

Letter to the Editor

Response to "Letter to the Editor: The importance of quantifying training loads and applying exercise principles in respiratory muscle training studies"

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Dear Editor,

We appreciate the thoughtful commentary provided by Torres-Castro and colleagues on our article, *Impact of Respiratory Muscle Training on Muscle Strength, Pulmonary Function, Symptoms, and Quality of Life in COPD*.¹ Their observations reflect a careful reading of our work and a shared interest in strengthening methodological approaches in respiratory muscle training research. We address their comments below.

We agree that quantification of training load (intensity) is an important component of exercise-based interventions and that the principles of specificity, overload, progression, and individualization are central to exercise training. As noted in our Methods section, the PowerLung device used in our study permits adjustable threshold loading but does not provide calibrated pressure equivalents for each incremental turn. Although this limits the ability to quantify precise cmH₂O loads, our protocol incorporated these training principles in operational terms. Inspiratory and expiratory threshold loading targeted the muscle groups assessed by MIP and MEP (specificity); participants were instructed to increase resistance when 10 breaths could be completed with ease, and device settings increased significantly over the 8-week period (progression); and the magnitude of the MIP and MEP improvements across GOLD 2–4 participants indicates that the loads imposed exceeded baseline respiratory muscle demand (overload). The titration model, based on each participant's perceived ease of breathing, allowed individuals with varying disease severity to progress according to their physiological capacity (individualization). The structured nature of the protocol, including standardized session frequency, defined progression criteria, and documented increases in resistance settings, supports reproducibility even in the absence of calibrated pressure increments. Collectively, these factors indicate that the training principles highlighted by Fleck² and mentioned by Torres-Castro et al. were applied in the context of a pragmatic clinical intervention.

We also acknowledge the authors' emphasis on reproducibility and dose–response considerations. Many prior studies, particularly those examining inspiratory muscle training alone, have prescribed training intensity as a percentage of baseline MIP or MEP. However, research using concurrent inspiratory and expiratory training is less well established, and many commercially available threshold devices do not provide precise load quantification.³ Despite these constraints, our findings are consistent with studies that employed calibrated devices, demonstrating physiologically meaningful improvements in respiratory muscle strength and patient-reported outcomes. This concordance supports the feasibility and clinical relevance of concurrent respiratory muscle training while reinforcing the value of future research using externally calibrated pressure measurements or digitally instrumented threshold devices. Fleck's description of training intensity being performed "at or close to repetition maximum resistances" illustrates that valid exercise intensity can be established through performance-based criteria rather than precise numerical load values.² This framework aligns with our protocol, in which participants increased resistance when the prescribed number of breaths could be completed with ease, thereby individualizing intensity in accordance with established training principles.

With respect to the interpretation of FEV₁ changes, we concur that the mean increase of 37 mL across all participants could be due to test–retest variability and therefore must be interpreted cautiously. We noted this in the original article. At the same time, our GOLD-stratified analyses demonstrated directionally positive changes that merit acknowledgment. In our study, GOLD 3 and GOLD 4 participants experienced mean increases of 83 mL and 63 mL, respectively, representing an average 8.8% improvement from baseline, a change that is within the commonly cited 5–10% threshold associated with clinically meaningful changes in COPD.^{4,5} These values are notable given that severe and very severe COPD are typically characterized by progressive annual declines in FEV₁ of approximately

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50–60 mL.⁴ While learning effects cannot be completely excluded, the magnitude and consistency of the MIP and MEP improvements, together with the subgroup spirometry findings, are consistent with physiologic adaptation rather than measurement variability alone. These exploratory results may inform the design of future controlled studies powered to evaluate spirometric outcomes more definitively.

We appreciate that Torres-Castro and colleagues recognized the clinical relevance of examining a concurrent inspiratory and expiratory training model using a device commonly available in pulmonary rehabilitation settings. Our aim was to evaluate a realistic intervention consistent with what patients and clinicians encounter in routine practice. The significant improvements in MIP, MEP, CAT, and AQ20 across GOLD stages indicate that clinically meaningful benefits may be achievable even when using non-calibrated devices. At the same time, we agree that future investigations would benefit from integrating calibrated threshold systems, direct cmH₂O load reporting, and training intensities

expressed as a percentage of maximal respiratory pressures. Such refinements would enhance mechanistic interpretation, dose–response modeling, and reproducibility across studies.

In conclusion, we appreciate the constructive feedback from Torres-Castro and colleagues and their commitment to advancing methodological rigor in respiratory muscle training research. While our study demonstrates the feasibility and potential benefits of a pragmatic concurrent RMT model, we agree that future work incorporating calibrated load quantification, device-independent pressure verification, and individualized intensity prescription based on maximal respiratory pressures is an important methodological goal. We value continued dialogue aimed at improving the precision and applicability of respiratory rehabilitation interventions.

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