

Comparative Analysis of Tidal Breathing versus Deep Inhalation and Breath Hold Techniques: Implications for Respiratory Health

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BACKGROUND

The UK National Institute for Health and Care Excellence (NICE) and the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines advocate for patient training and education in operating a new inhaler, before prescribing for use by individuals with COPD.

Two options for inhalation are provided for the **AeroChamber Plus*** valved holding chamber (VHC):

Pattern 1

Exhale, actuate the inhaler, follow with a slow and deep inhalation to vital capacity; Ideally breath-hold for at least 5 s before exhaling.

Pattern 2

Breathe tidally through the chamber for 2-3 breaths, keeping lips sealed around the mouthpiece.

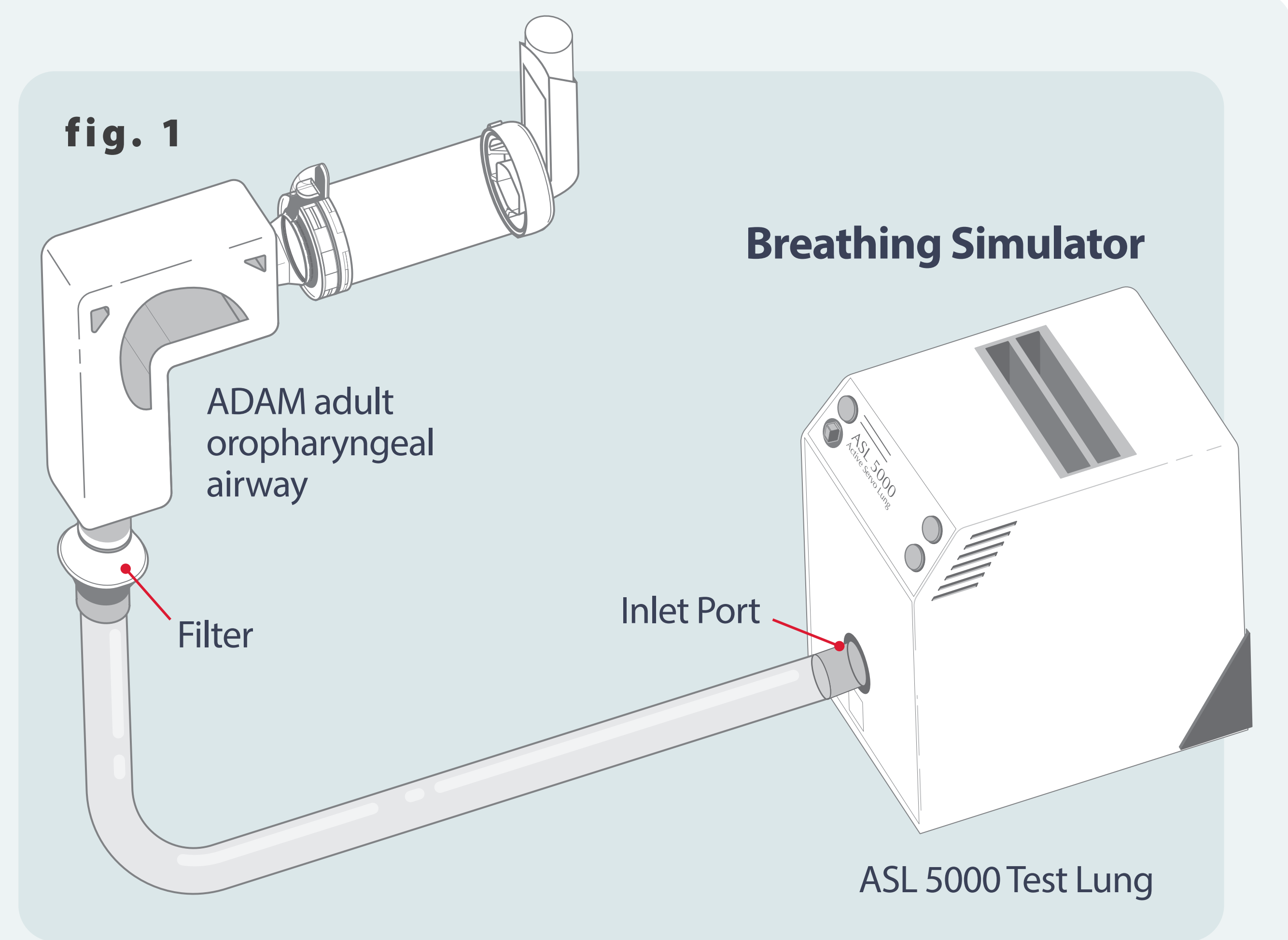
OBJECTIVE

We sought to evaluate the delivery of pMDI+VHC delivered albuterol using an adult oropharyngeal model with two inhalation patterns

Each participant garnered from a group (n=27), consenting healthy volunteers, was trained in correct use to perform both types of inhalation maneuvers

MATERIALS & METHODS

- Staff members at TMI (n=27, 15 M, aged 20-65 years) were recruited and enrolled after giving informed consent. None had a history of asthma or COPD, but all were familiar with VHC use.
- Each volunteer was presented with a written instruction set and asked by a trained staff member to follow the instruction for Pattern 1 and the process repeated with Pattern 2.
- Inhalation Patterns were recorded using the purpose constructed attachment to a pneumotachometer (SpiroQuant H, Honeywell-Envitec, Wismar, Germany) attached to the VHC.
- Each inhalation flow profile was then replayed via a breathing simulator (ASL5000, Ingmar Medical, Pittsburgh, PA) (n = 3 replicates) using an albuterol pMDI (Ventolin[†], 100 µg/actuation).
- In all cases, actuation of the inhaler coincided with the onset of the recorded inhalation waveform with the mouthpiece of the VHC attached to a model adult oropharynx (**fig. 1**).
- We collected the drug mass penetrating to the carina and therefore capable of lung delivery (inhalable drug mass) by a bacterial/viral filter located at the distal end of the model.
- The mass of albuterol recovered from the filter was subsequently assayed by a validated HPLC-UV spectrophotometric procedure at 276 nm.



RESULTS

The data we present in fig. 2a and 2b in terms of mass albuterol per actuation (mean ± SD) as a function of volunteer number, were categorized based on the sex of the subjects.

High variability: There were significant differences between participants in how much medication each person inhaled, even when using the same technique.

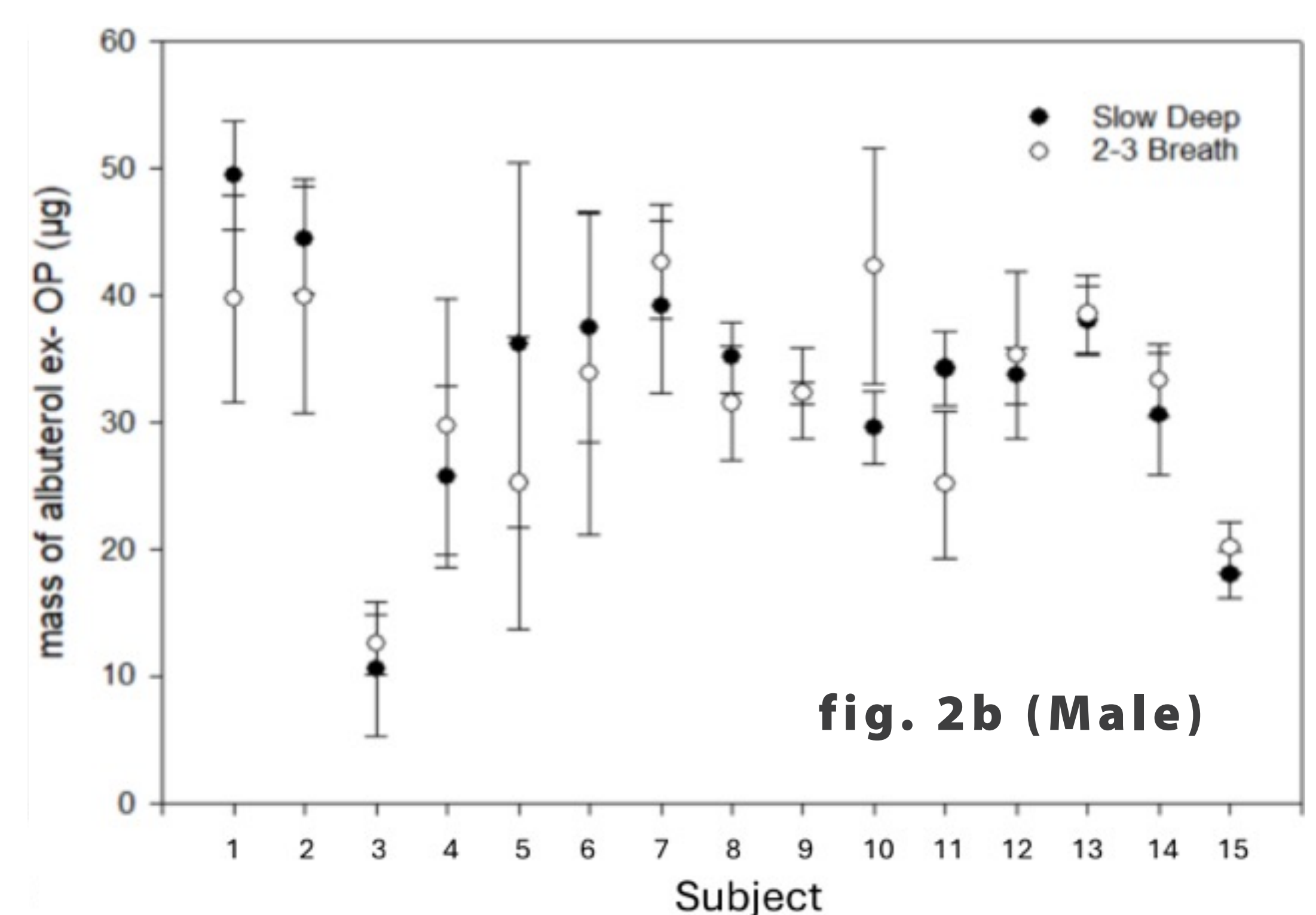
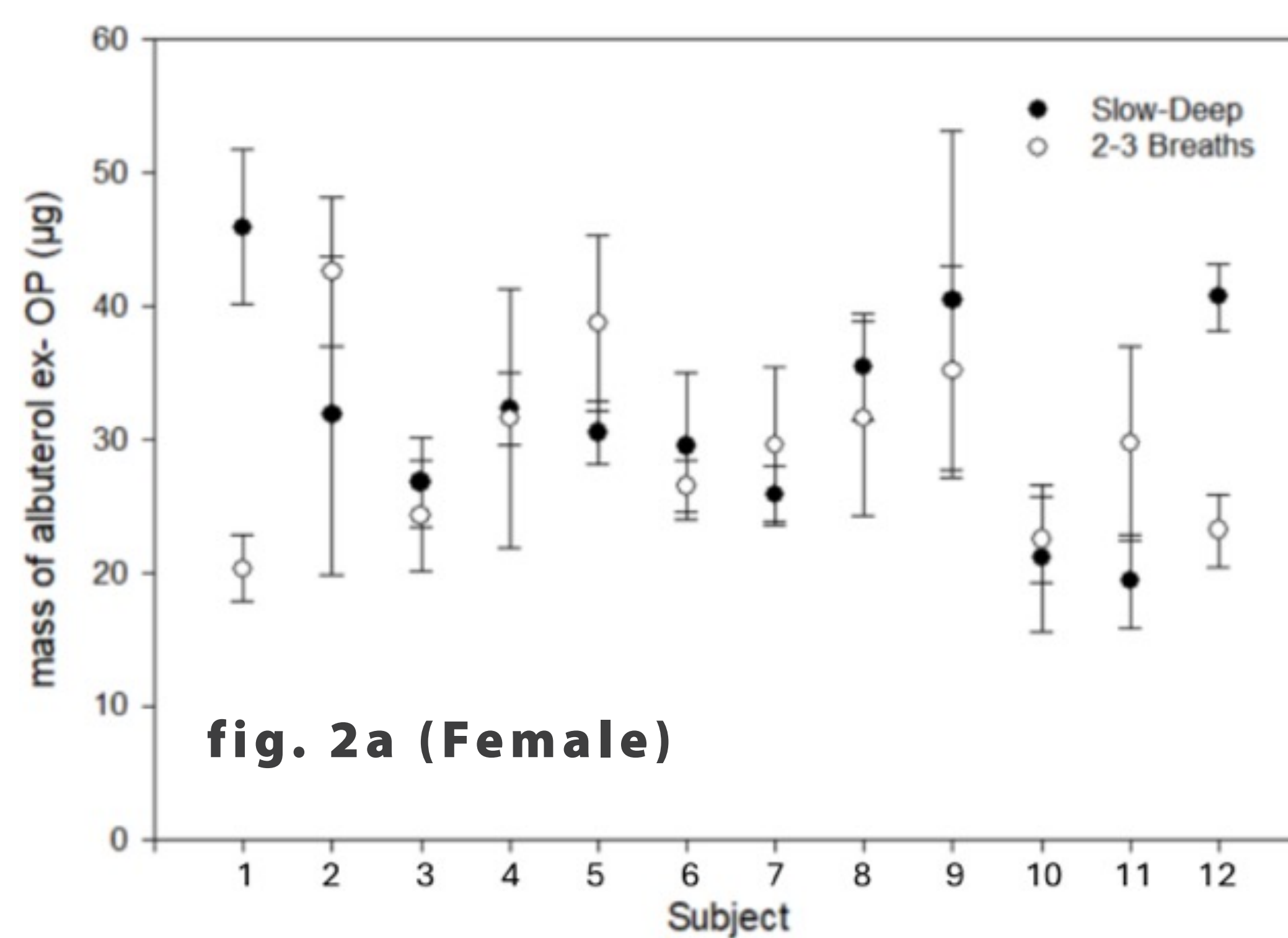
No clear sex-based differences: Generally, men and women inhaled similar amounts of medication.

Similar variability across techniques: Either inhalation pattern resulted in roughly the same level of variability (around 30%).

Individual differences:

- Volunteers 3 and 15 (M) and 3 and 10 (F) exhibited low inhalable drug delivery regardless of inhalation technique, suggesting that they were having difficulty mastering either modality.
- Greater drug delivery was achieved with option 2 compared with option 1 for volunteer 10 (M) and volunteer 11(F). However, the reverse pattern was observed with volunteers 1 and 12(F).

Most subjects received similar delivery regardless of inhalation pattern



Sex	Total Inhaled Volume Range (mL)	
	Deep Inhalation	Tidal Breathing
Male (n=15)	155 - 5002	617 - 7772
Female (n=12)	214 - 2711	450 - 3879

DISCUSSION

Since all subjects were healthy and received training on the correct use of the device, it can be argued that the results include 'best case' scenario for lung volumes.

The large range in drug delivery across the cohort may be indicative of both variation in lung capacity as well as interpretation of what the inhalation technique training meant to each subject.

CONCLUSIONS

- Our small study has provided insight to help resolve the question whether a multistep controlled inhalation process or a simplified tidal breathing technique is likely to be more effective.
- We found no consistent trend in terms of one technique providing higher medication delivery.
- The WHO has stated that complex medication regimens reduce patient adherence across various diseases. Simplifying the inhalation process might be an effective strategy to enhance patient adherence by ensuring consistent medication intake.
- By reducing the complexity of inhaler use, patients might achieve more consistent medication delivery and asthma control, potentially mitigating the adverse effects associated with incorrect inhaler technique.
- We conclude that future research and clinical practice should focus on developing and promoting user-friendly inhaler methods that accommodate the diverse needs of patients.