

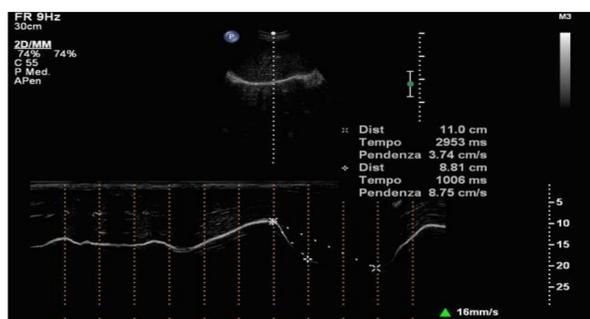
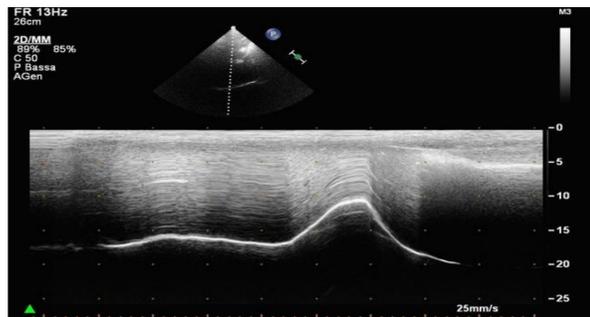
# M-mode obstruction index (MIO): an ultrasound method to evaluate presence and severity of airway obstruction in COPD patients

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## Introduction

In a recent study, Zanforlin et al, given the similarity between the volume/time curve obtained with spirometry and the diaphragmatic motility ultrasound curve obtained with M-mode evaluation, hypothesized the possibility of inferring the presence of airway obstruction using MIO index. MIO is an ultrasound index obtained from the ratio between the diaphragmatic excursion during the first second of a forced expiration (FEDE1, cm) and the total expiratory excursion (EDEmax, cm).



Zanforlin et al. demonstrated that a MIO below 77% may discriminate patients with airway obstruction from healthy subjects.

## Aims

- Confirming the correlation between MIO and FEV1%, FEV1/FVC % values.
- Confirming the presence of a difference in MIO and FEDE1 between controls and COPD patients.
- Assessing the performance (sensitivity, specificity and accuracy) of MIO in differentiating controls from COPD patients and validating the 77% MIO cut-off previously proposed.
- Evaluate if there is a significant difference in MIO values between mild-moderate COPD (Group B1=GOLD 1-2) compared to severe-very severe (Group B2=GOLD 3-4).
- Identifying a MIO threshold able to assess the severity of the obstruction.

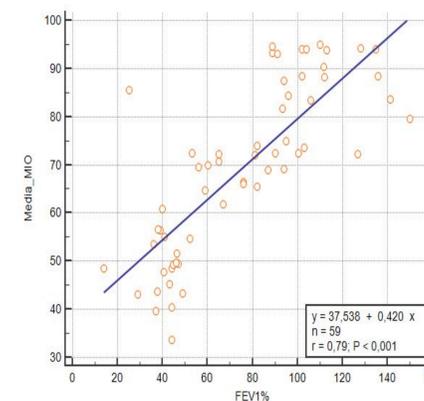
## Methods

Spirometry and M-MODE diaphragmatic ultrasound with Convex probe were performed in 21 subjects with normal spirometry (Group A) and in 38 COPD patients (Group B): 18 GOLD 1-2 (Group B1) and 20 GOLD 3-4 (Group B2). FEDE1, EDEmax and their percent ratio (MIO) were calculated during a maximal forced open-mouth expiration.

## Results

	Group A	Group B1	Group B2	p value A vs B, A vs B2, B1 vs B2
FEDE 1 mean (cm)	5.84±1.03	4.60±1.19	2.85±1.14	p<0.05
EDEmax mean (cm)	6.57±1.08	6.62±1.67	5.60±1.65	p>0.05
MIO mean	88±6.85	68.74±4.96	50.11±10.61	p<0.05

There was a statistically significant difference in FEDE1 and MIO between controls and COPD patients (p value < 0,05)

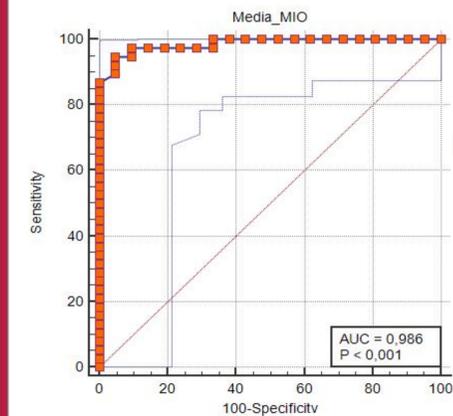


Correlation analysis between MIO and FEV1% showed a significant linear regression.

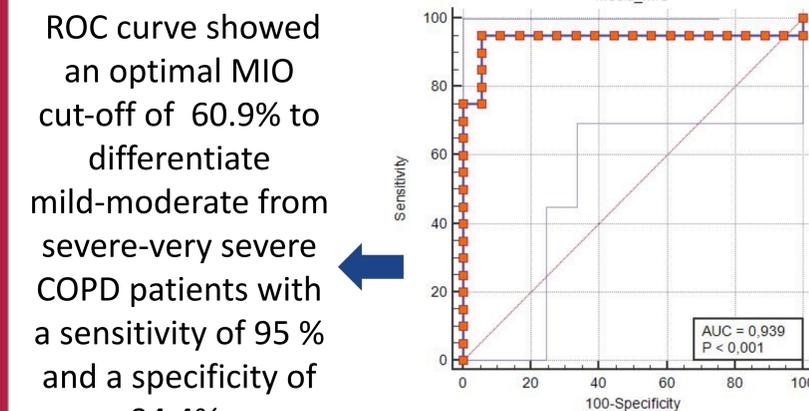
Correlation analysis between MIO and FEV1/FVC% also showed a significant linear regression.

The 77% MIO cut-off differentiates controls from COPD with a 94.8% sensibility, a 95% specificity and a 94.9% accuracy.

	FEV1/FVC < 70%	FEV1/FVC ≥ 70%	Total	
MIO<77	37	2	39	sens 94.8%
MIO>77	1	19	20	spec 95%
Total	38	21	59	acc 94.9%



ROC curve showed an optimal MIO cut-off of 73.5% to differentiate controls from COPD patients with a sensitivity of 94.74% and a specificity of 95.24%.



ROC curve showed an optimal MIO cut-off of 60.9% to differentiate mild-moderate from severe-very severe COPD patients with a sensitivity of 95% and a specificity of 94.4%.

**CONCLUSIONS:** Our study confirmed the ability of MIO index to predict the presence of airway obstruction. Based on the data we obtained, we also found a MIO cut-off of 60.9% able to differentiate the severity of the obstruction (mild-moderate versus severe-very severe) in COPD patients.

Conflict of interests: all authors declare the absence of any conflict of interest concerning this study