Cutaneous and respiratory symptoms among professional cleaners

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Background
Occupational dermatitis is very common and has a large economic impact. Cleaners are at an increased risk for both work-related cutaneous and respiratory symptoms.

Aims
To compare the prevalence of occupational cutaneous symptoms among professional indoor cleaners to other building workers (OBW) and to determine associations with exposures and with respiratory symptoms among cleaners.

Methods
A questionnaire completed by indoor professional cleaners and OBW to compare rash and respiratory symptoms between these groups examined workplace factors such as training, protective equipment and work tasks.

Results
In total, 549 of the 1396 professional cleaners (39%) and 593 of the 1271 OBW (47%) completed questionnaires. The prevalence of rash was significantly higher in the cleaners compared to the OBW. For male cleaners, 21% (86/413) had a rash in the past 12 months compared to only 11% (13/115) of OBW ($P < 0.05$). The rashes experienced by the cleaners were more likely to be on their hands and worse at work. Cleaners washed their hands significantly more often than OBW. Cleaners with a rash were less likely to have received workplace training regarding their skin and were more likely to find the safety training hard to understand. Cleaners with a rash within the past year were significantly more likely to have work-related asthma symptoms than cleaners without a rash ($P < 0.001$).

Conclusions
This study demonstrates a strong link between work-related symptoms of asthma and dermatitis among cleaners. Effective preventive measures, such as the use of protective skin and respiratory equipment, should be emphasized.

Key words
Asthma; gloves; hand washing; occupational dermatitis; occupational health; protective equipment; rash; workplace training; work-related asthma.

Background
Occupational contact dermatitis is a very common disease. It is the most prevalent occupational disease in many countries and constitutes up to 30% of all occupational diseases for which compensation is payable [1]. Each year, ~1000

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Cleaners are an important occupational group in Canada. According to the 2001 Census of Canada of the total Canadian labour force of 15,872,072, the category of ‘cleaners (Occupational Classification G93)’ consisted of 425,130 workers [7] ~3% of the workforce. The economic impact of dermatitis is considerable. Leigh and Miller [8] found that dermatitis was the sixth- and third-ranking occupational disease for permanent partial disability and temporary disability, respectively, with janitors and cleaners identified as the third most frequently affected group in both categories.

There has been recent interest in possible interactions between skin and lung sensitization at work [9]. There is some evidence to suggest that skin exposure to diisocyanates may cause sensitization [10] and increase risk of occupational asthma. Beryllium may cause sensitization via skin exposure, as suggested by animal studies [11], perhaps increasing risks for development of subsequent chronic beryllium disease of the lungs. Asthma has been reported to occur more commonly among professional cleaners than office workers [12–16]. The mechanism is unclear but an increased risk of asthma has been reported mainly among domestic cleaners rather than office cleaners. Domestic cleaners would be expected to have greater exposure to allergens such as household pets and dust mites, but most associations have linked asthma symptoms to exposure to dust mites, but most associations have linked asthma symptoms and personal and workplace factors [17]. Symptoms and personal and workplace factors [17] may affect this condition: protective equipment, workplace exposures and workplace training. Furthermore, a major and original objective of this study was to investigate the possible association between work-related asthma and work-related dermatitis among cleaners.

Methods

The study design was cross-sectional. A 56-question survey was composed to assess respiratory and cutaneous symptoms and personal and workplace factors [17]. Sample size calculations showed that a sample size of 559 was needed in each group, in order to identify an OR of 2.0 given a 5% prevalence of asthma in the comparison group. The aim of this study was to compare cleaners to other building workers (OBW) in the prevalence of occupational cutaneous symptoms and to determine occupational factors that affect this condition: protective equipment, workplace exposures and workplace training. Furthermore, a major and original objective of this study was to investigate the possible association between work-related asthma and work-related dermatitis among cleaners.

Quantitative data were analysed using SAS v 9.1. Categorical variables were compared between cleaners and OBW using $\chi^2$. The Fisher’s exact test was used for small sample sizes. For continuous variables, the $t$-test was used. Estimation of relative risk was done by the Mantel–Haenszel odds ratio. The level of significance accepted for this study was $P < 0.05$.

Ethics approval for this study was obtained from the Health Sciences Research Ethics Board of the University of Toronto and the University Health Network Review Ethics Board.

Results

Completed questionnaires were returned by 549 of the 1396 professional cleaners (39% response rate, 460 males, 89 females) and 593 of the 1271 OBW (47% response rate, 123 males, 470 females). See Table 1 for demographics.

The prevalence of rash was higher in the cleaning population compared to the OBW for males with a rash in the past 12 months and for females with a rash now (Table 2). For male cleaners, 21% (86/413) had a rash in the past 12 months compared to only 11% (13/115) of OBW ($P < 0.05$). For female cleaners, 15% (13/89) had a current rash compared to only 5% (22/470) of OBW ($P < 0.01$). There was no significant difference between male cleaners and OBW with a current rash and between female cleaners and OBW with rash in the past 12 months.

Among those with a rash, male cleaners were more likely to experience a rash on their hands than OBW
Table 1. Survey participant baseline demographics and characteristics

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>OBW</th>
<th>Females</th>
<th>OBW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cleaners, n (%)</td>
<td>OBW, n (%)</td>
<td>OR (95% CI)</td>
<td>P-value</td>
</tr>
<tr>
<td>Age (mean ± SE)</td>
<td>49 ± 0.4, 460</td>
<td>46 ± 0.9, 123</td>
<td>49 ± 0.9, 88</td>
<td>50 ± 0.4, 470</td>
</tr>
<tr>
<td>Years working (mean ± SE)</td>
<td>18 ± 0.3, 457</td>
<td>14 ± 0.8, 122</td>
<td>16 ± 0.7, 88</td>
<td>16 ± 0.4, 470</td>
</tr>
<tr>
<td>Current smokers</td>
<td>116 (26)</td>
<td>22 (18)</td>
<td>22 (25)</td>
<td>73 (16)</td>
</tr>
<tr>
<td>Ex-smokers</td>
<td>145 (32)</td>
<td>33 (27)</td>
<td>17 (19)</td>
<td>131 (28)</td>
</tr>
<tr>
<td>Never smoked</td>
<td>193 (43)</td>
<td>69 (56)</td>
<td>49 (56)</td>
<td>268 (57)</td>
</tr>
<tr>
<td>&gt;20 Pack years</td>
<td>29 (6)</td>
<td>7 (6)</td>
<td>1 (1)</td>
<td>24 (5)</td>
</tr>
<tr>
<td>Childhood asthma</td>
<td>21 (5)</td>
<td>2 (2)</td>
<td>6 (7)</td>
<td>17 (4)</td>
</tr>
<tr>
<td>High school or higher education</td>
<td>438 (95)</td>
<td>115 (93)</td>
<td>80 (91)</td>
<td>468 (99)</td>
</tr>
</tbody>
</table>

The number of subjects responding to each outcome variable varied slightly from item to item. SE, standard error.

*P < 0.05, **P < 0.01, ***P < 0.001.

Table 2. Skin rash occurrence among cleaners and OBW

<table>
<thead>
<tr>
<th></th>
<th>Current rash</th>
<th>Rash in the past 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cleaners, n (%)</td>
<td>OBW, n (%)</td>
</tr>
<tr>
<td>Male</td>
<td>43 (10)</td>
<td>12 (10)</td>
</tr>
<tr>
<td>Female</td>
<td>13 (15)</td>
<td>22 (5)</td>
</tr>
</tbody>
</table>

The number of subjects responding to each outcome variable varied slightly from item to item. NS, not significant.

*P < 0.05, **P < 0.01, ***P < 0.001.

Table 3. Comparison of skin rash characteristic among male and female cleaners and OBW

<table>
<thead>
<tr>
<th></th>
<th>Current rash</th>
<th>Rash in the past 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cleaners, n (%)</td>
<td>OBW, n (%)</td>
</tr>
<tr>
<td>Males Location of rash</td>
<td>17 (42)</td>
<td>3 (27)</td>
</tr>
<tr>
<td>Hands</td>
<td>21 (53)</td>
<td>2 (18)</td>
</tr>
<tr>
<td>Effect of work on rash</td>
<td>1 (2)</td>
<td>1 (9)</td>
</tr>
<tr>
<td>Rash worse when working</td>
<td>Causes time off work</td>
<td>7 (54)</td>
</tr>
<tr>
<td>Females Location of rash</td>
<td>9 (69)</td>
<td>9 (43)</td>
</tr>
<tr>
<td>Hands</td>
<td>4 (31)</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>

The number of subjects responding to each outcome variable varied slightly from item to item. NS, not significant.

*P < 0.05, **P < 0.01, ***P < 0.001.

For female cleaners, there was significantly higher incidence of a rash on their hands in the past 12 months with 70% of those with a rash (14/20) affected as compared to female OBW with only 45% (33/74) affected (P < 0.05). Although no other comparisons regarding rash location were significant, the data show rashes in other areas than the hands being more common among OBW.

Rashes experienced by cleaners were reported to be worse when working more frequently as compared with OBW (Table 3). Among male cleaners with a current rash, 53% (21/40) indicated that their rash was worse when
working compared to only 18% (2/11) of OBW (P < 0.05). Fifty-four per cent (45/83) of male cleaners with a rash in the past 12 months reported that it was worse during work compared to 15% (2/13) of OBW (P < 0.01). Seventy-five per cent (15/20) of female cleaners with a rash in the past 12 months reported that it was worse when working compared to only 30% (24/82) of OBW (P < 0.001). Female cleaners were more likely to miss work, with 31% (4/13) with a current rash indicating that the rash caused them to miss work versus only 5% (1/22) of OBW (not significant). Cleaners washed their hands significantly more often than OBW. The mean number of hand washes per day for male cleaners was 10 (n = 422) compared to 7 (n = 119) for OBW (P < 0.001). The mean number of hand washes per day for female cleaners was 11 (n = 78) compared to 6 (n = 446) for OBW (P < 0.001).

Cleaners with a rash were less likely to report that they received workplace training regarding skin protection compared to cleaners without a rash [13% (7/56) against 21% (103/491)] but this was not statistically significant.

While cleaners with a rash were generally less likely to wear protective equipment when using or mixing chemicals, this was not statistically significant (data not shown).

A few specific tasks were related to rash among cleaners. Male cleaners with a rash in the past 12 months were significantly more likely to spot clean carpets at least once a week (49%, 41/84) compared to male cleaners without a rash (37%, 112/306) (P < 0.05). Female cleaners with a rash in the past 12 months were significantly more likely to polish furniture at least once a week (21%, 68/321) (P < 0.05) compared to female cleaners without a rash (12%, 15/125) (P < 0.05).

Rash among cleaners was associated with respiratory symptoms, especially work-related respiratory symptoms (Table 4). Cleaners with a rash were significantly more likely to have respiratory symptoms than cleaners without a rash. Male cleaners with a rash in the past 12 months were significantly more likely to have physician-diagnosed asthma (16%, 14/86) compared to male cleaners without a rash (8%, 26/321) (P < 0.05). This continued as a trend, but without statistical significance, for the female cleaners. Male cleaners with a rash in the past 12 months were significantly more likely to have WRAS3 (41%, 35/86) than the male cleaners without a rash in the past 12 months (21%, 68/321) (P = 0.001). Similarly, female cleaners who had a rash in the past 12 months were significantly more likely to have WRAS3 (60%, 12/20) than those who did not have a rash (24%, 14/58) (P < 0.01).

Although a history of atopy was not formally assessed, a question was included on the presence of previous symptoms typical of atopic dermatitis. Cleaners with a work-related rash were more likely to report previous atopic dermatitis symptoms (14%, 23/169) than cleaners without a work-related rash (8%, 25/360) (P < 0.05). Cleaners with WRAS2 (37%, 67/181) were also significantly more likely to report previous atopic dermatitis symptoms than cleaners without WRAS2 (19%, 68/366) (P = 0.001).

### Discussion

In this study, cleaners were more likely to have a rash than OBW. The rash was more likely to be on their hands and they washed their hands more often than OBW suggesting that contact agents such as water and chemicals are the causative agents of rash as has been previously reported [1]. Cleaners were also more likely to indicate that their rash was worse at work, suggesting that occupational factors may be causative or exacerbating this.

Wet work has been cited as the main cause of occupational contact dermatitis in the cleaning industry [20]. Jungbauer et al. [20] found that wet work comprised 50% of cleaning work. Nielson [21], in a study of female cleaners in nursing homes, schools and offices, found that 20% reported problems with cleaning agents and a key risk factor was the number of hours per week with wet hands. Similarly, Nilsson [22] found that water, cleaning

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**Table 4. Comparison of respiratory symptoms among male cleaners**

<table>
<thead>
<tr>
<th>Respiratory variable</th>
<th>Current rash</th>
<th>Rash in the past 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rash, n (%)</td>
<td>No rash, n (%)</td>
</tr>
<tr>
<td>Asthma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician-diagnosed asthma</td>
<td>8 (19)</td>
<td>39 (10)</td>
</tr>
<tr>
<td>New onset asthma</td>
<td>6 (14)</td>
<td>17 (4)</td>
</tr>
<tr>
<td>Respiratory symptoms in past 12 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three or more respiratory symptoms</td>
<td>33 (77)</td>
<td>164 (40)</td>
</tr>
<tr>
<td>Two or more WRAS</td>
<td>27 (63)</td>
<td>146 (36)</td>
</tr>
<tr>
<td>Three or more WRAS</td>
<td>17 (40)</td>
<td>103 (25)</td>
</tr>
</tbody>
</table>

The number of subjects responding to each outcome variable varied slightly from item to item. NS, not significant.

*P < 0.05, **P < 0.01, ***P < 0.001.
agents, disinfectants and wearing gloves were associated with hand dermatitis in 92% of those studied.

Only 21% of male cleaners and 16% of female cleaners reported that they had received workplace training about skin care. Moreover, cleaners with a rash were less likely to report receiving workplace training regarding their skin as compared to cleaners without a rash. Workplace training aimed at skin care awareness and prevention is an especially important measure [23]. Held et al. [23] found that formalized educational training for wet work employees as part of an occupational health and safety management system increased knowledge about skin care, changed behaviour with respect to wet work habits and decreased clinical dermatitis symptoms. A similar educational programme directed at cleaners may be a successful preventive measure.

Personal protection is a widely cited preventive strategy for dermatitis among cleaners [6,20]. However, the role of glove use was inconclusive in our study.

In the present study, only 2 of 27 tasks performed by the cleaners were significantly associated with a rash: spot cleaning for men and polishing furniture for females. Spot cleaning carpets involves spraying the carpet with a chemical and then rubbing the stain. A rash associated with this task may be due to chemical exposure to the hands of male cleaners performing the task. Although harsh chemicals are used to spot clean carpets and polish furniture, these are not unique as many of the other tasks also involved the use of irritating solvents. Although the relationship between tasks and rash may be spurious, it may deserve further investigation. Small numbers of subjects may have limited our ability to detect additional statistically significant differences.

We observed a strong association in this study between rash and WRAS among cleaners. This was especially true for male and female cleaners with a rash in the past 12 months. Previous studies in large groups examining an association between contact dermatitis and work-related asthma, in any work environment, are lacking. Small case series and case reports have been published regarding patients with contact dermatitis also developing occupational asthma. These include florists, cosmeticians, workers exposed to latex and to polyurethane chemicals [24–27]. Our study is noteworthy as it demonstrates a strong relationship between WRAS and dermatitis in cleaners in a large questionnaire study. Additionally, our findings are important because cleaners represent a large occupational group.

The exact mechanisms underlying both contact dermatitis and asthma are not clear. Whether individuals who are prone to developing allergic contact dermatitis are more susceptible to developing work-related asthma remains to be determined. One possible mechanism may be an association due to underlying atopy. Although cleaners reported few symptoms of previous atopic dermatitis generally, cleaners with a work-related rash and those with WRAS were more likely to report a history of symptoms of previous atopic dermatitis. This suggests an association with atopy, implying that cleaners with underlying atopy, if identified early in their work, could benefit from additional workplace training and safety measures.

One limitation is the small sample size of female cleaners in the questionnaire survey and the low response rate. The questionnaire was administered during the summer months and this could have contributed to the low response rate. The low response rate may have also related to a low English literacy rate in a multicultural city. Cleaners on temporary leave could not be included, possibly underestimating the magnitude of the association. The outcomes (rashes) were self-reported and were not clinically confirmed.

This study highlights the importance of effective preventive measures in this population, including safety and skin care training, protective skin and respiratory equipment and emollient cream use.

**Key points**

- Our study demonstrated that cleaners were more likely to have a skin rash than other building workers.
- Effective preventive measures for cleaners are important, including safety and skin care training, use of protective equipment and emollient cream use.
- There was a strong relationship between work-related asthma symptoms and dermatitis in cleaners which should be further explored to identify the mechanisms underlying this association.

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**Conflicts of interest**

S.M.T. has provided medical consultations for patients referred by Ontario Workplace Safety and Insurance Board in addition to research study support (peer reviewed) and workshop support.

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