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Regulatory mechanisms of high-polyphenol dietary intervention on exercise-induced immunosuppression during high-intensity training periods in adolescent athletes

Submission date 15/05/2026	**Recruitment status** No longer recruiting	[_] Prospectively registered [_] Protocol
Registration date 19/05/2026	**Overall study status** Completed	[_] Statistical analysis plan [_] Results
Last Edited 18/05/2026	**Condition category** Other	[_] Individual participant data [X] Record updated in last year

Plain English summary of protocol

Background and study aims
This study will test whether a daily high-polyphenol supplement can help protect adolescent athletes from temporary weakening of the immune system during periods of high-intensity training. The main goal is to determine whether the supplement helps maintain immune balance and reduce training-related immune suppression during heavy training.

Who can participate?
Healthy adolescent athletes aged 15–17 years

What does the study involve?
Participants will be randomly assigned to receive either the polyphenol supplement or a placebo for 12 weeks. The study team will compare changes in immune function, inflammation, salivary immune markers, gut microbiome, metabolism, and upper respiratory tract infection occurrence at baseline and during follow-up at weeks 4, 8, and 12.

What are the possible benefits and risks of participating?
Benefits and risks not provided at time of registration

Where is the study run from?
Jiangxi University of Science and Techonology, China.

When is the study starting and how long is it expected to run for?
September 2024 to May 2025.

Who is funding the study?
Chizhou University, China.

Who is the main contact?
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Study information

Scientific Title
Regulatory mechanisms of high-polyphenol dietary intervention on exercise-induced immunosuppression during high-intensity training periods in adolescent athletes: a systems biology analysis based on immune-metabolic pathways

Study objectives
The purpose of this study is to evaluate whether a 12-week high-polyphenol dietary intervention can prevent or attenuate exercise-induced immunosuppression in adolescent athletes undergoing high-intensity training. The study aims to determine whether supplementation helps maintain immune homeostasis, reduce inflammatory and mucosal immune disturbances, modulate gut microbiota and short-chain fatty acid production, and identify potential immune-metabolic biomarkers associated with individual responses to the intervention.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 15/01/2024, Ethics Committee of Chizhou University (No. 199, Muzhilu Road, Guichi District, Chizhou City, Anhui Province, 247000, Korea, South; -; ma056789024@163.com), ref: cz20240733

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Placebo

Assignment
Crossover

Purpose
Basic science, Prevention

Study type(s)

Health condition(s) or problem(s) studied
Exercise-induced immunosuppression in adolescent athletes during periods of high-intensity training, particularly immune homeostasis disruption, reduced mucosal immune protection, inflammatory and oxidative stress responses, altered T-cell balance, gut microbiome changes, and increased susceptibility to upper respiratory tract infections.

Interventions
Participants were randomly allocated in a 1:1 ratio to either the high-polyphenol dietary intervention group or the placebo group. Randomisation was stratified by sex, sport discipline, and baseline immune function. The random allocation sequence was generated using a computer-based randomisation program by an independent researcher who was not involved in participant recruitment, intervention delivery, outcome assessment, or data analysis. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes. Participants, coaches, investigators, laboratory staff, and outcome assessors were blinded to group allocation throughout the trial.

The intervention group received a high-polyphenol dietary supplement containing 1200 mg/day in total: quercetin 300 mg/day, EGCG 400 mg/day, resveratrol 200 mg/day, and curcumin 300 mg /day. The supplement was administered as two 600 mg doses per day, taken at approximately 07: 00 and 19:00 with meals, during the 12-week high-intensity training period. Participants were instructed to take the supplement with at least 10 g of dietary fat and to avoid calcium-rich foods, iron supplements, and polyphenol-rich beverages within two hours of administration.

The placebo group received matched placebo capsules containing microcrystalline cellulose, identical in appearance, packaging, and administration schedule to the active supplement. Compliance was monitored using electronic medication event monitoring systems, bi-weekly pill counts, and urinary polyphenol metabolite assessment at weeks 4, 8, and 12.
The intervention was delivered during a 12-week periodized high-intensity training programme, including a preparatory phase, competition/peak-load phase, and recovery phase. Training load was monitored using session rating of perceived exertion multiplied by training duration, and heart-rate-based training impulse.

Blood samples were collected at the following timepoints:
Baseline/week 0: before the intervention
Week 4: end of the preparatory phase
Week 8: end of the peak-load competition phase
Week 12: end of the recovery phase / longitudinal follow-up
To reduce the influence of acute exercise responses, biological samples were collected 36–48 hours after the last training session of each phase, following an overnight fast of at least 10 hours. All sample collection procedures were performed between 06:00 and 08:00.

Intervention Type
Supplement

Primary outcome(s)

1. CD4+/CD8+ T-cell ratio measured using flow cytometric immunophenotyping of EDTA-anticoagulated peripheral blood samples at baseline, week 4, week 8, and week 12. The primary comparison is the change in CD4+/CD8+ T-cell ratio from baseline to week 8.

Key secondary outcome(s)
1. Peripheral blood T-cell subsets, including CD4+ T cells, CD8+ T cells, regulatory T cells, and Th17 cells measured using flow cytometric immunophenotyping at baseline, week 4, week 8, and week 12

2. Peripheral blood natural killer cell count and percentage measured using flow cytometric immunophenotyping at baseline, week 4, week 8, and week 12

3. Salivary IgA measured using laboratory assays at baseline, week 4, week 8, and week 12

4. Inflammatory and immune-related biomarkers in blood samples measured using laboratory assays at baseline, week 4, week 8, and week 12

5. Metabolomic, proteomic, transcriptomic, and microbiome-related markers in blood, urine, and /or fecal samples measured using omics platforms at baseline, week 4, week 8, and week 12, as applicable to each platform

6. Upper respiratory tract infection incidence measured using data recorded during the 12-week intervention period, and collected at one time point

Completion date
15/05/2025

Eligibility

Key inclusion criteria
Adolescent athletes aged 15–17 years who met all of the following criteria:
1. At least 3 years of systematic training experience
2. Participation in provincial-level competition within the previous 12 months
3. Weekly training volume of ≥10 hours
4. Tanner stage III–V pubertal development

Healthy volunteers allowed
Yes

Age group
Child

Lower age limit
15 Years

Upper age limit
17 Years

Sex
All

Total final enrolment
75

Key exclusion criteria
1. An acute infection within the previous 4 weeks
2. Chronic inflammatory or autoimmune disease
3. Regular medication or supplement use that could affect immune function
4. A history of overtraining syndrome
5. A musculoskeletal injury that prevented normal training

Date of first enrolment
15/09/2024

Date of final enrolment
15/12/2024

Locations

Countries of recruitment
China

Sponsor information

Organisation
Chizhou University

ROR
https://ror.org/007cx7r28

Funder(s)

Funder type

Funder Name
Chizhou University

Alternative Name(s)
, CZU

Funding Body Type
Private sector organisation

Funding Body Subtype
Universities (academic only)

Location
China

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available