

Article

Allergic Sensitization and Psychosomatic Involvement in Outdoor and Indoor Workers: A Preliminary and Explorative Survey of Motorway Toll Collectors and Office Employees

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Abstract: The incidence of respiratory and cutaneous allergic disorders may be variable if we consider work activity. These disorders are reported in the current literature to have a relevant psychosomatic involvement. The aim of the study was to submit a survey on the self-reported occurrence of allergic respiratory and cutaneous diseases in outdoor and indoor workers to verify the onset or exacerbations of such pathologies, encourage surveillance, and suggest the need for further studies. Two groups of workers were compared when exposed and not exposed to air pollutants. An outdoor population of motorway toll collectors (153 workers; M: 58.03 years old, SD: 6.1; and female prevalence of 66.01%) and an indoor group of office employees (59 workers; mean age 54.44 years, SD: 8.50; and male prevalence of 61.02%) entered the study. The results of three multivariate analyses of the obtained data, investigating contributions of external factors, including age, sex, smoking habits, working type, and seniority, on allergic conditions were significant in both workers' groups. The findings highlighted that age and smoking habits were significant contributors to allergic conditions, both independently and in combination with other factors, such as sex and working type. The data suggest the presence of phenomena related to different etiological domains, as already reported in the literature. Through the collection of these data, it was possible to highlight the need to analyze clinical signs from different perspectives.

Keywords: indoor and outdoor workers; occupational allergic sensitization; psychosomatic disorders



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1. Introduction

Air pollution is defined as any substance in the air that may harm humans, animals, vegetation, or materials [1]. Traffic-related air pollution has been well-documented to be associated with increased risks of airway diseases in the general population [2], and they can also be secondary to environmental, ecological, psychobiological, psychological, and health-related components. In this sense, air pollution has been widely reported in the literature to impact physical, psychological, neuropsychological, and psychosomatic factors [3–5].

The two main fields of investigation are air pollution and work activities. Considering the current literature, a need to investigate factors related to air pollution has emerged, as well

as working dynamics, such as stress and pressure on workers, the physical and psychological functioning of workers, and, overall, all these factors build a multifaceted framework.

According to Rathee & Singh [6], subjects living in air-polluted areas show greater psychological discomfort, lower well-being, and low health perception. Decreased forced lung capacity, lower maximum voluntary ventilation, and higher respiration rates have been observed in subjects exposed to pollution.

Psychosomatic disorders correlated to medical respiratory conditions have been detected in subjects exposed to air pollution, to the point of requiring an analysis of their involvement when extended to different geographical areas and conditions [7], as well as evaluating significant risk factors for the subjects involved [8,9].

Many studies have linked the development of asthma to urbanization and exposure to pro-oxidative and traffic-related air pollutants [10]. Asthma is a clinical reality that foresees a multifactorial configuration in etiological terms, including psychological dynamics related to affectivity, alexithymia, issues related to the management of emotional experiences, and related to defensive mechanisms used improperly [11–20].

This attitude occurs not only in subjects with asthma but also in other different chronic conditions, grouped into dermatological [21–24], gastrointestinal [25–30], cardiologic [31–35], and respiratory domains other than asthma [36–39]. Psychological conditions linked to work activities in subjects with chronic diseases have found a wide resonance in the scientific literature [40–44].

In particular, it is known that factors such as burdens, adaptation disorders, and working conditions with relevant environmental dynamics, such as pollution, are risk factors for the onset of various psychopathological conditions [45–49].

From a biological perspective, air pollutants such as nitrogen dioxide (NO₂), ozone (O₃), and respirable particulate matter are usually classified by size or aerodynamic diameter (PM_{2.5}-defined particles are <2.5 μm in diameter; PM₁₀-defined particles are <10 μm), differ in their chemical composition, reaction properties, emissions, time of disintegration and ability to diffuse in long or short distances [1]. The worker's exposure to these agents has been documented to be stressful and a possible etiological factor of cognitive, psychological, and, in a broad sense, neuropsychological effects [9,50–53].

It has been seen that particulate matter, both fine (FP; ≤2.5 μm in diameter) and ultrafine (UFP; ≤0.18 μm in diameter), emitted by diesel engines in vehicular traffic correlate with an increased incidence of asthma and atopy. The particles of particulate matter promote a Th2-mediated inflammatory response through the activation of cytokines, such as IL-4 and IL-13, which upregulate the production of IgE [10]. These phenomena are known in the literature to cause the onset of many psychosomatic conditions [54–58]. Thus, it is essential to understand their relevance in order to structure diagnostic and intervention paths.

There are not many data relating exposure to pollution to the skin [59]. The common mechanism by which pollution can affect skin physiology is attributable to the induction of oxidative stress and inflammation [60]. Recent contributions considered variables such as inflammation and oxidative stress in different fields, such as psychiatric disorders, psychosomatic and psychobiological conditions, as well as physical conditions, all affecting subjects' quality of life and health status [61–67]. Such research requires implementation, considering the results and the difficulties still present in linking chronic skin diseases in workers to psychophysiological mechanisms directly centered on the aforementioned lesion and functional domains.

Nowadays, entire populations of workers are not included in scientific studies that could highlight risks and potentially pathogenic dynamics. In this sense, this study constitutes a preliminary exploratory investigation useful to the emergence of relevant phenomena and the understanding of the effects of biological and psychological variables in subjects involved in working activities, including exposure to pollutants or contact allergens.

Motorway toll collectors are generally exposed to the following working risks: poor ergonomics (posture), sleep disorders (night shifts), respiratory (air pollution), and contact

with nickel-containing coins [68]. In our study, these factors were evaluated to assess whether their occupational exposure is a favorable substrate for the onset or exacerbation of allergic pathologies, such as rhinitis, asthma, or allergic contact dermatitis. Office workers are indoor workers, generally exposed to video terminal and poor ergonomics risks, but are not exposed to traffic-related environmental pollutants and were considered as a control group in this study.

2. Materials and Methods

During a work surveillance visit, two populations of workers from the same motorway company were studied: one of toll collectors (group 1) and the other of office workers (group 2).

The survey involved 153 toll collectors (group 1) working at booths of a Sicilian motorway in the Strait of Messina area and 59 office workers (group 2) of the same company. Group 1 workers (52 males and 101 females) had an average age of 58.03 years (± 6.1) and an average working seniority of 24.03 years (± 8.50), while group 2 workers (36 males and 23 females) had an average age of 54.44 years (± 8.74) and an average working seniority of 26.01 years (± 8.87).

During a health check carried out by the occupational doctor, they were asked to fill in a survey drawn out by the Operative Unit of Allergology and Clinical Immunology of the University of Messina, answering questions that were reported in the electronic folder available at the G.Martino Hospital in Messina, Italy, where the research was conducted. The questionnaire consisted of 4 questions about patients' characteristics, 4 about any history of allergic diseases, and 4 about the onset of allergic sensitization during the last year. The questions were explained by the medical staff when submitting the questionnaire to facilitate its comprehension and answering. The questionnaire is reported in Figure 1.

Survey

Age: ____ years old Sex: Male Female

Smoker: Yes No

If you smoke for how many years? _____

Working Seniority _____

Are you allergic? Yes No

Did you suffer from:

1. Rhinitis? Yes No

2. Asthma? Yes No

3. Atopic Dermatitis? Yes No

4. Allergic contact Dermatitis? Yes No

with Nickel? Yes No

In the last 12 months did you have at work symptoms of:

1. Rhinitis? Yes No

2. Asthma? Yes No

3. Contact Dermatitis? Yes No

Figure 1. Questionnaire submitted to all workers examined. It consists of four questions about workers' characteristics, four questions about the history of allergic diseases, and three about the onset of allergic sensitization during the last year.

All the workers were informed about privacy and the use of anonymous data for research purposes and signed an informed consent form according to the European GDPR regulation 2016/679. The study was approved by the Ethics Committee of the University Hospital "G. Martino" of Messina, Italy, registration number 24/20. As reported in Figure 1, data were anonymous and collected without the initials of the workers investigated.

3. Statistical Analysis

Statistical analysis and graphs were performed using SPSS for Windows (version 17.0). Data are presented as average \pm standard deviations (SDs). A chi-square test (χ^2) was also performed to compare the observed frequencies of allergic conditions in the two study groups.

Furthermore, three multivariate analyses were carried out to investigate the possible contributions of external factors, including age, gender, smoking habits, working type, and years, on allergic conditions. To each variable, a numerical form was attributed and then reported in the database used for the statistical analysis (see the attached file in the Supplementary Materials). To carry out this analysis, a multivariate General Linear Model (GLM) was adopted, with age and working years categorized into two groups according to the median values, respectively.

4. Results

Data analysis of the 153 outdoor workers and motorway toll collectors showed that 53 (35%) were smokers (19 males and 34 females), and 100 (65%) were non-smokers (33 males and 67 females). Among outdoor workers, 20 (13%) had rhinitis (8 males and 12 females), and of these 8 were smokers (2 males and 6 females) and 12 non-smokers (6 males and 6 females), and 10 (7%) had asthma (3 males and 7 females), of which 5 were smokers (1 male and 4 females) and 5 non-smokers (2 males and 3 females). A total of 18/153 (12%) workers reported respiratory symptoms in the last 12 months; 15 (10%) presented with rhinitis symptoms (7 males and 8 females), and 3 (2%), 1 smoker and 2 non-smokers, experienced the exacerbation of asthma symptoms, which refers to an acute onset of symptoms of a chronic disease such as asthma.

Data also showed that 18 workers (11%) (8 males and 10 females) had dermatitis; 5 (3%) (3 males and 2 females) had atopic dermatitis, 13 (8%) (5 males and 8 females) had allergic contact dermatitis of which 10 (7%) had allergic contact dermatitis with nickel (4 males and 6 females). During the working activity in the last year, nine workers (6%) (4 males and 5 females) reported a new onset of contact dermatitis.

Data analysis of the 59 indoor workers and motorway office workers showed that 27 (46%) were smokers (18 males and 9 females), and 32 (54%) were non-smokers (16 males and 16 females).

In this population, 10 (17%) had a history of rhinitis (4 males and 6 females), and of these, 3 were smokers (2 males and 1 female) and 7 non-smokers, (2 males and 5 females); 7 (12%) had asthma, (2 males and 5 females), of which 2 were smokers, (1 male and 1 female) and 5 were non-smokers, (1 male and 4 females). A total of 10/53 indoor workers reported respiratory symptoms in the last 12 months. Rhinitis symptoms were present in 7 workers (12%) (3 males and 4 females), and 3 (5%) experienced the exacerbation of asthma symptoms (1 male and 2 females), all of which were non-smokers.

Data also showed that 10 (17%) indoor workers had a positive history of dermatitis, including 4 males and 6 females, of which 4 (7%) had atopic dermatitis (1 male and 3 females) and 6 (10%) had allergic contact dermatitis with nickel, (3 males and 3 females). During working activity in the last year, 2 (3%) of these workers (1 male and 1 female) presented with a new onset of contact dermatitis (Table 1).

Table 1. The table shows the prevalence of allergic conditions in outdoor and indoor workers from the same motorway company. Data are stratified by age, sex, smoking habits, and working seniority; the occurrence of allergic conditions in the last year is also reported.

External Factors		Outdoor Workers with Allergic Conditions				Outdoor Workers (No. 153)
		Rhinitis (13%)	Asthma (7%)	AD (3%)	DAC (8%)	
Average Age ($\mu \pm \sigma$)		58.4 \pm 6.93	60.4 \pm 2.59	61.8 \pm 2.68	60.5 \pm 3.18	58.03 \pm 6.1
Sex	Male	8	3	3	5	52
	Female	12	7	2	8	101
Smoking Habits	Smoker	8	5	2	8	53
	No-Smoker	12	5	3	5	100
Working Seniority ($\mu \pm \sigma$)		25.8 \pm 7.92	26.5 \pm 5.72	30.8 \pm 5.63	27.8 \pm 6.28	24.03 \pm 8.50
External Factors		Outdoor Workers with Allergic Conditions in the Last Year				
		Rhinitis (10%)	Asthma (2%)	Dermatitis (6%)		
Age ($\mu \pm \sigma$)		60.1 \pm 4.37	59.7 \pm 2.08	59.4 \pm 3.32	/	
Sex	Male	7	1	4	/	
	Female	8	2	5	/	
Smoking Habits	Smoker	6	1	4	/	
	No-Smoker	9	2	5	/	
Working Seniority ($\mu \pm \sigma$)		28.3 \pm 6.08	27.3 \pm 5.51	29.8 \pm 4.35	/	
External Factors		Indoor Workers with Allergic Conditions				Indoor Workers (No. 59)
		RHINITIS (17%)	ASTHMA (12%)	AD (7%)	DAC (10%)	
Age ($\mu \pm \sigma$)		51.7 \pm 8.58	52 \pm 9.18	51.5 \pm 13.13	59.5 \pm 4.28	54.44 \pm 8.74
Sex	Male	4	2	1	3	36
	Female	6	5	3	3	23
Smoking Habits	Smoker	3	2	2	3	27
	No-Smoker	7	5	2	3	32
Working Seniority ($\mu \pm \sigma$)		23.3 \pm 7.59	23.6 \pm 8.92	21.3 \pm 11.47	27.7 \pm 6.41	26.01 \pm 8.87
External Factors		Indoor Workers with Allergic Conditions in the Last Year				
		Rhinitis (12%)	Asthma (5%)	Dermatitis (3%)		
Age ($\mu \pm \sigma$)		51.6 \pm 9.71	56 \pm 2	59.5 \pm 6.36	/	
Sex	Male	3	1	1	/	
	Female	4	2	1	/	
Smoking Habits	Smoker	1	1	2	/	
	No-Smoker	6	2	/	/	
Working Seniority ($\mu \pm \sigma$)		21.9 \pm 9.11	26 \pm 7.81	28 \pm 11.31	/	

To determine if there was a significant difference in the occurrence of exacerbations for allergic conditions between the two groups of outdoor and indoor workers with different forms of environmental exposure, we performed a chi-square test. The calculated chi-square value ($\chi^2 = 2.182$) was less than the critical value ($\alpha = 0.05$: 7.815), indicating no significant difference between the two groups of workers (Table 2).

Table 2. The table describes the results of the statistical analysis performed with a chi-square test to compare observed (O) and expected (E) frequencies of allergic conditions among outdoor and indoor workers.

Condition	Outdoor Workers Observed (O)	Indoor Workers Observed (O)	Total Observed (O)	Outdoor Workers Expected (E)	Indoor Workers Expected (E)	χ^2 Outdoor Workers	χ^2 Indoor Workers	χ^2
Rhinitis	15	7	22	15.87	6.13	0.048	0.122	
Asthma	3	3	6	4.33	1.67	0.409	1.100	
Dermatitis	9	2	11	7.94	3.06	0.134	0.368	
No Allergic Symptoms	126	47	173	125.87	47.13	0.001	0.000	
Totals	153	59	212			0.592	1.590	2.182

Three multivariate analyses were carried out to investigate the possible contributions of external factors, including age, gender, smoking habits, working type, and years, on atopic conditions.

To carry out this analysis, a multivariate General Linear Model (GLM) was adopted, with age and working years categorized into two groups according to the median values, respectively.

The first analysis was conducted by estimating all output variables together (allergy, asthma, rhinitis, AD, DAC, DAC with nickel, recent rhinitis, recent AD, and asthma relapse). Significant effects were calculated, and for them, a partial η^2 value was also displayed, describing the proportion of total variability attributable to the respective factor, singularly or a combination of them. Of note, η^2 between 0.01 and 0.06 indicated a small effect of the variable or combination of variables, where a value between 0.06 and 0.14 indicates a medium effect, whereas a value above 0.14 is related to a large effect.

To this end, according to Pillai's Trace, it was observed that both age (partial $\eta^2 = 0.103$, $p = 0.014$) and smoking habits (partial $\eta^2 = 0.092$, $p = 0.030$) singularly contribute with a medium effect to the onset of the above mentioned clinical conditions, whereas a significant medium contribution was also seen for the combination of gender \times type of work (indoor or outdoor) \times age (partial $\eta^2 = 0.101$, $p = 0.015$) and for the combination of gender \times smoking habits \times type of work (indoor or outdoor) \times age (partial $\eta^2 = 0.138$, $p = 0.001$).

Secondly, we aimed to estimate the contributing factors to the clinical conditions above-mentioned, yet not recently occurring, therefore eliminating from the output the recent occurrence of rhinitis, AD, and asthma relapse. The results obtained showed a significant medium contribution for age (partial $\eta^2 = 0.080$, $p = 0.013$) and the combination between factors of age \times smoking (partial $\eta^2 = 0.067$, $p = 0.037$), gender \times type of work (partial $\eta^2 = 0.064$, $p = 0.048$) and, more significantly, for the combination of gender \times smoking habits \times type of work \times age (partial $\eta^2 = 0.125$, $p < 0.001$).

Lastly, we analyzed the recent conditions (recent rhinitis and AD, asthma relapse) as outputs of the model, and to this end, we observed a significant medium effect for smoking (partial $\eta^2 = 0.061$, $p = 0.007$) when considered alone or, as a smaller effect, in combination with the type of work (partial $\eta^2 = 0.052$, $p = 0.016$) (Table 3).

Table 3. This table summarizes the results of the three multivariate analyses conducted, providing an overview of the significant factors and their interactions.

Analysis	External Factor	Partial η^2	p -Value
First Analysis Output Variables: allergy, asthma, rhinitis, atopic dermatitis (AD), allergic contact dermatitis (ACD), ACD with nickel, recent rhinitis symptoms, recent AD manifestations, and asthma relapse.	Age	0.103	0.014
	Smoking habits	0.092	0.030
	Sex \times Type of work (indoor/outdoor) \times Age	0.101	0.015
	Sex \times Smoking habits \times Type of work \times Age	0.138	0.001
Second Analysis Output Variables: allergy, asthma, rhinitis, atopic dermatitis (AD), allergic contact dermatitis (ACD), and ACD with nickel (excluding conditions in the last year: rhinitis symptoms, AD manifestations, and asthma relapse).	Age	0.080	0.013
	Age \times Smoking	0.067	0.037
	Sex \times Type of work (indoor/outdoor)	0.064	0.048
	Sex \times Smoking habits \times Type of work \times Age	0.125	<0.001
Third Analysis Output Variables: recent rhinitis symptoms, recent AD manifestations, and asthma relapse.	Smoking	0.061	0.007
	Smoking \times Type of work (indoor/outdoor)	0.052	0.016

5. Discussion

The present study evaluates through a survey the possible onset or exacerbations of allergic respiratory and cutaneous pathologies in motorway toll collectors and office workers from the same motorway company. According to several studies [8,69,70], a strong psychosomatic involvement of chronic conditions, such as allergic respiratory and cutaneous pathologies, can be related to multifactorial etiology. In particular, Tzvia and colleagues [9] highlighted the role of long-term outdoor air pollution exposure, suggesting the need for studies simultaneously investigating air pollution in association with mental health.

It is known that gases and particles present in polluted air can cause damage to both the upper and lower respiratory tracts and induce the onset of clinical conditions such as rhinitis and asthma [71,72]. Both conditions, which can also be present in comorbidity, represent two functional phenomena influenced by different types of variables [73], including affective factors, such as anxiety and depression, and the personality and stress of different orders [74–77].

People with asthma generally suffer significant pollution effects compared to non-asthmatics [78].

Considering biological factors, the genetic substrate does not fully explain the mechanisms underlying the development of this clinical picture: epigenetics has attracted the attention of researchers by suggesting mechanisms that could lead to a better understanding of the pathogenetic mechanisms [79]. The first contact between atmospheric pollutants and the respiratory system occurs at the level of the epithelial cells, which are in line with the airways and act as an immunological and mechanical barrier: these cells are connected by tight junctions, secrete mucus, and express innate immune receptors that are activated in the presence of pollutants, such as O_3 and SO_2 , causing damage to the epithelium with the activation of Toll-like receptors and induction of oxidative stress [80]. Pollution has also been reported to induce oxidative stress and inflammation based on the combined effects of ambient air pollutants, such as nitrogen dioxide (NO_2) and FP matter, with a median aerodynamic diameter of less than $2.5 \mu m$ [59]. Inflammation and oxidative stress are the mechanisms by which FP matter determines its effects on health, generating oxygen-free radical activity, DNA oxidative damage, mutagenicity, and the stimulation of proinflammatory factors [81]. The altered function of the mitochondria or nicotinamide adenine dinucleotide phosphate-oxidases (NADPHs) and activation of inflammatory cells causes

the generation of ROS and reactive nitrogen species [82]. Some studies have focused on the role of oxidative stress compared to psychosomatic and general psychological variables; in particular, identifying a link between oxidative stress and psychopathological variables could be useful to better understand not only the role of some variables on the onset of conditions but also on comorbidities. Some recent contributions [83] considered the relationship between oxidative stress and dynamics, such as mental disorders, brain functioning, stress, and stress-related disorders, including adaptation and post-traumatic stress disorders.

Considering recent contributions to the understanding of psychoneuroimmunological and psychosomatic factors suggested by Kiecolt-Glaser and colleagues [84] as well as by Sahin and colleagues [85] and Sultana et al. [86], it is particularly interesting to understand all the factors competing with the onset, maintenance, and worsening of such pathological conditions. Recent and relevant studies directly correlated oxidative stress, inflammation, and functional and lesional psychosomatic phenomena, indicating a useful multidisciplinary approach to inspire further studies to investigate competing factors, decreasing the quality of life of subjects and their state of health [56,57,87].

Referring directly to the subjects involved in this study, relatively little has been published on these risks to outdoor workers. Most relevant studies have focused on traffic police, service station workers, and highway maintenance, especially in urban areas with high-traffic pollution; these studies suggest an increase in respiratory symptoms and a decrease in spirometry indices in non-smoking workers in these occupations compared to control subjects [2].

The importance of considering the above variables in workers exposed to pollution is crucial, as suggested by several contributions in the literature. The question concerns areas such as productivity and well-being at work [88], the psychological effects of general exposure [89], economic and social factors [52], as well as general psychological perspectives in different workers' populations and on a social level [53,90,91]. The data in the literature show the need to consider population groups and workers not previously investigated. In this sense, this study represents an exploratory approach to relevant clinical real-life data that need further attention and detail.

Thus, in our study, data collected through a survey submitted to outdoor and indoor workers from a motorway company in Sicily, in the South of Italy, reported a similar prevalence of respiratory allergic symptoms in both populations, respectively, for rhinitis in 13 and 7% and asthma in 10 and 3%. These ranges are also reported in the general population [92,93]. Therefore, occupational exposure to traffic pollutants did not increase the incidence of allergic symptoms in outdoor workers included in our study. It must also be underlined that these percentages were reported even if the workers had been employed for several years and, therefore, had a long working seniority.

The results of the present study have to be considered preliminary data, and therefore, further research is needed.

A confounding variable in the present research could be that motorway workers considered in this study, both outdoor and indoor, worked in the Strait of Messina area, which is characterized by low pollution levels [94].

Considering the information threshold for the ozone setting (O_3) and the annual average value of nitrogen dioxide (NO_2) and FP (PM 2.5 and PM10), it emerges that the air quality in our reference area is better when compared to a city like Genoa with similar geographical characteristics: these data were acquired by the Regional Agency for Environmental Protection [95] in the regions of Sicily and Liguria (Table 4).

Table 4. In this table, data acquired by the Regional Agency for Environmental Protection of Sicily and Liguria regions are reported considering Messina in Sicily and Genoa in Liguria.

Urban Area	NO ₂	O ₃	PM2.5	PM10
Messina (1)	Annual average 20 µg/m ³	Day of exceedance OLT: 1	Annual average 11 µg/m ³	Annual average 22 µg/m ³
Genoa (2)	Annual average 54 µg/m ³	Day of exceedance OLT: 7	Annual average 13 µg/m ³	Annual average 23 µg/m ³

Allergic contact dermatitis has proven to be a professional problem affecting quality of life and working capacity, although nickel allergies have a genetic predisposition [96] and are known as a condition of high psychosomatic incidence; therefore, they are dependent on several factors worthy of consideration [97,98]. The hands are commonly involved in occupational contact dermatitis [99]. Nickel is an allergen that commonly causes contact dermatitis [100], and the risk of the elicitation of nickel dermatitis, concerning repeated exposure to low levels of this metal in exposed workers, such as motorway toll workers, is described as nickel is used in coins due to its low cost, shiny surface, and corrosion resistance [101].

Nucera et al. [102] evaluated the presence of nickel in Euro coins; twenty-five patients underwent a patch test with 1- and 2-Euro coins, and nineteen of them were positive. Outdoor toll collector workers and indoor office workers in our population reported a new onset of contact dermatitis in 6% and 3% of workers, respectively, overlapping the prevalence of contact allergies in the European general population [103].

Our study, unfortunately, has some limitations, such as the small sample size and the self-reported nature of the data, even if the multivariate analysis showed a statistically significant result, which highlights the importance of considering both individual and combined effects of external factors on allergic conditions in outdoor and indoor workers. Age and smoking habits resulted as significant contributors, both independently and in combination with other factors, such as sex and working type. The present study is a preliminary exploratory report. Further studies should be based on the data that emerged to perform analyses useful to reveal phenomena related to the onset, maintenance, and exacerbation of pathological conditions interfering with quality of life. Surveys like the one used in this study could be easily administered to investigate the presence of allergic respiratory and skin pathologies in workers to verify and possibly report the onset or exacerbations of such pathologies, improving occupational health policies. In all, employees' well-being could be further investigated in larger samples to obtain appropriate and informative results, analyzing different variables correlated to allergic sensitization, psychosomatic phenomena, and working environments through a complete allergic and psychometric work-up and evaluating work-related environmental quality.

6. Conclusions

Allergens and haptens can cause allergic sensitization, inducing the appearance of various allergic diseases that need early diagnosis for timely treatment. Allergic respiratory and cutaneous sensitization are pathological entities that adversely affect the quality of life and workers' state of health. Moreover, it has been possible to suggest that the etiology, often not fully known, and competing factors represent a multifactorial configuration that needs to be appraised.

Data obtained during the above-reported work surveillance visit of motorway toll collectors and office workers from the same motorway company through self-reported answers to a survey about allergic respiratory and cutaneous symptoms were encouraging in terms of the low incidence of occupational allergic sensitization, while age and smoking habits were significant contributors both independently and in combination with other

factors, such as sex and working type. Nevertheless, the results obtained from different workers with different risk factors rule this study as a starting point for a more articulated consideration of phenomena, their causes, and their relationships with other types of factors.

Other surveillance studies should be performed on these and other categories of workers to follow up on the possible onset of allergic diseases in various geographical areas with different levels of air pollution and different levels of psychosomatic involvement.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/healthcare12141429/s1>.

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References

1. Kampa, M.; Castanas, E. Human Health Effects of Air Pollution. *Environ. Pollut.* **2008**, *151*, 362–367. [[CrossRef](#)] [[PubMed](#)]
2. Choudhary, H.; Tarlo, S.M. Airway Effects of Traffic-Related Air Pollution on Outdoor Workers. *Curr. Opin. Allergy Clin. Immunol.* **2014**, *14*, 106–112. [[CrossRef](#)] [[PubMed](#)]
3. Bullinger, M. Psychological Effects of Air Pollution on Healthy Residents—A Time-Series Approach. *J. Environ. Psychol.* **1989**, *9*, 103–118. [[CrossRef](#)]
4. Lundberg, A. Psychiatric Aspects of Air Pollution. *Otolaryngol.—Head Neck Surg.* **1996**, *114*, 227–231. [[CrossRef](#)] [[PubMed](#)]
5. Masci, F.; Spatari, G.; Giorgianni, C.M.; Bortolotti, S.; Rosecrance, J.; Colosio, C. A Wearable Device to Assess the Spine Biomechanical Overload in a Sample of Loggers. In Proceedings of the 21st Congress of the International Ergonomics Association (IEA 2021) Volume V: Methods & Approaches 21, Online, 13–18 June 2021; Springer: Cham, Switzerland, 2022; pp. 162–170. [[CrossRef](#)]
6. Rathee, N.; Singh, R. Prolonged Exposure to Air Pollution in Relation to Psychosomatic and Psychophysiological Parameters. *J. Indian* **2008**, *64*, 1–14.
7. El-Sayed, M.M.; Saadia, M.A.; Mostafa, H.R.; Kadry, M.H. The psychosomatic disorders among those exposed to interrelated environmental stresses (an ecological field). *J. Environ. Sci.* **2022**, *51*, 135–172. [[CrossRef](#)]
8. Petrowski, K.; Bastianon, C.D.; Bühner, S.; Brähler, E. Air Quality and Chronic Stress: A Representative Study of Air Pollution (PM: 2.5; PM: 10) in Germany. *J. Occup. Environ. Med.* **2019**, *61*, 144–147. [[CrossRef](#)] [[PubMed](#)]
9. Tzivian, L.; Winkler, A.; Dlugaj, M.; Schikowski, T.; Vossoughi, M.; Fuks, K.; Weinmayr, G.; Hoffmann, B. Effect of Long-Term Outdoor Air Pollution and Noise on Cognitive and Psychological Functions in Adults. *Int. J. Hyg. Environ. Health* **2015**, *218*, 1–11. [[CrossRef](#)] [[PubMed](#)]
10. Xia, M.; Viera-Hutchins, L.; Garcia-Lloret, M.; Rivas, M.N.; Wise, P.; McGhee, S.A.; Chatila, Z.K.; Daher, N.; Sioutas, C.; Chatila, T.A. Vehicular Exhaust Particles Promote Allergic Airway Inflammation through an Aryl Hydrocarbon Receptor–Notch Signaling Cascade. *J. Allergy Clin. Immunol.* **2015**, *136*, 441–453. [[CrossRef](#)] [[PubMed](#)]
11. Albus, C. Basic Concepts of Psychosomatic Medicine. In *Psychocardiology: A Practical Guide for Doctors and Psychologists*; Springer: Berlin/Heidelberg, Germany, 2022; pp. 41–49. [[CrossRef](#)]
12. Gangemi, S.; Ricciardi, L.; Caputo, A.; Giorgianni, C.; Furci, F.; Spatari, G.; Martino, G. Alexithymia in an Unconventional Sample of Forestry Officers: A Clinical Psychological Study with Surprising Results. *Mediterr. J. Clin. Psychol.* **2021**, *9*, 1–18. [[CrossRef](#)]
13. Khosravani, V.; Samimi Ardestani, S.M.; Alvani, A.; Amirinezhad, A. Alexithymia, Empathy, Negative Affect and Physical Symptoms in Patients with Asthma. *Clin. Psychol. Psychother.* **2020**, *27*, 736–748. [[CrossRef](#)] [[PubMed](#)]
14. Korkmaz, H.; Karasu, M.; Ateşçelik, M.; Özsoy, F.; Korkmaz, S. The Relationship between Defence Mechanisms and Clinical Variables in Myocardial Infarction Patients. *Arch. Med. Sci. Atheroscler. Dis.* **2022**, *7*, e136. [[CrossRef](#)] [[PubMed](#)]
15. Moes-Wójtowicz, A.; Wójtowicz, P.; Postek, M.; Domagała-Kulawik, J. Asthma as a Psychosomatic Disorder: The Causes, Scale of the Problem, and the Association with Alexithymia and Disease Control. *Adv. Respir. Med.* **2012**, *80*, 13–19. [[CrossRef](#)]

16. Plaza-González, S.; Zabala-Baños, M.d.C.; Astasio-Picado, Á.; Jurado-Palomo, J. Psychological and Sociocultural Determinants in Childhood Asthma Disease: Impact on Quality of Life. *Int. J. Environ. Res. Public Health* **2022**, *19*, 2652. [[CrossRef](#)] [[PubMed](#)]
17. Pylypenko, N.; Kovalova, O.; Prokofieva, O.; Kochkurova, O.; Kriukova, M.; Zelinska, Y. Contemporary Approaches to Diagnosis, Psychotherapy and Neuro-Psychocorrection of Emotional Disorders in Psychosomatic Diseases. *BRAIN Broad Res. Artif. Intell. Neurosci.* **2022**, *13*, 277–294. [[CrossRef](#)] [[PubMed](#)]
18. Ricciardi, L.; Spatari, G.; Vicario, C.M.; Liotta, M.; Cazzato, V.; Gangemi, S.; Martino, G. Clinical Psychology and Clinical Immunology: Is There a Link between Alexithymia and Severe Asthma? *Mediterr. J. Clin. Psychol.* **2023**, *11*, 1–18. [[CrossRef](#)]
19. Silvestro, O.; Ricciardi, L.; Catalano, A.; Vicario, C.M.; Tomaiuolo, F.; Pioggia, G.; Squadrito, G.; Schwarz, P.; Gangemi, S.; Martino, G. Alexithymia and Asthma: A Systematic Review. *Front. Psychol.* **2023**, *14*, 1–14. [[CrossRef](#)]
20. Ye, G.; Baldwin, D.S.; Hou, R. Anxiety in Asthma: A Systematic Review and Meta-Analysis. *Psychol. Med.* **2021**, *51*, 11–20. [[CrossRef](#)] [[PubMed](#)]
21. Gieler, U.; Gieler, T.; Peters, E.M.J.; Linder, D. Skin and Psychosomatics—Psychodermatology Today. *JDDG J. Dtsch. Dermatol. Ges.* **2020**, *18*, 1280–1298. [[CrossRef](#)] [[PubMed](#)]
22. Jafferany, M.; Patel, A. Understanding Psychocutaneous Disease: Psychosocial & Psychoneuroimmunologic Perspectives. *Int. J. Dermatol.* **2020**, *59*, 8–15. [[CrossRef](#)]
23. Marek-Jozefowicz, L.; Czajkowski, R.; Borkowska, A.; Nedoszytko, B.; Żmijewski, M.A.; Cubala, W.J.; Slominski, A.T. The Brain–Skin Axis in Psoriasis—Psychological, Psychiatric, Hormonal, and Dermatological Aspects. *Int. J. Mol. Sci.* **2022**, *23*, 669. [[CrossRef](#)] [[PubMed](#)]
24. Millington, G.W.; Shobajo, M.T.; Wall, J.; Jafferany, M. Somatization in Dermatology. *Skin Health Dis.* **2022**, *2*, e164. [[CrossRef](#)] [[PubMed](#)]
25. Artemieva, M.S.; Kuznetsov, V.I.; Sturov, N.V.; Manyakin, I.S.; Basova, E.A.; Shumeyko, D. Psychosomatic Aspects and Treatment of Gastrointestinal Pathology. *Psychiatr. Danub.* **2021**, *33*, 1327–1329. [[PubMed](#)]
26. Feng, L.; Li, Z.; Gu, X.; Jiang, J.; Liu, X. Psychosomatic Disorders in Patients with Gastrointestinal Diseases: Single-Center Cross-Sectional Study of 1186 Inpatients. *Gastroenterol. Res. Pract.* **2021**, *2021*, 6637084. [[CrossRef](#)] [[PubMed](#)]
27. Olden, K.W.; Drossman, D.A. Psychologic and Psychiatric Aspects of Gastrointestinal Disease. *Med. Clin. N. Am.* **2000**, *84*, 1313–1327. [[CrossRef](#)] [[PubMed](#)]
28. Person, H.; Keefer, L. Psychological Comorbidity in Gastrointestinal Diseases: Update on the Brain-Gut-Microbiome Axis. *Prog. Neuropsychopharmacol. Biol. Psychiatry* **2021**, *107*, 110209. [[CrossRef](#)] [[PubMed](#)]
29. Sun, X.; Cao, S.; Liu, J.; Dong, F. Psychosomatic Approach of Functional Gastrointestinal Disorders. *Chin. J. Clin. Healthc.* **2022**, *25*, 428–432.
30. Zhang, X.; Li, Y.; Zhong, Y.; Wang, Z. Variables Associated with Body Image Concerns in Acromegaly Patients: A Cross-Sectional Study. *Front. Psychol.* **2022**, *13*, 733864. [[CrossRef](#)] [[PubMed](#)]
31. Fava, G.A.; Cosci, F.; Sonino, N. Current Psychosomatic Practice. *Psychother. Psychosom.* **2017**, *86*, 13–30. [[CrossRef](#)] [[PubMed](#)]
32. Goldstein, M.G.; Niaura, R. Psychological Factors Affecting Physical Condition: Cardiovascular Disease Literature Review. *Psychosomatics* **1992**, *33*, 134–145. [[CrossRef](#)] [[PubMed](#)]
33. Littman, A.B. Review of Psychosomatic Aspects of Cardiovascular Disease. *Psychother. Psychosom.* **1993**, *60*, 148–167. [[CrossRef](#)] [[PubMed](#)]
34. Swenson, J.R.; Clinch, J.J. Assessment of Quality of Life in Patients with Cardiac Disease: The Role of Psychosomatic Medicine. *J. Psychosom. Res.* **2000**, *48*, 405–415. [[CrossRef](#)] [[PubMed](#)]
35. Tatayeva, R.; Ossadchaya, E.; Sarculova, S.; Sembayeva, Z.; Koigeldinova, S. Psychosomatic Aspects of the Development of Comorbid Pathology: A Review. *Med. J. Islam. Repub. Iran* **2022**, *36*, 152. [[CrossRef](#)] [[PubMed](#)]
36. Cheraghian, H.; Kiani, A.R.; Sharif, A.R.; Ghamari Ghivi, H.; Momeni, A. Emotion Regulation in Psychosomatic Diseases: Qualitative Study. *Shenakht J. Psychol. Psychiatry* **2021**, *8*, 121–133. [[CrossRef](#)]
37. Henning, M.; Subic-Wrana, C.; Wiltink, J.; Beutel, M. Anxiety Disorders in Patients with Somatic Diseases. *Psychosom. Med.* **2020**, *82*, 287–295. [[CrossRef](#)]
38. Samushiya, M.A.; Rozhkova, Y.I.; Lobanova, V.M.; Dankovtseva, E.N.; Zateishchikov, D.A. Psychosomatic Disorders in Patients with Pulmonary Hypertension: Impact on Treatment Adherence. *Psikhiatriya* **2020**, *17*, 6–16. [[CrossRef](#)]
39. Xie, H.; Jiang, Y.; Liu, L.; Peng, H.; Li, J.; Chen, Z. Global Prevalence and Risk Factors of Depression in Patients with Chronic Obstructive Pulmonary Disease: A Systematic Review and Meta-Analysis from 2000 to 2022. *J. Psychosom. Res.* **2023**, *175*, 111537. [[CrossRef](#)] [[PubMed](#)]
40. Bakusic, J.; Schaufeli, W.; Claes, S.; Godderis, L. Stress, Burnout and Depression: A Systematic Review on DNA Methylation Mechanisms. *J. Psychosom. Res.* **2017**, *92*, 34–44. [[CrossRef](#)] [[PubMed](#)]
41. Mols, F.; Denollet, J. Type D Personality in the General Population: A Systematic Review of Health Status, Mechanisms of Disease, and Work-Related Problems. *Health Qual. Life Outcomes* **2010**, *8*, 9. [[CrossRef](#)] [[PubMed](#)]
42. Rugulies, R.; Aust, B.; Greiner, B.A.; Arensman, E.; Kawakami, N.; LaMontagne, A.D.; Madsen, I.E. Work-Related Causes of Mental Health Conditions and Interventions for Their Improvement in Workplaces. *Lancet* **2023**, *402*, 1368–1381. [[CrossRef](#)] [[PubMed](#)]
43. Shouman, A.E.; Abou-Elwafa, H.S.; El-Gilany, A.-H. Work-Related Mental Health Problems: A Narrative Review. *Int. J. Epidemiol. Health Sci.* **2023**, *4*, e58. [[CrossRef](#)]

44. Skogstad, M.; Skorstad, M.; Lie, A.; Conradi, H.S.; Heir, T.; Weisæth, L. Work-Related Post-Traumatic Stress Disorder. *Occup. Med.* **2013**, *63*, 175–182. [[CrossRef](#)] [[PubMed](#)]
45. Althaus, V.; Kop, J.-L.; Grosjean, V. Work, Stress and Health: From Theoretical Models to a Meta-Model: Critical Review of Theoretical Models Linking Work Environment, Stress and Health: Towards a Meta-Model. *Trav. Hum.* **2013**, *76*, 81–103. [[CrossRef](#)]
46. Harshana, P.V.S. Work Related Stress: A Literature Review. *Ann. Soc. Sci. Manag. Stud.* **2018**, *2*, 555586. [[CrossRef](#)]
47. Hassard, J.; Teoh, K.R.; Visockaite, G.; Dewe, P.; Cox, T. The Cost of Work-Related Stress to Society: A Systematic Review. *J. Occup. Health Psychol.* **2018**, *23*, 1. [[CrossRef](#)] [[PubMed](#)]
48. Nakao, M. Work-Related Stress and Psychosomatic Medicine. *Biopsychosoc. Med.* **2010**, *4*, 4. [[CrossRef](#)] [[PubMed](#)]
49. Nieuwenhuijsen, K.; Bruinvels, D.; Frings-Dresen, M. Psychosocial Work Environment and Stress-Related Disorders, a Systematic Review. *Occup. Med.* **2010**, *60*, 277–286. [[CrossRef](#)] [[PubMed](#)]
50. Allegra, A.; Cicero, N.; Mirabile, G.; Giorgianni, C.M.; Gangemi, S. Novel Biomarkers for Diagnosis and Monitoring of Immune Thrombocytopenia. *Int. J. Mol. Sci.* **2023**, *24*, 4438. [[CrossRef](#)] [[PubMed](#)]
51. Li, Y.; Guan, D.; Tao, S.; Wang, X.; He, K. A Review of Air Pollution Impact on Subjective Well-Being: Survey versus Visual Psychophysics. *J. Clean. Prod.* **2018**, *184*, 959–968. [[CrossRef](#)]
52. Lu, J.G. Air Pollution: A Systematic Review of Its Psychological, Economic, and Social Effects. *Curr. Opin. Psychol.* **2020**, *32*, 52–65. [[CrossRef](#)] [[PubMed](#)]
53. Trushna, T.; Dhiman, V.; Raj, D.; Tiwari, R.R. Effects of Ambient Air Pollution on Psychological Stress and Anxiety Disorder: A Systematic Review and Meta-Analysis of Epidemiological Evidence. *Rev. Environ. Health* **2021**, *36*, 501–521. [[CrossRef](#)] [[PubMed](#)]
54. Byrne, M.L.; Whittle, S.; Allen, N.B. The Role of Brain Structure and Function in the Association between Inflammation and Depressive Symptoms: A Systematic Review. *Psychosom. Med.* **2016**, *78*, 389–400. [[CrossRef](#)]
55. Liotta, M.; Liotta, M.; Saitta, S.; Ricciardi, L. Severe allergic asthma: Does alexithymia interfere with omalizumab treatment outcome? *Asian Pac. J. Allergy Immunol.* **2023**, *41*, 53–59. [[CrossRef](#)] [[PubMed](#)]
56. Nisar, H.; Srivastava, R. Fundamental Concept of Psychosomatic Disorders: A Review. *Int. J. Contemp. Med. Surg. Radiol.* **2018**, *3*, 12–18.
57. Peters, E.M. Stressed Skin?—A Molecular Psychosomatic Update on Stress-causes and Effects in Dermatologic Diseases. *JDDG J. Dtsch. Dermatol. Ges.* **2016**, *14*, 233–252. [[CrossRef](#)] [[PubMed](#)]
58. Rohleder, N. Stimulation of Systemic Low-Grade Inflammation by Psychosocial Stress. *Psychosom. Med.* **2014**, *76*, 181–189. [[CrossRef](#)] [[PubMed](#)]
59. Kousha, T.; Valacchi, G. The Air Quality Health Index and Emergency Department Visits for Urticaria in Windsor, Canada. *J. Toxicol. Environ. Health Part A* **2015**, *78*, 524–533. [[CrossRef](#)] [[PubMed](#)]
60. Puri, P.; Nandar, S.K.; Kathuria, S.; Ramesh, V. Effects of Air Pollution on the Skin: A Review. *Indian J. Dermatol. Venereol. Leprol.* **2017**, *83*, 415. [[CrossRef](#)] [[PubMed](#)]
61. Anderson, G.; Maes, M. Oxidative/Nitrosative Stress and Immuno-Inflammatory Pathways in Depression: Treatment Implications. *Curr. Pharm. Des.* **2014**, *20*, 3812–3847. [[CrossRef](#)] [[PubMed](#)]
62. Fraguas, D.; Díaz-Caneja, C.M.; Ayora, M.; Hernández-Álvarez, F.; Rodríguez-Quiroga, A.; Recio, S.; Leza, J.C.; Arango, C. Oxidative Stress and Inflammation in First-Episode Psychosis: A Systematic Review and Meta-Analysis. *Schizophr. Bull.* **2019**, *45*, 742–751. [[CrossRef](#)] [[PubMed](#)]
63. Hahad, O.; Prochaska, J.H.; Daiber, A.; Muenzel, T. Environmental Noise-Induced Effects on Stress Hormones, Oxidative Stress, and Vascular Dysfunction: Key Factors in the Relationship between Cerebrocardiovascular and Psychological Disorders. *Oxid. Med. Cell. Longev.* **2019**, *2019*, 4623109. [[CrossRef](#)] [[PubMed](#)]
64. Hassan, W.; Noreen, H.; Castro-Gomes, V.; Mohammadzai, I.; Batista Teixeira da Rocha, J.; Landeira-Fernandez, J. Association of Oxidative Stress with Psychiatric Disorders. *Curr. Pharm. Des.* **2016**, *22*, 2960–2974. [[CrossRef](#)] [[PubMed](#)]
65. Maes, M.; Kubera, M.; Obuchowiczwa, E.; Goehler, L.; Brzeszcz, J. Depression's Multiple Comorbidities Explained by (Neuro) Inflammatory and Oxidative & Nitrosative Stress Pathways. *Neuroendocr. Lett.* **2011**, *32*, 7–24.
66. Picard, M.; McEwen, B.S. Psychological Stress and Mitochondria: A Conceptual Framework. *Psychosom. Med.* **2018**, *80*, 126–140. [[CrossRef](#)] [[PubMed](#)]
67. Yan, Q. Stress and Systemic Inflammation: Yin-Yang Dynamics in Health and Diseases. *Psychoneuroimmunol. Methods Protoc.* **2018**, *1781*, 3–20. [[CrossRef](#)]
68. Bentivenga, R.; Deitingner, P.; Ghelli, M. A Review of Measures Taken to Improve Organizational Wellbeing in Italy. *G. Ital. Med. Lav. Ergon.* **2014**, *36*, 54–64. [[PubMed](#)]
69. Marynowski, M.; Likońska, A.; Zatorski, H.; Fichna, J. Role of Environmental Pollution in Irritable Bowel Syndrome. *World J. Gastroenterol. WJG* **2015**, *21*, 11371. [[CrossRef](#)] [[PubMed](#)]
70. Medenica, S.; Stojaković, M.; Zrnić, B.; Vasić, G.; Prodanović, V.; Marić, H. Allergies: From Stress to Psychosomatic Diseases. *Biomed. Istraž.* **2010**, *1*, 56–60. [[CrossRef](#)]
71. Lee, Y.-G.; Lee, P.-H.; Choi, S.-M.; An, M.-H.; Jang, A.-S. Effects of Air Pollutants on Airway Diseases. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9905. [[CrossRef](#)] [[PubMed](#)]
72. El Hennawi, D.E.D.M.; Ahmed, M.R.; Farid, A.M. Psychological Stress and Its Relationship with Persistent Allergic Rhinitis. *Eur. Arch. Otorhinolaryngol.* **2016**, *273*, 899–904. [[CrossRef](#)] [[PubMed](#)]

73. Tsiakiris, G.; Neely, G.; Lind, N.; Nordin, S. Comorbidity in Allergic Asthma and Allergic Rhinitis: Functional Somatic Syndromes. *Psychol. Health Med.* **2017**, *22*, 1163–1168. [[CrossRef](#)] [[PubMed](#)]
74. Kim, C.H.; Kim, J.; Song, J.A.; Choi, G.S.; Kwon, J.H. The Degree of Stress in Patients with Empty Nose Syndrome, Compared with Chronic Rhinosinusitis and Allergic Rhinitis. *Ear Nose Throat J.* **2021**, *100*, NP87–NP92. [[CrossRef](#)] [[PubMed](#)]
75. Mou, Y.-K.; Wang, H.-R.; Zhang, W.-B.; Zhang, Y.; Ren, C.; Song, X.-C. Allergic Rhinitis and Depression: Profile and Proposal. *Front. Psychiatry* **2022**, *12*, 820497. [[CrossRef](#)] [[PubMed](#)]
76. Sansone, R.A.; Sansone, L.A. Allergic Rhinitis: Relationships with Anxiety and Mood Syndromes. *Innov. Clin. Neurosci.* **2011**, *8*, 12. [[PubMed](#)]
77. Vamanshankar, H.; Hegde, K.S.; Chaturvedi, J.; Pratibha, C.B.; Ross, A.; Nayar, R.C.; Parameshwaran, S. Do Patients with Allergic Rhinitis Have a Particular Personality Trait? *J. Laryngol. Otol.* **2013**, *127*, 378–382. [[CrossRef](#)] [[PubMed](#)]
78. Künzli, N.; Bridevaux, P.-O.; Liu, L.S.; Garcia-Esteban, R.; Schindler, C.; Gerbase, M.W.; Sunyer, J.; Keidel, D.; Rochat, T. Traffic-Related Air Pollution Correlates with Adult-Onset Asthma among Never-Smokers. *Thorax* **2009**, *64*, 664–670. [[CrossRef](#)] [[PubMed](#)]
79. Zhang, L.; Zhang, X.; Zheng, J.; Wang, L.; Zhang, H.-P.; Wang, L.; Wang, G. Co-Morbid Psychological Dysfunction Is Associated with a Higher Risk of Asthma Exacerbations: A Systematic Review and Meta-Analysis. *J. Thorac. Dis.* **2016**, *8*, 1257. [[CrossRef](#)] [[PubMed](#)]
80. Ntontsi, P.; Photiades, A.; Zervas, E.; Xanthou, G.; Samitas, K. Genetics and Epigenetics in Asthma. *Int. J. Mol. Sci.* **2021**, *22*, 2412. [[CrossRef](#)] [[PubMed](#)]
81. Valavanidis, A.; Fiotakis, K.; Vlachogianni, T. Airborne Particulate Matter and Human Health: Toxicological Assessment and Importance of Size and Composition of Particles for Oxidative Damage and Carcinogenic Mechanisms. *J. Environ. Sci. Health Part C* **2008**, *26*, 339–362. [[CrossRef](#)] [[PubMed](#)]
82. Schiavone, S.; Jaquet, V.; Trabace, L.; Krause, K.-H. Severe Life Stress and Oxidative Stress in the Brain: From Animal Models to Human Pathology. *Antioxid. Redox Signal.* **2013**, *18*, 1475–1490. [[CrossRef](#)] [[PubMed](#)]
83. Karanikas, E.; Daskalakis, N.P.; Agorastos, A. Oxidative Disregulation in Early Life Stress and Posttraumatic Stress Disorder: A Comprehensive Review. *Brain Sci.* **2021**, *11*, 723. [[CrossRef](#)] [[PubMed](#)]
84. Kiecolt-Glaser, J.K.; McGuire, L.; Robles, T.F.; Glaser, R. Psychoneuroimmunology and Psychosomatic Medicine: Back to the Future. *Psychosom. Med.* **2002**, *64*, 15–28. [[CrossRef](#)] [[PubMed](#)]
85. Sahin, E.K.; Caykoçlu, A.; Senat, A.; Erel, O. A Comprehensive Study of Oxidative Stress in Patients with Somatic Symptom Disorder. *Acta Neuropsychiatr.* **2019**, *31*, 100–105. [[CrossRef](#)] [[PubMed](#)]
86. Sultana, A.; Rahman, K.; Heyat, M.B.B.; Akhtar, F.; Muaad, A.Y. Role of Inflammation, Oxidative Stress, and Mitochondrial Changes in Premenstrual Psychosomatic Behavioral Symptoms with Anti-Inflammatory, Antioxidant Herbs, and Nutritional Supplements. *Oxid. Med. Cell. Longev.* **2022**, *2022*, 3599246. [[CrossRef](#)] [[PubMed](#)]
87. Maria Michel, T.; Pulschen, D.; Thome, J. The Role of Oxidative Stress in Depressive Disorders. *Curr. Pharm. Des.* **2012**, *18*, 5890–5899. [[CrossRef](#)] [[PubMed](#)]
88. Cook, N.; Heyes, A. Pollution Pictures: Psychological Exposure to Pollution Impacts Worker Productivity in a Large-Scale Field Experiment. *J. Environ. Econ. Manag.* **2022**, *114*, 102691. [[CrossRef](#)]
89. Colligan, M.J. The Psychological Effects of Indoor Air Pollution. *Bull. N. Y. Acad. Med.* **1981**, *57*, 1014. [[PubMed](#)]
90. Evans, G.W.; Campbell, J.M. Psychological Perspectives on Air Pollution and Health. *Basic Appl. Soc. Psychol.* **1983**, *4*, 137–169. [[CrossRef](#)]
91. Sass, V.; Kravitz-Wirtz, N.; Karceski, S.M.; Hajat, A.; Crowder, K.; Takeuchi, D. The Effects of Air Pollution on Individual Psychological Distress. *Health Place* **2017**, *48*, 72–79. [[CrossRef](#)] [[PubMed](#)]
92. Levy, M.L.; Bacharier, L.B.; Bateman, E.; Boulet, L.-P.; Brightling, C.; Buhl, R.; Brusselle, G.; Cruz, A.A.; Drazen, J.M.; Duijts, L. Key Recommendations for Primary Care from the 2022 Global Initiative for Asthma (GINA) Update. *NPJ Prim. Care Respir. Med.* **2023**, *33*, 7. [[CrossRef](#)]
93. Passalacqua, G.; Cecchi, L.; Canonica, G.W.; Lombardi, C.; Ventura, M.T.; Bachert, C.; Fokkens, W.J.; Haahtela, T.; Klimek, L.; Papadopoulos, N.G. ARIA (Allergic Rhinitis and Its Impact on Asthma) 2019. Treatments for Allergic Rhinitis-Italy. *Recenti Prog. Med.* **2021**, *112*, 516–528. [[CrossRef](#)] [[PubMed](#)]
94. Salvo, A.; La Torre, G.L.; Rotondo, A.; Mangano, V.; Gervasi, T.; Gervasi, C.; Vadalà, R.; Bartolomeo, G.; Iaria, C.; Lanteri, G. Accumulation of PCBs, PAHs, Plasticizers and Inorganic Elements in *Hexanchus Griseus* from the Strait of Messina (Central Mediterranean Sea). *Nat. Prod. Res.* **2020**, *34*, 172–176. [[CrossRef](#)] [[PubMed](#)]
95. ARPA. [Internet]. 2023. Available online: <https://www.arpal.liguria.it> (accessed on 11 June 2024).
96. Thyssen, J.P.; Gawkrödger, D.J.; White, I.R.; Julander, A.; Menné, T.; Lidén, C. Coin Exposure May Cause Allergic Nickel Dermatitis: A Review. *Contact Dermat.* **2013**, *68*, 3–14. [[CrossRef](#)] [[PubMed](#)]
97. Buske-Kirschbaum, A.; Geiben, A.; Hellhammer, D. Psychobiological Aspects of Atopic Dermatitis: An Overview. *Psychother. Psychosom.* **2001**, *70*, 6–16. [[CrossRef](#)] [[PubMed](#)]
98. Lind, N.; Nordin, M.; Palmquist, E.; Nordin, S. Psychological Distress in Asthma and Allergy: The Västerbotten Environmental Health Study. *Psychol. Health Med.* **2014**, *19*, 316–323. [[CrossRef](#)] [[PubMed](#)]
99. Aquino, M.; Rosner, G. Systemic Contact Dermatitis. *Clin. Rev. Allergy Immunol.* **2019**, *56*, 9–18. [[CrossRef](#)]

100. Ricciardi, L.; Furci, F.; Gangemi, S. Nickel Sensitization Influence on Microbiota in Allergic and Non-Allergic Disorders: What's Up? *J. Biol. Regul. Homeost. Agents* **2021**, *35*, 757–760. [[CrossRef](#)] [[PubMed](#)]
101. Almutairi, N.; Almutawa, F. The Role of Nickel Allergy in Hand Dermatitis and Its Impact on Handling Cupronickel Currency Coins. A Comparative Cohort Study from Kuwait. *Adv. Dermatol. Allergol. Dermatol. Alergol.* **2017**, *34*, 313–321. [[CrossRef](#)] [[PubMed](#)]
102. Nucera, E.; Schiavino, D.; Calandrelli, A.; Roncallo, C.; Buonomo, A.; Pedone, C.; Lombardo, C.; Pecora, V.; De Pasquale, T.; Pollastrini, E. Positive Patch Tests to Euro Coins in Nickel-sensitized Patients. *Br. J. Dermatol.* **2004**, *150*, 500–503. [[CrossRef](#)] [[PubMed](#)]
103. Ahlström, M.G.; Thyssen, J.P.; Wennervaldt, M.; Menné, T.; Johansen, J.D. Nickel Allergy and Allergic Contact Dermatitis: A Clinical Review of Immunology, Epidemiology, Exposure, and Treatment. *Contact Dermat.* **2019**, *81*, 227–241. [[CrossRef](#)] [[PubMed](#)]

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