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# Cross-sectional and longitudinal comparison of $N_2$ and $SF_6$ multiple breath washout in children with CF aged 2-45 months

R. Mulvad Sandvik [1], M.N. Schmidt [1], J. Hovland Olsen [2], S. Rubak [2], H.V. Olesen[2], F. Buchvald [1], T. Pressler [1], A. Lindblad [3], M. Skov [1], P. Gustafsson [4], K.G. Nielsen [1]

[1]Copenhagen University Hospital, Rigshospitalet, Danish Paediatric Pulmonary Service, CF Center Cph., Copenhagen, Denmark,
[2]Aarhus University Hospital, Department of Paediatrics and Adolescent Medicine, Cystic Fibrosis Centre Aarhus, Aarhus, Denmark,
[3]Queen Silvia Children's Hospital, Sahlgrenska University Hospital, CF Centre, Gothenburg, Sweden,
[4]Central Hospital Skövde, Department of Pediatrics, Skövde, Sweden

CONTACT INFORMATION
Rikke.mulvad.sandvik.01@regionh.dk

## INTRODUCTION

The Exhalyzer®D (ECO MEDICS AG, Switzerland) is a feasible and sensitive inert gas washout (MBW) method to assess lung impairment in children with cystic fibrosis (CF), using either sulfur hexafluoride ($SF_6$) (washed out by ambient air), or nitrogen ($N_2$) (washed out by pure $O_2$). As previously shown in two smaller studies with infants the methods are not interchangeable, and questions were raised on which to consider most appropriate in infants.

## AIM

We aimed to explore the differences between $N_2$ and $SF_6$MBW in a larger group of children, including longitudinal testing.

## METHOD

An international (Danish - Copenhagen and Århus, Swedish - Gothenburg and Skövde) cross-sectional and longitudinal study of $SF_6$ and $N_2$MBW (Exhalyzer® D, set 1, Rüsch face mask #1 or #2) within the same occasion during sleep, including children with CF aged 2-45 months and healthy children (HC) aged 2-36 months. Children with CF were tested at one (N=45) or more test occasions (N=21). First test occasions were used cross-sectionally for paired t-test.

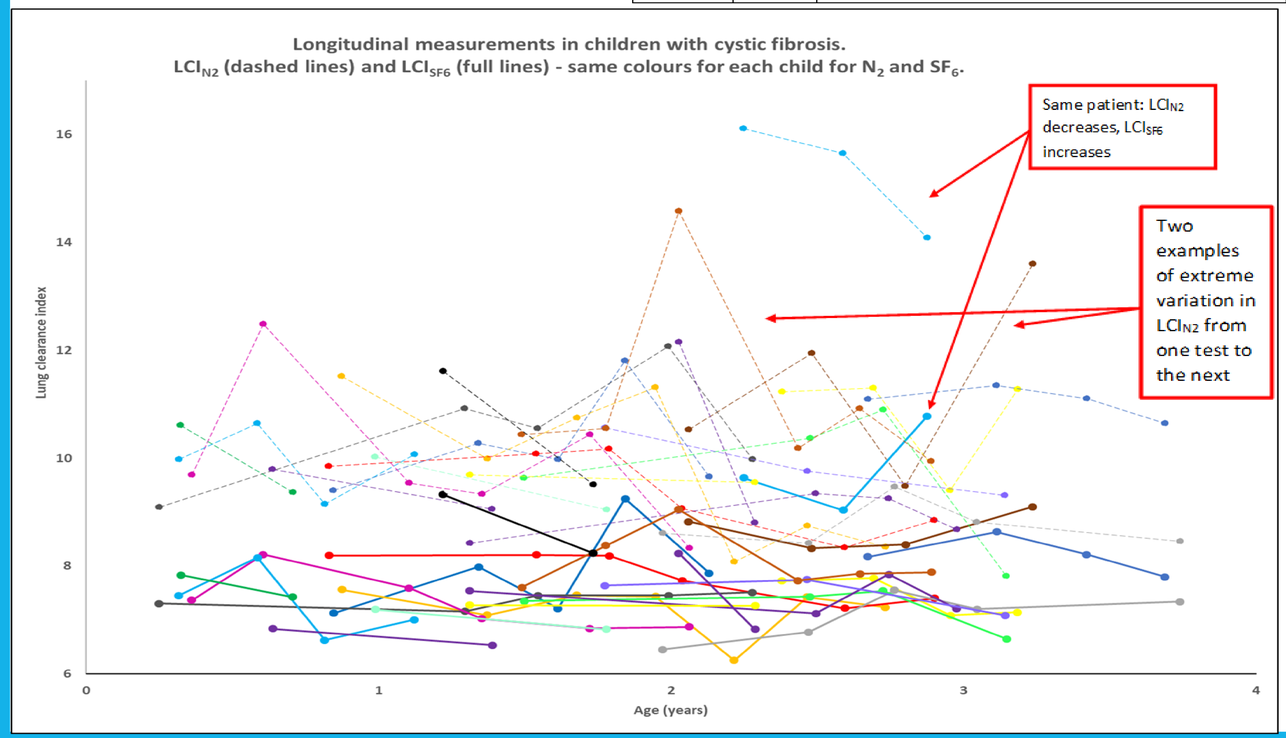
## RESULTS

### Demographics:

Median (range) age for CF was 1.79 (0.25-3.74) years

Median (range) age for HC was 1.68 (0.14-2.97) years

| | Descriptive data, mean (SD) | | | | | | Cross-sectional data, Mean (SD) | | | Longitudinal data, median (range) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Group (N) | MBW tests | Age, months | LCI $SF_6$ | LCI $N_2$ | FRC $SF_6$, mL | FRC $N_2$, mL | N | ΔLCI between $N_2$ and $SF_6$ | ΔFRC between $N_2$ and $SF_6$, mL | N (MBW tests) | ΔLCI between $SF_6$ test occasions | ΔLCI between $N_2$ test occasions |
| CF (45) | 106 | 21.86 (10.55) | 7.76 (0.81) | 10.41 (1.61) | 256.3 (85.0) | 295.0 (96.7) | 45 | 2.79* (1.16) | 37.4* (24.5) | 21 (82) | -0.002 (-1.5 to 2.0) | -0.25 (-4.4 to 4.1) |
| Healthy (57) | 57 | 16.03 (9.12) | 7.29 (0.51) | 9.01 (0.94) | 207.4 (73.8) | 234.7 (82.2) | 57 | 1.72* (0.85) | 27.3* (18.4) | - | - | - |




**Data is presented in the table and the figure.**

### Cross-sectional data:

Mean (SD) LCI and FRC were markedly higher using $N_2$ compared to $SF_6$MBW in both CF and HC.

For children with CF mean (SD) LCI$_{N2}$ was 10.4 (1.6) and LCI$_{SF6}$ was 7.8 (0.8). For HC LCI$_{N2}$ was 9.0 (0.9) and LCI$_{SF6}$ was 7.3 (0.5).

The mean difference in LCI and FRC between $N_2$ and $SF_6$ were all statistically significant (* $p < 0.0001$).

### Longitudinal data:

The absolute changes in LCI (ΔLCI) from one test occasion to the next (median 3.7 months, range 2.5 - 14.2) were more pronounced using $N_2$MBW. The median (range) difference between ΔLCI$_{N2}$ and ΔLCI$_{SF6}$ was -0.14 (-3.3 to 3.4).

In 27% of all test intervals, the development in LCI was opposite between the two test methods.

## CONCLUSIONS

Both cross-sectional and longitudinal measurements favor the use of $SF_6$MBW for children aged 2-45 months as $N_2$MBW showed high values, unreliable large spread and pronounced inter-test differences for LCI. The differences were larger in children with CF than in HC.

## FUTURE PERSPECTIVE

**New data on corrected $N_2$MBW method is now available**: *Rikke M. Sandvik[1], Per M. Gustafsson[2,3] Anders Lindblad[3,4], Paul D. Robinson[5], Kim G. Nielsen[1,6]. Improved agreement between $N_2$ and $SF_6$ multiple breath washout in healthy infants and toddlers with improved EXHALYZER D® sensor performance. Journal of Applied Physiology. In press.*

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