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Gender differences in experience and reporting of acute symptoms among cleaning staff

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Abstract

Background: Cleaning tasks pose risks of hazardous chemical exposure and adverse health effects for cleaning workers. We examined gender differences among cleaning staff in the experience of chemical-related symptoms and in reporting to supervisors.

Methods: We analyzed cross-sectional reports from 171 university hospital or campus cleaning staff on chemical exposures to cleaning products, experience of acute symptoms, reporting of symptoms to supervisors, as well as demographic and psychosocial factors (risk perception, job demand/control, supervisor/co-worker support, and safety climate). Results were analyzed using multivariable logistic regression, adjusting for demographic, job, and psychosocial factors. Interactions of gender and psychosocial variables were also examined.

Results: Men and women reported different frequencies for exposure-related tasks. Acute symptoms of chemical exposure were more prevalent in women compared with men (46.0% vs. 25.4%; adjusted odds ratio [OR] = 2.63; 95% confidence interval [CI] 1.27–5.46). Women were more concerned about exposure to cleaning chemicals ($p = 0.029$) but reported symptoms to their supervisor less often than men (18.5% vs. 40.6%, adjusted OR = 0.28; 95% CI 0.09–0.93). More supervisor support was significantly associated with less frequent symptom experience among women (OR = 0.83; 95% CI 0.70–0.99). Asian workers and less educated workers were less likely than others to report symptoms to supervisors. Gender differences in symptom reporting to supervisors were not explained by psychosocial factors.

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AUTHOR CONTRIBUTIONS

Lee conceived the study, obtained the funding, conducted data collection, analysis, and interpretation, and wrote the manuscript. Kyung participated in manuscript writing and revision. Leung participated in critical revision of the manuscript. Hong contributed to development of the study, grant funding, and critical review of the manuscript. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy and/or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DISCLOSURE BY AJIM EDITOR OF RECORD

Paul A. Landsbergis declares that he has no conflict of interest in the review and publication decision regarding this article.

ETHICS APPROVAL AND INFORMED CONSENT

The study was approved by the Institutional Review Board of the University of California, San Francisco. All study participants signed an informed consent form.

Conclusions: Women may have increased susceptibility or perception of symptoms from cleaning compared to men, but this may be mitigated by supervisor support. Female Asian workers with lower education may perceive more significant barriers in reporting work-related symptoms to supervisors. Further research is needed to explore factors related to underreporting.

Keywords

chemical exposure; cleaners; gender difference; irritation symptom; symptom reporting

1 | INTRODUCTION

Cleaning products are composed of various chemical agents, including disinfectants, surfactants, solvents, and fragrances, which can have a detrimental impact on health.¹ Cleaning workers may be exposed to high levels of chemicals in cleaning products during their work. Particularly, cleaning tasks in health care involve frequent use of disinfectants, which are one of the most hazardous cleaning agents, to avoid transmission of infectious pathogens.^{2,3} There is cumulating evidence that exposure to cleaning products causes acute and chronic health problems among cleaning workers.^{4–7} Previous studies reported that cleaning workers have a higher prevalence of skin^{8,9} and respiratory irritation^{10,11} problems compared to other occupational groups. Furthermore, studies report that cleaning workers have an increased incidence of asthma associated with exposure to cleaning agents and disinfectants.^{5,10,12,13}

Gender differences are often observed in the perception of health symptoms, health protection behaviors, and healthcare seeking, with women generally reporting higher rates of somatic symptoms.^{14–17} Such patterns are also observed in responses to chemical exposure. Studies have shown that women are 14%–30% more sensitive to olfactory stimuli, have lower detection thresholds, and present a higher prevalence of odor-related environmental complaints such as chemical intolerance.^{18,19} Differences by gender have also been reported in regard to work-related health symptoms or illnesses.^{12,20–29} Among cleaning workers, women were shown to have a higher prevalence of dermatologic or irritation symptoms than men.^{20–22} As for musculoskeletal problems, a higher prevalence of pain has been shown among women compared to men in studies using various occupational group samples.^{23–27} For example, a Netherland study of 16,874 employees from 21 different occupational groups including cleaning workers reported that the prevalence of neck and shoulder complaints was 1.4–1.9 times higher in women than in men.²⁸ Women are also reported to have higher rates of work-aggravated asthma or pesticide-illness than men.^{12,29}

To identify unsafe or unhealthy conditions and develop interventions to prevent further exposure or minimize risk, it is critical to establish a system and culture to facilitate the reporting of work-related problems to the employer or management. It is alarming that underreporting of work-related illness or injury is common in a wide range of workplaces.^{30–33} According to a review by Tucker et al.,³² underreporting of work-related injuries by employees ranged between 29% and 81%. In a study of 941 Las Vegas hotel room cleaners, only 31% reported their work-related pain or discomfort to management.³³ There is very limited research on whether women and men differ in reporting workplace

injuries or illnesses to management. In a study of 1249 employees from 44 different organizations in the United States and Italy, no significant differences were found by gender; however, men had a tendency to report injuries less often than women in the US sample.³¹ On the other hand, in a Canadian study of 21,345 young workers aged 15–25 years, men were more likely to report lost-time, work-related injuries to employers or physicians than women.³²

Although gender plays an important role in the perception and reporting of work-related health problems to the employer or management, there is a lack of such data for cleaning workers. We previously reported on observed gender differences in symptom prevalence and reporting among cleaning workers in a medical center and university campus.²² We further investigated (1) the role of gender in symptom experience and reporting after adjusting for demographic and job factors and (2) interaction effects between gender and psychosocial factors (i.e., risk perception and supervisor support) on symptom experience and reporting. Here, we report our findings on gender differences in acute symptom experience and reporting of symptoms to supervisors among cleaning workers.

2 | METHODS

2.1 | Study design and sample

This study was a cross-sectional study using a convenience sample of 171 cleaning staff employed in a university medical center or health sciences campus in Northern California. Cleaning staff included custodians and patient support assistants who performed janitorial, cleaning, or housekeeping services regardless of job title. Cleaning staff who were employed for at least 1 month were eligible to participate. To recruit participants, the research team attended and provided study information at staff meetings of the hospital's hospitality service department and the campus custodial service department. As most cleaning staff spoke Chinese or Spanish as their first language, the research team included bilingual members and provided the study information in English, Chinese, and Spanish. We also placed flyers on the department bulletin boards and staff lounges. A total of 183 workers participated in the study. Twelve supervisors were excluded from the analysis because we aimed to identify factors affecting regular staff's reporting to their supervisors.

2.2 | Data collection

The study questionnaire was developed in English, Chinese, and Spanish and the participants answered the questionnaire in their preferred language. Initially, bilingual research team members administered the questionnaire with face-to-face interviews. Later, to facilitate participant recruitment, if participants preferred self-administration, they were allowed to take the questionnaire home. We then collected completed questionnaires at their workplace in person. All participants signed the informed consent form and received a \$25 gift card for their participation. The study was approved by the Committee on Human Research of the University of California, San Francisco. More details on the methods are available elsewhere.²² The survey questionnaires are available from the corresponding author upon request.

2.3 | Study variables and measures

2.3.1 | Chemical-related acute symptom experience and reporting—The outcome variables of interest in this study were chemical-related acute symptom experience and reporting. In the literature, symptom experience and symptom reporting are often used interchangeably. In this study, it should be noted that symptom reporting exclusively refers to the reporting of symptoms to the supervisor. The participants were asked to indicate how often they experienced symptoms from chemicals used to perform work tasks in the past 12 months. Items included 16 symptoms in respiratory, eye, skin, neurological, and gastrointestinal systems (e.g., cough, burning in nose or throat, itchy or burning eyes, rash, headache, and nausea) with five response categories (daily, several times weekly, several times monthly, several times yearly, or never). Concerning symptom experience, participants were subsequently asked whether they reported the symptom to the supervisor, whether they sought medical care, and how many days they missed work due to the symptom.

2.3.2 | Demographic and job characteristics—In addition to gender, demographic variables included age, race/ethnicity, country of birth (United States or other), and education. Job variables included job location (hospital or campus), job title (patient support assistant [PSA] or custodian), job tenure, and job status (full-time or part-time).

2.3.3 | Chemical exposure—Chemical exposure items were adapted from studies by Zock et al.¹³ and Nielsen and Bach.⁵ We assessed chemical exposure by work task and the use of cleaning products. We asked how many days in the usual work week the worker performed the cleaning task (e.g., floor polishing, window or mirror cleaning, or discharge cleaning of in-patient rooms) and used cleaning products (e.g., liquid multiuse cleaning products, polishes, disinfectants, bleach, solvents/stain removers, glass-cleaning sprays, products for mopping the floor, products for cleaning carpets, furniture sprays, products that smell like lemon or orange, and products that need to be combined and used right away after mixing). Exposure frequency per week ranged from 0 to 5 days, and the duration of exposure per day was recorded using a 5-point scale (1 = < 0.5 h/day, 2 = 0.5–1 h/day, 3 = 1–2 h/day, 4 = 2–4 h/day, and 5 = > 4 h/day). The exposure score for each item was calculated by the product of exposure frequency (0–5) and exposure duration categories (1–5), and each item score ranged from 0 to 25. For cleaning products, we created an aggregate exposure index as the sum of exposure scores for the 11 items, which ranged from 0 to 275.

2.3.4 | Psychosocial variables—Risk perception of chemical exposure was assessed by the question “How much do the following tasks or cleaning products (25 items) make you concerned about your health regarding exposure to chemicals?” Examples of cleaning tasks include mixing or diluting cleaning solutions, dusting/sweeping/vacuuming, mopping/wet cleaning/damp wiping, stripping floors, cleaning in-patient rooms, washing patient beds or surgical tables, cleaning tasks using sprays, and so forth. The response format used a 5-point scale (1 = not at all, 2 = a little concerned, 3 = somewhat concerned, 4 = moderately concerned, and 5 = very concerned). The perceived risk score was calculated as the mean of item responses; this approach was taken because variations existed in duties and some items were not applicable depending on one’s job title or assigned work areas (e.g., campus

custodians do not clean patient rooms or clinical areas; not all cleaning staff perform floor stripping).

Job demand (5 items), job control (9 items), supervisor support (4 items), and co-worker support (4 items) were measured using the Job Content Questionnaire.³⁴ The questionnaire is widely used to measure work-related stress, and the psychometric properties of the scales have been well documented.^{34,35} Job demand reflects the employee's psychological workload related to work speed, amount, and intensity. Job control reflects the employee's control over his or her job with skill discretion and decision authority. Supervisor support and co-worker support reflect perceived social support at the workplace in regard to employee welfare, job performance, and interrelationships. All scale items were recorded on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree).

Safe climate was measured by the 16-item safe climate instrument developed by Zohar and Luria.³⁶ Safe climate reflects employees' shared perceptions about the safety of the workplace and organizational safety practices. The scale used a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Studies have demonstrated excellent reliability and good predictive validity of this measure.^{36,37}

2.4 | Data analysis

Data analysis was performed using the SAS version 9.2 (SAS Institute). Study variables were summarized using descriptive statistics. χ^2 tests, Fisher's exact tests, or *t*-tests were used to compare study variables between male and female workers and between those who reported symptoms and those who did not. Two-tailed tests and 95% significance levels were used to test statistical significance. For chemical exposure, considering possible task variations by job location and title, we examined gender differences within each job category (i.e., hospital PSAs, hospital custodians, and campus custodians). For multivariable analysis, we included all variables that indicated $p < 0.10$ in the bivariate analyses for either gender or symptom reporting. With this approach (using $p < 0.10$), we adjusted for variables showing marginal significance (i.e., supervisor support) and also were able to examine whether a true association of that variable was masked in the bivariate analysis due to confounding. Multivariable logistic regression analyses were conducted to examine the associations of gender and other independent variables with symptom experience and reporting, and adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were calculated.

For psychosocial variables with $p < 0.10$ in the bivariate analysis (i.e., risk perception and supervisor support), interaction effects with gender were examined to identify whether the relationships between psychosocial factors and symptom experience/reporting differed by gender. The interaction analysis included variables that indicated $p < 0.05$ in the initial multivariable model; we adjusted for race and education for the outcome of symptom reporting to a supervisor. Plots of predicted probabilities and ORs for the associations between psychosocial factors and symptom experience or reporting were produced for women and men.

3 | RESULTS

3.1 | Characteristics of the study sample

The study sample consisted of 100 female and 71 male cleaning workers (Table 1). About 40% of the participants were hospital PSAs, and 60% were custodians at the hospital or the campus. The mean age was 48 years and the mean job tenure was 8.1 years. The majority of the participants were Asian (67.3%) and foreign-born (87.7%). The female group included more hospital PSAs and fewer campus custodians than the male group ($p = 0.002$). Women were more likely to be foreign-born ($p = 0.014$) and less educated ($p = 0.010$) than men. Risk perception of chemical exposure was significantly higher among women compared to men ($p = 0.029$), indicating that women were more concerned about exposure to cleaning chemicals. No significant difference was observed in job tenure and other psychosocial job factors between women and men (Table 1).

3.2 | Work tasks and chemical exposure by gender and job location and title

Table 2 presents work tasks and the use of cleaning products among women and men as well as the comparisons between hospital PSAs, hospital custodians, and campus custodians. Significant gender differences were observed for several tasks. Among PSAs, women reported greater exposure frequency/duration for dusting/sweeping/vacuuming and cleaning of toilets/sinks. Among hospital custodians, women reported greater exposure frequency/duration for dusting/sweeping/vacuuming, cleaning of windows/mirrors, toilets/sinks, and furniture, washing patient beds or surgical tables, and regular cleaning of patient rooms in use, while men reported greater exposure frequency/duration for buffing/polishing/waxing and stripping floors. Among campus custodians, men reported greater exposure frequency/duration for stripping floors, whereas women reported greater exposure frequency/duration for mopping/wet cleaning tasks. For the use of cleaning products, a significant difference was observed only for liquid multiuse cleaning products among campus custodians, with women reporting greater exposure than men. For the composite chemical exposure index for cleaning products, no gender difference was found in any job categories ($p > 0.05$).

3.3 | Symptom experiences and reporting by gender

Table 3 shows acute symptom experiences and consequences among cleaning workers. More detailed information on all reported symptoms related to chemical exposure among the study participants has been previously published.²² Of the participants, 57.3% experienced symptoms associated with the use of cleaning chemicals: 14.0% daily, 8.8% weekly, 14.6% monthly, and 19.9% several times a year. Women had more frequent symptom experiences (daily, weekly, or monthly) than men ($p = 0.006$). Specifically, eye symptoms were more frequent among women (21% vs. 7%, $p = 0.012$). Respiratory and neurological symptoms also tended to be more common, but not statistically significant, among women than among men (38% vs. 25%, $p = 0.083$ and 16% vs. 7%, $p = 0.079$). Among the workers with symptoms, 26.3% reported the symptom to their supervisors. Women were significantly less likely to report the symptom to their supervisor than men (18.5% vs. 40.6%, $p = 0.024$).

Table 4 shows the comparisons of demographic, job, and psychosocial characteristics between workers who reported experienced symptoms to their supervisors and workers who

did not. Significant differences in acute symptom reporting were observed for race/ethnicity and education variables. Symptom reporting to their supervisors were significantly less frequent among Asian ($p < 0.0001$) and less-educated workers ($p = 0.045$). No significant difference was observed for psychosocial job factors ($p > 0.05$), but perceived supervisor support was slightly greater among workers who reported symptoms compared with those who did not report symptoms ($p = 0.063$).

3.4 | Factors associated with symptom experiences and reporting

Table 5 shows multivariable analysis results on factors associated with symptom experience and reporting. Gender differences in symptom experience and reporting remained significant after adjusting for race/ethnicity, country of origin, education, job location and title, risk perception, and supervisor support. Women were more likely to experience symptoms related to chemical exposure than men (aOR = 2.63; 95% CIs 1.27–5.46). No other variables were significant for symptom experience. For symptom reporting, women were less likely to report symptoms to their supervisors (aOR = 0.28; 95% CIs 0.09–0.93). In addition, Asian workers were less likely to report symptoms (aOR = 0.06; 95% CIs 0.01–0.28) and workers with a college education were more likely to report symptoms (aOR = 4.43; 95% CIs 1.29–15.2).

Finally, the interaction effects of gender with risk perception and supervisor support on symptom experience and reporting were examined, and the results are presented in Figure 1. Different patterns were observed between women and men, but there were no statistically significant interaction effects between gender and risk perception or supervisor support. However, higher supervisor support was significantly associated with less frequent symptom experience among women (OR = 0.83; 95% CI 0.70–0.99).

4 | DISCUSSION

We identified gender differences in chemical-related acute symptom experiences and reporting among cleaning workers in hospital and health sciences campus settings. In our cohort of cleaning workers, 37% experienced acute symptoms associated with exposure to cleaning products every month or more often, and only 26% of the workers reported the symptoms to their supervisor. We found that women were more likely to experience acute symptoms but less likely to report the symptom to their supervisor than men. While gender and psychosocial factors of risk perception and supervisor support did not show significant interaction effects on symptom experience or reporting, we observed a significant association between supervisor support and decreased symptom experience only for women.

Our findings of more acute symptom experiences among female workers are consistent with existing knowledge of women's greater sensitivity to nasal irritant exposures.^{18,19} Our findings are also in line with other studies that reported a greater prevalence of work-related symptoms or health problems among female workers.^{21–29} Differences between men and women can involve biological, psychological, and sociocultural factors, and this aspect is reflected in its terminological distinction. Sex differences are based on biological differences, and gender differences are based on social roles.¹⁶ In this study based on self-reporting, we did not have the ability to separate the two and only used the term gender

differences. However, differences in biological responses to chemical exposure should be referred to as sex differences.

Gender or sex differences in symptom experience is a well-identified phenomenon across various populations, including community residents, medical patients, and laboratory subjects.¹⁴ Previous research explains gender or sex differences in symptoms with various factors in the process of symptom development to perception and reporting.^{14,18,19} Biological differences such as a difference in nociception or autonomic and physiological responses may result in greater sensitivity or susceptibility to symptoms among women. In a recent review, Mogil³⁸ concluded, “robust differences exist in the genetic, molecular, cellular and systems-level mechanisms of acute and chronic pain processing in male and female rodents and humans.” In symptom appraisal, evidence suggests that women generally have greater somatic awareness of symptoms¹⁴ and that women present a greater ability to discriminate among different levels of pain than men.³⁹ Social or cultural factors can also play a role, so expressing distress may be more socially acceptable for women. Studies also report that women have greater recall of prior symptoms than men, resulting in reporting bias.¹⁴ As such, our findings of the higher prevalence of acute symptoms among female cleaning workers may have been contributed by biological or sociocultural factors and methodology relying on self-reporting.

Potential differences in occupational exposures between women and men may explain some of the differences in symptom experience by gender. Occupational segregation or gender differences in employment conditions, job titles, or work assignments have been documented in occupational health literature.^{27,40,41} Indeed, our study observed some differences in work activities between female and male cleaning workers. However, the overall chemical exposure measured by the use of cleaning products was not significantly different by gender. Moreover, we adjusted for job location and job title in the multivariable model. Therefore, our finding of significant gender differences in symptom experience is not likely explained by the difference in chemical exposure. Instead, we found a suggestive role of supervisor support, which was a significant factor for decreased acute symptom experience among women, but not among men. A substantial amount of research has reported the significant role of supervisor support in worker health and work-related outcomes such as mental health, burnout, stress-related disorders, musculoskeletal symptoms, job satisfaction, and workability.^{37,42–47} Similar to our findings, Messing et al.⁴¹ found a significant association of supervisor support with workday systolic blood pressure level only for women.

Regardless of gender differences, our findings of frequent symptom experiences among cleaning workers warrant the need to mitigate chemical exposure from cleaning tasks to prevent adverse health effects. Airborne chemicals activate the chemosensory system via mucous membranes in the eyes and upper respiratory tract, and sensory irritation results from the stimulation of receptors on trigeminal nerves.^{48,49} Sensory irritation symptoms are used as a critical parameter for setting occupational exposure limits (OELs), and 40% of the OELs were developed based on the threshold of sensory irritation.^{48,49} Repetitive exposures to cleaning chemical agents could result in more serious chronic health effects such as asthma.^{5,10,12,13} Women’s greater sensitivity to chemical irritants can aid in identifying

hazards and thus improve workplace control methods, such as substituting hazardous products for less hazardous ones. Therefore, even in the case of minor symptoms, reporting of symptom experience to the supervisor could help improve workplace safety and should be encouraged.

In reporting symptoms to their supervisors, we also identified gender differences. While symptom experiences were more common among women as discussed above, the odds of symptom reporting to their supervisors was 71% lower among women compared to men. We also found that underreporting was associated with being Asian or education less than college. Underreporting of a workplace injury or illness has been a well-identified problem in occupational health literature.^{30–33} Reporting work-related symptoms to the supervisor may be considerably different from talking about their symptoms to family, friends, medical providers, researchers, or co-workers. Workers may be concerned about negative social consequences at work, such as job insecurity. In this process, women, compared to men, may perceive more social or emotional barriers to reporting a problem to their supervisors. Previous studies identified various barriers to reporting a work-related injury, such as fear of job loss, concerns of getting in trouble by reporting, the lack of knowledge of workers' compensation or reporting process, the lack of support by their supervisor, perception of the reporting process as time-consuming or requiring too many steps, perceiving the injury as a part of the job, or injury or problems considered not a serious problem.^{33,50,51} In our study, we examined psychosocial variables of job stress, supervisor support, and safety climate, and found that gender differences in symptom reporting were not explained by these variables. However, we observed a tendency of increased reporting with greater supervisor support among female workers, although not statistically significant. Our findings suggest that female workers may benefit from their supervisors' support and need to be empowered.

This study has several limitations deriving from the study methodology. First, our findings, which are based on self-reporting, are subject to reporting errors or social desirability bias. Possible recall bias cannot be excluded in explaining the higher prevalence of symptom experience among women compared to men. However, a gender difference identified in symptom reporting to the supervisor is not likely to be explained by recall bias. If it exists, it is more likely to be a nondifferential bias, which leads to the null hypothesis; therefore, our finding of the significant gender difference in symptom reporting can be further supported. Second, our findings from a small convenience sample are subject to selection bias and are not generalizable to other workers. Our participants worked at university campuses or hospitals; therefore, our findings may not be generalizable to workers in other fields. Lastly, in reporting a problem to supervisors, the gender match between the supervisor and staff may play a role; however, as we did not collect this information, we were unable to examine this.

5 | CONCLUSIONS

Cleaning tasks pose a risk of hazardous chemical exposure and may lead to adverse health effects for cleaning workers. Our study showed gender differences in chemical-related symptom experience and reporting among cleaning workers. Particularly, acute symptom experience and underreporting of symptoms to supervisors were more prevalent among

women. These findings suggest that women may have a greater susceptibility to health problems from cleaning tasks but may also experience greater barriers to taking action to advocate for their health matters at work. Our findings also suggest that the increased risk of symptoms among women may be mitigated by supervisor support. Reporting work-related health problems to the supervisor is important for proper management of the problems and interventions to improve the work environment. Our findings indicate the need to reduce chemical exposure and related acute symptom experience and to provide more support, particularly for female workers. Further research with a larger sample that includes both workers and supervisors is needed to validate the findings and elucidate specific obstacles faced by female workers.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. Bello A, Quinn MM, Perry MJ, Milton DK. Characterization of occupational exposures to cleaning products used for common cleaning tasks—a pilot study of hospital cleaners. *Environ Health*. 2009;8(1):11. [PubMed: 19327131]
2. Virginia W, Melissa M, Jill C, Frances H, John S. Occupational chemical exposures in an academic medical center. *American College of Occupational and Environment Medicine*. 1993;35(7):701–706.
3. Centers for Disease Control and Prevention. Acute antimicrobial pesticide-related illnesses among workers in health-care facilities — California, Louisiana, Michigan, and Texas, 2002–2007. *Morb Mortal Wkly Rep*. 2010;59:551–556.
4. Ciuchta HP, Dodd KT. The determination of the irritancy potential of surfactants using various methods of assessment. *Drug Chem Toxicol*. 1978;1(3):305–324. [PubMed: 755672]
5. Nielsen J, Bach E. Work-related eye symptoms and respiratory symptoms in female cleaners. *Occup Med*. 1999;49:291–297.
6. Hansen KS. Occupational dermatoses in hospital cleaning women. *Contact Dermatitis*. 1983;9(5):343–351. [PubMed: 6226477]
7. Quinn MM, Henneberger PK, Braun B, et al. Cleaning and disinfecting environmental surfaces in health care: toward an integrated framework for infection and occupational illness prevention. *Am J Infect Control*. 2015;43(5):424–434. [PubMed: 25792102]
8. Gawkrödger DJ, Lloyd MH, Hunter JAA. Occupational skin disease in hospital cleaning and kitchen workers. *Contact Dermatitis*. 1986; 15(3):132–135. [PubMed: 2946535]
9. Mirabelli MC, Vizcaya D, Martí Margarit A, et al. Occupational risk factors for hand dermatitis among professional cleaners in Spain. *Contact Dermatitis*. 2012;66(4):188–196. [PubMed: 22268785]

10. Zock JP, Kogevinas M, Sunyer J, Jarvis D, Toren K, Anto JM. Asthma characteristics in cleaning workers, workers in other risk jobs and office workers. *Eur Respir J*. 2002;20(3):679–685. [PubMed: 12358347]
11. Obadia M, Liss GM, Lou W, Purdham J, Tarlo SM. Relationships between asthma and work exposures among non-domestic cleaners in Ontario. *Am J Ind Med*. 2009;52(9):716–723. [PubMed: 19609981]
12. White GE, Seaman C, Filios MS, et al. Gender differences in work-related asthma: surveillance data from California, Massachusetts, Michigan, and New Jersey, 1993–2008. *J Asthma*. 2014;51(7):691–702. [PubMed: 24673105]
13. Zock J-P, Kogevinas M, Sunyer J, et al. Asthma risk, cleaning activities and use of specific cleaning products among Spanish indoor cleaners. *Scand J Work Environ Health*. 2001;27(1):76–81. [PubMed: 11266151]
14. Barsky AJ, Peekna HM, Borus JF. Somatic symptom reporting in women and men. *J Gen Intern Med*. 2001;16(4):266–275. [PubMed: 11318929]
15. Anson O, Paran E, Neumann L, Chernichovsky D. Gender differences in health perceptions and their predictors. *Soc Sci Med*. 1993; 36(4):419–427. [PubMed: 8434267]
16. Greenspan JD, Craft RM, Leresche L, et al. Studying sex and gender differences in pain and analgesia: a consensus report. *Pain*. 2007; 132:S26–S45. [PubMed: 17964077]
17. Courtenay WH, McCreary DR, Merighi JR. Gender and ethnic differences in health beliefs and behaviors. *J Health Psychol*. 2002;7(3):219–231. [PubMed: 22114246]
18. Doty RL, Cometto-Muñiz JE, Jalowayski AA, Dalton P, Kendal-Reed M, Hodgson M. Assessment of upper respiratory tract and ocular irritative effects of volatile chemicals in humans. *Crit Rev Toxicol*. 2004;34(2):85–142. [PubMed: 15112751]
19. Olofsson JK, Nordin S. Gender differences in chemosensory perception and event-related potentials. *Chem Senses*. 2004;29(7):629–637. [PubMed: 15337687]
20. Singih SIR, Lantinga H, Nater JP, Woest TE, Kruij-Gaspersz JA. Occupational hand dermatoses in hospital cleaning personnel. *Contact Dermatitis*. 1986;14(1):14–19. [PubMed: 2936557]
21. Stingni L, Lapomarda V, Lisi P. Occupational hand dermatitis in hospital environments. *Contact Dermatitis*. 1995;33(3):172–176. [PubMed: 8565458]
22. Lee SJ, Nam B, Harrison R, Hong O. Acute symptoms associated with chemical exposures and safe work practices among hospital and campus cleaning workers: A pilot study. *Am J Ind Med*. 2014; 57(11):1216–1226. [PubMed: 25223949]
23. Ferguson R, Riley ND, Wijendra A, Thurley N, Carr AJ, Bjj D. Wrist pain: A systematic review of prevalence and risk factors—what is the role of occupation and activity? *BMC Musculoskelet Disord*. 2019;20(1). [PubMed: 30630465]
24. Harutunian K, Gargallo-Albiol J, Figueiredo R, Gay-Escoda C. Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the School of Dentistry of the University of Barcelona (Spain). A cross-sectional study. *Med Oral Patolog Oral Cirugia Bucal*. 2011:e425–e429.
25. Lee SJ, Tak S, Alterman T, Calvert GM. Prevalence of musculoskeletal symptoms among agricultural workers in the United States: an analysis of the National Health Interview Survey, 2004–2008. *J Agromedicine*. 2014;19(3):268–280. [PubMed: 24959759]
26. D’Agostin F, Negro C. Symptoms and musculoskeletal diseases in hospital nurses and in a group of university employees: a cross-sectional study. *Int J Occup Saf Ergon*. 2017;23(2):274–284. [PubMed: 27277971]
27. Hoofman WE, Van Der Beek AJ, Van De Wal BG, et al. Equal task, equal exposure? Are men and women with the same tasks equally exposed to awkward working postures? *Ergonomics*. 2009;52(9):1079–1086. [PubMed: 19606366]
28. De Zwart BCH, Frings-Dresen MHW, Kilbom X000C. Gender differences in upper extremity musculoskeletal complaints in the working population. *Int Arch Occup Environ Health*. 2000;74(1):21–30.
29. Kasner EJ, Keralis JM, Mehler L, et al. Gender differences in acute pesticide-related illnesses and injuries among farmworkers in the United States, 1998–2007. *Am J Ind Med*. 2012;55(7):571–583. [PubMed: 22495938]

30. Pransky G, Snyder T, Dembe A, Himmelstein J. Under-reporting of work-related disorders in the workplace: a case study and review of the literature. *Ergonomics*. 1999;42(1):171–182. [PubMed: 9973879]
31. Probst TM, Barbaranelli C, Petitta L. The relationship between job insecurity and accident under-reporting: a test in two countries. *Work & Stress*. 2013;27(4):383–402.
32. Tucker S, Diekrager D, Turner N, Kelloway EK. Work-related injury underreporting among young workers: prevalence, gender differences, and explanations for underreporting. *J Saf Res*. 2014;50:67–73.
33. Scherzer T, Rugulies R, Krause N. Work-related pain and injury and barriers to workers' compensation among Las Vegas hotel room cleaners. *Am J Public Health*. 2005;95(3):483–488. [PubMed: 15727981]
34. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol*. 1998;3(4):322–355. [PubMed: 9805280]
35. Siegrist J, Starke D, Chandola T, et al. The measurement of effort-reward imbalance at work: European comparisons. *Soc Sci Med*. 2004;58(8):1483–1499. [PubMed: 14759692]
36. Zohar D, Luria G. A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *J Appl Psychol*. 2005;90(4):616–628. [PubMed: 16060782]
37. Johnson SE. The predictive validity of safety climate. *J Saf Res*. 2007; 38(5):511–521.
38. Mogil JS. Qualitative sex differences in pain processing: emerging evidence of a biased literature. *Nat Rev Neurosci*. 2020;21(7):353–365. [PubMed: 32440016]
39. Mogil JS, Bailey AL. Sex and gender differences in pain and analgesia. *Prog Brain Res*. 2010;186:141–157. [PubMed: 21094890]
40. Scarselli A, Corfiati M, Di Marzio D, Marinaccio A, Iavicoli S. Gender differences in occupational exposure to carcinogens among Italian workers. *BMC Public Health*. 2018;18(1):413. [PubMed: 29587708]
41. Messing K, Stock S, Cote J, Tissot F. Is sitting worse than static standing? How a gender analysis can move us toward understanding determinants and effects of occupational standing and walking. *J Occup Environ Hyg*. 2015;12(3):D11–D17. [PubMed: 25493919]
42. de Wijn AN, van der Doef MP. Patient-related stressful situations and stress-related outcomes in emergency nurses: a cross-sectional study on the role of work factors and recovery during leisure time. *Int J Nurs Stud*. 2020;107:103579. [PubMed: 32446016]
43. Dick RB, Lowe BD, Lu M-L, Krieg EF. Trends in work-related musculoskeletal disorders from the 2002–2014 general social survey, quality of work life supplement. *J Occup Environ Med*. 2020;1.
44. Hämmig O. Health and well-being at work: the key role of supervisor support. *SSM - Popul Health*. 2017;3:393–402. [PubMed: 29349232]
45. Karlin WA, Brondolo E, Schwartz J. Workplace social support and ambulatory cardiovascular activity in New York City traffic agents. *Psychosom Med*. 2003;65(2):167–176. [PubMed: 12651983]
46. Nieuwenhuijsen K, Bruinvels D, Frings-Dresen M. Psychosocial work environment and stress-related disorders, a systematic review. *Occup Med*. 2010;60(4):277–286.
47. Thiese MS, Lu M-L, Merryweather A, et al. Psychosocial factors and low back pain outcomes in a pooled analysis of low back pain studies. *J Occup Environ Med*. 2020;62:810–815. [PubMed: 32568818]
48. Söderbacka T, Nyholm L, Fagerström L. Workplace interventions that support older employees' health and work ability: a scoping review. *BMC Health Serv Res*. 2020;20(1):472. [PubMed: 32456635]
49. Brüning T, Bartsch R, Bolt HM, et al. Sensory irritation as a basis for setting occupational exposure limits. *Arch Toxicol*. 2014;88(10):1855–1879. [PubMed: 25182421]
50. Green DR, Gerberich SG, Kim H, et al. Knowledge of work-related injury reporting and perceived barriers among janitors. *J Saf Res*. 2019;69:1–10.
51. Kosny A, Maceachen E, Lifshen M, et al. Delicate dances: immigrant workers' experiences of injury reporting and claim filing. *Ethn Health*. 2012;17(3):267–290. [PubMed: 21970445]

FIGURE 1.

Predicted probabilities for acute symptom experience and reporting to a supervisor among cleaning workers: Analysis of interaction between gender and psychosocial variables. Note: Analyses for symptom reporting to a supervisor were adjusted for race and education [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 1
Study sample: Demographic, job, and psychosocial characteristics among cleaning workers

Variable	Total (n = 171)			Women (n = 100)			Men (n = 71)			p value
	N	%		N	%		N	%		
Job title and location										0.002
Patient support assistant, hospital	68	39.8		48	48.0		20	28.2		
Custodian, hospital	64	37.4		38	38.0		26	36.6		
Custodian, campus	39	22.8		14	14.0		25	35.2		
Race/ethnicity										0.053
Hispanic	34	19.9		19	19.0		15	21.1		
Asian	115	67.3		72	72.0		43	60.6		
African American	17	9.9		5	5.0		12	16.9		
Other	5	2.9		4	4.0		1	1.4		
Country of birth										0.014
United States	21	12.4		7	7.0		14	19.7		
Other	149	87.6		92	92.0		57	80.3		
Education										0.010
Elementary	12	7.0		12	12.0		0	0.0		
Some high school	47	27.5		30	30.0		17	23.9		
High school graduate	65	39.0		35	35.0		30	42.3		
College 1 year or more	47	27.5		23	23.0		24	33.8		
Job status										0.451
Full-time	164	95.9		97	97.0		67	94.4		
Part-time	7	4.1		3	3.0		4	5.6		
Age, years	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p value	
Age, years	48.0	9.9	48.0	8.1	48.6	11.9	48.6	11.9	0.693	
Duration of employment, years	8.1	5.7	8.6	6.0	7.4	5.3	7.4	5.3	0.174	
Risk perception (1–5)	2.7	1.4	3.0	1.4	2.4	1.3	2.4	1.3	0.029	
Job demand (12–48)	30.6	5.2	30.9	5.2	30.0	5.0	30.0	5.0	0.264	
Job control (24–96)	61.4	8.5	61.2	9.3	61.8	7.4	61.8	7.4	0.753	
Supervisor support (4–16)	10.9	2.5	22.5	3.6	22.9	3.6	22.9	3.6	0.569	

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Variable	Total (n = 171)		Women (n = 100)		Men (n = 71)		p value
	N	%	N	%	N	%	
Co-worker support (4–16)	11.8	1.7	11.8	1.8	11.8	1.6	0.631
Safety climate (16–80)	57.6	11.0	58.2	11.5	56.9	10.4	0.261

Note: The sample size may vary due to missing data.

Chemical exposure by work task and use of cleaning products among cleaning workers by job title, location, and gender

TABLE 2

	Patient support assistant, hospital			Custodian, hospital			Custodian, campus		
	Women (n = 48)	Men (n = 20)	p	Women (n = 38)	Men (n = 26)	p	Women (n = 14)	Men (n = 25)	p
Chemical exposure (range 0–25)^a									
Work task									
Mixing or diluting cleaning solutions	7.1	6.3	0.609	7.1	8.7	0.380	6.8	6.6	0.905
Cleaning equipment after use	10.2	8.3	0.370	6.7	7.2	0.749	6.8	6.2	0.667
Dusting, sweeping, vacuuming	18.4	14.1	0.033	20.3	15.4	0.001	16.9	15.0	0.410
Mopping, wet cleaning, damp wiping	21.9	20.3	0.270	18.9	18.8	0.944	18.6	14.0	0.035
Buffing, polishing, waxing floors	0.7	0.8	0.909	1.3	9.6	0.0003	1.1	3.8	0.137
Stripping floors	0.6	0.2	0.304	0.1	7.2	0.0005	0.0	0.9	0.043
Cleaning windows or mirrors	11.0	8.8	0.288	13.5	9.1	0.009	9.3	7.4	0.362
Cleaning toilet bowls or sinks	15.1	10.7	0.042	17.4	12.4	0.002	13.6	12.2	0.477
Cleaning furniture	14.8	12.6	0.337	11.4	6.0	0.004	7.6	3.8	0.058
Washing patient beds or surgical tables	18.1	15.3	0.158	5.7	1.3	0.008	n/a	n/a	n/a
Regular cleaning of patient rooms in use	14.5	14.0	0.842	3.7	0.1	0.010	n/a	n/a	n/a
Cleaning isolation rooms	7.3	7.4	0.974	3.2	0.8	0.114	n/a	n/a	n/a
Discharge cleaning of patient rooms	13.3	11.1	0.400	2.6	1.0	0.264	n/a	n/a	n/a
Cleaning operating or surgical procedure rooms	7.5	10.0	0.407	3.0	2.4	0.761	n/a	n/a	n/a
Cleaning other procedure or intervention rooms	1.0	0.0	0.130	6.7	3.4	0.138	n/a	n/a	n/a
Cleaning medical or clinical Laboratories	0.8	0.0	0.125	4.6	4.4	0.925	7.1	9.6	0.448
Cleaning tasks using sprays	4.4	5.0	0.780	7.4	6.3	0.614	9.9	7.0	0.280
Use of cleaning products									
Liquid multiuse cleaning products	14.8	16.8	0.469	16.8	15.1	0.449	18.6	13.2	0.035
Polishes, waxes	1.6	1.3	0.824	3.9	4.3	0.841	2.1	3.1	0.508
Disinfectants	20.9	20.5	0.826	17.4	16.8	0.802	16.8	12.5	0.076
Bleach	11.9	8.8	0.245	8.3	5.7	0.251	1.6	0.7	0.442
Solvents, stain removers	2.5	1.2	0.231	2.1	2.2	0.948	2.6	2.2	0.820
Glass cleaning products	9.3	8.8	0.851	11.1	7.9	0.109	10.6	8.4	0.325
Products for mopping the floor	18.8	18.7	0.959	18.3	17.6	0.710	15.7	14.5	0.587
Products for cleaning carpets	1.2	0.5	0.409	1.9	4.9	0.073	1.5	1.9	0.794

	Patient support assistant, hospital				Custodian, hospital				Custodian, campus			
	Women (n = 48)	Men (n = 20)	p		Women (n = 38)	Men (n = 26)	p		Women (n = 14)	Men (n = 25)	p	
Chemical exposure (range 0–25)^a												
Furniture sprays	0.3	2.6	0.135		3.6	1.6	0.214		0.8	1.0	0.746	
Products that smell like lemon or orange	2.6	3.3	0.668		3.2	2.8	0.835		0.4	2.6	0.074	
Products combined immediately before use	1.9	1.9	0.969		1.1	4.2	0.096		0.7	2.8	0.190	

Note: Numbers in bold indicate significant at $p < 0.05$.

^a Scores were calculated as the product of exposure frequency (days per week) and duration category (1 = < 0.5 h/day, 2 = 0.5–1 h/day, 3 = > 1–2 h/day, 4 = > 2–4 h/day, 5 = > 4 h/day).

Symptoms associated with chemical exposure in the past 12 months among cleaning workers: Prevalence and consequences by gender

TABLE 3

Variable	Total (<i>n</i> = 171)		Women (<i>n</i> = 100)		Men (<i>n</i> = 71)		<i>p</i> value
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Experienced symptom(s) in the past 12 months							0.055
Daily	24	14.0	18	18.0	6	8.5	
Several times weekly	15	8.8	10	10.0	5	7.0	
Several times monthly	25	14.6	18	18.0	7	9.9	
Several times a year	34	19.9	20	20.0	14	19.7	
Never	73	42.7	34	34.0	39	54.9	
Experienced symptom(s) at least monthly	64	37.4	46	46.0	18	25.4	0.006
Respiratory (e.g., itchy/burning nose, cough, or wheeze)	56	32.8	38	38.0	18	25.4	0.083
Eye (itchy, burning, red eyes, or blurred vision)	26	15.2	21	21.0	5	7.0	0.012
Neurological (headache or dizziness)	21	12.3	16	16.0	5	7.0	0.079
Skin (itchy or burning skin, or rash)	10	5.9	6	6.0	4	5.6	1.000
Gastrointestinal (nausea or vomiting)	6	3.5	4	4.0	2	2.8	1.000
Cases with any symptoms							
	Total (<i>n</i> = 97)		Women (<i>n</i> = 65) ^{<i>a</i>}		Men (<i>n</i> = 32)		<i>p</i> value
Saw a healthcare provider due to symptoms	33	34.0	23	35.4	10	31.3	0.686
Missed work due to the symptom	14	14.4	10	15.4	4	12.5	0.704
Reported the symptom to the supervisor ^{<i>b</i>}	25	26.3	12	18.5	13	40.6	0.024

^{*a*} Among 66 female workers with any symptoms, one was excluded due to missing data for all three variables.^{*b*} *N* = 95 due to missing data.

Comparisons of demographic, job, and psychosocial characteristics between cleaning workers who reported acute symptoms to the supervisor and workers who did not report symptoms

TABLE 4

Variable	Report (n = 25)			No report (n = 70)			p value
	N	%		N	%		
Job title and location							0.377
Patient support assistant, hospital	9	36.0		29	41.4		
Custodian, hospital	8	32.0		28	40.0		
Custodian, campus	8	32.0		13	18.6		
Race/ethnicity							0.0005
Hispanic	12	48.0		10	14.3		
Asian	8	32.0		53	75.7		
African American	3	12.0		5	7.1		
Other	2	8.0		2	2.9		
Country of birth							0.321
United States	5	20.0		8	11.4		
Other	20	80.0		61	87.1		
Education							0.045
Elementary	2	8.0		5	7.1		
Some high school	2	8.0		19	27.1		
High school graduate	7	28.0		27	38.6		
College 1 year or more	14	56.0		19	27.1		
Job status							0.604
Full-time	23	92.0		67	95.7		
Part-time	2	8.0		3	4.3		
	Mean	SD		Mean	SD		p value
Age, years	45.4	13.2		47.7	9.3		0.415
Duration of employment, years	8.4	6.0		8.4	6.0		0.981
Risk perception	2.77	1.14		3.01	1.30		0.437
Job demand	30.8	6.8		31.4	4.4		0.665
Job control	59.4	8.8		61.0	8.7		0.514

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Variable	Report (<i>n</i> = 25)		No report (<i>n</i> = 70)		<i>p</i> value
	<i>N</i>	%	<i>N</i>	%	
Supervisor support	23.1	5.0	22.0	3.0	0.063
Co-worker support	11.8	2.4	11.6	1.6	0.407
Safety climate	55.8	13.2	56.2	10.4	0.773

Abbreviation: *SD*, standard deviation.

TABLE 5

Factors associated with symptom experience and symptom reporting to the supervisor: Multivariable analysis^a

Variable	Symptom experience at least monthly (<i>n</i> = 170)			Symptom ^b reporting to the supervisor (<i>n</i> = 94)		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Women	2.63	1.27–5.46	0.010	0.28	0.09–0.93	0.038
Asian	0.65	0.26–1.63	0.355	0.06	0.01–0.28	0.0003
Foreign born	0.63	0.19–2.16	0.475	4.78	0.92–24.9	0.063
College education	1.63	0.75–3.53	0.218	4.43	1.29–15.2	0.018
Job location (hospital) ^c	1.17	0.44–3.09	0.757	0.94	0.22–4.05	0.937
Job title (patient support assistant) ^d	1.18	0.56–2.49	0.656	1.20	0.31–4.57	0.790
Risk perception	1.11	0.86–1.44	0.434	1.37	0.83–2.25	0.219
Supervisor support	0.88	0.77–1.01	0.078	1.11	0.87–1.41	0.408

Abbreviations: CI, confidence interval; OR, odds ratio.

^a All variables included were adjusted for in the multivariable model.

^b Any symptoms experienced in the past 12 months.

^c Ref = University campus.

^d Ref = Custodian.