesis, there is a statistical difference in the children that were screened in 1972 than in 1973

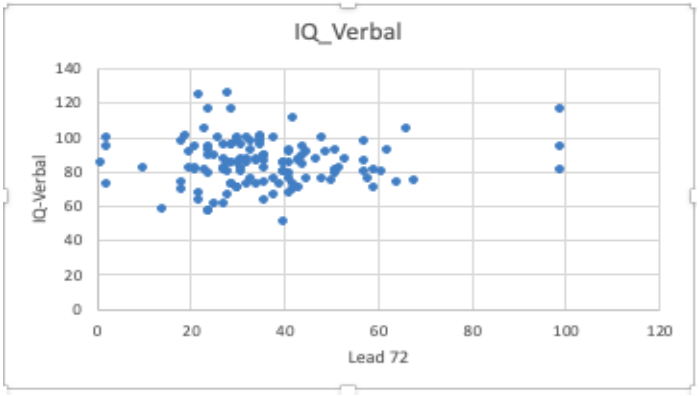


Figure 5: Scatter Plot of IQ Verbal 1972

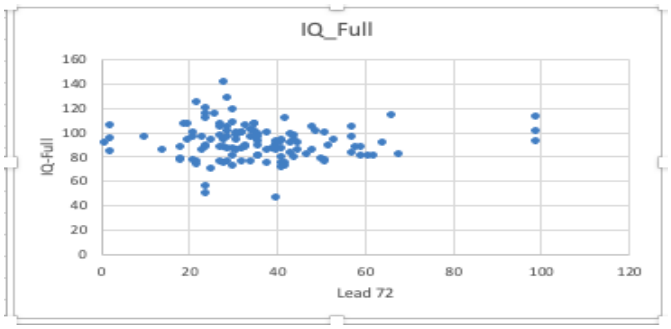


Figure 6: Scatter Plot of IQ Full 1972

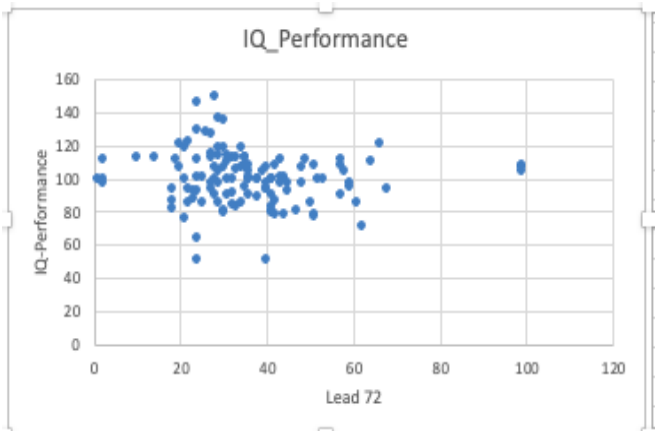


Figure 7: Scatter Plot of IQ performance 1972

4. The chi-square test revealed that these four symptoms (irritability, colic, pica, hyperactivity) could be related to the blood lead levels between 40 and 68 ug/100 ml.

There is enough evidence to suggest a statistically significant relationship between IQ measures and blood lead levels in 1972.