# Is Free Running Asthma Screening Test Still Useful?

C Pitsios[1], SR Del Giacco[2], C Grigoreas[3]

***ABSTRACT***

***Objective:*** *The aim of this study is to evaluate the usefulness of Free Running Asthma Screening Test (FRAST) as a method that may help the diagnosis of exercise-induced bronchospasm (EIB) in children from a rural area and to compare the results with their history of asthma.*

***Methods:*** *A FRAST challenge took place at 9 schools. It lasted for 6 minutes and pupils performed it properly with the help of an athlete. The best out of three Peak Expiratory Flow Rate (PEFR) efforts was recorded before and after challenge, using a mini-Wright peak-flow-meter. A more than 15% drop in PEFR was considered an indication of EIB. A questionnaire defining asthmatic symptoms had been distributed and already completed by their parents.*

***Results:*** *The exercise was successfully performed by 268 children. Eleven children presented a fall of PEFR of at least 15%, five or ten minutes after the exercise; among these, only three boys had a history of asthma, while the remaining 8 children were undiagnosed. No difference regarding age, gender or locations' altitude was found.*

***Conclusion:*** *FRAST can be of great use in the diagnosis of EIB in areas that lack proper tools and specialized personnel. A poor correlation between self-reported symptoms and the results of exercise challenges was confirmed.*

**Keywords:** Asthma, exercise-induced brochospasm, exercise-induced asthma

# ¿Es la Prueba de Carrera Libre para el Tamizaje del Asma Todavía útil?

C Pitsios[1], SR Del Giacco[2], C Grigoreas[3]

***RESUMEN***

***Objetivo:*** *El objetivo de este estudio fue evaluar la utilidad de la prueba de la carrera libre para el tamizaje del asma (PCLTA) como método que puede ayudar al diagnóstico del broncoespasmo inducido por ejercicio (BEI) en los niños de un área rural, y comparar los resultados con su historia de asma.*

***Métodos:*** *Una prueba de reto PCLTA tuvo lugar en 9 escuelas. La prueba tuvo una duración de 6 minutos, y los alumnos la realizaron correctamente con la ayuda de un atleta. El mejor de tres esfuerzos de la tasa de flujo espiratorio máximo (TFEM) fue registrado antes y después de la prueba, usando un medidor Mini-Wright de flujo espiratorio máximo. Una caída de más del 15% en la TFEM fue considerada una indicación de BEI. Un cuestionario que define los síntomas asmáticos había sido distribuido y respondido por sus padres.*

***Resultados:*** *El ejercicio se realizó con éxito por 268 niños. Once niños presentaron una caída de TFEM de por lo menos 15%, cinco o diez minutos después del ejercicio. De ellos, tres varones tenían una historia de asma, mientras los otros 8 niños restantes no tenían diagnóstico. No se halló diferencia con respecto a edad, género o altitud de las localizaciones.*

***Conclusión:*** *La prueba PCLTA puede ser de gran utilidad en el diagnóstico de BEI en áreas en las que faltan las herramientas apropiadas y el personal especializado. Se confirmó la existencia de una pobre correlación entre los síntomas auto-reportados y los resultados de los ejercicios de reto.*

**Palabras claves:** Asma, broncoespasmo inducido por ejercicio, asma inducida por ejercicio

**West Indian Med J 2010; 59 (3): 287**

From: [1]Simopoulo Health Center, Amaliada's General Hospital, Amalias, Greece, [2]Department of Medical Sciences, University of Cagliari, Cagliari, Italy [3]Allergy Department, 251 Airforce General Hospital, Athens, Greece.

Correspondence: Dr C Pitsios, Ipsilantou 32, 11521 Athens, Greece. Fax: +30 210 7211831, e-mail: pitsios@yahoo. com

## INTRODUCTION

The experience of an asthma attack after performing a physical activity is a common problem in asthmatic patients out of therapy. The symptoms of asthma provoked by exercise are described by the term "Exercise-induced asthma" (EIA) while the term "Exercise-induced bronchoconstriction" (EIB) describes the acute lung narrowing after an exercise test or a vigorous natural exercise (1, 2). Exercise-induced asthma is more common in children than in adults probably because of their high level of physical activity. The detection and the appropriate treatment of EIA in children offer them a normal growth and the possibility of a better quality of life with no restrictions during their sports and games.

In an era in which asthma phenotypes are determined using new diagnostic tools and a lot of progress has been achieved in the exploration of the genetic background, the access to specific exercise testing facilities is not always easy. In rural areas, with lack of diagnostic devices and experts, EIA diagnosis is often based on exercise related respiratory symptoms.

"Free Running Asthma Screening Test" (FRAST) is an old method to detect EIB using a peak flow meter as the only device. It has been proven to be a useful test identifying children with EIA in community settings, while general practitioners and paediatricians can perform it without long experience or training (3, 4). Exercise-induce bronchoconstriction is easy to be assessed by a non-specialist with the detection of a Peak Expiratory Flow Rate (PEFR) decrease while the monitoring of symptoms and more complicated equipment is necessary to define EIA.

The aim of this study is to detect whether there is a correlation among the results of FRAST, the medical history of asthma and the self-reported symptoms (as determined by the answers of a questionnaire). The probable effect of parameters such as gender and altitude of the localities were also examined.

## SUBJECTS AND METHODS

The pupils from nine Greek elementary schools (from 9 Peloponnesian villages of Ilias' Prefecture) were invited to participate in this study. The study was performed with the assistance and the approval of the school committees and the committee of the local health authority. A questionnaire and an informed consent form were distributed to the parents of 310 children (the complete elementary pupil population of this area) aged 8–12 years. The questionnaire was similar to the one used in the ISAAC study (5) but it was adapted so as to address a larger range and included a question on asthma treatment (Fig. 1).

The teachers informed pupils and parents about the study and collected the questionnaires with the written consent. They also fixed the date of the challenge test while their presence was fundamental for the collaboration of the pupils. The teachers of the elementary schools, a family doctor, a paediatrician and an elite athlete (who assisted as a coach as well as to attract children to the study) comprised the study team.

Figure 1: Asthma Symptoms Questionnaire

1. Has your child ever had wheezing or whistling in the chest at any time in the past?
   Yes No
2. Has your child ever had wheezing or dry cough disturbances during the night, apart from a cough associated with a cold or a chest infection?
   Yes No
3. If the answer in question 1 is YES, has your child's sleep ever been disturbed due to wheezing?
   Yes No
4. If the answer in question 1 is YES, has your child's speech ever been limited to one or two words at a time between breaths?
   Yes No
5. Has your child ever had asthma?
   Yes No
6. If the answer in question 5 is YES, how many asthma attacks during the last 12 months?
7. If the answer in question 5 is YES, what was the medication prescribed by your doctor?
8. Has your child's chest sounded wheezy during or after exercise?
   Yes No

Children were advised to wear comfortable clothes and sport shoes and to have eaten a light breakfast. The use of $\beta_2$-agonists was forbidden for at least 24 hours before the test. None was taking inhaled corticosteroids nor had received any oral or injected corticosteroids in the previous two weeks. No child reported any respiratory infection in the last two weeks. Besides the use of those medications, the other exclusion criteria for the study were the history of exercise-induced anaphylaxis and current orthopaedic problems that could interfere with the participation in the study. The challenge was performed during the morning, between 9:00 and 10:00 am, so that the children were yet in a rest state. The study was performed during May or September, of the same year, under similar conditions (temperature: 20° – 24°C, humidity: 60 – 80%).

The use of mini-Wright peak flow meters was demonstrated before the challenge. Heights and weights were measured and no child was below 80% of the predicted PEFR values, for age and gender. The heart rate and the best measurement out of three PEFR attempts were recorded at rest. Children were divided into groups of ten and the free running challenge took place at the schoolyard or at a football field. Nose clips were not used during FRAST, since we desired to test it in as natural conditions as possible. It lasted for 6 minutes and the athlete tried to keep a high and stable performance of the pupils reaching a heart rate of 170–180 beats/min (43–45 beats/15", measured by each pupil with the coordination of the athlete).

The children were under medical standby throughout the FRAST and after its completion. Medical devices and medications such as oxygen, inhaled $\beta_2$-agonists and epinephrine were available. Children that stopped before the six minutes of exercise were excluded from validation. Gender and age distribution of children that completed FRAST is described in the Table. Flow measurements were repeated 5 and 10 minutes after exercise. The best out of three efforts was recorded and a more than 15% drop in PEFR was considered an indication of EIB. The chi-squared test was used to compare the rate of EIB at different altitudes, ages and between girls and boys.

Table: Demographics of the children that completed FRAST

| Age subgroups | Boys | Girls | Number (%) |
|---|---|---|---|
| 8 | 28 | 32 | 60 (22.3%) |
| 9 | 30 | 33 | 63 (23.5%) |
| 10 | 25 | 23 | 48 (17.9%) |
| 11 | 28 | 28 | 56 (20.8%) |
| 12 | 21 | 20 | 41 (15.2%) |
| **Total** | 132 | 136 | 268 |

## RESULTS

Two hundred and ninety-four children finally participated in the study. The outcome from the questionnaires was that 7 children (3 boys and 4 girls) had a history of asthmatic symptoms but wheezing, dry cough and night awakening due to dyspnoea, were in most cases, considered as symptoms of infections by their GPs, so antibiotics were prescribed to them in most asthma attacks. Furthermore, none of them had been adequately treated (enough medication dose or duration of treatment) with inhaled $\beta_2$-agonists and corticosteroids, as reported by the questionnaire and by their personal prescriptions' book.

Twenty-six out of the 294 children that participated in the study abandoned the exercise before completing 6 minutes (9 boys, 17 girls), 4/26 of these children had a history of asthma symptoms and stopped the exercise reporting cough or shortness of breath (4 girls). They remained under surveillance but symptoms remitted with no need for medications. Children with no EIB-history that stopped the exercise reported that "they got tired" due to poor physical fitness or were emotionally stressed to run with older children.

Two hundred and sixty-eight children completed the exercise (Table). There were 11/268 children (4.1% of the ones that completed the challenge) who had a fall of PEFR > 15%; 3/11 of the children presenting with EIB had a history of asthmatic symptoms. Eight children out of the 265 that gave a history free of asthma symptoms presented with EIB. An emergency treatment of inhaled $\beta_2$-agonists was prescribed to them and they were advised when to use it and to keep it with them at sports. They were referred for further investigation of asthma and atopy.

No statistically significant difference was found regarding age or gender ($x^2 = 1.57$, $p = 0.21$). However, it was observed that among children who presented with EIB, there were 3 boys with a history of asthma and 2 boys undiagnosed, while all 6 girls were undiagnosed. No difference ($x^2 = 0.07$, $p = 0.79$) in the percentages of EIB was noticed among children living at low altitudes, near the sea (4%), in comparison with children living at altitudes higher than 300 m (4.4%).

## DISCUSSION

There are two main theories explaining the mechanisms that cause EIA. The airway cooling and vasoconstriction due to respiratory heat loss with consequent hyperaemia and rewarming of the bronchial vasculature is the mechanism supported by McFadden (6) while the mediator release due to change of osmolarity of the periciliary fluid lining the surface of the respiratory mucosal membranes is supported by Anderson (7). Combining these theories, cooling and drying of the airways with the contribution of environmental factors (humidity, temperature and pollutants) may stimulate the release of new and pre-formed inflammatory mediators, such as histamine and cysteinyl leukotriens. Exercise may be used as an easy-to-perform indirect challenge stimulus to assess the levels of bronchial hyper-responsiveness in patients with a history of dyspnoea during or after exercise.

An exercise challenge test is an excellent way to detect EIB and EIA. Electromagnetically braked cycle ergometer and motor-driven treadmill with adjustable speed and grade are the two preferred devices to use for that purpose (8). Treadmill speed and grade are chosen in a modality to produce 4- to 6-minute exercise closely to the maximum calculated targets for the subject; total duration of exercise is usually of 6 minutes in children aged less than 12 years old and 8 minutes for older children and adults. Speed and exercise load are progressively increased during the first 2–3 minutes of exercise until the heart rate attains 80–90% of the predicted value (8). Heart rate monitoring and pulse oximeter are additional devices recommended during the detection of EIB. A nose clip can also be useful since it decreases the water loss during the exercise challenge test but in children performing FRAST it may be annoying and restrict their maximum performance.

It is difficult to consider any kind of exercise challenge as a gold standard for the study of EIB. Variations of the exercise load, the exercise time, the humidity or the temperature of the inspired air affect challenge tests as the well-defined treadmill test (9–11). On the other hand, performing FRAST is extremely practical since a large number of subjects can be tested in a short time, inexpensively, with no need of specialized personnel or special devices. Its reliability though has been questioned in former studies (12). At the same time, the lack of objective monitoring and

controlled indoor environment are some of its disadvantages. Also, since the monitoring of the challenge is inadequate, a person may not reach the maximum target of exercise during FRAST and this would result in a false negative EIB.

There are various differentials for EIB (or just dyspnoea) such as poor physical fitness, habit cough, vocal cord dysfunction, heart disorders, exercise-induced hyperventilation and chronic lung disorders (2, 13, 14). Further investigation was recommended to the parents of the children that did not complete the FRAST challenge. This may be an indication of asthma or other health problems.

The prevalence of EIB in the present study (4.1%) is lower than in the ones performed in other European countries. The prevalence of EIA has been calculated to be 11% in Barcelona (15) and 6.9% in Mataro, Spain (16), 6% in Copenhagen, Denmark (17) and 5.7% in Sheffield, UK (3). A rise in EIB/EIA prevalence is mirrored in longitudinal studies (18, 19). The influence of the environment (pollution, relative humidity and temperature) and genetic factors on EIB explains the variation of its prevalence among different continents, countries or even among rural and urban locations. The lack of pollution in the area of the present study, the ideal environmental parameters during the study and the rural lifestyle of the study's volunteers may explain the low incidence of EIB.

An interesting finding of the study was that the outcome of FRAST resulted in a higher rate of EIB than expected from the replies to the questionnaires. Former studies have also shown a poor correlation between self-reported exercise symptoms and the results of exercise challenges but mostly with an over-diagnosis based on the answers of the questionnaires (13, 20, 21).

No effect of age or gender has been noticed in this study but the fact remains that most of the children with EIA history that didn't complete FRAST and most of those children with a newly diagnosed EIB were girls. This may be explained by the fact that girls do not practise vigorous outdoor games or sport, partly due to social restrictions in these rural areas. Since symptoms of EIA in children are mainly perceived during games, indoor or restricted games in childhood may result in EIA under-estimation.

In conclusion, although exercise-induced challenge tests performed in a controlled environment under monitoring are the best way to set EIB diagnosis, FRAST is still a useful and simple screening test, especially in rural areas, helping family doctors and paediatricians to set a primary diagnosis and refer children with suspected EIA for further investigation. Settling an early and correct diagnosis and providing the necessary treatment leads to a normal childhood with no restrictions to sport and games.

**ACKNOWLEDGEMENTS**

The authors wish to thank all the teachers, the paediatrician G Nikolopoulou, the family doctors T Avramopoulou, T Panagiotakopoulou and the 400m-hurdles European champion P Iakovakis for their excellent contribution in the study.

**REFERENCES**

1. Cabral ALB, Conceição GM, Fonseca-Guedes CHF, Martins MA. Exercise-induced bronchospasm in children. Effects of asthma severity. Am J Respir Crit Care Med. 1999; **159:** 1819–23.
2. Carlsen KH, Anderson SD, Bjermer L, Bonini S, Brusasco V, Canonica W et al. Exercise-induced asthma, respiratory and allergic disorders in elite athletes: epidemiology, mechanisms and diagnosis: part I of the report from the Joint Task Force of the European Respiratory Society (ERS) and the European Academy of Allergy and Clinical Immunology (EAACI) in cooperation with GA2LEN. Allergy 2008; **63:** 387–403.
3. Tsanakas JN, Milner RD, Bannister OM, Boon AW. Free running asthma screening test. Arch Dis Child 1988; **63:** 261–5.
4. Williams D, Bruton J, Wilson I. Screening a state middle school for asthma using the free running asthma screening test. Arch Dis Child 1993; **69:** 667–9.
5. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. Eur Respir J 1995; **8:** 483–91.
6. Gilbert IA, McFadden ER, Jr. Airway cooling and rewarming. The second reaction sequence in exercise-induced asthma. J Clin Invest 1992; **90:** 699–704.
7. Anderson SD, Daviskas E. The mechanism of exercise-induced asthma. J Allergy Clin Immunol 2000; **106:** 453–9.
8. Crapo RO, Casaburi R, Coates AL, Enright PL, Hankinson JL, Irvin CG, et al. Guidelines for metacholine and exercise challenge testing-1999. Am J Respir Crit Care Med 2000; **161:** 309–29.
9. Carlsen KH, Engh G, Mork M. Exercise-induced bronchoconstriction depends on exercise load. Respir Med 2000; **94:** 750–5.
10. Brudno D, Wagner J, Rupp N. Length of post-exercise assessment in the determination of exercise-induced bronchospasm. Ann Allergy 1994; **73:** 227–31.
11. Eliasson AH, Phillips YY, Rajagopal KR, Howard RS. Sensitivity and specificity of bronchial provocation testing: an evaluation of four techniques in exercise-induced bronchospasm. Chest 1992; **102:** 347–55.
12. Powell CVE, White RD, Primhak RA. Longitudinal study of free running exercise challenge: reproducibility. Arch Dis Child 1996; **74:** 108–114.
13. Seear M, Wensley D, West N. How accurate is the diagnosis of exercise induced asthma among Vancouver schoolchildren? Arch Dis Child 2005; **90:** 898–902.
14. Weinberger M. Exercise induced dyspnea: if not asthma, then what? Arch Dis Child 2006; **91:** 543–4.
15. Busquets RM, Anto' JM, Sunyer J, Sancho N, Vall O. Prevalence of asthma-related symptoms and bronchial responseveness to exercisein children agad 13–14 yrs in Barcelona, Spain. Eur Respir J 1996; **9:** 2094–8.
16. Bardagi S, Agudo A, Gonzalez CA, Romero PV. Prevalence of exercise-induced airway narrowing in schoolchildren from a Mediterranean town. Am Rev Respir Dis 1993; **147:** 1112–25.
17. Backer V, Ulrik CS. Bronchial responsiveness to exercise in a random sample of 494 children and adolescents from Copenhagen. Clin Exp Allergy 1992; **22:** 741–7.
18. Addo-Yobo EOD, Woolcock A, Allotey A, Baffoe-Bonnie B, Strachan D, Custovic A. Exercise-induced bronchospasm and atopy in Ghana: two surveys ten years apart. PloS Med 2007; **4:** e70.
19. Burr ML, Wat D, Evans C, Dustan FD, Doull IJ; British Thoracic Society Research Committee. Asthma prevalence in 1973, 1988 and 2003. Thorax 2006; **61:** 296–9.
20. Panditi S, Silverman M. Perception of exercise induced asthma by children and their parents. Arch Dis Child 2003; **88:** 807–11.
21. Hallstrand TS, Curtis JR, Koepsell TD, Martin DP, Schoene RB, Sullivan SD et al. Effectiveness of screening examinations to detect unrecognized exercise-induced bronchoconstriction. J Pediatr 2002; **141:** 343–9.