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ORIGINAL RESEARCH STUDY

The effect of climatic conditions on exercise-induced bronchoconstriction in 10–12 year old students

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Summary Exercise-induced asthma is seen following vigorous or prolonged exercise or physical exertion. It has been suggested that climatic conditions have an influence on exercise-induced asthma. Therefore, the aim of the present study was to examine the effect of two climatic conditions on exercise-induced deterioration of pulmonary function tests in 10–12 year old students.

Two hundred and fifty six students were randomly chosen from two cities namely Kerman and Gorgan (128 subjects in each who were equally from both cities) including 62 girls and 66 boys of 10–12 years old. A questionnaire was used to obtain demographic information and to identify the prevalence of asthma symptoms. Each subject performed a seven-minute free run exercise with maximum effort and sufficient motivation until they reached 70–75% heart rate. Pulmonary function tests (PFT) including, forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), peak expiratory flow (PEF), and maximum expiratory flow at 50% of vital capacity (MEF_{50}) were measured before, at the beginning, and 7 and

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20 min after physical activity.

The prevalence of both asthma (28.12%) and exercise-induced asthma (20.31%) in Kerman students was higher than those of Gorgan students (21.09% and 17%, respectively). All PFT values declined 7 and 20 min post-exercise in both groups. Although all baselines PFT in Kerman students were higher than those of Gorgan students, the decline in PFT values in Kerman students was greater than those of Gorgan students. At 20 min post exercise, the decline in FEV_1, PEF and MEF_{50} in Kerman students was significantly higher than those of Gorgan students ($p < 0.05$ to $p < 0.01$).

The results of the present study showed that prevalence of both asthma and exercise-induced asthma in a city with dry and cool climate such as Kerman was higher than in a city with humid climate such as Gorgan. In addition, the results showed that in a humid climate, post-exercise decline in PFT values was less than in a dry climate.

Introduction

Exercise-induced asthma (EIA) is known as a temporary obstruction of the airways occurring immediately after exercise, and its main symptoms are coughing and wheezing. EIA can be proven by the decrease in the forced expiratory volume in one second (FEV_1) and other spirometric parameters (Kiley et al., 2007). During normal breathing, the inspired air is warmed and humidified in the upper airways (Parlato, 1937). In EIA, airways smooth muscles are sensitive and contract in response to temperature and humidity changes, which leads to airway narrowing. EIA results in coughing, chest, tightness wheezing, unusual fatigue, and shortness of breath during exercise (Dryden et al., 2008). The symptoms of EIA generally begin within 5—20 min after the start of exercise, or 5—10 min after the end of brief exercise (Moshe et al., 2008). Inhaler bronchodilators that are used prior to exercise can prevent exercise-induced asthma symptoms.

In addition, warming up prior to exercise and cooling down after exercise can prevent exercise-induced asthma (Pelkonen et al., 2003). In allergic and asthmatic patients, exercise should be limited during high pollen period or when temperatures are extremely low and air pollution levels are high. EIA could be diagnosed by taking a history and measurement of PFT values before, during and after exercise.

Although several studies were conducted in order to clarify the mechanisms of induction of EIA, the mechanism of development of EIA has not been fully defined yet. The prevalence of EIA varies in different sports modalities, being 50% in cross-country skiing athletes, 35% in ice hockey, 43% in velocity skaters and 17% in winter and summer Olympic athletes (Laitano and Meyer, 2007). It is worth mentioning that the highest EIA prevalence occurs in athletes who compete in cold weather, which is two times higher than that of summer exercises (Helenius and Haahtela, 2000). The importance of physical activity for health is well recognized, but little is known about the influence of physical activity on pulmonary physiology (Boskabady et al., 2014). Therefore, in the present study, the effect of two different climates on the incidence of EIA in young students was examined.

Methods

Population

Two hundred and fifty six students, 10—12 years old were included in this study from two cities of Iran namely Kerman and Gorgan. This study performs in two cities of Iran namely Kerman and Gorgan. Distance from gorgan to kerman 1123 km. Kerman (dry city) is the capital city of Kerman Province in the central south of Iran. The city of Kerman has a moderate climate with average annual temperature of 16.8 °C, and average annual rainfall of 135 mm. Because it is located close to the Kavir-e lut, Kerman has hot summers, and in the spring it often has violent sand storms. At the 2011, its population was 821,374, making it the 10th most populous city of Iran. This city is 1755 m above sea level, making it third in elevation among provincial capitals in Iran. Gorgan (humid city) is the capital of Golestan Province in the north east of Iran, approximately 30 km away from the Caspian Sea. In the 2006, its population was 269,226. The average annual temperature is 18.2 °C (64.8 °F) and the annual rainfall is 600 mm. One hundred and twenty eight students from each city (including 62 girl and 66 boys) were randomly recruited. Eight schools from different regions of each city and 16 students in each school were selected by electoral roll. Therefore, the studied subjects were of different socioeconomic classes.

No subject had history or symptoms of cardiovascular diseases that require treatment. The protocol was approved by the ethics committee of Shahid Bahonar University of Kerman. Demographic information was shown in Table 1.

Protocol

All participants completed specific and standard questionnaire in Farsi language which was provided according to the