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ASTHMA IN THE WORKPLACE

Job strain, bullying and violence at work and asthma in Peruvian cleaners—a cross-sectional analysisKatja Radon, MSc¹, Uriel Llanqui, MSc², Andrés Arce, MD, MSc³, Ronald Herrera, MSc¹, Britta Herbig, PhD⁴, Dennis Nowak, PhD¹, and Manuel Parra, MD^{1,5}

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Abstract

Objectives: An increased asthma prevalence was found in cleaners. Many of them work in precarious employment conditions, potentially leading to stress, a known risk factor for asthma. We aimed to analyze whether asthma in cleaners might partly be explained by psychosocial working conditions. **Methods:** The study population of this cross-sectional study included 199 cleaners employed at regional public health services in Puno Province (Peru). They were compared to 79 unexposed workers from Lima, Peru (response 83%). Both groups answered the short version of the European Working Condition Survey and a modified version of the European Community Respiratory Health screening questionnaire. After multiple imputation, the association between psychosocial working conditions and asthma (wheeze without cold or use of asthma medication) was assessed. **Results:** The 12-months prevalence of asthma was 22% among cleaners versus 5% among unexposed workers ($p_{\text{Chi}^2} = .001$). Cleaners were more likely than unexposed workers to work with temporary or sub-contracts, have a high employment insecurity, high strain working conditions and low social support (all $p_{\text{Chi}^2} < .05$). Twenty-six percent vs. 10% reported a high bullying score; 39% vs. 8% had experienced violence at work (both $p_{\text{Chi}^2} < .001$). High bullying score (adjusted Odds Ratio 5.6; 95% Confidence Interval 1.5–21.4) and violence (2.4; 1.1–5.4) were the main predictors of asthma. Taking these factors into account, being a cleaner was not statistically significantly associated with the outcome (3.5; 0.9–13.8). **Conclusions:** Poor psychosocial working conditions of cleaners may partly explain the high prevalence of asthma. The underlying mechanism might be a stress-induced inflammatory immune response.

Keywords

Asthma, occupational, social support, workplace violence, developing country, Peru

HistoryReceived 20 December 2015
Revised 29 February 2016
Accepted 16 April 2016**Introduction**

Epidemiological studies in Europe and North America have shown an increased risk of asthma in cleaners [1–5]. A number of agents that might cause asthma in cleaners have been identified [6], especially bleach and other irritating chemicals in spray form [4]. Short-term studies in this occupational group confirmed the acute increase of respiratory symptoms over the working day [7, 8]; one study confirmed a worsening of respiratory function following spray use and the use of strong irritants [9]. Although the irritating effect on the airways predominates, sensitization might also be facilitated [5].

In contrast, the clinical experience of occupational physicians does not comply with these findings because very few

cleaners are compensated for occupational asthma [10]. Some authors found that asthma might not be caused by work as a cleaner but rather worsened by exposure in the workplace [2, 4, 8, 9]. One would then expect that in Germany, where work-aggravated asthma can be compensated as an occupational disease, the compensation rates among cleaners are higher. However, in 2014, only eight cases of asthma were recognized among the 700,000 registered cleaners in Germany [11]. One contributing factor might be that many cleaners are migrants, and language and cultural barriers might result in underreporting [5, 10]. Another factor might be the frequently precarious employment conditions of cleaners, including high turn-over and informal work in jobs without social insurance [10].

Such precarious and other stressful employment conditions and certain job characteristics (e.g., high demand, low control, lack of social support, role conflicts) are known to negatively affect mental health [12–15]. Moreover, they have been shown to increase the risk for psychological (e.g., bullying, mobbing) and physical violence, which in turn also negatively affect

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mental (and physical) health [13, 16]. Recent research indicates that these factors might also be associated with asthma [17–21]. Mechanisms are thought to be similar to other stressful life events and neighborhood violence seen in children [22–24], namely, an activation of the hypothalamic pituitary axis resulting in elevated plasma levels of cortisol and mediators of the cellular inflammatory response [25, 26].

Based on these findings, we hypothesized that the high prevalence of asthma in cleaners compared to other occupations might partly be explained by the poor psychosocial working conditions many cleaners face. We analyzed data obtained in two cross-sectional questionnaire surveys, one performed in a population of hospital cleaners from Puno, Peru and the other conducted with workers taking part in annual surveillance exams at an occupational health office offering services to various enterprises in Lima, Peru. The focus of these analyses was bullying and workplace violence, taking into account employment conditions, job demand, job control, social support and distress.

Material and methods

Study design and study populations

Since 2010, the Center for International Health has conducted cross-sectional questionnaire surveys on employment, working conditions and health in different groups of workers across Latin America [27].

In the course of these surveys, one of the authors invited all professional cleaners ($N = 617$) employed in one of the public health services in the Puno Region (Peru) to participate in an Occupational Safety and Health (OSH) training session at the regional hospitals. The Peruvian Health Ministry and the local social security manage these public health services. The written invitation was sent out by the persons in charge of the occupational health of these entities (Occupational Health Unit of the Regional Health Directorate and the Social Security Insurance of Puno Region). In addition, cleaners were informed personally about the training sessions.

The training sessions were organized between September and December 2011 during the working hours of the cleaners. Overall, 201 of the 617 cleaners (33%) participated in the training sessions. The main reason for not participating was the large distances between the respective healthcare unit and the closest hospital. In addition, in each healthcare unit, some of the cleaners had to stay to maintain the cleaning service.

Before the start of the training sessions, one of the authors (UL) invited the cleaners to complete an anonymous questionnaire, which was accepted based on informed consent by all participating cleaners. To answer the questionnaire, a trained interviewer read the questions to a small group of workers while each worker completed the questionnaire individually. This was necessary due to the limited level of literacy of many cleaners. For the final data analyses, two cleaners were excluded because they only answered two of the questions (sex and age category), leaving 199 cleaners for the analyses (99%).

The comparison group was formed by workers taking part in a periodic occupational surveillance program at an occupational health center in Lima, Peru. This private health center offers occupational health services to various enterprises in Lima. All 250 workers taking part in these check-ups between

November 2012 and March 2013 were invited by one of the authors (AA) to answer the written anonymous questionnaire after giving informed consent. Of these, 207 participated (83%). The current jobs of these workers were ISCO coded, and the asthma-specific job exposure matrix proposed by Kennedy et al. [28] was applied. Only workers in jobs without known asthma risk were selected as the unexposed comparison group ($N = 101$). To control for the level of education we only included workers in jobs requiring a lower or medium level of education (ISCO groups 3 and higher; $N = 79$). The resulting unexposed group included 51 office workers, 20 watchpersons and 8 electrical equipment assemblers/electrical mechanics and fitters.

Ethical approval was obtained by the ethics committee of the University Hospital Munich (LMU), the Consejo Departamental Puno, Colegio de Enfermeros del Perú and the Universidad Católica Santa María de Arequipa (Perú).

Questionnaire instrument and variable definition

We used the Spanish short version of the European Working Condition Survey using the recommended minimum set of questions [29]. In addition, a modified Spanish version of the validated screening questionnaire of the European Community Respiratory Health Survey I was included [30, 31].

Using the questions of the latter survey [30, 31], asthma was defined in those who reported having experienced wheezing without a cold in the 12 months prior to the survey and those taking asthma medication. Allergic rhinitis was considered present if the answer to the question “Do you have any nasal allergies, including rhinitis” was affirmative. Work disability was defined as self-reported job change due to respiratory problems.

As sociodemographic characteristics, we considered sex, age categories (<30 yrs; 30–39 yrs; 40+ yrs) and smoking (never vs. ever). Because only 20 subjects reported having ever been smokers, we did not stratify for current and ex-smoking.

Employment characteristics included employment duration in the current job (categorized into <1 yr (median), 1–2 yrs (75th percentile) and >2 yrs), type of contract (permanent, temporary, other), being subcontracted (yes vs. no), and employment insecurity (low, medium, high).

Following Karasek’s demand-control-support model [32], we applied the approach suggested by the European Working Condition Survey [33]:

- Four items of job demands (working at high speed; working to tight deadlines; not having enough time to get the job done; pace of work dependent on the work of colleagues).
- Seven items of job control mirroring different aspects of autonomy, i.e., design-, activity-, and decision-latitudes (applying own ideas in work; freedom to decide; being able to choose or change a) order of tasks, b) methods of work, c) speed or rate of work; being able to take a break when one wishes; being free to decide when to take holidays/days off).
- Three items of social support (getting assistance from a) colleagues or b) superiors/boss when needed; having good relationships at work).

As suggested by Niedhammer et al. [33] (Online appendix), the Likert-scale based responses (1 = never to 5 = always) were

transformed based on the formula:

$$x = 1 + \frac{\text{response on Likert scale} - 1}{\text{Number of response categories} - 1}$$

The resulting values (ranging between 1 and 2) of each item were summed to form the respective score. Using the 75th percentile of job demands and job control as the cut-off point, we defined four groups of jobs [34]: low strain jobs (low strain, high control), passive jobs (low strain, low control), active jobs (high strain, high control), and high strain jobs (high demands, low control). Likewise, social support was a-priori dichotomized at the 75th percentile of the distribution.

Using the same approach, the bullying score was created using three items: problems in communication, personal discredit and threats at work during the 12 months prior to the survey [29]. Each item was assessed on a scale from “No” (coded as 1) to “Yes, daily” (coded as 5). To analyze a potential dose-response relationship this score was a-priori divided into four groups based on the quartiles of its distribution.

Physical workplace violence, taken from the Spanish short version of the European Working Condition Survey [29], was considered present if the worker gave an affirmative response to having—during the 12 months prior to survey—either experienced violence from co-workers (colleagues, supervisors, subordinates), violence from other persons at the workplace (e.g., patients, customers), or sexual harassment at work (unwanted sexual attention, sexual harassment or abuse).

Distress was measured using Goldberg’s general health questionnaire (GHQ-12), a screening instrument to measure common mental health disorders (anxiety, depression) [35, 36]. The general mental health score was formed using the 0–0–1–1 scaling method. Because no validation study of the GHQ-12 exists for Peru, we used the Chilean cut-off of 5+ to define workers suffering from psychological distress [37].

Statistical analyses

Data were double entered in an EpiInfo Database (EpiInfo™ Vs. 3.5.4, CDC) with error check and were subsequently analyzed using SPSS vs. 23 (IBM).

The number of missing values for single items was $\leq 16\%$, with highest values in questions about workplace bullying and violence. This resulted in up to 28% of missing values in the scores. Therefore, after checking for missing patterns, we assumed data to be missing at random and imputed 10 datasets using the full conditional specification algorithm, and the convergence with the algorithm was checked using diagnostic measurements. For each of the datasets, scores were calculated as described here. Descriptive data before and after imputation were calculated to compare cleaners and unexposed workers (Table 4). We then combined the 10 imputed datasets in logistic regression models, and estimates were pooled using Rubin’s rules [38]. For each of the outcomes (wheezing, allergic rhinitis, work disability), the potential risk factors under consideration associated with the outcome in the crude models at $p < 0.10$ were included in a final logistic regression model. Type of job (unexposed worker vs. cleaner) was a-priori kept in all models.

In a sensitivity analysis, logistic regression models were repeated, restricting the study population to cleaners. To check

whether certain psychosocial working conditions are more important after a longer duration of exposure, analyses were additionally stratified by duration of employment (<1 yr vs. $1+1$ yr) taking all psychosocial working conditions into consideration.

Results

Approximately half of the study population was younger than 30 yrs. Sixty four percent of cleaners were female compared to 44% of the unexposed workers ($p = .002$). Smoking was less frequent among cleaners (4%) than among unexposed workers (15%) ($p = .002$). Employment duration was short; 50% of the population was employed for less than a year, without differences between cleaners and unexposed workers. Employment conditions were precarious, especially among cleaners, with 63% working on temporary contracts, 72% being subcontracted and 64% reporting high employment insecurity (Table 1).

The majority of both groups considered their jobs as passive jobs with low job demands and low job control. Cleaners were more likely to consider their job a high strain job (21% vs. 6% among unexposed workers; $p = .001$), and 93% of the cleaners were in the low social support group, compared to 49% of the unexposed workers ($p < .001$). Likewise, bullying and violence were statistically more frequently reported by cleaners than by unexposed workers ($p < .001$). Approximately one third of both groups was classified as being distressed ($p = .88$). When comparing the imputed results, no major differences with the complete data were found (Online Appendix, Table 3).

Prevalence of asthma was 22% in cleaners and 5% in unexposed workers ($p = .001$), whereas a higher prevalence of allergic rhinitis (21% vs. 13%; $p = .12$) and work disability (6% vs. 1%; $p = .08$) were not statistically significant (Figure 1).

In the bivariate analyses, bullying and violence at work, as well as smoking and duration of employment, were additional predictors of asthma (Table 2). After mutual adjustment, these associations were confirmed for the highest quartile of the bullying score (adjusted Odds Ratio 5.6; 95% Confidence Interval 1.5–21.4), violence at work (2.4; 1.1–5.4) and smoking (8.7; 1.9–38.8). Being a cleaner was not statistically significantly related to asthma in this model (3.5; 0.9–13.8), neither was duration of employment.

For allergic rhinitis, no association with bullying was found (highest quartile 1.4; 95% CI 0.5–4.5), whereas violence was associated with allergic rhinitis (3.5; 1.6–7.8). With respect to job characteristics, those in low strain jobs reported the highest prevalence of allergic rhinitis. Women (4.5; 2.0–10.1) and smokers (3.6; 1.1–12.2) were more likely to report allergic rhinitis. The crude and adjusted confidence intervals overlapped, indicating no major change in risk estimates.

With respect to work disability, confidence intervals were wide due to the low number of subjects who had changed their job due to respiratory problems ($N = 13$). The only factor statistically significantly related to this outcome in the final model was distress (4.7; 1.3–17.7).

Restricting the analyses to cleaners, the results were confirmed (Online appendix, Table 4). The same was true when

Table 1. Sociodemographics, employment characteristics, psychosocial working conditions and distress of 79 unexposed workers and 199 cleaners from Puno, Peru prior to imputation.

Variable	Category	N _{missing}	Unexposed (N = 79)		Cleaners (N = 199)		PChi ²
			n	%	n	%	
Sociodemographics							
Sex	Female	1	35	44.3	127	64.1	0.002
Age(yrs)	<30	2	35	44.3	94	47.7	0.17
	30–39		24	30.4	72	36.5	
	40+		20	25.3	31	15.7	
	40+		20	25.3	31	15.7	
Ever smoked	Yes	8	12	15.2	8	4.2	0.002
Job	Cleaner	0	0	0.0	199	100.0	—
	Office worker		51	64.6	0	0.0	
	Watchperson		20	25.3	0	0.0	
	Electrical mechanic		8	10.1	0	0.0	
Employment characteristics							
Duration of employment (yrs) ¹	<1	3	38	48.1	96	49.0	0.46
	1–2		28	35.4	68	34.7	
	>2		13	16.5	32	16.3	
Type of contract	Permanent	7	36	45.6	17	8.9	<0.001
	Temporary		27	34.2	121	63.0	
	Other ²		16	20.3	54	28.1	
Subcontractor	Yes	34	4	5.1	119	71.7	<0.001
Employment Insecurity	Low	6	48	60.8	17	8.8	<0.001
	Medium		18	22.8	52	26.9	
	High		13	16.5	124	64.2	
Psychosocial working conditions							
DCM Job Type ³	Low Strain	42	23	29.1	17	10.8	0.001
	Passive		47	59.5	98	62.4	
	Active		4	5.1	9	5.7	
	High strain		5	6.3	33	21.0	
Social support ⁴	Low	10	39	49.4	176	93.1	<0.001
Bullying ⁵	1st quartile	55	52	71.2	31	20.7	<0.001
	2nd quartile		12	16.4	29	19.3	
	3rd quartile		2	2.7	51	34.0	
	4th quartile		7	9.6	39	26.0	
Violence ⁶	Yes	36	6	8.1	66	39.3	<0.001
Distress ⁷	Yes	77	28	35.4	42	34.4	0.88

¹Range 1 month – 37 yrs; Median 1 yr.²Other: Fixed-term contract, self-employed, no contract.³DCM Job Type Demand Control Model Job Type: Low strain job: Low demand, high control; Passive job: Low demand, low control; Active job: High demand, high control; High strain job: High demand, low control where High demand: Upper quartile of the sum score of working at high speed; working to tight deadlines; not having enough time to get the job done; pace of work dependent on the work of colleagues; split at upper quartile of the distribution; Range 4 – 8; Quartiles 5.75, 6.25, 6.5625; Low control: Lower quartile of the sum score of applying own ideas in work; freedom to decide; being able to choose or change a) order of tasks, b) methods of work, c) speed or rate of work; being able to take a break when one wishes; being free to decide when to take holidays/days off; Range 8.25–14; Quartiles 10, 11, 12.⁴Lower quartile of the sum score of getting assistance from a) colleagues or b) superiors/boss when needed; having good relationships at work; Range 3–6; Quartiles 4.25, 4.75, 5.25.⁵Defined as violence from co-workers or other persons at the workplace or sexual harassment at work.⁶Bullying score (3 items: problems in communication, personal discredit, threats); Range 3–6; Quartiles 3, 3.5, 4.25.⁷GHQ-12 Score ≥ 5 .

stratifying for duration of employment (Online appendix, Table 5). The only effect modification found in the latter analyses was an interaction between sex and employment duration for allergic rhinitis, where the Odds Ratio for women was only increased in those with an employment duration of at least one year.

Discussion

This study among almost 200 Peruvian cleaners in the health-care setting indicates a high prevalence of asthma symptoms. At the same time, the employment conditions were precarious, and the psychosocial working conditions were poor, including alarmingly high levels of exposure to physical and psychological violence in the workplace. The latter explained part of the

increased odds of asthma symptoms in cleaners. For allergic rhinitis and work disability, associations were ambiguous, with psychological distress being the major predictor of work disability.

The prevalence of respiratory symptoms in cleaners in our study population was comparable to other studies, as was the prevalence in the unexposed group [1, 24, 39–41]. When comparing prevalences, one has to consider differences in definitions between studies. We could confirm known risk factors for our outcomes, like being female and smoking [42–44]. However, age and duration of employment were at most weakly associated with the outcome under study. One reason for this might be the young age of the population and the short employment duration. Unfortunately, for reasons of data confidentiality, age could only be assessed in broad categories.

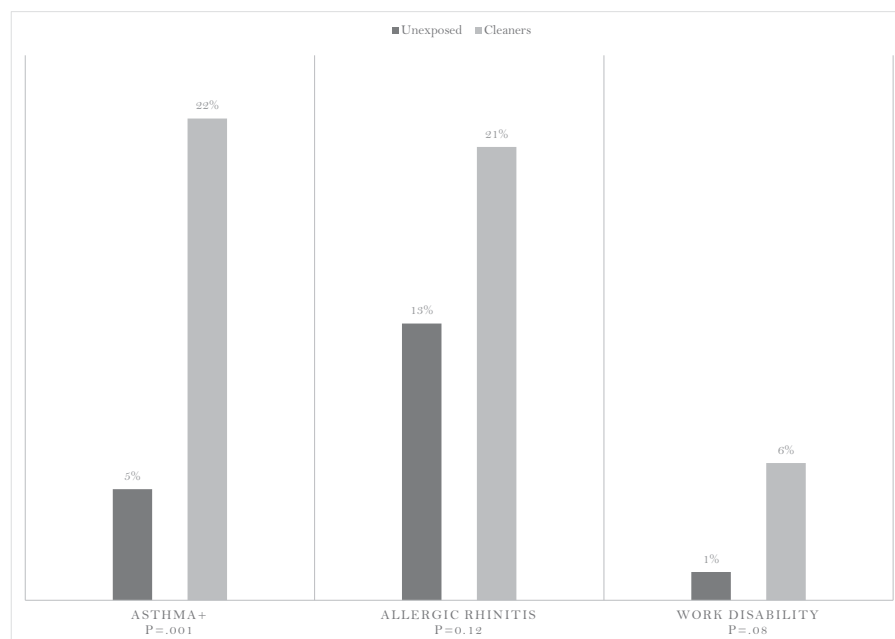


Figure 1. Prevalence of respiratory symptoms and work disability by exposure status using complete data (N = 269 for asthma, N = 275 for allergic rhinitis, N = 270 for work disability). + Wheezing without cold during the 12 months prior to survey or asthma medication.

The short duration of employment reflects the high job turnover in cleaners and in Latin America [10].

The associations seen between bullying, workplace violence and asthma symptoms are consistent with our hypothesis that at least part of the high prevalence of asthma in cleaners found in other studies might be due to stressful working conditions. However, the level of violence faced by the cleaners in our study is potentially much higher than in other populations due to the high prevalence of violence in Latin American countries [45]. In contrast, employment conditions were not associated with any of the symptoms under study. One reason for this might be the fact that 50% of our population reported an employment duration of less than 1 year. Employment conditions and imbalance between job demand and control might only result in respiratory health effects after a longer duration of employment [41], whereas violence results in acute effects. This would be in line with the result that unexposed workers and cleaners in our study reported similar levels of distress and the prevalence of distress was comparable to a previous Peruvian study where the authors found a prevalence of distress of 33% in an urban and 49% in a rural population [46].

Among the strengths of our study are that it is one of the first publications on work-related respiratory symptoms in Latin America. As recently stated, asthma and other respiratory diseases are understudied in developing countries [24, 42, 47]. Even so the expected prevalence of asthma was lower in the rural areas of Puno than in Lima we could nevertheless show a higher prevalence of asthma in cleaners [48]. The number of cleaners involved was relatively high despite the fact that this study population is hard to reach. An unexposed comparison group was included. Almost all eligible cleaners attending the OSH training session completed the questionnaire; response in the unexposed group was also relatively high (83%), minimizing the potential of selection bias.

Spanish versions of the same internationally established questionnaire instruments were used in both populations, and

the studies were conducted within an 18 months period during the same time of the year to avoid recall bias (spring to summer). Missing data imputation increased the power of the analyses and helped to reduce bias [49]; however, the missing at random hypothesis for the violence variables could not be studied because the lack of information available among the non-respondents to these variables. A variety of employment conditions and psychosocial working conditions were assessed; the evaluation scheme followed internationally recommended approaches to reduce information bias.

Nonetheless, it would have been useful to include clinical measures, like spirometry and skin prick tests, to confirm our findings. This was unfortunately not possible due to limited resources. One may therefore speculate that the association between violence and respiratory symptoms is due to over-reporting of symptoms in affected workers (common method bias) [50]. We therefore included distress in our analyses because we assumed that those over-reporting respiratory symptoms would also be more likely to report distress. Cleaners were neither more likely to suffer from distress nor did we find an association between distress and asthma symptoms or allergic rhinitis.

However, a weak association with work disability was found. Whether this association is due to reporting bias, reverse causality or distress being in the causal pathway between the psychosocial work environment and work disability due to respiratory disease cannot be determined based on our data. One has to take into account the limited power of these analyses because only 13 participants reported work disability with only one of them being part of the unexposed group. Our questionnaire did not assess access to health care or sick day benefits in our study populations. Furthermore, females were overrepresented in our exposed group. These aspects might have led to an underestimation of the true effect.

Although overall participation was good, only one third of the cleaners invited to take part in the OSH training sessions

Table 2. Crude and mutually adjusted Odds Ratios (ORs) with 95% Confidence Intervals (95% CIs) for respiratory symptoms by sociodemographics, job type, employment conditions, and psychosocial working conditions.

	Outcome	Asthma ⁺		Allergic Rhinitis		Work Disability	
Variable	Category	Crude OR (95% CI)	Adjusted OR(95% CI)	Crude OR (95% CI)	Adjusted OR(95% CI)	Crude OR (95% CI)	Adjusted OR(95% CI)
Sociodemographics							
Sex	Male	1	—	1	1	1	—
	Female	1.330.69–2.54	—	3.211.57–6.57	4.471.99–10.05	1.860.58–6.02	—
Age (yrs)	<30	1	—	1	—	1	—
	30–39	0.620.30–1.28	—	0.510.25–1.06	—	0.700.19–2.60	—
	40+	0.870.37–2.04	—	0.850.38–1.91	—	1.570.44–5.57	—
Smoking	Never	1	1	1	1	1	—
	Ever	3.681.38–9.81	8.651.93–38.77	3.221.24–8.36	3.591.06–12.17	1.040.12–8.84	—
Job	Unexposed	1	1	1	1	1	1
	Cleaner	5.371.86–15.52	3.530.90–13.82	1.860.88–3.93	0.790.27–2.32	6.160.79–47.85	2.660.28–25.76
Employment conditions							
Duration of	<1	1	1	1	—	1	—
Employment ¹ (yrs)	1–2	0.930.45–1.94	1.060.46–2.45	0.960.50–1.95	—	0.930.25–3.34	—
	>2	2.080.93–4.64	1.130.42–3.05	1.210.53–2.76	—	2.540.74–8.75	—
Type of contract	Permanent	1	—	1	—	1	—
	Temporary	0.890.39–2.00	—	1.330.56–3.15	—	1.180.32–4.38	—
	Other ²	0.770.30–1.96	—	1.560.61–4.00	—	0.220.02–2.53	—
Sub-contractor	No	1	—	1	—	1	—
	Yes	1.380.69–2.75	—	1.370.72–2.61	—	1.240.34–4.47	—
Employment Insecurity	Low	1	—	1	—	1	—
	Medium	1.930.76–4.87	—	1.560.67–3.61	—	1.360.34–5.41	—
	High	1.080.46–2.55	—	0.950.43–2.10	—	0.340.08–1.57	—
Psychosocial working conditions							
DCM Job Type ³	Low strain	1	—	1	1	1	—
	Passive	1.020.38–2.72	—	0.360.16–0.82	0.230.09–0.61	1.540.18–13.13	—
	Active	1.760.40–7.78	—	0.590.14–2.47	0.390.08–2.01	1.990.12–32.68	—
	High strain	1.170.38–3.67	—	0.770.31–1.91	0.550.18–1.62	3.170.37–27.18	—
High social support ⁴	No	1	—	1	1	#	—
	Yes	0.660.27–1.62	—	0.380.14–1.01	0.320.09–1.07	#	—
Bullying ⁵	1st quartile	1	1	1	1	1	1
	2nd quartile	1.260.27–5.85	0.720.13–3.97	2.260.88–5.83	1.630.55–4.85	1.890.11–31.28	1.040.06–18.86
	3rd quartile	3.961.21–12.95	2.410.58–9.96	1.840.72–4.68	1.290.41–4.08	7.580.89–64.63	2.880.28–29.18
	4th quartile	10.703.46–33.14	5.581.45–21.43	2.420.99–5.88	1.420.45–4.50	10.371.21–88.67	3.500.35–35.20
Violence ⁶	No	1	1	1	1	1	1
	Yes	5.002.46–10.17	2.391.06–5.38	3.281.72–6.25	3.491.56–7.80	4.191.33–13.14	2.240.65–7.81
Distress ⁷	No	1	—	1	—	1	1
	Yes	1.300.68–2.49	—	0.920.48–1.76	—	6.061.66–22.14	4.741.27–17.69

> Results of the logistic regression models using multiple imputation.

⁺ Wheezing without cold during the 12 months prior to survey or asthma medication.

Model unsTable due to low numbers.

¹ Range 1 month – 37 yrs; Median 1 yr.

² Other: Fixed-term contract, self-employed, no contract.

³ DCM Job Type Demand Control Model Job Type: Low strain job: Low demand, high control; Passive job: Low demand, low control; Active job: High demand, high control; High strain job: High demand, low control where High demand: Upper quartile of the sum score of working at high speed; working to tight deadlines; not having enough time to get the job done; pace of work dependent on the work of colleagues; split at upper quartile of the distribution; Range 4 – 8; Quartiles 5.75, 6.25, 6.5625; Low control: Lower quartile of the sum score of applying own ideas in work; freedom to decide; being able to choose or change a) order of tasks, b) methods of work, c) speed or rate of work; being able to take a break when one wishes; being free to decide when to take holidays/days off; Range 8.25–14; Quartiles 10, 11, 12.

⁴ Lower quartile of the sum score of getting assistance from a) colleagues or b) superiors/boss when needed; having good relationships at work; Range 3–6; Quartiles 4.25, 4.75, 5.25.

⁵ Bullying score (three items: problems in communication, personal discredit, threats); Range 3–6; Quartiles 3, 3.5, 4.25.

⁶ Defined as violence from co-workers or other persons at the workplace or sexual harassment at work.

⁷ GHQ-12 Score ≥ 5.

actually participated. We unfortunately do not know any of the characteristics of the non-participants, so it is hard to assess the direction of the potential selection bias in this group. One may assume that the hospitals sent only healthy workers. Another assumption might be that primarily young workers who had not received any previous safety training were sent.

However, prior to this, OSH training sessions were rarely offered to cleaners in the public health service of Puno Region.

We could not include those in remote areas of Puno Province due to difficult access. One might assume that control of working conditions is poorer in the remoter the area. This might also have affected the comparison between the unexposed and exposed groups because the comparison group consisted of workers from the capital, whereas cleaners lived in a rural province. Therefore, it cannot be ruled out that respiratory conditions are under-diagnosed in the cleaners under study. For this

reason, we did not consider doctor diagnoses of asthma as an outcome but based our analyses on symptoms in combination with the use of asthma medication.

We did not take family history of atopy into account. Nor did we determine whether symptoms are incident or due to a work-aggravation of pre-existing disease. Furthermore, specific exposures at the cleaners' workplace, like specific cleaning solvents, frequency of spray use or use of bleach, was not assessed. Therefore, we could not assess any dose-response relationship between workplace-specific chemical exposures and health. We also did not include other job characteristics, like working hours and days worked per week, in our analyses because they were not associated with the outcomes.

Finally, the cross-sectional nature of the study does not permit any causal inferences. Especially challenging is the fact that the 12-months prevalence of symptoms might include exposures outside the current workplace because for 50% of the population, duration of employment was <12 months. Nevertheless, stratifying the analyses for duration of employment confirmed the results, although the confidence intervals were wide due to the low number in both strata.

Conclusions and key findings

We confirmed an increased risk of asthma symptoms for Peruvian cleaners. Workplace bullying and violence were common and explained part of the effect. Whether this finding is generalizable to populations in other countries needs to be evaluated.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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