

Original Research Article

Spirometry and mannitol bronchial challenge test among firefighters in Bhuj district: a questionnaire based study

Kashyap Buch, Vinayak Chauhan*

Department of Medicine, Gujarat Adani Institute of Medical Science, Bhuj, Gujarat, India

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***Correspondence:**

Dr. Vinayak Chauhan,

E-mail: researchguide86@gmail.com

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ABSTRACT

Background: Asthma is a common chronic lung disease that inflames and narrows the airways. It causes recurring period of wheezing, chest tightness, shortness of breath and coughing.

Methods: A questionnaire, spirometry, direct and indirect airway challenge tests, exhaled nitric oxide, and skin-prick tests were administered prospectively to 100 out of 120 firefighters employed in Bhuj district, Gujarat, India. Asthma was defined as the combination of respiratory symptoms with airway hyper responsiveness.

Results: Twenty out of 100 firefighters (12%) had physician-diagnosed asthma, which could be confirmed in 8 firefighters. In contrast, asthma was diagnosed in 28% (28 of 100 firefighters). Wheezing was the most sensitive symptom for the diagnosis of asthma (sensitivity, 88%; specificity, 90%).

Conclusions: Asthma was considerably under diagnosed in firefighters. The combination of a structured symptom questionnaire with a bronchial challenge test allows identifying patients with asthma and should routinely be used in the assessment of active firefighters and may be of help when evaluating candidates for this profession.

Keywords: Asthma, Firefighters, Mannitol bronchial challenge test, Spirometry

INTRODUCTION

Asthma is a common chronic lung disease that inflames and narrows the airways. It causes recurring period of wheezing, chest tightness, shortness of breath and coughing.¹ They become even more swollen and the muscles around the airways can tighten when something triggers your symptoms. This makes it difficult for air to move in and out of the lungs, causing symptoms such as coughing, wheezing, shortness of breath and/or chest tightness.²

For many asthma sufferers, timing of these symptoms is closely related to physical activity. And, some otherwise healthy people can develop asthma symptoms only when exercising. This is called exercise-induced bronchoconstriction (EIB), or exercise-induced asthma

(EIA). Staying active is an important way to stay healthy, so asthma shouldn't keep you on the sidelines. Your physician can develop a management plan to keep your symptoms under control before, during and after physical activity.³

People with a family history of allergies or asthma are more prone to developing asthma. Many people with asthma also have allergies. This is called allergic asthma. Occupational asthma is caused by inhaling fumes, gases, dust or other potentially harmful substances while on the job.⁴

According to the leading experts in asthma, the symptoms of asthma and best treatment for you or your child may be quite different than for someone else with asthma.

The most common symptom is wheezing. This is a scratchy or whistling sound when you breathe. Other symptoms include: shortness of breath, chest tightness or pain, chronic coughing, trouble sleeping due to coughing or wheezing, asthma symptoms, also called asthma flare-ups or asthma attacks, are often caused by allergies and exposure to allergens such as pet dander, dust mites, pollen or mold.⁵ Non-allergic triggers include smoke, pollution or cold air or changes in weather.

Asthma symptoms may be worse during exercise, when you have a cold or during times of high stress. Children with asthma may show the same symptoms as adults with asthma: coughing, wheezing and shortness of breath. In some children, chronic cough may be the only symptom.⁶

An allergist diagnoses asthma by taking a thorough medical history and performing breathing tests to measure how well your lungs work. One of these tests is called spirometry.^{6,7} You will take a deep breath and blow into a sensor to measure the amount of air your lungs can hold and the speed of the air you inhale or exhale. This test diagnoses asthma severity and measures how well treatment is working.

Guidelines for diagnosing asthma in firefighters do not incorporate different available tests for routine assessment unless specifically requested by the examining physician. It is known that there may be underreporting of symptoms at job recruitment to avoid exclusion from the job.⁸ In professions such as firefighting, it is important to have a highly sensitive objective tool to diagnose asthma. This study prospectively determined the diagnostic value of different respiratory symptoms, spirometry in the assessment of asthma in a cohort of firefighters.

METHODS

The fire department employs 214 full-time firefighters in the overall Bhuj district. Firefighters were involved in all types of work when responding to an incident, so they were all exposed to similar conditions during work. Present study was approved by the local ethics committee. All subjects gave written informed consent.

All participants answered a self-administered questionnaire with items of the Swiss study on air pollution and lung diseases in adults (SAPALDIA) I questionnaire, an extended version of the questionnaire used in the European community respiratory health survey (ECRHS). The questionnaire contained items about respiratory symptoms, living conditions, active and passive smoking and occupational and leisure exposure to air pollutants. Spirometry was performed using American Thoracic Society criteria. A spirometer (Easy One; nddMedizintechnik; Zurich, Switzerland) was used to measure FVC and FEV1. The higher of two values for FEV1 repeatable to within 100 mL were recorded, and the percentage of predicted values¹⁸ was calculated.

Sensitization to allergens was measured by reactions to skin-prick tests on the forearm according to the protocol of the SAPALDIA. Nine different allergens or allergen mixtures were tested: mixture of six grass, mixture of three trees, the molds *Alternaria alternata* and *Cladosporium herbarum*, cat and dog epithelium, and the house dust mites *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*.

Histamine was used as the positive control and a saline/glycerol solution as the negative control. Atopy was defined as a positive response to at least one of the allergens tested. Office spirometry was performed by GPs using a portable multifunction spirometer. Each of these spirometers is calibrated before being sold and does not need further regular calibration unless major damage occurs. GPs were previously trained on spirometry by reference specialists using the same type of device. No technical or interpretation problems were reported by specialists. Spirometry supplies were given free. Continuous variables are expressed as mean \pm SD or as geometric means with interquartile range, and categorical variables are expressed as relative frequencies and percentages. A receiver operating characteristic (ROC) curve was plotted that allowed a graphical representation of sensitivity and specificity in order to view the best cutoff level for diagnosis of asthma. All tests were performed using software.

RESULTS

Eighty out of 120 male firefighters (93%) gave informed consent for this study. They were employed for a mean of 20 years (range, 1 to 40 years). Forty out of the 100 firefighters (40%) were current smokers. Asthma was diagnosed in 20 of 100 subjects (20%). These subjects had cough and phlegm production but did not have wheeze in the last 12 months. They were considered to be positive to methacholine as well as to mannitol provocation test for the purposes of analysis.

Table 1: Demographic profile of the study participants.

Variable	Numbers (n=100)	Percentage
Smokers	40	40
Diagnosed with asthma	20	20

Twelve firefighters (12%) stated that they had physician-diagnosed asthma. In eight of these firefighters, this diagnosis could be confirmed and asthma was diagnosed. However, an asthma diagnosis was only reported by the board physician in four of them. The board physician is the only physician responsible for the pre-employment screening and the regular medical check-up examinations for all the firefighters hired. Four firefighters were classified as not having asthma. Two firefighters were completely symptom free, and results of all administered tests to detect asthma were normal.

DISCUSSION

Swiss firefighters undergo a medical screening program including spirometry prior to employment and also regular medical examination when in service to confirm the status fit for duty. Physician-diagnosed asthma is often used to assign the diagnosis of asthma to a subject in an epidemiologic study setting or in a screening questionnaire at conscription.⁹ This might not reflect the final diagnosis of asthma as has been shown in studies from the British and American armies. In the British army, Sinclair and coworkers found exercise-induced asthma in 29% recruits who had a history of probable asthma during childhood but had no symptoms and treatment during the last 4 years. Nish and Schweitz examined 192 recruits who failed a pre-enlistment exercise training test and had denied having asthma since the age of 12 years.¹⁰ Fifty-nine percent of these recruits had asthma diagnosed subsequently based on further investigations.

In present study, only 6% of firefighters reported a diagnosis of asthma; in two of them, the diagnosis could not be confirmed. The mean ages of the firefighters as well as duration in the service were similar to literature reports. The diagnosis of asthma is important from the treatment perspective and also may affect work performance. It has been shown that firefighters who were fighting a fire had an increase in AHR when measured within 24 h after exposure. Furthermore, legal aspects have to be considered when firefighters with a diagnosis of asthma are exposed to risks.⁸

In clinical practice, the diagnosis of asthma often relies on a positive history of wheeze and other symptoms consistent with asthma such as cough and dyspnea. However, in a study by Baumann and coworkers, wheeze, cough, and dyspnea only occurred simultaneously in 36% of asthmatics.¹¹ Burrows and coworkers identified wheezing as the most frequent finding in a longitudinal study with patients with a recent diagnosis of asthma. Wheezing in the last 12 months was the most efficient symptom for the diagnosis of asthma.^{12,13}

Although present study population was representative, including 95% of all firefighters of the municipal firefighting department, it can be argued that the group size is relatively small. Further studies are needed to confirm our findings in firefighters in other countries and in firefighters mainly engaged in hazardous material or wild land fire operations, and when firefighters undergo the different pre-employment screening and regular check procedures.¹⁴

CONCLUSION

In summary, the combination of a structured symptom questionnaire with the mannitol BCT allows identifying

patients with asthma. Whether subjects without symptoms but with a positive mannitol challenge response have to be excluded from firefighting or should be treated with inhaled steroids has to be determined.

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