

**COURSE DATA****Data Subject**

|                      |   |
|----------------------|---|
| <b>Code</b>          | 34500                                     |
| <b>Name</b>          | Physiology of physical exercise and sport |
| <b>Cycle</b>         | Grade                                     |
| <b>ECTS Credits</b>  | 4.5                                       |
| <b>Academic year</b> | 2023 - 2024                               |

**Study (s)**

| <b>Degree</b>             | <b>Center</b>                      | <b>Acad. year</b> | <b>Period</b> |
|---------------------------|------------------------------------|-------------------|---------------|
| 1204 - Degree in Medicine | Faculty of Medicine and Odontology | 3                 | Second term   |

**Subject-matter**

| <b>Degree</b>             | <b>Subject-matter</b>  | <b>Character</b> |
|---------------------------|------------------------|------------------|
| 1204 - Degree in Medicine | 18 - Optional subjects | Optional         |

**Coordination**

| <b>Name</b>              | <b>Department</b> |
|--------------------------|-------------------|
| GOMEZ CABRERA, M. CARMEN | 190 - Physiology  |

**SUMMARY**

Exercise and Sport Physiology is the science which studies the functioning of organs and systems that define the human body during exercise, from the molecular and cellular level to the full level of the person, the interrelation between them and the external environment, as well as the regulatory mechanisms and functional integration that make possible the relation of physical exercise. It also covers the study of both structural and functional changes that chronic exercise, or exercise, causes.

**PREVIOUS KNOWLEDGE****Relationship to other subjects of the same degree**

There are no specified enrollment restrictions with other subjects of the curriculum.



## Other requirements

## OUTCOMES

### 1204 - Degree in Medicine

- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Understand and recognise the structure and normal function of the human body, at the following levels: molecular, tissue, organic, and of systems, in each phase of human life and in both sexes.
- Proper organisation and planning of the workload and timing in professional activities.
- Team-working skills and engaging with other people in the same line of work or different.
- Criticism and self-criticism skills.
- Capacity for communicating with professional circles from other domains.
- Acknowledge diversity and multiculturality.
- Consideration of ethics as a fundamental value in the professional practise.
- Working capacity to function in an international context.

## LEARNING OUTCOMES

At the end of this subject, the students should have:

- Acquired the necessary skills to prescribe exercise in different populations.
- Acquired the skills for the development of functional assessment test.
- Known to make sport training programs applied to various pathologies and population sectors.

## DESCRIPTION OF CONTENTS

### 0. THEORY



### **1. Introduction to exercise and sport physiology.**

Concept of Physiology. Division of Physiology. Short history of Physiology. Teaching plan: program of theoretical, practical and seminar lessons. Assessment of students. General concepts of physical activity, exercise and sport. Classification of exercise.

### **2. Anthropometry. Body composition. Somatotype.**

Introduction. Compartments of the human organism. Composition of the human body. Changes in body composition of the human body. Main techniques to determinate body composition. Calculation of body density, fat weight, bone weight, muscle weight, residual weight and lean weight. Ideal weight and desirable weight. Concept of Somatotype. Concept of endomorphy, ectomorphy and mesomorphy. Calculate of endomorphy, ectomorphy and mesomorphy Somatochart. Reference anthropometric values of spanish centres.

### **3. Skeletal muscle fibres.**

Physiological characteristics of each one of them. Plasticity of skeletal muscle fibres. Muscle fatigue: concept, classification. Causes of muscle fatigue. Types of muscle contractions. Muscular circulation: its regulation. Muscle strength: factors which modify it. Muscle hypertrophy and hyperplasia: effects of training on muscle, hormonal effects on muscle fibres, effects of diet on muscle, effects of detraining. Muscle regeneration. Fatigue: types and causes of muscle fatigue. Overtraining.

### **4. Hormonal adaptations and responses to exercise.**

CNS influences on hormone secretion and changes produced by exercise. Sympatho-adrenal response on exercise. Hormones: generalities. Factors affecting the physiological actions of hormones during exercise. Physiological effects, variations in plasma concentrations produced by exercise and training in hormones of particular interest: antidiuretic hormone (ADH), insulin and glucagon, catecholamine, growth hormone, steroid hormone, erythropoietin and endorphins.

### **5. Hematological adaptations and responses to exercise and sport.**

Introduction. Plasma modifications: plasma volume, ionic concentrations, osmolarity, hormonal concentration, enzyme concentration. Erythrocyte modifications. Blood changes. Blood volume, hematocrit, blood viscosity. Hemostasis modifications: platelet aggregation, blood coagulation and fibrinolysis. Immune system modifications.



## **6. Respiratory adaptations and responses to exercise and sport.**

Introduction. Biological significance. Respiratory responses to exercise, mechanisms of respiratory adaptation: stimuli, changes in respiratory rate, in tidal volume, in dead space, in pulmonary ventilation, in ventilator effort. Change of composition of alveolar air during exercise: variation of the partial pressures of the gases, variation in the alveolar-blood diffusion. Change of gas exchange in tissues: debt and deficit of O<sub>2</sub>, variations in the transport of CO<sub>2</sub>, factors that modify it. Oxygen consumption and maximum oxygen consumption: concepts, values, measurement methods and factors that modify them. Regulation of pulmonary ventilation during exercise.

## **7. Cardiovascular adaptations and responses to exercise and sport (I)**

Introduction. Main responsible factors of cardiovascular responses to exercise, duration and intensity of the response. Modification of heart rate during exercise. Maximum heart rate. Change of stroke volume during exercise. Modification of cardiac output during exercise. Adaptation produced by resistance training. Summary of changes and cardiac adaptations induced by exercise and training.

## **8. Regulation of fluid and electrolyte metabolism during exercise.**

Regulation of fluid balance. Loss of fluid and electrolytes during exercise. Location. Amount. Fluid balance during exercise. Osmotic balance and movement of fluids between the extracellular and intracellular spaces during exercise. Dehydration and athletic performance. Seawater intake. Replacement of fluids and electrolytes during exercise.

## **9. Regulation of acid-base balance during exercise.**

Causes of alterations in acid-base balance during exercise. Production of hydrogen ions during exercise. Lactic acid and acidosis. Acid-base balance during exercise. Buffer capacity and its modification by training.

## **10. Regulation of body temperature during exercise.**

Causes of changes in thermal balance during exercise. Abnormalities of thermoregulation during exercise. Heat balance during exercise. Temperature measurement during exercise. Thermal changes during exercise. Exercise in warm environments. Heat acclimation. Acclimation loss. Exercise in cold environments. Cold acclimation.

## **11. Interaction of energy systems during exercise.**

Tissue interactions during exercise. Timing of utilization of substrate and energy channels. Muscle utilization of substrates during: moderate, heavy and strenuous exercise. Production and utilization of lactate at rest and during exercise: effects of lactate accumulation.



## **12. Human energy expenditure during exercise.**

General concepts of bioenergetics. Cellular metabolism and energy metabolism. Respiratory quotients: carbohydrates, lipids and proteins, factors affecting the respiratory quotient. Energy balance. Basal metabolism: concept, measurement methods, normal values, ways of expressing it, factors which modify it. Energy expenditure during physical activity: concept, measurement methods, values in different physical activities, factors which modify it. Energy expenditure during physical activity. Classification of physical activity by energy expenditure. Calculation of daily energy expenditure by: heart rate / VO<sub>2</sub> link, occupational tables. Energy expenditure in professional athletes. Energy expenditure during practicing football, basketball, walking, jogging, running and swimming.

## **13. Functional assessment**

General concepts and principles. Utility. Methodological bases: characteristics of functional assessment. Basic methods for functional assessment: clinical-exercise history: assessment of apparatus and systems, assessment of functions: metabolic, respiratory, cardiovascular, march and sensitivity. Assessment of aerobic and anaerobic power and capacity. Valuation of qualities or physical abilities: assessment of power and energy capacities. Methods for functional assessment of the athlete.

## **14. Exercise in children.**

Physiological characteristics of the child. Growth and maturation of the athlete. Development of muscle strength during childhood. Development of anaerobic power and local muscular endurance. Cardiorespiratory and metabolic responses to exercise. Detecting sports talents.

## **15. Exercise in the elderly**

The aging process. Physiological changes by aging. Exercise in the elderly.

## **16. Molecular biology: a new vision for the physiology of exercise.**

The human genome. Protein synthesis. New horizons in molecular biology. Research on human performance

## **17. Clinical exercise physiology for cardiovascular and pulmonary rehabilitation and cancer.**

Clinical applications of the exercise physiology to different diseases and disorders. Prescription of physical activity.



**18. PRACTICES****LABORATORY PRACTICAL**

1. Heart rate submaximal, maximum and reserve.
2. Evaluation of respiratory changes during exercise.
3. Laboratory tests to assess fitness (VO<sub>2</sub>max).
4. Field tests to assess fitness.
5. Preparation of diets for athletes.

**SEMINARS**

1. Training schedule to normal subjects.
2. Benefits and disadvantages of exercise and sport.
3. Molecular Biology applied to sport.
4. Ergogenic aids and doping in exercise.
5. Satellite cell as stem cell. Future prospects.
6. Physical exercise in special populations (children, elderly, pregnant women, etc.).
7. Clinical application of exercise physiology: cardiac rehabilitation, pulmonary disease, renal pathology, diseases and disorders cognitive and emotional.
8. The exercise acts like a drug. Pharmacological benefits of physical exercise.
9. Physical exercise and oxidative stress.

**WORKLOAD**

| ACTIVITY                             | Hours         | % To be attended |
|--------------------------------------|---------------|------------------|
| Theory classes                       | 19,00         | 100              |
| Laboratory practices                 | 12,00         | 100              |
| Seminars                             | 10,00         | 100              |
| Tutorials                            | 4,00          | 100              |
| Development of group work            | 11,00         | 0                |
| Development of individual work       | 15,00         | 0                |
| Study and independent work           | 28,50         | 0                |
| Readings supplementary material      | 5,00          | 0                |
| Preparation of evaluation activities | 7,00          | 0                |
| Resolution of online questionnaires  | 1,00          | 0                |
| <b>TOTAL</b>                         | <b>112,50</b> |                  |



## TEACHING METHODOLOGY

-**Theoretical lessons.** The masterclass will last for 1 hour in which Professor will expose the lesson. The maximum participation of students by asking questions will be promoted during the development of the class.

-**Practices in laboratory classes.** Practices will be held in small groups. Each session will last for 2 hours. After a brief theoretical statement, by the teacher, which will explain the rationale for the practice, students will develop it by groups. Practical classes are conducted in the laboratory of Physiology of the exercise in the Department of Physiology.

-Practical **seminars** classes. The students will be divided into small groups and assigned a topic related to the subject, which must work and exhibit in class. Seminar topics will be selected from the list proposed in Chapter 6 of this guide.

The gender perspective and the sustainable development goals (SDGs) will be incorporated into teaching, whenever possible.

## EVALUATION

**Theoretical assessment: 60% of the final mark.** It will be made by a written test about the contents of the theoretical program and which aim is to assess the acquisition of the knowledge. The content of the test will be the same to each groups of the same subject. The test will be made by 40 multiple-choice with four answer options. 1 of the successful is subtracted for each 3 questions answered incorrectly.

**Practical assessment: 40% of the final mark.** It will be made by the assessment of the participation on the different activities and by a test which assesses the acquisition of the knowledge related to the general and specific competences.

To pass the subject you must pass each of its parts: theory and practice.

In order to access to an advance on the call of this subject, it is a requirement that the student has coursed all his/her practices.

Attendance to practical sessions is mandatory. Unjustified non-attendance to more than 20% of the sessions will make it impossible to pass the course.

Students are reminded of the importance of carrying out evaluation surveys on all the teaching staff of the degree subjects.

## REFERENCES



### Basic

- López-Chicharro J, Fernández-Vaquero A (2022). Fisiología del Ejercicio. 4ª ed. Panamericana.
- McArdle WD, Katch FI, Katch VL (2015). Fisiología del Ejercicio. Nutrición, rendimiento y salud. 8ª edición. Wolters Kluwer.
- Recursos-e Salut: ClínicaKey Student. Elsevier (Scopus, ScienceDirect).  
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### Additional

- Guyton AC, Hall JE (2021). Tratado de Fisiología Médica. 14ª ed. Madrid. Ed. Elsevier.
- Segura Cardona R (1987). Prácticas de Fisiología. 1ª ed. Barcelona. Ediciones científicas y técnicas, Masson-Salvat.
- Fox SI (2022). Fisiología Humana. 15ª ed. Madrid. Ed. McGraw-Hill Interamericana de España S.A.U.