



ORIGINAL ARTICLE

Occupational Rhinitis and Asthma in the Textile Sector of the Central Region of Tunisia

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Abstract

Introduction: The association between occupational asthma (OA) and occupational allergic rhinitis (OAR) is often described in the literature supporting the concept of “United airways disease” based on a parallel significant reaction of the nose and lungs after challenges with occupational agents and involving several occupational, host-related and environmental factors and thus exacerbating the medical and socio-economic impact of the OR. In Tunisia, only limited studies were carried out to explore association between OA and OR.

Objectives: Assess the incidence and prevalence of OR among workers in the textile sector, to determine their socioprofessional characteristics, and to study the association between this pathology and OA.

Material and methods: We carried out a descriptive epidemiological study about charts of occupational allergic rhinitis cases in the textile sector recognized by the competent commissions of the National Medical Care Fund (CNAM) in the region of the Tunisian center during the period from January 1st, 2008 to December 31, 2012.

Results: One hundred seventy-three cases of OAR declared in the central region of Tunisia were enrolled in the study during the study period representing a prevalence of 3.9% of all occupational diseases, recognized during this same period. Our study population was mainly women with a mean age of 40 ± 8.32 years. The mean delay of respiratory complaints onset was of 13.46 years. The average duration of OR evolution before it is reported to CNAM was of 5.13 years. Rhinitis was isolated in 34.10% of the cases. The association between OA and OR was present among 59.5% of the cases. Rhinitis symptoms preceded asthma

symptoms in most of the cases (96.12%). According to the results of rhinomanometry, 40.5% of OR (i.e. n = 70) were severe. Most of reported OR cases were attributable to Vegetable textile dusts. After multiple binary logistic regression, the association was 2.29 times more frequent in the subjects aged more than 39 years (IC at 95% [1.08 - 4.86]) and 3.22 times more frequent in subjects poorly or not skilled (IC at 95% [1.38 - 7.5] (p = 0.05)).

Conclusion: Our study is the first one to evaluate the association between rhinitis and asthma among workers in the textile sector in Tunisia. The standard profile of our cases reporting allergic occupational rhinitis is a young unskilled worker in the textile sector. There is a strong association between OAR and OA. A rigorous and adequate prevention is necessary and allows reducing the importance of these occupational pathologies and their serious consequences.

Keywords

Occupational rhinitis, Occupational asthma, Textile sector, Epidemiology

Introduction

The nose is the first barrier of defense on the respiratory tract. It is involved in almost all respiratory pathologies, whether occupational or not. More than 250 substances have been suspected to be responsible for occupational rhinitis which are also involved in occupational asthma [1].

Occupational rhinitis (OR) is characterized by nasal congestion, rhinorrhea, nasal itching, and/or sneezing

that occur secondary to exposures in the workplace. This disease can be classified into allergic or non-allergic subgroups.

Work-related rhinitis is a particular form of rhinitis with symptoms that occur in the workplace. In occupational rhinitis, symptoms develop in a previously unaffected individual as a result of an exposure in the workplace. This is in contrast to work exacerbated rhinitis where there is a preexisting history of rhinitis and symptoms worsen during exposures at work [2].

Although OR is not a severe disease, it has been acknowledged to have great impact on quality of life, impairments in social life and productivity at work [3].

The severity of this affection is defined by the degree of discomfort and the rhinitis-related symptoms which may show influence on work productivity and consequently cause a significant decrease or loss of earnings for workers [3,4].

The prevalence of OR across the world and in Tunisia remains unknown and still underestimated. Despite this, numerous studies have been published that investigate the prevalence and incidence of occupational rhinitis in certain occupations. The results vary widely from one study to another, reflecting different exposure conditions [2].

The association between occupational asthma (OA) and OR is often described in the literature supporting the concept of "United airways disease" based on a parallel significant reaction of the nose and lungs after challenges with occupational agents and involving several occupational, host-related and environmental factors and thus exacerbating the medical and socio-economic impact of the OR [5,6].

This may explain the clinical heterogeneity among patients presenting different situations: occupational allergic rhinitis (OAR) with or without occupational asthma, which also may occur alone. Hence the importance of early detection of OA in patients with OAR.

The main purpose of the management of OR is to stop exposure to risk while still working. It depends on three key points: the first is the pre-employment screening and counseling on the occurrence of occupational sensitization by clinical observation and specialized tests [7]. The second point is about workplace prevention by application of protection measures and the third is reporting and compensation [8,9].

In Tunisia, OA occurs frequently among workers in the textile sector, which is a highly developed sector in the region of the Tunisian center. OR was associated with asthma in 40.7% of cases [10].

The socio-professional consequences of these diseases are serious especially as it affects active and often young subjects, and persists in a considerable number of cases, even after cessation of exposure to the risk [10].

In Tunisia, only limited studies were carried out to explore association between OA and OR. Nonetheless, we conducted this epidemiological investigation on the cases of declared OR in textile sector to assess the incidence and prevalence of OR among workers in the textile sector, to determine their socioprofessional characteristics, and to study the association between this pathology and OA.

Methods

We carried out a descriptive epidemiological study during the year 2016. All cases were collected through the files from the National Medical Care Fund (CNAM), which is responsible for the recognition of occupational diseases in the private sector. The cases of occupational allergic rhinitis (OAR), in the textile sector, reported from January 1st, 2008 to December 31, 2012, in the region of the Tunisian center, and recognized by the CNAM were included in our study. The recognition of occupational diseases is a task out by the medical committees of the CNAM on the basis of administrative, technical and medical conditions.

In order to meet the conditions of forensic recognition, clinically diagnosed rhinitis should be:

- Mentioned in one of the tables of occupational diseases provided for by the 94 - 28 law of February 21, 1994 [11].
- Occurred in a worker usually exposed to the causal agents.
- Declared before the expiry date of cost management.

The usual exposure to the risk is proved by the technical investigation carried out by the CNAM's engineers. Data collection was performed using a pre-established synoptic form. Data sources were medical documents (initial medical certificate, pulmonary function test results) and administrative ones (occupational disease tax form, employment certificate, income inquiry, an investigation report, results of experts' opinions, medical board's answer, charge sheets), which makes up the patients' files. The collected data focused on:

- Patient identification: Name, First name, CNAM registration number.
- Socioprofessional data: age, gender, origin, professional qualification, sector of work, seniority
- Lifestyle habits.
- Medical-surgical history.
- Data relating to the history of installation and evolution of the disease.
- Medical examination.
- Data from allergy assessments, and functional explorations.

- Technical survey data for the causal agent.
- Data on asthmatic disease if associated.

Our study gains the consent from ethic committee and from the National Medical Care Fund representing patients. A unit and multivariate, analytic and descriptive statistical analysis was carried out. The inclusion of independent variables in the regression models was done when their degree of significance was less than 0.2. Regarding statistic tests, the signification threshold p was fixed at 0.05.

Results

One hundred seventy-three cases of OAR declared in the central region of Tunisia were enrolled in the study during the study period representing a prevalence of 3.9% of all occupational diseases, recognized during this same period. Taking into account the number of active workers in the textile sector affiliated to the CNAM between 2008 and 2012, the cumulative annual incidence of OR, is estimated to be 42 cases per 100,000 textile sector workers in the Private Sector in the Tunisian center. **Table 1** shows the annual distribution of occupational rhinitis.

A predominance of women was noticed with 129 women (74.6%) versus 44 men (25.4%) with a sex ratio estimated to 0.34. The mean age was of 40 ± 8.32 years and most of women (27.75%) were aged between 35 and 45 years (**Table 2**).

Average seniority of workers in their jobs was 13.41

Table 1: Annual distribution of cases of occupational rhinitis.

Year	Number of cases of occupational rhinitis	% of total of cases
2008	27	15.6%
2009	34	19.7%
2010	53	30.6%
2011	33	19.1%
2012	26	15%
Total	173	100%

Table 2: Distribution of patients with OAR by basic demographic characteristics.

	Number	Percentage (%)
All	173	100
Sex		
Male	44	25.4
Female	129	74.6
Age		
< 25	5	2.9
25-35	56	32.4
35-45	64	37
45-55	40	23.1
> 55	8	4.6
Origin		
Sousse	46	26.6
Monastir	119	68.8
Mahdia	6	3.5
Kairouan	2	1.2

± 8.76 years with extremes of 0 and 35 years and a median of 12 years. The majority (39.9%) had a seniority between 5 and 15 years.

Table 3 shows the distribution of the patients according to their jobs in the textile sector. Most of them were workman (39.9%) and seamstress (35.8%).

The mean delay of respiratory complaints onset, corresponding to the delay between the beginning of exposure and the onset of symptoms, was of 13.46 with extremes of 1 and 35 years. In addition, the average duration of OR evolution before it is reported to CNAM was of 5.13 years with extremes of 1 and 35 years and a median of 5 years. An occupational rhythmicity of complaints was noticed in 74.6% of OA cases (i.e. in 129 cases).

Among the cases of recognized OR, only 6 patients (i.e. 3.5% of cases) presented a family history of atopic disease, while most of the cases ($n = 167$ i.e. 96.6%) did not complain of personal history of allergy.

Rhinitis was isolated in 34.10% of the cases (i.e. 59 patients). The association between OA and OR was present among 103 patients, i.e. 59.5% of the cases. Rhinitis symptoms preceded asthma symptoms in 96.12% of cases (i.e. 99 patients) and appeared concomitantly in 3.88% (i.e. 4 patients). Prick tests were performed to 9 patients and were positive to 7 and attributed to HMW agents (i.e. 4 % of cases).

Table 3: Distribution of patients according to their jobs in the textile sector.

Job	Numbers (n)	Percentage (%)
Workman	69	39.9
Seamstress	62	35.8
Auditor	8	4.6
Team supervisor	7	4
Cleaning lady	6	3.5
Sewing machine	4	2.3
Miller	4	2.3
Ironing	3	1.7
Mechanic	2	1.2
Production manager	1	0.6
Secretary	1	0.6
Technical director	1	0.6
Soldering	1	0.6
Instructor	1	0.6
Technician	1	0.6
Storekeeper	1	0.6
Machine operator	1	0.6
Total	173	100

Table 4: Distribution of workers in the textile sector according to the severity of nasal obstruction.

Nasal obstruction	Number	Percentage (%)
Rhinomanometry Not done	62	35.9
Mild	9	5.2
Moderate	32	18.5
Severe	70	40.5
Total	173	100

Table 4 shows the results of Rhinomanometry which was fulfilled in more than two-thirds of cases (i.e. 138 patients). According to these results, most of OR were severe (n = 70 i.e. 40.5% of cases), 18.5% were moderate (i.e. 32 patients) and 5.2% were mild (i.e. nine patients).

Spirometry was performed to 145 patients. An obstructive syndrome was noticed in six cases i.e. in 3.5% of patients and restrictive syndrome in four patients (i.e. 2.3% of cases). Spirometry was normal in most of cases (n = 135 i.e. 78% of cases). Applied to 65 patients, a non-specific methacholine bronchial provocation test was positive in 49 cases (i.e. 28.32% of cases).

Most of reported OR cases were attributable to Vegetable textile dusts. We studied the relationships between the association between occupational rhinitis and asthma and the variables of interest. Only age and professional qualification had a statistically significant relationship with this association.

After multiple binary logistic regression, the association was 2.29 times more frequent in the subjects aged more than 39 years (IC at 95% [1.08 - 4.86]) and 3.22 times more frequent in subjects poorly or not skilled (IC at 95% [1.38 - 7.5] (p = 0.05)).

Discussion

The present study included all reported cases of OR from 2008 to 2012. Epidemiological data about OA and OR are highly variable due mainly to the variability of the definition of the disease as well as the modalities of the study.

Numerous studies have reported the prevalence of OA in a selected group but also in the general population. However, studies reviewing prevalence of the OR are limited and carried out only in selected populations. In these published studies, the prevalence of OR was two to four times greater than that of asthma, regardless of the etiologic agent or the occupational sector.

Indeed, prevalence is often underestimated because exposed and symptomatic workers tended to leave or change their jobs [12-15]. Unlike the OA, OR is generally immune to this effect since most workers with rhinitis maintains their occupational activity [3].

The estimated prevalence of OR depends on the criteria for identification of the disease [16]. For example, a study was conducted in Singapore using different questionnaires based on four different definitions of the OAR and the prevalence values vary according to the definition attributed to the rhinitis [17].

This was the reason for the creation of a SFAR (Score for Allergic Rhinitis) by experts to validate the diagnosis of OR with high sensitivity (74%) and high specificity (83%). Subsequently, the occupational exposure is confirmed according to the data of interrogation and the results of investigations [18,19].

The prevalence varied, according to the type of the causal factor, between 2 and 87% or 3 and 48% [2]. The prevalence of the OAR is also variable according to occupational sector. In a Finnish study conducted during the 1986-1991 period, the prevalence ranged from 1.9% to 41.2%. The occupational sectors involved in OAR were exposed to animal dander, bakers and carpenters [20].

In two other studies carried out in France during the period 1977-1998 and 1999-2003, bakers, hairdressers and health workers were found to be among the main occupations concerned by the OAR with a prevalence between 2.7% and 22.3% and 4.7% and 26% respectively [21]. A recent Slovak study was carried out in 2014 and the catering sector was responsible for half of the cases of OAR [22].

In the textile sector, the prevalence of OAR is also variable according to the type of textile fibers (natural or synthetic) [23]. Many recent studies estimate the prevalence of rhinitis symptoms related to exposure to natural textile fibers dominated by cotton. However, prevalence of OR was not estimated as a completely well-defined entity [24,25].

The prevalence of OA was variable according to the causal agent and from one study to another for the same agent. This was mainly explained by the heterogeneity of the exposure conditions and the evaluation methods [13]. Indeed, the prevalence of OA vary also depending on the type of industry.

In 1998, Kopferschmitt-Kubler M. studied the main occupations responsible for OA based on four monitoring programs in different countries and concluded that bakers and painters were still at the top of the occupational groups the most affected. On the other hand, the textile industry occupied the sixth place according to the NAPO program (1996-1997) [15].

According to different studies, the prevalence of OA in the textile sector varies also according to the type of textile fibers (vegetable, natural or synthetic fibers). Indeed, in a Croatian comparative study published in 1998 the prevalence of OA among workers exposed to synthetic textile fibers was about 1% [23] and in a more recent Greek study, the prevalence of OA in workers exposed to cotton dust was 57.7% [26].

The association between OA and OR has been strongly mentioned in literature. More than 92% of workers with OA have symptoms of OR [5,15,16,27]. However, the prevalence of this association varies from one study to another between 13.4% and 43% [28]. This association would be much more important with workers exposed to high molecular weight allergens [2,8,28].

In Tunisia, respiratory diseases rank third among the occupational diseases reported to the National Health-CNAM with a frequency ranging from 14.5% to 18.5% of the total reported diseases. These diseases are mainly represented by asthma and allergic rhinitis; but statisti-

cal data on the prevalence of OA and OAR are not available since most of the studies conducted in Tunisia express the prevalence of the pathology within a particular sector, or a group exposed to the same etiologic agent. A retrospective descriptive study of all cases of asthma reported in the private sector in the region of center of Tunisia and recognized as occupational disease during a nine-year period (2000-2008) showed that the association between asthma and allergic rhinitis was found in 42.9% of cases [10].

Regarding the incidence of OA and OAR, the epidemiological studies are rare in Tunisia and worldwide. The incidence of OR varies depending on the occupational field. Indeed, in a British [29], a Canadian [30] and Polish [31] cohorts, the incidence of OAR was estimated to be respectively 15, 11.3 and 62.5 per year and per 1000 among bakers exposed to flour. On the other hand, the incidence of rhinitis to latex proteins was 7 per 1,000 exposed and per year in a cohort of Canadian dental apprentices followed during their 2 years [32].

The estimated number of cases of OA reported in the occupational disease registries was between 17.5 and 79 per million workers. The differences were mainly related to the industrial structure of countries, the definition of occupational exposure, the compensation risk, research methodologies and the temporal variability of incidence.

The cumulative annual incidence of OA was estimated at 24.42 cases/million workers in the private sector in Tunisia [10], but no study had assessed the incidence of OR. In our study, we found an incidence of 42 cases/year/100,000 workers in the private textile sector in the Tunisian Central Region.

Since asthma and allergic rhinitis often coexisted, the concept of "one airway, one disease" emerged, and the terms "allergic rhinobronchitis" [33] and "United airways disease" (UAD) [34] have been proposed.

Recently, researches on OR and OA have been increased and widely supported. Thus, it seems that the association between OA and OR is now better understood, and that these pathologies have more similarities than differences. However, many questions remain unanswered, particularly concerning their pathogenesis.

In our study, only age and occupational qualification had a statistically significant relationship with the inaugural development of OAR and OA, after linear regression.

Analyzing the determinant factors related to the association between OA and OR, an interaction, has been recently suggested, between environmental exposure, genetic factors, and various stochastic events, as a trigger for diseases such as OA and OR.

UAD model is occurring with higher frequency among workers exposed to high molecular weight agents than with those exposed to low molecular weight agent. In-

deed, nasal symptoms often precede asthma due to high molecular weight agents and usually begin simultaneously with asthmatic symptoms in subjects exposed to low molecular weight agents. Rhinitis onset is less frequent among people sensitized to low molecular weight agents than to the high molecular weight agents [5,28,35].

Castano R. and coll assessed the concomitance of bronchial and nasal reactions in the diagnosis of asthma and rhinitis following exposure to occupational allergens.

A "stepwise sensitization" may occur where the nose-as the first line of defense-becomes sensitized first and then the sensitization process extends to the respiratory tract until it reaches the bronchi, and this was independent of the type of causal agent (HMW or LMW). According to this pattern, a gradual worsening of lower respiratory tract symptoms among subjects with OR alone may ultimately lead to OA if exposure to the offending agent continues [36].

However, the "stepwise sensitization" does not occur under all circumstances, contrary to the hypothesis of the "allergic march model", which shows that in most subjects who developed occupational asthma, rhinitis occurred at the same time as the chest symptoms did [31].

Different authors have suggested several other alternatives in this direction. As a result, workers could present different clinical aspects (isolated OA, isolated OAR or an association of both diseases). In our study, family atopy was present in 1.2% of cases and personal atopy was present in 6 workers.

A cross sectional study was carried out among Danish workers in the textile industry to explore respiratory disorders and atopy, and to estimate the association of these disorders with atopy. The mean change in FEV1 and FVC was greatest among atopic individuals in both the cotton and wool industry and in other textile industries although the differences were not significant [37].

According to Garnier R., atopy is the only validated individual risk factor increasing the risk of developing rhinitis. However, according to Ameille J., this doesn't seem to be relevant to workers exposed to LMW for which the role of IgE is not formally documented [12,13].

In our study, we found that workers with OA and OAR tend to be young and economically active. This is consistent with other studies in Tunisia and worldwide. In Finland, a study was carried out between 1986 and 1991 and covered the cases of OAR and OA postponed by the Finnish register of occupational diseases. OAR was more frequent in women aged between 40 and 44 years and men between 25 and 29 years. However, OA appears at an older age than OAR and this suggests that rhinitis precedes OA [20].

Concerning the textile sector, several studies have

been conducted such as the study of Sibel O. among workers employed in textile dyeing factory in Turkey where the mean age was 29.51 ± 0.56 years [38].

The women's predominance in our series is partly explained by the importance of the clothing and textile sector in Tunisia mainly in the center of the country.

Through the analysis of the different studies, it appears that, regardless of age and gender, occupational diseases of the lower airways such as asthma are generally more pronounced in men (except farmers where women are the most affected). Contrarily, the upper airway diseases such as OAR are more frequent in women. These results could be explained by physiologic gender differences and gender specific workplace exposures or other gender variables not defined or demonstrated in the literature [39].

Occupational activity is one of the main circumstances of environmental exposure. According to the literature, there is a significant association between the level of exposure and the risk of asthma and/or rhinitis, but this association is variable whether it is linked to the cumulative dose or to the dose of inhalable dust.

Indeed, in a Swedish cohort study on the incidence rates (IRs) of asthma and rhinitis amongst bakers, IRs of asthma and rhinitis increased by dust concentration at onset of disease. The risk of asthma seemed to be increased at inhalable dust concentrations $> 3 \text{ mg/m}^3$ (dough making or bread forming), whereas the risk of rhinitis was increased at all concentrations $> 1 \text{ mg/m}^3$, indicating an increased risk in all bakery job-tasks. The risks seemed to be less dependent on the cumulative exposure dust than the inhalable dust concentrations. This implies the strength of the probability of association between OA and OR at concentrations $> 3 \text{ mg/m}^3$ [40].

The mode of exposure to the occupational agent affects the allergic response as well. This could be explained by the physico-chemical properties of low molecular weight factors [41] and aerodynamic diameter of the inhaled particles [28].

Several studies have proven that OR; whether allergic or not; could be a risk factor for the development of OA. Indeed, it represents an early predictive marker of OA but still, the proportion of subjects with rhinitis who developed, afterwards, an OA is uncertain. A study was carried out in this direction among trainees in animal health technologies and showed that the predictive value of occupational nasal symptoms in the later development of a probable asthma was only 11.4% over a period of follow-up of 44 months [27,41,42].

Conclusion

Occupational allergic rhinitis is one of the most common occupational respiratory diseases in industrialized countries. Few studies have been conducted to assess its prevalence and incidence, but current data are highly variable, and this heterogeneity is the result of confluence

of several factors. Since OR is not very disabling, workers often neglect it. However, it could be the first manifestation of a more severe and disabling occupational respiratory pathology which is occupational asthma.

Our study is the first one to evaluate the association between rhinitis and asthma among workers in the textile sector in our country. The standard profile of our cases reporting allergic occupational rhinitis is a young unskilled worker in the textile sector. There is a strong association between OAR and OA.

OAR is an alarming condition for further development of OA if the exposure persists, thus causing a heavy medical and socio-economic impact. The clinical presentation is rather heterogeneous: isolated rhinitis, isolated OA or association of the two pathologies resulting from a complex physio pathological mechanism and involving several predictive factors of the development of the OA during the clinical evolution of the OAR. In our study, only age and occupational qualification had a statistically significant relationship with the inaugural development of OAR and OA, after linear regression.

It is necessary to highlight the importance of early detection of OA in workers with OAR. The complete and early eviction, even though not always possible, is the best solution to fight the perpetuation of the OAR or its evolution towards asthma. Therefore, the emphasis should lie on primary prevention measures that need to be strengthened by individual and collective technical protection measures as well as multidisciplinary medical care.

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