Master of Science in Exercise Physiology

Programme code: MSPORT
Webpage: www.ntnu.edu/studies/msport

This programme description is valid for students admitted in the academic year 2016/2017.

Introduction

The Master of Science in Exercise Physiology is a research and thesis-based integrated programme of study at the Faculty of Medicine. It is exclusively concerned with basic research training and comprises compulsory courses together with specialization courses dependent upon the research interest of students.

The MSc programme is associated with the Exercise research group at the Department of Circulation and Medical Imaging. One of the main research interests of this group is to examine basic mechanisms behind central and peripheral limitations to the supply and demand of oxygen transport, and to identify training responses. The group is also involved in examining the mechanisms behind muscular and neural limitations to strength and coordination, the prescription of effective endurance and strength training, and the effects on top sports performance.

Another aspect is based upon the fact that the fastest developing diseases within the population, such as obesity, atherosclerosis, diabetes II, osteoporosis and chronic obstructive pulmonary disease, are related to inactivity. Furthermore, physical activity is a key determinant of energy expenditure, and is thus fundamental to energy balance and weight control. The MSc programme aims to identify effective exercise programs for large populations as well as specific patients and risk groups in order to develop effective tools for prevention, treatment, and rehabilitation, and to provide detailed exercise training recommendations that will improve overall health. Effective new training interventions based on basic biological adaptations have positive effects and are effective treatments with high socioeconomic as well as quality of life outcomes.

Physiology has not just delivered huge advances in understanding, diagnosing, and treating human disease, but it is also the cornerstone of what is currently the major biomedical research push – translation research. Physiological research remains the essential links between genes and clinical care. Enormous amounts of new knowledge are barrelling down the information highway, but they are not arriving at the doorstep of our patients. The MSc programme is meant to play a role in ensuring the future of the discipline and, as a result, in translating basic discoveries into clinical care. Translational research just cannot be accomplished without physiology.

Scientific research on physical activity, sports and health has touches on biological (dose-response relations between physical activity and health) and psycho-social questions (how to change physical activity behaviour). The role of physical activity in health promotion during the next decades is evidently crucial.

Learning Outcome

The graduated student should be able to:

- demonstrate a solid knowledge about Exercise Physiology, good experimental and theoretical skills, and competence to obtain and critically appraise own and already published experimental and theoretical data and to pursue a career in Exercise Physiology;

- show advanced knowledge in Exercise Physiology reaching from the molecular to whole body level, and have practical skills relevant for the field;
- have knowledge of relevant methodologies and techniques including both historical as well as more recent techniques;
- describe how physical activity and exercise influence the heart, arteries and skeletal muscles in our bodies, both for health and performance;
- identify and describe the limitations for the energy delivery and utilization, as well as the muscular and neural limitations for strength and coordination;
- understand and describe the beneficial effects of physical activity for successful aging and disease prevention, and prescribe effective training programs for treatment and rehabilitation;
- understand basic concepts and principles of statistical analysis, and to perform and interpret results from simple statistical analyses;
- have practical skills in how to apply their academic learning in a project work, and develop teamwork skills by learning from their own experience in collaborating on a joint project in an interdisciplinary team;
- recognize and validate problems; formulate and test hypotheses;
- evaluate and formulate a theoretical concept. Evaluation includes originality, independence and applicability;
- apply and adopt experimental methods to gain new knowledge within Exercise Physiology, and have practical skills relevant to perform the tests;
- carry out and present an experiment that can be developed to quality of an international peer-reviewed paper;
- present, evaluate and discuss scientific results in English (orally and in writing);
- reflect on the existence of ethical aspects, sound experimental approaches and scientific thinking;
- collect relevant background information about topics within Exercise Physiology;
- have knowledge about mainstream concepts of Exercise Physiology, advantages/limitations of its applications, history, traditions and the position in the society;
- apply his/her knowledge and capabilities to analyze and carry out complex experiments in not-familiar domains;
- prove capability to apply his/her knowledge to new domains within Exercise Physiology; has skills and knowledge to search for relevant data on his/her own scientific question, and can critically assess published data within the theoretical framework chosen for a particular project;
- summarize, document, report, and reflect on own findings;
- know how to participate in discussions, put forward his/her results both in a constellation of peers as well as for lay-people;
- prove capabilities to contribute to the generation of new idea/concepts/technical approaches to experimental research questions.

Target Groups and Admission Requirements

Candidates should hold a bachelor’s degree (or 3-year equivalent), preferably within biochemistry, biology, exercise physiology/sport sciences, movement science, nursing, occupational therapy, physiotherapy, or similar fields. A firm foundation in human biology is required. The minimum average grade required is the Norwegian "C".

International applicants need to submit proof of English proficiency (TOEFL, IELTS, APIEL or University of Cambridge test). More details about the language requirements are available at www.ntnu.edu/studies/langcourses/languagerequirements

Applicants who are not citizens of the European Union (EU) or the European Economic Area (EEA) need to provide a financial guarantee to get a residence permit in Norway.

Teaching Methods, Learning Activities and Student Social Activities

In 2010 the new Hearth and Lung Centre opened at Øya campus in Trondheim. In this building students get to work in high-tech laboratory environments side by side with researchers both from NTNU and St. Olav's Hospital.

The teaching includes lectures, colloquiums, problem-based learning (PBL), seminars, demonstrations, practical training, self-tuition, and independent work. During the work with the master's thesis the student will do research in our well-equipped laboratories.

SOMA is the master's students' own social student organization. SOMA has various activities during the semesters, including welcome parties and other activities for new students, excursions, courses and much more. For more information, visit SOMA's blog: http://somantnu.blogspot.com

Compulsory HSE Training

All master's students must participate in compulsory Health, Safety and Environment (HSE) training. This includes a HSE lecture and a fire protection course, both held in the first two weeks of the semester. When these activities have been completed, the student must pass an electronic test. This is to be done by 1 September 2016. If the student fails to do so, the access card to the campus/hospital buildings will be withdrawn.

Programme Structure

The master's degree is a two-year, full-time programme starting in the autumn semester. There are two main components:

- Theoretical and methodological courses (totalling 60 credits)
- Master's thesis (60 credits)

The first semester is primarily based on theory and lectures. From the second semester most attention is directed towards preparing for carrying out an experiment representing work at the forefront of the research in exercise physiology in close co-operation with the professors in the research group.

Experts in Teamwork (EiT) is compulsory for all master's degree students at NTNU, and it is taught intensively in the weeks 2, 3 and 4 in the second semester. Read more about EiT here: http://www.ntnu.edu/eit

By the end of the first semester, the student must choose a topic for the thesis. A master's thesis agreement (including a project description) is drawn up by the student and submitted to the programme board within the first academic year. More information is available at www.ntnu.edu/dmf/studies/master.

The student must have passed all theoretical and methodological courses before he/she can submit the thesis.

<table>
<tr><th colspan="2">Year 1</th><th colspan="2">Year 2</th></tr>
<tr><td>1st semester
(autumn)</td><td>2nd semester
(spring)</td><td>3rd semester
(autumn)</td><td>4th semester
(spring)</td></tr>
<tr><td>KLH3100
Introduction to Medical Statistics
(7.5 credits)</td><td>EiT
Experts in Teamwork
(7.5 credits)</td><td colspan="2" rowspan="5">SPO3900
Thesis in Exercise Physiology
(60 credits)</td></tr>
<tr><td>SPO3020
Training Circulation and Oxygen Consumption
(7.5 credits)</td><td>SPO3040
Environmental Adaptations
(7.5 credits)</td></tr>
<tr><td>SPO3030
Training Muscle and Force Production
(7.5 credits)</td><td rowspan="2">SPO3060
Specialisation in Exercise Physiology
(15 credits)</td></tr>
<tr><td>SPO3055
Research Methods in Exercise Physiology
(7.5 credits)</td></tr>
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Course Descriptions

Year 1

KLH3100	**Introduction to Medical Statistics**
Credits:	7.5
Period:	Autumn
Teaching methods:	Lectures and exercises. Approved exercises from the same or previous semesters are required to sit for the exam. Approved compulsory activities are valid for three subsequent semesters after approval.
Required previous knowledge:	The course is primarily intended for students admitted to a 2-year master's programme at the Faculty of Medicine, NTNU. Other students may be accepted after an individual evaluation.
Compulsory activitiy:	Exercise assignments
Mode of assessment:	4-hour written examination Letter grades (A-F)
Credit reductions due to overlapping courses:	HLS3550: 7.5 credits KLH3004: 7.5 credits KLMED8004: 5.0 credits MNFSIB1: 7.5 credits PH3003: 7.5 credits ST3000: 7.5 credits ST3001: 7.5 credits
Host department:	Department of Public Health and General Practice
Course coordinator:	Associate Professor Turid Follestad

Learning outcome

After completing the course KLH3100, the student should be able to

- select appropriate summary statistics and graphical displays for describing data for continuous and categorical variables in an empirical data set;
- describe and apply statistical methods for comparing a mean value or a proportion in one sample to a reference value, and for comparing mean values or proportions in two independent

or paired samples;
- describe and apply the methods of correlation and simple linear regression for identifying associations or relationships between two continuous variables, and methods for evaluating agreement in repeated measures for continuous and categorical data;
- select the appropriate statistical method for analyzing a specific research question, study design and data set;
- perform statistical analyses to an empirical data set by means of a statistical software package (SPSS);
- interpret and present the results from statistical analyses, and critically evaluate the validity of the results in light of the assumptions for the chosen method.

Academic content

- Introduction to the statistical software package SPSS.
- Descriptive statistic for continuous and categorical variables (measures of location and spread, frequency tables, graphical display), probability and probability distributions, estimation, hypothesis testing, one- and two-sample tests on mean values (Student T-test), non-parametric tests (Wilcoxon signed-rank test and Mann-Whitney U test), tests on differences in proportions (cross-table analysis; chi-square test and McNemar's test, Fisher's exact test), correlation and simple linear regression, methods for assessing agreement (Kappa coefficient, Bland-Altman plot).

SPO3020	**Training Circulation and Oxygen Consumption**
Credits:	7.5
Period:	Autumn
Teaching methods:	Lectures, laboratory work, PBL. Approved practice report and written report. Timetable: timeplan.medisin.ntnu.no/timetable_show.php
Entry requirements:	Admission to MSc in Exercise Physiology
Compulsory activities:	1. Written report 2. Approved practice report
Mode of assessment:	4-hour written examination Letter grades (A-F)
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Professor Jan Helgerud

Learning outcome

After completing the course SPO3020, the student should be able to: •

- Demonstrate in depth insight into limitations for oxygen transport and effective training regimes for improved circulation and aerobic endurance performance and have practical skills relevant for the field
- Describe biological adaptations as a result of physical activity and exercise training on the heart, arteries and skeletal muscles in our bodies both for health and performance
- Identify and describe the supply and demand limitations for the oxygen transport and utilization in athletes and patients
- Identify and prescribe effective endurance training programs, and to study their effect on top sports performance
- Understand and describe the beneficial effects of endurance training for successful aging and disease prevention, and prescribe effective training programs for treatment
- Apply and adopt experimental methods such as maximal oxygen uptake, lactate threshold and work economy and have practical skills relevant to perform the tests
- Present outcomes of research in a written report, evaluate and discuss scientific results in English Insight into limitations for oxygen transport and effective training regimes for improved circulation and aerobic endurance performance.

Academic content

Circulatory function, supply and demand limitations of oxygen to working muscle. Limitations and adaptations in patients and athletes. Training methods and their application to various limitations.

SPO3030	**Training Muscle and Force Production**
Credits:	7.5
Period:	Autumn
Teaching methods:	Lectures, laboratory work, PBL. Approved practice report and written report. The timetable is available at https://timeplan.medisin.ntnu.no/timetable_show.php
Entry requirements:	Admission to MSc in Exercise Physiology
Compulsory activities:	1. Written report 2. Approved practice report
Mode of assessment:	4-hour written examination Letter grades (A-F)
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Associate Professor Eivind Wang

Learning outcome

After completing the course SPO3030 the student is able to:

- demonstrate in depth insight into limitations for muscular force and effective training regimes for improved muscular function and coordination and have practical skills relevant for the field;
- describe biological adaptations as a result of physical activity and exercise training on the neuromuscular system in our bodies both for health and performance;
- describe muscle architecture and differences in the population;
- identify and prescribe effective strength training programs, and to study their effect on top sports performance both for neural adaptations and protein synthesis;
- understand and describe the beneficial effects of strength training for successful aging and disease prevention, and prescribe effective training programs for treatment;
- apply and adopt experimental methods such as one-repetition maximum, peak force, rate of force development and have practical skills relevant to perform the tests;
- present outcomes of research in a written report, evaluate and discuss scientific results in English Insight into limitations for muscular force and effective training regimes for improved muscular function and its effect on muscular as well as circulatory performance.

Academic content

Muscle architecture and differences in the population. Changes related to age and diseases. Limitations and functional adaptations in patients and athletes. Training methods for neural adaptations and protein synthesis. Neuromuscular basis for motor skill acquisition.

SPO3040	Environmental Adaptions
Credits:	7.5
Period:	Spring
Teaching methods:	Lectures, approved written report. The timetable is available at https://timeplan.medisin.ntnu.no/timetable_show.php
Entry requirements:	Admission to MSc in Exercise Physiology
Compulsory activity:	Written report
Mode of assessment:	4-hour written examination Letter grades (A-F)
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Professor Ulrik Wisløff

Learning outcome

After completing the course SPO3040 the student is able to:

- demonstrate in depth insight into temperature regulation at rest and during exercise at different ambient temperatures;
- describe biological processes during scuba diving and diving in space and how those processes may be regulated by both chronic and acute exercise;
- describe the physiological process of acclimatization to high altitude and understand various treatments strategies for high altitude sickness;
- describe the physiological challenges with exercise training at high altitude;
- describe nutritional requirements for human performance in various environments;
- knowing basic physiological impact from environmental stressors such as hyperoxia, hypoxia, high and low temperatures and how to cope with them in an exercise physiology setting.

Academic content

Cardiovascular and functional responses to a changed environment, such as cold environment / hypothermia,diving,high altitude and space. Acute and chronic responses and adaptation to training in various environments. Nutrition and performance in a changed environment.

SPO3055	Research Methods in Exercise Physiology
Credits:	7.5
Period:	Autumn
Teaching methods:	Lectures, laboratory work, group work and tutoring. The timetable is available at https://timeplan.medisin.ntnu.no/timetable_show.php
Entry requirements:	Admission to MSc in Exercise Physiology
Mode of assessment:	5-day home examination Letter grades (A-F)
Credit reduction due to overlapping courses :	SPO3050: 7.5 credits
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Associate Professor Trine Karlsen

Learning outcome

After completing the course SPO3055 the student is able to:

- know the nature of research - unscientific vs. scientific - ethical aspects in research;
- demonstrate in depth insight into different medical research designs (RCT, epidemiology, experimental studies);
- plan, design and apply for a research project to the Regional Ethical Committee;
- know in detail external and internal threats when designing studies as well as during the interpretations of data (reliability/validity);
- critical review of literature and presentation of studies, evaluate and discuss scientific results in English;

- practice in scientific writing and writing a review;
- requirement of scientific evidence before it can be implemented into clinical practice;
- knowledge of the main methods used in exercise sciences.

Academic content

How to perform high quality physiological and medical research.

SPO3060	**Specialisation in Exercise Physiology**
Credits:	15
Period:	Spring
Teaching methods:	Lectures, tutoring. The timetable is available at https://timeplan.medisin.ntnu.no/timetable_show.php
Entry requirements:	Admission to MSc in Exercise Physiology
Compulsory activity:	Compulsory literature: A minimum of 30 articles from peer-reviewed scientific journals.
Mode of assessment:	Report Letter grades (A-F)
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Professor Jan Helgerud

Learning outcomes

After completing the course SPO3060 the student is able to:

- demonstrate intimate knowledge of the research forefront in the area of interest for the master's thesis and have practical skills relevant for the field;
- describe biological adaptations as a result of physical activity and exercise training within the area of research planned for the thesis;
- apply and adopt experimental methods within the area of specialisations and have practical skills relevant to perform the tests;
- present outcomes of research in a review article, evaluate and discuss scientific results in English leading to a logical research question for their thesis. Intimate knowledge of the research forefront in the area of interest for the master’s thesis.

Academic content

Specialisation within the area of research planned for the thesis. Review of research literature, and writing a review article in the area of specialisation for the thesis leading to a logical research question.

Year 2

SPO3900	**Thesis in Exercise Physiology**
Credits:	60
Period:	Autumn and spring
Teaching methods:	Tutoring and laboratory work
Required previous knowledge:	Admission to the MSc in Exercise Physiology
Mode of assessment:	Thesis and oral presentation/examination. The grade given on the thesis may be adjusted after the oral exam.
Credit reduction due to overlapping courses :	SPO3901:45 credits
Host department:	Department of Circulation and Medical Imaging
Course coordinator:	Associate Professor Eivind Wang

Learning outcome

After successful defense of the thesis the student is able to:

- carry out and present an experiment that can be developed to quality of an international peer-reviewed paper;
- demonstrate in depth knowledge of the theme built upon the specialisations in SP03060 and have practical skills relevant for the field;
- apply and adopt experimental methods within the area of specialisations and have practical skills relevant to perform the tests;
- present outcomes of research in the thesis as an article with an extended introduction, evaluate and orally present and discuss the results in English;
- Carrying out and presenting av experiment that can be developed to the quality of an international peer reviewed paper.

Academic content

The thesis should be within the area of the research competence among the available supervisors. The theme has to build upon the specialisation in SPO3060, and will be subject to approval by the programme board. The thesis is to be in the format of an article in a peer-reviewed research journal with an extended introduction, and will be subject to external evaluation. The evaluation is based on the thesis and an oral examination where the student presents his/her project (ca 30 minutes) with discussion. The oral examination is used to adjust the grade of the thesis.

More information is available at www.ntnu.edu/dmf/studies/master