# The applicability of fingernail lead and cadmium levels as subchronic exposure biomarkers for preschool children

Allan Santos de Oliveira[1], Elizeu C. Pereira[1], Millena A. S. de Freitas[2], Bruna M. Freire[3], Rodrigo P. de Souza[2], Bruno Lemos Batista[3], Maciel Santos Luz[2], **Kelly Polido Kaneshiro Olympio[1]**

1 Department of Environmental Health, School of Public Health, University of São Paulo, Av. Dr. Arnaldo, 715, Cerqueira César, Sao Paulo, SP, Brazil
2 Centro de Tecnologia em Metalurgia e Materiais, Instituto de Pesquisas Tecnológicas do Estado de São Paulo, Av. Prof. Almeida Prado, 532, Cidade Universitária, Butantã, São Paulo, SP, Brazil
3 Center for Natural and Human Sciences, Federal University of ABC, Av. dos Estados, 5001, Santa Terezinha, CEP 09210-580, Santo André, SP, Brazil

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## BACKGROUND

Preschool children are daily exposed to metals in their homes or daycare centers (DCC) (Figure above). Health effects are associated with even low doses of Potentially Toxic Elements (PTE) exposure and children comprise a concern group to public health [1]. Nail PTE levels have been studied for exposure biomonitoring and compared to other biological matrices [2].

## OBJECTIVE

The aim of this study was to explore the applicability of Fingernail Lead and Cadmium Levels (FLL and FCL) as subchronic exposure biomarkers for preschool children.

## METHODS

FLL and FCL were analyzed for 1-4 year-old preschool children (n=602) who attended 21 DCC in São Paulo, Brazil, in 2013 (Fig. 1).
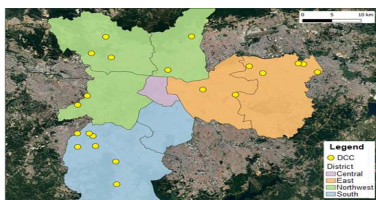


Inductively coupled plasma mass spectrometry (ICP-MS) analyses were performed. Results were compared to Blood Lead and Cadmium levels (BLL and BCL) found in a previous study[3].
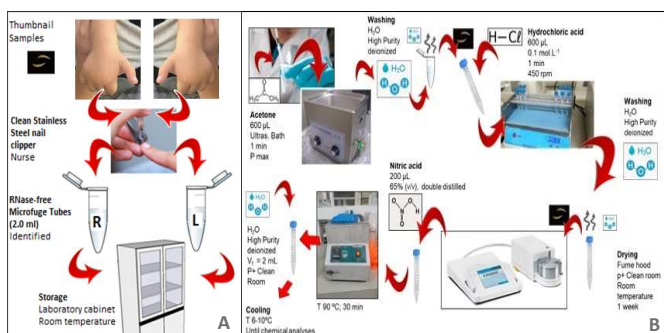
**Fig. 1 –** DCCs location, by District of São Paulo-SP, Brazil



**Fig. 2 –** Flow diagram showing stages of nail sample collection and storage (A) and washing and digestion (B).

## RESULTS

FLL geometric mean was 0.02 µg.g$^{-1}$ (95%CI: 0.02-0.03 µg.g$^{-1}$). Positive correlations (Table 2) were found between: FLL-BLL ($r=0.08$; $p=0.04$); FLL-BLL of DCC located in high vehicle traffic density streets ($r=0.23$; $p<0.0001$); FLL-BLL in the group with uncommon post-cleaned nails ($r=0.13$; $p<0.05$); FLL-FCL ($r=0.31$; $p<0.0001$), being the correlation stronger in DCC located in Sao Paulo's east region ($r=0.44$; $p<0.0001$); and BLL-BCL ($r=0.35$; $p<0.0001$).

**Table 1.** Spearman correlation between FLL and BLL of preschool children (n=602).

| Risk factor | FLL-BLL | FCL-BCL | FLL-FCL | BLL-BCL |
|---|---|---|---|---|
| | | | $r$ | |
| General | 0.08* | 0.06 | 0.31*** | 0.35*** |
| Vehicle flow | | | | |
| Low | -0.05 | 0.11 | 0.36*** | 0.44*** |
| High | 0.23* | 0.03 | 0.26*** | 0.29*** |
| DCC location | | | | |
| Northwest | 0.12 | -0.04 | 0.20** | 0.35*** |
| South | -0.01 | -0.05 | 0.08 | 0.39*** |
| East | 0.12 | 0.12 | 0.44*** | 0.24* |
| Smoker at home | | | | |
| Yes | 0.06 | 0.01 | 0.35*** | 0.35*** |
| No | 0.09 | 0.09 | 0.30*** | 0.38*** |
| Post cleaning visual appearance | | | | |
| Common | -0.01 | 0.01 | 0.27*** | 0.36*** |
| Uncommon | 0.13* | 0.07 | 0.33*** | 0.33*** |
| Lead exposure level | | | | |
| Low (≤5.0 µg.dL$^{-1}$) | 0.07 | - | - | - |
| Medium/High (>5.0 µg.dL$^{-1}$) | 0.27 | - | - | - |

* p-value <0.05; ** p-value <0.01; *** p-value <0.0001

Moreover, lead exposure magnitude, measured with BLL biomarker, presented no significant impact in FLL (Table 2).

**Table 2.** Mann-Whitney Test between FLL geometric means between lead level exposure

| Lead Level exposure* | $n$ | FLL geometric mean (µg.g$^{-1}$) |
|---|---|---|
| Low (≤5.0 µg.dL$^{-1}$) | 551 | 0.02 (IC95%: 0.01-0.03) |
| Medium-High (>5.0 µg.dL$^{-1}$) | 41 | 0.05 (IC95%: 0.02-0.14) |
| $p$-value | | 0.1346 |

* ≤5.0 µg.dL$^{-1}$ are the P97,5$^{th}$ BLL reference value, by CDC[4].

## CONCLUSIONS

FLL should only be selected as an exposure biomarker, when an initial screening must be planned and the financial resources are scarce, especially in high traffic vehicle areas. Preschool children were co-exposed to lead and cadmium, reinforcing the importance of planning broader studies to environmental contaminants exposure and not just for one chemical element.

## REFERENCES

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Allan Santos de Oliveira (allansoliveira@usp.br), Maciel Santos Luz (macielluz@ipt.br), Bruno Lemos Batista (bruno.lemos@ufabc.edu.br), **Kelly Polido Kaneshiro Olympio (kellypko@usp.br)**