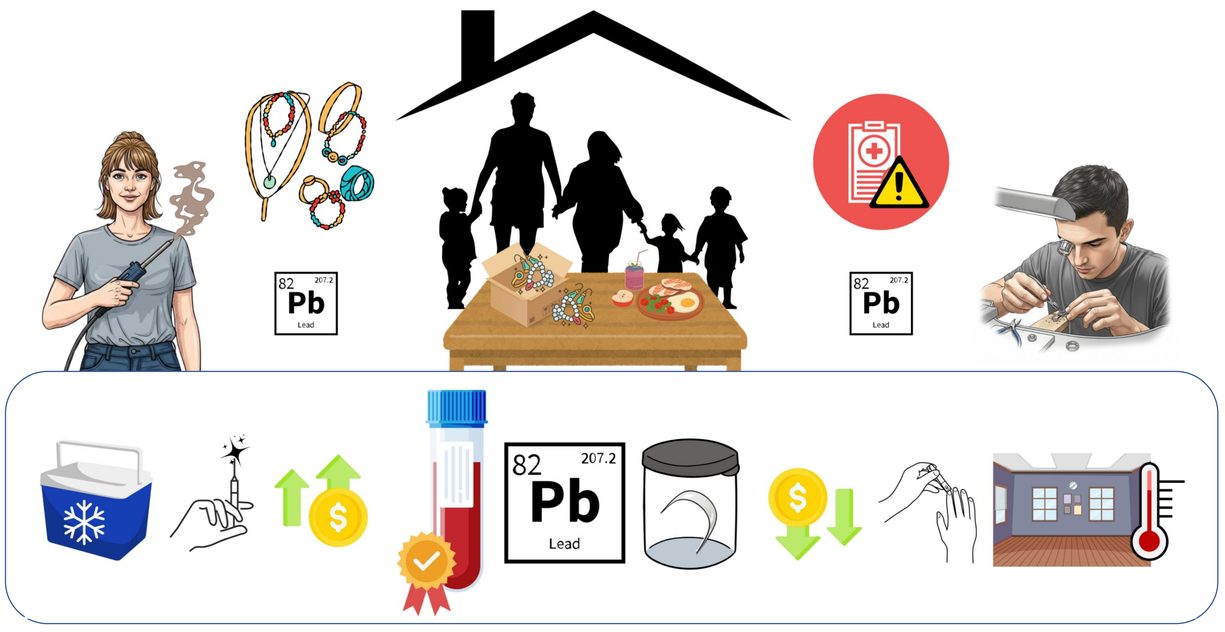
NAIL AND BLOOD LEAD LEVELS ARE RELIABLE INTERNAL DOSE BIOMARKERS TO EVALUATE OCCUPATIONAL EXPOSURE IN INFORMAL WORK JEWELRY PRODUCTION SCENARIO?

Allan Santos de Oliveira[1], Elizeu Chiodi Pereira[1], Henrique Yudi Furihata Nascimento[1], Rafaela Michelan Pipolo[1], Aline de Carvalho Elias[2], Maciel Santos Luz[2], Kelly Polido Kaneshiro Olympio[1]

1 Department of Environmental Health of the School of Public Health - University of São Paulo, São Paulo, SP; The Human Exposome Research Group (eXsat).
2 Laboratório de Processos Metalúrgicos, Instituto de Pesquisas Tecnológicas do Estado de São Paulo, São Paulo, SP, Brazil.

allansoliveira@usp.br

Introduction

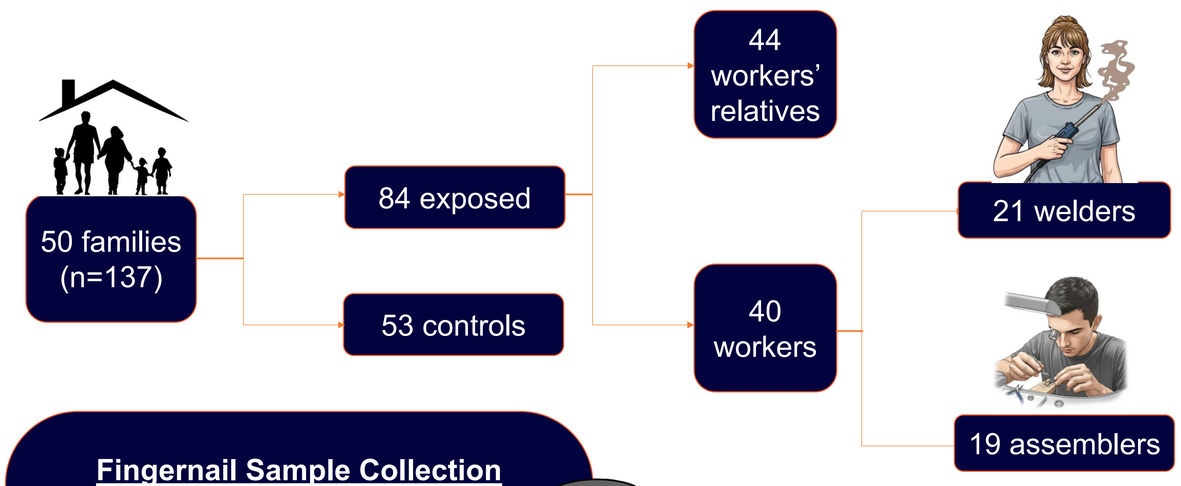


Ferreira et al. 2019; Oliveira et al., 2021; Salles et al., 2021.

Objectives

To assess whether nail lead levels (NLL) are reliable internal dose biomarkers for household exposure in informal home-based jewelry production.

Methods



Fingernail Sample Collection

- *Two sampling campaigns were conducted in a four-month interval;*
- *In the first, 115 nail samples (thumbs) were collected; in the second, 184;*
- *Stored in Ribonuclease-free microfuge tubes at room temperature.*

Washing and digestion procedures

Analysis by ICP-MS at the Institute for Technological Research

Secondary data (Ferreira et al. 2019)

Questionnaries data

- *Sociodemographic information;*
- *Workplace details;*
- *Blood lead levels (BLL).*

Statistical analysis by Stata 14

- *Mann-Whitney tests assessed differences between groups and campaigns;*
- *Spearman's correlation tested associations between BLL and NLL.*

Results

Table 1. Geometric means (GM) and 95th percentiles of nail lead levels (NLL) found in exposed (n = 84) and control group (n = 53)

Study group	NLL (µg.g^{-1})			
	First Campaign		Second Campaign	
	GM (95% CI)	95th	GM (95% CI)	95th
Overall	0.07 (0.05 – 0.11)	7.47	0.32 (0.22 – 0.46)	4.41
Exposed	0.10 (0.05 – 0.19)	13.26	0.36 (0.22 – 0.58)	10.56
Welders (n=21)	0.23 (0.06 – 0.86)	14.36	**0.83 (0.27 – 2.58)***	15.19
Assemblers (n=19)	0.04 (0.01 – 0.12)	7.47	0.14 (0.05 – 0.44)	3.37
Workers' relatives (n=44)	0.11 (0.04 – 0.28)	10.64	0.36 (0.20 – 0.64)	3.37
Control	0.04 (0.02 – 0.07)	0.77	0.26 (0.17 – 0.41)	1.67

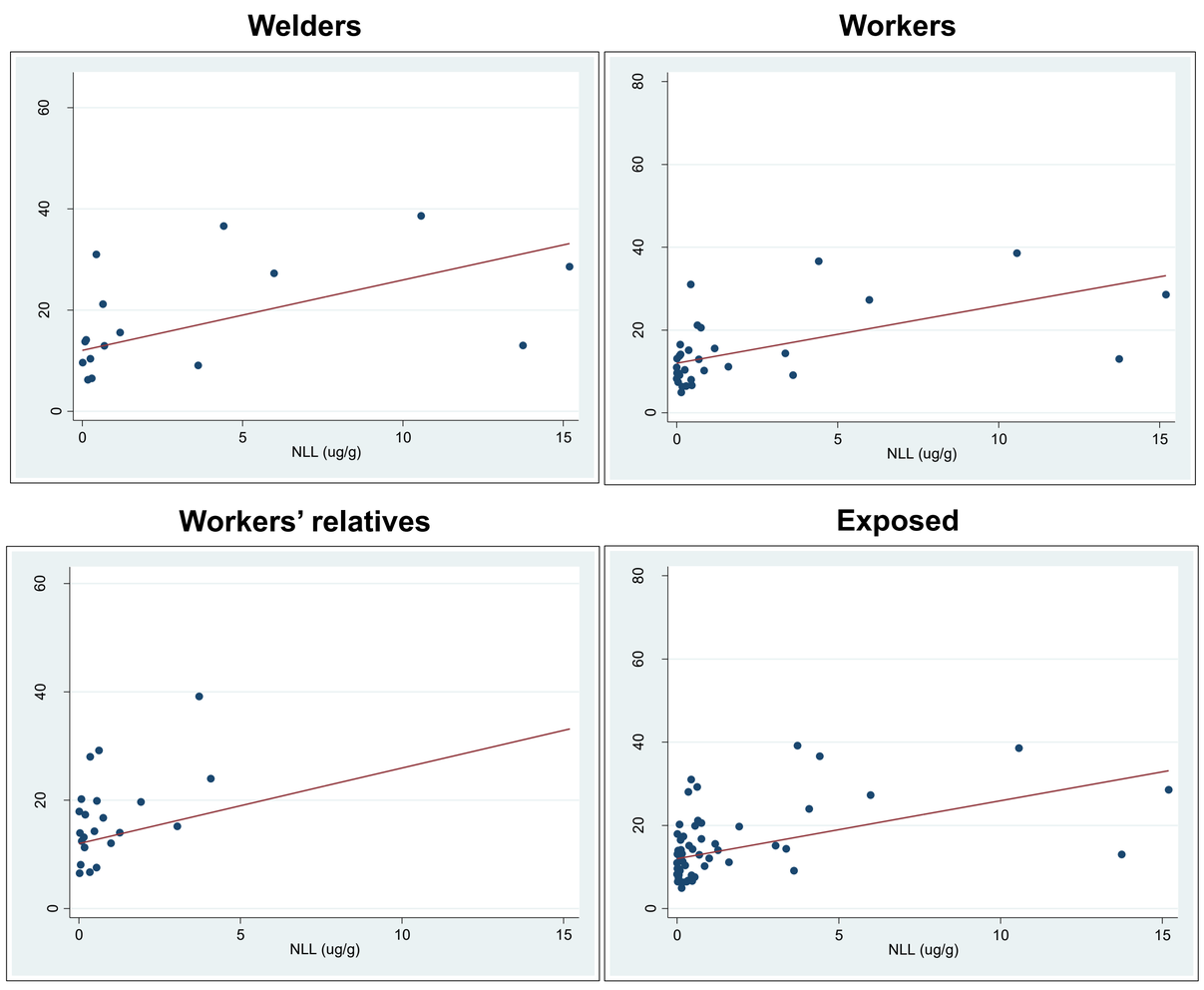
* Significant difference compared to assemblers (p=0.036).

Table 2. Absolute frequency of demographic characteristics of the participants, by group and sex

Variable	Overall		Exposed Group						Control Group	
	Females	Males	Welders		Assemblers		Workers' relatives		Females	Males
			Females	Males	Females	Males	Females	Males		
Subjects	86	51	17	4	18	1	14	30	37	16
Age (Years)										
0-5	6	5	-	-	-	-	3	4	3	1
6-11	6	6	-	-	-	-	3	6	3	-
12-19	8	14	-	3	2	-	3	9	3	2
>20	66	26	17	1	16	1	5	11	28	13
Educational level										
Illiterate	5	1	-	-	2	-	2	1	1	-
Basic school incomplete	36	25	6	-	9	-	6	17	15	8
Basic school complete	18	19	4	4	3	1	3	11	8	3
Secondary school complete	24	4	7	-	4	-	2	1	11	3
University complete	1	1	-	-	-	-	1	-	1	1

Moderate correlations were found between NLL and BLL in the second campaign for welders (r=0.52; p=0.037), workers (r=0.48; p=0.006), workers relatives (r=0.43; p=0.045), and the exposed group (r=0.47; p<0.001).

Figure 1. Scatter plots representing moderate Spearman's Correlations between nail lead levels and blood lead levels for exposed group and their subgroups (workers, welders, workers' relatives)



Conclusions

- ❖ In this occupational exposure scenario, jewelry workers, especially welders, may face greater Pb contamination.
- ❖ BLL and NLL correlations suggest that both biomarkers tend to vary together, particularly after nail growth period.
- ❖ These findings support the potential use of NLL as a biomonitoring tool for informal workers at risk of low Pb exposure.

References

- ❖ Ferreira, A.P.S.S., Pereira, E.C., Salles, F.J., Silva, F.F., Batista, B.L., Handakas, E., Olympio, K.P.K., 2019. Home-based and informal work exposes the families to high levels of potentially toxic elements. Chemosphere. 218, 319–327. https://doi.org/10.1016/j.
- ❖ Oliveira AS, Costa EAC, Pereira EC, Freitas MAS, Freire BM, Batista BL, Luz MS, Olympio KPK. The applicability of fingernail lead and cadmium levels as subchronic exposure biomarkers for preschool children. Sci Total Environ. 2021 Mar 1;758:143583. doi: 10.1016/j.scitotenv.2020.143583. Epub 2020 Nov 11. PMID: 33243496.
- ❖ Salles, F.J., Tavares, D.J.B., Freire, B.M., Ferreira, A.P.S. da S., Handakas, E., Batista, B.L., Olympio, K.P.K., 2021. Home-based informal jewelry production increases exposure of working families to cadmium. Sci Total Environ 785, 147297. https://doi.org/10.1016/j.scitotenv.2021.147297.

ACKNOWLEDGMENTS:

Funded by São Paulo Research Foundation - FAPESP (Grants #2016/11087-8, #2016/10060-9, #2017/14392-9 and #2023/04803-2) and CNPq (Grant #314637/2021-4).