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Asthma and body mass index in occupational setting

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Abstract

Background: Asthma is the most common respiratory disease with an increasing prevalence. On the other hand, obesity is also a challenging disease compromising health in human communities. This study sought to assess the correlation of asthma and body mass index (BMI) in occupational setting.

Methods: This study was conducted in a cable manufacturing company in 2012. A total of 551 workers from the production (exposed group) and non-production (unexposed group) units were studied. A questionnaire specifically designed for this purpose was filled out for study subjects and then all workers with respiratory symptoms suggestive of asthma thoroughly examined by a physician and medical history was taken from them. Complementary diagnostic tests were also carried out.

Results: A total of 11.6% of our understudy subjects had asthma. The prevalence of asthma in exposed subjects with BMI≥25 kg/m^2 was found to be significantly higher than in exposed workers with BMI<25 kg/m^2 ($p<0.01$). However, no significant differences existed in prevalence of asthma between the two subgroups of BMI≥25 kg/m^2 and BMI<25 kg/m^2 in the unexposed group ($p>0.05$). After adjusting for confounding factors significant associations were observed between BMI and asthma at cut points of 30 kg/m^2 and 25 kg/m^2 (OR: 8.53 and 2.41, respectively).

Conclusion: Our study results showed that prevalence of asthma might be higher in workers with higher BMI who are exposed to occupational asthmogens. This finding highlights the necessity of offering weight loss recommendations in periodic examinations to workers with exposure to occupational asthmogens.

Keywords: Asthma, BMI, Occupational exposure.

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Introduction

Asthma is a common disease of all ages and affects 5 to 10% of adults (1). It is the most common respiratory disease and in contrast to many other respiratory conditions, prevalence of asthma is increasing (2-4). During the past three decades, its prevalence has increase d by more than three folds (5). Asthma is a costly disease considering its related direct and indirect expenses (6). It has been demonstrated that asthmatics have 1.4 days more absence from work, and activity limitation in them is greater than in normal subjects (6).

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Asthma is prevalent in all areas of Iran and about 10% of Iranians have asthma (7). On the other hand, obesity is a very common condition with a highly growing trend during the past few decades (2-4). Studies show that 30% of 20 year-old or older adults in the United States during 1999-2002 had BMI of 30 or higher; which indicates a growing trend compared to statistics in 1994 (23%) and 1976-1980 (15%) (2). Decreased physical activity and sedentary lifestyle have been the major contributors to weight gain during the recent decades. Considering the trend of industrialization in Iran and subsequently reduced in physical activity, BMI is rapidly increasing in our country as well. Asthma and obesity are among the major health concerns worldwide (8). During the past several decades, the effects of indoor and outdoor triggers on asthma have been well documented (2). Numerous studies have evaluated the possible correlation of obesity and asthma (9-13). For instance, a meta-analysis on 7 prospective studies in adults showed that prevalence of asthma increases by higher BMI in adults. In overweight subjects (BMI of 25 to 29.9), risk of asthma increased by 38% in comparison to normal weight subjects (OR: 1.92, CI: 1.17-1.62); in obese (BMI≥30) individuals this risk increased by 92% (OR: 1.92, CR: 1.43-2.59) (14). Some studies discuss that obesity may complicate the control of asthma and worsen its outcomes (15-16). It may also increase the rate of asthma-related hospitalizations (6). Obese asthmatic patients in comparison to overweight or normal weight asthmatics experience more severe respiratory symptoms with higher frequency, greater number of exacerbations and decreased quality of life due to asthma (17).

Genetics, changes in the immune system and mechanical mechanismsare all responsible for the correlation of asthma and high BMI (9). Several epidemiologic studies demonstrate that obesity increases the prevalence and incidence of asthma and weight loss in obese subjects improves their asthma symptoms and pulmonary function and reduces the consumption rate of asthma medications (9). The association of asthma and BMI in women has been shown in some studies (13, 18-20). However, this correlation in men is weak or insignificant (12, 13, 21).

Various factors are suggested to be responsible for the lack of correlation between asthma and obesity in men. For instance, it has been explained that the definition of obesity by the WHO may not be accurate in men and does not necessarily indicate their body fat (22).

To date, the synergy of occupational asthmogens such as Toluene diisocyanate (TDI) with BMI in development of occupational asthma has not been evaluated. A reason for the weak correlation between BMI and asthma in men, apart from hormonal differences, may be due to difference in occupations of men and women. A more specific evaluation of men in occupational subgroups may reveal this correlation. According to some published studies, the American Thoracic Society estimates that 15% of cases of asthma in adults are due to occupational exposures (23). Based on the mentioned explanation and considering the fact that no study has used this approach to evacuate the work environment, the present study sought to assess the correlation of asthma prevalence (occupational and non-occupational) and the BMI in workers of a cable manufacturing company.

Methods

Study design and population

This cross-sectional study was conducted on workers of a cable manufacturing company in Iran in 2012. All workers in the production units who were exposed to TDI, polyvinyl chloride, polyethylene or polypropylene considered as the “exposed” and workers of the warehouse and packaging units considered as the “unexposed” groups and entered the study. Measurements revealed that the concentrations of mentioned substances in the production units of the company were higher than the safe threshold while these concentrations were insig-

nificant in the warehouse and packaging units. All workers were males. Eventually, a total of 189 unexposed workers (34.3%) and 362 (65.7%) exposed workers were evaluated.

History of exposure to asthmogen materials in their second job or previous occupation, history of respiratory diseases (like asthma and rhinitis) before employment in the understudy cable manufacturing company and unwillingness about recruitment in the study were considered as the exclusion criteria**.**

All study subjects signed written informed consent prior to the study and were informed that they are free to leave the study whenever they wish to do so. The Ethics Committee of the National Research Institute of Tuberculosis and Lung diseases approved the study design.

A questionnaire specifically designed for this purpose was first filled out for all workers. The questionnaire included demographic characteristics, medical history, medical family history, respiratory complaints (coughing, sputum production, dyspnea, wheezing, sneezing, rhinorrhea, nasal congestion, post-nasal discharge, itchy eyes and nose, etc.) at work or outside the work environment, time of occurrence of symptoms, resolution of symptoms after leaving work or not, history of allergy or asthma and their onset, history of diseases such as hay fever and eczema, drug intake, smoking status, respiratory diseases or complaints prior to current employment, a thorough work history (type of occupation, risks, previous job, etc), shift work, triggers of symptoms such as cold weather, exercise, aero-allergens (such as pollens, house dust mite, pet allergens, etc), and nonspecific triggers such as cigarette smoke and perfumes. Also, the questionnaire contained one question about the first-degree relatives with asthma (24).

A trained staff measured height and weight of subjects in a standardized way. Height was measured without shoes and weight measured with the subject wearing light clothing. The BMI defined as weight in Kg divided by height in meters squared.

In terms of weight standards, understudy subjects were divided into three groups of normal weight, overweight and obese with BMI<25, 25≤BMI<30 and BMI≥30 (5).

Diagnostic criteria for asthma

After filling out the questionnaire, subjects with asthma symptoms were thoroughly examined by aphysician and a complete medical history was taken from them. All understudy subjects were also examined with special attention to their respiratory system. Diagnostic tests including spirometry (Spirolab III, MIR Co, Italy) with bronchodilator and methacholine challenge test were carried out for subjects who had symptoms suggestive of asthma in their medical history or physical examination. Final diagnosis of asthma was made according to the available guidelines (25). Subjects identified by the specialist to have asthma criteria were considered asthmatic. These criteria were as follows:

1- Episodic signs and symptoms of airway obstruction or airway hyperresponsiveness (Symptoms favoring airway obstruction on physical examination)

2- Minimum partial reversibility of airway obstruction

a. Observing reversible airway obstruction in spirometry with FEV1≥12% of the baseline value or≥ 10% of the predicted FEV_1 value following inhalation of a short-acting bronchodilator

3- Ruling out other alternative diagnoses (25).

Statistical analysis

Percentage, frequency, mean and standard deviation (SD) were used for descriptive analysis. Chi-square test was used to assess the univariate associations between asthma and BMI, age group, occupational exposures, smoking, shift work and work experience. Logistic regression analysis was applied for precise evaluation of the correlation between asthma and BMI. In all statistical tests the confidence interval (CI) was

95% and p<0.05 was considered as significant. All analyses were performed with SPSS version 11 software.

Results

A total of 551 subjects participated in this study. All participants were males with the mean age of was 38.77± 4.98 years. The mean BMI and work experience of participants were 25.84 ± 3.29 Kg/m^2 and 11.35 ± 4.78 years, respectively.

Overall, 107 (19.4%) were smokers and 444 (80.6%) non-smokers. The mean rate of cigarette consumption among smokers was 5.66packs/year. No significant difference existed between the two groups of exposed and unexposed in terms of BMI (p>0.05, Table 1).

In total, 64 (11.6%) subjects had asthma. In the exposed group, of 362 participants 58 (16.0%) had asthma; whereas, in the unexposed group, of 189 workers, 6 (3.2%) had asthma. A significant difference was observed in prevalence of asthma between the exposed and unexposed groups (P<0.001, OR: 5.82, 95% CI: 2.46-13.75). In order to evaluate the association of asthma and BMI, understudy subjects were divided into three groups of normal, overweight and obese in terms of weight standards with BMI<25 kg/m^2, BMI=25-29.9 kg/m^2 and BMI≥30 kg/m^2, respectively. As observed in Table 2, by increased BMI prevalence of asthma increased as well (p<0.05).

Subjects were divided into two groups of BMI< 30 kg/m^2 and BMI≥30 kg/m^2 and a significant correlation detected between BMI and prevalence of asthma (Table 2, p<0.05). Subjects divided into two groups of BMI<25 kg/m^2 and BMI≥25 and still the prevalence of asthma was significantly higher in the group with BMI≥25 kg/m^2 (Table 2). Understudy workers were then divided into two groups of exposure above and below the TLVs (threshold limit values) and it was observed that incidence of asthmatic symptoms was significantly higher in workers with exposure over the threshold limit values (p<0.001).

Comparison of subjects with BMI< 25kg/m^2 and BMI≥ 25kg/m^2 in two groups of exposed and unexposed in terms of prevalence of asthma revealed that in the

Table 1. BMI comparison in exposed and unexposed groups

	Exposure		p value	OR (CI95%)
	Yes (%)	No (%)		
BMI				
<25	191 (64.7)	104 (35.3)		
25-29.99	143 (71.1)	58 (28.9)	>0.05	-
≥30	28 (51.9)	26 (48.1)		
BMI				
<30	334 (67.3)	162 (32.7)	>0.05	1.91(0.98-3.37)
≥30	28 (51.9)	26 (48.1)		
BMI				
<25	191 (64.7)	104 (35.3)	>0.05	1.11(0.78-1.58)
≥25	171 (67.1)	84 (32.9)		
Total	362 (65.8)	188 (34.2)	-	-

Table 2. Asthma prevalence based on BMI in all participants

	Asthma		p value	OR (CI95%)
	No (%)	Yes (%)		
BMI				
<25	271 (91.9)	24 (8.1)		
25-29.99	175 (87.1)	26 (12.9)	<0.01	-
≥30	40 (74.1)	14 (25.9)		
BMI				
<30	446 (89.9)	50 (10.1)		
≥30	40 (74.1)	14 (25.9)	<0.05	3.12 (1.59-6.13)
BMI				
<25	271 (91.9)	24 (8.1)		
≥25	215 (84.3)	40 (15.7)	<0.01	2.10 (1.23-3.59)
Total	486 (88.4)	64 (11.6)	-	-

Table 3. Asthma prevalence based on BMI in exposed and unexposed groups

	Exposed Group				Unexposed Group			
	Asthma				Asthma			
	Yes (%)	No (%)	p value	OR (CI95%)	Yes (%)	No (%)	p value	OR (CI95%)
BMI								
<25	21 (11.0)	170 (89.0)	-----	-----	3 (2.9)	101 (97.1)		
≥25	37 (20.4)	134 (79.6)	<0.01	2.23 (1.25-3.99)	3 (3.6)	81 (96.4)	>0.05	1.25 (0.24-6.34)
BMI								
<30	46 (13.8)	288 (86.2)	------		4 (2.5)	158 (97.5)		
≥30	12 (42.8)	16 (57.2)	<0.01	4.69 (2.09-10.56)	2 (7.7)	24 (92.3)	>0.05	3.29 (0.57-18.96)

Table 4. Relationship of BMI and asthma by logistic regression analysis

	OR	95% CI	p-value
BMI (kg.m-2)			
<30	1	--------	---------
30≤	8.53	3.65-19.92	<0.001
BMI (kg.m^{-2})			
<25	1	--------	---------
25≤	2.41	1.34-4.34	<0.01

Adjusting for age, occupational exposure, work experience, smoking and shift work.

exposure group, subjects with BMI≥25 kg/m^2 had a significantly higher prevalence of asthma than subjects with BMI<25 kg/m^2 (p<0.01). However, in the unexposed group, no significant difference was found between the two subgroups with BMI≥25 kg/m^2 and BMI<25 kg/m^2 in terms of asthma prevalence (p>0.05, Table 3). When considering the BMI of 30 kg/m^2 as the cut point, it was noticed that in the exposure group, prevalence of asthma in subjects with BMI≥ 30kg/m^2 was significantly higher than that in subjects with BMI< 30kg/m^2 (p<0.01). However, in the unexposed group, no significant difference was noted between the two groups in terms of asthma prevalence (p>0.05, Table 3).

For a more precise investigation and adjusting for confounding factors, data were analyzed with logistic regression test (Table 4). As observed, after adjusting for confounding factors significant associations were observed between BMI and asthma at cut points of 30kg/m^2 and 25kg/m^2 (Table 4).

Discussion

In general, asthma is more prevalent among women (even in lower-weight women) than men (8). The correlation between asthma and obesity in women is stronger than in men (13, 18-20). This correlation in men is weak or insignificant (12, 13,21). Some studies have shown a U shaped correlation between BMI and asthma in men (26,27) and some others failed to find any correlation in this respect (11, 20) . The null hypothesis in this study was that asthma might be correlated with obesity in men working in an environment with occupational exposure to asthmogens. Thus, workers of a cable manufacturing company who had exposure to asthmogens such as TDI, polyvinyl chloride, polyethylene or polypropylene were evaluated. In general, 11.6% of understudy subjects had asthma and the majority of these patients were in the exposed group (p<0.001, OR: 5.82, CI95%: 2.46-13.75). As observed, in the exposure group, by increased BMI prevalence can increases incidences of asthma as well (Tables 3 and 4). However, in the unexposed group, no significant association was noted between asthma and BMI. Obesity has a direct mechanical effect on airway smooth muscles and increases bronchial hyper-responsiveness (28). On the other hand, Schachter et al, (29) could not find a correlation between airway hyper-responsiveness and BMI and explained that respiratory symptoms in obese subjects

may be mistakenly diagnosed as asthma. In some studies weight loss in obese subjects improved pulmonary function but did not change airway hyper-responsiveness (30, 31). No significant correlation was observed between atopy and BMI in studies either (29, 32). Some studies have only detected an association between atopy and BMI in women (20, 33).

Epidemiologic studies use BMI and WHO definitions for overweight and obesity (34) because measurement of BMI is easy but erroneous and does not necessarily indicate patient's body fat. Some muscular individuals may not have excess fat but according to BMI classification are categorized as overweight or obese and on the other hand, some individuals with excess body fat are categorizedas normal weight based on their height. Thus, BMI may not be an accurate method for the measurement of body fat especially in men (22). This issue may be responsible for no or weak correlation between BMI and asthma in men. No significant association was found between obesity and asthma in men even when body fat portion was measured instead of BMI. However, in women both BMI and body fat percentage were significantly correlated with asthma (34). In another study (35) researchers used different methods for definition of obesity (BMI, waist circumference, waist to hip ratio) but failed to find a significant association between asthma and obesity with any of these methods.

On the other hand, lack of such correlation may be due to other factors and occupational exposures may somehow justify this issue. Men usually have different jobs and subsequently different occupational exposures than women. In this study, we used BMI as a practical and easy method for screening and used the WHO definitions for obesity and overweight. In our study, no association was detected between asthma and obesity in the unexposed group (Table 3); whereas, in the exposed group, increased BMI prevalence was related to higher incidence of asthma (OR:2.23 versus 4.69 at two BMI cut points of overweight and obesity).

Study weaknesses

Since this was a cross-sectional study, we could not conclude a cause and effect relationship. Also, we did not have access to the subjects' BMI at the onset of asthma and thus we could not cast a final judgment on the correlation of BMI and asthma in presence of occupational exposure. On the other hand, the prevalence of asthma in our study might have been underestimated due to the healthy worker effect.

Study strengths

This was the first study in Iran to evaluate the correlation of BMI and asthma in men from the standpoint of occupational exposure. Its results can be helpful in making more cautious decisions when employing men with high BMI for occupations with high exposure to asthmogens.

Conclusion

A total of 11.6% of the understudy subjects had asthma. Study results revealed that prevalence of asthma might be higher among male workers with high BMI and occupational exposure to asthmogens. Emphasis should be made on weight loss of workers with exposure to asthmogens in periodic examinations. Considering the importance of this issue, larger studies are recommended with better methodology and more effective methods for measuring body fat percentage rather than BMI.

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