



Faculty of Physical Education and Sport Sciences

Dept. of Exercise Physiology

Module code: 8718118

Module name: Exercise Immunology

Module Pre-requisite: -----

Module Coordinator/s: Prof. Vahid Sari-Sarraf

Assessment due date: Depends on University program

Credit: 2/ 32 h

After studying this chapters, students should be able to appreciate:

Week 1:

1. The influence of exercise on infection risk

- appreciate the different agents that cause common infections;
- appraise the J-shaped model of upper respiratory tract infection risk and exercise volume;
- appreciate the strengths and limitations of the methods used to measure the incidence of infection;
- evaluate the evidence concerning the effect of single bouts of prolonged exercise and intensive endurance training on infection risk; appreciate the influence of airway inflammation on symptoms of respiratory infection;
- evaluate the evidence concerning the effect of regular moderate exercise on infection risk compared with a sedentary lifestyle;
- appreciate other factors that influence symptoms of infection.

Week 2,3:

2. The human immune system

- describe the main components of the immune system and their functions;
- distinguish between innate and acquired (adaptive) immunity;
- explain the basis of how the body recognises and responds to non-self material;
- describe the components and actions of humoral and cell-mediated immune mechanisms;
- appreciate some of the factors that affect immune function;

- describe the principle of enzyme-linked immunosorbent assay (ELISA) methods to measure the concentration of specific soluble proteins in body fluids.

Week 4:

3. The effects of exercise on blood leukocyte numbers

- describe the effects of a single bout of exercise on the total number of leukocytes and their subsets in peripheral blood;
- understand the mechanisms by which discrete leukocyte subsets are selectively deployed into the blood and tissues in response to a single bout of exercise;
- explain some of the factors known to affect the leukocyte response to acute exercise including training status, intensity and duration of the exercise bout, fitness level, age, nutritional status and infection history;
- describe the effects of exercise training on the total number of leukocytes and the composition of leukocyte subtypes in resting blood.

Week 5:

4. Effects of exercise on innate immune function

- describe the effect of acute exercise on neutrophil functions, including chemotaxis, phagocytosis, degranulation, oxidative burst and microbicidal capacity;
- describe the effect of acute exercise on monocyte and macrophage innate immune functions including phagocytosis, oxidative burst, Toll-like receptor expression;
- describe the effect of acute exercise on natural killer cell cytolytic activity;
- understand the mechanisms of innate immune system modulation by acute exercise;
- discuss the impact of exercise intensity, duration and fitness of subjects on the innate immune response to exercise;
- identify the effect of exercise training on innate immune cell functions;
- appreciate the *in vitro* methods used to measure innate immune cell functions.

Week 6:

5. Effects of exercise on acquired immune function

- understand how acute exercise affects T cell functions, including cytokine production, proliferation and migration;
- understand how acute exercise affects B cell antibody production;
- appreciate the mechanisms of acquired immune system modulation by exercise;
- recognise the influence of exercise intensity, duration and fitness level on the acquired immune response to exercise;
- identify the effect of exercise training on acquired immune cell functions;
- appreciate the *in vivo* methods used to measure immune function.

Week 7:

6. Effects of exercise on mucosal immunity

- understand the basic structure and effector mechanisms of immunoglobulin;
- identify the different antimicrobial proteins present in saliva;
- understand the effect of acute exercise and exercise training on levels of secretory immunoglobulins and other antimicrobial proteins;
- appreciate the potential mechanisms of mucosal immune system modulation by exercise;

- understand the relationship between levels of saliva secretory IgA and risk of upper respiratory tract infection.

Week 8: Laboratory Work

Week 9: Assessment

Week 10:

7. Effect of extreme environments on immune responses to exercise

- describe research evidence from studies examining the effects of environmental extremes (e.g. heat, cold, high altitude, air pollution and spaceflight) on the immune response to exercise.
- demonstrate an understanding of the possible mechanisms by which environmental extremes have been hypothesised to alter the immune response to exercise.
- provide a case both for and against a possible role for immune dysregulation in exertional heat illness aetiology.
- critically discuss whether the commonly held belief that cold exposure increases the incidence of the common cold is credible and, if so, whether cold-induced depression of the immune function is responsible.
- demonstrate an understanding of the effects of high altitude on the incidence of infection and immune function.
- describe the effect of air pollution on immune function during exercise.
- describe the effect of space travel on infection and immune function.
- demonstrate an understanding of the strengths and weaknesses of laboratory and field studies investigating the effects of environmental extremes on the incidence of infection and immune function.

Week 11:

8. Exercise, nutrition and immune function

- summarise the effects of chronic exercise training on immune function;
- describe changes in innate, mucosal and acquired immune function that occur in response to short periods of intensified training in athletes;
- discuss associations between impaired immune function in athletes and increased incidence of infectious illness;
- describe the effects of overtraining syndrome on immune function and susceptibility to infection;
- discuss possible immune markers of impending overtraining.

Week 12:

9. Exercise, nutrition and immune function

- describe the mechanisms by which nutrient availability may alter the immune response to heavy exercise and training;
- describe how poor dietary practices during training and competition may be involved in the etiology of exercise-induced immune depression;
- provide examples of research findings from studies investigating the effects of macronutrient and micronutrient availability on the immune response to heavy exercise and training;
- critically evaluate the evidence that diet and nutritional supplements can modify immune responses and reduce infection incidence, severity and duration during heavy training and competition.

Week 13:

10. Practical guidelines on minimising infection risk in athletes

- describe the value of monitoring the immune system status of athletes;
- describe some practical guidelines for minimising the risk of developing immunodepression in athletes;
- describe some practical guidelines for minimising exposure to pathogens and reducing the risk of infection in athletes;
- describe some practical guidelines on vaccination and medicines for the travelling athlete;
- describe some practical guidelines about training when suffering from infection and recovery from infection.

Week 14:

11. Allergy in sport

- describe the allergic response to inhalant allergens such as grass, dust house mites;
- explain the classification of allergens;
- discuss the potential impact of exercise on T-helper cell polarisation and the allergic response;
- describe the clinical tests which are used to identify sensitisation to allergens;
- understand effective management recommendations for the treatment of allergy in athletes;
- understand the rare condition of exercise-induced anaphylaxis.

Week 15:

12. Exercise and the prevention of chronic diseases: the role of cytokines and the anti-inflammatory effects of exercise

- describe the effects of exercise on plasma cytokines;
- discuss the evidence that interleukin(IL)-6 is secreted from contracting muscle;
- describe the metabolic and immunoregulatory roles of IL-6;
- describe the effects of exercise on cytokine production by leukocytes;
- understand the link between chronic disease risk and chronic inflammation;
- describe the effects of a sedentary lifestyle and obesity on inflammation in adipose tissue;
- describe the long-term health benefits of performing regular exercise;
- discuss the anti-inflammatory actions of IL-6 and IL-10;
- appreciate other mechanisms by which exercise can exert anti-inflammatory effects.

Week 16:

13. Exercise, infection risk, immune function and inflammation in special populations

- understand the differences in immunity and immune response to exercise between males and females;
- recognise the importance of the relationship between exercise, immune function and infection risk in populations who may be immune-compromised;
- identify the effects of moderate intensity training programmes on immunity and risk of upper respiratory tract infection (URTI) in older people;
- understand the current view of the relationship between acute and regular exercise and the effect on disease progression in people with human immunodeficiency virus (HIV);
- appreciate the relationship between exercise, immune function and inflammation in individuals with chronic conditions such as diabetes, chronic kidney disease, certain cancers and spinal cord injury;
- appreciate the potential clinical applications of exercise immunology and key future directions in exercise immunology.

Week 17: **Final Exam**

Note: Compensatory sessions will be held virtually by prior appointment.

Teaching and Learning Methods: Lectures, community based learning, practical classes (role play)

Assessment Details

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Presentation	Role Play		15%	TBC
Fieldwork	Laboratory works, Journal Search		5%	7, each week
Final Exam			80%	17

Note: To pass this module overall-a pass must be obtained in both the service learning component and the end of semester exam.

Reference:

1. Gleeson, M. Bishop, N. and Walsh, N. (2014): Exercise Immunology. Routledge.

Recommended Reading List:

Note: This is for reference only. It is NOT necessary to buy these references. Many are available in the faculty library. A list of websites you might find useful is also included.

Souza, D.; Vale, A.F.; Silva, A.; Araújo, M.A.S.; de Paula Júnior, C.A.; de Lira, C.A.B.; Ramirez-Campillo, R.; Martins, W.; Gentil, P. Acute and Chronic Effects of Interval Training on the Immune System: A Systematic Review with Meta-Analysis. *Biology* **2021**, *10*, 868. <https://doi.org/10.3390/biology10090868>

Kamarauskas P, Conte D. Changes in salivary markers during basketball long-term and short-term training periods: a systematic review. *Biol Sport*. 2022;39(3):673–693.

Ruiz-Iglesias, P.; Gorgori-González, A.; Massot-Cladera, M.; Castell, M.; Pérez-Cano, F.J. Does Flavonoid Consumption Improve Exercise Performance? Is It Related to Changes in the Immune System and Inflammatory Biomarkers? A Systematic Review of Clinical Studies since 2005. *Nutrients* **2021**, *13*, 1132. <https://doi.org/10.3390/nu13041132>

J. Xiao (ed.), *Physical Exercise for Human Health*, Advances in Experimental Medicine and Biology 1228, https://doi.org/10.1007/978-981-15-1792-1_27

Główka, N. et al. Immunological Outcomes of Bovine Colostrum Supplementation in Trained and Physically Active People: A Systematic Review and Meta-Analysis. *Nutrients* 2020, *12*, 1023; doi:10.3390/nu12041023

Kartaram, S.W.; Teunis, M.; van Norren, K.; Smits, M.; M'Rabet, L.; Verschuren, M.C.M.; Mohrmann, K.; Garsen, J.; Witkamp, R.; Pieters, R. Markers for Immunological Resilience:

Effects of Moderate- and High-Intensity Endurance Exercise on the Kinetic Response of Leukocyte Subsets. *Immuno* **2024**, 4, 43–56. <https://doi.org/10.3390/immuno4010003>

Du, F and Wu, C. Review on the Effect of Exercise Training on Immune Function. *BioMed Research International* Volume 2022, Article ID 9933387, 6 pages
<https://doi.org/10.1155/2022/9933387>

Allsopp GL, Addinsall AB, Stephenson G et al. The acute leukocyte and cytokine response of older adults to resistance exercise in normobaric hypoxia. *Biol Sport*. 2023;40(2):425–438.

Rumpf,C. The Effect of Acute Physical Exercise on NK-Cell Cytolytic Activity: A Systematic Review and Meta-Analysis. *Sports Medicine* (2021) 51:519–530 <https://doi.org/10.1007/s40279-020-01402-9>

Sari-Sarraf V, Reilly T, Doran DA, Atkinson G. The effects of single and repeated bouts of soccer-specific exercise on salivary IgA. *Arch Oral Biol*. 2007 Jun; 52(6):526-32. doi: 10.1016/j.archoralbio.2006.11.016.

Balogh, L.; Szabó, K.; Pucsok, J.M.; Jámbor, I.; Gyetvai, Á.; Mile, M.; Barna, L.; Szodoray, P.; Tarr, T.; Csiki, Z.; et al. The Effect of Aerobic Exercise and Low-Impact Pilates Workout on the Adaptive Immune System. *J. Clin. Med.* **2022**, 11, 6814. <https://doi.org/10.3390/jcm11226814>

Forte, P.; Branquinho, L.; Ferraz, R. The Relationships between Physical Activity, Exercise, and Sport on the Immune System. *Int. J. Environ. Res. Public Health* **2022**, 19, 6777.
<https://doi.org/10.3390/ijerph19116777>