Introduction
This paper presents a risk assessment of exposure to metal residues in laundered shop towels by workers. The study of these exposures was not prompted by any known or reported health effects in workers using shop towels.

The concentrations of 27 metals measured in a synthetic sweat leachate were used to estimate the releasable quantity of metals which could be transferred to workers’ skin. Worker exposure was evaluated quantitatively with an exposure model that focused on towel-to-hand transfer and subsequent hand-to-food or -mouth transfers. The exposure model was based on conservative, but reasonable assumptions regarding towel use and default exposure factor values from regulatory guidance.

Process
Laundered shop towels were obtained from 10 different rental/laundering facilities and forwarded to Exova laboratories (Santa Fe Springs, CA) for analysis of metals. Each facility provided a bundle of 10 towels from which a composite sample was prepared, such that a single analytical result would be obtained for each towel bundle. Composite samples were obtained by collecting large cut-outs (approximately 8 × 1000 in size and representing approximately 50% of the towel area) from individual towels.

A leachate analysis was performed to determine the available concentration of residual metals from a standard shop towel that could be transferred onto the skin of workers. Exposures were quantified with standard US EPA-type models and scientifically-based inputs, focused on towel-to-hand, and towel-to-mouth exposure pathways. The conclusions of this assessment apply to normal, foreseeable towel use and conditions of worker exposure.

Summary of Findings
The results indicate that there is no increased health risk above regulatory levels of concern for workers who routinely use shop towels, from a variety of exposure pathways.

The exposure model was based on the premise that dermal absorption of metals will be negligible as compared to indirect exposure pathways that lead to the incidental ingestion of the metals. This was confirmed by a brief analysis of the potential dermal absorbed dose using US EPA permeability constants for inorganic metal salts.

Hazard indices calculated for 26 metals (excluding lead) were below 1, indicating that predicted worker exposures were below levels which would indicate a potential health risk. The incremental cancer risks estimated for metals that are regulated as carcinogens (arsenic only) was 2 × 10⁻⁷, near the lower end of the range of risks considered to be acceptable by US EPA (10⁻⁶ to 10⁻⁴). Additionally, lead risks as evaluated by US EPA ALM were below levels of a significant health concern as evaluated in this assessment.

Based on our findings, the residual concentrations of metals in laundered shop towels do not present a health hazard for workers using the towels.

The full study can be found at http://www.sciencedirect.com/science/article/pii/S0273230014001342

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