Ethnic differences in lung functions of children in the Colombo District, Sri Lanka

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(Index words: spirometry, Sri Lanka, ethinicity, Tamil, Moor, Sinhalese)

Abstract

Background Reference values of lung functions vary with age, height, ethnicity and sex of the reference population. Global Function Initiative 2012 compared reference equations for Sri Lankan children with those of South Indian and South East Asian equations. Sri Lanka has a multi-ethnic society comprising of Sinhalese, Tamils, Moors and other ethnic minorities. Applicability of existing Sri Lankan equations to children from different ethnic groups in the country has not been adequately verified. Our aim was to investigate the effect of ethnicity on spirometry parameters in school aged children.

Methods We enrolled healthy boys and girls between 9-15 years of age from 6 schools in Colombo District using stratified cluster sampling. A pretested self-administered questionnaire collected details on demography, respiratory health and other chronic illnesses. Anthropometric measurements (standing height and weight) were collected. Spirometry was performed with a flow sensing spirometer that complies with American Thoracic Society/European Respiratory Society (ATS/ERS) standards adopted for children. Highest FVC and FEV1 values were obtained from 2 repeatable tests.

Results Spirograms of 849 students were analysed. Majority (n=496) were Sinhalese. There were 240 Tamils and 113 Moors. Multiple regression found that height, age and sex were significantly associated with lung functions (p<0.05). Ethnicity was not significantly associated with parameters measured in spirometry when the regression was performed controlling for height and age.

Conclusions The same spirometry reference equations could be used for children of all ethnic groups in Sri Lanka aged 9-15 years.

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Introduction

Lung function tests have a pivotal role in respiratory disease. They assist in diagnosis, assessment of severity of airway obstruction, monitoring lung diseases, assessment of lung growth and early detection of occupational lung diseases. For interpretation of tests, measured values of the patient needs to be compared with appropriate reference values for that particular individual. Generally, reference values vary with age, height, ethnicity and sex of the reference population. European Respiratory Society Task Force has formulated multi ethnic reference values that can be applied to 3-95 year olds from all ethnic groups (Global Lung Function Initiative 2012) [1]. However, predictions for the Indian subcontinent were not included in formulation of these equations due to lack of data from this region. Generally, we use South Indian reference values for interpretation of spirometry in Sri Lanka. Recently published reference values for spirometry between 8-16 year old children have shown that South Indian values are comparable to our values [2]. However, we have a multi-ethnic society consisting of Sinhalese, Tamils Moors and other ethnic minorities. Predictions we use may not be accurate and applicable to all ethnic groups since there are still gaps in knowledge regarding ethnic differences in lung function. Balasubramaniam et al. reported on spirometry of Tamil females (between 20-28 years) in Jaffna [3]. These values were different to those of Sinhalese female medical students from another study [4]. Balasubramaniam *et al*. concluded that there is an ethnic variation in spirometry between Tamil and Sinhalese females. However, the equipment and techniques used in these two studies were different. Thus, these variations may have had some influence on the values. Furthermore, Moors were not included in this comparison. Thus, there is a dearth of published studies investigating ethnic differences in spirometry in Sri Lankan children. One study that was conducted to formulate reference values for children shows that there are no differences among ethnic

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groups [2]. Therefore, because of the conflicting evidence, we carried out this study using the American Thoracic Society 2005 standards to investigate the effect of ethnicity on spirometry parameters in school aged children from different ethnic groups.

Methods

This cross sectional study was carried out in the Colombo district. We enrolled healthy boys and girls aged between 9-15 years from six schools in the Colombo district using multi-stage cluster sampling. Sample size was calculated with a power of 0.8 and 95% confidence interval, based on FEV1values for Tamil females (2.19 ± 0.39 l) and Sinhalese females (2.35 ± 0.405 l) from two studies conducted in Sri Lanka [3,4].

A self-administered questionnaire based on the International Study of Asthma and Allergies in Childhood (ISAAC) collected details on demography, respiratory health and other chronic illnesses [5]. All children with parental consent were eligible to enroll. However, children with a history of respiratory tract illness within the previous two weeks, acute febrile illness, and chronic medical and surgical illnesses and bone deformities that are likely to influence lung functions were excluded at the final analysis.

A brief, standardized clinical examination was conducted and anthropometric measurements (standing height and weight) were taken. Height was measured to the closest centimeter. The stadiometer and the digital weighing scale were calibrated daily. Spirometry was performed with a flow sensing spirometer that complies with American Thoracic Society/European Respiratory Society (ATS/ERS) standards [6]. Spirometer was calibrated daily with a 3-litre syringe. Attempts were made to achieve at least 3 acceptable and 2 repeatable error-free forced expiratory maneuvers. Highest Forced vital capacity (FVC) and Forced expiratory volume at 1 second (FEV1) were obtained from 2 repeatable tests. The attempt with the largest sum of FVC and FEV1, other parameters (Peak expiratory flow rate-PEFR and forced expiratory flow between 25% and 75%- FEF 25-75%) was selected. Data were double entered and checked for outliers.

Ethics approval was obtained from Ethics Review Committee of the University of Sri Jayewardenepura. Written informed consent from the parents and assent from children above 12 years were obtained before enrollment.

Statistical analysis

Multiple linear regression examined the effect of ethnicity, gender, age, standing height and on measures of lung functions. The model included variables that were significant at $p<0.05$ level with the highest explained variance (R^2). The statistical package SPSS version 16 was used for all statistical analysis.

Results

A total of 1066 children aged between 9-15 years with parental consent were invited to participate in the study. Self-administered questionnaires were given to taken home. Two hundred and seventeen were excluded. Reasons for exclusion were unacceptable spirograms, diagnosis of asthma or allergic rhinitis, recent respiratory or febrile illness, chronic illnesses or bony deformities and incomplete questionnaires. A total of 849 underwent spirometry. Majority was Sinhalese (n=496, 56% males). There were 240 Tamils (55% males) and 113 Moors (56% males). Their baseline characteristics are shown in Table 1.

Multiple regression showed that height, age and sex were significantly associated with the parameters measured in spirometry. Ethnicity was significantly associated with certain parameters measured in spirometry (Table 2). However, these differences disappeared when regression controlled for age (Table 2).

Table 1. Baseline characteristics of the sample

Parameter	*Sinhalese*		*Tamils*		*Moors*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*
Standing height (cm)	150 (14)	150 (10)	145 (12)	146 (12)	145 (15)	148 (12)
Weight (kg)	38.62(13.53)	39.54(11.08)	34.72(12.02)	37.21(11.21)	36.47(11.83)	7.59(10.15)
BMI (kg/m^2)	16.61(2.52)	16.55 (2.79)	15.49 (2.77)	17.78 (3.68)	17.67 (4.02)	17.41(3.26)
FVC (L)	2.40 (0.69)	2.21 (0.47)	2.16 (0.62)	2.03 (0.50)	2.32 (0.69)	2.15 (0.44)
FEV1(L)	2.10 (0.58)	2.03 (0.43)	1.89 (0.54)	1.82 (0.42)	2.03 (0.56)	1.95 (0.41)
FEF 25-75%	2.62 (0.86)	2.77 (0.70)	2.34 (0.74)	2.43 (0.69)	2.54 (0.75)	2.68 (0.77)
PEFR	4.46 (1.31)	4.19 (1.06)	4.09 (1.19)	3.99 (1.18)	4.13 (1.19)	3.90 (0.92)

Mean (SD) unless otherwise indicated. BMI-Body Mass Index

Table 2. Estimated coefficients associated with independent variables for spirometry indices

Spirometry parameters	*Gender*	*Constant**	*Ht Coefficient #*	*Age Coefficient #*	*Coefficient** for Tamils (D1)*	*p value*	*Coefficient for Moors (D2)*	*p value*	*Mean p value for (D1) (fixed for age)*	*Mean p value for (D2) (fixed for age)*	R^2
FVC	M	-3.845	0.039	0.037	-0.063	0.106	0.011	0.026	0.470	0.317	73.1
	F	-2.827	0.031	0.033	-0.066	0.058	0.009	0.847	0.404	0.463	63
FEV1	M	-3.146	0.031	0.045	-0.078	0.019	0.078	0.064	0.402	0.302	73
	F	-2.426	0.026	0.045	-0.101	0.001	-0.016	0.689	0.346	0.426	63.9
FEF	M	-2.991	0.03	0.090	-0.155	0.023	0.069	0.427	0.465	0.435	44.4
25-75%	F	-2.674	0.028	0.096	-0.208	0.003	-0.002	0.985	0.530	0.406	39.1
PEFR	M	-4.611	0.046	0.185	-0.191	0.055	-0.126	0.32	0.522	0.596	51.5
	F	-3.917	0.039	0.178	-0.006	0.955	-0.163	0.219	0.467	0.546	39.8

*, #,** p values are <0.05. D1: Indicator variable for Tamil ethnicity and D2: Indicator variable for Moors. Ht: Height, M: Males, F: Females. Mean p value: average of all p values of regression coefficient in each age group.

Discussion

At a given height and age, parameters measured in spiro-metry were not different between the three ethnic groups. The absence of such ethnic difference emphasize that the same reference values could be used for all ethnic groups, when interpreting spirometry data. Absence of a difference between ethnic groups in our country may be due to simila-rities in physical built, socioeconomic, nutritional and environmental factors.

Balasubramanium *et al*. have compared lung functions of young adult Sinhalese from a higher altitude and young adult Tamils living at sea levels [3,4]. In this comparison, mean values of Sinhalese for FVC, FEV1, FEF25-75 (standardized to height) were higher than Tamil males and lower than Tamil females (p<0.001). This disparity could have been due to differences in equipment and techniques of measurements (eg. nose clip during the manoeuver) or sampling bias. In the present study measurements were taken with same pulmonary function equipment and all children were from urban or semi-urban areas, living at sea level and we included Moors, the 3rd commonset ethnic group in Sri Lanka, in our sample [7]. However, our study population was narrow in terms of age (9-15 years) and the region, ie. Colombo district. Further studies which can include a broader represen-tation are recommended.

Conclusions

This study confirms that the parameters measured in spirometry are comparable among 9-15 year children belonging to different ethnic groups of the Colombo District, Sri Lanka. Thus, application of existing spirometry reference equations can be continued for children from all ethnic groups.

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Conflicts of interest

The authors declare that they have no conflicts of interests.

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