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# How should we determine the presence of functional impairment in people with COPD?

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# How should we determine the presence of functional impairment in people with COPD?

Dear Editor,

Impaired functional capacity is a critical consequence of chronic obstructive pulmonary disease (COPD), commonly assessed across settings with the 1-minute sit-to-stand test (1-minSTS). Results in the 1-minSTS must be compared with the lower limit of normality (LLN) to determine the presence or absence of this treatable trait. Different methods have been used to define this LLN, such as 70% or 80% of the predicted value (determined either by reference values or reference equations) and the 5$^{th}$ or 10$^{th}$ percentile of the performance of a healthy population.[1,2] This can lead to different classifications regarding the presence or absence of impairment and misinform clinical practice. We explored the impact of using different criteria to classify patients' functional capacity.

This was a secondary analysis of a cross-sectional study conducted in people with COPD and age-/sex-matched healthy controls, between September 2016 and June 2019, in Portugal. All participants provided written informed consent. Details regarding ethical approvals, inclusion and exclusion criteria, matching process and data collection have been described elsewhere.[3]

Participants' functional capacity was assessed with the 1-minSTS. A straight-backed armless chair of 48 cm, with a hard seat, stabilised against a wall was used to perform the test.[4] Participants were asked to sit with their hands stationary on the hips and were instructed to stand up all the way and sit down, as many times as possible, in 1 minute.[4] No verbal encouragement was given during the test.[4] The best of three measurements was considered for analysis and the percentage predicted values were calculated based on the available reference equation.[5] The LLN for participants with COPD was established based on: i) 70% of their predicted value; ii) 80% of their predicted value; iii) the 5$^{th}$ percentile of the performance of healthy controls; and iv) the 10$^{th}$ percentile of the performance of healthy controls. People with COPD were then classified according to their performance above/below the LLN as without/with impairment, respectively.

Statistical analyses were performed using IBM SPSS Statistics 28.0 (IBM Corporation, Armonk, NY, USA) and plots created using GraphPad Prism 8.0 (GraphPad Software, Inc., La Jolla, CA, USA). Descriptive statistics were used to describe the sample. Data are presented as mean±standard deviation or relative frequency, accordingly. The levels of agreement between the different methods used to determine the LLN were explored using Cohen's kappa.

Three-hundred and two people with COPD (79.1% male; 67.5 ± 10.4 years; $FEV_1$ 55.2 ± 20.4 %predicted) and 304 healthy controls (75.3% male; 66.2 ± 9.4 years; $FEV_1$ 104.3 ± 18.1 %predicted) were included. Detailed characteristics of the sample have been described elsewhere.[3] The percentage of people with COPD presenting impaired functional capacity, according to the different definitions of LLN, was 20% for the 5$^{th}$ percentile, 33% for the 10$^{th}$ percentile, 20% for 70% of the predicted value and 31% for 80% of the predicted value. While 16% of people with COPD were classified as having impaired functional capacity and 64% as having preserved functional capacity, independently of the criteria, in 20% of the participants the classification changed depending on the criteria applied (Figure 1).

The best level of agreement was found between the 10$^{th}$ percentile and 80% of the predicted value (Table 1).

In conclusion, the use of different methods to define the LLN has a huge impact on determining the presence or absence of impaired functional capacity. Frequent patients' misclassifications may occur regarding this important treatable trait in both research and clinical practice, which further influences clinical decision making. The use of a LLN based on the 10$^{th}$ percentile of the performance of a healthy population or on 80% of the individuals' predictive value seem to be the most consistent options. Future studies should explore the best methodology to determine the LLN to guide its use in research and practice.

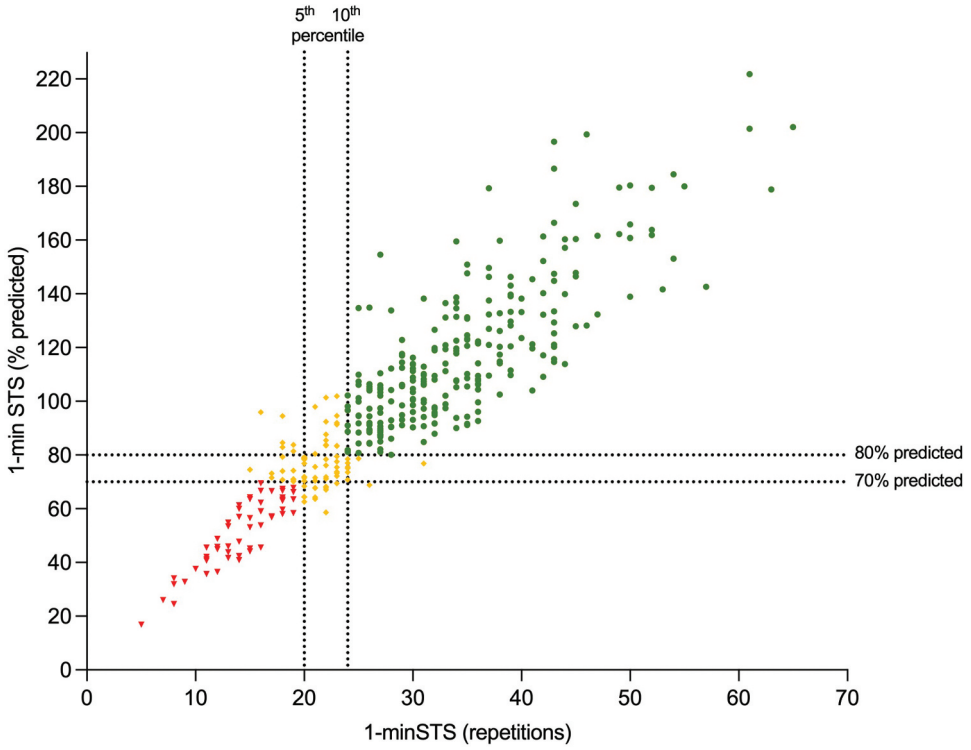


**Figure 1.** Performance of people with chronic obstructive pulmonary disease in the 1-minute sit-to-stand test according to the different lower limits of normality (LLN) determined. Red inverted triangles denote individuals with an impaired functional capacity according to all LLN, green dots denote individuals with preserved functional capacity according to all LLN, and yellow diamonds denote individuals whose classification changes depending on the LLN established. 1-minSTS, 1-minute sit-to-stand test.

**Table 1.** Levels of agreement between the different methods to determine the lower limit of normality, calculated using Cohen's kappa.

| | 70% predicted | 80% predicted | 5th percentile | 10th percentile |
|---|---|---|---|---|
| 70% predicted | | | | |
| 80% predicted | 0.73 [0.64; 0.81] | | | |
| 5th percentile | 0.73 [0.64; 0.83] | 0.66 [0.56; 0.75] | | |
| 10th percentile | 0.65 [0.56; 0.75] | 0.82 [0.75; 0.89] | 0.67 [0.58; 0.76] | |

Data are presented as Cohen's kappa [95% confidence interval].

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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