HHS Public Access

Author manuscript

Am J Ind Med. Author manuscript; available in PMC 2016 September 01.

Published in final edited form as:

Am J Ind Med. 2015 September ; 58(9): 988–995. doi:10.1002/ajim.22484.

Traditional and environmentally preferable cleaning product exposure and health symptoms in custodians

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Abstract

BACKGROUND—We investigated the associations between traditional and environmentally preferable cleaning product exposure and dermal, respiratory, and musculoskeletal symptoms in a population of custodians.

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Conflicts of Interest
The authors declare that they have no conflicts of interest.

Author Contributions Statement
All authors substantially contributed to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work and drafting of the work or revising it critically for important intellectual content, and provided final approval of the version to be published. All authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics Review and Approval
The Institutional Review Board at the University of Connecticut Health Center approved the study protocol (IE-10-050-1). Participants verbally assented to participate in this study as written consent would prevent participants from remaining anonymous.

METHODS—We analyzed associations between symptoms and exposure to traditional and environmentally preferable cleaning product exposure among 329 custodians.

RESULTS—We observed increased odds of dermal ($p<0.01$), upper ($p=0.01$) and lower respiratory ($p=0.01$), and upper extremity ($p<0.01$), back ($p<0.01$), and lower extremity ($p=0.01$) musculoskeletal symptoms associated with increased typical traditional cleaning product exposure. We observed significant trends for increased odds of dermal ($p=0.03$) and back ($p=0.04$) and lower ($p=0.02$) extremity musculoskeletal symptoms associated with increased typical environmentally preferable cleaning product exposure.

CONCLUSIONS—Fewer positive associations and reduced odds of health symptoms associated with environmentally preferable cleaning product exposure suggest that these products may represent a safer alternative to traditional cleaning products.

Keywords

Health and safety; occupational hygiene; exposure assessment

Introduction

Custodians, housekeepers, and other workers employed in cleaning jobs are at increased risk for several health symptoms including respiratory and dermatological symptoms as a result of their cleaning product use (Charles et al. 2009, Rosenman et al. 2003, Vizcaya et al. 2011). Traditional cleaning products contain ingredients including 2-butoxyethanol, quaternary ammonium compounds, glutaraldehyde, ethanolamines, and volatile organic compounds (Bello et al. 2009, Vandenplas et al. 2013). Such ingredients can be harmful to human health; for example, exposure to 2- butoxyethanol can result in sensory irritation (Wolkoff 2008), and quaternary ammonium compounds may promote development of airway allergy (Nielson et al. 2007). In addition, ingredients in traditional cleaning products can also be harmful to the environment, affecting factors such as wildlife reproduction and air quality (EPA 2015).

The substitution of environmentally preferable cleaning products that reduce or eliminate the use of some chemicals found in traditional cleaning products has been proposed as a way to potentially reduce health symptoms in custodians (Bello et al. 2009, Siqueira and Roche 2013). Science-based standards established by third-party organizations such as Green Seal (2015) and Ecologo (2014) have been developed for classifying environmentally preferable cleaning products used in the cleaning industry. Some of these standards require the removal of known harmful chemicals such as asthmagens or carcinogens from cleaning products. However, the criteria of the standards vary by the category of product being used. For example, cleaning products certified under the Green Seal Standard for Industrial and Institutional Cleaners (GS-37), which includes general purpose, restroom, and carpet cleaners, prohibit phthalates, a class of chemicals that may be associated with respiratory and reproductive symptoms (Green Seal 2015). However, standards for other cleaning products such as hand cleaners (GS-41) allow some phthalates. Custodians regularly use cleaning products across many categories, complicating their exposure profiles and potentially reducing the efficacy of environmentally preferable cleaning products for

protecting health. In addition, there is some indication that using environmentally preferable cleaning products could be associated with a higher prevalence of unfavorable musculoskeletal symptoms even compared to the use of traditional cleaning products. A qualitative study by Simcox et al. (2012) found that custodians were concerned about having to work harder (e.g. more forceful scrubbing, more frequent cleaning) to clean and also reported greater musculoskeletal complaints when using environmentally preferable compared to traditional cleaning products.

The objective of our study was to investigate the association between exposure to cleaning products and dermal, respiratory, and musculoskeletal symptoms in a population of custodians. In 2007, Connecticut mandated the adoption of environmentally preferable cleaning programs when possible inside buildings owned by the state (PA 07-100). This provided us with the opportunity to assess health symptoms associated with typical use of both traditional and environmentally preferable cleaning products by custodians. We hypothesized that increased typical use of traditional and environmentally preferable cleaning products would be associated with increased health symptoms, with stronger associations observed between traditional compared to environmentally preferable cleaning products and dermal and respiratory symptoms and weaker associations observed between traditional compared to environmentally preferable cleaning products and musculoskeletal symptoms.

Methods

Study Design and Population

A cross-sectional survey of typical cleaner use and associated health symptoms in cleaners and custodians was conducted in 2011 as part of the larger Green Cleaning and Health Study. A community based participatory research approach was used to identify and engage community partners including a local union, a labor-based advocacy organization, and local state agencies employing custodians. The overall purpose of the Green Cleaning and Health Study was to identify barriers for implementing green cleaning programs, to describe use patterns, exposures, and health symptoms of traditional and disinfectant cleaning products, and to develop an intervention to improve implementation of environmentally preferable cleaning programs. Custodians, lead custodians (area supervisors), and supervising custodians were recruited from state agencies to participate in the study. Participating custodians completed a survey (the Green Cleaning and Health Survey) in which they answered questions about dermal, musculoskeletal, and respiratory symptoms and typical cleaning product exposure. Surveys were available in English, Spanish, and Polish. All custodians working at each of the agencies were eligible to complete the survey. Custodians were given a small gift card incentive, which they were allowed to keep even if they did not complete the survey.

State-employed custodians from four state agencies – i.e.three universities and one university-affiliated hospital - were included in this sub-study. Several agencies were included in this study in order to ensure a sufficient range of cleaning product exposure, as different agencies had different practices regarding types and amounts of cleaning products used. Contract custodians from two of the agencies were also included. The response rates

ranged from 59% to 97% across the four agencies, with an overall response rate of 87%. The Institutional Review Board at the University of Connecticut Health Center approved the study protocol.

Dermal, Respiratory, and Musculoskeletal Symptoms

All information on health symptoms was collected using responses from the Green Cleaning and Health Survey as described in Table I. Questions used to assess dermal and musculoskeletal symptoms were developed for the Green Cleaning and Health Survey. Respiratory symptoms were assessed using questions adapted from the European Community Respiratory Health Survey II and the Behavioral Risk Factor Surveillance System (ECRHS 2002, BRFSS 2010).

Cleaning Product Exposure

Detailed information about characteristics of custodians' typical cleaning product exposure was collected using responses from the Green Cleaning and Health Survey. A list of cleaning products used at each agency was included in the survey. To develop the lists used in the survey, a researcher from the Green Cleaning and Health Study contacted representatives from each agency to identify a list of cleaning products being used at that agency, and then performed walkthrough assessments of custodial closets within the agency to confirm the products that were being used at each agency. On the survey, participants indicated how frequently (none or don't use/less than 1 hour per day/1 to 3 hours per day/4 to 6 hours per day/7 to 8 hours per day) they used each product on their agency-specific list during a typical 8 hour workday. Participants were also allowed to write in other products that they used that were not on the list. Participants were not required to indicate whether they thought that each cleaning product on the list was traditional or environmentally preferable, all cleaning products were listed in the survey by their name only in alphabetical order with no indication of whether they were classified as traditional or environmentally preferable. In survey post-processing, a researcher classified each cleaning product as environmentally preferable if it was included in the Ecologo (2014) or Green Seal (2015) databases, or "traditional" if it was not included in either database. Each frequency was assigned a numeric value (none or don't use = 0/less than 1 hour per day = 1/1 to 3 hours per day = 2/4 to 6 hours per day =3/7 to 8 hours per day =4), and each participant was assigned a traditional and an environmentally preferable cleaning product exposure score calculated by summing the assigned numeric values corresponding to each response for each traditional or environmentally preferable cleaning product used by that participant. Therefore, our exposure metric takes into consideration both the number of cleaning products used and the duration of use simultaneously, so participants could be assigned a high score if they used many products for a short period of time each or used a few products for a long period of time each. Given the semi-qualitative nature of the questions used to create the cleaning product exposure scores, the summed exposure scores themselves do not have an objective meaning, and simply represent each participant's traditional and environmentally preferable cleaning product exposures relative to all other custodians in our study population. For this reason, we categorized participants into low, medium, and high exposure tertiles based on their scores for all analyses. Two categorizations summarizing exposure to traditional and to environmentally preferable cleaning products were thus created for each participant. The

tertile cutoffs for traditional cleaning product exposure were 12 and 20: the 33% of participants with a traditional cleaning product exposure score less than 12 were categorized as having low exposure, the 34% of participants with a traditional cleaning product exposure score between 12 and 20 were categorized as having medium exposure, and the 33% of participants with a traditional cleaning product exposure score greater than 20 were categorized as having high exposure. The tertile cutoffs for environmentally preferable cleaning product exposure were 9 and 16.

Confounders

Potential covariates and confounders were collected in the Green Cleaning and Health Survey. These included participant's working status (part time or full time), worker type (state worker or contract worker), age, gender, language (English, Spanish, Polish, other), smoking status (non-smoker, current smoker), and number of years working in a job using cleaning products.

Statistical Analysis

We calculated descriptive statistics to describe the distribution of health symptoms and confounders in our population. Using SAS v 9.3 Statistical Software (Cary, NC), we performed logistic regression analyses with each health outcome treated as a dichotomous dependent variable and traditional or environmentally preferable cleaning product exposure category as a categorical independent variable to get estimates of the odds of health outcomes associated with traditional or environmentally preferable cleaning product exposure category. To test for trend (p-values), we also performed logistic regression analyses with traditional or environmentally preferable cleaning product exposure as a continuous variable. Due to the limited prevalence of severe lower respiratory symptoms, doctor diagnosed asthma, work-related asthma, and current asthma in our population we did not perform analyses on these symptoms. All analyses were adjusted for working status, worker type, age, gender, language, smoking status, and number of years working in a job using cleaning products. While we allowed for participants to have missing health symptoms data, if participants had missing data for a confounder variable we replaced it with the mean (continuous) or most frequent (categorical) value from the overall dataset (Table II). All confounders except for years working in a job using cleaning products (continuous) were treated as categorical variables. We evaluated p-values and odds ratios. Two-tailed $p<0.05$ was considered significant.

Results

A total of 329 custodians participated in the study and completed the survey for this study. Custodians in the study population were predominantly female (56%), full-time workers (89%), state-employed workers (72%), English-speaking (51%), non-smokers (77%), and aged 51–60 years old (38%) (Table II). On average, custodians in our population have spent 12 years in jobs where they worked with cleaning products. The distribution of dermal, respiratory, and musculoskeletal symptoms in our population is shown in Table III. Few custodians in our population had severe lower respiratory symptoms (6%), doctor-diagnosed asthma (13%), work-related asthma (4%), or current asthma (6%) (Table III).

Odds ratios for health symptoms by category of traditional and environmentally preferable cleaning product exposure are shown in Figure 1. We observed significant trends for increased odds of dermal (high exposure odds ratio = 4.07, 95% confidence interval = 1.56–10.62, p<0.01), upper respiratory (high exposure odds ratio = 2.42, 95% confidence interval = 1.20–4.91, p=0.01) and lower respiratory (high exposure odds ratio = 2.93, 95% confidence interval = 1.30–6.64, p=0.01), and upper extremity (high exposure odds ratio = 2.68, 95% confidence interval = 1.30–5.51, p<0.01), back (high exposure odds ratio = 3.71, 95% confidence interval = 1.66–8.27, p<0.01), and lower extremity (high exposure odds ratio = 2.82, 95% confidence interval = 1.33–5.98, p=0.01) musculoskeletal symptoms associated with increased typical traditional cleaning product exposure. We observed significant trends for increased odds of dermal symptoms (high-exposure odds ratio = 2.57, 95% confidence interval = 1.10–6.01, p=0.03) and back and lower) extremity musculoskeletal symptoms (high exposure odds ratios 2.00, 95% confidence interval = 1.01–3.97, p=0.04, and 2.27, 95% confidence interval = 1.16–4.46, p=0.02 respectively) associated with increased typical environmentally preferable cleaning product exposure. Despite some positive trends observed for environmentally preferable cleaning product exposure, for any set of health symptoms the magnitude of the associations were uniformly smaller for environmentally preferable than for traditional cleaning product exposure.

Discussion

As expected based on prior data, we observed significant increases in dermal as well as upper and lower respiratory symptoms associated with increased typical traditional cleaning product exposure. We also observed significant increases in upper extremity, back, and lower extremity musculoskeletal symptoms associated with increased traditional cleaning product exposure. We expected that typical exposure to environmentally preferable cleaning products would be associated with increased musculoskeletal symptoms, which we observed in the back and lower extremity but not for upper extremity conditions.

The trend that we observed for increased dermal, respiratory, and musculoskeletal symptoms associated with increased typical traditional cleaning product exposure among custodians is in line with and builds upon the previous literature that has demonstrated that custodians are at higher risk for developing health symptoms than workers in other occupations (e.g. Charles et al. 2009, Rosenman et al. 2003, Vizcaya et al. 2011). This observation also corresponds to the limited previous literature that has demonstrated indications of exposure-response relationships between cleaning product exposure and health among custodians and other populations. One previous study reported a progressive increase in odds of asthmatic symptoms for participants with intermediate and high exposure to bleach (Medina-Ramon et al. 2005). Medina-Ramon et al. (2006) demonstrated that custodians' lower respiratory symptoms were more common on working days and were predominantly associated with exposure to several traditional cleaning products. de Fátima Maçãira et al. (2007) demonstrated that risk of work-related asthma/rhinitis increased with years of employment in non-domestic cleaning. Among adults cleaning their own homes, Zock et al. (2007) demonstrated that asthma incidence was higher among those using spray cleaners at least 4 days per week. However, ours is the first study to demonstrate a progressively increasing prevalence of symptoms or symptoms with increasing typical cleaning exposures.

Our study is the first to investigate the health symptoms of environmentally preferable cleaning products and to compare health symptoms associated with traditional and environmentally preferable cleaning product exposure. We observed stronger associations between typical traditional cleaning product exposure and dermal, respiratory, and musculoskeletal symptoms compared to those estimated for typical environmentally preferable cleaning product exposure. This observation provides some preliminary support for suggestions that environmentally preferable cleaning products could be substituted for traditional products in order to improve health of custodians (Bello et al. 2009, Siqueira and Roche 2013). However, our results do not indicate that environmentally preferable cleaning products are free of potential health hazards. Participants with higher typical use of environmentally preferable cleaning products had significantly increased odds of reporting back and lower extremity musculoskeletal symptoms. However, in this study the effects were not larger than for traditional cleaning product exposure, indicating that environmentally preferable cleaning products could be beneficial for reducing musculoskeletal symptoms compared to traditional cleaning products, although in a previous focus group study custodians were concerned about having to work harder (e.g. more forceful scrubbing, more frequent cleaning) to clean and reported greater musculoskeletal complaints when using environmentally preferable compared to traditional cleaning products (Simcox et al. 2012).

In general, we observed a high prevalence of musculoskeletal symptoms among custodians in our study population, which corresponds to findings from previous studies (e.g. Chang et al. 2012). Custodial work, regardless of the type of cleaning products used, can be physically demanding, requiring static muscle loads and repetitive movements of arms and hands (Kumar and Kumar 2008). Some new cleaning technologies such as microfiber (Gillespie et al. 2015, Rutala et al. 2007) that are being developed for the custodial field may help to reduce physical load for custodians, but other ergonomic solutions are needed in conjunction with changes to cleaning products to reduce musculoskeletal symptoms among custodians.

For our analyses, the category of traditional cleaning products included disinfectants. Disinfectants, which kill and prevent microbial growth, are not regulated under Connecticut's environmentally preferable cleaning product laws. Some disinfectants such as bleach may be more strongly related to health symptoms than other traditional chemicals (Medina-Ramon et al. 2005, 2006). However, when we re-examined the associations between traditional cleaning product exposure, excluding disinfectants, and health conditions we observed similar results compared to when the disinfectants were included (data not shown). This indicates that the use of disinfectants was not driving our results for traditional cleaning products.

The cutoffs for classification in the low/medium/high exposure tertiles were different for traditional and environmentally preferable cleaning product exposure. For traditional cleaning product exposure, participants were categorized as having low exposure with traditional cleaning product exposure scores less than 12, medium exposure with traditional scores between 12 and 20, and high exposure with traditional scores greater than 20, while the cutoffs for low, medium, and high environmentally preferable cleaning product exposure were less than 9, between 9 and 16, and greater than 16. This indicates that participants had

less exposure to environmentally preferable than traditional cleaning products, which may explain why we observed weaker associations between environmentally preferable cleaning product exposure and health symptoms than between traditional cleaning product exposure and health symptoms. To investigate the effects of the tertile cutoffs on our associations, we performed sensitivity analyses that defined environmentally preferable cleaning product exposure according to the same cutoffs as traditional cleaning product exposure. Based on these analyses, we did not observe that any other health symptoms became associated with environmentally preferable cleaning product exposure (data not shown). Further, while it is possible that our original lower exposure cutoffs indicate incomplete transition of the agencies to environmentally preferable cleaning products, suggesting that custodians may have greater exposure to environmentally preferable products in the future, it is also possible that our data indicate that fewer products are needed as part of environmentally preferable cleaning programs, and therefore custodians using environmentally preferable cleaning products truly do have less exposure. Environmentally preferable technology has been evolving and includes new equipment for cleaning in addition to new formulations for cleaning products containing less harmful chemicals. New equipment has the potential to reduce cleaning product exposure. For instance, microfiber and steam technologies, which do not use any chemicals, may be effective for cleaning and disinfecting (Gillespie et al. 2015, Rutala et al. 2007). It is possible that as the technology and chemical formulations continue to evolve the health hazards associated with environmentally preferable cleaning products will be reduced even further.

Although we observed consistently higher tertile cutoff values for traditional compared to environmentally preferable cleaning products at all agencies, the cutoffs for the four agencies included in this study varied considerably. The lower and higher tertile cutoffs ranged from 8–22 and 11–27 for traditional cleaning product exposure, and from 5–16 and 8–18 for environmentally preferable cleaning product exposure. Factors such as different total numbers of cleaning products used at each site (34–45) and different proportions of traditional versus environmentally preferable cleaning products (15%–26% environmentally preferable) contributed to the exposure differences between agencies. It is possible that the differences in cleaning product use reflects inter-agency differences in policies and practices that could also affect health symptoms, so that agency could act as a potential confounder for this study. Because we intentionally recruited agencies using prior information on their differential use of cleaning products, in order to ensure a sufficient range of cleaning product exposure for analysis we elected not to include agency as a nested or random-effects variable. Additional investigations using a larger sample of agencies or sites would be required to distinguish the effects of broader policies on the health conditions we studied from the effects of individual-level exposures to the two sets of cleaning materials.

Custodians within our population were exposed to both traditional and environmentally preferable cleaning products simultaneously. While we would have liked to compare health symptoms in custodians exposed solely to traditional or to environmentally preferable cleaning products, this was not possible due to the incomplete transition to environmentally preferable cleaning programs at all agencies included in our study. It would be possible for a participant to frequently use many traditional and environmentally preferable cleaning products and therefore to be classified as having medium to high environmentally preferable

cleaning product exposure to also have high traditional cleaning product exposure. This could potentially confound the specificity of association with type of cleaning product. However, in analyses where we removed participants with high traditional exposure we observed no difference in the association between environmentally preferable cleaning product exposure and health symptoms compared to the results presented without excluding those participants (data not shown).

Some other limitations of our study should also be considered. In this study, we only assessed self-reported health symptoms. It is unclear how self-reported health symptoms may be related to longer term health symptoms or disorders. However, at least for the musculoskeletal system, a previous study of office workers demonstrated that participants reporting upper extremity musculoskeletal symptoms also likely had a diagnosable musculoskeletal disorder (Gerr et al. 2002). Our method of assessing exposure was also limited. The mechanism by which our exposure metric may cause health symptoms is not clear and cannot be determined based on the results of this study alone. We only assessed self-reported “typical” exposure, which does not take into account potential variation in exposure across different days or cumulative exposure over time. Our exposure metric was based only on the number of cleaning products used and the duration of use. We did not consider other factors that could affect custodians’ exposures such as the tasks performed, the route of exposure, use of personal protective equipment, or the specific chemicals contained in each product (Bello et al. 2009). Our exposure metric takes into consideration both the number of cleaning products used and the duration of use simultaneously, so participants could be considered to have high exposure if they used many products for a short period of time each or used a few products for a long period of time each. These limitations of our exposure metric may lead to exposure misclassification and it is unclear how this misclassification could have affected our results. Future studies including more detailed assessments of cleaning product exposure should be conducted to confirm our results. Due to the cross-sectional design of the study, we cannot conclude that the cleaning product exposure caused the health symptoms reported by our participants. Further, while we did adjust for some demographic and occupational confounders, residual confounding may remain. Regardless of the limitations, this study provides new information on the dermal, respiratory, and musculoskeletal health symptoms associated with traditional and environmentally preferable cleaning products among custodians.

In conclusion, we observed increased odds of several health symptoms associated with progressive increases in cleaning product exposure. While traditional cleaning products were more strongly associated with health symptoms than environmentally preferable cleaning products, we still did observe associations between environmentally preferable cleaning products and musculoskeletal symptoms. However, environmentally preferable cleaning products do not appear to increase risk for musculoskeletal symptoms compared to traditional cleaning products. Environmentally preferable cleaning products may represent a safer alternative to traditional cleaning products to protect the health of custodians, but custodians using environmentally preferable cleaning products may still be at increased risk for some health symptoms.

Acknowledgments

The authors would like to thank the agencies and custodians who participated in this study.

Disclosure of Grant Funding

Grant Sponsor: Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health; Grant Number: 5R21OH009831-02. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

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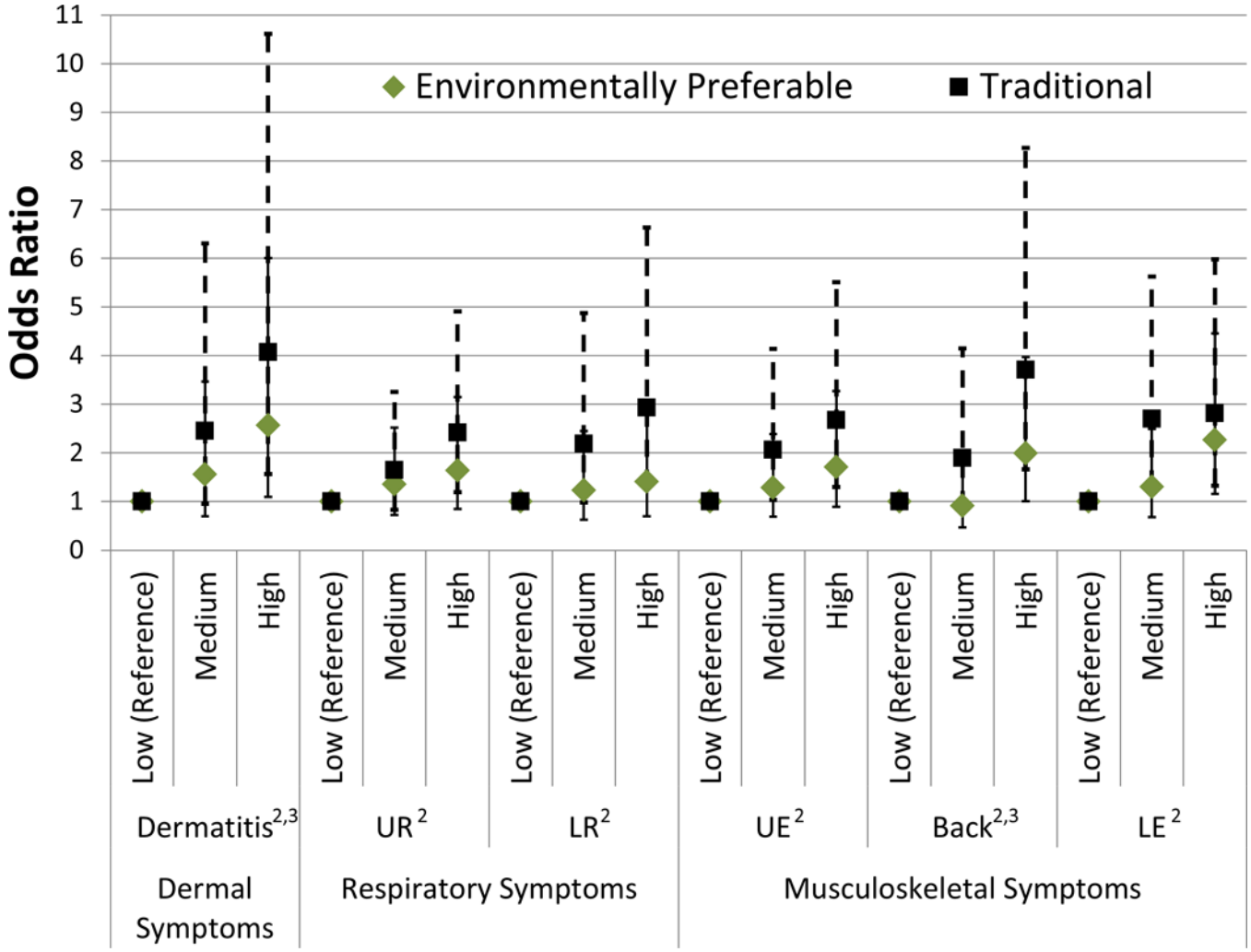

Figure 1.

Traditional and environmentally preferable cleaning product exposure: adjusted[1] odds of dermal, respiratory, and musculoskeletal health symptoms among custodians with medium and high compared to low traditional and environmentally preferable cleaning product exposure.

[1]Odds ratios are adjusted for working status, worker type, age, gender, language, smoking status, and number of years working in a job using cleaning products.

[2]Indicates that there was a significant linear trend with increased traditional cleaning product exposure associated with increased odds of that health symptom.

[3]Indicates that there was a significant linear trend with increased environmentally preferable cleaning product exposure associated with increased odds of that health symptom.

UR = Upper Respiratory

LR = Lower Respiratory

UE = Upper Extremity

LE = Lower Extremity

Table I

Questions from the Green Cleaning and Health Survey used to define dermal, respiratory, and musculoskeletal symptoms.

Dermal	Dermal Symptoms	Yes to any of:
		In the last 12 months, have you had skin rashes, itching, or redness on hands or arms that lasted more than one week?
		In the last 12 months, have you had skin chapping or cracking on hands or arms that last more than one week?
Respiratory	Upper Respiratory Symptoms	Yes to any of:
		In the last 12 months, have you had any nasal allergies, including hay fever
		In the last 12 months, have you had sinusitis or sinus problems
		In the last 12 months, have you had hoarseness
	Lower Respiratory Symptoms	Yes to any of:
		In the last 12 months, have you had chest tightness
		In the last 12 months, have you had wheezing or whistling in your chest
	Doctor Diagnosed Asthma	Yes to: have you ever been told by a doctor, nurse, or other health professional that you had asthma
	Work-related Asthma	Yes to: have you ever been told by a doctor, nurse, or other health professional that you had work-related asthma
	Current Asthma	Yes to either doctor-diagnosed asthma or work-related asthma and yes to any of:
		Do you still have asthma
		Have you had an asthma attack anytime in the last 12 months
		Are you currently taking any medicine (including inhalers, aerosols and tablets) for asthma
Musculoskeletal	Upper Extremity Symptoms	Yes to: in the last 12 months, have you had pain or discomfort in neck, shoulders, arms, or hands for a week or more
	Back Pain Symptoms	Yes to: in the last 12 months, have you had pain or discomfort in back every day for a week or more
	Lower Extremity Symptoms	Yes to: in the last 12 months, have you had pain or discomfort in legs or feet every day for a week or more

Table II

Distribution of confounders among custodians in study population (total N=329)

		N or Mean	(%) or (Standard Deviation)
Gender	Female (reference)	185	(56)
	Male	131	(40)
Work Schedule	Full Time (reference)	292	(89)
	Part Time	29	(09)
Type of Job	State (reference)	238	(72)
	Contractor	60	(18)
Primary Language	English (reference)	167	(51)
	Spanish	66	(20)
	Polish	56	(17)
	Other Language	29	(09)
Smoking Status	Non-Smoker (reference)	253	(77)
	Current Smoker	55	(17)
Age (years)	20–30	21	(06)
	31–40	44	(13)
	41–50	102	(31)
	51–60 (reference)	124	(38)
	61–70	33	(10)
Years Working with Cleaning Products		12	(9)

Note: numbers may not add up to 329 due to missing values

Table III

Distribution of health outcomes among custodians in study population (total N=329)

		N	(%)
Dermal	Dermatitis	63	(19)
Respiratory	Upper Respiratory Symptoms	139	(42)
	Lower Respiratory Symptoms	84	(26)
	Severe Lower Respiratory Symptoms	19	(6)
	Doctor Diagnosed Asthma	44	(13)
	Work-related Asthma	14	(4)
	Current Asthma	44	(13)
Musculoskeletal	Upper Extremity Symptoms	138	(42)
	Back Pain	100	(30)
	Lower Extremity Symptoms	116	(35)

Note: numbers may not add up to 329 due to missing values