DMOs as passive at-home alternative to the 6MWT for assessing dyspnea in COPD patients

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FACTS & FIGURES

- Study start – end : 01/04/2019 - 30/06/2024
- IHI Funding: 25,395,897 €
- EFPIA in kind: 24,515,667 €
- Other: 0 €
- Total Cost: 49,911,564 €
- Project website: http://mobilise-d.eu/
- Social media: @Mobilise_D

CHALLENGE

Dyspnea is one of the most burdensome symptoms in COPD patients, significantly impacting patients' quality of life [1].

Dyspnea assessment relies on the 6-Minute Walk Test (6MWT), which correlates with the modified Medical Research Council (mMRC) dyspnea scale [2]. However, the 6MWT requires burdensome clinic visits with a single timepoint assessment that limits its real-world validity. At-home wearables offer a cost-effective, passive solution to capture day-to-day dyspnea fluctuations that remain invisible to clinic-based testing, without logistical burden for patients.

The Mobilise-D consortium has developed validated Digital Mobility Outcomes (DMOs) derived from lower-back mounted inertial measurement units (IMUs) that assess continuous, real-world activity features like walking bouts speed, step length, cadence, and duration [3].

Here, we tested whether DMOs could offer a passive approach to measure dyspnea in COPD patients

APPROACH & METHODOLOGY

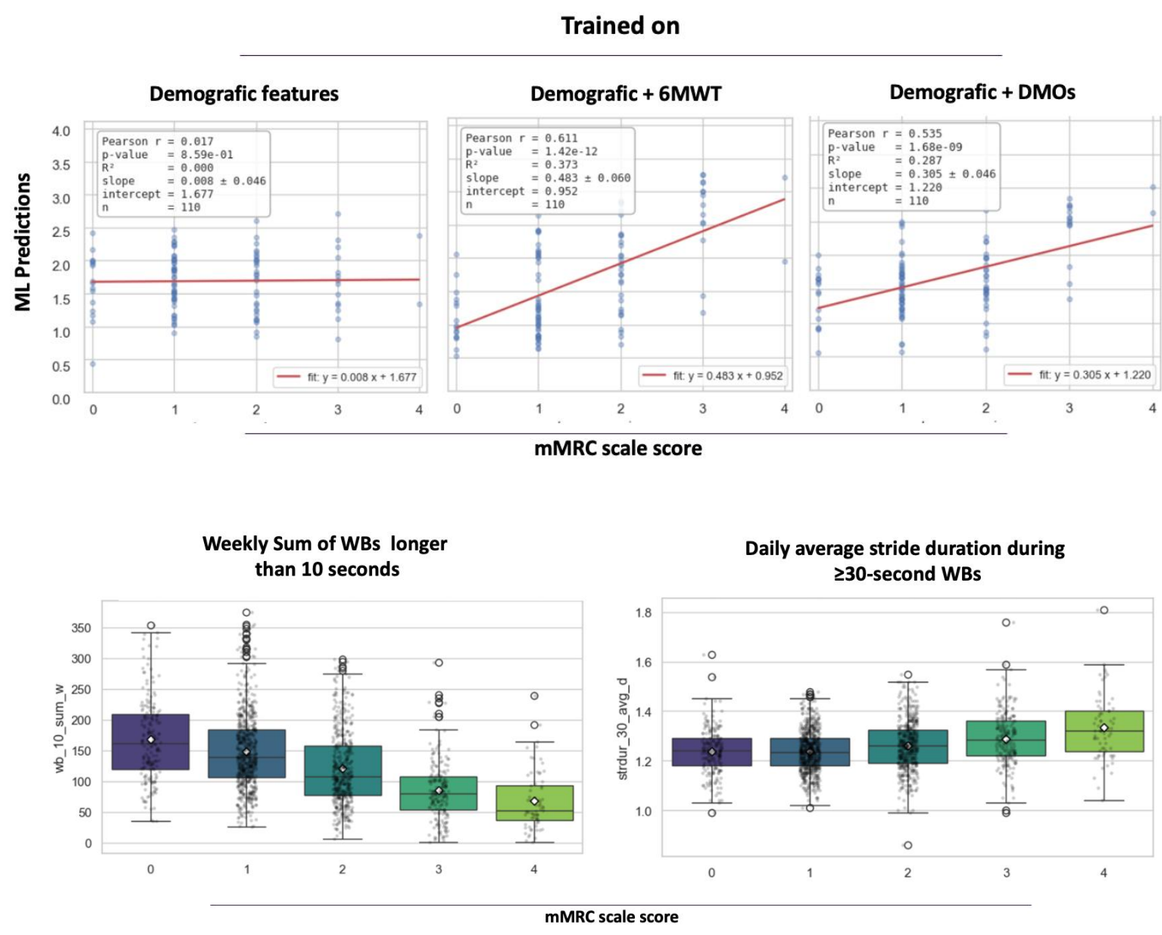
- Participants: ~600 COPD participants from the Mobilise-D CVS multi-center prospective cohort.
- Wearable: lower-back mounted Inertial Measurement Units (IMUs), capturing real-world mobility data at 100 Hz.
- Study duration: ≥7 days of free-living monitoring.
- Outcome measurements: DMOs were extracted using the validated Mobgap pipeline, aggregated at daily and weekly timescales.
- Reference measure: 6MWT (walk distance and speed).
- Dyspnea measurement: mMRC dyspnea scores (0-4).
- Machine Learning approach: Two feature sets (DMOs vs 6MWT) were compared using three algorithms (Decision Tree, Linear, and Deep Learning models) trained with 5-fold cross-validation. Performance was evaluated via accuracy, AUC-ROC, sensitivity, and specificity. Feature importance was assessed using SHAP values.

CAREER IMPACT

Contributing to DMO validation places us at the forefront of a rapidly growing field with only a handful of formally validated endpoints. This work enables us to be part of the pioneering efforts to translate DMOs into regulator- and clinician-accepted Digital Biomarkers.

RESULTS

DMOs predicted dyspnea severity comparably to the 6MWT (r=0.535 vs. 0.611). As expected, patients with worse dyspnea (higher mMRC) performed fewer walking bouts longer than 10s and walked more slowly (longer stride duration).



Despite low R^2 values, both model types reliably predicted severe dyspnea (high mMRC). The most predictive DMOs were weekly walking activity (wb_10_sum_w) and daily stride duration (strdur_30_avg_d), consistent with reduced mobility in worse dyspnea.

CONCLUSIONS

Wearable-derived DMOs demonstrate predictive capacity comparable to the 6MWT for dyspnea assessment (r=0.535 vs. 0.611), with strong precision for identifying high mMRC scores. Weekly walking bout count and daily stride duration emerged as key predictors. By enabling continuous, passive, real-world monitoring, DMOs capture day-to-day variability that single-timepoint clinic visits cannot detect, positioning them as a cost-effective complement to traditional testing. Validation across independent cohorts is essential to establish generalizability

VALUE OF COLLABORATING WITH IHI

- Access to Large-Scale, Real-World Data set (~600 COPD)
- Standardized, device agnostic, pipeline for extraction of peer-reviewed DMO features, that facilitates the use of DMOs that are on a clear path for regulatory acceptance.
- Enabled the development of non-burdensome, reliable dyspnea assessment through continuous real-world activity features.
- Demonstrated how public and private sectors can collaborate to develop trustworthy scalable digital health solutions with clear pathways to clinical adoption.

References

1. Poosiri S. *ASEAN J Rehabil Med*. 2025;35(1):42-5.
2. Mazzà C, et al. *Digit Biomark*. 2021;5(1):13-30.
3. Delgado-Ortiz L, et al. *ERJ Open Res*. 2026. (Mobilise-D COPD cohort)

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