

Occupational Risk Factors for Hoarseness Among Police Officers in Finland

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Summary: Purpose. Police officers have many work-related risks. In Finland, hoarseness and other respiratory symptoms and related risk factors have not been investigated on a national level. In many of the work tasks carried out by the police, an excellent physical and mental condition is essential.

Method. Our aim was to determine the prevalence of hoarseness and related respiratory symptoms and to investigate eventual occupational risk factors associated with hoarseness. We also compared different work tasks and remediation procedures in three police stations with indoor air problems.

Material. In all, 767 persons completed a nation-wide e-mail survey. The study population is approximately 11% of the total police force in Finland. Half of the study population were men. In three cities, we evaluated the outcome of different type of remediation methods after the moisture damaged buildings were renovated. The prevalence of hoarseness was compared in different work tasks and the risk associated with indoor air, work-related stress, and background factors were estimated. Information on the remediation was obtained from the employer.

Results. Altogether, 30.5% of the respondents had hoarseness and 15.5% had work-related stress. Almost 9% were smokers and 43% had pets at home. Of all the respondents, 13% had asthma. Hoarseness was not related to work-related stress. The strongest risk factors for hoarseness were asthma and exposure to mold odor, dusts and cold temperatures after adjusting for age, gender, smoking and pet-owning. When three renovation techniques were compared, the best results were found in the building with a thorough remediation and the removal of mold from the building.

Conclusions. We conclude that the exposure to irritant gases, fumes, and bioaerosols should be minimized whenever possible in order to avoid incident asthma and voice problems.

Key Words: Vocal disorders—Hoarseness—Occupational health—Police officers—Environmental problem—Indoor air quality.

INTRODUCTION

Police officers are exposed to work-related stress, threats of violence, and physical and mental strain during their work duties more often than employees in many other occupations. Outdoor work, car exhaust, street dust, cold, and hot weather conditions are additional exposure risks. Such issues as the health status and well-being of policemen, as well as work absenteeism and their occupational risk factors have very rarely been the focus of scientific research or interventions.

Even before applying for police training, applicants are tested for several physical and psychological characteristics, which ensure suitability for future police work. In spite of this, they tend to develop work-related stress, respiratory symptoms and diseases during their working career. During their early working years, the lack of experience may increase the stress and again at the end of the career,

cynicism, and exhaustion may endanger their work ability.¹ In Finland, the police forces are employed by the state and the vast majority of policemen are members of their trade union, and thus the sample for studies can be obtained *via* the trade union.

Job related stressors of voice and respiratory health

Physical fitness, respiratory health and a clear voice are essential aspects of policemen's work ability. A clear and strong voice is needed when a policeman is on duty, in order to give instructions to the public, to communicate with other policemen, and other authorities often in critical situations. There is often background noise due to traffic, outdoor sounds due to the weather and eg, crowds shouting during a demonstration etc. Tear gas used in demonstrations and riots may cause eye irritation and dermatitis.² These kinds of situations occur very infrequently in our country, but other type of stressors occurs in different kind of work tasks of police officers, emergency calls, traffic surveillance, and criminal investigations. Different work tasks are associated with different level of exposures and stressors.³ However, most of previously published articles have no information of hoarseness and other voice problems and their association with work related exposures.

In office work, the surroundings are considerably quieter, but as policemen work in teams, good communication and a strong voice is also needed indoors. In office work, noise

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from the ventilation system, unpleasant temperatures, dust, fibers, draughts, insufficient ventilation, printers, poor acoustics, and cleaning chemicals may produce irritation to the vocal cords and the respiratory tract. The work as a police officer is different from other office work because a part of the working day is spent outdoors. Interrogations, writing reports, and investigations of crime scene may include both indoor and outdoor work, work in the car etc.

Environmental exposures and stressors

Working and cooperation with other actors, such as fire fighters and ambulance personnel may include both similar and different exposures (drugs, human excrements, vehicle exhaust, dusts, and microbes). Tear gas and pepper spray are known irritants of the eyes, skin and the respiratory tract.⁴ In Finland, police officers use their handguns extremely rarely, only an average of 10-20 times per year for the entire national police force. Policemen are sometimes exposed to tear gas or pepper spray, but also these situations occur very seldom in our country and mostly in the capital, Helsinki. Policemen are also trained in the use of handguns and other defense equipment. Policemen are in these situations exposed to irritant gases and fumes from the ammunition.

Some policemen work with dogs or horses. These policemen often have pets at home, or they train their dogs themselves. In Finland, we have mounted policemen only in the capital region in Helsinki. In Turkey, every fifth of the dog trainers showed sensitization to dog dander in skin tests.⁵ The corresponding prevalence rate of dog allergy is not known in Finnish police force.

Mental health stressors

Stress is often present in acute operative situations both during and after the event in the traffic or on the crime scene. The physical health of elderly policemen deteriorates for the same reasons as any other profession involving physical and mental strain: overweight, impaired physical fitness, sleeping difficulties due to shift work, stress, the consequences of injuries and accidents and sometimes also alcohol abuse.¹ According to studies in other countries, eight percent of police officers suffer of post-traumatic stress in the United Kingdom,⁶ and the problem seems to be increasing.⁷ We found no previous studies on the association of hoarseness and other voice problems and work-related mental health stressors among policemen.

Indoor air factors

In Finland, a considerable proportion of public buildings have moisture and microbial problems, insufficient ventilation, and other indoor air problems. The prevalence of indoor air problems in police stations is unclear and has not been investigated earlier on national level. Case reports have found that moisture damage in a police station can lead to severe health consequences.^{8,9} Unlike fire stations, police stations are owned in Finland by the government. So

far, most of the investigations of indoor air exposures have been performed in schools and office buildings and very little is known of governmental buildings.

Hyvönen and coworkers⁹ published health consequences of a severely damaged police station in Northern Finland. To prevent incidents like this, it is necessary to examine what the general working conditions are in our country and in what way the buildings have been remediated and how they should be maintained in the future. It is important to know how great the risks from poor indoor air quality are when compared with other occupational risks in police officers' work.

The indoor air exposure in police stations has a public health component as well because anyone in the society may sometimes be visiting a police station, eg, when being interrogated or after an incident in traffic, when witnessing in court etc.

Hoarseness or voice problems have been seldom mentioned in previous research when the health of police officers and their assisting personnel are concerned.

AIM OF THE STUDY

The aim of this study was to discover how police officers and other workers in police stations experience their occupational risks, working conditions and indoor air factors and also to what extent respiratory irritation and general symptoms occur among the police force; in addition, we questioned how the policemen experienced their workability, job satisfaction, and work-related stress.

MATERIAL AND METHODS

A survey was sent *via* e-mail to a sample of the total police force in Finland *via* their trade union (SPJL). In all, 767 persons responded, of which 50.3% were men and 49.7% were women. The questionnaire was based on the questionnaire previously used in research on the occupational risks of fire fighters and farmers. The questionnaire comprises 57 questions, 22 questions about working conditions, work related risks, ventilation system, remediation of the premises etc, and 10 questions about life-style and background factors. Altogether 14 questions concerned subjective health status, symptoms and diagnosed diseases, medication, and medical examinations. Some specific questions concerning the policemen's work and exposures were added. The questionnaire included the so-called Örebro-questionnaire¹⁰ and questions about respiratory infections and workability were selected from the Tuohilampi questionnaire.¹¹ The questionnaire has been validated by Kilpeläinen and coworkers (2001)¹². Examples of the questions: Have you had any of the following respiratory / general / neurological symptoms during the previous 12 months. Alternatives "Yes, daily or almost daily," "yes, every week," "more seldom," and "not at all." The four alternatives were combined to form a dichotomous (yes/no) variable by combining alternatives "daily, every week" and respectively combining "seldom" and "not at all." Dichotomous variables are mainly yes/no

categories and continuous variables such as age and “How many years you have been working in your current occupation?”

In addition to the national survey, a follow-up survey was sent to the same group of workers described earlier in the study by Hyvönen and Syrjälä (2019)⁸; this follow-up survey was conducted after the workers had been transferred to other premises.

The data were analyzed with SPSS 26 statistics (IBM Corp. Armonk, NY) and the dichotomous variables were tested with a chi square-test and the continuous variables with the *t*-test. The association between stress, symptoms and the indoor air quality were analyzed with multivariate logistic regression models and risk ratios after which the 95% confidence intervals were calculated. The *P*-value of <0.05 was considered statistically significant and in the logistic regression model, the OR and 95% confidence interval were calculated. In the analysis, we compared individuals with voice problems with healthy, nonsymptomatic individuals paying special attention to background factors, working conditions and risk factors and perceived indoor environment factors prior and after the remediation.

All respondents participated voluntarily, and informed consent was obtained as an attachment to the questionnaire. The study plan was approved by an Internal Review Board (IRB), ie, the ethical committee of the University of Turku, and also by the ethical committee of the local university hospital VSSHP (Dnr. 59/1801/2019).

The exposure data were obtained from the employer, ie, the cultivation and identification of microbes and the technical inspection of the buildings. These measurements were not performed in all police stations. The remediation methods were compared where microbiological data were available from the buildings.

RESULTS

Overall, 29.3% had hoarseness every week or daily. The respective prevalence was 26.0% for men and 32.7% for women. The difference between genders was statistically significant. The age of the participants varied between 22 and 64 years, the mean age of the men was 44.3 years and 47.7 years for the women.

Background and building related factors

Nine per cent of the respondents smoked regularly. In all, 43% had pets at home. Pet owners and smokers had only a slightly higher prevalence of hoarseness compared with individuals who had no pets and were nonsmokers, respectively. The differences were nonsignificant (Table 1). Indoor air problems at home (13%) had no significant association with hoarseness (data not shown).

The work task, site, floor in the building or the age of the work place building did not have a significant effect. However, employees working in the basement and working in an old building had a higher prevalence of hoarseness than others (Table 1).

Police work includes a number of different contaminants and exposures. Dust from the renovations, low temperatures, vehicle exhaust and mold or actinomyces exposure were significantly associated with hoarseness and a similar trend was observed in association with disinfectants and perfumes (*P*= 0.06) (Table 2).

Association of hoarseness with diagnosed diseases

Most of the respondents (74%) considered the state of their general health state to be good or excellent. Only four percent thought that their health was poor. Altogether, 13% had asthma, 21% had allergic rhinitis, eight percent had allergic eczema and three percent had allergic conjunctivitis.

Hoarseness correlated significantly with asthma and allergic rhinitis, but not with atopic eczema or with conjunctivitis. Hoarseness correlated with other diagnosed diseases, such as coeliac disease (five cases), and thyroid nodules (seven cases), but not with inflammatory bowel diseases, diabetes or hypertension.

Only a small number of participants had diabetes-I (1.3%), diabetes-II (3.7%), cancer (1.1%), or coronary heart disease (1.9%), and 17% had hypertension. Hypertension was associated with subjective stress, but none of the previously mentioned diseases was associated with stress or hoarseness. Two percent of the participants reported a mental disorder and these cases were associated with subjective stress, but not with hoarseness. Anxiety disorder and depression were not asked separately (Table 3).

Association of hoarseness with stress factors

Approximately 16% report work-related stress “often” and 50% “sometimes” and 29 % “only seldom.” Individuals with hoarseness reported stress slightly more often, but the association was not statistically significant. Men had hoarseness more infrequently than women, but the difference between genders was not significant.

Logistic regression models

Hoarseness was significantly correlated with asthma and exposure to a smell of mold, but not with pets, smoking or stress (Table 3).

Hoarseness associated with the remediation of the workplace

Additionally, when the work place building was awaiting remediation, the OR for hoarseness was 2.12 (CI, 1.25-3.58).

Almost 30% of all respondents had been working in premises that had been under repair during the last 12 months. Overall, 40% of the respondents replied that there had been ongoing repairs or renovations elsewhere in the same building, but not in their own working rooms. These respondents had hoarseness significantly more often (*P*< 0.05).

When different methods of remediating police stations were compared, a thorough remediation was associated with lower levels of hoarseness with the second-best results

TABLE 1.
Description of the Study Population (n, %). The Number (n) and Percentage (%) of Respondents with Hoarseness among the Total Number of the exposed (N). The Proportion of Persons with Hoarseness was Compared with Respective Proportion in Each Subgroup. P-Value <0.05 Shows the Statistical Significance

	Number of Hoarse Respondents, n	%	Total Number, N	P-Value
Men	98	26.0	377	0.04
Women	123	32.7	376	
Total	221	29.3	753	
Pets at home	100	30.8	325	0.47
No pets	124	28.4	437	
Smoker	24	35.3	68	0.29
Nonsmoker	202	29.1	693	
Work task				0.60
- Police	171	29.6	578	
- Ministry	40	27.8	144	
- Emergency center	10	41.7	24	
Site				0.43
- Office, ministry	18	27.7	65	
- Police office	127	31.8	400	
- Car, out in the field	35	23.2	151	
- Police prison	8	42.1	19	
- Emergency center	8	34.8	23	
- Varying task and site	11	26.2	42	
Age of the building				0.37
- Before 1950s	10	32.3	31	
- 1950s	7	36.8	19	
- 1960s	17	37.0	46	
- 1970s	20	29.9	67	
- 1980's	36	24.0	150	
- 1990s	61	35.3	173	
- 2000-2010	24	27.3	88	
- 2011 of after	12	21.8	55	
- Not known	32	27.8	115	
Floor of the working room				0.75
- Basement, cellar	29	39.7	73	
- 1 st floor	669	28.6	241	
- 2 nd floor	42	27.6	152	
- 3 rd floor	29	28.4	102	
- 4 th floor	25	28.4	88	
- 5 th or upper	9	27.3	33	
- Varying working room	16	29.1	55	

being shown in the group that had been moved to other premises. Higher levels of symptoms were found in the group where repeated tightening of the building structures had been performed ie, by reducing drafts and leakage of air through the construction (Table 4).

Association of hoarseness with workability and sickness absence

Before remediation, hoarseness was significantly associated with sick-leave due to respiratory illnesses (<0.001). Of the 21 respondents who had >25 days of work absence because of respiratory illnesses, 81% had hoarseness. Hoarseness

was not significantly correlated with work absence due to other diseases than respiratory illnesses (data not shown).

The proportion of different work tasks varied between genders. More than 60% of the women did mainly office work and almost one fourth worked in crime investigation. An equal percentage of the men worked in acute field work and crime investigation, and only nine percent worked mainly in the office. The difference between the work tasks among genders were statistically significant.

DISCUSSION

A clear and strong voice and good health are vital for policemen. We found no previous articles about the

TABLE 2.
Work-related Exposures and Contaminants and Their Association With Hoarseness (n, %). The Number (n) and Percentage (%) of Respondents With Hoarseness Among the Total Number of the Exposed (N). The Proportion of Persons With Hoarseness was compared With Respective Proportion Among the nonexposed. P-Value <0.05 shows the Statistical Significance

	n	%	N	P-Value
Noise	73	28.7	254	0.57
Asbestos	10	37.0	27	0.42
Dust from renovation	76	42.7	178	<0.001
Low temperatures	124	35.9	345	0.001
High temperatures	69	30.1	229	0.98
Mold, actinomycetes	129	42.9	301	<0.001
Street dust, soil, sand	16	29.1	55	0.87
Animal dander, feed	3	27.3	11	0.84
Vehicle exhaust	41	41.8	98	0.01
Gunpowder fumes	14	20.9	67	0.09
Physical strain	34	29.6	115	0.90
Risk of violence	66	26.7	247	0.16
Disinfectants	28	40.0	70	0.06
Perfumes	38	38.0	100	0.06
Excretions (human or animal)	49	31.4	156	0.68
Medicines, drugs	32	25.6	125	0.23
Excessive work load	83	32.8	253	0.25
Stress	109	29.6	368	0.79
Shift job	65	29.1	223	0.72
Too short recovery time	63	34.4	183	0.14

prevalence of hoarseness and associated risk factors. In Finland, a considerable number of the police force are women, which makes the comparison between genders possible and more reliable than eg, among employees in day care centers or schools where the staff are mainly women. It has been suggested that acoustic conditions and noise are large risk

factors for voice disorders and that as women's voices are generally weaker, they are therefore more subject to strain.^{13,14} Women tend to report stress more often than men, and thus far it has been unclear whether such stress is due to voice problems or *vice versa*. Our longitudinal study showed that hoarseness in schools is more prevalent than stress. Additionally, the renovation of buildings increased stress but diminished hoarseness.¹⁵ Our study presented in this article, is a cross-sectional survey and more follow-up studies are needed.

In other countries, the work of police officers is considered to be one of the most stressful occupations, and stress has been previously associated with metabolic syndrome, diabetes, cardiovascular diseases, and cancer.^{16,17} In a Polish study of 235 policemen, metabolic syndrome was associated with lower lung function parameters.¹⁸ Our study results showed similar association between stress and hypertension, but not with other diagnosed diseases associated with metabolic syndrome (cardiovascular disease or type II diabetes). A very low frequency of mental disorders may be due to under-reporting or the so-called "healthy worker effect," where individuals prone to anxiety are transferred to other duties or they change their occupation.

In countries with heavy outdoor air pollution, police officers are exposed to high concentrations of small particles (PM_{2.5}), formaldehyde, benzene, polyaromatic hydrocarbons, and diesel exhaust in the streets. An association has been suspected between polluted outdoor air and cancer clusters as well as other adverse health effects.^{19,20} Our study material showed no association with reported cancer. The outdoor air in Finland is less polluted than in most other countries in the world.^{21,22} Our study found a significant association with low temperatures, car exhaust, renovation dust and microbes but not with street dust or gunpowder fumes.

Policemen and firefighters are selected for their profession because of their physical and mental endurance and they are probably less prone to work-related stress than eg, office

TABLE 3.
Risk for Hoarseness in a Logistic Regression model, after Controlling for Age, Gender, Smoking and Pet Owning

	n	%	OR	95% CI	P-Value
Gender male	377	49.2	1		0.06
Female	376	49.0	1.47	0.98-2.20	
Age	759	mean 46 y	1.01	0.99-1.04	0.10
Pets	325	42.4	1.11	0.74-1.67	0.60
No pets	437	57.0			
Smoking	68	8.9	0.70	0.33-1.52	0.37
No/ex-smoker	693	90.4	1		
Work-related stress often	117	15.3	1.60	0.94-2.74	0.08
Less stress	638	83.2	1		
Asthma	101	13.2	2.04	1.22-3.42	0.01
No asthma	531	69.2	1		
Mold smell	67	8.7	5.50	2.98-10.14	0.001
No mold	580	7.6	1		

TABLE 4.
The Associations Between Renovations During the Previous 12 Months, the Renovation Method and Hoarseness (n, % of Respondents with Hoarseness)

	n	%	N	P-Value
Renovation in the Respondents own room	68	32.4	210 (27.9)	0.34
Elsewhere in the building	103	33.8	305 (39.8)	0.05
No renovation during past 12 months	68	23.5	289 (38.3)	0.003
Thorough remediation	7	25.7	24 (3.1)	0.001
Tightening of construction	40	53.3	75 (9.8)	
Transfer to clean premises	18	42.9	42 (5.5)	
No repair/method not known	161	25.7	626 (82.9)	

workers. Therefore, the follow-up of long-term exposure in a built environment is especially interesting in these occupations. In this material, we found no association between hoarseness and self-reported work-related stress. Stress was not a significant risk factor even when controlling for possible confounders in a logistic regression model.

Asthma was a risk factor for hoarseness in our study. This is in line with other studies published recently.¹⁵ Asthma and hoarseness may have common risk factors, eg, microbial exposures, and asthma medication tends to increase voice problems.²³

In our nation-wide project, entitled the SataKunta-program, we have collected health data from different occupations and collected exposure data directly from building owners, municipalities, cities, regional authorities, and the Finnish government. Previously, we have published articles about hoarseness and related risk factors among nurses, teachers, and children,^{14,15,24} but less research is available about policemen and other occupations where men are exposed. Different professions and occupational risk factors can be compared when it is possible to use similar questionnaires. We have used questionnaires that have been developed for indoor and outdoor air research in the 1980s and the current questionnaires have been validated for children in Finland,²⁵ and for adults in Finland¹² and in Sweden.¹⁰ This makes the national and international comparison of the results more reliable. Up to the present time, the association between stress and voice problems has been inconsistent. In cross-sectional studies, the association is significant,¹⁴ but not in follow-up studies.¹⁵

One of the strengths of this data is that the study material represents the whole country and represents 11% of the entire national police force, including all types of police tasks, and incorporates the ministry of internal affairs. The remediation data could be validated by obtaining

information about the repairs from the owners of the buildings, and not only from the participants themselves.

Some of the weaknesses of this study are the cross-sectional study design and the relatively small sample size, but we believe that the data represent the entire work force of Finnish policemen as we received replies from all parts of the country. The subsample of the follow-up survey conducted by Hyvönen and Syrjälä provided material (2019)⁸ that increases the reliability of our finding as the participation rate was higher in the follow-up survey than in the national survey.

Another weakness is the lack of clinical measurements, such as spirometry, and the NO in the exhaled air and immunological analysis, but we intend to continue the follow-up and combine clinical measurements in the study protocol in a similar way as in our previous study among teachers.²⁶

CONCLUSION

In conclusion, the study has demonstrated that both men and women report hoarseness and other respiratory symptoms in indoor exposure. Eventual causality cannot be stated in a cross-sectional study and more follow-up studies are needed. As found in a recent study among teachers, the subsequent symptoms and respiratory diseases can at least be partly avoided or reduced when police stations are eventually remediated in a proper way and according to the national recommendations and the Finnish building code, or when the employees are transferred to cleaner premises.²⁶

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REFERENCES

1. Soininen H. Työterveyshuollon järjestämisen liikuntaohjelman toteutavuus ja vaikutukset ikääntyvien poliisien terveyteen, fyysiseen toimintakykyyn ja työkykyyn [The feasibility of worksite fitness programs and their effects on the health, physical capacity and work ability of aging police officers. Academic dissertation]. *Kuopio University Publications D Med Sci.* 1995;68:1–169.
2. Treudler Tebbe, Blume-Peytavi Krasagakis, Orfanos. Occupational contact dermatitis due to 2-chloroacetophenone tear gas. *Br J Dermatol.* 1999;140:531–534. <https://doi.org/10.1046/j.1365-2133.1999.02724.x>.
3. Habersaat SA, Geiger AM, Abdellaoui S, et al. Health in police officers: Role of risk factor clusters and police divisions. *Soc Sci Med.* 2015;143:213–222. <https://doi.org/10.1016/j.socscimed.2015.08.043>.

4. Tidwell RD, Wills BK. *Tear Gas and Pepper Spray Toxicity*. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. 2022 Sep 19.
5. Kesici GG, Karataş A, Ünü İ, et al. Occupational allergy to dog among police dog trainers. *Eur Ann Allergy Clin Immunol*. 2019;51:265–272. <https://doi.org/10.23822/EurAnnACI.1764-1489.102>.
6. Brewin CR, Miller JK, Soffia M, et al. Posttraumatic stress disorder and complex posttraumatic stress disorder in UK police officers. *Psychol Med*. 2022;52:1287–1295. <https://doi.org/10.1017/S0033291720003025>.
7. Steel C, Tehrani N, Lewis G, et al. Risk factors for complex posttraumatic stress disorder in UK police. *Occup Med (Chic Ill)*. 2021;71:351–357. <https://doi.org/10.1093/occmed/kqab114>.
8. Hyvönen S, Syrjälä H. Asthma case cluster during renovation of a water-damaged and toxic building. *Microorganisms (Basel)*. 2019;7:642. <https://doi.org/10.3390/microorganisms7120642>.
9. Hyvönen S, Poussa T, Lohi J, et al. High prevalence of neurological sequelae and multiple chemical sensitivity among occupants of a Finnish police station damaged by dampness microbiota. *Arch Environ Occup Health*. 2021;76:145–151. <https://doi.org/10.1080/19338244.2020.1781034>.
10. Andersson K. Epidemiological approach to indoor air problems. *Indoor Air*. 1998;8(suppl 4):32–39. <https://doi.org/10.1111/j.1600-0668.1998.tb00005.x>.
11. Susitaival P, Husman T. *Tuohilampi Kysymyssarjat. Kyselylomakeisto Hengityselinten, Ihon Ja Silmien Yliherkkyyssairauksien Väestötutkimuksia Varten. [Tuohilampi Questionnaire Series on Allergic Respiratory, Skin and Eye Diseases for Population Studies]*. Haka-paino Oy Helsinki; 1996.
12. Kilpeläinen M, Terho EO, Helenius H, et al. Validation of a new questionnaire on asthma, allergic rhinitis, and conjunctivitis in young adults. *Allergy (Copenhagen)*. 2001;56:377–384. <https://doi.org/10.1034/j.1398-9995.2001.056005377.x>.
13. Sala E, Laine A, Simberg S, et al. The prevalence of voice disorders among day care center teachers compared with nurses: a questionnaire and clinical study. *J Voice*. 2001;15:413–423. [https://doi.org/10.1016/S0892-1997\(01\)00042-X](https://doi.org/10.1016/S0892-1997(01)00042-X).
14. Vertanen-Greis H, Löytyniemi E, Uitti J, et al. Work ability of teachers associated with voice disorders, stress, and the indoor environment: A questionnaire study in Finland. *J Voice*. 2022;36(6):879.e5-879. <https://doi.org/10.1016/j.jvoice.2020.09.022>.
15. Putus T, Vilén L, Atosuo J. The Association Between Work-Related Stress, Indoor Air Quality, and Voice Problems Among Teachers is There a Trend? *J Voice*. 2021;9:S0892-1997(21)00307-6. online ahead of print. [doi:10.1016/j.jvoice.2021.09.007](https://doi.org/10.1016/j.jvoice.2021.09.007).
16. Schilling R, Colledge F, Ludyga S, et al. Does cardiorespiratory fitness moderate the association between occupational stress, cardiovascular risk, and mental health in police officers? *Int J Environ Res Public Health*. 2019;16:2349. <https://doi.org/10.3390/ijerph16132349>.
17. Magnavita N, Capitanelli I, Garbarino S, et al. Work-related stress as a cardiovascular risk factor in police officers: a systematic review of evidence. *Int Arch Occup Environ Health*. 2018;91:377–389. <https://doi.org/10.1007/s00420-018-1290-y>.
18. Janczura M, Bochenek G, Nowobilski R, et al. The relationship of metabolic syndrome with stress, coronary heart disease and pulmonary function - An occupational cohort-based study. *PLoS One*. 2015;10:e0133750. <https://doi.org/10.1371/journal.pone.0133750>.
19. Patil RR, Chetlapally SK, Bagavandas M. Global review of studies on traffic police with special focus on environmental health effects. *Int J Occup Med Environ Health*. 2014;27:523–535. <https://doi.org/10.2478/s13382-014-0285-5>.
20. Mona GG, Chimbari MJ, Hongoro C. A systematic review on occupational hazards, injuries and diseases among police officers worldwide: Policy implications for the South African Police Service. *J Occup Med Toxicol*. 2019;14:2–15. <https://doi.org/10.1186/s12995-018-0221-x>.
21. Khreis H, Cirach M, Mueller N, et al. Outdoor air pollution and the burden of childhood asthma across Europe. *Eur Respir J*. 2019;54:1802194. <https://doi.org/10.1183/13993003.02194-2018>.
22. Chen J, Hoek G. Long-term exposure to PM and all-cause and cause-specific mortality: a systematic review and meta-analysis. *Environ Int*. 2020;143: 105974. <https://doi.org/10.1016/j.envint.2020.105974>.
23. Vilén L, Putus T. Hoarseness among nurses. *J Voice*. 2021;17:S0892-1997(21)00125-9. online ahead of print. [doi:10.1016/j.jvoice.2021.03.030](https://doi.org/10.1016/j.jvoice.2021.03.030).
24. Kallvik E, Putus T, Simberg S. Indoor air problems and hoarseness in children. *J Voice*. 2016;30:109–113. <https://doi.org/10.1016/j.jvoice.2015.02.012>.
25. Savilahti R, Uitti J, Husman T. Validity and recall of information from questionnaires concerning respiratory infections among schoolchildren. *Cent Eur J Public Health*. 2005;13:74. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/15969454>.
26. Vilén L, Päivinen M, Atosuo J, et al. Transferring from moisture damaged school building to clean facilities - The avoidance of mold exposure induces a decline in symptoms and improvement in lung function among personnel. *Environ Res*. 2022;212(Pt D): 113598. <https://doi.org/10.1016/j.envres.2022.113598>.