Nutritional Immunology: Summary Guide

The Science of How Diet Impacts Immune Function

1. Core Principles of Nutritional Immunology

Examines how nutrients modulate immune responses through:

- Immune cell proliferation and differentiation
- Cytokine production regulation
- Gut-immune axis interactions
- Epigenetic modifications of immune genes

Key immune-modulating systems:

- Gut-associated lymphoid tissue (GALT)
- Mucosal immunity
- Systemic inflammatory pathways

2. Critical Nutrients for Immune Function

2.1. Macronutrients

- **Proteins:**
  - Essential for antibody production
  - Critical amino acids: glutamine, arginine
- **Fats:**
  - Omega-3s (EPA/DHA) reduce pro-inflammatory cytokines
  - Medium-chain triglycerides (MCTs) support gut immunity

2.2. Micronutrients

- **Vitamin D:** Regulates T-cell responses
- **Zinc:** Crucial for lymphocyte development
- **Selenium:** Enhances NK cell activity
- **Vitamin A:** Maintains mucosal barriers

2.3. Phytonutrients

- Curcumin (anti-IL-6)
- Quercetin (mast cell stabilizer)
- Sulforaphane (Nrf2 activator)

3. Diet Patterns for Immune Regulation

3.1. Anti-Inflammatory Diets

- Mediterranean diet (polyphenol-rich)
- Low-FODMAP (for gut-immune disorders)
- Ketogenic diet (modulates NLRP3 inflammasome)

3.2. Autoimmune Protocols

- Elimination of molecular mimics (e.g., gluten in celiac)
- Nightshade avoidance (for lectin sensitivity)
- Dairy restriction (for casein intolerance)

4. Gut-Immune Axis Interventions

4.1. Microbiome Modulation

- **Prebiotics:** Resistant starch, inulin
- **Probiotics:** Specific strains for immune conditions:
  - *L. rhamnosus GG* (Th1 balance)
  - *B. infantis* (anti-TNF-α)

4.2. Barrier Repair Protocols

- L-glutamine supplementation
- Colostrum/Lactoferrin for tight junctions
- Polyphenols for mucus layer support

5. Clinical Applications

5.1. Condition-Specific Protocols

- **Rheumatoid Arthritis:**
  - Omega-3 >3g/day + vitamin D
  - Nightshade elimination trial
- **IBD (Crohn's/UC):**
  - Exclusive enteral nutrition (EEN) phases
  - Specific carbohydrate diet (SCD) modifications
- **Multiple Sclerosis:**
  - High-dose biotin protocol
  - Swank diet principles

5.2. Preventive Immunology

- Vaccination response optimization
- Immunosenescence delay strategies
- Food allergy prevention

6. Monitoring & Biomarkers

6.1. Laboratory Assessment

- hs-CRP (inflammation)
- IgA/IgG food antibodies
- Vitamin D (25-OH) serum levels
- Microbiome sequencing

6.2. Functional Tests

- Intestinal permeability (lactulose/mannitol)
- Lymphocyte proliferation assays
- Cytokine panels (Th1/Th2/Th17)

7. Emerging Research Areas

- Fasting-mimicking diets for immune reset
- Hyperimmune eggs for passive immunity
- Exosome-based nutrient delivery
- Personalized nutrition via immune phenotyping

8. Implementation Guidelines

8.1. Dietary Prescription

- **Phase 1 (4-6 weeks):** Elimination/anti-inflammatory
- **Phase 2:** Targeted reintroduction with immune monitoring
- **Phase 3:** Maintenance with cyclic ketogenic or Mediterranean

8.2. Supplement Protocols

- **Acute support:**
  - Vitamin C (time-released)
  - Beta-glucans
- **Chronic support:**
  - Low-dose naltrexone (LDN) adjunct
  - Medicinal mushrooms (Coriolus, Reishi)

9. Contraindications & Cautions

- Over-immunosuppression risk in elderly
- Nutrient-drug interactions (e.g., vitamin K with warfarin)
- Heavy metal contamination in marine-sourced nutrients