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Blood Lead Levels of the Southern Ghanaian Population

Ghana: Elaboration of Reference Values
for Lead in Blood



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Summary of the doctorate thesis titled:
**“Blood Lead Levels of the Southern Ghanaian Population
Ghana: Elaboration of Reference Values for Lead in Blood”**

This doctorate thesis is part of the Ghana Environmental Toxicology Project that the RWTH Aachen Technical University has been undertaking together with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the University of Ghana (Legon University) since 2015. The project examines the exposure to heavy metals of the people working and living in Agbogbloshie, an e-waste recycling site in Accra, the capital of Ghana, by biomonitoring blood and urine samples for heavy metals. In order to assess the results found at the recycling site within their environmental setting it is necessary to establish toxicological reference values for the Ghanaian population, which up to the completion of this work, have not existed.

This doctorate thesis establishes the reference values of lead in blood for the Southern Ghanaian population. Due to logistical reasons the North of the country could not be considered yet. However, the northern parts of the country are of little relevance as a benchmark for assessing the situation at Agbogbloshie in the South of Ghana.

In order to establish representative reference values sub-collectives from different regions of the country were established. The three key regions were Offinso, Eikwe and Accra. The three age groups were 15-24, 25-34 and 35+. The chosen age groups correlate with the previous project at the Agbogbloshie e-waste recycling site.

The study design intended to collect samples from 40 participants in each subcategory, i.e. by location and age group, evenly distributed between men and women, resulting in 20 participants by location, age group and gender and a total of 120 participants per location.

Table: Study design

Location	Offinso	Eikwe	Accra	Total
15-24	40	40	40	120
25-34	40	40	40	120
35+	40	40	40	120
Total	120	120	120	360

The actual field study exceeded the location targets for Offinso and Eikwe. It came short in regards to the participants in Accra due to organisational difficulties and prolonged permission procedures. In total 292 subjects were examined: Offinso = 124, Eikwe = 130 and Accra = 38.

After consenting to the study, blood and urine samples were collected from each participant. Additional data was acquired by the means of a questionnaire.

The laboratory work to establish the blood lead level in each sample was conducted at the RWTH Aachen in the institute of Occupational and Social Medicine. Graphite furnace atomic absorption spectrometry was used in combination with a standard addition method to extract the levels of lead in each sample ($\lambda=283.3060$ nm; LOD: approximately 10 $\mu\text{g/L}$).

The total mean lead content of the Southern Ghanaian population was 43.3 $\mu\text{g/l}$ with a mean of 48.3 $\mu\text{g/l}$ for men and a mean of 38.1 $\mu\text{g/l}$ for women. Applying the Mann-Whitney Test the distributions between men and women are significantly different at the 0.05 level and a p-value of 2.92547 $\cdot 10^{-10}$ with men having more lead in their blood.

The German reference values consist of the 95th percentile, currently 40 $\mu\text{g/l}$ for men and 30 $\mu\text{g/l}$ for women. The 95th percentiles of the Ghanaian population are 81 $\mu\text{g/l}$ and 76 $\mu\text{g/l}$ for men and women, respectively. The Southern Ghanaian reference values are thus twice as high in the case of men and 2.5 times as high in the case of women. In comparison to most European countries Ghana has a higher blood lead level in terms of geometric mean and 95th percentile.