ACOUSTIC NASAL THERAPY AND LONGITUDINAL CHANGES IN NASAL AIRFLOW AND SYMPTOM BURDEN IN ALLERGIC RHINITIS AND CHRONIC RHINOSINUSITIS

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BACKGROUND AND RATIONALE

Allergic rhinitis (AR) and chronic rhinosinusitis (CRS) are prevalent upper-airway disorders characterised by nasal obstruction, impaired sleep, reduced productivity, and diminished quality of life.

- Standard pharmacotherapy does not provide complete or sustained relief for all patients.
- Acoustic and vibration-based nasal therapies are emerging non-pharmacological adjuncts.
- Longitudinal evidence integrating objective airflow and validated patient-reported outcomes remains limited.

AIM AND HYPOTHESIS

Aim: To evaluate longitudinal changes in peak nasal inspiratory flow (PNIF) and Sino-Nasal Outcome Test-22 (SNOT-22) scores during treatment and after discontinuation.

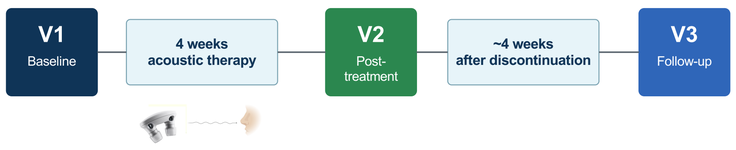
Hypothesis: Four weeks of acoustic therapy would improve objective nasal airflow and reduce sinonasal symptom burden.

INTERVENTION

Goodair® Nosebuds positioned in the anterior nares during therapy. The device delivers 130 Hz acoustic stimulation during nasal inhalation.

STUDY DESIGN

Prospective single-arm quasi-experimental longitudinal study; each participant served as their own control.



Assessments at each visit: PNIF, SNOT-22 and structured participant feedback.

METHODS

Participants: Adults aged 18-80 years with clinician-confirmed or symptom-consistent AR and/or CRS (n = 30).

Intervention: Goodair® Nosebuds; bilateral intranasal 130 Hz acoustic stimulation synchronised with nasal inhalation, 10 minutes twice daily for 28 days.

PNIF: Mean of three maximal inspiratory manoeuvres using a VMedical PNIF meter.

SNOT-22: Validated 22-item patient-reported outcome (0-110; higher scores indicate greater burden).

Responder definition: Minimum clinically important difference (MCID) = ≥9-point reduction from baseline.

Statistical analysis: Linear mixed-effects models with visit as fixed effect and participant as random intercept; estimated marginal means with Holm-adjusted pairwise comparisons.

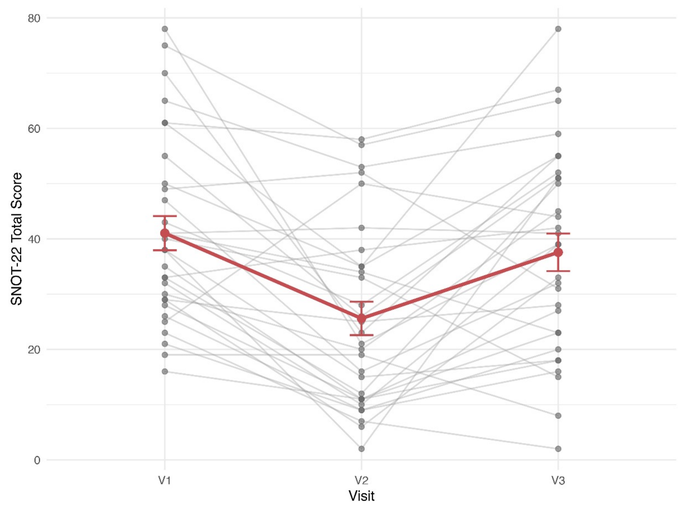
COHORT AND DEVICE EXPERIENCE

30 participants	**57%** AR	**23%** CRS
20% AR/CRS	**60%** female	**47%** aged 30-44

- 70% reported daily device use; 27% reported use on most days.
- 70% reported using the device for approximately 10 minutes twice daily.
- 60% described the device as somewhat or very comfortable.
- 57% reported no side effects; reported effects were otherwise rare or occasional.

PRIMARY OUTCOME: SNOT-22

Individual SNOT-22 trajectories across baseline (V1), post-treatment (V2) and follow-up (V3)



Grey lines represent individual participants; red line represents the group mean with uncertainty.

Linear mixed-effects model: Holm-adjusted pairwise comparisons

V2 - V1	-15.43 points	**p < 0.0001**
V3 - V2	+11.97 points	**p = 0.0003**
V3 - V1	−3.47 points	**p = 0.242**

66.7% achieved MCID at V2

33.3% retained MCID at V3

Patient-reported improvement

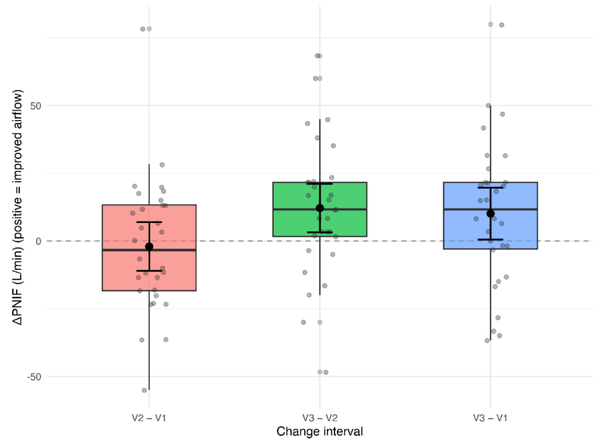
91% reported at least slight improvement at V2.

Perceived improvement aligned with SNOT-22 change (Spearman ρ = -0.55, p = 0.001).

Interpretation: symptom improvement was clinically meaningful during active use but substantially attenuated after discontinuation.

OBJECTIVE OUTCOME: PNIF

Within-participant change in peak nasal inspiratory flow across study intervals.



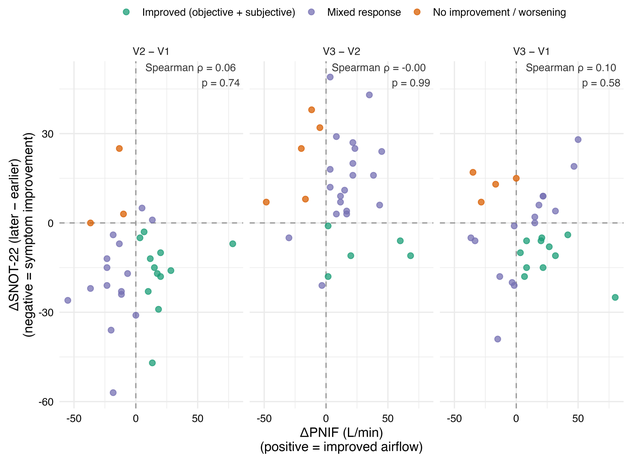
Positive values indicate improved airflow. Boxes show interquartile range; points show individual participants.

Holm-adjusted pairwise comparisons

V2 - V1	-2.0 L/min	**p = 0.67**
V3 - V2	+12.2 L/min	**p = 0.036**
V3 - V1	+10.1 L/min	**p = 0.069**

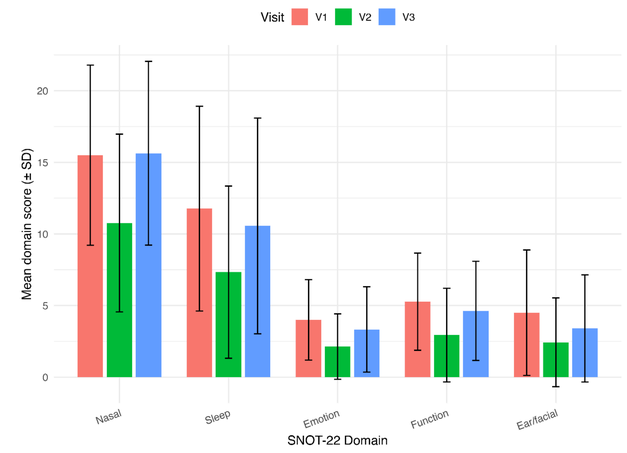
No significant immediate post-treatment improvement was observed. The V2–V3 increase occurred after device withdrawal, and baseline-to-follow-up change was not significant after multiplicity correction.

CONCORDANCE BETWEEN OBJECTIVE AND SUBJECTIVE OUTCOMES



PNIF and SNOT-22 changes were weakly correlated across all intervals (all p > 0.05), indicating that perceived symptom relief and maximal inspiratory airflow captured different aspects of response.

SNOT-22 DOMAIN ANALYSIS



All five domains improved from V1 to V2; no domain remained significantly different from baseline at V3.

V1 → V2 change (linear mixed-effects model)

Nasal	-4.73 points	**p = 0.0013**
Sleep	-2.33 points	**p = 0.0010**
Emotion	-4.43 points	**p = 0.0007**
Function	-4.73 points	**p = 0.0013**
Ear/facial	-1.87 points	**p = 0.0004**

ADDITIONAL FINDINGS

- Visit × diagnosis interactions were not significant for PNIF or SNOT-22; subgroup estimates were imprecise because of the small heterogeneous cohort.
- Medication use was not significantly associated with PNIF change or MCID responder status.
- Frequency and duration of self-reported use were not associated with SNOT-22 change.
- The inverse association between reported duration and PNIF change was exploratory and should not be interpreted as a causal dose-response relationship.

CLINICAL INTERPRETATION

- The magnitude of SNOT-22 improvement exceeded the accepted MCID and was broad across nasal, sleep, functional, emotional and ear/facial domains.
- The divergence between PNIF and SNOT-22 is consistent with the known distinction between maximal airflow and perceived nasal patency.
- The return toward baseline after discontinuation suggests that benefit may depend on ongoing use rather than durable disease modification.

LIMITATIONS

- No sham control; expectancy and placebo effects cannot be excluded.
- Small sample and mixed AR/CRS phenotypes limited subgroup inference.
- PNIF was effort-dependent and not standardised for time of day or nasal cycle phase.
- Adherence was self-reported rather than electronically monitored.

BROADER STUDY CONTEXT

These airflow and wellbeing findings form part of a broader acoustic nasal therapy study that is also evaluating nasal microbiota and circulating cytokine changes. Integrating clinical, physiological, microbial and immunological outcomes may help identify mechanisms and responder phenotypes.

CONCLUSIONS

1. Four weeks of acoustic nasal therapy was associated with a large and clinically meaningful reduction in SNOT-22 during active use.

2. Symptom benefit attenuated after discontinuation: MCID response declined from 66.7% at V2 to 33.3% at V3.

3. PNIF changes were modest, heterogeneous and did not consistently align with patient-reported improvement.

4. The device was feasible and generally well tolerated, supporting further controlled evaluation rather than definitive efficacy claims.

FUTURE DIRECTIONS

- Randomised, double-blind, sham-controlled design.
- Objective adherence monitoring.
- Time-standardised acute and longitudinal airflow measurements.
- Rhinomanometry, acoustic rhinometry, nasal nitric oxide and mucosal temperature.
- Integrated microbiota and cytokine endpoints.

SELECTED REFERENCES

1. Fokkens, W. J., Lund, V. J., Hopkins, C., Hellings, P. W., Kern, R., Reitsma, S., Toppila-Salmi, S., Bernal-Sprekelsen, M., Mullol, J., Alobid, I., Terezinha Anselmo-Lima, W., Bachert, C., Baroody, F., Von Buchwald, C., Cervin, A., Cohen, N., Constantinidis, J., De Gabory, L., Desrosiers, M., … Zwetsloot, C. P. (2020). European Position Paper on Rhinosinusitis and Nasal Polyps 2020. *Rhinology Journal*, *0*(0), 1–464. https://doi.org/10.4193/Rhin20.600

2. Hopkins, C., Gillett, S., Slack, R., Lund, V. J., & Browne, J. P. (2009). Psychometric validity of the 22-item Sinonasal Outcome Test. *Clinical Otolaryngology*, *34*(5), 447–454. https://doi.org/10.1111/j.1749-4486.2009.01995.x

3. Soler, Z. M., Nguyen, S. A., Salvador, C., Lackland, T., Desiato, V. M., Storck, K., & Schlosser, R. J. (2020). A novel device combining acoustic vibration with oscillating expiratory pressure for the treatment of nasal congestion. International Forum of Allergy & Rhinology, 10(5), 610–618. https://doi.org/10.1002/alr.22537

4. Luong, A. U., Yong, M., Hwang, P. H., Lin, B. Y., Gopi, P., Mohan, V., Ma, Y., Johnson, J., Yen, D. M., DeMera, R. S., & Bleier, B. S. (2024). Acoustic resonance therapy is safe and effective for the treatment of nasal congestion in rhinitis: A randomized sham-controlled trial. International Forum of Allergy & Rhinology, 14(5), 919–927. https://doi.org/10.1002/alr.23284

5. Bartley, J., & Hankin, R. (2024). A nasal airflow oscillation device targeting nasal congestion: A preliminary report. *European Archives of Oto-Rhino-Laryngology*, *281*(5), 2743–2747. Scopus. https://doi.org/10.1007/s00405-024-08576-2

Ethics: HDEC 2025 EXP 22987 • ANZCTR: ACTRN12624001309572p • Contact: jude.alao@aut.ac.nz

Competing interests: DW is Chief Scientific Officer and shareholder of My Better Breathing Ltd (Goodair). All other authors declare no competing interests.