Influence of Lead from Used Lead- Acid Batteries on Blood, Soil and Tap water

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Introduction

Lead acid batteries are rechargeable batteries made of lead plates situated in a ‘bath’ of sulfuric acid within a plast ic casing. They are used in every country in world, and can commonly be recognized as “car batteries”.

Once the lead acid battery ceases to be effective, it is unusable and deemed as used lead acid battery (ULAB), which is classified as a hazardous waste.

Introduction

- Recycled lead is a valuable commodity and for many people in the developing world the recovery of car and similar batteries (ULABs) can be a viable and profitable business.

- Used Lead-Acid Batteries, are classified as toxic and, therefore, their disposal and recycling have to be handled properly.

- Unregulated recycling industries and informal methods of extracting lead-often conducted in homes or backyards -can lead high levels of environmental lead contamination.

Introduction

- According to the Blacksmith Institute of New York and Green Cross of Switzerland, the Philippines is one of the most severely affected countries by lead pollution and contamination in the world.

- The informal sector which process large tonnages of used-lead acid batteries (ULAB) manually breaks these ULAB (without the benef
it of personal protective equipment) and releases the sulfuric acid and lead into our environment.

Introduction

- In the Philippines, there are only a few small licensed lead acid battery recyclers and thousands of unregulated or informal recyclers.

- This possess environmental hazards and health effects both to the recyclers, their families and nearby communities.

- This study aimed to determine the effect of lead recycling in the environment by determining the lead contamination in soil and tap water. It also evaluate possible health effects in the recycler, thus, blood lead levels of ULAB recyclers were analyzed.

The objectives of our study are the following:

1. To determine the concentration of Lead in blood, soil and tap water within the vicinity of recycling shop;

2. To determine the significant relationship between ULAB exposure and the lead concentration in blood, soil and tap water and;

3. To determine the relationship between years of exposure to ULAB to the concentration of lead in blood
.

Methods

- Recycling shops which recycle ULAB around Dasmarinas City, Cavite were conveniently selected.

- Informed consent was gathered from the municipal health office and recyclers who are willing to participate in the study.

- Recyclers were selected based on inclusion-exclusion criteria design by the researchers.

Methods
Data Collection

- Recyclers were interviewed using questionnaire made by researchers in order to assess their knowledge about the health effects of lead exposure, demographic profile, assess their suitability to be included in the study and years of exposure to lead.

- Eight recyclers consented to participate. Most recyclers did not consent for blood extraction so, post-hoc power analysis was calculated. Post hoc analysis yielded an 80% at alpha level of 0.05

- Blood samples were collected from the recyclers and were analyzed for blood lead levels at East Avenue Medical Center; the national toxicology center of the Philippines.

Methods:
Sample size post hoc analysis

- t tests - Means: Difference between two independent means (two groups)

- Analysis: Post hoc: Compute achieved power

- Input: Tail(s) = One
- Effect size d = 1.3109449
- α err prob = 0.05
- Sample size group 1 = 8
- Sample size group 2 = 8

- Output: Noncentrality parameter δ = 2.6218898
- Critical t = 1.7613101
- Df = 14
- Power (1-β err prob) = 0.8015448

Sample size post hoc power analysis

- A sample size of 16 respondents yielded a power of 80.15% (0.8015) at an alpha of 0.05. These results denote that the acquired sample size is sufficient and the likelihood of committing Type II error (false negative) was limited to 19.85%.

Select participants for exposed and unexposed group by undergoing preliminary screening in a form of interview

Present consent letter to be signed by the participants that they agree to participate in the study.

Extract 5 mL of venous blood from participants and place it in EDTA tube.

Study locale

Recyling shop
Dasmariñas City, Cavite

East Avenue Medical Center
National Reference Laboratory

Methods

- About 50 grams of composite soil sample using
  polyethylene brush were collected by sweeping
  from communities around recycling shops (exposed gro
up) and residential areas far from the shops. (unexposed)

- Similarly, about 500 ml of tap water were collected from the sites previously mentioned.

- All samples were collected and analyzed in
triplicates.

- Environmental samples were sent to De La Salle
 University- Dasmarinas for lead analysis by Flame
atomic absorption spectrophotmetry and blood was sent t
o national reference hospital for toxicology- East Avenue M
edical Center.

Obtain an official list of junkshops in Dasmariñas City, Cavite from City Health Unit

Select research locale by visiting the suitable junkshops and a subdivision of more than 1 kilometer radius from vicinity of junk shops

Collect less than 50 grams of composite soil samples using polyethylene brush and tray by sweeping from selected locations of study

Properly label the collecte d soil samples and place i n a polyethylene bag

After soil collection, gather 500 mL of tap water samples from the main faucet of use in the selected locations

Place tap water samples in a poly propylene bottle added with 6 mL concentrated HNO_3 and pre-wash ed with 10 mL concentrated HCl and distilled water twice

Transport samples and meas ure lead concentration using FAAS in DLSU-D

Methods
Statistical Computation

- Comparisons were made using Chi-Square test of Homogeneity for nominal variables, Mann-Whitney Rank Sum Test for ordinal data, and independent t-test for continuous variables

RESULTS

Table 4.1
Demographic Profile of the **Participants According to Exposure Status (*N = 16*)**

Characteristic	Exposed (n=8)	Unexposed (n=8)	*p*-value[a] (two-tailed)
Age (Md, IQR)	49.50 (35.50, 54.50)	31 (23, 44.50)	0.1415
Sex (*f*, %)			1.00
Male	7 (87.50%)	7 (87.50%)	
Female	1 (12.50%)	1 (12.50%)	
Educational Attainment (*f*, %)			0.046*
Elementary Level	0 (0.00%)	0 (0.00%)	
Elementary Graduate	2 (25.00%)	0 (0.00%)	
High School Level	3 (37.50%)	0 (0.00%)	
High School Graduate	2 (25.00%)	2 (25.00%)	
College Level	1 (12.50%)	2 (25.00%)	
College Graduate	0 (0.00%)	4 (50.00%)	
Marital Status (*f*, %)			0.119
Single	1 (12.50%)	5 (62.50%)	
Married or Live-in	7 (87.50%)	3 (37.50%)	
Annulled	0 (0.00%)	0 (0.00%)	
Widow/Widower	0 (0.00%)	0 (0.00%)	
Occupation (*f*, %)			
White-Collared	0 (0.00%)	2 (25.00%)	
Blue-Collared	8 (100.00%)	6 (75.00%)	
Years of Residency (Mean, SD)	25.63 (±10.86)	13.13 (±4.73)	0.0099†
Ingestion of Herbal Medicines (*f*, %)			0.569
Yes	1 (12.50%)	3 (37.50%)	
No	7 (87.50%)	5 (62.50%)	
Smoking Status (*f*, %)			0.619
Smoker	5 (62.50%)	3 (37.50%)	
Non-Smoker	3 (37.50%)	5 (62.50%)	
Years in Recycling Industry (Mean, SD)	12.80 (±5.48)	0.00 (±0.00)	–
Years Exposed in ULA Batteries (Mean, SD)	12.80 (±5.48)	0.00 (±0.00)	–
Family Size (*f*, %)			1.00
1 – 3 Family Members	2 (25.00%)	2 (25.00%)	
4 – 6 Family Members	3 (37.50%)	3 (37.50%)	
More than 7 Family Members	3 (37.50%)	3 (37.50%)	
Drinking Water at Home (*f*, %)			0.569
Mineral Water	5 (62.50%)	7 (87.50%)	
Faucet or Tap Water	3 (37.50%)	1 (12.50%)	
Ventilation Status at Home (*f*, %)			
Door Only	3 (37.50%)	0 (0.00%)	0.200
1 Window	0 (0.00%)	1 (12.50%)	
≥2 Windows	5 (62.50%)	7 (87.50%)	

[a]Comparisons were made using Chi-Square test of Homogeneity for nominal variables, Mann-Whitney Rank Sum Test for ordinal data, and independent t-test for continuous variables
***Significant at 0.05**
†Significant at 0.01

Results: Demographic Profile

- It can be noted that for the exposed group (those who are working in the junk shop), the median age was 49.50. Most of them are males (87.50%), were married (87.50%), who had high school level education (37.50%), have blue-collared jobs (100%), do not ingest herbal medicines (87.50%), are smokers (62.50%), have more than 4 family members (75%), use mineral water (62.50%), and have more than 2 windows at home (62.50%).

- For the unexposed group, the median age was 31. Most were males (87.50%), had college degrees (50.00%), were single (62.50%), do not ingest herbal medicines (62.50%), are non-smokers (62.50%), have more than 4 family members (75.00%), use mineral water (87.50%), and have 2 windows at home (87.50%).

- Throughout all characteristics, only 2 were statistically different between the two groups: educational attainment and years of residency. The proportion of college graduate is higher in the unexposed group (p=0.046) while those in the exposed group have longer residency period than those in the unexposed (p=0.0099).

RESULTS

Table 4.2

Between-Group Comparison of Serum Lead according to Exposure Status (N = 16)

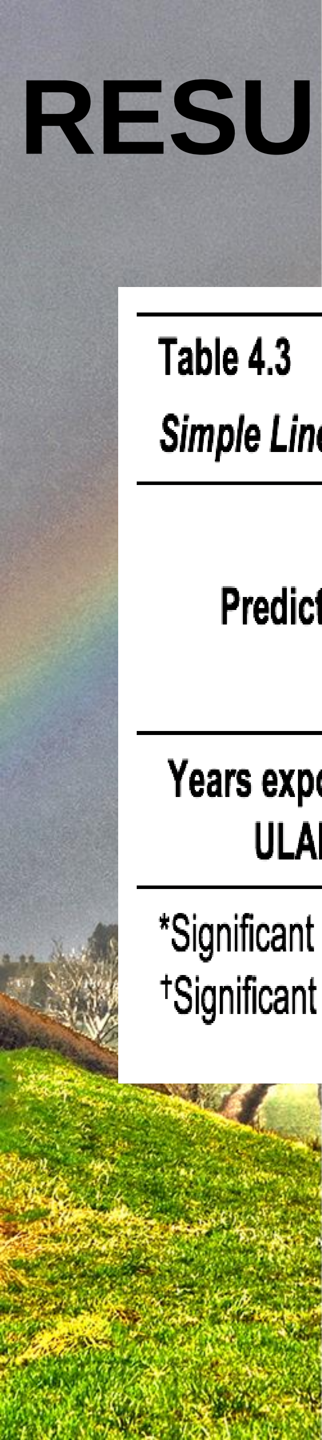
	Exposed (n=8)		Unexposed (n=8)		t-value	p-value (Two-tailed)	Partial η^2
	Mean	SD	Mean	SD			
Serum Lead	6.55	±3.92	2.21	±2.56	–2.62*	0.0203	0.33

*Significant at ≤ 0.05 level

†Significant at ≤ 0.01 level

Results: Comparison of blood lead according to exposure

- •The tables above illustrate the comparison of the serum lead levels according to the exposure status.
- •It can seen that the mean serum lead of the exposed group was 6.55 with a standard deviation of 3.92. On the other hand, the mean seen that the mean serum lead of the unexposed group was 2.21 with a SD of 2.56.
- •Comparing these means gave us a t-value of -2.62 and a p-value of 0.0206. Since the computed p-value is less than the alpha 0.05, we can say that THERE IS
- A STATISTICALLY SIGNIFICANT DIFFERENCE between the mean scores. That is, those in the exposed group have higher serum lead scores than those who were unexposed. Therefore, we accept the alternative hypothesis.
- •It can also be seen that the partial eta squared was 0.33. Partial eta squared is a measure of effect size or how strong was the result because of the exposure. It is interpreted in percentage attributed or caused by the exposure. That is, in this case, 33% of the difference in serum lead levels is because of the exposure (ULAB). This is considered a moderate effect size by convention (0.30 is the cut for small. 0.31 to 0.69 are moderate effect size and 0.70 or more are large effect size).



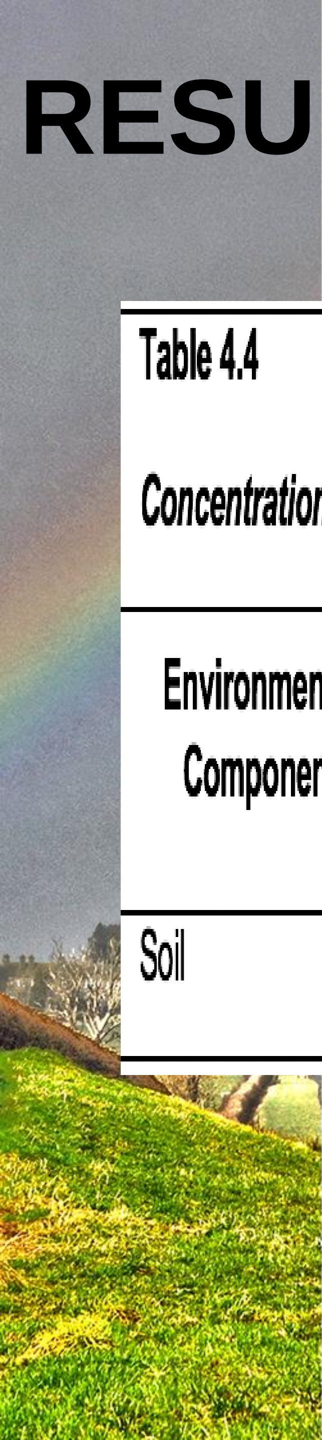
RESULTS

Table 4.3

Simple Linear Regression of the Association between Blood Lead and Years of Working with ULAB (N= 16)

Predictors	Blood Lead	
	Regression Coefficient (95% CI)	*p*-values (Two-tailed)
Years exposed to ULAB	0.21	0.114

*Significant at ≤ 0.05 level
†Significant at ≤ 0.01 level

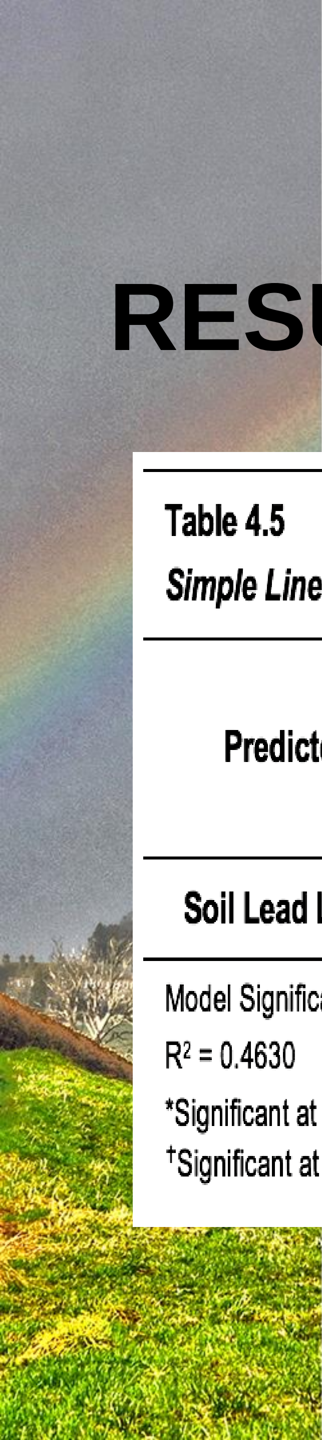


RESULTS

Table 4.4

Concentration of Lead in Soil

Environmental Component	N	Median	Min	Max	Geometric		
					Mean	LCL	UCL
Soil	4	64.96	3.33	307.96	45.61	2.24	926.85



RESULTS

Table 4.5

Simple Linear Regression of the Association between Blood Lead and Soil Level Levels (N= 16)

Predictors	**Blood Lead**			
	***r*-value**	***p*-value (Two-tailed)**	**Regression Coefficient (95% CI)**	***p*-values (Two-tailed)**
Soil Lead Levels	0.68	0.0037	0.68	0.004

Model Significance: $F = 12.07$, $p = 0.0037$

$R^2 = 0.4630$

*Significant at ≤ 0.05 level

†Significant at ≤ 0.01 level

RESULTS

Table 4.6

Concentration of Lead in Water

Environmental Component	N	Median	Min	Max	Geometric		
					Mean	LCL	UCL
Water	4	0.003	0.003	0.003	0.003	0.003	0.003

RESULTS

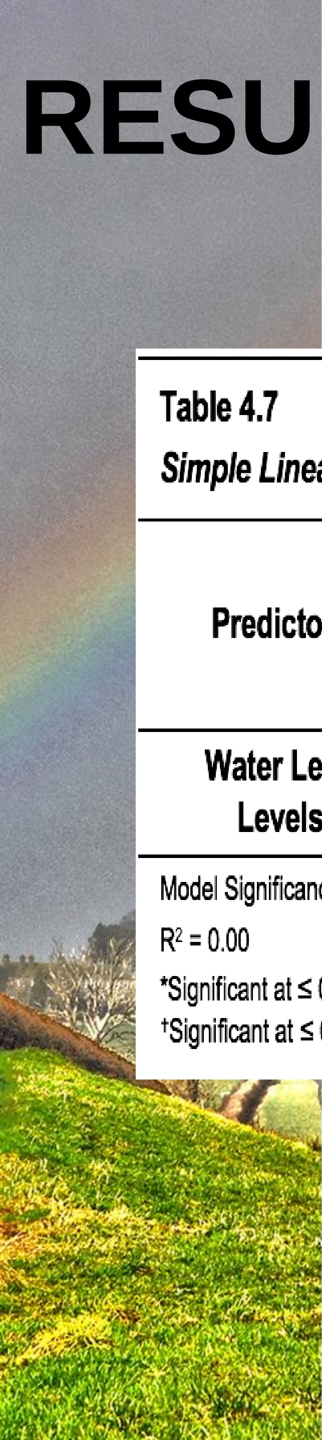


Table 4.7

Simple Linear Regression of the Association between Blood Lead and Water Lead Levels (N= 16)

Predictors	Blood Lead			
	r-value	*p*-value (Two-tailed)	Regression Coefficient (95% CI)	*p*-values (Two-tailed)
Water Lead Levels	0.000	–	0.000	–

Model Significance: $F = 0.00$

$R^2 = 0.00$

*Significant at ≤ 0.05 level

†Significant at ≤ 0.01 level

CONCLUSION

- Recyling shop for used acid batteries have increased levels of lead in soil and its workers has increased level of lead in blood. Water sampl es have normal concentration of lead.

- There is significant relationship between exposure to ULAB with bloo d and soil lead levels.

- There is no significant relationship between the years of exposure to ULABs to concentration of lead in blood.

- Improper handling/recycling of used lead cid batteries can lead to contamination of soil and water which can be ingested and significantlya ffect health of recyclers, their families, and communities.

Recommendation

- There should be a stricter implementation of laws pertaining proper han dling and disposal of toxic waste such as ULAB.

- Health education must be strengthened for ULAB recyclers regarding the ill effect of not using proper PPE and disposal of toxic wastes.

- There should be a regular monitoring of recycling shops particularly
those that hande toxic chemicals and those that emit toxic wastes.

- Regular monitoring of soil, water and blood lead levels must be impleme ntedin those areas identified with high numbers of recycling shop using ULAB.