

Dietary fiber-based oral nanovaccine promotes gut-nose trafficking of regulatory cells and drives antigen-specific tolerance to relieve airway allergy

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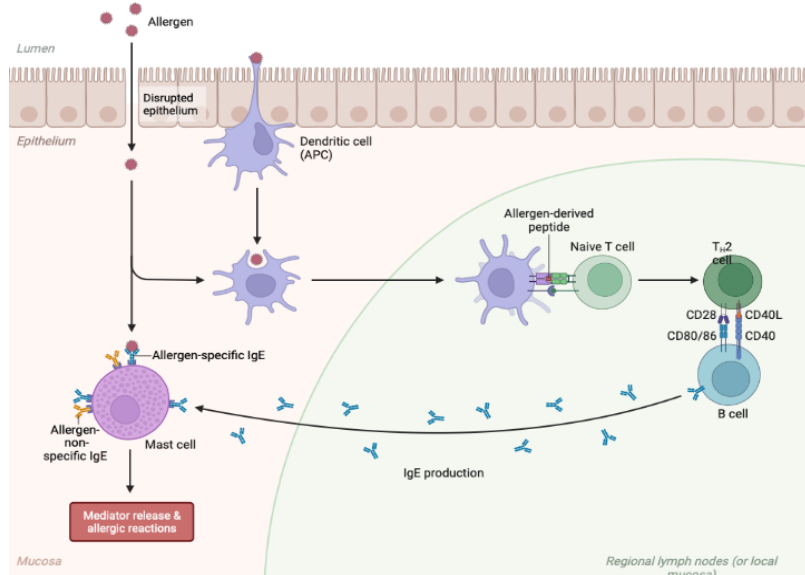


Current Therapeutic Strategies for Allergic Rhinitis

Contributing factors

- Accelerated urbanization
- Changes in dietary patterns
- Environmental exposures
- Microbiota dysbiosis

Pathogenesis



S Galli *et al.* Nature. 2008

Current Clinical Sublingual Allergen Immunotherapy (SLIT)



Pollen or house dust mite allergen extract drops, administered in combination with antihistamines.

The allergen extract is available in five concentration grades for the initiation and maintenance phases of desensitization therapy:

Grade 1: 1 µg/mL

Grade 2: 10 µg/mL

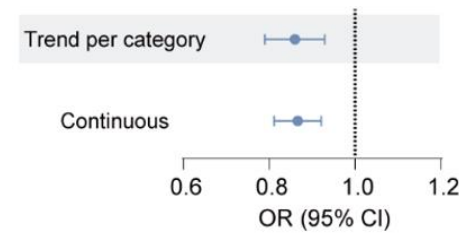
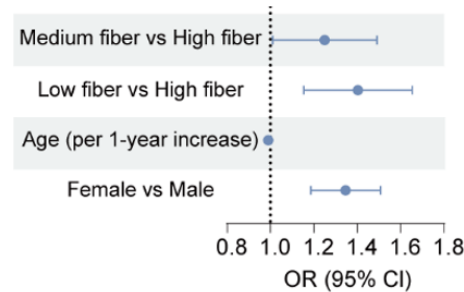
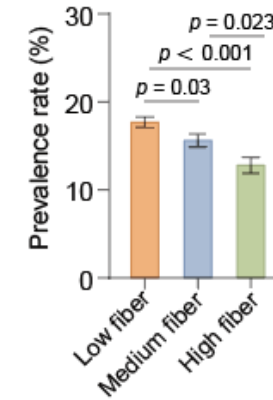
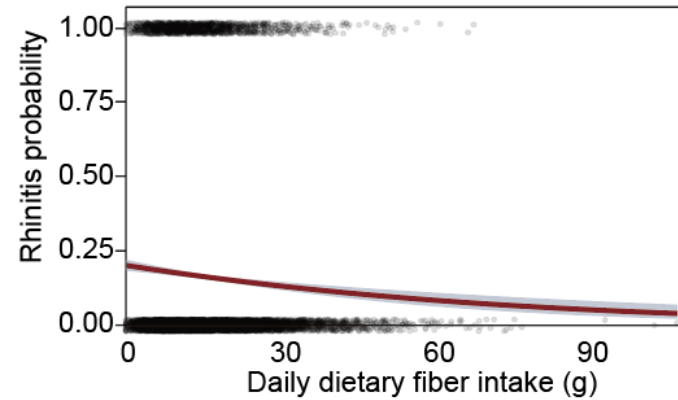
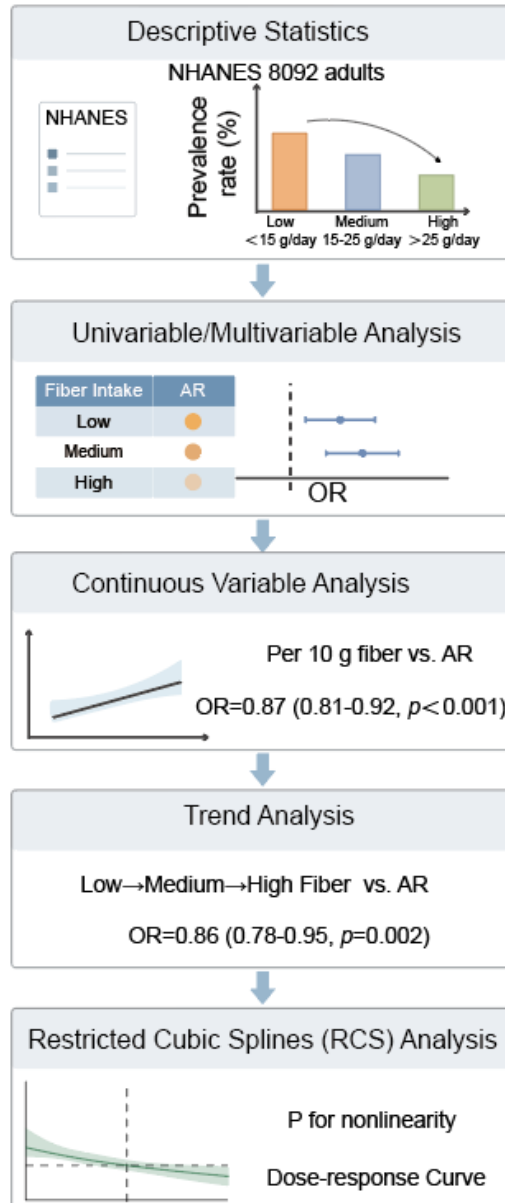
Grade 3: 100 µg/mL

Grade 4: 333 µg/mL

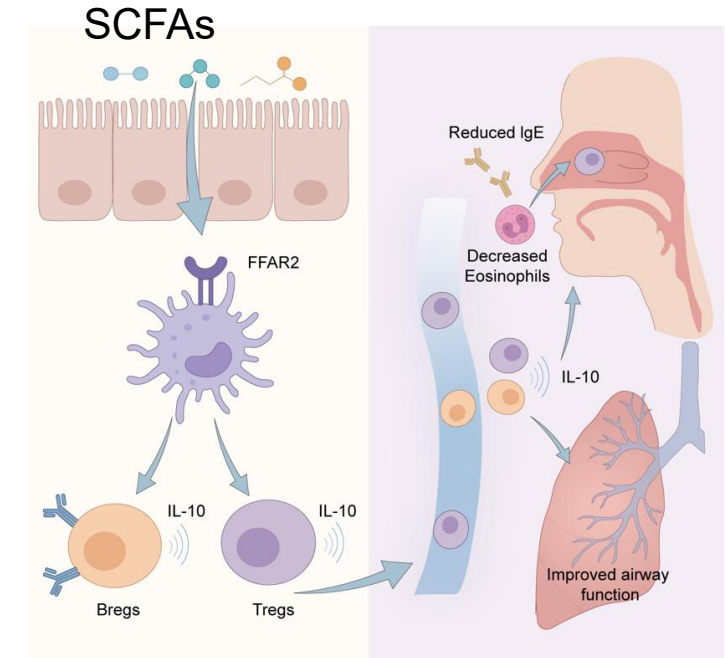
Grade 5: 1000 µg/mL



Association Between Dietary Fiber Intake and Allergic Rhinitis



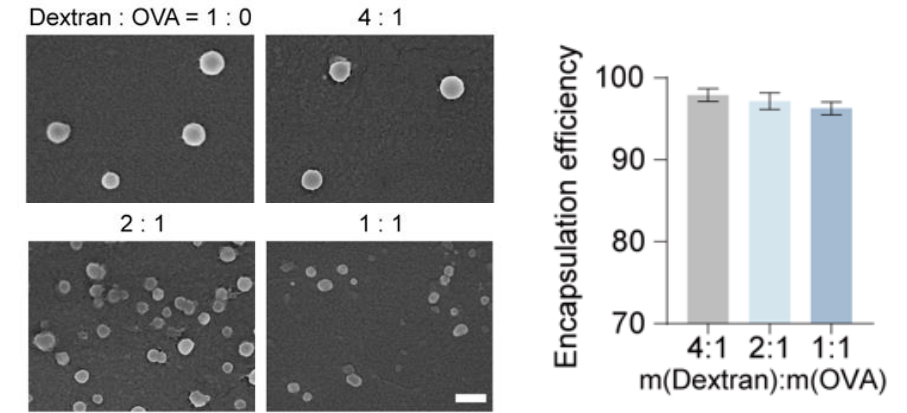
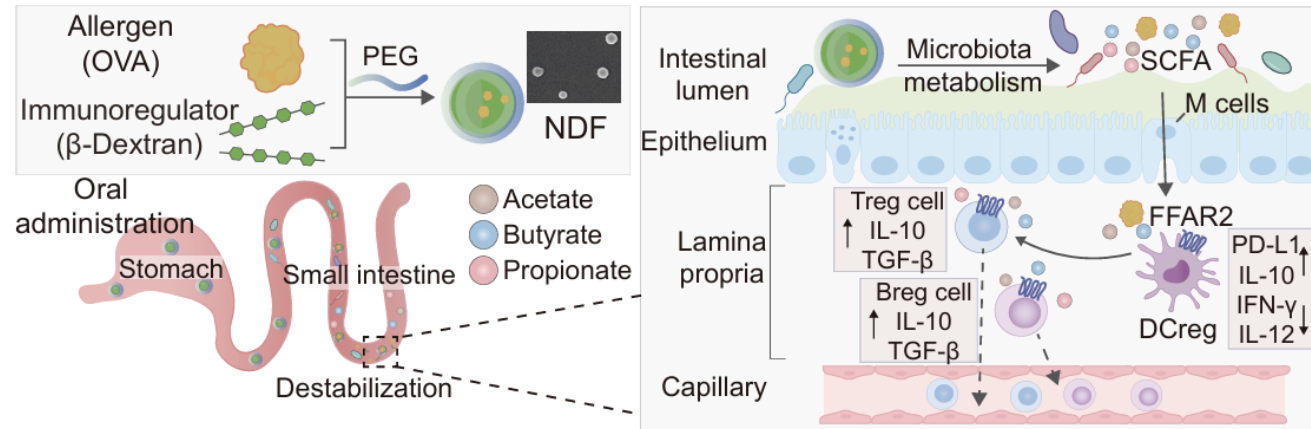
The Gut–Nose Immune Axis



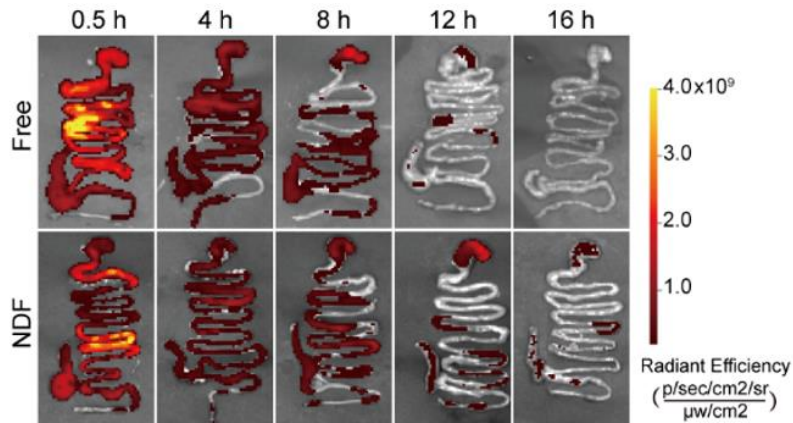
Data from the U.S. National Health and Nutrition Examination Survey (NHANES)

The prevalence of allergic rhinitis is significantly lower among individuals with high dietary fiber intake than among those with low or moderate dietary fiber intake.

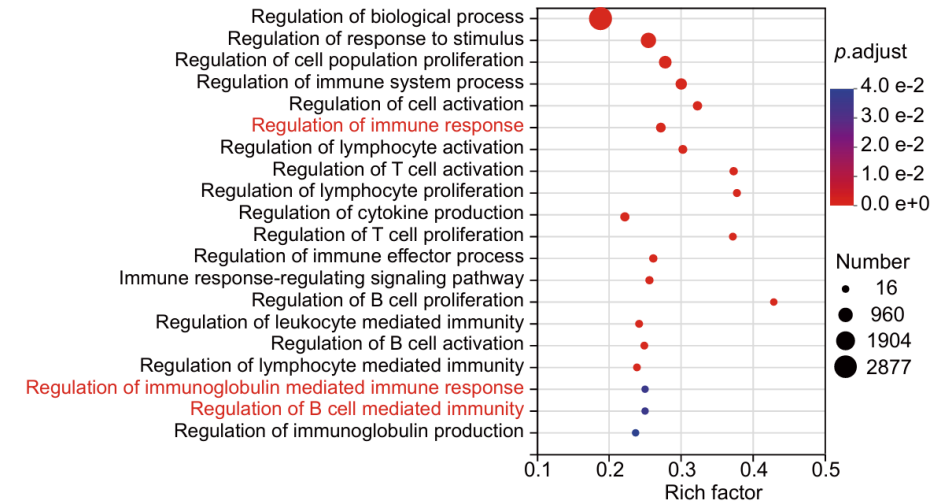
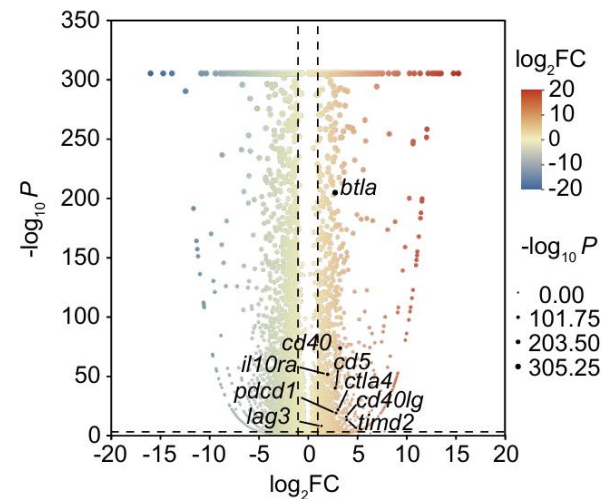
Design and immunomodulatory characterization of NDF



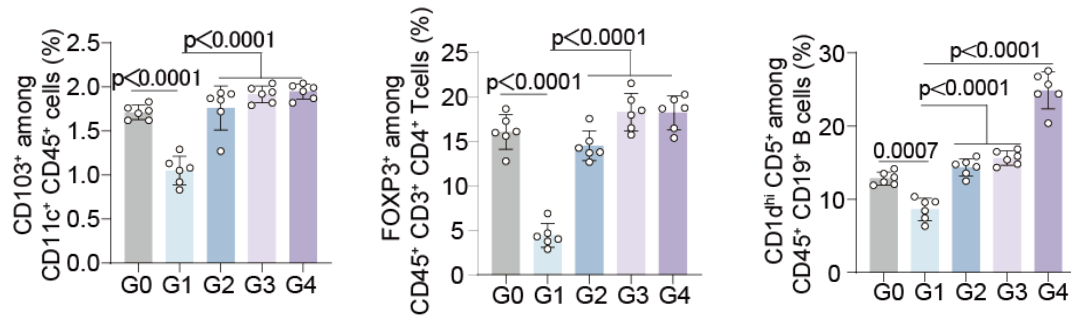
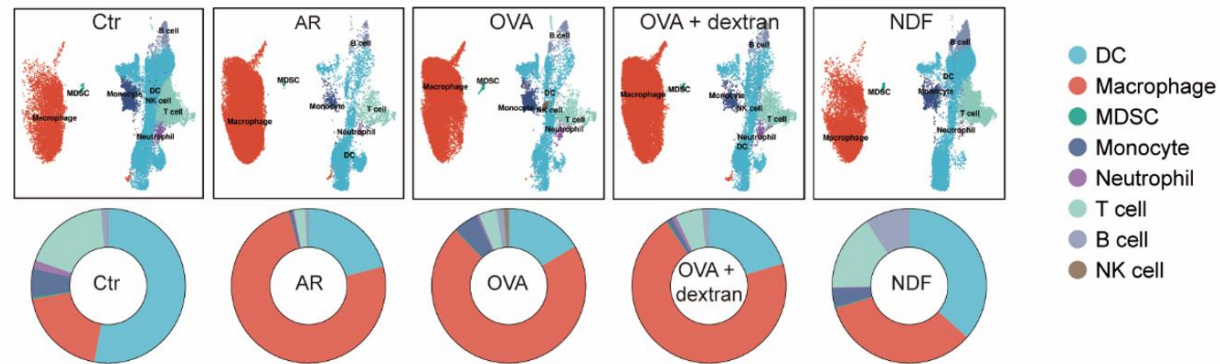
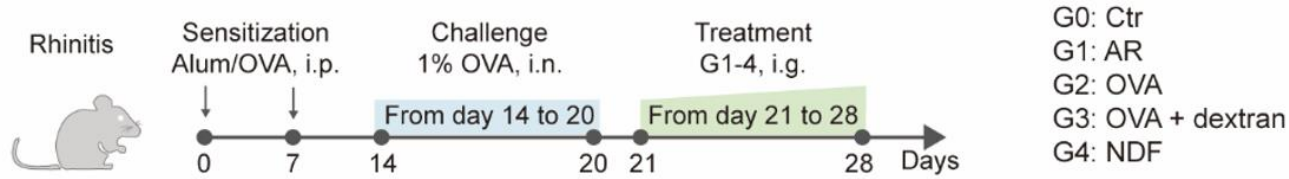
Dextran-based nanocarriers enhance intestinal retention of NDF



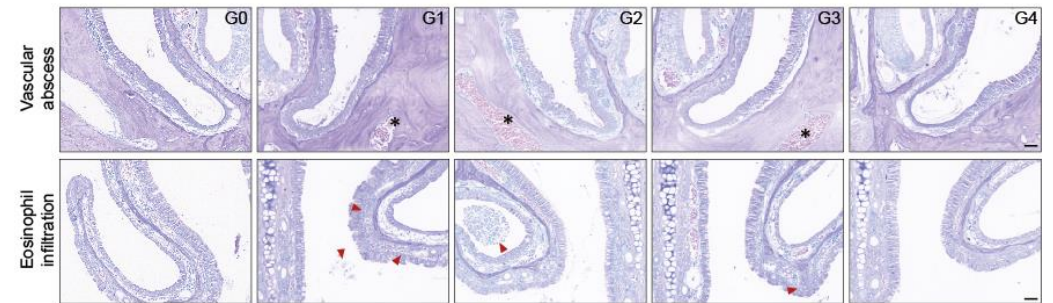
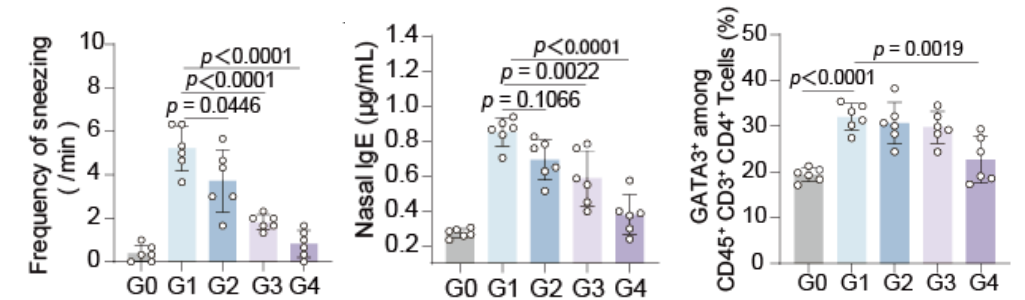
NDF upregulates immunoregulatory gene expression in the intestine



Therapeutic efficacy of NDF in allergic rhinitis



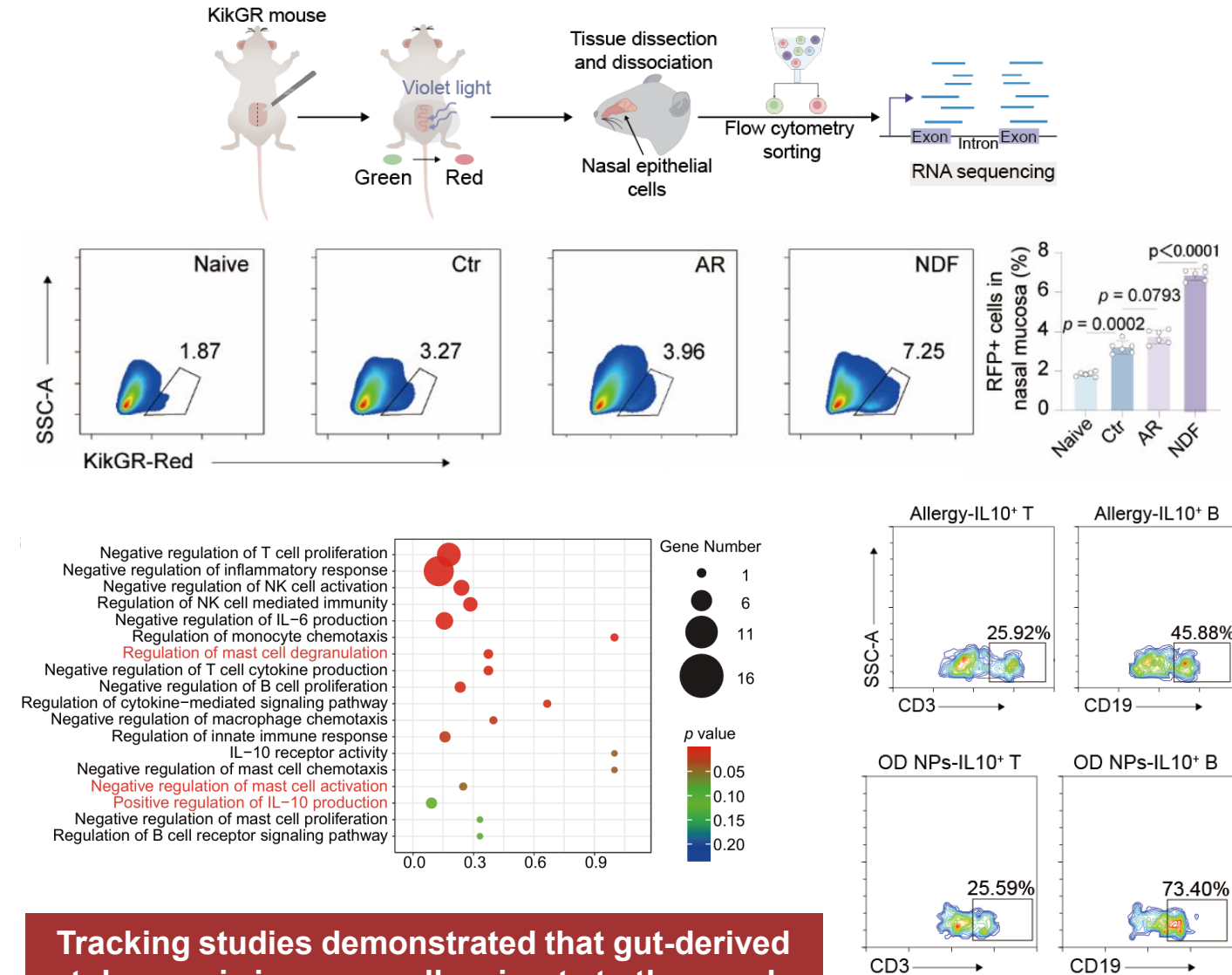
NDF restores intestinal immune homeostasis



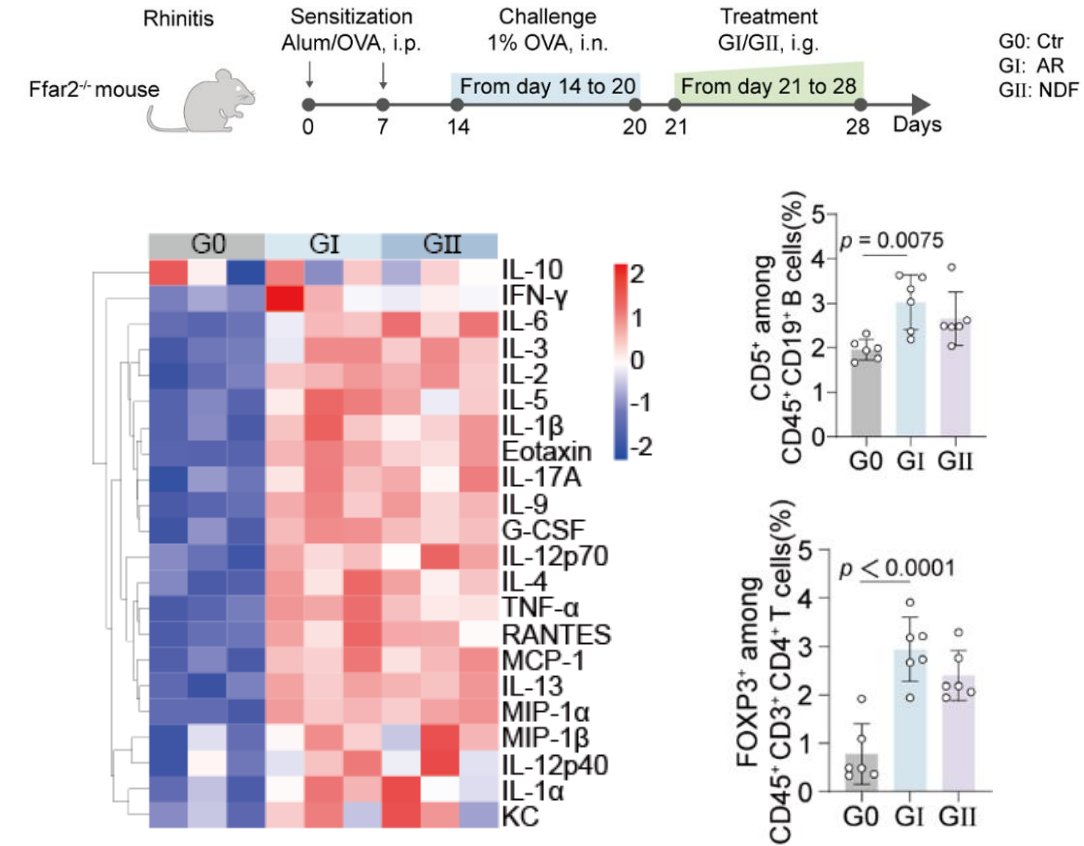
NDF attenuates allergic responses and alleviates mucosal injury during repeated allergen challenge

These findings demonstrate that induction of intestinal immune tolerance effectively confers protection against nasal allergic inflammation

Mechanistic Investigation of NDF-Mediated Regulation



Tracking studies demonstrated that gut-derived tolerogenic immune cells migrate to the nasal mucosa, where they suppress local inflammation.



Microbiota-derived SCFAs maintain intestinal immune tolerance through FFAR2-dependent signaling, which is essential for immune regulation and inflammatory suppression.



Summary

❑ **An Oral Tolerogenic Vaccine Enables Co-delivery to the Intestine**

We developed a dextran nanoparticle–based oral vaccine that co-delivers allergens and prebiotics to the gut. Coordinated antigen release together with sustained SCFA production promotes the expansion of regulatory lymphocytes.

❑ **Elucidating the Gut–Nose Axis in Mucosal Immune Tolerance**

IL-10-producing regulatory lymphocytes induced in the gut home to the nasal mucosa, where they suppress local allergic inflammation, providing mechanistic evidence for long-range mucosal immune tolerance via the gut–nose axis.

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