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Assessing the Impact of Asthma: A Cross-Sectional Study in Workers Undergoing Therapy

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Abstract

Background: *This study aimed to investigate the impact of asthma on work productivity among adults receiving asthma therapy.* **Methods:** *A cross-sectional study involving 101 asthmatic patients treated at the Pulmonology Department of University Hospital in Mahdia (Tunisia) who had been employed for at least six months was conducted over the course of a year. Recruited patients were asked to complete a self-administered questionnaire that consisted of the Simplified Medication Adherence Questionnaire (SMAQ), the Work Productivity and Activity Impairment (WPAI), and the Pichot questionnaire.* **Results:** *The study's participants had a sex ratio of 0.51 and a mean age of 44.1 ± 13.2 years. Exposure to aerocontaminants was high among 64.4% of patients. The majority of the patients were treated with inhaled corticosteroids (ICS) and long-acting beta-agonists (LABA) (54.4%), and nearly half were classified as having moderate asthma. Our findings revealed significant challenges faced by these patients, with 62.4% experiencing poorly controlled or uncontrolled asthma. Additionally, 69.3% were non-adherent to treatment, and 71.3% reported worsening symptoms while at work. They worked an average of 38.3 ± 16.4 hours per week. The impact of general health status on work productivity was measured at 3.3 ± 2.5. Absenteeism and presenteeism rates were 4.2% and 33.1%, respectively, resulting in a productivity loss of 30.4%. Activity impairment was associated with factors such as gender, alcohol consumption, and uncontrolled asthma.* **Conclusion:** *Addressing asthma control, working conditions, and mental health emerges as essential strategies to enhance workplace productivity. When evaluating the effectiveness of interventions among active asthmatic patients, presenteeism, absenteeism, and productivity loss should be considered.*

1. Introduction

Asthma is a heterogeneous disease, usually characterized by a chronic inflammation of the airways [1]. It is defined by a history of respiratory symptoms such as wheezing, chest tightness, dyspnea, and cough, that vary in frequency and intensity, associated all along with expiratory airflow limitation (confirming that when FEV1 is reduced, FEV/FVC is reduced in spirometry) [2]. It is considered the world's most common chronic respiratory disease, currently affecting almost 300 million people worldwide [3].

This serious pathology affects individuals of all age groups, and its frequency is clearly on the rise, especially in developing countries [2]. Its prevalence

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worldwide is estimated to range from 1% to 18% in both adults and children [2, 3]. In fact, the mortality rate during the period from 2006 to 2012 reached 0.19 deaths per 100,000 people globally [4]. In Tunisia, it poses a significant public health issue due to its high prevalence and considerable socio-economic impact [5]. Despite the development of effective treatments and new management paradigms, asthma has a substantial effect on patients' personal and professional lives. Indeed, it is estimated that over 45% of asthmatics are poorly controlled [6, 7].

The latest recommendations from the Global Initiative for Asthma (GINA) indicate that asthma management should lead to effective clinical control [8]. This involves managing the asthmatic condition, which includes controlling daytime symptoms, preventing nocturnal awakenings, reducing the impact of symptoms on daily activities, and minimizing the use of rescue medication [8]. Achieving optimal clinical control continues to be a primary goal of asthma management. Although various clinical studies show that reasonable control can be attained among most asthmatics, many patients still experience uncontrolled symptoms in real-life situations, revealing a significant gap between the expected treatment goals and the actual level of asthma control in the general population [9, 10]. Research indicates that in 50% of cases, asthma patients tend to underestimate the severity of their condition by believing their symptoms are under control [11]. Nonetheless, uncontrolled or poorly controlled asthma leads to more frequent exacerbations and increased absenteeism from work [12]. Furthermore, economic evaluations of asthma from several sources highlight that decreased productivity at work and school contributes to morbidity, adding to the indirect health costs associated with this chronic lung disease [13, 14]. To effectively evaluate work-related health issues, it is crucial to first consider the time lost from work, known as absenteeism, and secondly, the growing productivity losses at work, referred to as presenteeism [15].

Numerous recent publications have motivated this work, which aims to investigate the impact of asthma on work productivity in adults treated for asthma.

2. Patient and Methods

2.1. Study Design

This cross-sectional study was conducted between January 2020 and February 2021. It involved asthmatic patients with full-time or part-time employment who were investigated and followed up in the Pulmonology Department of Taher Sfar teaching hospital in Mahdia, Tunisia.

2.2. Study Population

This study exhaustively included asthmatic patients who had been employed for at least six months and were aged 18 to 65 years. A total of 101 patients were included in this study. Their socio-professional characteristics are described in Table 1.

Most patients (66.3%) were women with a mean age of 44.1 ± 13.2 years. Of the 101 patients, 67.3% were married and had dependent children, with an average of three. Thirty-five patients (34.7%) had comorbidities ma,inly diabetes (12.9%).

The majority of patients (89.1%) were non-smokers, 6.93% were active smokers and 3.9% had quit smoking. Nearly half of the patients (42.6%) had a primary school education.

The most important sector of activity was textile manufacturing, with a prevalence of 29.7%, and the mean age at recruitment was 23.9 ± 7.7 years. The median job tenure at the time of diagnosis was four years. Eighty-one patients (80.2%) had typical work schedules, with an average number of hours per week of 43.5 ± 12.5. Exposure to aerocontaminants was reported in 64.4% of cases, mainly textile dusts (24.4%), cereals and flour (5.9%) and wood dusts (7%).

Clinical data and/or spirometry results, using GINA 2019 criteria, confirmed the diagnosis of asthmatic disease [16].

Patients with any other chronic lung disease associated with asthma, psychiatric illnesses, or psychotropic medication that might affect their ability to answer the questionnaire were excluded from this study.

Table 1. Socio-professional characteristics of the study population.

Variables	N (%)
Age (years) mean ± SD	44.1 ± 13.2 [19–65]
Gender	
Male	34 (33.7)
Female	67 (66.3)
Marital status	
Married	68 (67.3)
Single	29 (28.7)
Divorced	2 (2.0)
Widowed	2 (2.0)
Having children in charge	68 (67.3)
Having a medical history	
Diabetes	13 (12.9)
Hypertension	3 (3.0)
Dyslipidemia	4 (4.0)
Glaucoma	6 (5.9)
Others	8 (7.9)
Having a surgical history	16 (15.8)
Smoking status	
Active smoker	7 (6.93)
Weaned smoker	4 (3.97)
Non-smoker	90 (89.1)
Level of education	
Illitrate	6 (5.9)
Primary	43 (42.6)
Secondary	36 (35.6)
Superior	16 (15.9)
Activity field	
Textile	30 (29.7)
Cleaning	14 (13.9)
Health	12 (11.9)
Food	8 (7.9)
Education	6 (5.9)
Security	5 (5.0)
Other Activities	26 (25.7)
Average age at hiring (years)	23.9 ± 7.7
Median job tenure since the diagnosis	4
Presence of an occupational doctor	44 (43.5)
Schedule type	
Typical	81 (80.2)
Rotation by night shift	17 (16.8)
Fixed night	3 (3)
Average working hours/week	43.5 ± 12.5
Thermal stress	52 (51.5)
Exposure to airborne contaminants	65 (64.6)
Type of air contaminants	
Textile dusts	25 (24.4)
Cereals & Flour	6 (5.9)
Others	70 (69.7)

2.3. Study Instrument

A survey form was completed based on the patient's medical records.

2.3.1. The Survey Form Involved Three Parts

- Sociodemographic characteristics: Age, gender, marital status, number of dependent children, medical (cardiovascular, psychiatric, etc.) and surgical history, lifestyle habits (smoking, alcohol, sports, leisure activities, etc...);
- Professional characteristics related to School-leaving diploma, age at recruitment, sector of activity at the time of asthma diagnosis, job tenure at the time of recruitment, name of the company, presence of an occupational physician in the current company, work position, number of hours worked per week, work schedule, the existence of thermal stress in the company and occupational exposure to aero-contaminants;
- Characteristics of asthmatic disease:
  - *General characteristics* related to diagnosis age, disease progression duration, and current treatment.
  - *Spirometry performed at the last consultation and interpreted with reference to GINA*

2019 measures FEV1 (forced expiratory volume in one second), Tiffeneau ratio (RT=FEV1/ Forced Vital Capacity (FVC)), Obstructive ventilatory disorder (diagnosed if the Tiffeneau ratio is < 0.7) and Reversibility after administration of beta-2-agonists (defined by an increase of 200 ml and 12% in FEV1) [16].

- *Non-specific bronchial provocation test with methacholine* is a diagnostic method designed to reveal bronchial hyperreactivity. The test generally involves inhalation of an irritant (metacholine) in increasing doses. After each methacholine dilution dose, spirometry is performed. A decrease of at least 20% in FEV1 confirms bronchial hyperreactivity [17].
- *Allergic skin test (prick test):* an examination carried out when an allergic etiology of asthma is suspected. It consists of testing the skin's reaction to a small quantity of allergen: the epidermis is superficially pricked with a drop of allergenic extract placed on the forearm, along with a negative and a positive control. The reading is taken within 15 minutes by measuring the largest diameter of the papule. The main allergens tested are: *Pneumallergens: House dust mites; DPT (Dermatophagoides farinae), DF (D. pteronyssinus) pollens from gaminia, herbaceous plants and trees, animal dander (cat, dog, etc..), molds (c-albicans), and trophallergens (food allergens).*
- *Determination of specific Ig E:* performed by blood sampling. The serum is brought into contact with the product to be tested (pneumallergen or trophallergen) to determine the level of specific Immunoglobulins.
- *Etiologies:* Allergic or non-allergic asthma (occupational, hormonal, gastroesophageal reflux, drug-induced) or asthma with undetermined cause.
- *The severity of asthmatic disease*: Asthma severity is assessed retrospectively based on the level of treatment required to control symptoms and attacks, according to GINA 2019. A distinction is made between intermittent, mild, persistent, moderate, and severe asthma. Acute exacerbations (AE) and duration of absenteeism during the previous year were determined.
- *Asthmatic disease control:* Asthma symptom control is based on a GINA 2019 assessment comprising four items covering the last 4 weeks, determining if it is a controlled asthma, a poorly controlled asthma, or an uncontrolled asthma [16].

Afterward, the patients answered a self-administered questionnaire.

2.3.2. The Questionnaire Included Three Validated Questionnaires

- Assessment of productivity and work impairment: it was carried out using a validated Work Productivity and Activity Impairment (WPAI) questionnaire in its version used for asthma and other pulmonary pathologies [21]. It is a self-administered questionnaire comprising six questions covering the last seven days, quantitatively measuring presenteeism, absenteeism, reduced productivity, and impairment of usual daily activities due to health problems [22]. Overall, three parameters were calculated:
  - Absenteeism: percentage of hours that have not been worked due to illness.
  - Presenteeism: presence at work with a loss of productivity due to illness.
  - Reduced work productivity reflects both absenteeism and presenteeism [22].
- Therapeutic compliance questionnaire: Compliance was assessed using the Simplified Medication Adherence Questionnaire (SMAQ) (18). This short, simple tool, based on questions asked directly to the patient about his or her medication-taking habits, was initially validated for measuring adherence in patients on antiretroviral therapy [19]. It contains six questions assessing the patient's compliance with treatment: forgetfulness, routine, adverse effects, and quantification of omissions. The patient responds to each question on a binary yes/no scale [18].

- Fatigue assessment: a feeling of physical or mental weakness following sustained effort and indicating the need to rest. It is considered pathological if the individual feels handicapped about his or her usual level of fitness, enabling him or her to carry out daily activities [23].

The Pichot self-questionnaire, translated into Arabic, was used in the study population to assess the extent of this handicap. It is organized into eight items, each describing a state in which the individual may perceive him/herself [23].

The patient chooses a response on a five-choice Likert scale, rated from 0 to 4 (not at all, a little, moderately, a lot, extremely). A total score of over 22 indicates excessive fatigue [24].

2.4. Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS 21.0) software. The Shapino-Wilk Test verified the normality of quantitative variables. Qualitative variables were calculated as percentages, and quantitative variables as mean ± standard deviation (SD) or median and interquartile range. Means were compared using the Student's t-test or U Mann-Whitney test, and percentages were compared using the Chi 2 test. Factors associated with productivity and work impairment were determined by Pearson's correlation test for quantitative variables and Student's t-test for qualitative variables. A multiple linear regression model analyzed variables significant at the 20% level. A P-value below 0.05 was considered statistically significant.

2.5. Ethical Considerations

The research was conducted in accordance with current legislative and regulatory provisions as well as good clinical practice. A request for authorization was submitted, and the Ethics Committee of Taher Sfar University Hospital issued a favorable opinion. An information letter was provided to subjects during an objective individual interview, and it was explained in simple terms throughout the course of the

Table 2. Clinical features of asthmatic disease in the study population.

Variables	N (%)
Average age at diagnosis (years) ± SD	29.1 ± 14.9
Average duration of symptoms (years) ± SD	18.3 ± 13.2
Spirometry performed	68.3
FEV1(%)	81.0 ± 21.3 [31–130]
FVC(%)	82.9 ±21.6 [11–136]
FEV1/FVC	80.8 ±12.1 [39–100]
Normal spirometry	60 (86.9)
Obstructive ventilatory deficit	9 (13.1)
Bronchial provocation test performed	10 (9.9)
Mild hyper reactivity	6 (60)
Moderate hyper reactivity	4 (40)
Allergy skin tests present	38 (37.7)
Positif test : DPT/DF	16 (42.6)
Positif test : Mold	7 (18.4)
Negatif test	15 (39.4)
Etiologies of asthma	
Allergic	85 (84.2)
Occupational	13 (12.8)
Hormonal	1 (1)
Gastroesophageal reflux disease (GERD)	1 (1)
Widal syndrome	1 (1)
Treatment	
ICS only	1 (0.9)
ICS + LABA	55 (54.4)
Anticholinergics	11 (10.9)
Antileukotrienes	5 (4.9)
Severity of asthma	
Intermittent	24 (23.8)
Light persistent	29 (28.7)
Moderate persistent	42 (41.6)
Severe persistent	6 (5.9)
Asthma disease control	
Controlled asthma	38 (37.6)
Poorly controlled asthma	38 (37.6)
Non controlled asthma	25 (24.8)

(*Continued*)

Variables	N (%)
Adherent patients	31 (30.7)
Acute exacerbations in the previous year	66 (65.3)
Asthma and work	
Aggravation during work	72 (71.3)
Improvement during vacations	74 (73.3)
Declaration of occupational disease	11 (10.9)
Professional Reclassification	5 (4.9)

FEV1: forced expiratory volume in seconds, FVC: forced vital capacity, DPT: Dermatophagoides pteronyssinus, DF: Dermatophagoides farinae, GERD: gastroesophageal reflux disease, ICS: inhaled corticosteroids, LABA: long-acting beta 2 agonists.

study. Signed informed consent was obtained from each subject before their participation in the study.

3. Results

3.1. Characteristics of Asthmatic Disease

The mean age at diagnosis of asthma in the study population was 29.1 ± 14.9 years, with a mean duration of symptoms of 18.3 ± 13.2 years (Table 2).

Over half of the patients (68.3%) had a spirometry test, and the majority of cases (86.9%) had expected results. A bronchial provocation test was performed in 9.9% of cases. Bronchial hyperreactivity was observed in all cases. Allergy was the most common etiology (84.2%), followed by professional etiology (12.8%).

The majority of patients (54.4%) had been treated with inhaled corticosteroids (ICS) and long-acting beta2 agonists (LABA) in combination with short-acting beta2 agonists as rescue therapy. Almost half of the patients (41.6%) had moderate persistent asthma. Disease control assessment revealed that 37.6% of patients had controlled asthma, and 24.8% had uncontrolled asthma.

Only 31 patients (30.7%) adhered to their treatment. Over half of the patients (65.3%) had experienced acute exacerbations, with an average of two acute exacerbations per year. 71.3% of cases reported a worsening of symptoms during professional exposure. Eleven patients (10.9%) had benefited from an occupational disease declaration. Five patients had been reclassified (Table 2).

Table 3. Productivity scores of the study population.

Variables	Values
Number of hours missed for health reasons per weak	2.5
Number of hours missed for other reasons per weak	2.9
Number of hours worked per weak	38.3 ± 16.4
Impact of health on work productivity	3.3 ± 2.5
Impact of health on day-to-day activities	2.9 ± 2.4
Absenteeism	4.2%
Presenteeism	33.1 ± 25.9 %
Pourcentage of activity impairment	30.4 ± 22.2 %.

3.2. Activity Impairment and Fatigue

Of the patients included in the study, 82.2% were gainfully employed. Patients worked an average of 38.3 ±16.4 hours per week, and the average number of hours missed due to health status was 2.6 hours per week. The impact of general health status on work productivity and current activities was 3.3 ±2.5 and 2.9 ± 2.4, respectively.

Absenteeism was 4.2%, while presenteeism was 33.1 ± 25.9%. The resulting drop in activity was estimated on average at 30.4 ± 22.2% (Table 3). The mean Pichot score of the population was 13.5 ± 7.6. Nineteen patients (18.8 %) had excessive fatigue.

3.3. Analytical Study

3.3.1. Univariate Study of Productivity

Female gender ($p = 0.02$), alcohol consumption ($p < 0.001$), occupational etiology ($p = 0.01$), and uncontrolled asthma ($p < 0.001$) were factors associated with impaired productivity, as well as worsening of symptoms in the workplace ($p < 0.001$).

The declaration of an occupational disease was associated with productivity loss, with a p-value of 0.03.

Table 4. Socio-professional and clinical factors associated with productivity.

Variables			Absenteeism	P	Presenteeism	P	Productivity Loss	P
Age			r = 0.054	0.60	r = 0.09	0.3	r = 0.10	0.33
Gender	Female		5.6	0.04	37.6 ± 26.9	**0.01**	34.1 ± 22.7	**0.02**
	Male		1.7		24.1 ± 21.6		23.5 ± 19.7	
Medical history	No		1.2	**0.04**	28.3 ± 24.6	0.6	28.07 ± 23.4	0.3
	Yes		8.1		38 ± 26.8		32.6 ± 20.5	
Life habits	Alcohol	Yes	0	0.5	50	<**0.001**	50	<**0.001**
		No	4.3		32.7 ± 26.4		30 ± 22.3	
	Smoking	Yes	0	0.1	26.4 ± 23.3	0.3	26.3 ± 23.3	0.5
		No	4.8		33.9 ± 26.3		30.9 ± 22.2	
Age at hiring			r = - 0.2	**0.04**	r = 0.14	0.15	r = - 0.06	0.53
Number of working hours			r = 0.1	0.1	r = 0.03	0.69	r = - 0.07	0.46
Type of working hours	Typical		5.1	0.6	34.7	0.4	32.3	0.09
	Atypical Night shift rotation		0.6		25.9		19.1	
	Atypical Night shifts only		0		30		40	
Thermal stress	No		2.6	**0.05**	29.2 ± 22.0	0.14	27.6 ± 19.7	0.25
	Yes		5.6		36.7 ± 28.9		32.8 ± 24.1	
FEV1			r = 0.109	0.4	r = - 0.07	0.5	r = - 0.04	0.7
Bronchial provocation test	Mild hyperreactivity		0	0.08	11.7 ± 11.5	0.5	11.6 ± 4	0.5
	Moderate hyperreactivity		2		45 ± 49		47.5 ± 33.8	
Etiology of asthma	Allergic		0.6	<**0.001**	27.9 ± 21.7	<**0.001**	28.3 ± 21.6	**0.01**
	Professional		2.6		66.4 ± 26.2		44.8 ± 21.1	
Asthma control	Controlled		0.1	**0.02**	18.9 ± 17.8		19.07 ± 17.7	<**0.001**
	Uncontrolled		5.1		37.4 ± 25.6		33.1 ± 19.5	
	Poorly controlled		7.5		48 ± 27.08		43.4 ± 24.5	
Acute exacerbation	No		4.1	0.2	22.6 ± 21.7	<**0.001**	21.8 ± 19.3	**0.01**
	Yes		4.3		38.6 ± 26.4		34.4 ± 22.5	
Number of exacerbations			R = 0.1	0.1	r = 0.5	<**0.001**	r = 0.5	<**0.001**
Severity	Intermittent		0	0.1	22.9 ± 17.8	0.08	23.9 ± 17.5	0.1
	Mild persistent		1.3		32.4 ± 17.2		32.07 ± 17.03	
	Persistent		7.1		36 ± 31.7		30.7 ± 27.1	
	moderate		16.7		56.7 ± 30.1		45.7 ± 23.9	
	Severe persistent							
Worsening during work	No		0.3	**0.04**	12.4 ± 11.6	<**0.001**	13.2 ± 18.8	<**0.001**
	Yes		5.6		41.4 ± 24.1		36.6 ± 20.1	

(*Continued*)

Variables		Absenteeism	P	Presenteeism	P	Productivity Loss	P
Improvement during leave	No	0.3	0,06	15.2 ± 12.09	<**0.001**	16.56 ± 20.03	<**0.001**
	Yes	5.5		39.6 ± 25.18		34.94 ± 21.09	
Occupational Disease Claim	No	3.6	< **0.001**	30.9 ± 25.2	**0.01**	28.5 ± 21.7	**0.03**
	Yes	9.1		50.9 ± 26.2		28.5 ± 21.7	
Benefit from reclassification	No	3.4	<**0.001**	31.7 ± 25.5	**0.01**	29.4 ± 22.3	0.08
	Yes	19.3		60 ± 21.1		47.3 ± 11.6	
Number of absences		r = 0.3	<**0.001**	r = 0.4	<**0.001**	r = 0.3	<**0.001**
Number of hospitalizations		r = 0.16	0.1	r = 0.1	0.2	r = 0.005	0.9
Adherence	No	2.3	0.5	32.3 ± 24,5	0.65	31.1 ± 21.5	0.6
	Yes	8.04		34.8 ± 29.3		29.09 ± 24.02	

P= Pearson coefficient, r = Pearson correlation coefficient, FEV1: forced expiratory volume in second.

Table 5. Multivariate analysis of productivity determinants.

	Coefficients		
Model	**B**	**CI [low. bound ,up. bound]**	**p**
Number of exacerbations per year	0.3	[0.1 , 0.5]	<0.001
Aggravation of symptoms during work	0.4	[0.5 , 0.8]	<0.001
Number of absences	0.3	[0.00 , 0.03]	<0.001

B: odds ratio, CI: confidence interval, low: lower, up: upper.

Working hours and spirometry parameters were not associated with productivity.

The average number of acute exacerbations per year and absences in the previous year were significantly associated with lower productivity in the study population (Table 4).

3.3.2. Multivariate Study

The variable introduced in the multivariate productivity analysis was "decline in productivity". In the final model, this multivariate regression retained the following statistically correlated determinants of productivity decline: the number of exacerbations, worsening of the disease during work, and the number of absences (Table 5).

4. Discussion

This study aimed to investigate the impact of asthma on work productivity in adults receiving asthma therapy. Productivity, activity impairment, and fatigue were assessed using the SMAQ, WPAI, and Pichot questionnaires, respectively. Various studies have shown that patients suffering from asthma, whether occupational or not, generally experience unfavorable outcomes, including a very high frequency of absenteeism [25, 26], work disability [27, 28], and shorter working life [29]. Our study showed that asthma had a moderate impact on productivity at work: the number of work hours missed due to asthma was 2.5/10, the effect of general health status on productivity was 3.3 ± 2.5/10, and on activities of daily living was 2.9 ± 2.4/10. Absenteeism was 4.25%, and presenteeism was 33.3% ± 25.9. The drop in productivity was estimated at 30.4 ± 22.2%. At the end of the univariate and multivariate study, productivity was determined by sociodemographic factors: it was essentially associated with female gender ($p = 0.02$) and alcohol consumption ($p < 0.001$).

Regarding the association of female gender with the productivity of asthma patients, similar results were obtained from a survey of 11068 patients in France, conducted by Dress and Dares, which indicated that asthma was linked to a higher frequency of unemployment periods in women compared

to men, resulting in a shorter duration of professional activity that reflects a certain instability [30]. Data from the European Community Respiratory Health Survey (ECRHS) concluded that the risk of leaving a job due to respiratory problems during the follow-up of asthma patients was greater in women than in men [31]. Several hypotheses can be proposed to explain gender differences in asthma severity, including the role of hormones [32, 33]. Thus, the negative impact of asthma on productivity, especially in women, could be attributed to the presence of pathophysiological differences between the two genders. Indeed, asthma incidence is higher in boys than in girls before puberty, although it is more prevalent in women during adulthood [34, 35].

Differences in occupational exposure may play a role, as women do not hold the same jobs and, therefore, do not experience the same exposures. For instance, it has been noted that women are generally more exposed to cleaning agents in the workplace [36-38]. Moreover, several studies indicate that in adulthood, women experience more severe and less controlled asthma than men [39-41]. Conversely, comorbidities were associated with lower work productivity in this study (32.6 ± 20.5 vs. 28.07 ± 23.4), although no statistically significant difference was found between the two groups ($p = 0.32$). However, absenteeism was significantly higher among patients with comorbidities ($p = 0.01$). A study by Solmaz Ehteshami-Afshar et al, which involved 284 active asthma patients assessing the impact of comorbidities on productivity, demonstrated that comorbidities significantly reduced the productivity of working asthma patients [38]. This discrepancy between the two studies may be attributed to the small number of patients with comorbidities included in our study.

Another Canadian study of 300 asthmatic patients showed that over a third of asthmatic subjects suffered from psychological disorders and comorbidities (depression, osteoporosis, obesity...), and this affected absenteeism and presenteeism [43, 44]. As a matter of fact, asthma treatments can also cause or contribute to comorbidity. Oral corticosteroids are well known to produce significant adverse effects, but even inhaled corticosteroids may predispose to osteoporosis, increased fracture risk and pneumonia [45, 46].

In addition, poorly controlled asthma correlated significantly with psychological distress, thus loss of productivity was higher in these patients than in those with controlled asthma and no associated psychological pathology [47]. Despite the documented burden of comorbidities in asthma, their effect on productivity was overlooked in the past, as asthma patients represent a relatively young population and were thus assumed to be free of comorbidities [48].

In addition to socio-demographic characteristics, the results of the present study showed that the productivity of asthma sufferers was strongly dependent on asthma disease characteristics such as the occupational etiology of asthma ($p = 0.01$), disease control ($p < 0.001$), increase in the number of acute exacerbations and absences in the previous year ($p < 0.001$ and $p < 0.001$ respectively). Similarly, the worsening of the disease in the workplace ($p < 0.001$) and the declaration of asthma as an occupational disease ($p < 0.001$) were associated with lower productivity.

Several studies have demonstrated that poorly managed asthma is linked to lower work output and productivity compared to well-managed asthma [12, 49]. In each phase of this survey, asthma served as a marker for work disability and the utilization of healthcare facilities [50]. The researchers discovered that individuals with poorly controlled or uncontrolled asthma experienced higher absenteeism rates than those without asthma.

In a European study, 24-59% of asthmatic patients reported at least one day of absence from work in the past year [12]. Similarly, in an American study, workers with poorly controlled asthma experienced greater work disability than those with well-controlled asthma [51, 52]. Work-related asthma, whether occupational or a pre-existing condition worsened by exposure to respiratory irritants in the workplace, significantly impacted work productivity. Indeed, a study conducted in California involving asthmatic patients indicated that total or partial work incapacity was linked not only to the severity of asthma but also to work conditions, particularly exposure to sensitizing factors in the workplace [53].

In France, a follow-up study of patients with occupational asthma found that, one year after diagnosis, 30% of patients were still exposed to occupational hazards, 16% had found new employment, and a significant number had stopped working permanently [54]. Additionally, the likelihood of leaving the initial workplace was greater for workers who sought recognition of their asthma as an occupational disease, and it was inversely related to the employee's education level and the size of the company.

A cohort study in Finland involving 48,296 hospital and local authority employees revealed that asthmatic patients averaged 24 days off work per year, compared to 14 days for non-asthmatic employees. Predictors of work absence due to respiratory issues included the type of occupation (metal workers and welders faced a higher risk than office workers), low FVC, and occupational exposure to vapors, gases, dust, fumes, and cleaning products [55]. This study highlights that "symptomatic" asthma can negatively impact occupational activity. Therefore, first, actions must be taken to manage the disease and its associated comorbidities. Second, ongoing medical monitoring and proper education for workers exposed to sensitizing agents are crucial for effective prevention of acute exacerbations and management of productivity. Adequate support for asthmatic employees, involving clinicians and occupational physicians, is also necessary to sustain employment and encourage their return to work.

Strengths and Weaknesses of the Study

This mono-center study involved 101 subjects, which is a significant number. However, larger multi-center studies would have been preferable for generalizing the results. Nonetheless, this study has several strengths. First, data collection was based on a survey form previously developed and administered by a single investigating physician, minimizing discrepancies in the information collected. Secondly, several authors have agreed on the validity of the questionnaires used in the studies under certain precautions. Each question must be formulated clearly (with a choice of answers limited to a metric with a progressive meaning). This work only provided an introductory framework for more extensive longitudinal studies to enhance the professional fulfillment of individuals with asthma patients.

5. Conclusion

Asthma is considered one of the most common chronic diseases causing high morbidity and mortality, mainly in developing countries.

An extension of this work could involve continuing the study over a more extended period to enhance the sample size and statistical power. Additionally, managing asthma-related comorbidities, improving disease control, and providing therapeutic education could enable the pulmonologist to enhance these patients' productivity. Clinicians must inquire about the occupational impact of their patient's asthma. Workplaces could consider offering training and strategies to assist patients in managing their physical and mental fatigue, thereby reducing productivity. Establishing close collaboration between the pulmonologist and the occupational physician at the time of hiring is essential to achieve this aim.

Ethics Approval and Consent to Participate: No names or other participant identifiers were used. Participation in the study was voluntary, and oral informed consent was obtained from all participants. The study was approved by Taher Sfar Hospital Ethical Committee (Reference: CEM-2025-04-08).

Conflict of Interest Declaration: There is no conflict of interest to declare.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has also been obtained to publish this paper.

Availability of Data and Materials: Data and materials are available if needed.

Competing Interests: The authors declare no conflict of interest.

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