



Institute of Exercise and Sport Sciences

Research Strategy 2008 - 2012

Below is a short description of the research groups at the Department of Exercise and Sport Sciences. All groups have a high international reputation with an extensive collaboration within and outside of Denmark. All groups should, therefore, be strengthened with more researchers as well as economical and administrative support. The department has two main themes: "Physical activity and health" and "Optimising performance". These themes are of high international standard and cover a variety of research areas with contributions from all the research groups at the department.

Strategic research area 1: Physical activity and health

Despite widespread knowledge about the role of physical activity in prevention of disease and maintenance of health, a major part of the world's population is still physically inactive. It will be important to gain new knowledge about the physiological, psychological, sociological and cultural reasons for this in order to be able to change this behavior. The ability to perform physical activity has in an evolutionary perspective been a prerequisite for survival. In the developed world, however, physical activity is minimized since transport is motorized and physical activity at work is limited or nonexistent. Physical inactivity is a risk factor for development of a number of lifestyle diseases and physical activity is known to promote both physical and mental health, but we do not know exactly why. We need to know which molecular mechanisms are activated in the muscles when they are working, how muscles communicate with other organs and we need to know how these mechanisms can maintain the healthy body and prevent the development of lifestyle diseases through crosstalk with other organs. We also need knowledge about how diet, gender and physical activity interact in maintaining health and preventing disease. Such knowledge will help to better advise authorities and the population about the "healthy" life style, and will eventually be able to explain why some people benefit more from physical activity than others. Furthermore, molecular targets of potential importance for the pharmaceutical industry may be identified. Emphasis will also be on the health-, social- and cultural importance of physical activity in the modern welfare state, both in the local, national and international perspective. There will in the coming years also be a special focus on the role and importance of sport in the local political perspective. The increasing burden of life style diseases in the population creates a need for new knowledge about physical activity and sport opportunities for health promotion and prevention. Research that integrates knowledge about the influence of gender, age, social group, network and barriers, will provide an opportunity to develop crucial interventions in life style, both at the work place, during leisure time and everyday life.

Strategic research area 2: Optimising performance

The department has a long tradition and experience within the area of optimising performance. The area covers aspects of what causes the physiological limitations to performance in various types of exercise and how to train to effectively stimulate to adaptation leading to improvements of performance. In addition, research is carried out to elucidate how combinations of various types of training optimises recovery and performance. The research area is studied from a psychological, sociological, historical and physiological perspective such as how performance is related to environmental factors (e.g. high temperature and altitude). Various types of tests and their validity for different sports are also evaluated. Studies are carried out both in the laboratory and field. Research is also performed in the historical, social and ethical aspects of elite sport to, among other things, understand the political importance of elite sport. The importance of doping for the society and effect of the political initiatives for anti-doping are also investigated. Research is conducted within the historical, sociological and aesthetic dimensions of elite sport e.g. concerning a critical understanding of the growing political impact of this sector. Doping and other performance enhancing substances in sport are analyzed in a social context by investigating behavior of both elite and non-elite athletes.

A new area of research: Coaching

Coaching is a concept that is associated with the world of sport, and in the last years has become one of the world's quickest growing industries. Coaching is defined in this context as participation in and facilitation of a focus person's learning and developmental process. Coaching has shown to be an excellent tool in the development of employees and organizations, as well as in individual's personal and professional learning, development, stress reduction and health promotion. Coaching is a rather new area and research and development are exceedingly in demand from customers, for example from business, and increasingly from sport, education and the health sector. The researchers that focus on this area are spread out over various institutes in Copenhagen. These efforts should be joined and coordinated at our department. The future research perspectives lie in the areas of "Theoretical and philosophical foundations of coaching", "Case conceptualization", "Process studies" and "Empirical evidence-based studies".

Research groups

Molecular physiology- Metabolism, nutrition and health

- Molecular mechanisms explaining the health benefits of exercise
- Interaction between physical activity and nutrition
- Sex differences in metabolism and insulin sensitivity

The aim of the research is to understand how regulation of energy metabolism influences health and prevents development of disease. We focus on the interaction between physical activity, exercise training and nutrition. It is well known that regular physical activity is important for maintaining health yet the underlying molecular mechanisms are not known but likely include regulation of energy metabolism particularly in muscle. The regulation of energy metabolism as well as gene expression and epigenetic modifications in relation to physical activity are to a large extent regulated by phosphorylation/dephosphorylation reactions which consequently are in focus in our research. Metabolism is dependent upon nutrition and is not identical in men and women. We are therefore investigating whether changes in molecular signalling and epigenetic modifications can explain sex and nutrition related differences in insulin sensitivity and energy metabolism during and after physical activity. We research from "molecule to man" including techniques of molecular biology, transgenic organisms and human beings.

Our research also involves applied aspects regarding application of physical activity as treatment of life style diseases. Here the aim also is to elucidate the pathophysiological mechanisms related to the disease and to clarify mechanistically how physical activity can remedy the defects.

Integrated physiology- cardiovascular, metabolism and ionic transport

- Effect of various types of physical activity on the health profile
- Optimizing performance – testing and training the elite athletes
- Regulation of muscle blood flow, oxygen uptake, energy turnover and ion transport – effect of pharmacological agents and exercise training

The focus of the research group is regulation of muscle blood flow, metabolism and ionic transport at rest and during exercise. Each system and the interplay between the various systems are studied using different models ranging from subcellular fractions to human studies. In addition, the integrated physiological response of the entire body during exercise and causes of fatigue are examined. There is specific focus on the physiological adaptations with regular physical activity (training) and how they influence health and performance during exercise. Furthermore, tests to evaluate physical performance in different sports are developed and validated.

Within blood flow and respiration the mechanisms causing elevated blood flow and oxygen uptake to the contracting muscles during exercise are studied. Furthermore, the interplay between aerobic and anaerobic energy production during various types of exercise, and how it is changed by a period of exercise training is examined. Also regulation of ion homeostasis at rest and during exercise is evaluated, with a focus on the interplay between muscle ion transport and energy turnover as well as its importance for development of fatigue. A specific area is changes in expression of key muscle proteins and numbers of capillaries with exercise training and what is causing these adaptations. These areas are studied in experiments

with cells in culture, animals and humans as well as a combination of these models. Specifically the cause of a reduced capillary density in muscle of various patient groups and how it is affected by exercise training is studied.

Motor control and biomechanics

- Physical activity and brain
- Load-related musculoskeletal disorders
- Neuro-biological and biomechanical basis for training and rehabilitation

The research group's work aims at an understanding of 1) how movements are generated, controlled and optimized in an interaction between the brain, spinal cord, musculoskeletal and sensory apparatus and 2) the interaction between the body's physiological response, motor function and performance ability in relation to physical activity within both sport, work and rehabilitation. The methods span molecular, electro-physiological, biomechanical and imaging techniques.

The research group is working with several questions of general biological nature in relation to the influence of physical activity on health, including its impact on brain function, the neurobiological basis for rehabilitation, the impact of stress-related pain on neuromuscular function and the local metabolism in muscle. A major interest is also the importance of physical activity in the prevention of lifestyle-related diseases and symptoms. The research group also addresses issues related to muscle fatigue and pain mechanisms on relation to work and physical aging.

Sport, Politics and Public Welfare

- Health and Physical Activity – studied in target groups organised according to age, sex, ethnicity and social marginalisation.
- Evaluative research into sport, physical activity and welfare at State, regional and district-and-county levels.
- Sport and politics – Olympic Games, national identity and doping

Over a number of years, this research group has conducted both historical and sociological investigations into how sport has evolved in response to various political and cultural contexts. Research has been undertaken into the use of sport in mobilising the population in the struggle for democracy, and into how fascist ideologies have used sport for military preparation. The research group has placed special emphasis on sport and gender, and on how sport has played an important role for women's liberation and for modern management. Research is carried out into sporting trends and tendencies among the population, together with sport's role in the expansion of the welfare state, with focus on sport as a significant leisure-time activity and on its social and cultural importance for individuals, groups and for society as a whole.

Research into sport, politics and public welfare places a sharper focus on sport's already-increasing importance within the welfare state. In particular, this focus will be directed towards health, social and cultural-political fields, both historically and sociologically, and across local, national and international perspectives. In the coming years, the importance of sport in district-and-county political contexts will take on increased importance, as will various anti-doping initiatives. Growing health problems among the population creates a need for new knowledge about physical activity and about the potential of sport in promoting good health and as a preventative measure against bad health. Research that integrates scientific knowledge about age, sex, social groups, social networks, and about opportunities and restrictions, will make it possible to launch initiatives of crucial importance, for work, for leisure-time and for everyday life. Within the social-political field, the group will study sport as a means for integration among selected social groups: ethnic groups, as well as groups that are either socially deprived or otherwise marginalised. Within the cultural-political field, the group will continue to work on establishing an understanding for the importance of sport as a force for social cohesion through its public informational and cultural dimensions, in the spheres of voluntarism and democracy.

The State and its various districts and councils are turning more and more to policies of intervention followed by evaluation. The current research group has throughout the last ten years conducted a large number of evaluative tasks for both public authorities as well as sporting organisations, thereby gathering much experience and a large body of data from which it can draw. The group's unique and over-arching perspective, therefore, will aim at providing various evaluation initiatives with full scientific rigour.

Body learning and identity

- Motivation, sports involvement and healthy lifestyle
- Body experiences and identity processes
- Coaching, learning and development

The research group conducts pedagogical and psychological research and developmental work with a focus on the body, learning and identity in sport and body routines with a specific focus on the application of this research. Body experiences have an influence on developing identity and affect learning and are seen as processes that takes place in a social context.

The research field is widespread and focuses on concrete movement and athletic processes where processes of change are analyzed at different levels (individual, group or society) and in various institutional, organized and unorganized contexts, for example school classes, the university context, outdoor education, as well as in training, therapy or professional groups.

The group's research centers on learning and identity processes in sport with a focus on the body and movement as a creative and developing element of human practice, communication and self-presentation in sport; sport as community of practice; interplay between body, experience and identity in various forms of sport settings, motivation and volition, stress and disease, sport and personality, development of methods in applied settings, for example coaching and team-building, development of IT in teaching or the development of performative arts methods and creativity.

Qualitative narrative methods, action - and applied research as well as statistical methods are utilized. The overall aim of the research area is to develop knowledge about sport, body and movement psychology, pedagogy and aesthetics. The body's special meaning for learning and identity is connected to cultural and humanistic perspectives in relation to late or post modern societies and to ontological, epistemological and social political questions about health, quality of life, gender, age or ethnicity. In the future the research group will, among other topics, focus on talent development and on research on the importance of the relational perspective to teaching and coaching.

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