Defining and grading an obstructive ventilatory defect (OVD): ‘FEV$_1$/FVC lower limit of normal (LLN) vs. Z-score’ and ‘FEV$_1$ percentage predicted (%pred) vs. Z-score’

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Defining and grading an obstructive ventilatory defect (OVD): ‘FEV1/FVC lower limit of normal (LLN) vs. Z-score’ and ‘FEV1 percentage predicted (% pred) vs. Z-score’

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ABSTRACT

An obstructive ventilatory defect (OVD) is defined by a low forced expiratory volume/forced/slow' vital capacity (FEV1/FVC) (e.g. <lower limit of normal (LLN)). However, the LLN can be estimated either by the 90% confidence interval (or the 90th percentile) (American Thoracic and the European Respiratory Societies (ATS/ERS) method) or by the Z-score (global lung initiative (GLI) method). In 2014, a new alternative classification (GLI classification) for grading the OVD severity was proposed to replace the 2005-ATS/ERS one. The aims of the present study were to determine, according to the two methods (GLI vs. ATS/ERS), the frequency of participants having an OVD; and to compare the two classifications (GLI vs. ATS/ERS) of OVD severity. This was a prospective study including 1000 participants (mean age = 41 ± 10 years). The OVD was defined according to the ATS/ERS (FEV1/FVC < LLN (=local norms value – 1.64 × residual standard deviation)) and GLI (FEV1/FVC Z-score < –1.64) criteria. The following OVD classifications severity were applied: ATS/ERS (FEV1/%pred): mild (>70%), moderate (60–69%), moderately severe (50–59%), severe (35–49%), and very severe (<35%) and GLI (FEV1 Z-score): mild (≥–2.0), moderate (–2.0 to –2.5), moderately severe (–2.5 to –3.0), severe (–3.0 to –4.0), and very severe (–4.0). The frequencies of OVD were 14.4% (ATS/ERS method) and 10.5% (GLI method) (p < 0.05). Among the 103 participants having an OVD according to the two methods, the severity classification was mild (34.95% vs. 37.86%, p < 0.05), moderate (25.24% vs. 18.45%, p < 0.05), moderately severe (23.30% vs. 15.53%, p = 0.144), severe (9.71% vs. 20.39%, p < 0.05), and very severe (6.80% vs. 7.77%, p = 0.785), respectively for the ATS/ERS and GLI classifications. The two OVD definitions were not exchangeable. Moreover, the two grading severity systems misclassified the OVD grades.

In adults with a prior evidence of lung disease, an obstructive ventilatory defect (OVD) is usually defined by a low ratio between the 1st forced expiratory volume and the 1st forced/slow vital capacity (FEV1/FVC) (e.g. <lower limit of normal (LLN)). However, the LLN can be estimated either by the 90% confidence interval (or the 90th percentile) (American Thoracic and the European Respiratory Societies (ATS/ERS) method) or by the Z-score (global lung initiative (GLI) method). In 2014, a new alternative classification (GLI classification) for grading the OVD severity was proposed to replace the 2005-ATS/ERS one. The aims of the present study were to determine, according to the two methods (GLI vs. ATS/ERS), the frequency of participants having an OVD; and to compare the two classifications (GLI vs. ATS/ERS) of OVD severity. This was a prospective study including 1000 participants (mean age = 41 ± 10 years). The OVD was defined according to the ATS/ERS (FEV1/FVC < LLN (=local norms value – 1.64 × residual standard deviation)) and GLI (FEV1/FVC Z-score < –1.64) criteria. The following OVD classifications severity were applied: ATS/ERS (FEV1/%pred): mild (>70%), moderate (60–69%), moderately severe (50–59%), severe (35–49%), and very severe (<35%) and GLI (FEV1 Z-score): mild (≥–2.0), moderate (–2.0 to –2.5), moderately severe (–2.5 to –3.0), severe (–3.0 to –4.0), and very severe (–4.0). The frequencies of OVD were 14.4% (ATS/ERS method) and 10.5% (GLI method) (p < 0.05). Among the 103 participants having an OVD according to the two methods, the severity classification was mild (34.95% vs. 37.86%, p < 0.05), moderate (25.24% vs. 18.45%, p < 0.05), moderately severe (23.30% vs. 15.53%, p = 0.144), severe (9.71% vs. 20.39%, p < 0.05), and very severe (6.80% vs. 7.77%, p = 0.785), respectively for the ATS/ERS and GLI classifications. The two OVD definitions were not exchangeable. Moreover, the two grading severity systems misclassified the OVD grades.

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measured spirometric data differs from the mean value of what is being predicted, with merely 5% of healthy subjects having a Z-score of 1.64 or less [2,6].

The severity of the OVD correlates with the ability to work and function in daily life, morbidity, respiratory complaints, and prognosis, including a fatal outcome [7]. Surprisingly, there is a disagreement between the ATS/ERS and the GLI on the way to express the FEV₁ [1,13]. While the ATS/ERS classification is based on the FEV₁ expressed in percentage of the predicted value (%pred) [1], the GLI new classification is based on the FEV₁ Z-scores [3]. This could be a source of confusion [6,8].

The present Scientific Letter aimed to ascertain how well the GLI criteria to diagnosis the OVD [2] and to grade its severity [3] fit those recommended by the ATS/ERS [1].

A cross-sectional study including 1000 participants (145 females) was performed in a private function exploration center (http://placesmap.net/TN/centre-international-d-explorations-fonctionnelles-163323/). Measurements were carried by a plethysmograph (Jaeger MasterScreen Body, CareFusion Germany). Local norms [9] were applied to derive the predicted values and the LLN. The Z-scores were derived for each participant using norms from the GLI basing specially on developed software [10]. The OVD was defined according to the ATS/ERS [FEV₁/FVC < LLN (=local norms value – 1.64 × residual SD) [1]] and the GLI [FEV₁/FVC Z-score < −1.64] [2] criteria. The following two severity classifications were applied: ATS/ERS [1] (based on the FEV₁/%pred [11,12]: mild (>70%), moderate (60–69%), moderately severe (50–59%), severe (35–49%), and very severe (<35%)); GLI [based on the FEV₁ Z-score [3]: mild (≥−2.0), moderate (−2.5 to −2.0), moderately severe (−3.0 to −2.5), severe (−4.0 to −3.0), and very severe (<−4.0)]. Analyses were carried out using Statistica software (Statistica Kernel version 6; StatSoft, Paris, France). Significance was set at the 0.05 level. Descriptive analysis includes frequencies for categorical variables and mean ± SD for continuous ones. Chi-square test was used to assess the agreement between the presence of OVD or its severity degree according to the two classifications (GLI vs. ATS/ERS). The relationships between the three spirometric data (FEV₁, FVC, and FEV₁/FVC) expressed as %pred and their Z-scores were evaluated using the correlation coefficient (r).

The total sample age, height, and weight mean ± SD were, respectively, 41.29 ± 10.30 years, 1.71 ± 0.08 m, and 80.9 ± 12.2 kg. Twenty percent of participants were smokers or ex-smokers. The determined FEV₁ (L, %pred), FVC (L, %pred), and FEV₁/FVC (absolute value, %pred) were, respectively, 3.37 ± 0.79 (84 ± 14%), 4.25 ± 0.89 (90 ± 12%), and 0.79 ± 0.08 (97 ± 9%). According to the GLI norms, their mean ± SD Z-scores were, respectively, −0.87 ± 1.04, −0.75 ± 0.93, and −0.26 ± 1.04. There were strong and significant linear relationships between data expressed as %pred and their Z-scores (r = 0.9280 for FEV₁, r = 0.9210 for FVC and r = 0.9689 for FEV₁/FVC). The frequencies of participants having an OVD were 14.4% and 10.5%, respectively with the ATS/ERS and the GLI methods (p < 0.05). Conformity of OVD diagnosis was found in 103 cases. Among the 144 participants having an OVD according to the ATS/ERS method, 41 were free from OVD according to the GLI method. Among the 105 participants having an OVD according to the GLI method, only two were free from OVD according to the ATS/ERS method. Moreover, the two grading severity systems misclassified the grades of OVD (Pearson Chi-square = 214.095, df = 16, p < 0.05). In fact, for the 103 participants having OVD according to the ATS/ERS and the GLI methods, the severity classification was mild (34.95% vs. 37.86%, p < 0.05), moderate (25.24% vs. 18.45%, p < 0.05), moderately severe (23.30% vs. 15.53%, p = 0.144), severe (9.71% vs. 20.39%, p < 0.05), and very severe (6.80% vs. 7.77%, p = 0.785).

The main result of this study was that the diagnosis and the classification of the OVD using the GLI method [2,3] resulted in a change in the frequencies and the severity degrees established by the ATS/ERS recommendations [1].

It is conventional that a diagnosis of an OVD should be based on an abnormally low FEV₁/FVC ratio [3]. Unexpectedly, there is no worldwide consensus on what constitutes a low FEV₁/FVC ratio [3,13]. Whereas the ATS/ERS [1] advocated use of the 5th percentile of FEV₁/FVC from a healthy population as the LLN, the GLI [2] adopted the Z-score value of FEV₁/FVC. According to the GLI [2], unlike %pred the Z-score is free from bias due to age, height, sex, and ethnic group. In this study, the two OVD definitions (GLI vs. ATS/ERS) were not exchangeable. The above result was contrary to that found in another larger study (n = 21,191 participants) [3], where the overall prevalence of OVD was identical with the ATS/ERS [1] and the GLI [3] definitions. The authors concluded that this allows reliable reconstruction of ATS/ERS criterion diagnosis by simple replacement of the LLN with Z-score [3]. This study findings do not support the above conclusion and confirmed previous result that adopting the GLI norms [2] will have significant effects on the proportions of detection of spirometric defects [11].

The GLI new classification system was described as effortless, simply remembered, and clinically convincing [3]. It seems that it retains formerly established links with clinical results and circumvents biases due to the use of FEV₁/%pred [3]. According to Quanjer et al. [3], when merged with the GLI norms [2], it supplies a universal diagnostic
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IG conceived the study, participated in its design and
helped to draft the manuscript.
SR conceived the study, participated in its design and
helped to draft the manuscript.
HBS conceived the study, participated in its design, performed the statistical analysis, helped to draft the manu-
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RK conceived the study, participated in its design, per-
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