Assessment of five-year emphysema progression in the COPDGene study by Emphysema Severity Index (ESI), a novel spirometry-derived parameter

Pistolesi M.[1], Paoletti M[1], Occhipinti M[1], Lavorini F[1], Regan EA,[2] Lynch DA[2] , Silverman EK[3], Crapo J[2]

[1]University of Florence - Florence (Italy), [2]National Jewish Health - Denver (USA), [3]Harvard Medical School - Boston (USA)

Background and Aim

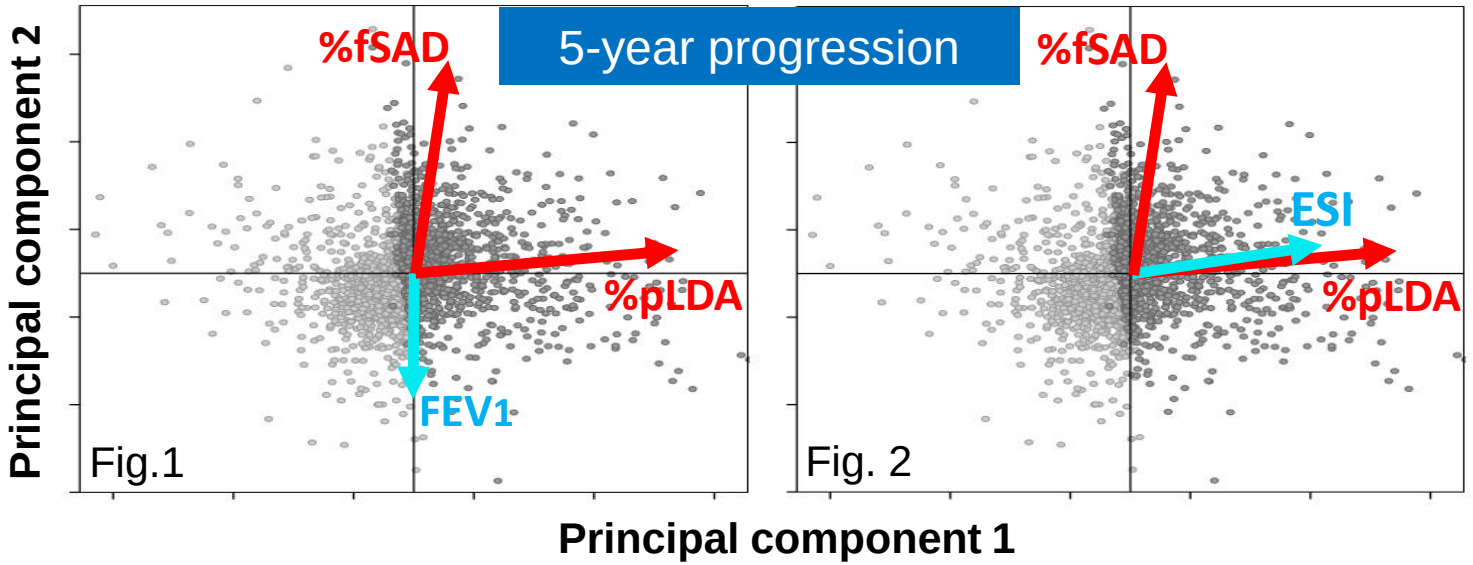
Emphysema severity on CT predicts long term functional impairment and reduced survival (Johannessen A, AJRCCM 2013; Lynch DA, Radiology 2018; Oh AS, Radiology 2022), An algorythm fitting the flow/volume curve descending limb (ESI) is highly correlated with emphysema extent on CT (Occhipinti M, Respir Res 2019 and 2020) and specifically predicts respiratory mortality in a Swedish general population sample (Luoto J, Respir Med 2022). We ascertain whether ESI, as quantitative CT, predicts 5-year emphysema progression in the COPDGene study.

Methods

Input variables to derive ESI, a numerical value ranging from 0 to10, are absolute values of FVC, PEF, FEF25%, FEF50% and FEF75%. ESI was measured in **4884** COPDGene subjects who had enrollment and 5-year spirometry and insp-exp CT. A CT index of functional small airway disease (%fSAD) and a CT index of persistent low density area (%pLDA) due to emphysema were measured by a dedicated software (Imbio, Boston, USA). Principal Component Analysis (PCA) was used to evaluate 5-year progression of spirometry (FEV1, ESI) and CT data (%fSAD, %pLDA).

Results

PCA resulted in vectors for each variable indicating by direction and versus the relative 5-year progression. PCA vectors indicating 5-year progression of FEV1 and %fSAD had same direction but opposite versus indicating that FEV1 and %fSAD progression have negative relationship (**Figure 1**). Airway disease (FEV1,%fSAD) and emphysema (%pLDA) vectors were 90° rotated indicating that 5-year progression of airway disease and emphysema are independent. ESI vector progression had same direction and versus of %pLDA, suggesting that ESI and CT are capturing similar information (**Figure 2**).



Main finding

ESI can derive from standard spirometry information about 5-year emphysema progression comparable to that obtained by co-registered inspiratory-expiratory CT.