

Table 2: Numbers and percentage of excluded subjects by exclusion criteria and number of acceptable tests

Exclusion criteria and acceptable test	N	%
Curves with a sub-maximal expiratory effort	56	6.1
Only 1 acceptable manoeuvre	4	0.4
Early interruption	100	10.9
Expiration time < 0.5 sec	7	0.8
Total excluded subjects	149	16.3
Subjects with acceptable tests	766	83.7

Among instantaneous maximum expiratory flows, also shown in Table 6, MEF75 increases with age, height and BMI and decreases, but without statistical significance, with weight with a R^2 of 0.41; MEF50 and MEF25 increase significantly only with height. ($R^2 = 0.29$ for MEF50 and 0.19 for MEF25). Because of the little and not significant effect shown, the age, the weight and the BMI were excluded from the final model.

The regression of volume time, expressed as an FVC fraction, versus anthropometric variables did not show any significant effect: a poor height effect gave a determination coefficient that is lower than 4%. The values were distributed asymmetrically and no linear transformation was able to correct for the absence of normality [22]. The lower normality limits were computed as the 5th percentile of non parametric distribution in asymptomatic children (Table 7).

Validation of reference values

The test sensitivity and its specificity versus symptoms in children with a reduced function parameter are reported in Figure 1. These were computed as the observed value, lower than predicted, minus 1.64 regression standard

error (RSE) for FVC, FEV_t and MEF_x, and lower than the 5th percentile for FEV_t/FVC%.

The sensitivity and specificity are comparable among all the recorded parameters: MEF75 showed the highest sensitivity (18.8%) with a specificity of 97.9% and a combination (ROC Receiver Operating Characteristic) of 58%; FVC showed the worst sensitivity (4.2%) and the best specificity (98.9%).

In Table 8 we reported the strength of association, expressed as OR, between symptom status and lung function normality parameters, adjusted for age, sex and anthropometric variables. Each given parameter, except for the FEV₁/FVC% ratio, was significantly associated with symptoms. MEF75 and FEV₁ showed the higher association with an OR respectively of 10.6 and 4.2.

Relationship between volumes/time measurements

The regression equations were calculated using FEV₁ as dependent variable and respectively FEV_{0.75} and FEV_{0.5} as predictive, and using FEV_{0.75} as dependent and FEV_{0.5} as predictive variable (Table 9). The FEV_{0.75} showed to be suitable to predicts FEV₁ quite well, with a 0.95 of determination coefficient: FEV₁ is expected to increase by 1.06 litres for each litre of increase in FEV_{0.75} with an intercept nearly equal to 0. The FEV₁ prediction, by using the measured FEV_{0.5}, is less precise than using the FEV_{0.75} with a 44 millilitres of systematic difference (intercept): FEV₁ is expected to increase by 1.166 litres. For every increase of 1 litre in FEV_{0.5}, the determination coefficient resulted to be 0.87.

Discussion

Quality control

In this study spirometries in young children were analyzed to determine whether they met the published qual-

Table 3: Repeatability within subject of lung function parameters expressed as within subjects variation coefficient (standard deviation within the two best/mean of the two best%)

	FVC ^a	FEV ₁ ^b	FEV _{0.75} ^c	FEV _{0.5} ^d	MEF ₇₅ ^e	MEF ₅₀ ^f	MEF ₂₅ ^g
N	458	576	680	766	458	458	458
Mean (%)	2.0	2.2	2.2	2.1	6.0	9.1	16.3
Max (%)	12.4	13.6	13.7	14.1	51.9	51.9	92.3
0-5% (%)	90.8	90.8	92.1	90.9	65.0	41.1	23.9
6-10% (%)	8.1	8.5	7.5	8.4	19.4	33.5	20.2
10%+ (%)	1.1	0.7	0.4	0.8	15.6	25.3	56.0

^aFVC = forced vital capacity;

^bFEV₁ = forced expiratory volume in one second;

^cFEV_{0.75} = forced expiratory volume in 3/4 of a second;

^dFEV_{0.5} = forced expiratory volume in half a second;

^eMEF₇₅ = instantaneous expiratory flow when 25% of FVC has to be expired

^fMEF₅₀ = instantaneous expiratory flow when 50% of FVC has to be expired

^gMEF₂₅ = instantaneous expiratory flow when 75% of FVC has to be expired