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RESEARCH ARTICLE

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Asthma Prevalence Among Migrant Workers Attending Shuaiba Industrial Medical Center in Kuwait

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ABSTRACT

Specific work environments, such as exposure to chemicals emitted during industrial processes, are related to occupational asthma. From 1985 to 2012, Kuwait was expected to have the highest asthma prevalence rate among Middle East nations at 15%. This cross-sectional study was conducted using secondary data from occupational health physicians' records in Shuaiba Industrial Medical Center (SIMC) extracted and analyzed using SPSS. Chi-square test and logistic regression were used to check the association between risk factors and bronchial asthma (BA). The data sample size was 3478 in 2018 and 3807 in 2019. In 2018, BA had a significant relationship with age categories, work year groups, and determinants of fitness. Migrant workers above 51 years of age had a high risk of developing BA (p-value=0.012). There was a high risk of developing BA in workers who worked >21 years (p-value <0.001) and in workers who worked between 11 and 20 years (p-value=0.042). Overweight workers had a risk of developing BA (p-value=0.042). In 2019, BA had an associated relationship with age categories and determinants of fitness. Workers above 51 years of age had about a 39% risk of developing BA (p-value=0.009). Otherwise, the BMI, working years groups, marital status, and smoking status had no association with BA. In conclusion, BA is prevalent among migrant workers at SIMC. Long hours, low income, and a lack of PPE are just a few of the issues that migrant workers have been exposed to, raising their risk of poor health.

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Introduction

Chronic airway inflammation, known as bronchial asthma, causes the airways to constrict, making breathing difficult [1]. Exposure to substances or chemicals can lead asthmatic patients to develop asthma attacks or exacerbations [2]. These exposures cause immune cells to develop lung inflammation, which can be life-threatening [3]. According to the World Health Organization (WHO), 15 million disability-adjusted life-years (DALY) are lost globally each year, and asthma is responsible for 250,000 deaths [4].

Chemicals such as petrochemicals, polyaromatic hydrocarbons, formaldehyde, chlorine, ammonia, nitric oxides, isocyanates, acid anhydrides, and metals (metal salts) released during industrial operations can cause occupational asthma. In several studies, occupational asthma is considered one of the significant and common forms of work-related respiratory diseases in different countries, accounting for between 9 and 15% of asthma cases in adults [5].

Based on prior studies, occupational asthma can be divided into two categories: sensitizer-induced OA (SIOA), which accounts for 90% of the cases [6]; and irritant-induced OA (IIOA), which represents 10% of the cases [7,8]. More than 400 OA-causing agents have been reported with new causative agents that are added each year to a fast-growing list that is quickly out of date and never complete [9].

The most prevalent chemicals and substances that are found in the oil industry include particular matter (PM), nitrogen dioxide (NO_x), carbon monoxide (CO), hydrogen sulfide (H_2S), and sulfur oxide (SO_2). In addition, a barely detectable amount of toxic hydrocarbon such as methane is discharged by the refineries. Exposure to PM causes lung dysfunction. To be more precise, it causes lower airway inflammation and upper airway irritation [10]. Nitrogen dioxide (NO_x) causes severe respiratory illnesses [11].

Worldwide, the prevalence of asthma is not only in-

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creasing due to genetic factors, but lifestyle and environmental risk factors may also be potential causes of the increment in the prevalence of asthma [12]. In the last ten years, the prevalence of asthma and allergy have risen, especially in Westernized countries [10,13]. Several studies indicated that exposure to some substances in the workplace could be the cause of more than 10% of all incidents of asthma cases [14,15].

Moreover, data illustrate that asthma prevalence varies across Middle East countries and within a single country's cities [16]. Kuwait had the highest asthma ranking with an estimated 15% by a self-designed questionnaire among adults. In addition, Tehran had the lowest prevalence with an estimated 2% from 1985 to 2012 [16,17].

In Kuwait, the data of 2019 showed that 70% of the total Kuwait population is non-Kuwaiti. More than 60% of the non-Kuwaiti population is migrant workers. Most of them are from South and Southeast Asia such as Afghanistan, Pakistan, India, Nepal, Bangladesh, and Sri Lanka [18]. The asthma prevalence in migrant workers' parent countries was estimated to be 5.2% in Bangladesh, 6.3% in India, and 4.2% in Nepal. In addition, in Pakistan, it was 3.7% and 5.3% in Sri Lanka [19].

The asthma prevalence has been increasing among workers in various industries including oil companies in Kuwait due to exposure to the emission of harmful substances. The amount and period of exposure to these toxic materials need to be addressed and assessed in order to protect these workers from health issues. In this proposal, data from workers who attend Shuaiba Industrial Medical Center (SIMC) will be assessed, and a recommendation will be drawn to prevent asthma that is caused by exposure to the substances which are associated with asthma.

Study hypothesis

Prolonged exposure to harmful chemicals and substances emitted from various industries in Kuwait may be associated with the development and/or exacerbation of asthma among migrant workers. Other variables might also contribute to speeding up this development and/or exacerbation of asthma such as age, exposure time, other health problems, worker experience, etc.

Purpose of the study

The cumulative evidence reviewed demonstrates a consistent lack of estimating occupational asthma among migrant workers in various parts of the world. However, the level of asthma prevalence among migrant workers in the state of Kuwait has not been estimated. The authors of this study strongly believe that exposure to harmful chemicals and substances is the first and most important initial step from which to start investigating occupational asthma among migrant workers. Therefore, the purposes of this study were to estimate the actual prevalence rate of occupational asthma among migrant workers who attend Shuaiba Industrial Medical Center in the state of Kuwait; investigate the prevalence of asthma among those workers and other possible risk factors, which are age, exposure time, other health problems, worker experience, rank, and position; and evaluate the association of asthma and the exposure to the harmful chemicals and substances to draw out a prevention recommendation.

Materials and Methods

Study design

The Shuaiba Industrial Area in Kuwait served as the site of this cross-sectional investigation. Secondary data from SIMC were obtained for the years 2018 and 2019, and the data analysis process commenced in November 2020 and ended in March 2021. Migrant workers from various industrial factories and corporations located in the Al Ahmadi governorate are served by SIMC [20]. However, Al-Ahmadi is one of Kuwait's six governates. Thus, SIMC is responsible for the workers who are employed in the Al Ahmadi governorate.

Procedure

Secondary 2-year data on asthma were used in this study, and the authors and SIMC occupational physicians examined the data by conducting a pilot study to verify if the data were appropriately collected. The data is a retrospective record that is protected in terms of privacy and confidence. We retrospectively retrieved the secondary data and analyzed these data that were collected during the medical surveillance. We obtained permission from the Ministry of Health MOH to analyze these data. Ethical approval to conduct this study was received from both MOH and Kuwait University Health Science Center Committees. The ethical approval number is 1658. As the record only contains data that has been anonymized, the workers' information will be protected and confidently secured.

Instruments

Pre-employment examination, periodical examination, confined space entry, and baseline health examination records are among the data-gathering tools used by SIMC's occupational physicians to assess the prevalence of asthma among migrant workers. These methods are used to diagnose occupational asthma by occupational physicians.

Data analysis

The SPSS software program version 26 was used for both data entry and statistical analysis of the data [21]. Statistical analysis of the results included both descriptive and analytic techniques. Descriptive statistics in-

cluding the mean, standard deviation, percentage, and frequency were used to describe personal and sociodemographic characteristics among the study population. Analytic measures included a two-sample t-test and a Chi-square test. A correlation matrix was used to assess the degree of association between different variables including working year experiences and other independent variables. A logistic regression model was used to describe the diagnosis of asthma and test more than one independent variable in their prevalence between the studied groups after adjusting for age, smoking habit, and exposure. A level of $p \leq 0.05$ was considered to be statistically significant.

Results

This study, the data sample size was 3478 in 2018 and 3807 in 2019 at the SIMC in Kuwait. Data of 2018 was collected among workers who may have been potentially exposed to chemicals and substances that could cause asthma. The age range was 21-77 years, with a mean age of 40 years. Moreover, the worker's experience years ranged from 3 to 52 years, with a mean of 7 years. Additionally, the score range was 14.98-51.39, with a mean of 27.19. However, the BMI categories were based on the general classification. The BMI categories are underweight, normal weight, overweight, obese, and extremely obese.

According to 2019 data, the age range was 20-72 years, with a mean age of 39 years. The worker's experience years was 7 years, with a range of 2-62 years. In addition, the score range of BMI was 15.15-50.38, with a mean of 26.98.

In 2018 data, Indians made up the largest percentage (56.8%), followed by Egyptian (13.9%), Bangladeshi (7.8%), and Filipino (5.2%). Most of the workers (80%) worked less than 10 years; 16.2% of the workers had a tenure of employment between 11 and 20 years; 2.7% of the workers had worked for more than 21 years.

Furthermore, the majority of the workforce in the Shuaiba area was made up of 31-40 year old workers, followed by 41-to-50 year old workers. At that time, 20.5% of the workers were between the ages of 21 and 30 while just 16.5% of the workers were above the age of 51. Additionally, 49.1% of the migrant workers were overweight, followed by 28.7% of the workers with a normal BMI, 16.9% of the workers who were obese, and a small percentage of the workers who were extremely obese and underweight.

On the other hand, about half of the workers in the 2019 data were Indian (56.4%), followed by workers from Egypt (10.5%), Bangladesh (6.6%), and Kuwait (5.9%). About 59.4% of the workers had tenures of less than 10 years (<10), followed by workers who worked between 11 and 20 years (10.5%) and those who worked more than 21 years with a percentage of 1.9%.

Table 1 represents descriptive analysis of distribution characteristics of industrial workers at SIMC Kuwait in 2018 and 2019.

Table 2 shows descriptive analysis and measuring the association between risk factors, including smoking, age categories, working year groups and determination of fitness, and bronchial asthma among migrant workers. Further, the Chi-Square Test was done among workload and Bronchial asthma of industrial workers at SIMC in years 2018 and 2019 (Table 3). Logistic regression model was checked the relationship between demographic categories and bronchial asthma (Table 4).

Table 1. Baseline descriptive analysis of distribution characteristics of industrial workers, SIMC Kuwait, 2018 and 2019

Years	2018		2019	
	n=3478		n=3807	
Worker's Experience Years	**Number**	**Column Total N %**	**Number**	**Column Total N %**
>10	2787	80.10%	2261	59.40%
Nov-20	563	16.20%	401	10.50%
<21	94	2.70%	74	1.90%
missing	34	1.00%	1071	28.20%
Age Categories				
21-30 years	712	20.50%	840	22.10%
31-40 years	1270	36.50%	1364	35.80%
41-50 years	921	26.50%	945	24.80%
above 51 years	575	16.50%	658	17.30%
missing	0	0%	0	0%

BMI categories				
Under weight	30	0.90%	29	0.80%
Normal	997	28.70%	828	21.70%
Overweight	1709	49.10%	1329	34.90%
Obese	588	16.90%	481	12.60%
Extremely obese	152	4.40%	98	2.60%
missing	2	0%	1042	27.40%
Nationality				
Kuwaiti	70	2.00%	223	5.90%
Egyptian	483	13.90%	401	10.50%
Indian	1976	56.80%	2148	56.40%
Bangladeshi	272	7.80%	252	6.60%
Filipino	181	5.20%	144	3.80%
Others	496	14.30%	639	16.80%
missing	0	0%	0	0%

Table 2. Descriptive analysis and measuring the association between risk factors and bronchial asthma among migrant workers, SIMC, 2018 and 2019.

Years	**2018**				**2019**		
	n=3478				n=3807		
	Bronchial asthma			**(P-value)**	**Bronchial asthma**		**(P-value)**
		No	Yes		NO	YES	
Smoking							
No	Count	2628	18	0.527	3095	43	0.324
	Expected count	2629	16.7		3098	40.4	
	%within smoking or not	99.30%	0.70%		1.40%	0.324	
Yes	Count	828	4		663	6	
	Expected count	826.7	5.3		660.4	8.6	
	%within smoking or not	99.50%	0.50%		99.10%	0.90%	
Age categories							
21-30 years	Count	712	0	0.001*	835	5	0.037*
	Expected count	707.5	4.5		829.2	10.8	
	%within age categories	100.00%	0.00%		99.40%	0.60%	
31-40 years	Count	1265	5		1348	16	
	Expected count	1262	8		1346	17.6	
	%within age categories	99.60%	0.40%		98.80%	1.20%	
41-50 years	Count	914	7		932	13	
	Expected count	915.2	5.8		932.8	12.2	
	%within age categories	99.20%	0.80%		98.60%	1.40%	
above 51 years	Count	565	10		643	15	
	Expected count	571.4	3.6		649.5	8.5	
	%within age categories	98.30%	1.70%		97.70%	2.30%	

Working Years Groups							
<10 years	Count	2777	10	<0.001*	2236	25	0.342
	Expected count	2769.4	17.6		2232	29.1	
	%within working years groups	99.60%	0.40%		98.90%	1.10%	
11–20 years	Count	556	7		393	8	
	Expected count	559.4	3.6		395.8	5.2	
	%within working years groups	98.80%	1.20%		98%	2.00%	
>21 years	Count	90	4		72	2	
	Expected count	93.4	0.6		73	1	
	%within working years groups	95.70%	4.30%		97.30%	2.70%	
Missing	Count	33	1		1057	14	
	Expected count	33.8	0.2		1057	13.8	
	%within working years groups	97.10%	2.90%		98.70%	1.30%	
Determination of Fitness							
FIT	Count	1798	0	<0.001*	1861	1	<0.001*
	Expected Count	1786.6	11.4		1838	24	
	%within Determination of fitness	100.00%	0.00%		99.90%	0.10%	
UNFIT	Count	7	2		8	0	
	Expected Count	8.9	0.1		7.9	0.1	
	%within Determination of fitness	77.80%	22.20%		100.00%	0.00%	
FSC	Count	1518	20		1785	48	
	Expected Count	1528.3	9.7		1809.4	23.6	
	%within Determination of fitness	98.70%	1.30%		97.40%	2.60%	
Note: FIT=Physically fit; UNFIT= physically unfit; FSC=Fit specific medical condition.							
*Significant differences at the p ≤ 0.05 level.							

Table 3. chi-square test among workload and bronchial asthma of industrial workers, SIMC Kuwait, 2018 and 2019

Year		**2018**				**2019**			
Variables		Bronchial asthma			Chi-square P-value	Bronchial asthma			Chi-square P-value
		No	Yes	Total		No	Yes	Total	
Workload category	Low Physical Activity	291	1	292	0.787	275	5	280	0.593
	Moderate Physical Activity	350	1	351		162	1	163	
	High Physical Activity	2815	20	2835		1494	21	1515	
Total		3456	22	3478		1931	27	1958	
Note. *Significant differences at the p≤ 0.05 level.									

Table 4. Logistic regression test between demographic categories and bronchial asthma, SIMC Kuwait, 2018 and 2019.

Year		**2018**				**2019**			
Variables		**P-value**	**OR**	**95% CI**				**95% CI**	
				Lower	**Upper**	**P**	**OR**	**Lower**	**Upper**
Age	21-30 years	-	-	-	-	-	-	-	-
	31-40 years	0.686	1.403	0.272	7.251	1.183	1.982	0.723	5.431
	41-50 years	0.123	2.719	0.563	13.128	1.11	2.329	0.827	6.562
	Above 51 years	0.012*	6.924	1.528	31.364	0.009*	3.896	1.409	10.775
Marital status	Single	-	-	-	-	-	-	-	-
	Married	0.507	1.971	0.266	14.624	0.76	0.874	0.37	2.067
Working Years	Less than 10 years	-	-	-	-	-	-	-	-
	11-20 years	0.042*	2.627	1.033	6.679	0.144	1.821	0.815	4.065
	More than 21 years	0.001*	9.313	2.963	29.276	0.222	2.484	0.577	10.69
BMI	Under Weight	-	-	-	-	-	-	-	-
	Normal	0.198	0.251	0.031	2.058	0.488	0.482	0.061	3.791
	Over Weight	0.042*	0.109	0.013	0.926	0.36	0.384	0.05	2.981
	Obese	0.292	0.317	0.037	2.688	0.271	0.294	0.033	2.603
	Extremely Obese	0.403	0.353	0.031	4.055	0.385	0.289	0.017	4.764
Smoking	No	-	-	-	-	-	-	-	-
	Yes	0.571	0.754	0.283	2.006	0.328	0.651	0.276	1.537
Note: a. variable (s) entered on step 1: Age categories, Marital status, Working Years Groups, BMI Categories, Smoking or not									
b. *Significant differences at the p ≤ 0.05 Level.									

Discussion

In Kuwait, being a migrant worker is associated with high-risk exposure to inhalant toxic chemicals and substances for extended periods of time because they start working at a younger age, which could lead to permanent health problems including lung changes and disability [22]. In this study, we estimated the actual prevalence of occupational asthma among migrant workers who attended SIMC in Kuwait and investigated the prevalence of asthma among the workers and other possible risk factors. Studies in this context focus on risk assessment and prevention strategies and approaches that will affect migrant workers' health.

The Association between Smoking and Bronchial Asthma

According to our findings, there was no association between smoking and bronchial asthma in either 2018 or 2019. It is disputed whether active smoking contributes to the onset of asthma. Prior to the year 2000, several studies found no link between smoking and the prevalence of asthma. According to Vignoud, L. and his colleagues in 2011 [23], it is still unclear whether smoking causes asthma. On the other hand, numerous studies have demonstrated a strong link between smoking and bronchial asthma. Asthma symptoms and occupational exposures were linked in 2017, according to research by R. Abrahamsen and his colleagues [24]. Additionally, Spears, M. showed in 2009 that smoking could cause occupational asthma [25].

The Association between Body Mass Index and Bronchial Asthma

In our study, the BMI had no significant relationship with bronchial asthma in 2018 and 2019. However, many previous published studies showed that there is a significant relationship between obesity and over-

weight and the incidence of asthma, but until today, there has been no clear understanding that the relationship is either due to a causal association or the two conditions sharing the same environmental, behavioral, or genetic influences [26-28]. Moreover, the precise mechanism is unknown regarding the association between high BMI and the incidence of asthma [29]. Additionally, Sin, D. and E.R. Sutherland in 2008 showed that high BMI was a significant risk factor for the incidence of bronchial asthma [30]. However, we found that there was a significant association between age categories and BMI in both years. In 2018, Dunn, R found that the relative risk associated with higher BMI decreases with age [31].

This study found that people who were less than 50 years of age were likely to have good fitness levels while people above 50 years of age were at risk of having lower fitness levels. In our results, the association between the fitness level and bronchial asthma was significant. However, further studies should be carried out to assess the association between the fitness level and bronchial asthma.

The Association between Workload and Bronchial Asthma

This study revealed a strong association between work experience duration and bronchial asthma in 2018. Additionally, there is an association between the duration of work experience and bronchial asthma, according to Rönmark, E., who aimed to establish evidence-based diagnostic and treatment guidelines for work-related asthma [32]. Future studies should also be conducted to establish a clearer correlation between work experience duration and bronchial asthma.

The Association between Industrial Toxic Chemicals and Bronchial Asthma

Many studies have indicated a significant relationship between asthma and occupational exposure [33,34]. Vlahovich, K in 2021 published a paper that showed an association between asthma and toxic chemical exposure in the workplace, and multiple respiratory disorders including asthma have a significant occupational impact that has clinical, policy, and research ramifications [35]. Moreover, in 2018, Zivadinovic, N carried out a study, which was a population-based sample (n=7120) of participants aged 16-55, from the Telemark study, with a five-year follow-up. By using logistic regression and adjusting for gender, age, education level, and smoking, it was possible to determine the relationship between newly developed asthma and self-reported occupational exposure to vapor, gas, dust, and fumes (VGDF). It showed that there is an association between occupational exposure and new-onset asthma [36].

However, it is difficult to protect any worker who must handle low-molecular-weight (LMW) chemicals. Respiratory masks and air-supplied respirators can leak, and many employees find it difficult to put up with uncomfortable safety gear for the duration of a shift. Grammer et al. observed a decreased prevalence of chemical sensitization and OA among workers utilizing respiratory protection equipment compared to those who did not in a cohort of workers exposed to an acid anhydride chemical sensitizer [37]. Fifty-two published studies on the treatment and outcomes of work-related asthma (WRA) were evaluated in a recent systematic review, which found that complete exposure avoidance is more effective than partial mitigation, persistent exposure is likely to exacerbate asthma, and personal protective equipment does not offer full protection. Careful medical supervision is necessary for any intervention intended to reduce exposure to prevent the worsening of the condition [38].

Limitations

Our study had several limitations including the sample size in both 2018 and 2019, which was too low to generate reliable findings. The migrant workers face many barriers, including language and cultural barriers. So, their educational level could affect the results from the secondary data we collected from SIMC. Additionally, selection bias could occur due to migrant workers' turnover or going back to their countries [39].

It is challenging to estimate the global prevalence of adult asthma in epidemiological studies. There are several causes, including the use of different terminology for asthma symptoms in various languages and variations in how patients report their symptoms depending on their back-ground. Additionally, because doctors practice in various healthcare systems, they have a variety of diagnoses.

Further, it is difficult to draw causal relationships from cross-sectional analysis. However, we can estimate the prevalence of disease and estimate the odds ratios to study the association between exposure and the outcomes in this design.

In this paper, we could not cover all the objectives, but we checked the association between the risk factors and bronchial asthma and evaluated the association between asthma and exposure to harmful chemicals and substances to draw out a prevention recommendation.

It was challenging to explore the main chemicals and substances that might be associated with asthma among these workers such as particulate matter, nitrogen oxides, and carbon monoxide, etc., because SIMC did not ask questions about the types of chemicals that the migrant workers work with daily in their jobs. So, in this secondary dataset, no specific chemical was re-

corded for each migrant worker regarding exposure in their work. We will recommend that SIMC collect data on chemicals that the migrant workers are exposed to while at work [40].

Conclusion

More than 60% of the people living in Kuwait are migrant workers. Occupational asthma is associated with a specific work environment and is regarded as one of the most prevalent types of work-related respiratory illnesses in several industrialized nations. Moreover, migrant workers have been subjected to a variety of factors, such as long working hours, low wages, and a lack of PPE, increasing their risk of developing health problem. The results of this study demonstrated that migrant workers who are registered in SIMC in Kuwait prevalently have bronchial asthma.

Future research should concentrate on both primary and secondary prevention to decrease occupational asthma, according to our study's recommendations. One of the occupational diseases that are difficult to confirm is occupational asthma. Investigations are required to develop better diagnostic techniques that will enable the earlier detection of occupational asthma (OA) and prevention of future OA cases. Further investigation is advised to examine the relationship between bronchial asthma and years of work experience in addition to the relationship between bronchial asthma and fitness/worker's health.

Author Contributions

The work was supervised by J.G. The methodology and data analysis were done by H.W.A. and A.M.F.S; H.W.A., A.A. and A.M.F.S worked drafted the manuscript and J.G. edited the manuscript. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Secondary data from the SIMC represent a retrospective record that is secure and confidential. Both Kuwait University's (KU) Health Sciences Center (HSC) Committees and the Ministry of Health (MOH) gave their permission for the study's ethical conduct. The records showed anonymized data, which protected and secured the workers' information.

Informed Consent Statement

The secondary data represent a retrospective record that is protected in terms of privacy and confidence. The participant's information was protected and confidently secured as the records showed anonymized data.

Data Availability Statement

Not applicable

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Conflicts of Interest

There are no conflicts of interest to declare.

References

[1] Kradin RL. Understanding Pulmonary Pathology. Elsevier. 2017.

[2] Etzel RA. How environmental exposures influence the development and exacerbation of asthma. Pediatrics 2003;112:233-239.

[3] Barnes PJ. Immunology of asthma and chronic obstructive pulmonary disease. Nat. Rev. Immunol 2008;8:183-192.

[4] Bousquet J, Bousquet PJ, Godard P, Daures JP. The public health implications of asthma. Bull World Health Organ 2005;83:548-554.

[5] Maestrelli P, Boschetto, P, Fabbri LM, Mapp CE. Mechanisms of occupational asthma. J Allergy Clin Immunol 2009;123:531-542.

[6] Cormier M, Lemière C. Occupational asthma. Int J Tuberc Lung Dis 2020;24:8-21.

[7] Brooks SM, Hammad Y, Richards I, Giovinco-Barbas J, Jenkins K. The spectrum of irritant-induced asthma:Sudden and not-so-sudden onset and the role of allergy. Chest 1998;113:42-49.

[8] Tiotiu AI, Novakova, S, Labor M, Emelyanov A, Mihaicuta S, Novakova, P, et al. Progress in Occupational Asthma. Int J Environ Res Public Health 2020;17:4553.

[9] Friedman-Jimenez G, Harrison D, Luo H. Occupational asthma and work-exacerbated asthma. Semin Respir Crit Care Med 2015;36:388-407.

[10] Baldacci S, Maio S, Cerrai S, Sarno, G, Baïz, N, Simoni M, et al. Allergy and asthma:Effects of the exposure to particulate matter and biological allergens. Respir Med 2015;109:1089-1104.

[11] Quah SR, Cockerham WC. International Encyclopedia of Public Health. Elsevier 2017.

[12] Nunes C, Pereira AM, Morais-Almeida M. Asthma costs and social impact. Asthma Res Pract 2017;3:1.

[13] Lee SY, Chang YS, Cho SH. Allergic diseases and air pollution. Asia Pac Allergy 2013;3;145-154.

[14] Torén K, Blanc PD. Asthma caused by occupational exposures is common-a systematic analysis of estimates of the population-attributable fraction. BMC Pulm Med 2009;9:7.

[15] Kogevinas M, Zock JP, Jarvis D, Kromhout H, Lillienberg L, Plana E, et al. Exposure to substances in the workplace and new-onset asthma:An international prospective population-based study (ECRHS-II). Lancet 2007;370:336-341.

[16] Alavinezhad A, Boskabady MH. The prevalence of asthma and related symptoms in Middle East countries. Clin Respir J 2018;12:865-877

[17] Khadadah M. The cost of asthma in Kuwait. Med Princ. Pract 2013;22:87-91

[18] Kuwait G. State of Kuwait. Kuwait government online.

[19] Alahmad B, Kurdi H, Colonna K, Gasana J, Agnew J, Fox MA. COVID-19 stressors on migrant workers in Kuwait:Cumulative risk considerations. BMJ Glob Health 2020;5:e002995.

[20] Sm AI F, Am S. Work-Related Accidents Referred to Industrial Medical Center, Kuwait, from 2015 to 2017. Egypt. J Occup Med 2018;42:285-302.

[21] Nagaiah M, Ayyanar K. Software for Data Analysis in SPSS On over view. SSRN 2016.

[22] Bishwajit G, Tang S, Yaya S, Feng Z. Burden of asthma, dyspnea, and chronic cough in South Asia. Int J Chron Obstruct Pulmon Dis 2017;12:1093-1099.

[23] Vignoud L, Pin I, Boudier A, Pison C, Nadif R, Le Moual N, et al. Smoking and asthma:Disentangling their mutual influences using a longitudinal approach. Respir Med 2011;105:1805-1814.

[24] Abrahamsen R, Fell AKM, Svendsen MV, Andersson E, Torén K, Henneberger PK, et al. Association of respiratory symptoms and asthma with occupational exposures:Findings from a population-based cross-sectional survey in Telemark, Norway. BMJ Open 2017;7:e014018

[25] Spears M, Donnelly I, Jolly L, Brannigan M, Ito K, McSharry C, et al. Effect of low-dose theophylline plus beclometasone on lung function in smokers with asthma:A pilot study. Eur Respir J 2009;33:1010-1017.

[26] Lang JE, Bunnell HT, Hossain MJ, Wysocki T, Lima JJ, Finkel TH, et al. Being Overweight or Obese and the Development of Asthma. Pediatrics 2018;142:e20182119.

[27] Miethe S, Karsonova A, Karaulov A, Renz H. Obesity and asthma. J Allergy Clin Immunol 2020;146:685-693.

[28] Mohan A, Grace J, Wang BR, Lugogo N. The Effects of Obesity in Asthma. Curr Allergy Asthma Rep 2019;19:49.

[29] Moosazadeh M. Meta-Analysis of Prevalence of Smoking in 15-64-year-old Population of West of Iran. Int J Prev Med 2013;4:1108-1114.

[30] Sin DD, Sutherland ER. Obesity and the lung:4. Obesity and asthma. Thorax 2008;63:1018-1023.

[31] Dunn RM, Busse PJ, Wechsler ME. Asthma in the elderly and late-onset adult asthma. Allergy 2018;73:284-294.

[32] Rönmark E, Andersson C, Nyström L, Forsberg B, JärvholmB, Lundbäck B. Obesity increases the risk of incident asthma among adults. Eur Respir J 2005;25:282-288.

[33] Dao A, Bernstein DI. Occupational exposure and asthma. Ann Allergy Asthma Immunol 2018;120:468-475.

[34] Laditka JN, Laditka SB, Arif AA, Hoyle JN. Work-related asthma in the USA:Nationally representative estimates with extended follow-up. Occup Environ Med 2020;77:617-622.

[35] Vlahovich KP, Sood A. A 2019 Update on Occupational Lung Diseases:A Narrative Review. Pulm Ther 2021;7:75-87.

[36] Zivadinovic N, Klepaker G, Svendsen MV, Kjell T, Henneberger P, Kongerud J, et al. Occupational exposure and new onset asthma in the Telemark study:A five-year follow up. Eur Respir J 2020;56:3850.

[37] Grammer LC, Harris KE, Yarnold PR. Effect of Respiratory Protective Devices on Development of Antibody and Occupational Asthma to an Acid Anhydride. Chest 2002;121:1317-1322.

[38] Vandenplas O, Dressel H, Nowak D, Jamart J. What is the optimal management option for occupational asthma?. Eur Respir Rev 2012;21:97-104.

[39] Jolly AT, Klees JE, Pacheco KA, Guidotti TL, Kipen HM, Biggs JJ, et al. Work-Related Asthma. J Occup Environ Med 2015;57:e121-e129.

[40] Alahmad B, Shakarchi AF, Khraishah H, Alseaidan M, Gasana J, Al-Hemoud A, et al. Extreme temperatures and mortality in Kuwait:Who is vulnerable? Sci Total Environ 2020;732:139289.