

## ORIGINAL ARTICLE

# Household cleaning products and the risk of allergic dermatitis: a prospective cohort study with primary-school children

X. Liu,<sup>1,2</sup> L. Tan,<sup>1</sup> I.T.S. Yu,<sup>1,3</sup> Z. Zhang,<sup>1</sup> C.C.-Y. Wong,<sup>1</sup> C. Guo,<sup>1</sup> K.F. Ho,<sup>1</sup> A.P.S. Lau,<sup>4</sup> E.K. Yeoh,<sup>1</sup> A. Lee,<sup>1</sup> X.Q. Lao<sup>1,5,\*</sup>

<sup>1</sup>JC School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong SAR, China

<sup>2</sup>School of Public Health, Sun Yat-sen University, Guangzhou, China

<sup>3</sup>Hong Kong Occupational and Environmental Health Academy, Hong Kong SAR, China

<sup>4</sup>Division of Environment, Hong Kong University of Science and Technology, Hong Kong SAR, China

<sup>5</sup>Shenzhen Research Institute of the Chinese University of Hong Kong, Shenzhen, China

\*Correspondence: X.Q. Lao. E-mail: xqlao@cuhk.edu.hk

## Abstract

**Background** Household cleaning products are widely used by the public, but limited data have been obtained on whether their use induces allergic dermatitis in children.

**Objective** This study investigated the association between exposure to household cleaning products and allergic dermatitis in primary-school children.

**Methods** A prospective cohort study of Hong Kong primary-school children was conducted between 2012 and 2014. A baseline survey was administered to 1812 students who did not have allergic dermatitis. Information on respiratory symptoms, exposure to household chemical cleaning products and other topics was collected using a self-administered questionnaire. A cumulative chemical burden (CCB) score was calculated for each student by summing the duration of exposure to 14 chemical cleaning products. Principal component analysis was used to identify patterns in the use of these cleaning products. Logistic regression was performed to calculate relative risk (RR) with 95% confidence intervals (CIs) after adjusting for potential confounders.

**Results** Eighty-nine (4.9%) of the students surveyed had dermatitis during the follow-up. However, exposure to individual chemical cleaning products was not found to be associated with the children's allergic dermatitis (all  $P > 0.05$ ). In contrast to those in the lowest tertile, neither CCB scores in the middle tertile (RR: 1.16, 95% CI: 0.67 to 2.00) nor those in the highest tertile (RR: 1.24, 95% CI: 0.73 to 2.14) were significantly associated with the risk of allergic dermatitis. The adjusted RR for every 5-unit increment in CCB score was 1.01 (95% CI: 0.98 to 1.03). Four patterns of cleaning-product use were derived, but none were found to be associated with the risk of dermatitis (all  $P > 0.05$ ).

**Conclusion** The use of household chemical cleaning products is not associated with the risk of dermatitis in primary-school children.

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## Conflicts of interest

None declared.

## Funding Sources

None declared.

## Introduction

Allergic dermatitis is common in the cleaning industry.<sup>1</sup> Cleaning products contain a wide range of chemicals, some of which may damage keratinocytes and thereby cause irritant dermatitis.<sup>1</sup> Studies have shown that even low concentrations of chemicals may activate keratinocytes to release cytokines and cause dermatitis.<sup>2</sup>

Regular contact with a wide range of detergent chemicals is not only common amongst occupational cleaning workers<sup>1,3,4</sup>; contact with allergens and irritants in household washing and cleaning products has also been reported.<sup>5–7</sup> Previous surveys have shown that up to 16.5% of household cleaning products contain hazardous chemical products.<sup>5,8</sup> This figure may even be an underestimation, as products are not always correctly labelled.<sup>9</sup>

Children are particularly vulnerable to hazardous chemicals. The prevalence of positive patch tests taken by children referred with suspected allergic contact dermatitis ranges from 27% to 95.6%.<sup>10</sup> Cotton *et al.*<sup>6</sup> reported the case of a 7-year-old girl with an unusual allergic contact dermatitis due to methylisothiazolinone in laundry detergent. Although a number of epidemiological studies have indicated that the use of household cleaning products has adverse effects on children's respiratory health, with consequences such as asthma, weakened lung function and rhinitis,<sup>11–15</sup> little epidemiological research has been conducted on the association between exposure to household cleaning products and the risk of allergic dermatitis in children, despite the widespread use of household cleaning products by the public. We therefore conducted a prospective cohort study to investigate the role of household cleaning-product use in the development of allergic dermatitis in primary-school children.

## Methods

### Study setting and participants

The data were collected from an ongoing longitudinal prospective cohort study conducted with Hong Kong primary-school children to investigate the effects of air pollution on children's respiratory health. The rationale for this study and the methods used have been described in detail elsewhere.<sup>11,16–18</sup> Of the 2299 students from 20 primary schools who completed the baseline survey and the first round of follow-up (at an interval of approximately 1 year) in 2012–2014, 1812 (78.9%) students who did not report allergic dermatitis in the baseline survey were included in the current analysis. The study was approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee. The study met the requirements of the Declaration of Helsinki, and written informed consent was obtained on behalf of each student by their parents or guardians.

### Data collection

In both the baseline survey and the first follow-up survey, a structured questionnaire was used to collect a wide range of information on social demographics, respiratory symptoms, self-reported doctor-diagnosed disease and factors that affected the air quality in the home environment. Most of the questionnaire items were adopted from the tools of the International Study of Asthma and Allergies in Childhood (ISAAC),<sup>19</sup> American Thoracic Society<sup>20</sup> and the European Community Respiratory Health Survey.<sup>21</sup> The parents or guardians were required to answer the questionnaires with their children at home. In addition to filling in the questionnaire, each student received a simple health examination at school to measure anthropometric parameters and pulmonary function in both the baseline survey and the follow-up survey.

### Ascertainment of allergic dermatitis

Information on the children's experience of allergic dermatitis was collected through the questionnaires completed by their parents or guardians. Allergic dermatitis is generally defined as skin inflammation with clinical symptoms including a red rash, bumps, a burn-like rash on the skin, itchy, painful or burning skin, blisters and leaking fluid. During the survey, an affirmative answer to the question 'Has your child experienced doctor-diagnosed dermatitis in the last 12 months?' was taken to indicate a child suffering from dermatitis. If the response was 'yes', two additional questions were asked to confirm the response: (i) in which month of the last 12 did your child suffer from allergic dermatitis? and (ii) in which part of the body did your child suffer from allergic dermatitis? Consistent responses to these three questions were deemed to indicate participants with allergic dermatitis.

### Use of household cleaning products

Information on the use of household cleaning products was also collected using the aforementioned structured questionnaire, with details provided in a previous report.<sup>11</sup> Briefly, we collected information on the use of 14 common types of chemical cleaning product (bathroom cleaner, floor cleaner, glass cleaner, kitchen cleaner, tile cleaner, leather cleaner, multipurpose cleaner, non-chlorinated bleach, chlorinated bleach, sanitizer, scented air freshener, unscented air freshener, insecticide and other chemical products). First, the parents were asked 'Have you used the following household cleaning products at home in the previous 12 months?' If the response was 'yes' for any product, information was also collected regarding weekly usage frequency (less than once, 1–3 times, 4–6 times and 7 or more times) and the average duration of each use (<15 min, 15–30 min, 31–45 min, 46–60 min and >60 min). In addition, information on the use of clean water only to clean the home environment was collected.

### Covariate factors

Information on a wide range of potential confounders collected in the baseline survey was used in the analysis. A questionnaire was used to collect information on age (years), gender, average size of house per member (m<sup>2</sup>), presence at home when using cleaning products (yes, no), windows open when using cleaning products (yes, no), presence of a pet at home (yes, no), presence of a plant at home (yes, no), incense or mosquito coil burned at home (yes, no), home renovation (yes, no), passive smoking at home (yes, no), exercise per week (less than once, once or twice, three or more times), education of mother and father (primary school or lower, secondary school, tertiary school or above), parental history of atopic disease (yes, no) and child history of other atopic diseases (yes, no). Each student underwent a simple health examination at school to measure their weight and height; their body mass index (BMI) (kg/m<sup>2</sup>) was calculated as weight

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