

# Peak expiratory flow rate nomogram in Libyan schoolchildren

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## مخطط المعادلة لذروة سرعة الجريان الزفيري في الأطفال الليبيين

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**خلاصة:** كان هدف هذه الدراسة تطوير مخطط معادلة لذروة سرعة جريان هواء الزفير لدى الأطفال الليبيين. ومن بين 900 طفل تم اختيارهم عشوائياً من تلاميذ أربع مدارس ابتدائية في طرابلس، انطبقت معايير الاختيار لهذه الدراسة على 670 طفلاً (330 من الإناث و340 من الذكور) وتراوح أعمارهم من 4.5 إلى 14.9 سنوات. وتم تسجيل ذروة سرعة الجريان الزفيري في وضع الوقوف باستعمال مقياس رايت الصغرى، وكذلك قياسات الوزن والطول ومحيط الرأس ومحيط منتصف العضد. وتم حساب المساحة ومنسب كتلة الجسم. وأظهرت النتائج أن ذروة سرعة الجريان الزفيري مرتبطة بدرجة جوهريّة بالطول ( $r=0.74$ ) والعمر ( $r=0.70$ ) والمساحة ( $r=0.64$ ) والوزن ( $r=0.62$ ):  $P < 0.001$ . وخلاصة القول إن مخطط المعادلة لذروة سرعة الجريان الزفيري في الأطفال الليبيين يختلف عن المستوى البريطاني، الأمر الذي يبرز الحاجة إلى مخطط معادلة مرجعي محلي.

**ABSTRACT** The study aimed to develop a peak expiratory flow rate nomogram for Libyan children. Of 900 children randomly selected from four Tripoli primary schools, 670 (330 girls and 340 boys) with age range 4.5–14.9 years, fulfilled the selection criteria. Peak expiratory flow rate (PEFR) was recorded in a standing position using a mini-Wright peak flow meter. Anthropometric measurements, weight, height, head circumference and mid-upper-arm circumference were recorded and surface area and body mass index were calculated. Our findings showed PEFR to be significantly related to height ( $r=0.74$ ), age ( $r=0.70$ ), surface area ( $r=0.64$ ) and weight ( $r=0.62$ ):  $P < 0.001$ . The PEFR nomogram in Libyan children differed from the British standard, which highlights the need for a local reference nomogram.

## Nomogramme du débit expiratoire de pointe chez des écoliers libyens

**RESUME** Le but de cette étude était d'établir un nomogramme du débit expiratoire de pointe pour des écoliers libyens. Sur les 900 enfants choisis au hasard dans quatre écoles primaires de Tripoli, 670 (330 filles et 340 garçons), dont l'âge variait de 4,5 à 14,9 ans, répondaient aux critères de sélection. Le débit expiratoire de pointe (DEP) a été enregistré en position debout à l'aide d'un débitmètre Mini-Wright. Les mesures anthropométriques - poids, taille, périmètre crânien et périmètre brachial à mi-hauteur - ont été enregistrées et la superficie du corps ainsi que l'indice de Quételet ont été calculés. Nos résultats ont montré que le DEP était lié de manière significative à la taille ( $r=0,74$ ), l'âge ( $r=0,70$ ), la superficie ( $r=0,64$ ) et le poids ( $r=0,62$ ):  $p < 0,001$ . Le nomogramme du débit expiratoire de pointe chez les enfants libyens différait du modèle britannique, ce qui souligne la nécessité d'un nomogramme local de référence.

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## Introduction

Peak expiratory flow rate (PEFR) has been shown to be very useful in the routine monitoring of healthy and asthmatic children [1-6]. There is a need for a simple, effective technique such as the PEFR measurement to screen for and control asthma in the community, particularly when the prevalence of asthma and asthma-related hospital admissions are rising. With better control of asthma, the number of children admitted to hospital is likely to decrease, and management costs, in terms of funds and time, reduced.

A clinical observation by one of the authors of the study, in the follow-up of asthmatic Libyan children using the mini-Wright peak flow meter with the nomogram of Godfry et al. [7] casts some doubt on the applicability of the British nomogram to Libyan children. This is possibly because of ethnic differences in PEFR [2-6] and thus there is a the need for a local nomogram for Libyan children. Only two local studies have previously been carried out on Libyan adolescents (age range: 12-21 years) [8,9].

In this study we present for the first time a reference nomogram for Libyan children living in Tripoli (age range: 5-15 years), and for Libyan boys and girls separately. The reference nomogram for Libyan children is discussed in relation to a number of anthropometric measurements.

## Subjects and methods

The study initially looked at a random sample of 900 primary-school children, out of a total population of 2324 pupils from four Tripoli primary schools. After excluding non-Libyan children, children with asthma, heart problems, skeletal deformity, history

of recurrent hospital admission or respiratory tract infection within a 3-week period prior to commencement of testing, 670 children, with an age range of 4.5-14.9 years, completed the test. Of these, 330 were girls (mean age  $8.75 \pm 0.1$  years) and 340 boys (mean age  $9.15 \pm 0.34$  years).

Weight, height and head circumference were measured using internationally-accepted techniques. Mid-upper-arm circumference was measured in an extended arm, midway between the tip of the acromion process of the scapula and olecranon process of the ulna.

Surface area was calculated using the standard Dubois formula: surface area = weight 0.425 (kg)  $\times$  height 0.725 (cm)  $\times$  71.84. Body mass index was computed using the formula: weight/(height)<sup>2</sup>.

At rest and in the standing position, each child blew three times, without nose clip, into a standard (peak flow 239) mini-Wright peak flow meter (60-800 L/min). The highest reading was accepted.

Values are presented as mean  $\pm$  standard error of the mean. An unpaired Student *t*-test was used to test the differences between the means. Linear regression equations for PEFR in relation to height were determined for the total sample, and for boys and girls separately.

## Results

There was no significant difference between the mean age of the boys and girls. Girls were heavier than boys ( $P < 0.05$ ), with only 3 boys and 3 girls having a body mass index  $> 25$  kg/m<sup>2</sup>. The mean body mass index of the girls was significantly higher than that of the boys ( $P < 0.05$ ). Girls had a larger mean mid-upper-arm circumference ( $P < 0.001$ ) whereas the mean occipitofrontal circumference of the boys

Table 1 Anthropometric measurements of healthy Libyan children

Sex	Weight (kg)	Height (cm)	BMI (kg/m <sup>2</sup> )	Surface area (m <sup>2</sup> )	OFC (cm)	MUAC (cm)
Boys (n = 340)	29.16 ± 0.43	130.59 ± 0.58	16.8 ± 0.12	1.026 ± 0.009	53.4 ± 0.08	19.33 ± 0.15
Girls (n = 330)	29.73 ± 0.54*	130.22 ± 0.63	17.14 ± 0.18*	1.036 ± 0.012	52.43 ± 0.13**	19.92 ± 0.19**

\*P < 0.05 (two-tailed test)      \*\*P < 0.001 (two-tailed test)

Values are presented as mean ± standard error of the mean

BMI = body mass index

OFC = occipitofrontal circumference

MUAC = mid-upper-arm circumference

was significantly larger than that for the girls (P < 0.001) (Table 1).

PEFR in the children was significantly related to height (r = 0.74), age (r = 0.7), surface area (r = 0.64) and weight (r = 0.6); P < 0.001. The PEFR nomogram in Libyan children ranged from 70 L/min to 540 L/min and differed from the British standard [7] (Figure 1). The mean PEFR of the boys was significantly higher than that for the girls (P < 0.001) and the equations for their respective regression slopes were different (Figure 2). The height-PEFR regression slope for the boys was different to that for American boys [10] (Figure 3).

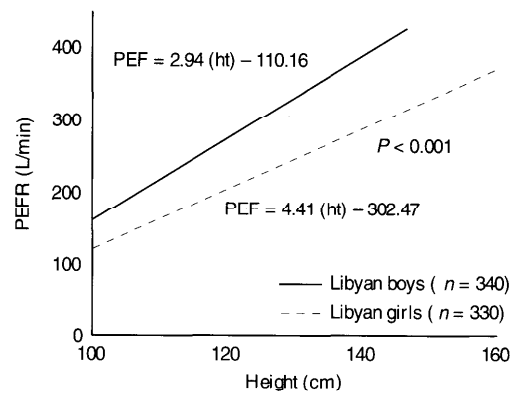


Figure 2 Peak expiratory flow rate (PEFR) of Libyan boys and girls

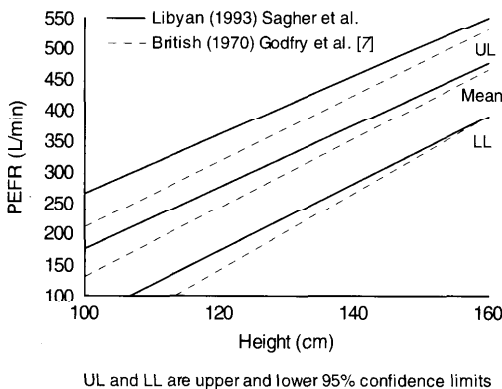


Figure 1 Peak expiratory flow rate (PEFR) of Libyan and British children

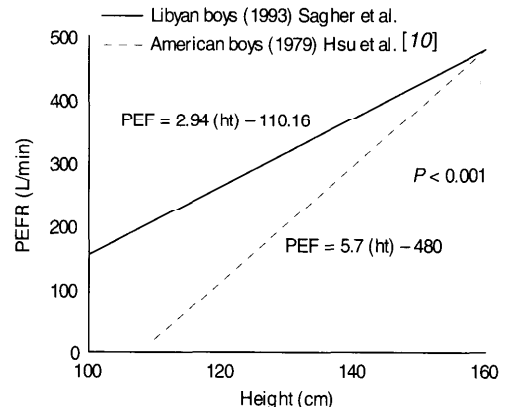


Figure 3 Peak expiratory flow rate (PEFR) of Libyan and American boys

## Discussion

PEFR in Libyan children followed the expected trends in relation to weight. Height was marginally better. This is consistent with Cotes et al. [11]. In British and Indian children the PEFR for boys and girls were similar [12]. The PEFR for Libyan boys, however, was significantly higher than that for Libyan girls, which is consistent with findings for Northern Nigerian [13] and Malaysian children [14].

Interestingly, the height-PEFR regression slopes for boys compared with girls (Figure 2) were significantly different. There were no significant differences between mean height for boys and girls, although girls had significantly higher values for body mass index (Table 1). This observation may partly explain the differences in PEFR between boys and girls.

Although chest circumference and chest expansion were not measured, lung volume and flow have been reported to bear a constant relationship to external thoracic di-

mension in both sexes [12,15]. This may also account for the disparity in PEFR.

## Conclusions

There is a need for a local PEFR nomogram for Libyan children living in Tripoli. The use of British or American PEFR standards when assessing Libyan children is inappropriate.

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### The Fifty-first World Health Assembly

Stressing the importance of the convention on the Rights of the Child, which *inter alia* recognizes the child's and adolescents's right to the highest attainable standard of health and access to health care; ...

Recognizing that the health children and adolescents constitutes a critical element for the health of future generations and for health and human development in general; ...

Stressing the special health needs of young children, particularly those in developing countries, and adolescents worldwide; ...

#### 1. URGES the Director-General

(1) to give high priority to improving child's and adolescents health across all relevant WHO programmes as an essential contribution to reaching the highest attainable level of health for all; ...

#### 2. CALLS UPON all Member States to undertake all appropriate measures to pursue the full implementation of the child's and adolescent's right to the highest attainable standard of health and access to health services; ...

Source: Extracted from Resolution WHA51.22 on health of children and adolescents. Fifty-first World Health Assembly, 16 May 1998