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Review Article

Occupational hazards experienced by cleaning workers and janitors: A review of the epidemiologic literature

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Abstract. Building cleaners are an important group of workers who experience diverse occupational hazards resulting in health problems. A review of epidemiologic studies conducted between 1981 and 2005 was performed using PubMed and PsychLit, to identify health outcomes and the associated hazards in the work environment of cleaners. Among 35 studies, respiratory diseases ($n = 17$) and dermatologic diseases ($n = 9$) were the most common and were associated with exposure to cleaning agents, wet work, and rubber latex. The potential for infectious diseases ($n = 3$) was identified among cleaners in medical laboratories and was associated with exposure to broken glass and uncapped needles in the trash. Musculoskeletal disorders ($n = 5$) were associated with several physical stressors (e.g., awkward postures, prolonged standing) and psychosocial stressors (e.g., monotonous job, low potential for promotion). Mental disorders ($n = 1$) were also associated with psychosocial stressors and societal stigma. Future studies may be enhanced by better assessment of the specific job exposures of cleaners and implementation of a prospective design.

Keywords: Occupational exposures, cleaning, housekeeping, respiratory disease, low back pain

1. Introduction

Millions of women and men worldwide are employed in cleaning occupations [17,35]. Cleaners, also known as housekeepers, janitors, caretakers (UK) or custodians, are employed in diverse economic sectors including hotels, restaurants, educational institutions, hospitals, transportation facilities, and private homes [35]. The term "cleaners" will be used throughout the paper to represent this group. Cleaners perform various tasks (e.g., vacuuming, polishing, mopping, washing and sterilizing equipment), usually with the aid of cleaning products, to improve and maintain the utility and appearance of the material being cleaned [35]. Cleaning duties include the disposal of trash and, for hospital cleaners, the removal of human excreta, radioactive and biologically contaminated ma-

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terials. Cleaners are among the lowest paid workers and many are employed on a part-time, contractual or informal basis [18,59]. A large proportion of these workers are women [35] and because of the prominence of contingent and informal work arrangements, people may enter the occupation at young ages and continue working past the customary age of retirement [45].

The diverse work environments of cleaners contain several hazards that are associated with several physical and mental health problems [47]. Research suggests that working as a cleaner is associated with significant increases in respiratory and dermatologic diseases, musculoskeletal disorders, and other conditions [5,12, 29,41,51]. However, because of the unusually varied exposures associated with cleaning occupations, the health consequences of this work are not easily summarized. Zock et al. [59] provided a brief summary of the work processes, exposures, and health risks associated with cleaning occupations, but no comprehensive review of relevant research is available. We therefore conducted this systematic review in order to describe, summarize, and discuss the epidemiologic research assessing the job-related health outcomes and hazards of cleaners and to highlight gaps and research needs.

2. Methods

We conducted a search of the scientific literature using the PubMed and PsychLit databases for all articles published between 1981 and 2005 that contained information on occupational hazards related to cleaning work. The terms occupational hazards, occupational exposures, shift work, job demands, ergonomics, detergents, latex, sharps, and asthma were used in conjunction with janitors, custodians, cleaners, housemaids, housekeepers or housekeeping as search terms. We examined the titles and abstracts of original research studies and selected all epidemiologic studies that investigated work-related hazards of cleaners; some studies focused only on cleaners while others included these workers among several other occupations. The only criterion for selecting articles was that they reported on an aspect of the work environment. We examined also the reference lists of original and review articles for other relevant papers. Case reports and risk assessments were not included in the review. Studies on chronic diseases (e.g., cancer, cardiovascular disease) as outcomes in cleaning work will be addressed in a separate review paper. Retrieved publications were limited to the English language.

The studies finally selected for inclusion considered various occupational hazards, and investigated the factors associated with health outcomes in cleaners employed in a variety of settings, for example, office buildings, schools, hospitals, private homes, and transportation facilities. Because of the diversity of exposures, health outcomes and study designs, it was not feasible to conduct a quantitative meta-analysis. Study findings are presented according to health outcomes.

3. Results

Thirty-five original epidemiological studies were retrieved from the literature search. The health outcomes were categorized as respiratory diseases, dermatologic and allergic disorders, musculoskeletal disorders, infectious diseases, and psychological disorders. The majority of papers ($n = 17$) addressed respiratory diseases (Table 1). Nine studies investigated dermatologic and/or allergic disorders due to hazards in the environment of cleaners. The other studies investigated musculoskeletal disorders ($n = 5$), the potential for infectious diseases ($n = 3$), psychological disorders ($n = 1$), and chronic diseases ($n = 1$). The majority of studies in each category were cross-sectional in design; four studies were case-control, three were longitudinal and one was experimental in design. Sample sizes ranged from 12 to $>$ 1,000 persons. Where several occupations were studied, investigators assessed occupational exposure from job titles, but in three studies, exposure assessment was performed using job-exposure matrices. Respiratory outcomes were generally ascertained from questionnaires and spirometry tests; other outcomes were obtained only from questionnaires. Most of the studies were conducted in European countries ($n = 22$), followed by the United States ($n = 8$), and one each in Canada, New Zealand, Taiwan, Singapore, and Brazil.

3.1. Respiratory diseases

Of all health conditions observed among cleaners, respiratory illness is the one most often studied [1,11, 22,24,25,60]. The types of respiratory illnesses reported in these epidemiologic studies include asthma [1, 11,19,22–25,30,32,39,60], reactive airways dysfunction syndrome (RADS) [58], and chronic bronchitis or shortness of breath [9,33,37]. Table 1 presents 17 studies that investigated respiratory effects and the associated hazards among cleaners.

Table 1
Epidemiologic studies of respiratory effects of hazards in the work environment of cleaners

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
			Studies investigating persons from multiple occupations		
Arif et al., 2003	Cross-sectional	5022 workers for asthma study and 4573 for wheezing study; population-based (NHANES III); U.S.	E – Various occupations (SR); O – asthma and wheezing (SR)	Cleaners – one of the occupations with significantly increased prevalence of work-related wheezing.	Age, sex, atopy, smoking
Fishwick et al., 1997	Cross-sectional	1609 persons; population-based; New Zealand	E – Various occupations (self-reported), dusts, gases, vapors, fumes (DGVF) (job titles); O – chronic bronchitis (SR & lung function tests)	Occupations with DGVF exposure significantly associated with chronic bronchitis and airway obstruction; POR for cleaners was not statistically significant.	Age, sex, smoking
Forastiere et al.,1998	Cross-sectional	1246 women; population-based; U.S.	E – Various occupations (self-reported), DGVFS; O – asthma/asthma-like symptoms	Occupations with high DGFVS exposure significantly associated with asthma/asthma-like symptoms.	Age, smoking
Jaakkola et al., 2003	Incident case-control	521 cases, 932 controls; population-based; Finland	E – Various occupations (SR); O – asthma (clinical diagnosis)	Among women, cleaning was one of the occupations for which risk of asthma was increased.	Age, gender, smoking
Karjalainen et al., 2002	Prospective cohort	54000 female cleaners, 203000 administrative workers; registry-based; Finland	E – Occupations (job titles from population census) – cleaners, administrative workers; O – asthma (registry records)	An increased relative risk of asthma observed among cleaners vs administrative workers.	Age
Kogevinas et al., 1996	Cross-sectional	2646 adults; general population; Spain	E – Various occupations (SR) and occupational exposures; O – asthma (SR & clinical tests)	Excess risk for asthma observed among cleaners and other occupations.	Age, sex, residence, smoking
Kogevinas et al, 1999	Cross-sectional	15637 adults; general population; 12 industrialized countries	E – Various occupations (job titles and JEM); O – asthma (SR & clinical tests)	Excess risk for asthma observed among cleaners and other occupations. Excess asthma risk with dusts, gases and fumes.	Age, sex, study centre
Kopferschmitt-Kubler et al., 2002	Cross-sectional	559 patients with asthma; surveillance – occupational asthma; France	E – Occupations, several agents including flour, isocyanates, latex, aldehydes, persulphates, wood dust etc. (SR); O – asthma (clinical diagnoses)	Several occupations, including cleaners, at increased risk for asthma.	na
Le Moual et al., 2004	Cross-sectional	14151 adults from 7 cities; general population; France	E – Occupations, cleaning agents, latex, flour, chemicals, textiles (SR, job titles, population-specific JEM, asthma-specific JEM); O – asthma (SR)	Industrial cleaning agents, latex, highly reactive chemicals significantly associated with asthma.	Age, sex, smoking
Medina-Ramon et al., 2005	Nested case-control	40 cases (of asthma and/or chronic bronchitis) and 155 controls; all domestic cleaning women, population-based; Spain	E – Bleach, other cleaning products, washing dishes, other cleaning duties (SR & JEM); O – asthma, chronic bronchitis (SR and lung function tests)	Washing dishes and non-domestic cleaning employment associated with chronic bronchitis. Use of bleach, washing dishes ($>$ 1X/day), inhalation of cleaning agents, and history of non-domestic cleaning employment associated with asthma.	Age, smoking, employment status in non-domestic cleaning, inhalation of cleaning agents, washing dishes, multi-use cleaning products, bleach.

Table 1, continued

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
Ng et al, 1994	Case-control	787 adults; community-based; Singapore	E – Occupations (SR); O – Asthma (clinical tests)	Increased risks of asthma for cleaners, particularly municipal cleaners and sweepers.	Sex, age, race, smoking, clinical atopy
Rosenman et al., 2003	Cross-sectional	1915 workers with work-related asthma; surveillance (SENSOR); U.S.	E – Use of cleaning products among several occupations (job titles); O – asthma (SR & medical records)	The rate (per 100,000) of work-related asthma among janitors was 4.3 compared with 2.3 for all other occupations combined.	na
Zock et al., 2002	Cross-sectional, Case-case study	6301 workers; several European countries	E – Cleaners, workers exposed to low and high molecular weight agents, and office workers (job titles); O – respiratory diseases (SR & clinical tests)	A higher prevalence of asthma, bronchial hyper-responsiveness, and chronic bronchitis observed among cleaners compared to other workers.	Sex, smoking, age, atopy
			Studies investigating cleaners only		
Medina-Ramon et al., 2003	Cross-sectional	4251 women; all domestic cleaning women, population-based; Spain	E – Occupation of cleaning (SR); O – asthma, chronic bronchitis (SR)	Domestic cleaning associated with asthma, chronic bronchitis, etc.	Age, smoking
Nielsen and Bach, 1999	Prospective cohort	1011 female cleaners at nursing homes, schools, public offices; population-based; Denmark	E – Cleaning: high-pressure equipment or sprayers, cleaning solutions; O – eye symptoms, nose/throat symptoms, allergy, asthma, bronchitis (SR)	Increased risk of asthma, nose or throat symptoms observed among cleaners. Those who developed asthma and bronchitis and then stopped using sprayers still suffered from these symptoms during the follow-up period.	Age, smoking
Zock et al., 2001	Cross-sectional	67 private home and commercial cleaners and office workers; population-based; Spain	E – Vacuuming, mopping, polishing, cleaning windows, kitchens etc. Use of cleaning products: soaps and detergents, disinfectants, solvents, polishes, ammonia, perfumed products (SR); O – asthma, respiratory symptoms (SR & clinical tests)	Over 50% of cleaners reported work-related respiratory symptoms. Asthma prevalence 1.7 times higher among cleaners than among the referents.	Age category, gender, smoking, area of residence

DGVFS – dusts, gases, vapors, fumes, sensitizers.
POR – Prevalence odds ratio.
E – exposures; O – outcomes.
SR – self-reported information.
JEM – Job-exposure matrix.

3.1.1. Studies conducted among multiple occupations

In a prospective cohort study, female workers in Finland without preexisting asthma were studied for adult-onset asthma incidence [22]. Compared to the administrative workers, cleaners were at increased risk for asthma, relative risk (RR) = 1.50 (95% C.I. = 1.48–1.57). Cleaners employed by companies concerned with the manufacture of basic metals and food products had the highest risk. Of the 2,414 cases of asthma among cleaners during the follow-up period, 25 were recognized as occupational asthma. The causative agents of these included flour dust, acrylates, isocyanates, detergents, ethanolamines and metal compounds. The authors obtained occupational and other data from a national register; there is usually insufficient information provided on confounders (e.g., socioeconomic status) in registries and exposure information is often not very specific. The study by Zock et al (2002) reported that the prevalence of asthma and chronic bronchitis was higher for cleaners than for three other occupational groups [60].

Rosenman and colleagues (1997) [42], using data from the Sentinel Event Notification System for Occupational Risks (SENSOR) surveillance system in the United States for 1993–1997, found that the prevalence rate (per 100,000 workers) of work-related asthma was 4.3 for janitors and cleaners, and 2.3 for all other occupations combined [41]. Exposure to clean-

ing products was associated with new-onset and work-aggravated asthma and reactive airway dysfunction syndrome (RADS). Work-aggravated asthma is characterized by recurrent asthmatic episodes caused by exposure to irritant aerosols, while occupational asthma is usually caused by a variety of chemical agents such as bleaching agents, floor sealants, and dyes [58]. According to the authors, 53% to 87% of work-related asthma cases occurring in the states are not captured by the SENSOR surveillance system, so the prevalence may be underestimated.

A population-based, incident case-control study that investigated the association between occupation and adult-onset asthma reported that the risk of asthma was increased, although not statistically significant, among female cleaners (and women in a few other occupations) after adjusting for age, gender, and smoking [19]. This study took into account job changes that might have been made because of respiratory symptoms and defined asthma based on the clinical and lung function findings in participants' medical records. Another case-control study conducted in Singapore reported increased risks of asthma for most service workers including cleaners, and particularly municipal cleaners and sweepers (OR = 1.91; 95% CI = 1.22–2.99) [39]. One of the largest population-based studies on occupational asthma was conducted among 15, 637 persons aged 20–44 who were randomly selected from 12 industrialized countries [23]. Occupation was defined by job titles and a job exposure matrix. Cleaners were among occupations that were at high risk of asthma (OR = 1.97; 95% CI = 1.33–2.92). The group of cleaners had an excess risk of asthma in 11 of 12 countries and was the largest of the 16 occupational groups to show an increase in asthma risk of more than 30%. Excess asthma risk was associated with high exposure to biological dusts, mineral dusts, and gases and fumes.

Contradictory results were reported in the cross-sectional study by Fishwick et al. [9] that assessed exposure to cleaning agents using job titles [9]. In this study, the occupation of cleaners was not significantly associated with chronic bronchitis or shortness of breath after adjustment for age, sex, and smoking. According to the authors, some workers were recalling jobs from many years prior to the time of questionnaire administration which might have resulted in the misclassification of exposure. There is also the possibility of a reporting bias of symptoms by participants who felt that their work might have contributed to those symptoms. Another cross-sectional study did not find that cleaners were at increased risk for asthma [30]. However, significant associations were found between exposure to industrial cleaning agents (assessed by a job-exposure matrix) and all definitions of asthma, and between exposure to latex and ever having asthma. These authors used an asthma-specific job-exposure matrix instead of assessing exposure from job titles.

3.1.2. Studies conducted among cleaners only

All studies that were conducted only among cleaners showed associations with significant respiratory problems. In a study population restricted to women, Medina-Ramón et al. (2003) found that excess risks for all respiratory outcomes were seen among those reporting as ever having worked as domestic cleaners compared with those who had never worked as cleaners [33]. The risk of chronic bronchitis was significantly higher among smokers compared to non-smokers and the risks for asthma were slightly higher among former compared to current cleaners. Among cleaners without symptoms at the start of employment, there was a significant risk of developing eye and nose/throat symptoms if they continued cleaning work [37]. In addition, those workers who suffered from asthma at baseline had an increased risk of developing bronchitis in the follow-up period. The risks of respiratory disorders for cleaners in private homes appear to be greater than for cleaners employed in other situations [61].

A comprehensive review of the detrimental effects of cleaning agents has been published [56]. The active components of most cleaning agents, the surfactants, can cause a range of skin problems (e.g., contact dermatitis, eczema) [56]. Some of the perfumes, fragrances, dyes, and preservatives (e.g., formaldehyde) that are included in the cleaning products, many of which are unnecessary, are irritants or allergens. Sodium hypochlorite (an active compound in disinfectants) is classified as corrosive and the borates and morpholine (found in disinfectants) are considered to have reproductive and neurotoxic effects.

3.2. Dermatologic diseases and allergies

In addition to respiratory problems, cleaning agents are responsible for various dermatologic diseases. Table 2 presents nine studies that investigated hazards associated with dermatologic and allergic effects among cleaners. Wet work, which makes up a significant proportion of the duties of cleaners, is responsible for various types of skin disorders such as eczema and dermatitis [12,21,27,34,38]. Rubber chemicals including latex are also among agents listed as most frequent risk fac-

Table 2
Epidemiologic studies of dermatologic and allergic effects of hazards in the work environment of cleaners

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
Desciak and Marks, 1997	Cross-sectional	130 cleaners; workforce-based; U.S.	E – Cleaning chemicals (e.g., disinfectants, detergents, deodorizers); O – irritant contact dermatitis (clinical tests)	6.2% of cleaners had occupationally-induced irritant contact dermatitis; patch-testing showed latex not a risk factor.	na
Gawkrodger et al., 1986	Cross-sectional	310 female cleaners (38 interviewed); 83 other workers (12 interviewed); workforce-based; UK	E – Wet work – working with water and chemicals; O – skin disorders (skin patch tests)	110/310 of cleaners reported skin disorders; 25/38 reported hand dermatitis; wet work – one risk factor for skin disorders.	na
Hansen, 1983	Cross-sectional	541 hospital cleaning women; workforce-based; Denmark	E – Formaldehyde, glutaraldehyde, chloramines, nickel, rubber; detergents, alkaline substances, acids, sodium perborate, hypochlorite and hypobromite combinations; O – skin diseases (skin patch tests)	15.3% of cleaners with occupational skin diseases; use of cleaning solutions associated with irritant dermatitis, allergic contact dermatitis, monilia of the finger webs, etc.	Stratified by age
Lammintausta et al., 1983	Cross-sectional	586 hospital workers (including 204 cleaners); workforce-based; Finland	E – Occupations (SR); O – hand dermatitis (clinical diagnosis)	Highest prevalence of hand dermatitis (55%) observed among cleaners.	na
Meding and Swanbeck, 1990	Cross-sectional	16584 persons; population-based; Sweden	E – Several occupations (job titles), several agents – e.g., chemicals, water, detergents, paints, foodstuffs, etc. (SR); O – hand eczema (clinical diagnoses)	Highest prevalence (21.3%) of hand eczema ($p < 0.001$) observed among cleaners. Exposures most associated with hand eczema were water and detergents, dust and dry dirt, and unspecified chemicals.	Stratified by sex
Nielsen, 1996	Cross-sectional and longitudinal	Female cleaners (cross-sectional – $n = 1166$; longitudinal – $n = 1011$); population-based; Denmark	E – Cleaning chemicals (e.g., disinfectants, detergents, deodorizers); O – skin symptoms (SR)	1/5 of cleaners reported problems with cleaning agents; cleaners who continued in cleaning work had higher risk of developing skin symptoms 2 years later compared to cleaners who left that work (OR = 2.6, 95% CI = 1.4–4.8).	Age
Singgih et al., 1986	Cross-sectional	356 hospital cleaners; workforce-based; the Netherlands	E – Nickel, cobalt, chromate, rubber chemicals, and others; O – eczema (clinical tests)	Prevalence of moderate and severe eczema was 12%; main allergens were nickel, cobalt, chromate, and rubber chemicals.	Stratified by sex
Valks et al., 2004	Cross-sectional	1171 patients; clinic-based; Spain	E – Healthcare and non-healthcare occupations, rubber latex (job titles); O – latex sensitivity (clinical tests)	Cleaners among occupations more likely to be sensitized to natural rubber latex.	na
Sussman et al., 1995	Cross-sectional	50 hospital cleaners; workforce-based; Canada	E – Latex material; O – hand dermatitis, rhinoconjunctivitis, itchiness of face, angioedema, lightheadedness (SR & clinical tests)	Contact with latex material among those allergic to latex associated with hand dermatitis, rhinoconjunctivitis, itchiness of face, angioedema, lightheadedness. 4/50 cleaners allergic to latex.	na

E – exposures; O – outcomes.

tors for contact dermatitis and have been known to be a major cause of allergies [4,38]. In one cross-sectional study, approximately 46% of cleaners reported at least one out of four skin symptoms (e.g., red and rough skin, itching, cracks, and vesicles) during a one-year period [38]. These skin problems caused cleaners to take sick leave (2%) or seek medical care (10%); the prevalence decreased among those who left cleaning work while the age-adjusted risk increased among those who continued during the two-year follow-up period. Another cross-sectional study conducted on 130 cleaners found that the frequency of occupational dermatoses among this group was 6.2% [7]. All cleaners were exposed to similar chemicals, and most of the tasks involved wet work with exposure to possible irritants and allergens dissolved in water.

Table 3
Epidemiologic studies of musculoskeletal disorders due to hazards in the work environment of cleaners

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
Houtman et al., 1994	Cross-sectional	5865 employees; general working population; The Netherlands	E – High work pace, low intellectual discretion; O – psychosomatic complaints, health problems, and musculoskeletal problems	Psychosocial stressors associated with psychosomatic complaints, health problems, and musculoskeletal problems.	Gender, age, education, physical stressors
Krause et al., 2005	Cross-sectional	941 unionized, hotel room cleaners; workforce-based; U.S.	E – Heavy lifting, awkward working positions; O – musculoskeletal problems	Heavy lifting, awkward working positions associated with bodily pain, neck and back pain.	Age, height, weight, smoking, drinking, years worked as hotel room cleaner, work hours/wk, family member with special needs, psychological demands, decision latitude, supervisor support, co-worker support
Sarri et al., 1991	Cross-sectional	239 cleaners (medical research laboratories of one university); U.S.	E – Moving and lifting activities; O – strains and sprains to the back, neck, legs, and feet	Lifting associated with strains and sprains to the back, neck, legs, and feet.	na
Sogaard et al., 1996	Experimental	12 cleaners; Denmark	E – Mopping method vs scrub and cloth method; O – musculoskeletal problems	Mopping group had higher shoulder load than other group; mopping as strenuous as scrubbing.	na
Svensson and Andersson, 1989	Cross-sectional	1,760 women; population-based; Sweden	E – Dissatisfaction with work environment, worry, fatigue at end of day; Lifting, forward bending, and standing; O – LBP	Psychosocial variables significantly associated with LBP; lifting, forward bending, and standing associated with LBP.	Not listed

LBP – low back pain.
H – hazards; O – outcomes.

A common cause of allergies among cleaners is exposure to latex gloves. Latex is composed of pure rubber, water, resins, proteins, sugars, minerals, and trace amounts of other chemical products. The major sensitizing agent in latex is the protein content which binds to the glove powder and may be expelled into the air during use [36]. Exposure to latex in sensitized persons can result in contact dermatitis, systemic reactions, and anaphylaxis [2]. Cleaners have an increased prevalence of natural rubber latex sensitization with consequential skin diseases (e.g., occupational irritant dermatitis, allergic contact dermatitis) than workers in many other occupations [15,53,55]. However, with the improvements in latex manufacturing [8] and the availability of latex-free alternatives such as nitrile, vinyl, neoprene, styrene, butadiene, and Tactylon [3] there is likely to be a decrease in the prevalence of latex sensitivity among cleaners in the future.

Some allergic skin disorders might also be due to the cleaners' sensitivity to traces of nickel found in detergents and water [6]. In a study among hospital cleaning personnel, the main allergens for moderate and severe eczema were nickel, cobalt, chromate and rubber chemicals [50]. The prevalence rate for eczema was 12% (10% in men and 19% in women). A majority of this group with moderate and severe eczema (72%) reported that they acquired their skin disorder during their occupation as a cleaner.

3.3. Musculoskeletal disorders

Cleaners are also engaged in physically demanding work. They perform duties that require lifting, forward bending, moving heavy equipment, and prolonged standing, which can result in low back pain and other musculoskeletal disorders [46,54]. Janitorial work was ranked the 22nd highest risk occupation for back pain among males (12.2% prevalence), and fourth among females (13.3% prevalence) [14]. Table 3 presents the studies that investigated hazards associated with musculoskeletal disorders among cleaners. Krause and colleagues [26], in their cross-sectional study, reported that pain in the neck, upper and lower back, and in the body overall was significantly as-

Table 4
Epidemiologic studies of contact with infectious agents from contaminated wastes in the work environment of cleaners

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
Jacobson et al., 1983	Descriptive report	207 hospital employees (including cleaners); U.S.	E – Accidental contact with blades, scalpels, and needles; O – injuries, infectious contact	55% of cleaners were injured; exposure to hepatitis B surface antigen and Staphylococcus aureus infection from blades, scalpels, and needles injuries.	na
Sarri et al., 1991	Cross-sectional	239 cleaners (medical research laboratories of one university); U.S.	E – Medical wastes (e.g., used, uncapped needles, broken glass); O – cuts and punctures injuries	70% of cuts and punctures attributable to glass, needles, or cutting instruments; perceived contributors to injury – "sharps" in the trash, not using gloves while working, lack of knowledge of hazards, inexperience, and inadequate safety training.	na
Shiao et al., 2001	Cross-sectional	684 support workers in hospitals; Taiwan	E – Contact with "sharps"; O – injuries	Cleaners received most injuries (65.7%) compared to other workers; inappropriate disposal of objects was associated with 54.7% of all injuries.	na

E – exposures; O – outcomes.

sociated with physical workload and ergonomic factors (e.g., moving heavy linen carts) among hotel room cleaners [26]. Their analyses adjusted for several variables relating to job characteristics, demographics, lifestyle habits, and psychosocial job factors. Approximately 60% of the cleaners experienced severe or very severe back pain during the four weeks preceding the interview. Low back pain and muscle and joint complaints are also significantly associated with a fast work pace, job dissatisfaction, and job-related worry and tension [16,26,54]. Houtman and colleagues (1994) show that several aspects of intellectual discretion such as monotonous work, poor opportunities for personal development, poor fit between work and experience or education, and poor prospects of promotion were related to all indicators of musculoskeletal problems [16]. In addition to musculoskeletal disorders, several psychosocial stressors were associated with poor overall health.

Floor cleaning (mopping versus scrubbing) forces the cleaners to adopt awkward postures of the neck, shoulder, and low back, and requires exertion of the cardiovascular system and muscles [52]. A review by Yeung et al. [57] highlighted the unique challenges of another group of cleaners [57]. Their report showed that cleaners who are assigned to aircraft cabins often experience bodily discomfort and musculoskeletal pain in the lower and upper back, neck, hips, shoulder, hand and wrists, and legs and feet. These workers are faced with physically demanding tasks in confined spaces performed sometimes in extremes of temperatures and compounded by a tight work schedule.

3.4. Infectious diseases

Table 4 presents studies that investigated hazards associated with infectious disease exposure among cleaners. Cleaners in some work settings may be exposed to infectious agents through contact with biologically-contaminated sharp objects such as uncapped, discarded needles and broken glassware, as well as from cleaning or disposing of soiled rags, bedding and clothing or removing excreta and other biological wastes [35,40, 43]. Not surprisingly, many of these injuries occurred among cleaners working in medical research laboratories and hospitals [20,46,49]. The major sources of injury are related to disposal of inappropriate objects in the trash, resulting in cuts or punctures to the hand or finger by used needles and broken glass or sharp objects. In one study, several of the needles, blades or scalpels had been used on patients known to be hepatitis B surface antigen (HBsAg) positive, and one needle injury resulted in a Staphylococcus aureus infection [20]. In another study, the authors felt that the actual incidence was underestimated since the cleaners did not always report their injuries [46].

3.5. Psychological disorders

Zock [59] highlighted a variety of psychosocial stressors among cleaners: the sense of social isolation, concern for one's physical safety (especially among women), working alone and outside of regular working hours, the ramifications of the low status of this job that prevents them from having any influence over several aspects of their work, monotonous work, low social and legal protection, and little or no job secu-

Table 5
Epidemiologic studies of psychological effects from hazards in the work environment of cleaners

Author, year	Study design	Study population	Exposures and outcomes	Key findings	Confounders assessed
Sales and Santana, 2003	Cross-sectional	335 women; community-based; Brazil	E – The occupation of housekeeping; O – mental pain	Housemaids had higher prevalence of depression, anxiety, sadness, tiredness, poor concentration than women of other occupations.	Age

E – exposures; O – outcomes.

rity [59]. One study was identified that addressed the psychological effects of cleaning work. Housemaids in Brazil reported higher prevalence of mental problems such as depression, anxiety, sadness and tiredness, and poor concentration compared to women with other occupations [44]. This mental suffering is an effect of the social stigma associated with the job. According to the authors, housemaids in Brazil are treated with contempt and disdain and housekeeping has very low social status. Unlike other studies, the psychosocial hazard in this study is primarily the stigma and social prejudice attached to the job.

4. Discussion

Through a systematic search of electronic data bases and the reference list of articles, we identified 35 epidemiologic studies that provided information on the occupational hazards and related health outcomes of workers employed in cleaning and housekeeping occupations.

These studies indicate that respiratory diseases, dermatologic disorders, and allergic conditions are associated with cleaning agents, wet work, and rubber latex. The potential for infection was associated with contaminated needles, broken glass, waste material, and other trash through which workers can be exposed to biological agents. Musculoskeletal disorders were associated with awkward postures and other ergonomic hazards, and with psychosocial stressors. Low job control and job strain, other characteristics of cleaning work, may contribute to the development of cardiovascular disease, depression, and other health problems [13,48], and are indirectly associated with adverse health behaviors such as smoking and drinking [31]. Mental disorders were mostly associated with psychosocial stressors and societal stigma of the job [44].

No studies were identified that investigated health problems associated with other aspects of cleaning occupations such as organizational factors (e.g., shift work). Cleaners, due to the nature of their work, are often assigned to work during the late evening and night hours. Even though this is an important area for cleaners, we were unable to find published studies on this topic.

The studies we reviewed have several notable limitations. Many studies were descriptive in nature and several provided information on the incidence or prevalence of health outcomes rather than on the quantitative exposure-outcome associations. The cross-sectional design used in most of the studies was also a significant limitation, in particular because workers with the most severe job-related diseases are more likely to change jobs and therefore to be excluded from the study population. The majority of original studies relied on job titles to ascertain exposure. Although use of job titles is quick and inexpensive, misclassification of exposure may be more likely to occur with job titles than with the more time- and resource-consuming job-exposure matrix. Another limitation is the wide definition of the study population. The occupation of cleaners included a wide variety of workers, from persons who only cleaned buildings or aircraft to groups that included a combination of chimney sweeps, domestic cleaners and other cleaning workers. Some studies included participants of both sexes while others used only women. The measurement of outcomes was also quite variable. Symptoms or outcomes were sometimes obtained from self-report and other times from clinical records. Lack of uniformity among these studies made comparison of results challenging.

Very few studies assessed the specific exposures (e.g., the type of detergents used, the type and number of beds that need to be made per shift, specific tasks performed) in the work environment of cleaners or took into consideration the unique characteristics or circumstances of cleaners. In areas where the majority of cleaners are immigrants, language difficulties and cultural factors are important issues to incorporate into studies [10,28]. Cleaners, especially immigrants, experience several barriers including low educational attainment, low literacy skills (even in their native languages), and few resources [10,47]. Some cleaners lack adequate health care, cannot afford to take time off from work for medical care, frequently work while still

in pain, and have poorer overall health quality than the general population [28,47]. These conditions would complicate their health problems.

This population of workers deserves to be studied with greater frequency to develop interventions that will decrease their risk of injury and disease. They are too often viewed as non-essential and expendable when, in reality, their jobs play a significant role in allowing us to continue our existence as a civilized society. They work in most businesses and establishments. Their occupationally-related health problems are exacerbated by their low pay and benefits and part-time or temporary job status. According to the Bureau of Labor Statistics, the numbers of these workers are expected to grow by 14% between 2006 and 2016, one of the largest increases in the number of new jobs arising in any occupation [62]. Effective interventions for ergonomic, respiratory, and other hazards, based on scientific research, are necessary. The public health impact made by reducing, even by a small percentage, the injuries and diseases experienced by cleaners could be substantial.

Future studies investigating this topic should concentrate on hazards specific to cleaning and would be able to produce a less biased measure of the estimate of effect by using a longitudinal design. In addition, future studies may be enhanced if investigators assess the specific exposures in the work environment of cleaners rather than use job titles as surrogates for exposures, include more potential confounders, and where necessary, attempt to interview participants in their native languages.

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