Feasibility and Inter-test Reproducibility of Lung Clearance Index in Children with Neuromuscular Disorders

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BACKGROUND

Children with a neuromuscular disorder (NMD) have progressive respiratory muscle weakness but there are ***no reliable outcome measures to predict changes in lung function.***

Lung clearance index (LCI) may be a marker of disease progression, but the ***inter-visit reproducibility is unknown*** in children with NMD.

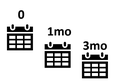
This preliminary cross-sectional analysis aimed to assess the ***feasibility*** and the ***inter-visit reproducibility of LCI*** in children with and without NMD.

Hypothesis: LCI is feasible and reproducible in between visits in children with and without NMD.

METHOD

Children with NMD (n=12) were recruited from the Perth Children's Hospital neuromuscular clinic. ***Children without NMD*** (n=58) with no history of wheeze/asthma or other respiratory conditions were recruited from community.

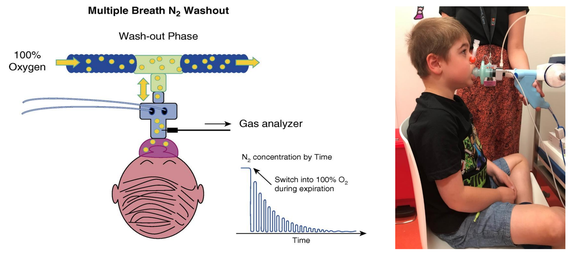
LCI was derived from ***Multiple Breath Nitrogen Washout (MBW) tests***, obtained with the Eco Medics Exhalyzer D system (Durnten, Switzerland) using Spiroware software.



MBW testing was attempted by participants on ***at least two occasions (baseline, 1 and/or 3 months).*** A MBW test was considered successful if the participant achieved two or more acceptable measurements during one visit.

RESULTS

Figure 1: Schematic representation of N_2 washout phase, where O_2 is delivered using a bias flow. The blue trace shows the decay in N_2 signal during expiration.



	NMD (n=12)	Control (n=58)
Males, n	9	29
Age, years	10.2 ± 3.8 (6–16)	10.3 ± 3.3 (5–17)
Height, z-score	-1.37 ± 1.26 (-3.16-0.84)	0.62 ± 1.17(-2.18-3.09)
Weight, z-score	-0.22± 1.75(-3.86-1.04	0.57 ± 0.75(-0.92-1.93)
BMI, z-score	-0.14 ± 2.32 (-2.98-2.61)	0.20 ± 0.65 (-1.14-1.56)
LCI	6.5 ± 0.50 (5.6-7.29)	6.36 ± 0.64 (5.03-8.32)

Table 1: Participant demographics and baseline LCI. Values presented as mean ± SD (range). There were ***no significant differences*** between children with and without NMD.

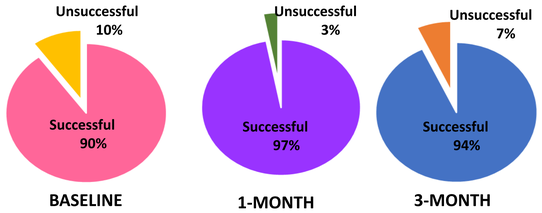


Figure 2: LCI testing was feasible in children as young as 6 years, with successful MBW tests achieved in 63 (90%) out of 70 children at the first visit. Feasibility improved to 97% at the subsequent 1-month visit, and 94% at the 3-month visit.

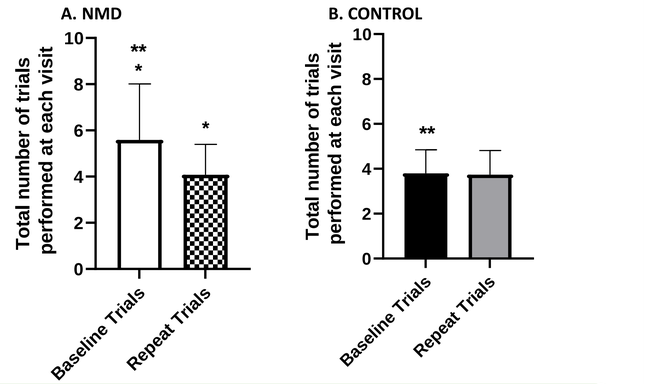


Figure 3: Number of MBW Trials taken by each participant on two separate occasions in NMD (A) and control (B) group. The average (±SD) for baseline trials was 5.6±2.4 in NMD participants and 3.8±1.0 in control participants. The average (±SD) for repeat trials in NMD participants was 4.0 ± 1.3 and 3.7 ± 1.0 in control participants. There was a significant difference ($p<0.05$) in number of trials at Baseline compared to Repeat trials in NMD participants. There was a significant difference ($p<0.05$) in number of Baseline Trials between children with and without NMD.

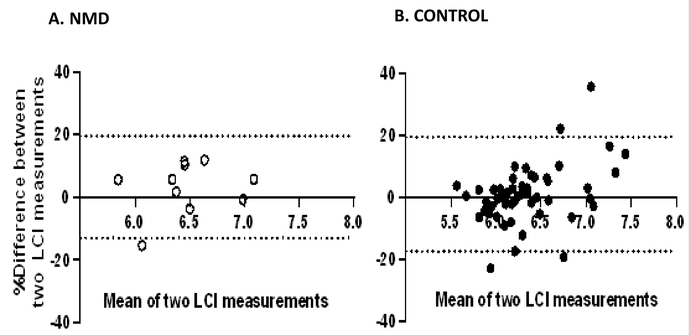


Figure 4: Inter-test reproducibility of LCI between occasions is similar. Bland-Altman plots of %difference in LCI measured on two separate occasions in NMD (A) and control (B) group. Dashed lines show 95% limits of agreement.
The average (± SD) difference in LCI between visits was -0.94±9.31 or ~10% in NMD participants, and -2.73±7.04 or ~9.7% in control participants.

CONCLUSION

- LCI testing is ***feasible in children as young as 6 years*** with NMD.
- Children with NMD required more trials than control to achieve an acceptable MBW test at the Baseline visit.
- However, at their repeat MBW test the number of trials to achieve a successful test was similar between the NMD and control groups.
- Preliminary analysis shows the ***reproducibility of LCI between occasions separated by 1-3 months is similar*** in children with and without NMD.
- Future directions include exploring relationships between MBW outcomes and the onset of nocturnal hypoventilation, as a marker of changing lung function and disease progression.

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Healthy lungs for every child, for life
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… and special thanks to all our research families!