Comparison of peak expiratory flow rates applying European and Iranian equations to Palestinian students

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مقارنة سرعات جريان الزفير الأقصى بتطبيق معادلات أوربية وإيرانية على طلاب فلسطينيين

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الخلاصة: إن إجراء قياس سرعة جريان الزفير الأقصى ضروري من أجل المعالجة الفعَّالة للربو، إلا أن التفاوتات الإثنية تؤثر على تطبيق معادلات التنبؤ بوظائف الرئة. وقد قاس الباحثون سرعة جريان الزفير الأقصى في عينة ممثلة تتألف من ألف طالب من نابلس في فلسطين، وطبقوا معادلات التنبؤ بسرعة جريان الزفير الأقصى الأوروبية والإيرانية على كل من الذكور والإناث في مجموعتين عمريتين هما أقل من 21 عاماً، و21 عاماً أو أكثر. واتضح للباحثين وجود ترابط إحصائي يُعتد به بين قيم سرعة جريان الزفير الأقصى التنبؤية لدى الفلسطينيين في كلا المعادلتين في كل من الذكور والإناث، بغض النظر عن الأعمار. كما لاحظوا أن المعادلات التي أعدت للإيرانيين أكثر فائدة للفلسطينيين من تلك التي أعدت للأوروبيين، ولكن هناك حاجة لإعداد مخططات السواء الخاصة بالفلسطينيين أنفسهم.

ABSTRACT Measurement of peak expiratory flow rate (PEFR) is required for effective asthma treatment, but ethnic differences affect the application of prediction equations for lung function. PEFR was measured in a representative sample of 1000 students in Nablus, Palestine. Predicted PEFR equations for Europeans and Iranians were applied to both males and females in age groups < 21 and ≥ 21 years. There was a statistically significant correlation between the predicted PEFR values in Palestinians and both equations in both males and females regardless of age. Equations developed on Iranians were more useful for Palestinians than the European equations, but there is a need to develop our own nomograms.

Comparaison du débit expiratoire de pointe avec application d'équations européennes et iraniennes aux étudiants palestiniens

RÉSUMÉ La mesure du débit expiratoire de pointe (DEP) est nécessaire pour traiter efficacement l'asthme, mais des différences ethniques affectent l'application des équations de prédiction de la fonction pulmonaire. Le DEP a été mesuré sur un échantillon représentatif de 1 000 étudiants de Nablus (Palestine). Les équations de prédiction du DEP pour les Européens et les Iraniens ont été appliquées aussi bien aux filles qu'aux garçons dans des groupes âgés de moins de 21 ans et de 21 ans et plus. Une corrélation statistiquement importante entre les valeurs du DEP prévues chez les Palestiniens et les équations aussi bien chez les hommes que chez les femmes, indépendamment de l'âge, a été observée. Pour les Palestiniens, les équations développées pour les Iraniens étaient plus utiles que les équations européennes, mais il est nécessaire de développer nos propres nomogrammes.

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Received: 17/05/07; accepted: 22/01/08

Introduction

Peak expiratory flow (PEF) is the maximum flow generated during expiration performed with maximal force and starting after a full inspiration [1]. Many reports have emphasized the importance of measuring peak expiratory flow rate (PEFR) in general practice to establish the diagnosis of asthma and for monitoring patients with asthma [2–5].

PEF meters have made a major contribution to the management of asthma by allowing patients to record their within-day variability of PEFR, which would be typical of asthma if it exceeds 20% of the mean value for the day. The most widely used guidelines for managing asthma recommend using PEFR measurements for diagnosing asthma, stratifying for severity, determining response to therapy and determining when to admit and when to discharge from hospital [6].

During the past 20 years, there has been increasing recognition that, in addition to age, sex, body weight and height differences in PEFR, there are differences in lung function between people from different ethnic origins [7–10]. For example, it has been reported that black males have spirometric parameters that are 10%–13% lower than white males of European descent. Thus, formulae derived from white children may not be generalizable to black children [7].

The aim of this study was to determine the effect of age, sex, and body weight on PEFR values among An-Najah University students in Nablus, Palestine, and to highlight ethnic differences in applying prediction equations for PEFR.

Methods

This was a cross-sectional study in the Nablus district of the West Bank in Palestine [11]. The geographical position of Nablus district in the northern part of the West Bank gives it a comparatively low temperature range.

Study sample

The study sample was chosen from An-Najah University in Nablus, currently the largest university in the West Bank with 16 colleges and around 13 000 enrolled students. Using simple randomization, the sample consisted of a total of 1000 students (about 10% of the total at the university), selected from all colleges, both sciences and humanities. Using proportional allocation techniques, the proportion of students in the sample was representative of the proportion of students in each college. The age range of the students was 18–27 years. Males and females were included in almost equal proportion and all participants reported that they were healthy with no previous respiratory diseases.

Data collection

Data were collected during the period 1 September 2005–31 March 2006 using structured interviews. An agreement was obtained from the Department of Public Health at the university to facilitate the researcher's work, including student interviews and weight, height and PEFR measurements. The researchers made 4 visits to the university each week, interviewing and measuring PEFR for about 20 students each day. The purpose of the study was explained to each group, then the researchers interviewed the students and asked them to complete the questionnaire. Height, weight and PEFR measurements were done between about noon and early evening [12].

Questionnaire

A questionnaire was designed, evaluated and reviewed by an expert statistician. A pilot test was carried out on 30 students to test students' understanding of the questionnaire wording and the questionnaire layout was modified accordingly. The results of this pilot test analysis were not included in the study. The questionnaire collected data about sociodemographic factors such as age, sex, college, weight, sports practice and smoking.

Height and weight measures

For all participants height and weight were measured using standard clinic scales, then body mass index (BMI) was calculated using the formula BMI = weight/height^2, where underweight was < 18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25.0–29.9 kg/m^2 and obese ≥ 30.0 kg/m^2.

PEFR measures

Based on the 1997 National Asthma Education Program guidelines for the diagnosis and management of asthma [13], PEFR was obtained in the upright position using the mini-Wright peak flow meter and the highest value of 3 efforts for each participant was recorded. To adjust for variability of measured PEFR, the level of error was corrected using the equations for PEFR derived by Miller et al. [14].

The prediction equations for PEFR for Europeans (British) which were revised by Nunn and Gregg [15] were applied to get the predicted value. We also calculated predicted PEFR for all participants using equations for normative lung function values for the Iranian population derived by Golshan et al. [16].

The percentage of predicted PEFR values were grouped into the following categories for analysis: < 50% (severe asthma), 50%–79.9% (moderate asthma); and ≥ 80% (normal).

Data analysis

The chi-squared test was used to compare PEFR readings for males and females in 2 age groups (< 21 and > 21 years) applying European and Iranian equations. Statistical analysis was done using *SPSS*, version 11.5, with *P*-value < 0.05 as significant.

Results

Table 1 shows the demographic and anthropometrics characteristics of the study sample. The mean age was 20.8 (standard deviation 1.1) years, with males and females almost equal. Most of the participants were single (95.3%), not working (95.6%) and nonsmokers (81.9%). The majority lived in a village (55.0%) or city (41.2%); only 3.8% lived in refugee camps. Most (80.2 %) had normal BMI.

Table 1 Demographic and anthropometric characteristics of the study sample (*n* = 1000)

Characteristic	No.	%
Sex		
Male	482	48.2
Female	518	51.8
Age (years)		
< 21	593	59.3
≥ 21	407	40.7
College		
Science	351	35.1
Humanities	649	64.9
Sports practice		
Yes	514	51.4
No	486	48.6
Marital status		
Married	47	4.7
Single	953	95.3
Job		
Employed	26	2.6
Manual work	18	1.8
Unemployed	956	95.6
Smoker		
Yes	181	18.1
No	819	81.9
Place of living		
Refugee camp	38	3.8
Village	550	55.0
City	412	41.2
Body mass index		
Normal[a]	802	80.2
Overweight[b]	159	15.9
Obese[c]	39	3.9

[a]< 25 kg/m²; [b]25–29.9 kg/m²; [c]≥ 30 kg/m².

The predicted PEFR measured values were shown to be significantly abnormal when the European equations were applied. This was true for both males and females regardless of the age (Tables 2 and 3). When the Iranian equations were applied on the measured predicted PEFR for all participants, most of the results were in the normal range (Tables 2 and 3).

The correlation between the predicted PEFR values comparing the European and the Iranian equations was statistically significant ($P < 0.01$). This was true for males and females regardless of age. The correlation between predicted PEFR and BMI was not, however, statistically significant in either males or females regardless of age (Table 4).

Discussion

PEFR has been shown to be very useful in the routine monitoring of healthy and asthmatic children [*17–20*]. There is a need for a simple, effective technique such as this to screen for and assist in controlling asthma in the community, particularly when the prevalence of asthma and asthma-related hospital admissions are rising.

Our results are consistent with other studies showing that the results of these tests cannot be interpreted appropriately without reference to predicted normal values [*21,22*], indicatingd that normal values of PEFR for Europeans cannot be applied to Palestinians, perhaps because of their smaller body frame. Several studies show that normal lung function values are influenced by many factors [*8,9,21*], among which ethnicity has consistently been shown to be important in lung function variation [*23,24*]. Forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) in white populations were greaterer than in Chinese and Indian populations [*25*]. black American were also found to have consistently lower lung volumes than whites [*26*]. These differences have been explained in terms of factors mostly related to body size and shape [*2*], which might be attributed to a larger trunk.

In our study, the first in Palestine, the comparison between PEFR predicted values using equations for European and Iranian ethnic types was statistically significant. This was true for both males and females. We used equations from Golshan et al.'s study in the Islamic Republic of Iran because it was done on a large group of people of similar age and

Table 2 Comparison of predicted peak expiratory flow rate (PEFR) values by the European [*15*] and Iranian [*16*] equations for males and females aged < 21 years

Sex and % predicted PEFR	European equations		Iranian equations	
	No. of subjects	%	No. of subjects	%
Males				
< 50%	82	29.9	9	3.3
50%–79.9%	128	46.7	36	13.1
≥ 80%	64	23.4	229	83.6
Total	274	100.0	274	100.0
	$\chi^2 = 203.1$, $P < 0.01$			
Females				
< 50%	92	28.8	8	2.5
50%–79.9%	190	59.6	56	17.6
≥ 80%	37	11.6	255	79.9
Total	319	100.0	319	100.0
	$\chi^2 = 306.3$, $P < 0.01$			

Table 3 Comparison of predicted peak expiratory flow rate (PEFR) values by the European [15] and Iranian [16] equations for males and females aged ≥ 21 years

Predicted PEFR (%)	European equations		Iranian equations	
	No. of subjects	%	No. of subjects	%
Males				
< 50	59	28.4	8	3.8
50–79.9	93	44.7	13	6.3
≥ 80	56	26.9	187	89.9
Total	208	100.0	208	100.0
	$\chi^2 = 169.8$, $P < 0.01$			
Females				
< 50	53	26.6	23	11.6
50–79.9	127	63.8	71	35.7
≥ 80	19	9.5	105	52.8
Total	199	1100.0	199	100.0
	$\chi^2 = 87.3$, $P < 0.01$			

perhaps ethnicity. We also divided our study group into 2 age groups in order to apply the Iranian equations [16]. BMI was normal in most of the study sample, which represents the relatively small body frame of young adults in Palestine. This may explain the abnormal PEFR results obtained when Nunn and Gregg's equations from Britain were applied. In the literature, several studies show that predicted PEF varies widely across formulae and therefore the choice of formula may alter guidelines on asthma care [7].

Several studies have tried to develop local PEFR nomograms in Arab countries such as the Libyan [26], Omani [27] and Kuwaiti [28] nomograms in children. No studies for adults have been done in the Arab World, but an Ethiopian study that included both children and adults also found local prediction formulae for PEFR, FVC and FEV1 [29]. Ashok et al. showed in their study that each ethnic group needs its own formulae for normal respiratory functions, as there were significant differences between Asian Indian and Caucasians, and also between Asian Indians and Mexicans living in the United States of America [30].

Conclusion

Population-specific equations for PEFR must be used in order to optimize use of the instrument measures. Application of equations developed on Iranian people seems to be useful for Palestinians, but there is a need to develop nomograms especially for Palestinians.

Table 4 Correlation between percentage of predicted peak expiratory flow rate (PEFR) values and body mass index (BMI) for males and females aged < 21 and ≥ 21 years

Age and % predicted PEFR	BMI categories						Correlation[a]	
	Normal < 25 kg/m²		Overweight ≥ 25 kg/m²		Total		*r*-value	*P*-value
	No.	%	No.	%	No.	%		
				Males				
Age < 21 years								
< 80%	33		7		40	14.6	1.141	0.285
≥ 80%	180		54		234	85.4		
Total	213	77.7	61	22.3	274	100.0		
Age ≥ 21 years								
< 80%	2		0		2	1.0	0.622	0.951
≥ 80%	157		49		206	99.0		
Total	159	76.4	38	23.6	208	100.0		
				Females				
Age < 21 years								
< 80%	53		8		61	19.1	0.220	0.639
≥ 80%	218		40		258	80.9		
Total	271	85.0	48	15.0	319	100.0		
Age ≥ 21 years								
< 80%	54		10		64	32.2	1.177	0.278
≥ 80%	105		30		135	67.8		
Total	159	79.9	40	20.1	199	100.0		

[a]*χ^2 correlation between BMI and PEFR for males and females < 21 and ≥ 21 years.*

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