

Short Communication

Does the Size of a Company Make a Difference in the Prevalence of Exposure to Asthmagens and in the Use of Respiratory Protective Equipment?

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Abstract

Introduction: About half of all workers in high-income countries work in small companies. However, regulatory bodies and researchers predominantly work with large companies because they are more convenient to study and easier to reach. We aimed to estimate the prevalence of exposure to asthmagens and the use of respiratory protective equipment (RPE) by company size.

Methods: This analysis used data from the Australian Work Exposures Study-Asthma, a telephone survey which investigated exposure to 27 asthmagen groups.

Results: Among 4844 respondents, 18.8, 19.9, 31.9, and 29.4% of workers reported working in micro (<5 employees), small (5–19 employees), medium (20–200 employees), and large (>200 employees) companies, respectively. Compared to workers in large companies, workers in micro, small, or medium companies had higher prevalence of exposure to most asthmagens and lesser use of RPE.

Conclusion: Our results suggest that policy actions and regulatory measures should target micro/small companies in order to have the greatest effect.

Keywords: asthmagens; company size; exposure; prevalence

Introduction

In high-income countries, including Australia (Connolly *et al.*, 2012), almost half of the workforce work in micro/small sized companies (<20 employees). Despite this, regulatory bodies and researchers tend to work with large companies (>200 employees) perhaps because

they are more convenient to study and easier to reach (Pinder *et al.*, 2016).

There is evidence that workers in micro/small companies have an increased risk of injuries compared to workers in large companies (Holte *et al.*, 2015). However, less is known about the prevalence of exposure

to occupational hazards by the size of the company. Two studies in Australia reported that workers in small workplaces had significantly increased odds of reporting exposure to occupational hazards compared to workers in larger workplaces (LaMontagne and Vallance, 2008; Safe Work Australia, 2015). The occupational hazards included exposure to dangerous airborne chemicals such as dust and fumes (LaMontagne and Vallance, 2008; Safe Work Australia, 2015). Workers in micro/small companies tend to have limited knowledge regarding risk and safety regulations and lack formal workplace systems for occupational health and safety (OHS) (MacEachen *et al.*, 2010), which might explain the higher prevalence of exposure to hazards in these companies.

We conducted the Australian Work Exposures Study (AWES)-Asthma in 2014 to investigate the prevalence of work-related exposure to asthmagens, reported elsewhere (Fritschi *et al.*, 2016). The current study uses these data to examine whether the prevalence of exposure to specific asthmagens and the use of respiratory protective equipment (RPE) varies by the company size.

Methods

AWES-Asthma was a national telephone survey conducted in 2014 to investigate the current occupational exposure to 277 workplace asthmagens, accumulated into 27 groups, among Australian workers (Fritschi *et al.*, 2016). All participants were asked to provide basic demographic information as well as occupational information including the size of the company they worked for. Company size was categorized as fewer than 5 workers (micro), 5–19 workers (small), 20–200 workers (medium), and more than 200 workers (large).

Using the web-based tool called OccIDEAS (Occupational Integrated Database Exposure Assessment System, www.occideas.org) (Fritschi *et al.*, 2009), we collected information about exposures in the current job held by the respondent using one of 52 job-specific modules (JSMs). When a job did not fit any of the 52 JSMs, the respondent was assigned a generic JSM. Each JSM contained questions related to specific tasks which had been identified as determinants of exposure to one or more of the asthmagens categories based on published literature and expert knowledge. Additionally, the JSMs included a question regarding the use of RPE when doing the job. At the end of the data collection, we coded each job according to the Australian and New Zealand Standard Classification (Australian Bureau of Statistics, 2006) and categorized them into 1 of 13 occupational groups determined to be relatively homogenous with regard to the relevant tasks undertaken and hence potential for exposure

to asthmagens. Unfortunately, this study did not collect information about industries. However, exposure to specific asthmagens groups by occupational groups has been published elsewhere (Zaemey *et al.*, 2017).

All statistical analyses were conducted using Stata v14. We used modified Poisson regression models with robust error variance to estimate the prevalence ratios (PRs) and 95% confidence intervals (CIs) of exposure to overall asthmagens and to specific asthmagens and to the use of RPE by the size of the company. The reference group was workers working in large companies. The trend test was conducted using the company size variable as continuous in the model and reporting the resulting P-value. The demographic variables of gender, age group, country of birth (Australia/other), highest level of education, socioeconomic status, remoteness of residence, and occupational group were adjusted for in all analyses. Because of convergence issues, some of the asthmagens groups were combined, particularly the groups which had low numbers of exposed workers.

Results

A total of 4844 (99.3%) workers completed the company size question. Among these workers, 18.8, 19.9, 31.9, and 29.4% reported working in micro, small, medium, and large companies, respectively. After adjusting for demographic characteristics and occupational groups, workers in micro, small, or medium companies were more likely to be exposed to one or more asthmagens compared to workers in large companies (Table 1). There was a clear trend of increasing prevalence of exposure for all groups combined and for most specific asthmagens groups with decreasing size of the company. The prevalence of exposure to industrial cleaning and sterilizing agents, latex, reactive dyes and chemicals, and other asthmagens did not vary by the size of the company.

Among the workers who were exposed to at least one asthmagens, workers in micro (aPR = 0.81; 95% CI 0.71–0.92), small (aPR = 0.66; 95% CI 0.58–0.76), and medium (aPR = 0.82; 95% CI 0.73–0.92) companies were less likely to report the use of RPE compared to workers in large companies. The use of RPE decreased with decreasing size of the company (P -trend < 0.01) (data not shown).

Discussion

To our knowledge, this is the first study to estimate the prevalence of exposure to specific asthmagens among workers by the size of the company. This study showed that workers in micro-sized companies had the highest prevalence of exposure to at least one asthmagens and to

Table 1. The PRs of exposure to at least one asthmagen group and to individual asthmagen groups by company size.

	Total <i>n</i> = 4844		Large companies (<i>n</i> = 1425)		Medium companies (<i>n</i> = 1,545)		Small companies (<i>n</i> = 965)		Micro companies (<i>n</i> =909)		<i>P</i> -trend
	Number exposed (%)	Number exposed (%)	Number exposed (%)	Adjusted PR ^a	Number exposed (%)	Adjusted PR ^a	Number exposed (%)	Adjusted PR ^a	Number exposed (%)	Adjusted PR ^a	
Any asthmagens	2122 (43.8)	476 (33.4)	693 (44.9)	1.07 (1.01–1.14)	437 (45.3)	1.14 (1.07–1.22)	516 (56.8)	1.20 (1.12–1.28)	<0.01		
Bio aerosols	1069 (22.1)	150 (10.5)	326 (21.1)	1.19 (1.02–1.39)	242 (25.1)	1.29 (1.11–1.50)	351 (38.6)	1.38 (1.19–1.61)	<0.01		
Latex	1044 (21.6)	259 (18.2)	362 (23.4)	1.06 (0.94–1.20)	214 (22.2)	1.12 (0.97–1.28)	209 (23.0)	1.09 (0.93–1.28)	0.18		
Arthropods or mites	913 (18.9)	119 (8.4)	261 (16.9)	1.15 (0.97–1.37)	210 (21.8)	1.28 (1.08–1.52)	323 (35.5)	1.42 (1.20–1.69)	<0.01		
Industrial cleaning and sterilizing agents	751 (15.5)	245 (17.2)	234 (15.2)	0.91 (0.80–1.03)	145 (15.0)	1.08 (0.92–1.28)	127 (14.0)	1.14 (0.94–1.39)	0.10		
Metals	714 (14.7)	90 (6.3)	183 (11.8)	1.29 (1.05–1.60)	154 (16.0)	1.73 (1.40–2.14)	287 (31.6)	2.23 (1.82–2.74)	<0.01		
Derived from plants (flour, flowers, other plants agents, wood)	698 (14.4)	108 (7.6)	193 (12.5)	1.06 (0.87–1.31)	149 (15.4)	1.41 (1.14–1.74)	248 (27.3)	1.96 (1.58–2.42)	<0.01		
Asthmagens derived from animals or fish/shellfish	602 (12.4)	71 (5.0)	174 (11.3)	1.21 (0.95–1.55)	128 (13.3)	1.45 (1.12–1.88)	229 (25.2)	1.71 (1.33–2.19)	<0.01		
Aldehydes	564 (11.6)	64 (4.5)	162 (10.5)	1.38 (1.06–1.81)	119 (12.3)	1.85 (1.40–2.44)	219 (24.1)	2.33 (1.77–3.06)	<0.01		
Ammonia	561 (11.6)	65 (4.6)	141 (9.1)	1.19 (0.91–1.56)	122 (12.6)	1.83 (1.39–2.40)	233 (25.6)	2.38 (1.82–3.10)	<0.01		
Biological enzymes	412 (8.5)	75 (5.3)	158 (10.2)	1.05 (0.83–1.33)	109 (11.3)	1.48 (1.16–1.90)	70 (7.7)	1.55 (1.15–2.09)	<0.01		
Foods	363 (7.5)	47 (3.3)	149 (9.6)	1.38 (1.04–1.84)	108 (11.2)	1.84 (1.37–2.47)	59 (6.5)	1.61 (1.11–2.32)	<0.01		
Acrylates	271 (5.6)	39 (2.7)	80 (5.2)	1.65 (1.14–2.39)	69 (7.2)	2.21 (1.52–3.23)	83 (9.1)	2.14 (1.43–3.19)	<0.01		
Anhydrides	193 (4.0)	29 (2.0)	33 (2.1)	0.88 (0.54–1.43)	31 (3.2)	0.91 (0.54–1.51)	100 (11.0)	1.63 (1.04–2.55)	0.01		
Epoxy	193 (4.0)	30 (2.1)	45 (2.9)	1.24 (0.80–1.94)	41 (4.3)	1.46 (0.93–2.30)	77 (8.5)	1.79 (1.15–2.78)	0.01		
Reactive dyes and chemicals	155 (3.2)	33 (2.3)	34 (2.2)	0.91 (0.58–1.42)	27 (2.8)	0.92 (0.56–1.50)	61 (6.7)	1.41 (0.93–2.13)	0.07		
Acids	134 (2.8)	34 (2.4)	47 (3.0)	1.50 (0.97–2.30)	18 (1.9)	1.02 (0.57–1.81)	35 (3.9)	1.76 (1.06–2.91)	0.09		
Isocyanates	117 (2.4)	14 (1.0)	30 (1.9)	1.59 (0.86–2.91)	20 (2.1)	1.32 (0.68–2.53)	53 (5.8)	2.18 (1.22–3.87)	0.01		
Others (soldering fluxes, ethylene oxide, pesticides, amines, medication)	258 (5.3)	69 (4.8)	60 (3.8)	0.90 (0.64–1.25)	44 (4.6)	0.94 (0.65–1.36)	85 (9.4)	1.26 (0.89–1.80)	0.21		

^aAdjusted PRs for gender, age, country of birth, education, socioeconomic status, remoteness, and occupational groups

most specific asthmagens. Moreover, workers in micro, small, and medium companies were less likely to report the use of RPE compared to workers in large companies.

While our study examined exposure to asthmagens, previous studies have found similar results in relation to other workplace hazards. A study in France showed that, compared to workers in companies with 1 to 9 employees, workers in companies with 500 or more employees had a lower prevalence of exposure to carcinogenic, mutagenic and reprotoxic chemicals (Havet *et al.*, 2017). Another Australian study found that the proportion of workers reporting co-exposure to airborne hazards declined with increasing workplace size (Safe Work Australia, 2015). A further Australian study looked at exposure to broad groups of chemicals and found that smaller companies had higher odds of exposure to cement, lime, paints, varnishes, and inks (MacFarlane *et al.*, 2012). In contrast, a study in New Zealand found that workers in medium sized companies were more exposed to noise than those in small or large companies (John *et al.*, 2014).

The higher prevalence of exposure in micro, small, and medium companies compared to larger companies could be attributed to the lower capacity of smaller workplaces to manage these hazards, which could be due to the lack of finances for safety programs (Hasle *et al.*, 2009). Another explanation is that micro/small companies lack knowledge of OHS rules and regulations. The lack of OHS knowledge in small companies might be due to less training or a lack of pressure to be knowledgeable because of policy flexibility and certain OHS exemptions (MacEachen *et al.*, 2010). Additionally, micro/small companies may have a lower chance of being inspected and therefore less of an incentive to implement OHS controls (MacEachen *et al.*, 2010). Further, workers in small companies may accept exposure to occupational hazards or health risks and perceive this as part of the job due to the informal social relations in the enterprise and their close relations with employers (MacEachen *et al.*, 2010).

The use of RPE has an important role in protecting workers from occupational diseases such as occupational asthma. In this study, the use of RPE was poor among workers in the micro/small companies in comparison to larger sized companies, which is consistent with findings from other studies (MacFarlane *et al.*, 2012; Jahangiri *et al.*, 2016; Top *et al.*, 2016). For example, a previous study showed that workers in smaller workplaces were less likely to report the provision of a range of individual control measures such as gloves and protective clothing (MacFarlane *et al.*, 2012). Top *et al.* reported that utilization of personal protective equipment was insufficient in micro scale wood product enterprises (Top *et al.*,

2016). A study in Iran found that personal protective equipment, such as face masks and hearing protectors, were available in only 26% of micro enterprises (<5 employees) (Jahangiri *et al.*, 2016).

The methodological strengths and limitations of AWES-asthma are considered elsewhere in more detail (Fritschi *et al.*, 2016). In short, limitations include non-response, self-reported data and not assessing the level of exposure. In this study, we have collected information on the use of a range of control measures (e.g. use of spray booths, extraction fans) when doing some tasks, which might have reduced the level of exposure to some chemical hazards. However, we are unaware if control measures were used for the other tasks in these companies, thus negating the need for RPE. Strengths of this study include the use of a task-based assessment of exposure and the examination of exposure across the working population rather than specific occupational groups or industries, which gives a better overall picture of where the majority of people are exposed to the chemical hazards.

In conclusion, Australian workers in micro/small companies have a higher prevalence of exposure to asthmagens compared to workers in larger companies and the literature suggests that this pattern may be similar for other chemical hazards. Furthermore, Australian workers in micro/small companies have a lower use of RPE compared to workers in larger companies. The results of this study indicate that initiatives to reduce exposure to asthmagens and to increase the use of protective equipments should be targeted towards workers in micro/small companies, as these are the workers who are likely to have the greatest benefit.

Declaration for publication

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