Agreement between forced expiratory volume in the first second (FEV_1) and peak expiratory flow (PEF) in severe acute asthma

Sir,

Spirometry is routinely performed to evaluate the lung function of patients with asthma, chronic obstructive pulmonary disease (COPD), and other respiratory diseases.[1,2] Forced expiratory volume in the first second (FEV_1) is the most widely used spirometric parameter for assessing the severity and response of bronchodilators in obstructive airway disorders. However, spirometry remains underutilized as it lacks wide availability.[1] On the contrary, the portability, low

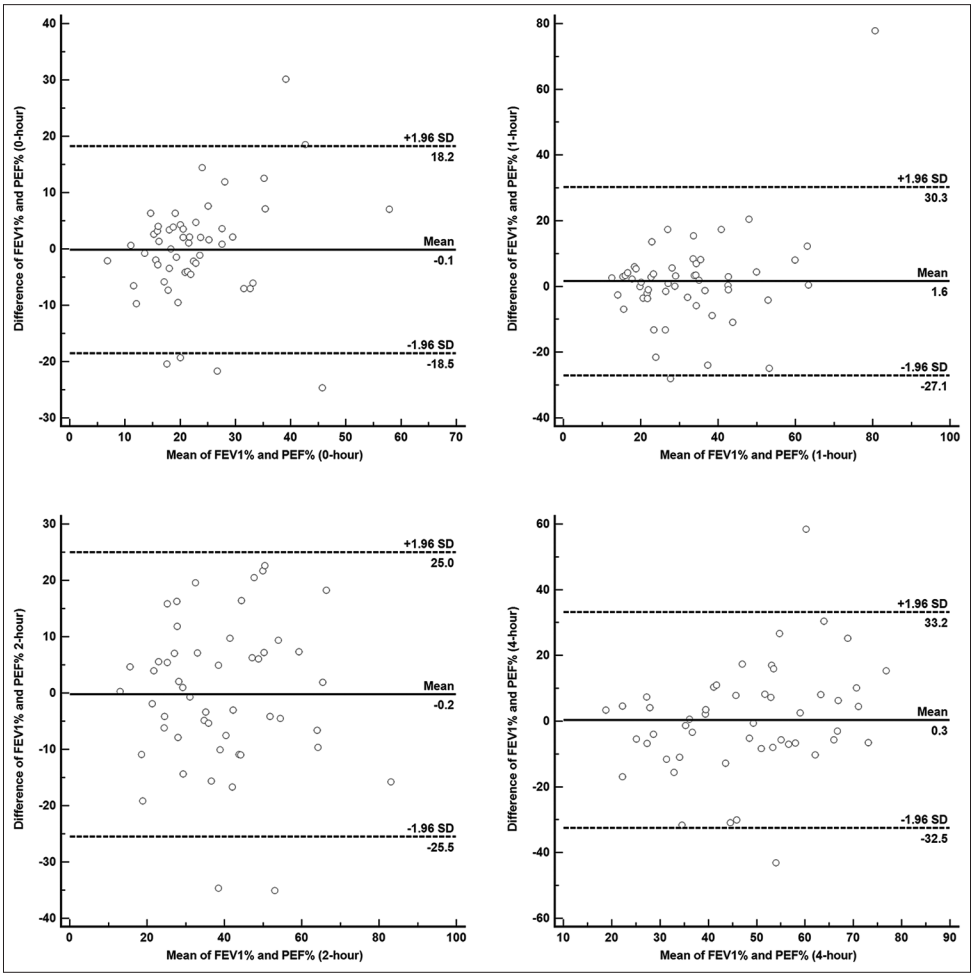

Figure 1: Bland–Altman plot shows the magnitude of difference between forced expiratory volume in the first second (FEV_1) and peak expiratory flow (PEF) values expressed as a percentage of predicted values at different time points. The solid horizontal line represents the mean bias, while the horizontal dashed lines depict the 95% confidence intervals

Table 1: Values measured at serial time points

	FEV_1 (L)	FEV_1%	PEF (L/min)	PEF%
0 hours	0.52 (0.45 to 0.59)	23.5 (20.2 to 26.7)	88.4 (78.3 to 98.5)	23.3 (20.5 to 26.0)
1 hour	0.76 (0.64 to 0.87)	34.0 (28.7 to 39.3)	120.2 (105.6 to 134.7)	31.8 (27.9 to 35.7)
2 hours	0.87 (0.76 to 0.98)	39.1 (34.5 to 43.8)	148.0 (130.9 to 165.1)	39.1 (34.3 to 43.8)
4 hours	1.07 (0.94 to 1.21)	47.9 (42.4 to 53.4)	179.4 (163.8 to 194.9)	47.6 (43.3 to 51.9)

All values are expressed in mean (95% confidence interval).
FEV_1: Forced expiratory volume in the first second; PEF: Peak expiratory flow.

Table 2: Mean bias and limits of agreement between FEV_1% and PEF%

	Bias	Limits of agreement
0 hours	−0.14	−18.5 to 18.2
1 hour	1.61	−27.1 to 30.3
2 hours	−0.23	−25.5 to 25.0
4 hours	0.34	−32.5 to 33.2

Bias=mean of (FEV_1% − PEF%); Limits of agreement=bias ± (1.96×standard deviation of bias).
FEV_1: Forced expiratory volume in the first second; PEF: Peak expiratory flow.

cost, and easy operability of the peak flow meter makes it an attractive alternate to standard spirometry.[3] Peak expiratory flow (PEF) monitoring is also pivotal in managing asthma exacerbations, for assessing the severity and aiding in discharge.[4] A few studies in obstructive airway diseases, including asthma, have shown a good correlation between the percentage of predicted PEF and FEV_1 values.[5,6] However, the limits of agreement between the predicted PEF and FEV_1 values were wide, suggesting that they cannot be used interchangeably in clinical trials.[7,8] Notably, the agreement between the percentage of predicted PEF and FEV_1 values is unknown in severe acute asthma (SAA). The primary objective of the study was to assess the agreement between the percentage of FEV_1 and PEF at different time points in patients with SAA.

We performed a retrospective analysis of lung function data of subjects included in a prospective randomized trial on the efficacy and safety of non-invasive ventilation in SAA.[9] The institutional ethics committee approved the study protocol, and we obtained written informed consent from all of the subjects. The study was conducted at the respiratory intensive care unit (ICU) of our institute between July 2006 and December 2007. We serially measure the FEV_1 and PEF at admission, and at 1, 2, and 4 hours using a spirometer (PIKO-1 monitor, Ferraris Respiratory Europe, Hertford, United Kingdom) followed by PEF measurement using a Wright peak flow meter,[3] according to the American Thoracic Society guidelines. We calculated the predicted values of FEV_1 and PEF using previously described prediction equations.[10] The observed values of PEF and FEV_1 were expressed as a percentage of predicted values. We used the Bland–Altman analysis to assess the bias and limits of agreement between measurements.[11]

We included 53 subjects (11 men) of SAA with a mean (standard deviation) age of 44.1(±14.6) years. The mean (standard deviation) duration of exacerbation was 3.3(±2.2) days. The values of FEV_1, FEV_1%, PEF, and PEF% at different time points are summarized in Table 1. The trend for serial FEV_1% and PEF% measurements was similar. The mean bias (limits of agreement) between FEV_1% and PEF% at 0 hours, 1 hour, 2 hours, and 4 hours were − 0.14 (−18.5 to 18.2), 1.61 (−27.1 to 30.3), −0.23 (−25.5 to 25.0), and 0.34 (−32.5 to 33.2), respectively [Table 2 and Figure 1]. The mean bias was low; however, the limits of agreement between FEV_1% and PEF% were wide.

We found a low mean bias but wide limits of agreement between FEV_1% and PEF% in subjects with SAA. The PEF, which is the maximal flow achieved during a forced vital capacity manoeuvre, is effort-dependent and measures large airway function and muscular effort. On the contrary, FEV_1 has an effort-independent portion in addition to effort dependency and measures both small and large airway functions. The site of airway obstruction can have differential effects on FEV_1 and PEF. In subjects with severe obstruction, the initial rise in expiratory flow may be similar. However, as the intrathoracic pressures rise further during expiration, the smaller airways collapse earlier, resulting in lower FEV_1 values than the corresponding PEF values.[7] This phenomenon could explain the wide limits of agreement between FEV_1% and PEF% found in our study. Our findings are similar to the previous studies conducted in stable patients of COPD and obstructive airway diseases.[7,8] Our study has a few limitations, such as its retrospective nature, small sample size, and monocentric design. Furthermore, we did not compare the FEV_1 by PIKO-1 instrument with a conventional spirometer. However, detailed spirometric measurements are challenging to obtain in patients with SAA.

In conclusion, the findings from this study reiterate that FEV_1% and PEF% values do not have parity in SAA and should not be used interchangeably.

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Conflicts of interest
There are no conflicts of interest.

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