Opetusministeriö

Undervisningsministeriet

Evaluation of sports and exercise medicine and biology research in Finland

Reports of the Ministry of Education, Finland 2003:3

Opetusministeriön työryhmämuistioita ja selvityksiä

Undervisningsministeriets arbetsgruppspromemorior och utredningar

KUVAILULEHTI

Julkaisija OPETUSMINISTERIÖ	Julkaisun päivämäärä 7.2.2003	
Tekijät (toimielimestä: toimielimen nimi, puheenjohtaja, sihteeri) Liikunnan biolääketieteellisen tutkimuksen arviointityöryhmä Hilkka Riihimäki, puheenjohtaja Ulla Silventoinen, sihteeri	Julkaisun laji Työryhmämuistio Toimeksiantaja Opetusministeriö Toimielimen asettamispvm 4.9.2000	Dnro 20/043/2000

Julkaisun nimi
Liikunnan biolääketieteellisen tutkimuksen arviointityöryhmän raportti

Tiivistelmä

Tutkimuksen tieteellinen taso
Arviointityöryhmä pitää suomalaisen biolääketieteellisen liikuntatutkimuksen yleistä tasoa erittäin hyvänä ja kansainväliset mitat täyttävänä.

- Epidemiologisen tutkimuksen vahvuutena olivat hyvin organisoidut, pitkän seuranta-ajan omaavat kohorttitutkimukset, huolellisesti suunnitellut ja toteutetut interventiotutkimukset (sisältäen vaativia randomoituja kontrolloituja kokeita) sekä tehokas kansallisten rekisteritietojen käyttö. Alan tutkijoiden tulisi edelleen tehostaa yhteistyötä perustieteiden tutkijoiden kanssa.
- Kuntoutustutkimuksen vahvuutena olivat hyvin organisoidut tuki- ja liikuntaelimistön vammojen hoitoon keskittyneet tutkimukset.
- Biomekaanisen tutkimuksen tieteellistä tasoa pidettiin erinomaisena ja sen tuottama tieto täydentää hyvin kliinisiä tutkimusohjelmia. Tutkimusalue tuottaa myös erittäin relevanttia tietoa niin urheilijoille, aktiiviliikkujille kuin ikääntyvälle väestölle.
- Liikuntafysiologisen tutkimuksen tason arviointiin olevan hyvä suhteessa kansainväliseen tutkimukseen. Tutkimus tuottaa käyttökelpoista tietoa kliinisen hoitotyön ja kuntoutuksen tarpeisiin.
- Perustutkimuksen laatu ja laajuus arvioitiin yleisesti vain kohtuullisen hyväksi. Tämä on uusi alue liikuntalääketieteellisessä tutkimuksessa ja tästä näkökulmasta on ymmärrettävää, ettei tutkimusryhmillä ole pitkää perustutkimuksen traditiota.
- Korkean viittauskertoimen (impact factori) lehdissä julkaistujen vertaisarvioitujen artikkelien määrä osoittaa, että alan suomalaisen tutkimuksen yleinen taso on hyvä. Eräät tutkimusryhmät julkaisevat töitään lehdissä joiden impact factor on huomattavasti alhaisempi kuin mitä tutkimuksen tieteellisen taso antaisi odottaa. Kaikkia tutkimusryhmiä kehotetaankin mahdollisimman kunnianhimoiseen julkaisupolitiikkaan.
- Julkaistujen artikkelien viittausten määrä kuvastaa tutkimuksen vaikuttavuutta tutkimusyhteisössä. Viittausanalyysistä saatu viittausten keskiarvo oli 6,9 ja parhaan tutkimusyksikön keskiarvo oli 15,8. Näiden lukujen pohjalta tutkimuksen vaikuttavuus arvioitiin hyväksi.

Kansallinen ja kansainvälinen yhteistyö
Kansallinen verkostoituminen ja yhteistyö vaikuttivat toimivan hyvin. Yhteistyötahoina olivat sekä yliopistojen eri laitokset että tutkimuskeskukset. Tutkimusryhmien kansanväliset yhteydet olivat laajat ja joissain tapauksissa yhteistyö myös tuotti yhteisiä tutkimusprojekteja ja julkaisuja. Vain muutamat tutkijaryhmät ovat saaneet rahoitusta EU:lta tai muista ulkomaisista läheteistä. Kansainvälistä yhteistyötä tulee edelleen kehittää ja siihen tulee sisällyttää yhteistyötä eurooppalaisten tutkijaryhmien kanssa. Tämä voisi edesauttaa EU -rahoituksen hankintaa.

Tutkijakoulutuksen määrä ja laatu
Tutkijakoulutuksen määrä arvioitiin hyväksi. Arviointi osoitti, että valtaosa tutkijoista väittelee suhteellisen nuorena, joka on kansallisen tutkimuspolitiikan mukaista. Jatko-opiskelijoiden rekrytoiminen vaikutti olevan joillain alueilla ongelmallista. Toinen ajankohtainen ongelma on post-doc tutkijapaikkojen vähyys. Tutkijakoulutuksen laatu vaihteli suuresti. Koulutuksen laatu oli yleisesti parempaa suurissa kuin pienissä yksiköissä. Työryhmä suosittelee, että jatko-opiskelijat olisivat alansa tutkijakoulussa.

Muita huomioita
Lyhytaikaiset, vuoden rahoitusjaksot luovat epävarmuutta ja tekevät tutkimusprojektien pitkän tähtäimen suunnittelun vaikeaksi. Tämä tekee nuorten tutkijoiden työllisyyden epävarmaksi ja vähentävät tutkijan uran kiinnostavuutta. Sama vaikutus on myös avustusten maksamisella henkilökohtaisina apurahoina ilman sosiaaliturvaa.

Useat tutkimusryhmät vaikuttavat erittäin riippuvaisilta opetusministeriön rahoituksesta. Työryhmä kannustaa tutkimusryhmiä ja -yksiköitä hakemaan rahoitusta entistä enemmän muista lähteistä. Erityisesti perustutkimuksen alueella työskenteleviä kehotetaan hakemaan avustusta Suomen Akatemiasta.

Organisatorisesti, liikunnan biolääketieteellinen tutkimus on jakaantunut liian moniin yksiköhin, joista monet ovat liian pieniä saavuttaakseen vaadittavan kriittisen massan.

Työryhmä suosittelee liikuntalääketieteen yksiköiden erillisarviointia. Tämä arviointi on kohdistunut vain yksiköissä tehtävään tieteelliseen tutkimukseen, eikä toiminnan muihin osa-alueisiin oteta kantaa. Tutkimuksen näkökulmasta olisi parempi jos alueella olisi vähemmän mutta vahvempia yksiköitä, joilla on riittävä kriittinen massa korkeatasoisten tieteellisten tutkimusten onnistuneeseen toteuttamiseen ja jotka pystyvät vakaampien tutkimusolosuhteiden ylläpitoon.

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Rapport av arbetsgruppen för utvärdering av den biomedicinska idrottsforskningen

Sammandrag

Forskningens vetenskapliga nivå
Utvärderingsarbetsgruppen finner allmänt taget nivån på den biomedicinska idrottsforskningen i Finland mycket hög och bedömer att forskningen väl motsvarar internationell standard.

- Styrkeområdena inom den epidemiologiska forskningen var välorganiserade kohortstudier med lång uppföljning, omsorgsfullt planerade och genomförda interventionsstudier (inklusive krävande randomiserade kontrollerade prov) samt ett effektivt utnyttjande av nationella registeruppgifter. Forskarna inom branschen borde ytterligare förstärka samarbetet med forskarna inom grundforskningen.
- Styrkeområdena inom rehabiliteringsforskningen var välorganiserade undersökningar inriktade på vården av rörelseorganen.
- Den vetenskapliga nivån på den biomekaniska forskningen ansågs vara utmärkt och den kunskap den producerar ett välkommet komplement till de kliniska forskningsprogrammen. Forskningsområdet ger också ytterst relevant kunskap för såväl idrottsmän, aktiva motionärer som den åldrande befolkningen.
- Nivån på den idrottsfysiologiska forskningen bedömdes som god i förhållande till den internationella forskningen. Forskningen producerar användbar kunskap för det kliniska vårdarbetet och rehabiliteringen.
- Grundforskningens kvalitet och omfattning bedömdes allmänt endast som förhållandevis god. Detta är ett nytt område inom den idrottsmedicinska forskningen och ur den synvinkeln är det förståeligt att forskningsgrupperna saknar en lång tradition inom grundforskningen.
- Antalet vetenskapligt granskade artiklar som publicerats i tidskrifter med ett högt inverkanstal (impact factor) visar att den finländska forskningens nivå på området allmänt taget är god. Vissa forskningsgrupper har publicerat sina arbeten i tidskrifter med en impact factor som inte motsvarar forskningens höga vetenskapliga nivå. Alla forskningsgrupper uppmanas därför att bedriva en så ambitiös publiceringspolitik som möjligt.
- Antalet citeringar för de publicerade artiklarna reflekterar forskningens inflytande inom forskningssamfundet. Medeltalet för antalet citeringar var 6,9 och den bästa forskningsenhetens medeltal var 15,8. Utgående från dessa siffror bedömdes verkningsfullheten som god.

Det nationella och internationella samarbetet
Det nationella nätverksbildandet och samarbetet föreföll att fungera väl. Samarbetsparter var såväl universitetens olika institutioner som forskningsinstituten. Forskargrupperna har haft omfattande internationella kontakter och i vissa fall gav samarbetet också upphov till gemensamma forskningsprojekt och publikationer. Endast några få forskargrupper har fått finansiering från EU eller andra utländska finansieringskällor. Det internationella samarbetet borde ytterligare utvecklas och även omfatta samarbete med europeiska forskargrupper. Detta kunde förbättra möjligheterna till EU-finansiering.

Forskarutbildningens omfattning och kvalitet
Omfattningen på forskarutbildningen bedömdes vara god. Utvärderingen visade att största delen av forskarna disputerar som relativt unga, vilket överensstämmer med den nationella forskningspolitiken. Inom vissa områden föreföll rekryteringen av forskarstuderande problematisk. Ett annat aktuellt problem är det låga antalet post-doktorala forskarplatser. Kvaliteten på forskarutbildningen varierade kraftigt. Kvaliteten var i allmänhet bättre i större enheter än i mindre. Arbetsgruppen rekommenderar att forskarstuderandena är inskrivna vid en forskarskola inom branschen.

Andra observationer
Kortvariga finansieringsperioder på ett år skapar osäkerhet och försvårar en långsiktig planering av framtida forskningsprojekt. Detta medför också en osäker sysselsättningssituation för unga forskare och gör forskarkarriären mindre attraktiv. Samma verkan har också det faktum att understöden betalas som personliga stipendier utan någon social trygghet.

Många forskningsgrupper förefaller mycket beroende av finansieringen från undervisningsministeriet. Arbetsgruppen uppmuntrar forskningsgrupperna och -enheterna att aktivare ansöka om finansiering också hos andra finansieringskällor. I synnerhet de som arbetar inom grundforskningen uppmanas söka understöd hos Finlands Akademi.

Organisatoriskt är den biomedicinska idrottsforskningen uppdelad på alltför många enheter, av vilka flera är alltför små för att nå upp till den kritiska massa som behövs.

Arbetsgruppen rekommenderar att de idrottsmedicinska enheterna utvärderas separat. Denna utvärdering har endast gällt den vetenskapliga forskning som bedrivs i enheterna och arbetsgruppen tar inte ställning till de övriga delområdena i verksamheten. Ur forskningens synvinkel skulle det vara bättre om det fanns färre men starkare enheter med tillräcklig kritisk massa för att de med framgång skall kunna bedriva vetenskaplig forskning på hög nivå och upprätthålla stabila forskningsförhållanden.

Nyckelord
Biomedicinsk forskning, utvärdering

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Name of publication
Report of the evaluation of sports and exercise medicine and biology research in Finland

Abstract

Scientific quality
In general, the scientific quality of research was evaluated as very high in many areas of biomedical and biological sports research, and it was judged to comply well with the international standard in the field.

- In epidemiology, the strengths were well-conducted cohort studies with long follow-up times, carefully planned and conducted intervention studies (including demanding randomized controlled trials), and efficient use of national register data. Collaboration with scientists in basic research needs to be continually strengthened.
- In rehabilitation research, the strengths were found to be well-conducted studies that were focused on the treatment of musculoskeletal injuries associated with activity in children, middle-aged subjects and the elderly
- The scientific quality of research that has focused on biomechanics was found to be excellent and a welcome complement to outstanding clinical research programs. Research in this area was found to be highly relevant to athletes, active individuals and the elderly.
- In exercise physiology in general, the scientific quality of research was considered to be good compared to international standards. Exercise physiology has much to offer for purposes of clinical treatment and rehabilitation.
- The quality and quantity of basic research was, in general, considered to be only rather good. This is a new field of research in sports medicine, and in this light it is understandable that, for the most part, research groups have no long-term basic research tradition.
- The number of peer-reviewed papers published in high-impact journals reflects the generally good international standard of Finnish research. Some of the units had published their work in low-impact journals that were incompatible with the high scientific quality. All research groups are encouraged to keep their ambition level in publishing as high as possible.
- The number of citations for the published papers reflects the impact of studies within the scientific community. The mean number of citations was 6.9; and for the highest-ranking research unit this mean was 15.8. Based on these figures, the impact was considered good.

National and international collaboration
National networking seemed to function well and was found to involve many universities and research institutes. The research groups have wide international contacts that in some cases have resulted in productive joint research projects and publications. Only a few groups have received funding from the EU or other foreign sources. International collaboration should be enhanced and include collaboration with European research groups. This could facilitate obtaining research funding from the EU.

The quantity and quality of researcher training
The quantity of researcher training was considered good. The review found that most students completed their doctoral training at a relatively young age. It was noted that it was not always easy to recruit graduate students. Another current problem is the shortage of posts for post-doctoral researchers.

The quality of researcher training varied substantially from one unit to another, the general tendency being that big units performed better than smaller ones. It is recommended that graduate students be registered in an appropriate graduate school.

Additional observations
Short-term, one-year funding cycles create an insecure research environment, and make the long-term planning of future research programs difficult. They also influence security of employment for young researchers, and make the choice of research as a career less attractive. The same is true for the practice of awarding personal grants without paying any social security contributions.

Many of the research groups seem to be very dependent on funding from the MoE. In general, the research units/groups are encouraged to actively apply for funds also from other sources besides the MoE and the scientist in the basic research from the Academy of Finland, in particularly.

Organizationally, sports and exercise research is split into too many units, many of which were considered to be too small to reach the desired critical mass.

A separate overall evaluation of sports medicine centers is recommended - the evaluation group could not take into account any functions of the centers other than research. From the research point of view, it would be better to have fewer but stronger units with sufficient critical mass to successfully conduct high quality research programs and ensure sustainability.

Other information

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Contents

1. Introduction

The Ministry of Education's Department for Cultural and Sports and Youth Policy allocate funds to research projects in sports sciences and research institutes from pools and lottery funds. The funding, planning and development of sports sciences proceeds according to 5-year plans made and carried out by the Ministries' expert committee, the Sports Science Subcommittee. In the most recent plan, the subcommittee recommended a general evaluation of sports research. An overall evaluation was last carried out during 1989-90.

It was decided that the next evaluation would be done in two parts: first behavioral research and then biomedical research. An evaluation of behavioral research in the field of sports was carried out during 1998-99. The task of this committee was to evaluate Finnish research in sports biology and sports medicine. The evaluation covered sports related research in physiology, biomechanics, health sciences and medicine, including traumatology, epidemiology and experimental research.

The Sports Science Subcommittee prepared the evaluation process and recruited the evaluation group. The Ministry of Education officially appointed the evaluation group proposed by the subcommittee in September 2000.

2. Evaluation

The evaluation concerned all the research institutes, research groups and individual researchers that had received state subsidy for research in the field of sports biology and sports medicine during the period under review (Appendix 1). In this context, research in the field of sports biology and sports medicine meant research primarily focusing on the impact of sport on health and on functional capacity.

The evaluation was expected to establish the current status of research in the field of sports biology and sports medicine and review its plans for the future. The specific goals were described in the decision of the Ministry of Education on the appointment of the evaluation group as follows:

The evaluation group will evaluate:
1) Scientific quality of research by selected research teams and their productivity
2) Standard of Finnish biomedical sports research compared to international research.
3) National and international contacts between researchers in the field
4) Quantity and quality of research training in the field.
In addition, the evaluation group will put forward proposals for the development of the discipline.

2.1. Evaluation Criteria

The evaluation group set the following evaluation criteria.

1) Scientific quality
While evaluating the scientific quality of research, the evaluation group considered quality in reference to international research (ranking of journals, citation analysis, panelists' judgment), originality, profoundness, extensiveness, timeliness, significance and multi/interdisciplinarity.

The following scale was used to evaluate scientific quality:

- Excellent
- Very good
- Good
- Fair
- Poor

2) Relevance to the needs of sports culture and society

3) Productivity

An attempt was made to obtain comparable data on productivity from different groups/units. It turned out to be difficult to get reliable estimates of person years allocated to relevant research for evaluation purposes, and the evaluation scale was limited to:

- Acceptable
- Unacceptable

4) National and international collaboration

While evaluating national and international collaboration, the evaluation group considered joint publications with national and international collaborators, individually reported collaboration and network analysis for the groups/units.

5) Quantity and quality of researcher training

A) Quantity

To rate research productivity, the evaluation group considered the number of licentiate and doctoral examinations, age at the time, and the number of post-doctoral researchers in training

B) Quality

To rate research productivity, the evaluation group considered individual reports about organizing researcher training, and interviewed graduate students/young doctors.

The scale used to rate the quantity and quality of researcher training was the same as that used for scientific quality in 1) above.

2.2. Evaluation group

Chair:

Professor Hilkka Riihimäki
Current position(s): Director of Department of Epidemiology and Biostatistics, Finnish Institute of Occupational Health, Helsinki, Finland. Docent (Public Health, especially epidemiology), Department of Public Health, University of Helsinki, Helsinki, Finland.
Education: MD, DMedSc, MSc
Main field(s) of scientific expertise: Epidemiology of musculoskeletal disorders and work-related diseases

Members:

Professor Leena Ala-Kokko
Current position(s): Professor of Medicine, Center for Gene Therapy, Tulane University, New Orleans, LA, USA
Education: MD, DMedSc, Docent (Department of Medical Biochemisty, University of Oulu, Oulu, Finland)
Main field(s) of scientific expertise: Molecular biology of extracellular matrix proteins and Genetics of musculoskeletal diseases.

Professor Bruce Beynnon
Current position(s): Professor of Orthopaedics and Rehabilitation and Director of Research
Education: BS, MS and PhD Biomechanical Engineering
Main field(s) of scientific expertise: Soft tissue biology and joint biomechanics. This includes shoulder, knee and ankle joint biomechanics, cartilage biomechanics, total hip and knee replacement biomechanics, clinical research focused on knee ligament reconstruction and rehabilitation, and clinical studies of knee and ankle injury risk factors.

Docent Juhani Smolander
Current position(s): Senior Research Fellow, ORTON Research Institute, Foundation For The Disabled, Helsinki; Finland, Docent (Department of Physiology, University of Kuopio, Finland)
Education: PhD
Main field(s) of scientific expertise: Applied physiology involving exercise, environmental and work physiology.

Professor Bengt Saltin
Current position(s): Director of the Copenhagen Muscle Research Centre, Docent in exercise physiology, KI, Stockholm,
Education: MD, PhD
Main field(s) of scientific expertise: Exercise physiology, using unique human experimental models to elucidate roles of heart and skeletal muscle in limiting the human maximal aerobic power and to what extent phenotype expression is modulated by physical activity and training.

Secretary:

Planning officer Ulla Silventoinen
Ministry of Education, National Sports Council, Sports Science Subcommittee, Finland

2.3. The evaluation process

Data collection

At the start of March 2001 a questionnaire was sent to the research groups/units asking them to report their research activities during the years 1995-2000. The groups/units were asked to report their resources and to evaluate the role of Ministry of Education funding.

The groups/units also reported their postgraduate and doctoral training, national and international collaboration and main areas of research, the main results in these areas and

articles published during the years 1995-2000. They also made a SWOT analysis concerning the work of the whole group. The groups/units were also asked to briefly describe future plans.

Agreement on the evaluation process and criteria

The evaluation group held a meeting in Helsinki on Monday, June 4th, 2001. At this meeting, it discussed the evaluation goals set by the Ministry of Education, agreed on the process and criteria, and finalized the program of site visits.

Site-visits

The evaluation group made site visits during the first week of June 2001. The directors of the research groups/units and responsible researchers in the main fields of research were asked to be present during these visits.

At the start, the chairperson of the evaluation group introduced the process; the members of the group, and the evaluation goals and criteria . Representatives of each group/unit presented the work done by them, their personnel, research facilities and future plans etc. Questions and discussion followed the presentations. The chairperson summarized the visit and explained how the evaluation process would continue. The evaluation group toured the premises of the research group/unit. It also discussed individually with one or two postgraduate students in every group/unit.

Preparation of the evaluation report

The first drafts of evaluations were discussed and written each evening after the site visits . Afterwards, the chairperson and secretary edited a draft of the evaluation as a whole. The members of the evaluation group commented on the draft via email. After several drafts, the final evaluation report was completed at the end of December, 2003.

During the writing process, Professor Saltin withdrew and Docent Smolander took his place in the evaluation group.

Feedback seminar

The evaluation group is going to organize a feedback seminar for the research groups/units, the aim of which is to present the results to the groups/units and give them a chance to comment on them and the evaluation process as a whole.

3. Research in sports sciences in Finland

Up to the 1950s, research into sports sciences in Finland was fairly sporadic and mainly depended on the interest shown by representatives of other disciplines. The Finnish Society for Research into Sports and Physical Education was established as early as 1933 and the Finnish Society of Sports Medicine in 1939. More systematic research into sports sciences has been carried out since the 1950s. The Faculty of Sports Sciences was established at the University of Jyväskylä in 1968 as the unit responsible for research and higher education in sports science. At the moment, sports researchers work in universities, research institutes and as independent researchers.

Higher education in sports sciences is given at the Faculty of Sport and Health Sciences of the University of Jyväskylä. The Faculty is still the only university level institute in this field in Finland. Along with education, the Faculty, due to its unique status, is chiefly responsible for research into sports sciences in Finland. It also has a significant role in developing research in the field of health sciences. The Faculty's research activities take place in its four departments: the Department of Biology of Physical Activity, the Department of Physical Education, the Department of Social Sciences of Sport, and the Department of Health Sciences. Both basic and applied research directed toward practical professional fields are carried out in cooperation with various research bodies.

The Faculty's permanent teaching and research staff consists of approximately 70 employees, including 19 professors. When taking into account part-time lecturers and teachers, research support and administrative personnel, the workforce of the Faculty totals over 100 employees. The number of students enrolled in the Faculty is approximately 1,000.

In addition to the Jyväskylä faculty, there are three multidisciplinary research institutes in the field: The Research Center for Sport and Health Sciences (LIKES, 1970) in Jyväskylä seeks to promote sports and public health, and research into these sectors. The UKK Institute for Health Promotion Research in Tampere (1980) works in the social and health services sector to promote healthy lifestyles, especially physical exercise, by means of research, education and information. The Research Institute for Olympic Sports (KIHU, 1989) in Jyväskylä carries out multidisciplinary research in support of competitive and top-level sports and provides relevant services.

Some sports research is also conducted by the National Public Health Institute, the Finnish Institute of Occupational Health, and the R&D department of the Social Insurance Institution (reorganized in 2001), as well as in different universities.

In the field of sports medicine, there are six research centers:
1) In the Turku Faculty of Medicine, sports medicine research was started as early as 1956. Since 1987 the sports medicine center has operated under the name of Paavo Nurmi Center (PNC).

2) The Unit for Sports and Excercise Medicine, Helsinki (USEM) began to operate in 1965. It has been attached to the Finnish Foundation of Sports Medicine since 1973.

3) The Research Center for Sport and Health Sciences (LIKES) in Jyväskylä also has a unit for sports medicine.

4) The Department of Sports Medicine (DMS) was established at the Oulu Deaconess Institute in 1972.

5) The Kuopio Research Institute for Exercise Medicine (KRIEM) was founded in 1976. Since 1991, it has operated under the auspices of the Foundation for Research in Health Exercise and Nutrition.

6) The Tampere Research Center of Sports Medicine (TRCSM) started at the Varala Sports Institute but has been an administratively independent department of the UKK Institute since 1984.

The missions of the sports medicine centers are threefold. First of all, they provide education and information. Their educational mission is very important because they are responsible for specialist training in sports medicine. Secondly, the centers carry out research. Medical and testing services constitute the third main task, and in this they have a regional role.

All these sports medicine centers are fairly small in size, which restricts the scope of their research. The centers pay special attention to strengthening their research activities by deepening their cooperation and creating links to basic research in the field.

The Association for the Promotion of Sports Medicine and Physiological Testing (LIITE, 1990) has an overall responsibility for coordinating and developing sports medicine in Finland.

4. Administration and financing of sports sciences

Administration

Research into sports sciences is primarily administered by the Ministry of Education. Public funding mainly comes from three sources: the Ministry's Department for Education and Science Policy, its Department for Cultural Policy and Sports and Youth Divisions, and the Academy of Finland (Table 1)

Table 1. The public funding of sports sciences in Finland

Organization	Ministry of Education: Department for Education and Science Policy	Ministry of Education: Department for Cultural, Sport and Youth Policy	Academy of Finland
Source	State budget	Pools and lottery proceeds	State budget / Pools and lottery proceeds
Target	University core funding (e.g. Jyväskylä Faculty of Sport and Health Sciences) Graduate schools	Research projects Research centers (sports medicine) centers)	Research projects Research programs Posts for researchers Centers of Excellence

The Department for Education and Science Policy is responsible for university core funding, part of which is allocated to basic research. These funds come from the State budget. This is how the Jyväskylä Faculty of Sport and Health Sciences get its basic funding.

The Academy of Finland is an expert organization for research funding. The Academy that is subordinate to the Ministry of Education, is financed through the State budget and concludes an agreement on target outcome and relevant resources with the Ministry.

The Academy promotes high-quality research by granting long-term funding based on scientific merits, providing science policy expertise and strengthening the status of science, scholarship and research. The Academy of Finland finances all disciplines and primarily allocates funds for high-quality basic research.

At the Academy, sports sciences come under the Research Council for Health. The Academy finances sports research projects every year. In addition, there are sports scientists at graduate schools financed by the Ministry of Education.

The Ministry of Education's Department for Cultural, Sport and Youth Policy allocate funds from pools and lottery funds to research projects in sports sciences and research institutes. The administration of this funding differs from other science administration in the Ministry of Education sector. The expert body corresponding to the Academy is the Sports Science Subcommittee of the National Sports Council appointed by the Ministry of Education for a single parliamentary term.

The Ministry of Education allocates funds for the following purposes:

- Researcher and other staff salaries and fees
- Purchase of research instruments and equipment
- Lease of the necessary premises
- Travel in Finland and abroad and travel to international conferences relating to research
- Other expenses qualifying for government aid
- Research programs.

The Sports Science Subcommittee is responsible for supporting, coordinating and developing applied sports science research, sectoral research in the field, sports medicine research and for disseminating sports science information.

This long-standing practice in research funding was reconfirmed in the Sports Act (and the relevant Decree) of 1999. According to the Decree, the Sports Science Subcommittee of the National Sports Council submits a proposal to the Ministry of Education concerning the allocation of lottery funds to sports research and information and to sports medicine. The final decision is made by the Minister.

A question raised from time to time in discussions on sports sciences is whether or not administration and financing should be transferred to the Academy of Finland. Since sports science research is applied and relatively narrow in scope, this would involve the risk of not getting sufficient funding from the Academy. On the other hand, close contacts with the Academy and with its funding and quality criteria would guarantee the same high level as in other sciences.

Financing

General research financing

In Finland, research and development (R&D) financing has been growing very rapidly in recent years. In 1999 it represented 3.1% of GDP. Public funding grew by nearly 45% from 1995 to 2001 (from FIM 5.5 billion to 8.0 billion), and the Academy of Finland's financing more than doubled over this period from FIM 493 million to FIM 1099 million. All in all, the government allocated a total of FIM 8.025 billion to R&D in 2001. The distribution of these funds is given in Figure 1.

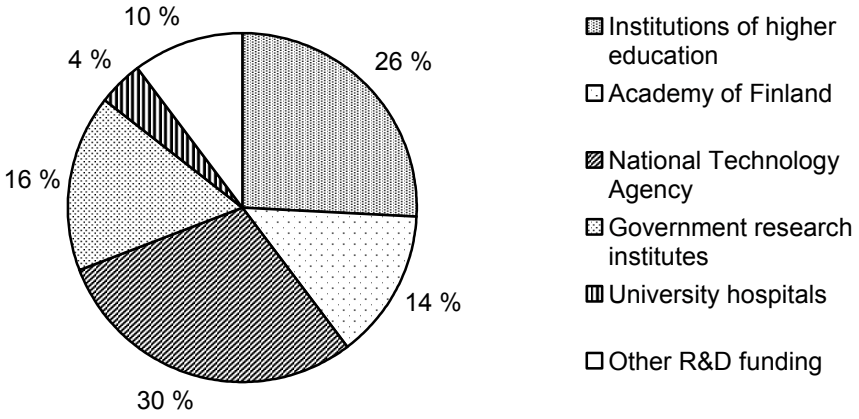


Figure 1. Distribution of government research funding in 2001.

The Department for Education and Science Policy allocated some FIM 2,080 million in core funding to the universities. This mainly covered the cost of the basic structures (premises, salaries etc.) and tuition.

The Academy of Finland financed research carried out in universities and research institutes with over FIM 1 billion (€180 million) in 2001. Most of these funds were allocated to high-quality research projects and to centers of excellence in research. The projects financed by the Academy amount to some 3, 000 researcher years.

The Ministry of Education's Department for Cultural, Sport and Youth Policy granted FIM 22 million to sports science research in 2001. In Figure 1, this funding is included in Other R&D funding.

Sports research funding

The growth in sports science research has not equaled that in R&D overall. The real value change in government funding to sports research shows a 6.8% fall from 1991 to 2000 (Table 2).

Table 2. Government funding to sports research during the years 1991-2000.

Year	Government funding	Index	Real value	Real value change
1991	19 000 000	93,0	21 880 645	
1992	20 000 000	95,5	22 429 319	2,5 %
1993	19 500 000	97,3	21 464 029	-4,3 %
1994	17 923 000	98,5	19 487 851	-9,2 %
1995	19 150 000	100,0	20 509 650	5,2 %
1996	18 300 000	101,9	19 233 857	-6,2 %
1997	19 300 000	102,9	20 087 755	4,4 %
1998	20 300 000	105,2	20 666 635	2,9 %
1999	20 300 000	107,1	20 300 000	-1,8 %
2000	20 400 000	107,1	20 400 000	0,5 %
90-00				**-6,8 %**

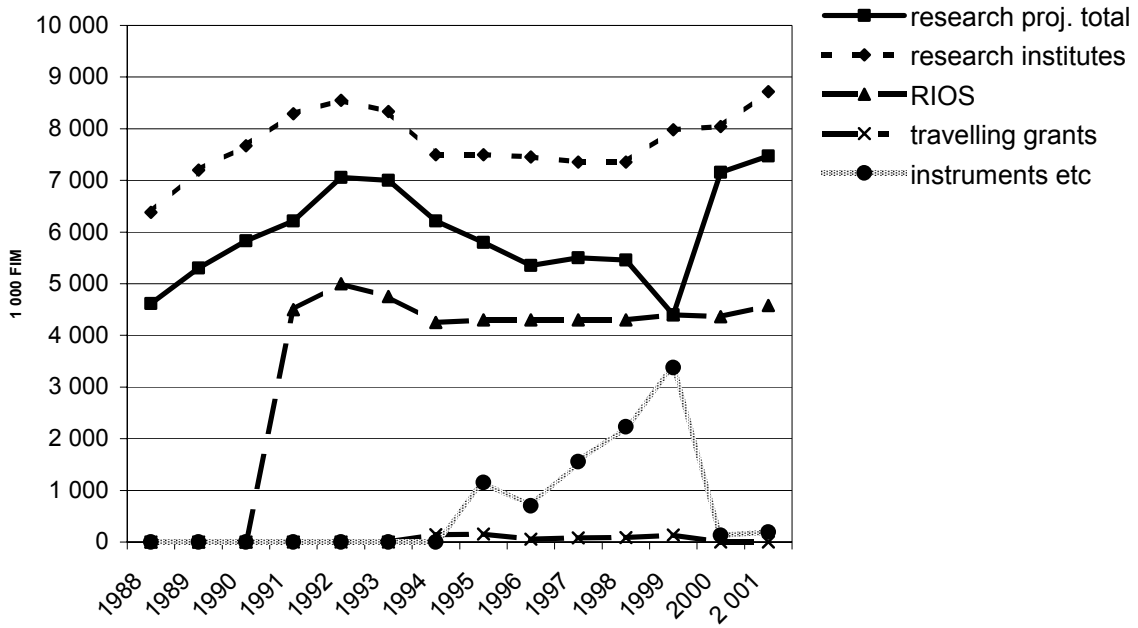


Figure 2. Distribution of government funding of research in sports sciences 1988-01.

Most government funding, FIM 13 million, is allocated to research institutes (Figure 2). The sports medicine centers and the Research Institute for Olympic Sports RIOS together receive some 80% of this funding. Research projects receive around FIM 8 million. Some funding is also allocated to travelling grants and research instruments, etc.

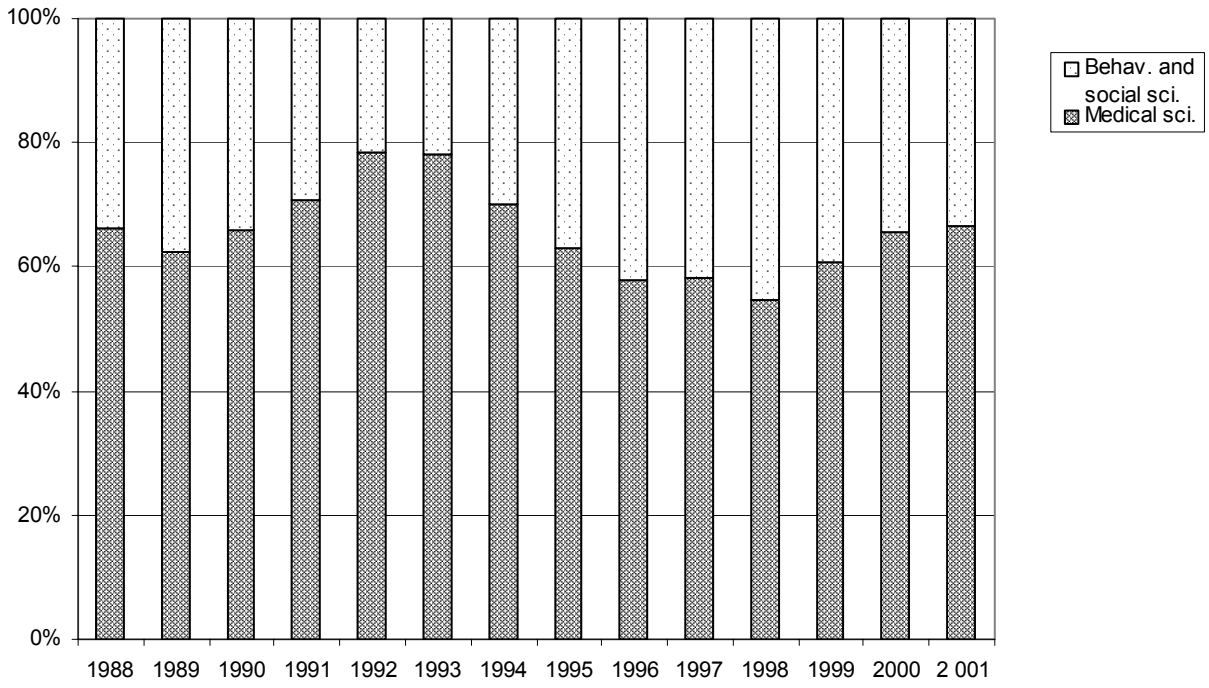


Figure 3. Distribution of government funding of sports science research projects 1988-99

About 60% of research project funding has been allotted to sports medicine and the biology of physical activity (Figure 3). During the period 1995- 2000, the average sum per research project was around FIM 150,000. Research projects mainly receive grants.

During the period under review, 70-90% of the sports medicine and biology of physical activity research grants were awarded to researchers with degrees in either medicine or health science and an average of 25% to sports scientists.

The sports medicine centers receive yearly government funding of about FIM 1 million each. This covers some 75% of their overall expenditure. The distribution of government funding to sports medicine centers is given in Figure 4.

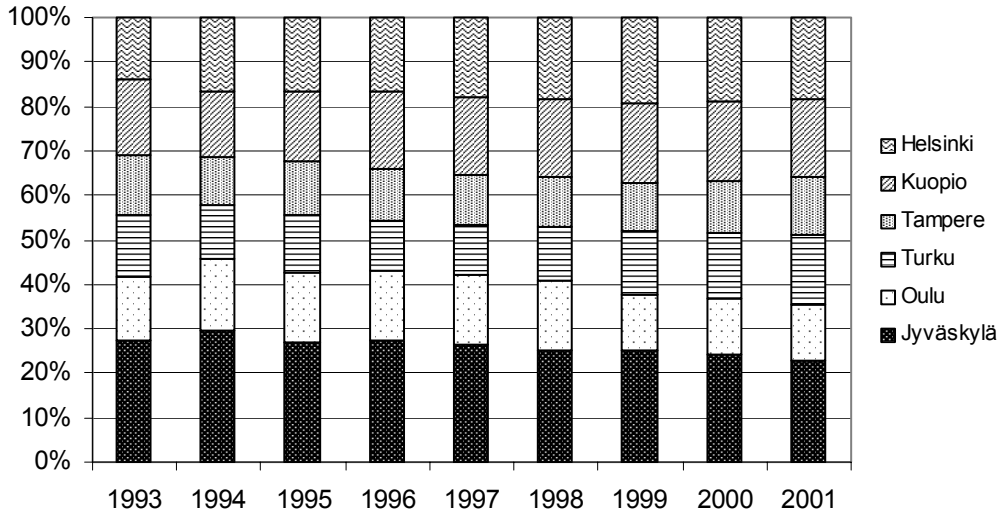


Figure 4. Government funding of sports medicine centers 1993-2001

5. Summary information of own reports

The research groups/units were asked to report their research activities during 1995-2000 by completing a questionnaire. The evaluation group got an extensive amount of information from each unit/group. A brief summary of the reports is presented here.

5.1. Human resources

The human resources of the research groups/units vary considerably. The biggest units employ from 50 to 75 persons and the smallest 5 to 10 persons. Table 3 shows the total number of staff in different units.

Table 3. Number of full time staff in research units and groups.

Unit	Number of staff
UKK Institute	53
Department of Health Sciences, University of Jyväskylä, DHS	75
Department of Biology of Physical Activity, University of Jyväskylä, DBPA	33
LIKES, Research Center	15
Unit for Sports and Exercise Medicine, Helsinki, USEM	10
Tampere Research Center of Sports Medicine, TRCSM	5
Kuopio Research Institute of Exercise Medicine, KRIEM	17
Paavo Nurmi Center, PNC	10
Oulu Deaconess Institute, Department of Sports Medicine, DSM	9
Research Institute for Olympic Sports, RIOS	22
Helminen et al.	16
Järvinen et al.	17
Kalimo et al.	8

Research groups/units were asked to estimate the person years used to research work during the years 1995-2000 in the context of this evaluation. It turned out to be very difficult to make these estimates and the numbers shown in Table 4 are not fully commensurable.

Table 4. Estimates of person years used for research in sports biology and medicine 1995-2000.

Unit	Person years
UKK Institute	154.0
Department of Health Sciences, University of Jyväskylä, DHS	91.8
Department of Biology of Physical Activity, University of Jyväskylä, DBPA	22.5
LIKES, Research Center	29.9
Unit for Sports and Exercise Medicine, Helsinki, USEM	10.0
Tampere Research Center of Sports Medicine, TRCSM	12.6
Kuopio Research Institute of Exercise Medicine, KRIEM	13.6
Paavo Nurmi Center, PNC	?
Oulu Deaconess Institute, Department of Sports Medicine, DSM	11.4
Research Institute for Olympic Sports, RIOS	40.0
Helminen et al.	18.0
Järvinen et al.	22.5
Kalimo et al.	?

5.2. Funding

Figure 5 shows the main sources of funding of the groups/units. The UKK Institute's strong basic funding from Finland's Slot Machine Association increases the ratio of the research institute's own funding to 45 % of total funding. If the UKK Institute is excluded, the share of units' own funding is only 21 %.

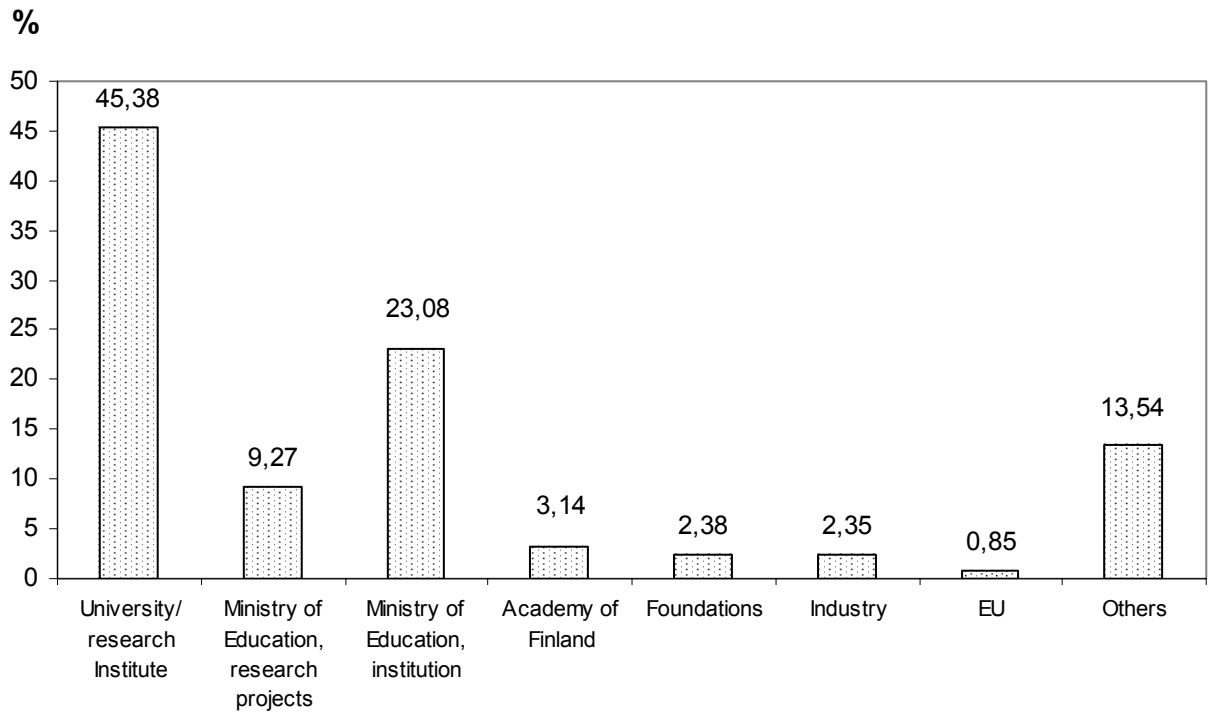


Figure 5. Sources of funding of research groups/units (%)

The role of the Ministry of Education's funding seems to be most important to the sports medicine centers and RIOS, being 56 % and 75 % of total funding respectively. The sports medicine centers get also a considerable amount of funding from the cities where they are located.

Funding from the Academy of Finland accounts for 21 % of total research funding of departments at the University of Jyväskylä. The role of the Academy's funding seems to be quite modest for the other units. On the average less than one percent comes from this source.

Co-operation with industry is just starting. Department of Health Sciences, RIOS and the UKK Institute seem to have the best relations to industrial companies. The amount of funding from the companies is still modest.

The research units have not been able get funding from the European Union, except the UKK Institute. The more detailed figures of funding are shown in Appendix 2.

5.3. Reported role of funding by the Ministry of Education (MoE)

The small research groups report that the role of funding by the Ministry of Education has been crucial. To some of these groups this has been practically the only source of funding and it has given an opportunity to researchers to concentrate full-time on research work.

Sports medicine centers get both institutional funding and research project funding from the Ministry. The role of institutional funding seems to be crucial for the existence as well as the scientific work of these Centers. It is a cornerstone for the operations and it ensures continuity.

Contributions to the specialization program of sports physicians would not be possible without funding from the Ministry of Education. The research projects rely on it to a very great extent. This funding makes many self-initated and co-operative projects possible and it was said to have a positive impact on other sources of funding.

For the University departments and the UKK Institute, the share of funding from the Ministry of Education in absolute terms is rather modest and it varies significantly between the research groups/units. Still, other sources of funding could not replace the support for doctoral studies received from the Ministry of Education.

Institutional and project funding from the Ministry of Education constitutes the main source of funding for research at the Research Institute for Olympic Sports.

5.4. Researcher training

The total number of licentiate examinations during years 1995-2000 was two and doctoral examinations 50. Of these examinations 19 were completed by female and 31 by male students. The yearly numbers of dissertations is shown in figure 6.

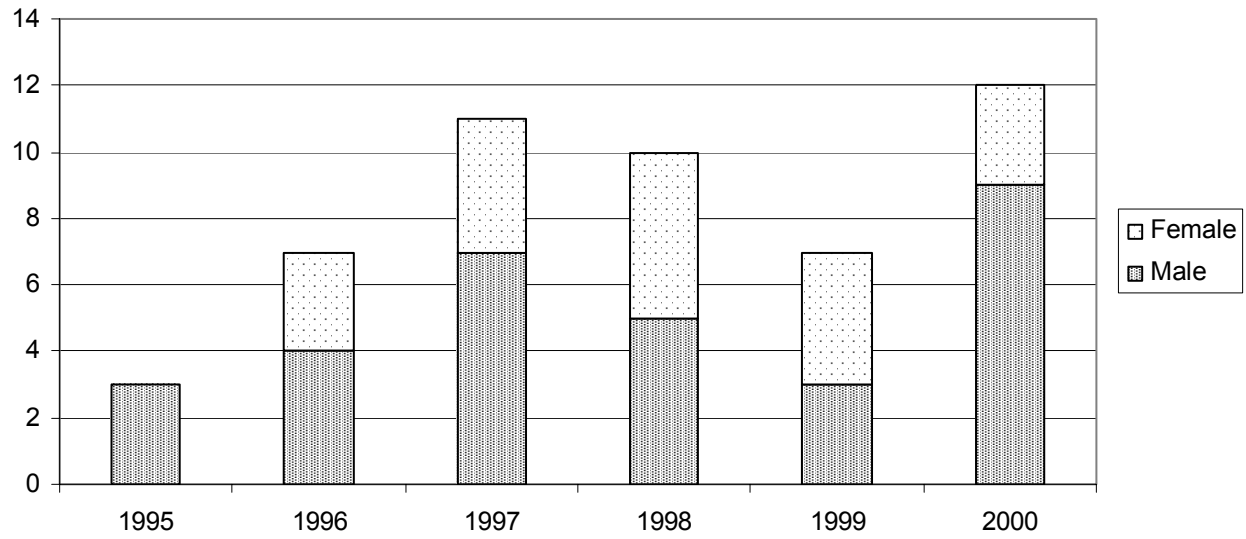


Figure 6. Number of doctoral theses 1995-2000

The average age at the time of earning a doctorate was 32 years (range 25 to 54 years) and there was no significant difference between male and female students.

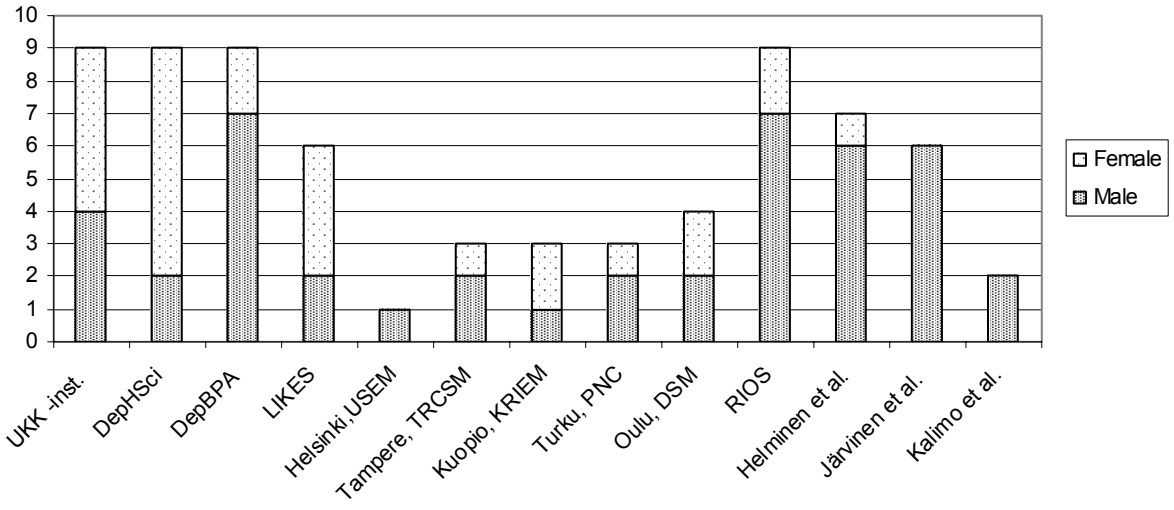


Figure 7. Number of doctoral examinations in research units/groups 1995-2000.

5.5. Publications

The number of publications is highly dependent on the resources of the research unit and the nature of the research. The highest number of international peer-reviewed publications during this five-year period was produced in one of the largest research units, the UKK Institute. The productivity rate of the sports medicine centers varied from 27 to 88 publications during years 1995-2000. RIOS seems to be at the same level as the average productivity rate of sports medicine centers.

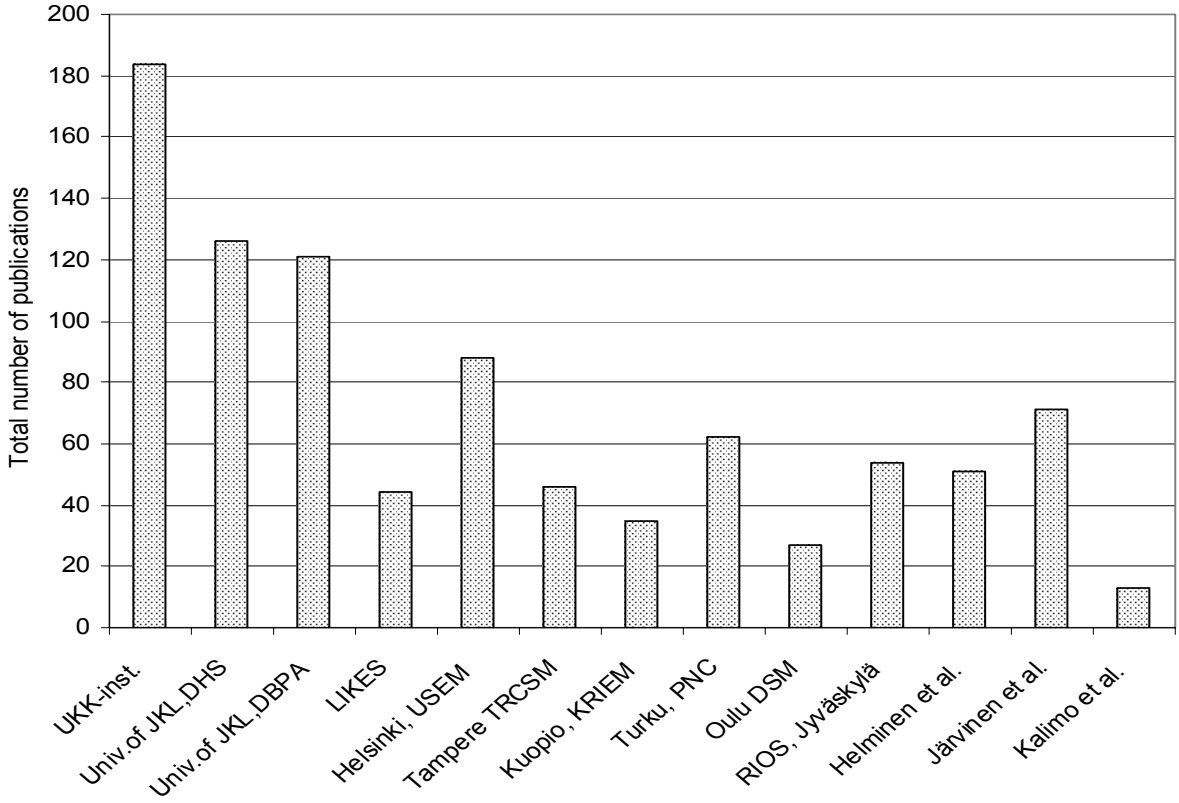


Figure 8. Number of international peer-reviewed publications 1995-2000.

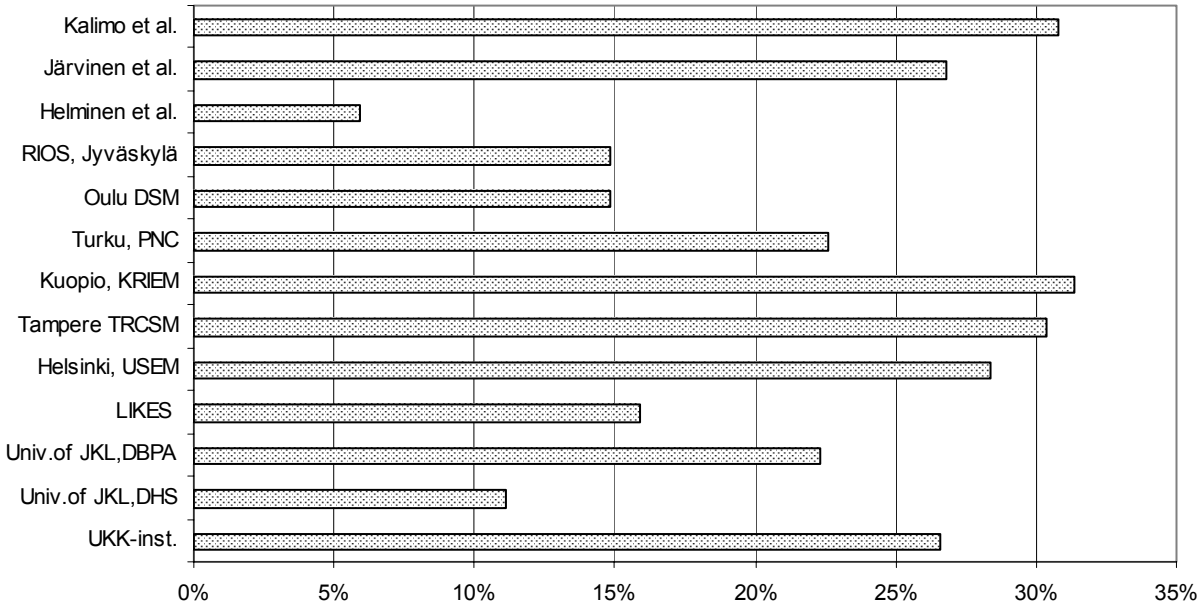


Figure 9. Percentage of high impact publications. Articles published in general journals with an impact factor over 5, or in the 10 highest impact factor sports science journals.

It is well understood that it is difficult to compare different fields of research using impact factors. Yet this classification takes into account high quality sports science and general science aspects.

The percentage of high impact publications along with the average impact factor of the publications express the quality of the publications and partly the ambition level of the groups. The average percentage of high impact publications was 21.7. The highest percentages were found at the Kuopio Research Institute for Exercise Medicine, Tampere Research Center for Sports Medicine and the Kalimo research group.

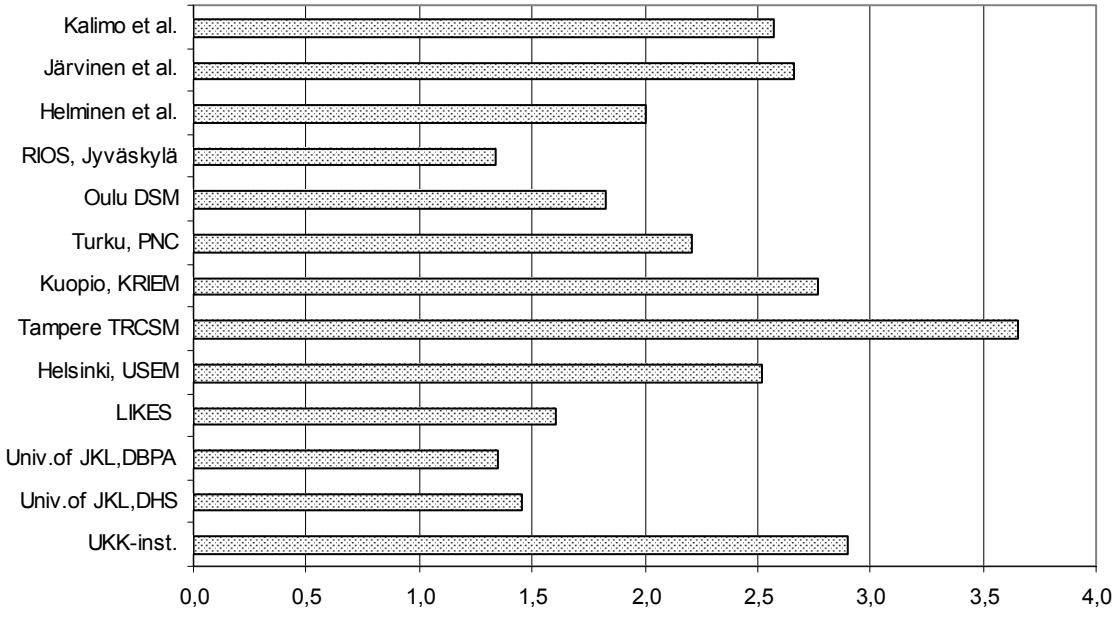


Figure 10. Average impact factors of the publications.

The average impact factor of all publications of the units/groups was 2.2. The impact factors of the publications varied from 0.023 to 28.857. The Tampere Research Center for Sports Medicine, the UKK Institute, the Kuopio Research Institute of Exercise Medicine and the Kalimo and Järvinen groups had highest mean impact factors.

The research groups were asked to name the 5 most important publications in the main fields of their research work. Their sets of articles may not have been their most cited ones, but probably the most relevant ones in view of this evaluation. A citation analysis of these articles was made. This analysis showed that a high impact factor does not necessarily guarantee a high citation rate. The results of the citation analysis and the impact factors are shown in Table 5.

Table 5. Results of citation analysis and impact factors of the 5 most important articles listed by groups/units.

Unit / group	Citations				Impact factor			
	Total	Average of all	Sum of 5 best	Average of 5 best	Total	Average of all	Sum of 5 best	Average of 5 best
UKK Institute	575	11.5	283	56.6	181.125	3.623	39.953	7.991
Univ. of Jyväskylä, DHS	155	7.05	108	21.6	52.848	2.402	28.773	5.755
Univ. of Jyväskylä, DBPA	95	3.8	61	12.2	36.131	1.455	12.025	2.405
Jyväskylä, LIKES	66	4.13	49	9.8	30.291	1.893	19.531	3.906
Helsinki, USEM	120	10.91	105	21	54.952	4.996	45.144	9.029
Tampere, TRCSM	160	8.89	117	23.4	37.493	2.083	19.053	3.81
Kuopio, KRIEM	51	10.2	51	10.2	24.954	4.991	24.954	4.991
Turku, PNC	40	3.64	36	7.2	27.927	2.539	18.829	3.77
Oulu, ODI	15	5	15	5	9.986	3.329	9.986	3.329
Jyväskylä, RIOS	90	2.5	44	8.8	62.502	1.736	24.585	4.917
Helminen group	38	4.75	35	7	8.813	1.102	7.183	1.437
Järvinen group	74	5.29	48	9.6	78.112	5.579	54.765	10.953
Kalimo group	62	12.4	62	12.4	22.64	4.528	22.64	4.528

5.6. Collaboration

The research groups and units were asked to report the national and international collaboration of the research unit/group as a whole. They gave a list of major collaborators and joint activities (e.g. joint research programs, exchange of researchers, joint publications, etc.). The information obtained might not be comprehensive, but it is indicative of the extent of collaboration.

Along with the UKK Institute, the Department of Biology of Physical Activity and the Department of Health Sciences enjoy the widest collaboration both nationally and internationally. As can be expected, LIKES actively collaborates on a national scale with universities and research units. It turned out that almost all the units collaborate with the University of Turku. Besides universities and hospitals, the key collaborator was the National Public Health Institute, Helsinki.

The network analysis of the groups/units is shown in Appendix 3.

5.7. SWOT -analysis

The research units and groups were asked to make a SWOT analysis concerning the work of the whole unit /group. The most important and most often mentioned strengths, weaknesses, threats and opportunities of the research units and groups were as follows:

Strengths

- Long research tradition
- Excellent national and international collaboration
- Multidisciplinarity of the research unit/group
- Competence and education of personnel
- Public and governmental interest in the area.

Unlike the other units, the UKK Institute views its basic funding as being stable and thus as a strength. This may be because the UKK Institute gets it's basic funding from a different source than the other units, The Finnish Slot Machine Association. The RIOS concentrates quite strongly on research of top sports and thus sees support from the National Olympic Committee to be one of its strengths.

Weaknesses

- Insufficient resources:
  - funding, needs to be applied for annually
  - staff
  - facilities
  - equipment
- Problems related to small size:
  - lack of critical mass
  - vulnerability

The Department of Health Sciences at the University of Jyväskylä (DHS) also mentions the inability to create joint research plans at the department / faculty level as one of their most important weakness. The potential for benefits from synergy are not fully used. The DHS also mentioned that it finds it hard to recruit young doctoral students (due to the background of the students Master's programs).

Opportunities

- New funding opportunities:
  - Graduate Schools, EU funds, industry
- Expansion of collaboration both nationally and internationally.
- Easy recruitment of young PhD students
- Physical exercise is perceived as an essential factor in health promotion

Threats

- Uncertainty of the continuation of funding
- Brain drain due to lack of senior researcher positions
- Insufficient collaboration with basic research

6. Evaluation of sports and exercise medicine and biology research in Finland

6.1. General evaluation of sports and exercise medicine and biology research

Confining research activities to what is relevant to the context of this evaluation was not always a straightforward matter. This was due to the fact that many groups were organized on an interisciplinary basis. Also, the principal focus in many projects was not on the effects of physical exercise or sports. Networking between different units was recognized as important, but this also made it difficult to allocate the research projects to the respective units. At times, these matters rendered the evaluation of the research units or groups, particularly rating their productivity, difficult. The evaluation group tried to base its evaluation on projects for which the groups/units were primary responsible.

Scientific quality of research and productivity

In general, the scientific quality of research was evaluated as very high in many areas of biomedical and biological sports research, and it was judged to comply well with the international standard in the field. In epidemiology, the strengths were well-conducted cohort studies with long follow-up times, carefully planned and conducted intervention studies (including demanding randomized controlled trials), and efficient use of national register data. Epidemiological research has provided nationally and internationally recognized important findings on the relationships between sports and exercise and health. This most demanding research must be done within dependable research institutes with experienced research staff and a well-functioning infrastructure. The strongest units have excellent epidemiological research programs. These include the UKK Institute, the Department of Health Sciences of the University of Jyväskylä, and the Kuopio Research Institute of Exercise Medicine. The review also revealed that very good epidemiological research was done in other units that participated as collaborators in studies administered by a university department or research institute. These collaborations were considered to be an efficient way to obtain information about the health effect of sports and exercise. It is not advisable for small research units to take an independent role in conducting extensive epidemiological studies. The conduct of epidemiological studies often requires multidisciplinary researcher groups. Collaboration with scientists in basic research needs to be continually strengthened. This was evident, for instance, for the groups involved in genetic epidemiology.

Development of methods is important for future research, specifically with regard to the assessment of physical activity, sports activity, health-related physical fitness, and functional performance capacity. The review found that much is known in qualitative terms about the associations between physical activity and health outcomes, and progress has been made in studies that have focused on dose-response relationships. Also, controlled interventions have either been completed or are under way. A future challenge is posed by community level interventions. They should be planned so that the impact can be evaluated in a scientifically valid way. In addition, the evaluation group recognized that future research efforts should focus on understanding the relationship between a combination of physical activity and diet, and how they affect health outcomes.

In rehabilitation research, the strengths were found to be well-conducted studies that were focused on the treatment of musculoskeletal injuries associated with activity in children, middle-aged subjects and the elderly. Not only has rehabilitation research focused on what are commonly assumed to be the sports injuries of young athletes alone, but also on those of older

individuals. This is very important because rehabilitation research serves the needs of all of society, and has had a key impact on the entire population. From this perspective, the research was considered to be broad enough in scope while remaining of a high scientific quality. This comprehensive approach is outstanding – it includes all those at risk for injury in society, it has led to important advances that have been recognized on national and international fronts, and was considered to be a very good use of MoE funds. This approach should continue to be encouraged. The evaluation group also found that rehabilitation research was comprehensive from the perspective that both soft and hard tissue injuries have been studied. This should be pursued further.

In biomechanics, the strengths were found to be the high scientific quality of the work, the welcome complement it provided to rehabilitation research programs, and the direct linking of the research findings to the clinical environment. Sports trauma research, although somewhat smaller in scope, was also found to be of a high scientific quality, and focused on the most common injuries associated with sports.

In general, the scientific quality of research into exercise physiology was considered to be good compared to international standards. To a large extent, research was descriptive and, in future, a mechanistic approach (for example, one that focuses on specific disease mechanisms) could open the way to higher quality research with a significant impact. This would mean deepening the methodology and establishing successful collaboration with researchers who are at the cutting edge of currently evolving methods. It could be beneficial to shift the priority from health effects to the effects on pathological processes. Exercise physiology has much to offer for purposes of clinical treatment and rehabilitation. Broader basic knowledge of physiology is needed for the assessment of functional capacity, which should not be restricted to measuring only muscle strength, body fat content and oxygen intake capacity.

The quality and quantity of basic research was, in general, considered to be only rather good. This is a new field of research in sports medicine, and in this light it is understandable that, for the most part, research groups have no long-term basic research tradition. The facilities are not adequately equipped for basic research, and the scientists in these groups are not sufficiently well trained to do basic research. In most instances, however, the groups have established excellent collaboration to overcome these limitations. Because basic science is a growing sector in sports medicine, more attention should be focused on recruiting basic scientists, training students, and obtaining reasonable funding for this type of research.

Many groups in basic research are almost totally dependent on funding from the Ministry of Education (which means that they do not apply for funding from the other sources). Funding from the Ministry is rather limited. Instead of splitting the funding, the Ministry should direct it towards groups with a good record and that have high potential. This would mean reducing the number of research units/groups.

In general, a good proportion (22 %) of all international peer-reviewed papers were published in high-impact journals (the 10 highest-impact-factor journals in sports science or general journals with an impact factor ≥ 5). For the highest-ranking units, the proportion exceeded 30 %. This reflects the generally good international standard of Finnish research. Some of the units had published their work in low-impact journals that were incompatible with the high scientific quality of their work, as judged by the evaluation group. All research groups are encouraged to keep their ambition level as high as possible, because even key findings can go unnoticed in low-ranking journals that are underestimated by the scientific community.

The number of citations for the published papers reflects the impact of studies within the scientific community. Based on the set of papers that the units/groups had selected as their most important, the mean number of citations was 6.9; and for the highest-ranking research unit this mean was 15.8. Based on these figures, the impact was considered good. When scrutinizing these figures, it should be kept in mind that the citation rates are not necessarily directly comparable across various fields of research.

An attempt was made to obtain comparable data on productivity from different groups/units. It turned out to be difficult to get reliable estimates of person years allocated to research relevant to the context of this evaluation, and thus the evaluation scale was limited to acceptable/unacceptable. The productivity rate was considered acceptable for all groups in general, but unacceptable for some single projects. The evaluation group wanted to acknowledge the exceptionally high productivity of the Unit of Sports and Exercise Medicine, Helsinki, due to the Unit's excellent and productive collaborative networking.

National and international collaboration

National networking seemed to function well and was found to involve many universities and research institutes. The Faculty of Health Sciences at the University of Jyväskylä and the UKK Institute form the core structure for biomedical sports and exercise research in Finland. In the Tampere area, networking between the UKK Institute, university researchers and the Tampere Research Center of Sports Medicine seemed to function well - to the extent that at times it was difficult to identify the unit primarily responsible for the studies. Unfortunately, the same does not seem to be true in Jyväskylä. Collaboration between the research units/groups does not function in an optimal way - not even across the departmental divisions in the Faculty. The Department of Health Sciences, the Department of Biology of Physical Activity, the LIKES Institute and the Research Institute of Olympic Sports should form a strong core for scientific work and researcher training in sports and exercise research in Finland. Therefore, every effort should be taken to enhance collaboration and coordination of the activities of these units.

The research groups have wide international contacts that in some cases have resulted in productive joint research projects and publications. Only a few groups have received funding from the EU or other foreign sources. International collaboration should be enhanced and include collaboration with European research groups. This could facilitate obtaining research funding from the EU.

The quantity and quality of researcher training

The quantity of researcher training was considered good. The review found that most students completed their doctoral training at a relatively young age, which has been one of the goals of research policy in Finland. It was noted that it was not always easy to recruit graduate students. Another current problem is the shortage of posts for post-doctoral researchers. Foreign exchange of post-graduate and post-doctoral level trainees was quite infrequent. Mobility among young scientists needs to be encouraged – particularly within the EU where the funding potential for this purpose is underutilized.

The quality of researcher training varied substantially from one unit to another, the general tendency being that big units performed better than smaller ones. It is recommended that

graduate students be registered in an appropriate graduate school. This would help to secure proper tutoring and appropriate planning of their formal training. All graduate students should be actively linked to a university department. Attending international scientific conferences is an important form of training, and this should be offered to all doctoral students.

Additional observations

Many of the research groups seem to be very dependent on funding from the MoE. Research funding from the MoE is meant to be directed towards applied research into sports and exercise, and research that provides reliable information for public decision-making and planning. However, progress in basic science is a prerequisite for progress in applied research. Sometimes, the relevance of basic science research, for instance on the musculoskeletal system, can be rather remote from its applications. The Academy of Finland should be the primary financier for such basic science research. The research groups should have no excuse for not reaching a high enough scientific level to succeed in the competition for funding from the Academy. In general, the research units/groups are encouraged to actively apply for funds also from other sources besides the MoE and the Academy.

A serious threat to the future success of research is the shortage of funds to replace outdated or malfunctioning equipment. This problem was obvious in the university departments and the UKK Institute. University core funding has decreased over recent years while the proportion of external research funding has increased. Adequate overhead allowance in research funding could help to alleviate this problem. In the sports medicine centers, the equipment primarily serves for testing and clinical work, and secondarily for research. It does not seem appropriate to supply these small units with sophisticated equipment without sufficient technical support. Research requiring sophisticated technical equipment is best done in larger units that have adequate resources and facilities.

Short-term, one-year funding cycles create an insecure research environment, and make the long-term planning of future research programs difficult. They also influences security of employment for young researchers, and make the choice of research as a career less attractive. The same is true for the practice of awarding personal grants without paying any social security contributions.

Organizationally, sports and exercise research are split into too many units, many of which were considered to be too small to reach the desired critical mass. It was quite obvious that in all respects the established big units do better than the small ones. The major centers in this field of research are the UKK Institute, the Department of Health Sciences and the Department of Biology of Physical Activity of the University of Jyväskylä. Each of these centers has well defined strategy and research programs, good leadership, a sufficient critical mass with multidisciplinary expertise and the necessary infrastructure. These units also have a good environment for graduate students to learn research skills. Most of the smaller units plan their research activities in an opportunistic manner on a "study-to-study" basis. Their research directions are fully dependent on the interest and skills of the persons involved in research, which makes the unit's research very vulnerable. This is proved by the fact that during the evaluation period two of the centers, the Paavo Nurmi Center and Department of Sports Medicine of the Oulu Deaconess Institute went through a transition that had a major impact on the performance of units.

Sports medicine centers receive their core funding from the MoE. This funding is classified as part of research support. The role of the centers is multifaceted and includes research,

specialist training in sports medicine, and local services. Research profiles vary substantially between the centers. At one extreme, the Kuopio Research Institute of Exercise Medicine has a high profile with a clear research strategy while at the other some centers act on a "study-to-study basis". In many cases, the centers seem to have provided facilities for data collection in support of epidemiological studies. Splitting resources into many small units is not the most efficient way to allocate resources to research. At the time of its evaluation, one of the units was led by an inexperienced junior scientist - all research units should be led by senior scientists.

A separate overall evaluation of sports medicine centers is recommended - the evaluation group could not take into account any functions of the centers other than research. From the research point of view, it would be better to have fewer but stronger units with sufficient critical mass to successfully conduct high quality research programs and ensure sustainability.

6.2. Discipline-specific evaluations

6.2.1. Epidemiological research of the relationship between physical activity, fitness and health

The scientific quality of epidemiological research into physical activity, fitness and health is excellent and its *relevance* is also very appropriate. This is proved by the respectable number of publications in the highest-ranking journals and also by high citation rates.

Research in this area has provided new information on the effects on health of a physically active lifestyle and sports on chronic diseases, such as coronary heart disease, diabetes, cancer and musculoskeletal disorders (osteoporosis, disc degeneration, osteoarthritis). It has also provided evidence of the adverse effects on health of low level physical activity and poor physical fitness as well as excessive physical stress from sports. The results concerning the benefits of moderate-intensity physical activity and dose-response relationships are of the utmost importance from a health promotion and public health perspective. Scientifically valid methods of assessing physical activity and health-related fitness in different age groups have been and are still being developed. Resources have been allocated to design "products" that can be used in health care and community interventions. This developmental work has contributed also to European collaborative research and surveillance programs. Injury rates at home, in leisure time and in different sports have been estimated. Several projects have addressed the question of genetic influences on physical fitness and the relation between physical exercise and health, based on twin studies or the analysis of DNA polymorphisms. Some interesting results have already been obtained. The significance of the information on genetic susceptibility remains to be seen in health promotion and the prevention of adverse health effects. Laboratory methods to assess r health outcomes and their determinants are up-to-date, but very little funding has been available for the renovation of facilities and new equipment. This situation, if it continues, can threaten the future development of high-quality research.

In observational epidemiology, several unique cohort studies with long-term follow-ups are going on. Many of the cohort studies have been designed specifically to study health-related physical activity as one of the primary objectives (e.g. the Kainuu Study, the Evergreen Study, the Kuopio Ischemic Heart Disease Study, the Finnish Athlete Cohort Study). Some other research programs, designed for more general purposes, have provided an excellent base to study the determinants of physical activity and the health effects of physical activity (e.g. the Finnish Twin Cohort, the Finnish Young Twin Cohort, the 1966 Birth Cohort of Oulu). A prerequisite for the successful execution of these large cohort studies with long-term follow-ups has been that the units in charge, primarily the UKK Institute and university departments, are big enough and stable enough to secure the continuity and know-how necessary for the management of these demanding studies. In some observational studies innovative study designs have been used. As an example, a study of the effect of unilateral training on growing and mature bones among tennis and squash players may be mentioned.

Well-conducted cohort studies provide the best evidence that can be found from observational epidemiology, and therefore they are very valuable. They are time-consuming, require a lot of resources and as such they are a challenge also for the funding organizations. Many of the cohort studies have succeeded in obtaining funding from the Academy of Finland and some also from international sources. The current policy of the Ministry of Education,

one of the major funding organizations, only awards funds on an annual basis. This renders the long-term planning of large research programs difficult.

In experimental epidemiology several successful randomized controlled trials to test the effectiveness of physical exercise interventions on various fitness and health outcomes have been completed and some are ongoing. Intervention research is obviously one of the strengths in the area of sports and exercise medicine research in Finland. The intervention research has provided evidence of the health effects of aerobic training, the dose-response of the effect of moderate to low intensity exercise that approaches the minimal beneficial dose, the effects of walking training on weight maintenance after weight reduction, the effect of high-impact exercise on bone mineral density, and the effects of physical training on skeletal muscles and strength in old age. The evidence stems from strictly controlled settings and hence a future challenge will be to test the effectiveness of the interventions in community trials. These trials should be evaluated using a sound scientific approach, which is not the case, for instance, for the ongoing Fit for Life Program.

National collaboration is extensive; it seems to function well and is productive. Epidemiological projects mostly require a multidisciplinary team of research scientists, and therefore networking is often a prerequisite for successful research. Most of the sports and exercise medicine groups/units are too small to be independent actors in large-scale epidemiological research, but they have successfully built up collaboration with academia, the UKK Institute and other research institutes, as well as with each other. The groups/units often provide facilities for collecting data on clinical and laboratory tests. In many cases, this networking has made it possible to include aspects of health-related physical activity in research primarily targeting other goals. Productive *international collaboration*, resulting in joint publications, has not been very common. The reason may be the nature of the research; in which case international collaboration may not produce any significant added value. The research groups have, however, active contacts with their international peers. In the future, particularly, evolving European collaboration should be utilized to create new opportunities in this field of research as well.

Training of a new generation of researchers, competent in epidemiology, has been successful. Currently, a major problem is the small number of post-doctoral positions.

Conclusions and recommendations

The general level of epidemiological research was very good with some excellent achievements of both international and national significance from both the scientific and practical point of view.

Continuation of valuable high-quality cohort studies is encouraged. Also, further studies focusing on the dose-response relationship between physical exercise and its beneficial and also potentially harmful (trauma) health effects are needed in all age groups from childhood to old age. Such research will improve the knowledge base for health promotion and preventive programs for many chronic diseases.

Community interventions with valid evaluation of their impact are a future challenge.

Large-scale epidemiological studies need to be conducted by stable institutes (that are also big enough) and research groups with sufficient experience and infrastructure. It is highly recommended that experts in sports exercise biology, physiology and medicine collaborate

with epidemiologists in various research institutes and universities, and include research questions in their studies that are of interest to sports and exercise research.

The benefits of physical exercise in the treatment and rehabilitation of patients with various diseases or injuries warrant further research.

It is also considered important to carry out national descriptive surveys to have reliable information on the status of physical exercise among the population.

Methods development for valid assessment of functional capacity as well as health-related fitness needs further research.
National networking has been efficient, although in many cases international networking has not been necessary. Building an international network particularly at the EU level can open new opportunities.

6.2.2. Biomechanics, rehabilitation, traumatology

Biomechanics

The scientific quality of Finnish research that has focused on biomechanics was found to be excellent and a welcome complement to outstanding clinical research programs. Research in this area was found to be highly relevant to athletes, active individuals and the elderly. Overall, the review revealed that Finnish biomechanics research was based on innovative hypotheses that were matched with well thought-out experimental designs and proper statistical methods. For the most part, the researchers used state-of-the-art instrumentation and methods to evaluate biomechanics and this led to publications in widely respected journals that have good impact factors. The availability of biomechanics training was considered to be limited at most institutions, the course work was of a fair quality or at times unavailable, and the level of mentoring was fair.

The review of the Järvinen group found that the scientific quality ranged between very good and excellent. Some of the most important biomechanics research has focused on osteoporosis and this has been recognized at national and international levels. Osteoporosis research has characterized the basic processes related to the interaction of the shape, material properties and strength of bones, and the key external stimulus, mechanical loading. This group was the first to demonstrate that recovery of bone loss produced by the lack of mechanical stimuli is both dose-dependent and bone-site specific. This has become an important consideration for the treatment and rehabilitation of hip and spine fractures. Another unique contribution has been the observation that the maintenance of mechanical loading-induced bone gain requires higher than normal levels of physical activity. This has led to the recommendation of new types of exercises for individuals interested in treating subjects with decreased bone mineral density, and for maintaining bone density levels in the elderly. Investigators also developed some of the key methods for studying bone biomechanics. For example, they have shown that bones are capable of adapting to their mechanical characteristics without necessarily simultaneously adding additional mineral to their structure. This is a key finding because it has implications with regard to how we quantify the outcome of investigations designed to increase bone health. Most of the tools used by the investigators have been thoroughly evaluated and this has led to an improved understanding of the inherent inaccuracies associated with dual X-ray absorptiometry measurements of bone mineral density in vivo. The research group also leads the field with

regard to the development and use of biodegradable materials for the fixation of anterior cruciate ligament grafts. The group introduced biodegradables for the treatment of sports injuries, and this has resulted in benefits such as permitting magnetic resonance imaging and revision surgery. Productivity by this group was considered acceptable.

The review of the Tampere research groups/units revealed that the scientific quality was excellent. Innovative and novel contributions have also been made with regard to treatment of hip fractures –soon to become a modern day epidemic for the elderly. This was considered highly relevant work that has had an important national and international impact. The research performed at the Tampere Research Center of Sports Medicine focused on several studies of energy shunting external hip protectors for the elderly. This group made significant advances with regard to our understanding of how hip fractures occur, and how to prevent them with passive protective equipment. This represents an important advance with regard to our understanding of the effect of physical activity and impact on the elderly who are at the greatest risk for hip fracture. In addition, the group also evaluated the biomechanical strength of a new fixation device for the treatment of anterior cruciate ligament disruptions. This work combined an innovative design with a new biodegradable material that eliminates the need for a permanent implant for the fixation of anterior cruciate grafts. This approach allows re-operations when necessary, and prevents contamination from magnetic resonance imaging of the knee. This advance has revolutionized the way in which cruciate ligament surgery is performed throughout the world. Productivity by this group was considered acceptable.

The review of the Jyväskylä Department of Biology and Physical Activity revealed that the scientific quality was good to very good. Research by this group has been quite impressive with regard to studies of the biological and biomechanical behavior of muscle and tendon. Specifically, this research group has developed innovative tools for the measurement of tendon and muscle forces in vivo. This has led to several studies of the force-length and force-velocity relationship of muscle at a basic science level. The investigators have developed the tools necessary to measure neuromuscular function, as well as stiffness of individual muscles and joints. Investigators at both national and international level much appreciate these advances. The research done by this group of investigators is unique, and represents the best work in the world with regard to understanding the loads developed during the triple jump, plantar pressure distributions during ski jumping, and aerodynamics during ski jumping. No other group is performing this type of research and all the work done here is truly unique and represents a significant contribution to enhancing athletic and human performance. Productivity by this group was considered acceptable.

The review of the Institute for Olympic Sports found that the scientific quality was good with regard to their studies of sports biomechanics and enhancement of human performance. This work has focused on javelin throwing, shot-put, ski jumping, cross country skiing, and kayaking, and has led to advances with regard to the best way in which athletes should train and compete in these athletic events.

Biomechanics research at the Research Center for Sport and Health Sciences (LIKES) was at the basic science level, and the scientific quality of this work ranged between poor and good. The scientific quality of research into biomechanics ranged from poor to good. The work has provided important input parameters for the development of future biomechanical models of human performance. Of particular note were biomechanical studies focusing on the effect of exercise on bone metabolism. This work was found to be sound science and an exciting investigation because of its unique contribution to the understanding of how loading affects the biological response of bone. This is important with regard to understanding how stress

fractures occur in athletes, particularly amongst young females at increased risk for this injury. Productivity of this unit was considered poor.

In conclusion, the scientific quality of the biomechanics research performed in Finland ranged between good and excellent. For the most part, biomechanics was founded on testable hypotheses that were matched with proper experimental designs and statistical methods. The design of the research was descriptive where appropriate, and mechanistic when needed. The review also revealed that the investigators understood the rationale for their research programs, and only pursued investigations that were novel and produced innovative and significant contributions for literature produced. It was also noted that, in most cases, biomechanics research was directly linked to the clinical environment.

Productivity was found to be acceptable and for some of the groups it was quite impressive. Researchers involved with biomechanics have established collaboration at national, and international level when necessary, and this has led to important discoveries with regard to the development of devices such as new soft tissue fixation systems and hip protectors to diminish the incidence of hip fractures. Perhaps the most impressive aspect of Finnish biomechanics research was its wide scope and diversity with regard to the diagnosis and treatment of sports and activity related injuries. Biomechanics research included investigations of both hard tissue (bone) and soft tissues (muscles, ligaments, tendons, etc.).

There were, however, several concerns. First, and perhaps foremost, biomechanics research done by the clinical groups/units should involve closer collaboration with basic scientists located in university settings. This approach would provide important opportunities for students who are working toward their doctoral degrees, and insight into the planning and execution of research. Although there were isolated cases where this occurred, there were many situations in which it appeared as if clinicians were involved in basic science research that was beyond their expertise. These individuals would benefit from the input of a basic science program, and clearly this is important for students. The second concern was the training given to students in biomechanics. It appears that most trainees obtained very little experience in didactic coursework. This is a very important component which most students should obtain, and it is important if they plan to continue with research after earning their degree. One way to accomplish this would be to establish collaboration with other institutions in Finland. With regard to the direction of biomechanics programs, there appeared to be very little research focused on the biomechanics of articular cartilage in both normal and diseased conditions. This will become an important issue for sports medicine research over the next decade.

Rehabilitation Research

The review of sports medicine rehabilitation research performed at institutions throughout Finland revealed that innovative work has been performed that has led to novel contributions and important advances with regard to the most serious injuries affecting athletes and active individuals. For the most part, the groups/units involved applied appropriate scientific methodology. The most impressive observation that the evaluation group made was that almost all of the research was based on testable hypotheses that were matched with appropriate experimental designs and statistical methods. Most of the institutions used state-of-the-art equipment and measurement techniques, and this resulted in impressive advances

with regard to the treatment of injuries to soft and hard tissue. From this perspective, the scientific quality of rehabilitation research was considered excellent.

Several of the research investigations reviewed involved an immense amount of work and intense commitment by the institutions over long time periods. This represents one of the biggest strengths of the Finnish sports medicine research program. It is obvious that both institutions and investigators are committed to performing properly thought-out and planned rehabilitation research.

Advances have been made with regard to the treatment of musculoskeletal injuries associated with activity. These have focused on children, middle-aged and elderly subjects, and were considered broad in scope. Rehabilitation research in Finland has not focused only on elite athletes, but included those involved with physical activity in general. This comprehensive approach is outstanding and has led to national and international impacts.

Rehabilitation research at the UKK Institute was considered excellent. The research focused on the effects of musculoskeletal injuries and disorders in the bone mineral density of growing and mature bones, and studied the importance of the functional recovery of the injured extremity for the recovery of bone. This research made an important advance by demonstrating that knee ligament tears can create considerable bone loss to the affected limb, and has shown that the loss occurs quite rapidly. Further, recovery of this post-traumatic osteoporosis was found to be slow and incomplete. This research is important because it not only demonstrates that severe knee ligament trauma alters the biomechanics of the knee; it also alters the biological response of bone, and emphasizes the importance of rehabilitation in treating deficiencies in bone mineral density. Another avenue of research that is quite unique with regard to its contribution to the field of sports medicine rehabilitation has been the study of the long-term effect of rotator cuff tendon ruptures on bone mineral density. As with knee ligament injuries, rotator cuff tendon rupture not only alters the biomechanics of the joint, it also produces substantial reductions in the bone mineral density of an injured limb. The investigators demonstrated that, in this non-weight-bearing joint, there is considerable post-traumatic osteoporosis that occurs following a rotator cuff tendon injury. This work emphasized that controlled mobilization and rehabilitation is critical for minimizing bone loss. The investigators also demonstrated that the age of an athlete, or active individual, has a dramatic affect on their ability to remodel bone and heal fractures. Insight was gained with regard to understanding why developing bones have an improved capacity to respond to exercise and physical loading in comparison to mature bones. This work is truly innovative, and has opened a new avenue of research with regard to understanding the management and rehabilitation of fractures in children and adults. Productivity by this unit was found to be outstanding.

Very impressive work was performed at the Tampere Research Center for Sports Medicine with regard to the rehabilitation of chronic and acute knee ligament tears, and ankle ligament tears. These are amongst the most common and severe injuries to affect athletes, and this group performed some of the most impressive rehabilitation research in this field. The scientific quality was found to be excellent and resulted in important contributions at the national and international levels. Specifically, clinical studies that focused on chronic and acute anterior cruciate ligament tears revealed that it is important to reconstruct these ligament tears and use appropriate rehabilitation in an effort to restore normal joint biomechanics and muscle function to knees with these severe injuries. Research also focused on surgical versus functional treatment of ankle ligament tears and revealed that surgery is not necessary to treat these disabling injuries. Instead, a well-controlled rehabilitation program focused on restoring

motion and strength is associated with an improved outcome. This work is important because it has eliminated the need for surgery on disrupted ankle ligaments. This has decreased the pain and morbidity associated with treatment of these injuries. Research also focused on the treatment of patients who have suffered severe tendonopathy, the most important of which focused on tears of the Achilles tendon. This work provided important insight into the mechanisms in which tendons degenerate and rupture.

Research done by the Järvinen group provided important insight into the effect of immobilization (both long- and short-term) on the healing response of skeletal muscle and was considered to be of very good scientific quality. It has provided the scientific basis for treating muscle strains, the most common sport related complaint, and has allowed quantification of the magnitude and duration of the motion needed to ensure formation of a sufficiently strong scar to withstand the biomechanical loading environment induced by the rehabilitation of muscle strains. Further, this work focused on the biological response of healing muscle tears, and shows that non-steroid anti-inflammatory drugs are beneficial in comparison to cortical steroids for regenerating skeletal muscle. Novel research has been done using unique models that have developed an understanding of the interaction between alpha 7 integrin and dystrophin associated complexes during the regeneration of injured skeletal muscle, and the effects of altered biomechanical loading during these processes. This work has facilitated a basic science understanding of the rehabilitation of severe muscle tears and strains. The group also made significant advances with regard to the treatment of tendon injuries. They described the effect of rotator cuff rupture on the skeleton, and defined factors in the treatment of these injures that contribute to the development of osteoporosis. They also described the long-term prognosis of Achilles tendonopathy, showing that the etiology has to do with intrinsic factors because patients initially complaining of unilateral symptoms are prone to problems in the contralateral, uninvolved Achilles tendon.

The Järvinen group also studied the most common graft material used to reconstruct the ACL, bone-patellar tendon-bone preparations. Important advances made here are the identification of the various surgical factors related to long-term success, including the development of patellofemoral arthrosis. The investigators identified the best means of treating patellofemoral arthrosis; which is physical therapy.

One of the more important research investigations that the evaluation group reviewed was the DNASCO randomized clinical trial carried out by the Kuopio Research Institute for Exercise Medicine. This work revealed that genetic factors modify the effect of physical activity on risk factors for atherosclerosis. Although this research does not fit within the framework of classic sports medicine rehabilitation research, it is important for the rehabilitation of middle-aged individuals who are either involved with sports or need to become involved with physical activity to improve their health. This research was well designed, founded on a novel hypothesis and included a comprehensive approach. This group of researchers should be encouraged to continue work. It will have an important impact on both national and international communities.

Similar to the above-mentioned approach, research at Oulu Deaconess Institute was founded on solid experimental design and appropriate scientific methodology. Specifically, the investigators focused on the effect of exercise on bone mineral density and geometry, balance, muscle strength and the likelihood of falls amongst elderly women with severe osteopenia. This work represents a new and innovative contribution to the literature that has both national and international impact. The researchers at this institute also focused on the efficacy of exercise and diet in preventing Type II diabetes in individuals with impaired glucose

tolerance. Although this may not have a direct impact on physically fit athletes, it certainly affects those who are not fit and need to become more active. From this perspective the work represents a considerable advance towards rehabilitating individuals at risk for adverse health outcomes.

Rehabilitation research in Finland was found to be important because it focused on the rehabilitation of individuals who suffer from the most common disabling musculoskeletal disorder, low back pain. For example, work done at the Department of Health Sciences at the University of Jyväskylä focused on the effect of a three-month active rehabilitation program on impairment and disability, and their permanence in subjects with low back pain. This was found to be a key contribution because of the high prevalence of this disease, coupled with what little is known about it.

A similar approach was being performed at LIKES with regard to lymphatic circulation and exercise, and a study of the effects of daily repeated exercise. This research was considered important because it will help develop the link between physical activity and rehabilitation following resection of the lymph nodes. Although this area of research was very important, the methods will only provide indirect results, and the review group questioned whether or not conclusive findings would be made. Some of the best research at LIKES focused on bone health. Specifically, the study on the effect of exercise and mobilization on the extracellular matrix of bone was found to be quite innovative. The research entitled Children First, Establishing Healthy Bones in the Twenty-first Century was recognized as important because it includes studies of both physical exercise and diet on bone health. This work was considered excellent and will have an impact at both the national and international level. The evaluation group considered this research significant, because it will provide an improved understanding of how diet and exercise interact with regard to bone health in developing children, and will provide innovative new contributions to our understanding of the optimal combination of exercise and diet to achieve optimal bone health. This will be accomplished with state-of-the-art outcome measures.

Research performed at the Unit for Sports and Exercise Medicine, Helsinki, has developed an association between physical loading, injuries and osteoarthritis. In addition, it has identified injury profiles of commonly practiced sports. This provided guidelines for the prevention of injuries, and identified the background of many of the symptoms found during adolescence. This work identified common causes for chronic back dysfunction in developing athletes. This research was founded on sound research designs, and is recognized as important at both national and international level with regard to the prevention of sports injuries and osteoarthritis. The scientific quality of this research was considered very good, and highly relevant from the perspective of both the athlete and society.
Research at the Department of Health Sciences at the University of Jyväskylä also led the way with regard to studying the effects of training on subjects with rheumatoid arthritis. Much of what we know about how to treat rheumatoid arthritis has been based on drug therapy and this group provided important insight into the treatment of the disorder with physical activity - an important alternative. In addition, the group also provided insight into the treatment of severe tibial shaft fractures combined with flap surgery, and this work established the best means of rehabilitating these problems that are quite difficult to treat among athletes and active individuals.

In conclusion, the review of Finnish rehabilitation research focusing on sports medicine revealed that the scientific quality ranged between very good and excellent. In most cases, the research was solidly founded on testable hypotheses matched with appropriate experimental

designs and statistical methods. Most of the work was based on novel hypotheses that led to innovative and significant contributions, advancing the field with regard to serious injuries affect both active individuals and athletes. The evaluation group found the rehabilitation research to be impressive because of its wide scope and diversity with regard to the investigation of musculoskeletal disorders. Not only has rehabilitation research focused on what is commonly considered to be sports injuries affecting young, active, athletes, it also focused on injuries that older individuals suffer. This is very important, because the research serves all of society's needs, and has an impressive impact on the entire range of the population. The evaluation group also found rehabilitation research to be impressive from the perspective of the different areas studied. This involved both soft and hard tissue research. There were several concerns noted that, when addressed, would improve the rehabilitation research that is currently underway. To enhance the quality of rehabilitation research, the evaluation group recommended that contacts with universities that have basic scientists be considered. This would allow a translational approach to research where there is a clear link between the research performed and the basic science environment. Almost everything accomplished with regard to rehabilitation research has been completely clinically oriented, and while this represents an important strength, it would be helpful, and at times beneficial, if there were basic science input into the design and execution of rehabilitation research. For example, this would allow future investigations with innovative outcomes measures that are currently being developed in the basic science setting. It would also provide an opportunity for direct communication between the students who are currently in training and the basic science programs. It would also provide trainees with access to the necessary coursework and foster the development of clinical scientists.

Traumatology

The most important advances made with regard to sports traumatology research have focused on anterior cruciate ligament tears, and hip fractures. Research performed at the Tampere Research Center for Sports Medicine focused on anterior cruciate ligament injuries, and this work was considered to be of excellent scientific quality. It identified specific injury patterns and mechanisms of anterior cruciate ligament disruptions. Research by this group led to the development of the best means of treating anterior cruciate ligament tears with different types of graft materials and fixation techniques. The research focusing on hip fractures in the elderly was also considered to be of excellent scientific quality. When one considers that this significant health care concern will increase dramatically over the next several decades, as the population at risk for this injury ages, this research has made a very important contribution. It revealed the incidence, time trends, injury patterns, and mechanisms of hip fractures. It also led to the best means of preventing this debilitating injury with the use of hip protection guards. The evaluation group found that this work was very well respected at both national and international level, and has appeared in very prestigious journals such as The New England Journal of Medicine.

In conclusion, the review of Finnish sports trauma research found that this area of investigation was much smaller in scope compared to rehabilitation and biomechanics research. The approach was considered to be well planned and appropriate in terms of resource allocation. It should continue. The sports trauma research was of excellent scientific quality. It was based on innovative hypotheses that were matched with proper experimental methods and statistical analysis. The work resulted in novel and significant advances with regard to the treatment of common soft and hard tissue injuries. It has been published in widely respected journals with high impact factors and has led to national and international contributions.

6.2.3. Exercise physiology

Exercise physiology deals with the functions of human body and bodily tissues above resting activity level. Thus, exercise is a powerful tool for examining the different functions of bodily systems, and how their interaction works. Even though this statement sounds very clear, it is not easy to define the areas that belong to exercise physiology research, because of overlapping, for example, with nutrition science or biomechanics.

Very little research has been done in the area of the nutritional basis of energy use. The modern imaging techniques (e.g. PET) in Turku provide the potential for high quality research in the future.

At the UKK Institute, a series of studies of a reliable quality was carried out in order to develop practical tools to assess energy expenditure during physical activity. The work relates to the enhancement of so called health-related physical activity (HEPA). The Research Institute for Olympic Sports developed a test for measuring anaerobic capacity (MART), especially for athletes. The work has been published as a special issue with separate articles in a moderately good level journal of sports medicine. Both of these research lines are very relevant for exercise physiology research, and have probably had an impact internationally. From the practical point of view, many exercise physiologists are employed in the physiological testing of energy capacities in athletes and non-athletes, as well as working with HEPA activities. Thus, the area is important as a basis for educating and training professionals in the field.

In the area of the delivery and utilization of energy, the Department of Biology of Physical Activity at the University of Jyväskylä completed an extensive and excellent research line in understanding human neuromuscular function during locomotion. This can also be considered as biomechanical research. It has clearly been the major area for more basic research, focusing on the mechanisms of human locomotion. Otherwise very little has been done in this area. Some contributions have been made on hormones and exercise, and the effects of hyper- and hypoxia on cardiovascular regulation. However, this work was evaluated as being of a modest quality. This area of research is an important one, because it is the central part of integrated physiology, i.e. how the different organs and organ systems are regulated, and what the limitations are in order to provide the optimum performance outcome in health and disease.

Most research into physiology during the evaluation period was in the area of enhancement of energy transfer by training. This traditional area of exercise training was studied in connection with various sports disciplines using a biomechanical, physiological, and psycho-physiological approach. Studies have mainly focused on the determinants of physical performance in cross-country skiing, running, ski-jumping, shooting, javelin throwing, and kayaking. The publications have been quite variable in quality, and many results have been published through non-scientific channels, especially in biomechanics. Clearly, the area is central for exercise physiology, but in science the focus should be more on the mechanisms of training adaptations. Some good quality research has been published on over-training issues, where the interest has been in autonomic nervous system responses and hormones.

Research into body composition and energy balance is not solely that of exercise physiology, but is also related to sports medicine and nutrition research, especially obesity research. The

development of new practical tools at the UKK Institute for the assessment of energy expenditure represents high quality research in this area.

At the University of Jyväskylä, several studies have been carried out on strength training in elderly people. This area is central for sports science because of the ageing population. This science was of a reliable quality, and resulted in a number of important publications. An interesting observation is that children's exercise physiology research seems to be wanting, despite the alarming news about low physical activity levels and low physical fitness levels among young people in Finland.

The prevention of disease is an area more related to sports medicine than to exercise physiology, but exercise physiology forms the basis for the preventive aspects of physical activity. In practice, exercise physiology is needed in different epidemiological projects, for example to document fitness changes during an intervention, or to examine preventive mechanisms. Therefore, the role of exercise physiology has become more central in sports and exercise science in this respect, rather than just focusing on the performance aspect

Some very good research was conducted in the area of clinical exercise physiology e.g. the effects of strength training in different diseased states, such as fibromyalgia and arthritis.

During the evaluation period, some reliable contributions were made dealing with the mechanism of muscle damage. This is clearly a cutting edge area in basic exercise physiology, but in fact not much has yet been done by exercise physiologists in Finland.

The above-mentioned list may not be exhaustive but it shows that the major areas of exercise physiology are covered by some research activity in every case. It must be noted that significant exercise physiology research is also done outside the evaluated groups/units, for example by central hospitals, rehabilitation units, the Finnish Social Insurance Institution, and the Finnish Institute of Occupational Health.

Most research in the evaluated groups/units belongs to applied exercise physiology and is mostly descriptive in nature. The scientific quality and productivity of exercise physiology research in the evaluated groups/units can generally be rated as good.

Conclusions and recommendations

The general view of exercise physiology research in the evaluated groups/units is that the scope and quality is rather uniform with some 'peaks'. In this respect, it is worth mentioning that DBPA in Jyväskylä is a top research unit in their specific area of neuromuscular research. Research into exercise physiology can roughly be classified into four areas:
- Physical fitness, conditioning, or health-related physical activity/fitness (testing, effects, amount of physical activity)
- Performance (athletes, training, and testing)
- Regulatory physiology (metabolism, circulation, neuromuscular etc)
- Epidemiology-related exercise physiology (the role of physical activity/fitness)

Research in the area of physical conditioning has focused on methodological development related in relation to physical fitness testing, and quantification of the amount of physical activity. Most of this research has been conducted by the UKK Institute, and it has had an impact on public health decision-making at an influential level in society. This research also

included many interventions: examining dose-response issues of physical activity and health, sometimes combined with a dieting slant. It is recommended that this line of research be continued because of its relevance to society. It is also recommended that it should be carried out more extensively in Jyväskylä. Health-enhancing physical activity plays an often major role in programs promoting work ability, and in rehabilitation. Thus, this research line is a vast field involving children, young adults, working age people, the handicapped, the chronically ill, and the elderly.

In sports sciences, applied research into sports performance and its development by training will continue to be a key area in exercise physiology. Most of this research has been done by the Research Institute for Olympic Sports in Jyväskylä. However, productivity and quality could be improved substantially while, by the same token, it is understood that applied research will probably have as high an impact value as epidemiological and basic science research. It is recommended that this line of research be continued in close collaboration between the groups/units in Jyväskylä. In addition, a clear distinction should be made between research and service oriented/commercial projects.

As mentioned above, the Department of Biology of Physical Activity has been an exception in the otherwise modest research area of the regulatory aspects of exercise physiology. The PET equipment in Turku may open up new possibilities in the area of energy metabolism and circulation. For the most part, research has used designs which look at responses, and has not gone deeper into examining the role of different factors in regulation. As an example, some good research has been done in the area of heart rate and blood pressure variability, where different types of pharmacological blockade were employed to separate the role of sympathetic and parasympathetic nervous outflow in the regulation of circulation during exercise. It is recommended that this type of research be carried out more extensively. It also means that exercise physiologists should get more training in basic physiology, and should collaborate more closely with basic scientists, for example in molecular biology, biochemistry and genetics. Thus, exercise physiology could penetrate from 'skin level to deeper tissues'. Some suggestions for new research areas in exercise physiology could include such topics as immunology and exercise or functional genomics.

Though it is recommended that research into regulatory physiology go more into mechanisms, it is still a science of integrated physiology, and students of exercise physiology become well versed in it – compared to, for example, medical students in the preclinical phase. Therefore, more use of exercise physiologists in clinical work may lead to fruitful collaboration. However, this also points out the importance of training exercise physiologists well in fields other than just physiology.

Many exercise physiologists work with physical fitness testing in combination with epidemiological projects, for example in documenting the effects of an exercise intervention. This is an important issue, because changes in physical activity/fitness are the prerequisites for expected changes in health-related variables. Therefore, valid documentation of these changes is important. However, in many projects indirect measures for maximal oxygen consumption, or so-called performance tests, are used to evaluate changes in fitness. They are liable to substantial errors. Thus, it is recommended that modern, more valid laboratory-based methodology be used in physical fitness testing.

Finally, much is known about the physiology of exercise in healthy humans. As indicated above, exercise physiology may also have a role in practical work in clinics, but also in

pathophysiology research, as well as in looking at the mechanism by which increased physical activity/improved physical fitness may enhance health.

6.2.4. Molecular biology/basic science

We have recently started to realize the significance of genetic factors also in sports medicine. It is important to understand how biology, environmental factors and physical activity interact with each other and what are the outcomes of these interactions. Basic research in this field focuses on the studies of these interactions at tissue and cellular level. This type of research is very demanding because our understanding of the basic biology (even without modifying factors) of tissues, cells and molecules is very limited. Despite the limitations, this area of research will have an enormous importance and impact in sports medicine.

About half of the evaluated groups here have adopted a molecular biology / basic science approach. Two of the groups, the Helminen group and Kuopio Research Institute of Exercise Medicine (KRIEM), rely heavily on it. Other groups such as the Department of Health Sciences at the University of Jyväskylä, LIKES, the Unit for Sports and Exercise Medicine, Helsinki, and the Järvinen group also use this approach. All of the basic research goals such as understanding molecular level events in aging, the repair of skeletal muscle and joint loading, and identifying genetic risk factors in atherosclerosis, lumbar disc disease and osteoarthritis, are excellent and considered highly relevant in sports medicine.

The quality and quantity of basic research is in general, however, considered to be only fair. This is a new field of research in sports medicine, and in this light it is understandable that for the most part there is no long-term basic research tradition in the groups, the facilities are not adequately equipped for basic research, and the scientists in these groups are not well trained as basic scientists. All this is applicable for all but the Helminen group. The Helminen group has know-how, a long- term basic research tradition and excellent facilities for this type of research.

Comments and recommendations

To improve the quality of basic research in sports medicine, it is strongly recommended that groups should establish close contacts and collaborate with basic scientists in universities and / or recruit basic scientists.

Especially, projects that rely heavily on basic research methodology, should build "in-house" expertise in molecular biology. This is especially important for the Kuopio Research Institute for Exercise Medicine.

More effective training of students in basic research is equally important. For the most part, this type of training in the groups is less common. It is also advisable to send students to other laboratories in Finland and abroad for short visits, if the group itself cannot arrange specific training.

Basic research requires also a good level of funding. The basic research funding level is relatively low in all the above-mentioned groups, preventing any effective development. Funding should be more actively sought from the Academy of Finland, the EU and various foundations.

6.3. Evaluation of research groups/units

6.3.1. UKK Institute

Overview

The mission of the UKK Institute is to promote public health through healthy living habits, especially health-enhancing physical activity. The Institute carries out its mission by conducting scientific research, education and training, by disseminating information, and by participating in international collaboration.

The UKK Institute was founded in 1980 and is owned and funded by the Urho Kaleva Kekkonen Fitness Institute Foundation. The Board of Trustees of the Foundation, consisting of representatives from the government, political parties and non-governmental organizations in the field of sports and health, makes all the key decisions..

A major part (62 %) of the Institute's financing comes from the Slot Machine Association (RAY). Smaller amounts of funding come from research grants, training proceeds and services. The gross expenditure of the Institute totaled FIM 14,5 million in 2000.

The UKK Institute has its own building, designed and equipped for the use of the Institute.

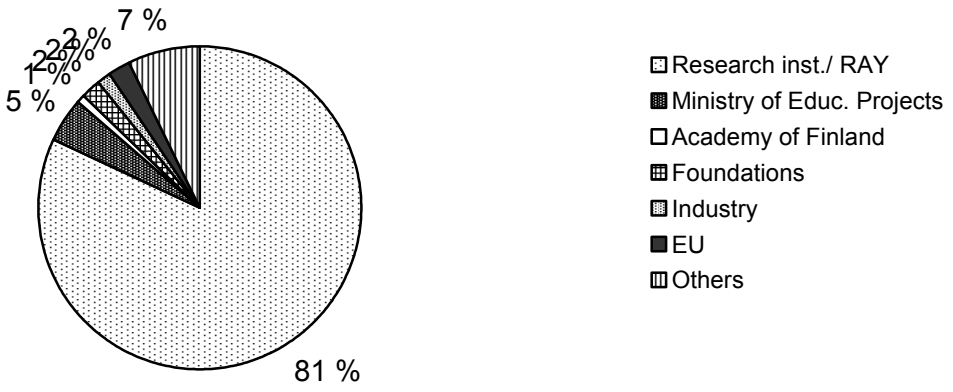
It employs nearly 60 people from the medical, biological, social and behavioral sciences, plus auxiliary staff. Prof. Ilkka Vuori was its director until 31.5.2001 followed by Docent Mikael Fogelholm.

The UKK Institute is organized according to the areas of research that are pursued. These include: 1) Health Enhancing Physical Activity, 2) Health-Related Fitness, 3) Epidemiology of Living Habits and Health, 4) Physical Exercise and Weight Maintenance, 5) Assessment of Energy Expenditure Based on Heart Rate, and 6) Physical Activity in the Prevention of Osteoporosis and Related Fractures. All the above research units are well organized, and matched with researchers that bring the necessary expertise to the group.
The building was constructed in 1983, and has over 60,000 sq. ft. of space for staff, laboratories (chemistry, physiology, biomechanics, anthropometry, sauna), rooms for clinical examinations and physical therapy, meeting rooms, fitness room, an indoor walking/running track, and an auditorium.

The UKK Institute has equipment necessary for the measurement of aerobic capacity, muscle strength, bone density, body composition, intravascular atherosclerosis, and cardiac function. In addition, there is adequate equipment for aerobic and strength training, data processing, library services, and telecommunications.

Review of the facility, and discussions with the researchers, revealed that advanced equipment for the testing and training of neuromuscular function in bone studies, and musculoskeletal and motor functions in the health related fitness research program is needed. If these research programs continue to be at the forefront of their field, there should be funding made available to this institution to buy the necessary neuromuscular and musculoskeletal equipment.

Sources of funding of the UKK Institute 1995- 2000 as estimated by the research unit itself.
Main Areas of Research



Research at the UKK Institute is organized into six different areas. These research areas and ongoing projects in 1995 – 2000 were as follows:

I Health-Enhancing Physical Activity
1. The Kainuu Study on Living Habits and Health: Physical activity and health
2. Risk factors for atherosclerosis
3. Dose-response of low-intensity exercise, and health in post-menopausal women
4. Effects of brisk walking on fitness and disease risk factors in middle-aged men and women
5. International Physical Activity Questionnaire (IPAQ)

II Health-Related Fitness
1. "International Study on Physical Activity, Fitness and Health", including a doctoral study development of a Health-related Fitness Test Battery for Middle-aged Adults
2. A study "Feasibility and Health-Related Content Validity of a Health-related Fitness and Functional Performance Test Battery for Middle-Aged and Older Adults," including a doctoral study "Effects of Physical Activity and Other Living Habits in Middle-age on Functional Ability and Health in Older Age"
3. Motor ability and skills among adults: health enhancement by means of physical activity and counseling
4. Physical activity, fitness and health: a further study on the national HEALTH 2000 – project conducted by the UKK Institute

III Epidemiology of Living Habits and Health
1. A doctoral study "Associations of Smoking, Alcohol Consumption and Physical Activity with Health and Health Care Utilization"
2. A doctoral study "Effects of Physical Activity and Other Living Habits in Middle-age on Functional Ability and Health in Older Age"

IV Physical Exercise and Weight Maintenance
1. Effects of walking training on weight maintenance after a very low-energy diet in premenopausal obese women.

2. Effects of walking or resistance training and dietary counseling on weight maintenance and metabolic syndrome in overweight men.

V Assessment of Energy Expenditure Based on Heart Rate
1. Assessment of physical activity and energy expenditure in overweight women
2. Factors affecting the relation between heart rate and energy expenditure during exercise
3. Use of heart rate in the prediction of daily energy expenditure.

VI Physical Activity in Prevention of Osteoporosis and Related Fractures
1. Effects of unilateral physical activity on mass and size of growing and mature bones and changes in activity-induced bone gain with decreased training
2. Contributions of calcium intake and physical activity to bones of healthy women at different ages
3. Effects of physical activity on bone mass, size, geometry and strength: a lifespan approach
4. Effects of musculoskeletal injuries and disorders on bone mineral density of growing and mature bones and the importance of functional recovery in an injured extremity for the recovery of the bone
5. Development and evaluation of bone research methodology with special emphasis on the effects of physical loading on bone structure

Productivity

Productivity in the six areas of research mentioned above has been acceptable. In all, 184 peer-reviewed publications were recorded. Each of the research groups has established an outstanding track record with both national and international peer reviewed scientific articles based on their work. This work has appeared in well-respected journals that have high impact factors, and the work is well cited.

Scientific Quality

The scientific quality of each of the above-mentioned six areas of research has been excellent. All the work reviewed was found to be original, and innovative. Studies were hypothesis driven, and the hypotheses were matched with appropriate experimental designs and statistical analyses. The rationale for the research hypotheses was always well defined and clear, and served as the basis for the research. In addition, the researchers established a clear link from the work done by their group and the clinical/rehabilitation environment and, when appropriate, a link back from the clinical/rehabilitation environment to athletes and the Finnish population was clearly articulated. From this perspective, the relevance of the work performed at the UKK Institute to the needs of athletes and society was considered outstanding. Researchers at the UKK Institute should be encouraged to maintain and build on the same research avenue. One suggestion was to consider studying how physical activity combined with a proper diet affects the musculoskeletal health of individuals.

Collaboration

While there has been little international collaboration, all the research performed at the UKK Institute has had an international impact and has led to interaction. At a national level, collaboration has been very good and this is demonstrated by shared publications.

Researcher Training

The quantity and quality of training was considered to be very good. The students seem to be well supervised and well directed, and this is reflects well on the faculty. It appears as if the faculty directs the students with regard to their research pursuits, and the students do not appear to undergo formal coursework. The evaluation group felt that a connection with the academic world and a university setting should be encouraged, and this should be developed with the idea of offering formal coursework to the students. In addition, it was recognized that the UKK Institute should receive some funding to reflect the time and effort that is spent mentoring students and helping them pursue their advanced degrees.

Conclusion and Recommendations

The strengths of the UKK Institute lie with the impressive background and experience of the researchers. It has established a long tradition of internationally recognized research that is considered excellent by their peers, and the large number of outstanding publications in well-recognized peer-reviewed journals is evidence of this. The research performed at the UKK Institute is grounded on sound hypotheses that are matched with appropriate experimental designs and statistical analyses. The work that was reviewed was found to be original and innovative and, for the most part, the publications were new contributions to the field. This represents an important strength, because it indicates that the UKK Institute leads the field.

The UKK Institute is encouraged to continue with their research into the effects of physical activity and mechanical loading on bone, bone structure, and the mechanical properties of bone. They have the necessary equipment (a peripheral QCT), a suitable environment, and a patient base upon which to perform this work. This is not so at most institutions. This represents an area where the UKK Institute can make a unique contribution that will help further our knowledge with respect to bone health.

The UKK Institute is encouraged to continue pursuing their prospective randomized control trials that are designed to examine the effects of strength and balance training on muscular performance, balance, gait, and bone mass and geometry in elderly people. It may be important to begin to consider international multicenter trials that incorporate the outcomes of falls and fall-induced injuries (osteoporotic fractures) .

The UKK Institute is also encouraged to continue examining the effects of new training modalities and devices on bone and musculoskeletal performance. It may well be that they can develop new interventions that produce substantial musculoskeletal as well as bone benefits. In part, one could envision studies that focus on the effect of different types of vibration inputs on bone (e.g. low amplitude-high frequency, etc.).

It is also important to continue with the implementation of research focused on the consequences of diet combined with physical activity on health outcomes. One approach to this would be to design a study that would test the hypothetical relationship between diet and exercise on gene expression, and how this affects lypo-protein-lypase (a key element for hydrolysis of triglycerides).

6.3.2. Department of Health Sciences (DHS), University of Jyväskylä

Overview

The Department of Health Sciences is a multidisciplinary research and educational unit in the field of health sciences. The disciplines represented include physiotherapy, gerontology, public health, sports medicine and health education. The students are able to take courses in both health sciences and sports sciences. The Department has more than 300 students of health sciences. It aims to educate experts skilled in teaching and research, and in administration and planning for health organizations.

Research focuses on the promotion of health and functional capability, and the prevention of disease and, especially physiotherapy and rehabilitation. Gerontological research is being carried out within the Finnish Center for Interdisciplinary Gerontology in the University of Jyväskylä.

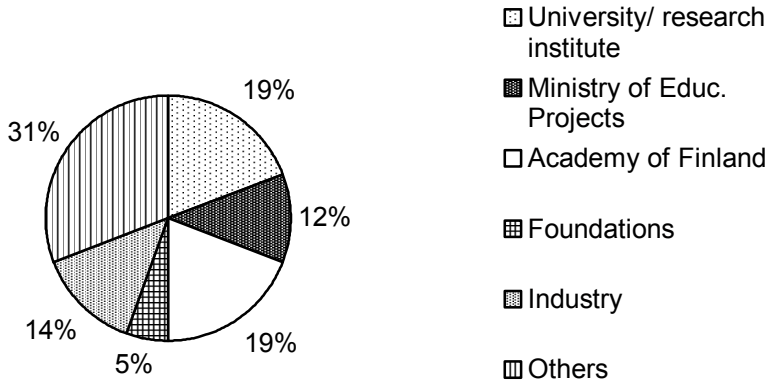
Core funding for the Department comes from the budget of the University. The Department gets additional funding from research project funding (The Academy of Finland and the Ministry of Education), collaboration with industry and the EU.

Research facilities include a) Sports and health laboratory (built in 1989), b) Main building of the Faculty and c) Finnish Center for Interdisciplinary Gerontology (built in 2000).

The total number of staff at the Department was 75 persons in the end of 2000. This included 19 persons in teaching positions, 16 docents (not full-time), 4 office workers, 3 members of technical staff, 15 full-time doctoral students, and 4 statisticians. The Head of the department is Prof. Eino Heikkinen.

Due to a significant increase in DHS's personnel during the 1990s, the facilities in the sports and health laboratory have become too small and there are plans to build a new laboratory linked to the present laboratory. Due to insufficient funding from the University, it has not been possible to purchase new equipment during the last 10 years, allocate enough funding to supplies (e.g. for biochemical analyses), or fund participation in international congresses.

Sources of funding of the DHS 1995- 2000 as estimated by the research department:



Main areas of research

Research at the DHS is characteristically interdisciplinary. The main research areas/disciplines and projects in 1995 - 2000 relevant to this evaluation focus on

I Physical exercise, health, functional capacity and aging (Gerontology and public health)
- The Evergreen project
- Finnish Twin Study on aging (FITSA) and international collaborative projects
- Effects of strength and endurance training in elderly women
- Bone and muscle structure and function in relation to exercise and estrogen replacement
- Studying bone with computed tomography and ultrasonography
- Effects of aging and exercise on speed performance
- Bone health projects (These projects are evaluated in connection with LIKES)

II Extracellular matrix, aging and repair of injured skeletal muscle

III Sports medicine
- Twin Spine Study
- Health promotion by physical activity
- Acute and long-term effects of androgenic anabolic steroid self-administration on physical health and fitness in strength trained persons
- Acute and long-term effects of exercise and training interventions on physical performance, functional capacity and symptoms of the disease in fibromyalgia

IV Physiotherapy
- ACRE. Active rehabilitation of subjects with musculoskeletal disorders and impairments

Productivity

The productivity of the DHS was rated as acceptable. In addition to a good track record of international peer-reviewed and other scientific articles, researchers at the DHS have been editors or authors of several books and also actively disseminated information of their results to the Finnish public through national scientific and popular articles.

Scientific quality

In terms of overall assessment of the impact factors of journals, the track record of the DHS is moderate, but for the 5 best of the most important publications listed by the unit, the impact factor was high (5.8). The average number of citations was 21.6 for the 5 best publications, which reflects a good impact.

The DHS has a long tradition of studying *physical exercise, health, functional capacity and aging*. The overall rating ranges from good to very good. In-depth longitudinal data collection is still ongoing for elderly men and women; the Evergreen project and the Nordic collaborative project NORA. Data have been collected in the FITSA project in which the effects of long-term physical activity and genetic factors on old age and frailty are being studied. The approach in FITSA is innovative and the study material unique. The research program has provided new information on the positive effects of physical activity, e.g. on mental health, physical performance, autonomy, and survival among elderly people. Methods for the assessment of functional capacity and bone structure have been developed and have

led also to commercial applications. The effects of strength and endurance training in elderly women as well as the effect of estrogen replacement and exercise on bone and muscle structure have been studied in randomized controlled trials. A novel marker for bone resorption has been found. Methods to study the density and geometry of bone have been developed resulting in two US patents. A project studying the effects of aging and exercise, and maintenance of speed performance has been started. This research question is important but drawing generalized conclusions from the results is a matter of concern when the subjects are athletes.

About one fifth of the peer-reviewed international articles of this research program appeared in the highest-ranking specialized journals in the field, but no publications in the highest-ranking general journals, even though this area of research is of considerable public health interest today.

The research program has an unambiguously high relevance to society, and is also very important from the point of view of physical exercise culture. The DHS plays an active role in pursuing the implementation of the study results in practice, such as developing physical exercise programs for the elderly. The DHS has gained an outstanding international reputation for research into physical exercise, health, functional capacity and aging, as indicated by several awards and invitations to give lectures at international forums.

Extracellular matrix, aging and repair of injured skeletal muscle. The overall rating is good. PI Kovanen worked at the DBPA until the beginning of 1997, when she started working on this experimental project at the DHS. The research would benefit from a clearer formulation of hypotheses. Approaches using knock-out and mutant mice carry great potential but are very demanding. The collaboration network is good both nationally and internationally. No publications are available yet. The evaluation group had concerns about the suitability of the research environment for this work and the research group was weakened when a key senior scientist left the university.

Research into sports medicine. Development of research into sport medicine has been hampered by a professor's leave of absence for most of the evaluation period. There has been uncertainty about the duration of the appointment of the acting professor, who therefore has not been able to make long-term plans. The major research program was the Twin Spine study investigating the determinants of musculoskeletal degeneration (intervertebral disc, back pain, function, joints and bone density). Two doctoral dissertations were completed at the DHS, but most of the work in the program was done elsewhere (in the USA and Canada with Finnish collaborators). The research program has been very productive and gained international recognition e.g. in the form of the highly esteemed Volvo Awards. This project was the first one to show the effect of a specific gene polymorphism on disc degeneration. About half the publications appeared in high-ranking specialized journals in the research area. The overall rating of the scientific quality of the Twin Spine research program is excellent. The research program has added to the knowledge of the etiology of disc degeneration. It is of high relevance for the understanding of the health effects of physical exercise, but with regard to sports medicine the scope is rather narrow. Other research activities in sports medicine were not evaluated due to sparse information in the self-report.

Research into physiotherapy/rehabilitation. Scientific quality was rated as fair**.** A PC-program and questionnaires and diaries were developed to assess physical activity at work, while commuting, during leisure time and other activities. Ultrasonography in assessing the effects of rehabilitation on the muscles, determinants of disability in patients with inflammatory

rheumatic disease, effectiveness of exercise programs in low back pain patients, and water exercise were investigated. Productivity was acceptable. One paper was published in a high-ranking journal in the field, others in mediocre journals. The nomination of the professor of physiotherapy has been a long process. Prof. Esko Mälkiä was appointed in the recent past and no major research programs have yet been established.

Collaboration

Both national and international collaboration was rated very good. The DHS has a wide and productive collaboration network. Nationally, there is collaboration locally with various university departments, and with other universities, research groups/units, and hospital departments. The Finnish Center for Interdisciplinary Gerontology is currently conducting more than 20 studies in the field of ageing research, including research into the effects of physical exercise on health and functional capacity. Collaboration with the different departments of the City of Jyväskylä has been an important element in research focusing on human ageing. It seems that collaboration within the Faculty of Sport and Health Sciences could be improved. Internationally, collaboration extends from the Nordic countries to the USA, Canada and China, but collaboration at the European level could be increased. The DHS is a WHO Collaborating Center in the field of Healthy Ageing.

Researcher training

Altogether 9 doctoral theses were completed during the evaluation period. For a unit of this size, the number is not very high. The mean age at graduation was 40.3 years and the average length of training 8.3 years, both figures being rather high. This is due to the background of the students with professional training before entering the university. Two post docs were training abroad. In general, willingness to post doc training abroad has not been very high.

Conclusions and recommendations

The strength of the DHS is its long tradition and internationally recognized excellence, and its interdisciplinary national and international collaboration in research into physical exercise, health, functional capacity and ageing. Other lines of research have not developed as strongly due to the long leave of absence of one professor and a delay in permanently filling a vacancy for another. This has also hampered the creation of intradepartmental collaboration with a potential for synergy. Cuts in the university's core funding have not allowed adequate renewal of the equipment and facilities during the evaluation period.

It is recommended that

- in the planning of the DHS's new strategy for 2000-2015, clear goals be set for the underdeveloped areas of research taking into account the great potential for interdisciplinary work by enhancing intradepartmental collaboration.
- experimental physiological research be concentrated in the DBPA to create sufficient critical mass; collaboration with the DBPA should be nurtured.
- funds for the renewal of necessary research equipment and facilities be provided from the University's budget.
- international collaboration particularly within the EU be enhanced
- special attention be paid to recruitment graduate students to doctoral training and to the quality of this training; the DHS has a major national responsibility for such training.

6.3.3. Department of Biology of Physical Activity (DBPA), University of Jyväskylä

Overview

Research in the Department of Biology of Physical Activity (DBPA) concentrates on the basic interaction between physical performance and biological factors in the human body. The phenomenon is investigated through two research program: biomechanics and exercise physiology. The department devotes 50% of its research projects to basic research into exercise biology.

The Department offers courses within the Faculty of Sport and Health Sciences in three specialized areas: biomechanics, exercise physiology, and coaching and testing science. These areas are well represented in the various curricula, such as coaching, physiotherapy, and fitness testing. In addition, DBPA is responsible for teaching basic biomedical sciences to all students in the faculty.

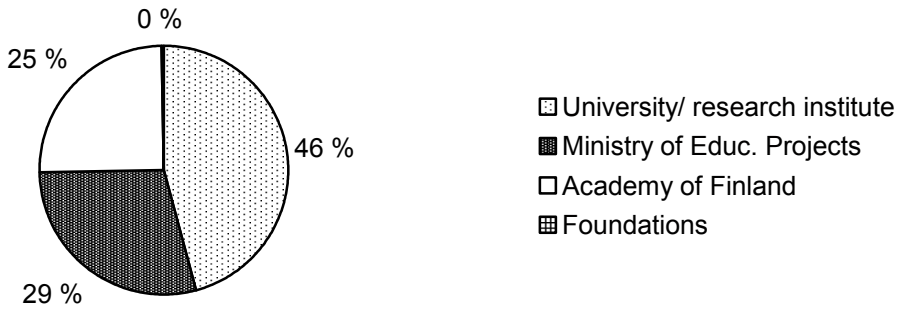
Core funding for DBPA comes from the university's budget. DPBA gets additional financing from research funding (the Academy of Finland and the Ministry of Education), collaboration with industry, and the EU.

DBPA occupies two separate buildings. The teaching laboratories are situated in the main building of the Faculty of Sport and Health Sciences, and the research laboratories in the Sport and Health Laboratory.

DBPA employed 41 persons at the end of 2000. This included 12 in teaching positions, 6 docents (not full-time), 3 office workers, 5 technical staff, 9 full-time doctoral students, 2 statisticians, and 4 laboratory staff. The Head of DBPA is Prof. Paavo V. Komi.

Since 1997, a new unit called the Neuromuscular Research Center has operated under the DBPA.

Sources of DBPA funding 1995- 2000 as estimated by the department itself.



The main research areas are:
1. Neuromechanical behavior of human skeletal muscle during normal locomotion
2. Neuromuscular fatigue and muscle damage
3. Motor unit recruitment and reflex sensitivity in different types of muscle actions
4. Strength and power training

5. Rehabilitation and physiotherapy
6. Sports-related performance profiles and technique analyses

Productivity

A total of 121 international peer-reviewed journal articles was published in 1995-2000. In this respect productivity has been acceptable.

Quality

The scientific quality at DBPA varies from fair to excellent. In general, it was rated very good, though the publication venues were modest with respect to quality.

Neuromechanical behavior of human skeletal muscle during normal locomotion

Jyväskylä has a long history in this area of research, and it is one of the key areas in exercise physiology. Prof. Komi has directed an excellent research line in the understanding of human locomotion at neuromuscular level. One of their unique techniques is the fiber optic in vivo measurement of tendomuscular forces. Reflex regulation of locomotion research is another outstanding field. The research done in this area has gained several international awards for the group, and the work done by DBPA is mentioned in major textbooks.

However, it must be noted that the publication venues for the most important articles (as reported by the group) have been modest. The research itself is of excellent quality.

Neuromuscular fatigue and muscle damage

In this area of research, three different lines are indicated. The first of these, 'fatigue mechanisms', is closely linked to the neuromechanical behavior of human skeletal muscle described above.

The second research line is related to muscle damage, and the mechanisms underlying it . The research line is of a very good quality. Researchers have found new markers for the identification of muscle damage. The utilization of molecular techniques in exercise physiology can be seen as a new frontier.

The third line of research is a mixture of projects including heart, hormone, and lymphatics physiology in relation to exercise. The research done in this area seems to be fair in quality, other institutes having done a large share of it, with DBPA as a collaborative partner.

Motor unit recruitment and reflex sensitivity in different types of muscle action

A basic tool for this research area is electromyography, and DBPA has again a history of expertise in such measurements. This research is closely connected to the areas mentioned above, but is not new. This was considered to be good quality research.

Strength and power training

Prof. Keijo Häkkinen is the principal person directing this area of research. It has dealt with diverse areas of strength and power training, including neuromuscular, hormonal, and

mechanical adaptation. The populations studied have also been diverse including athletes, elderly people and patients. This line of research is good, especially because it has tried to expand the area of strength training to other populations than athletes. Clearly, it has also stimulated interdepartmental collaboration in the faculty. The quality of publications is, however, rather modest. The effects of physical training is a key area of exercise physiology research, and thus this line of research can be seen as very important also in the future, especially for students of this faculty.

Rehabilitation and physiotherapy

The area has close links to research line 4, and deals specifically with different medical problems, such as bone healing, fibromyalgia, rheumatoid arthritis, and spinal cord injury. DBPA has been interested in studying underwater rehabilitation. This research area is certainly an important one, but not a key area in exercise physiology. It is worth noting that the highest impact factors for DBPA articles are found here. The research area can be considered of good quality.

Sports-related performance profiles and technique analyses

This area seems to be close to the research interests of RIOS in Jyväskylä, but collaboration between the two groups seems to be almost non-existent. The main research focus has been ski jumping, and it has produced one doctoral dissertation. The quality of this research is considered fair.

In general, scientific quality varies from fair to excellent at DBPA. The overall rating is very good, close to that given by the inter-institutional comparison by research parameters.

Collaboration

DBPA has an extensive international network with many outstanding research laboratories. Student exchange has been very active, and DBPA has had many international students finishing their doctoral work.

On the other hand, national collaboration has been rather modest, especially with RIOS, which should be a natural partner locally.

Researcher training

During the period of evaluation, nine doctoral theses were completed, which is considered as a good record for this size of unit. The mean age during the dissertation was 37.3 years. Nine post-graduate students were expected to finish their work during 2001. Three post-doctoral students were working at DBPA. Financial support from the Academy of Finland has contributed to effective research training through the graduate school system. The Doctoral School in Biology of Physical Activity, (1996 – 1999), was joined with the Tules Graduate School in 1999.

Conclusions and recommendations

DBPA has an important role in the teaching of exercise physiology nationally. The long established research line has guaranteed high quality in the neuromuscular area in exercise

physiology. This forms the basis for teaching and training researchers in the area. On the other hand, the other fields of exercise physiology have a narrow role in DBPA activities. For example, the only other visible breakthrough in their activities seems to be applied research in muscle strength and power training.

It is recommended that national collaboration (especially interdepartmentally and with RIOS) be enhanced. This would open wider research possibilities in the field of human performance and exercise physiology, including both basic and applied aspects.

There is a discrepancy between scientific quality of DBPA and the quality of publications based on research parameters. This fact remains even when the range of impact factors in exercise physiology journals is taken into account. DBPA is encouraged to adopt a more ambitious publication policy.

6.3.4. LIKES Research Center for Sport and Health Sciences

Overview

The aim of the multidisciplinary LIKES Research Center is to produce, acquire and pass on scientific information connected with physical culture, sport and health in the areas of social and behavioral sciences, pedagogic, sports biology and biomedicine.

In addition to actual research work LIKES maintains service activities in the fields of library information, sports planning, physical fitness and biomechanical tests, and medical services for athletes and people interested in physical recreation.

LIKES collaborates with the Faculty of Sport and Health Sciences in the graduate and post graduate training and education of faculty students.

The LIKES Sports Medical Clinic and Fitness Laboratory form one of Finland's six sports medicine centers. The main tasks of this center are medical care of athletes, fitness testing, and training of physicians specializing in sports medicine.

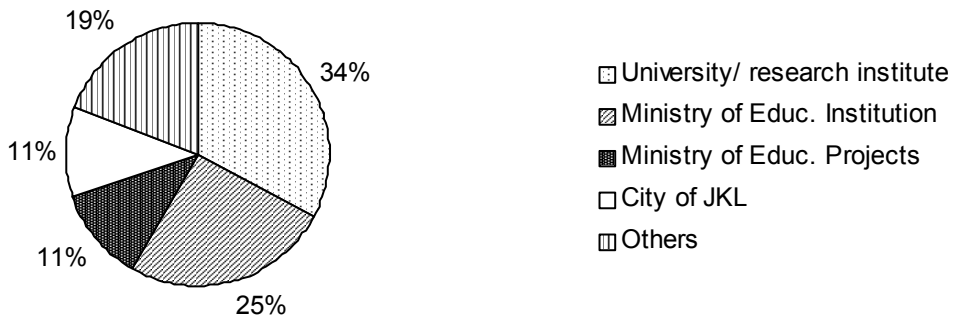
The LIKES Executive Board is the decision-making body. It consists of representatives appointed by the government and the University of Jyväskylä.

The Ministry of Education (Sports Division) is the main financial sponsor of LIKES. The City of Jyväskylä also supports it annually. Other sources of funding are research grants, services (medical care and fitness testing) and collaboration with industry.

The Research Center has facilities in two locations. The office and fitness laboratory are located in Hippos Sports Park, next to the research laboratory of the Faculty of Sport and Health Sciences. The medical clinic is in the city center.

LIKES has 14 permanent employees. The director of LIKES Dr Veikko Vihko, PhD..

LIKES funding sources 1995- 2000 as estimated by the research center itself.



The following research projects are being pursued with support from the Ministry of Education. Only the projects for which LIKES was the unit in charge are shown.

I Physical activity and health
1. Impact of training on learning gross-motor tasks among 65- to 70-75-year-old women
2. Physical activity and breast cancer among Finnish females
3. Children first: Healthy bones towards the 21st century (CALEX)
4. Paraspinal myoelectric activities and ultrasonography in scoliotic patients
5. Ice hockey injuries in Finland

II Sports biological and biomedical research
6. Neck muscle ultrasonography in athletes and non-athletes
7. Effects of various types and intensity of exercise on bone metabolism (resorption and formation)
8. Forced lengthening contractions and muscle fiber injury: regeneration and protective adaptations
9. Muscular force transmission. Structural adaptations in skeletal muscle
10. Lymphatic circulation and exercise
11. Effects of daily repeated prolonged exercises

III Biomechanics, other sports research
12. Development of physical performance and lifting characteristics in junior weightlifters
13. Biomechanical analysis of weightlifting at the Olympic Games, 1992
14. Biomechanical analysis of World Weightlifting Championships for men and women, 1998
15. Is a sense of rhythm important in sports?

Productivity

Productivity was acceptable, with most of the works from the above-mentioned areas of research accepted in well-respected journals.

Quality

The quality of research at LIKES ranged from poor to very good, with an average rating of good. Criticism of the work at this unit will be referenced to the above-mentioned projects in accordance with numbers.

Project 1, is an RCT and considered to be good research. It will result in a doctoral thesis, has a relevant topic, and is adequately designed.

Project 2, is reliable science that has confirmed prior results. It is unclear how carefully investigators monitored physical activity, and thus also unclear whether or not they can truly begin to determine the relationship between physical activity and breast cancer. The study has been adequately reported.

Project 3, "Children first: Healthy bones towards the 21st century" was considered to be very good, well-designed, well-conducted and to have used adequate methods. This work should continue to be supported. The statistical potential may not be sufficient to study genetic effects, and the investigator is encouraged to confer with an epidemiologist with expertise in genetics research.

Project 4, “Paraspinal myoelectric activities and ultrasonography in scoliotic patients” was considered to be a fair-quality research project. There was concern with the interpretation of the outcome measure. It is very difficult to interpret EMG data, particularly when one wants to use it as an input to understand the biological/biomechanical effect on progressive spinal deformity. In part, this is because the relationship between EMG activity, muscle force, and the relationship between muscle force and muscle moment arm are just not well understood. The investigators are encouraged to consider this issue in future investigations. This work resulted in one publication in an average level journal.

Project 5 focused on ice hockey injuries in Finland. This is very good descriptive research that is much needed. This work may be helpful for those involved in developing the rules for ice hockey and in designing equipment. The researchers should be encouraged to continue with this line of work. It resulted in several publications in prestigious sports medicine journals.

Project 6, “Neck muscle ultrasonography in athletes and non-athletes” was considered to be good research with acceptable productivity. More information is needed with respect to the geometry of the neck muscles, and the approach that these investigators are following is certainly capable of providing such data. This work resulted in only a few publications in well-respected journals.

Project 7 focused on studying the effects of various types and intensity of exercise on bone metabolism. This appeared to be very good science. There was concern with regard to the fact that the investigators did not report this in the study because they felt their findings were negative, and that they showed that two serum peptides did not respond to different kinds of exercises, as their initial hypothesis had suggested. It is unclear why they did not publish this work. The markers they used were relevant, and the work was completed, so it should have been published. The unacceptable publishing level led the evaluation group to give this project a poor rating.

Project 8 focused on forced lengthening contractions and muscle fiber injury. The productivity of this work was considered to be high; however, the quality was considered to be only fair.

Project 9 focused on studying muscular force transmission, and this work is not far enough advanced to evaluate it. There was concern with this work, because the investigators did not clearly articulate their approach and therefore, it was very difficult to evaluate.

Project 10, focused on lymphatic circulation and exercise and this was considered to be fair research. The idea itself is very interesting, and the investigators have been very productive. There was concern expressed by the evaluation group because it felt that the methods may only give indirect results, and it was questionable whether they could ever obtain conclusive findings.

Project 11, focused on the effects of daily repeated prolonged exercises. This study was rated as poor, no publications appeared in well-respected journals.

The evaluation group discussed projects 12, 13, 14, and 15, which it was felt were not hypothesis driven, and it was unclear how the work was done. The evaluation group came to the conclusion that it was not science, and therefore this effort was considered to be poor.

Collaboration

International and national collaboration has been very good. This is demonstrated by shared publications with others in the field at various institutions.

Researcher Training

There appears to be very little researcher training under way at LIKES, and the evaluation group recommended that no research training should occur in this environment, because it is not organized to provide such an experience for students.

Conclusions and Recommendations

It was difficult for the evaluation group to identify the fundamental role of LIKES in all the research activities going on there during the evaluation period. It seemed that, in addition to research into what LIKES itself undertakes, the Institute offers facilities to researchers from the Departments of the Faculty of Health Sciences. Accordingly, external research funds are "circulated" through LIKES. Also for some research projects, LIKES performed clinical examinations, and function and laboratory tests. In some cases, e.g. the CALEX Project, it seemed that the use of the facilities and infrastructure of LIKES was crucial for making the study feasible.

LIKES managers were satisfied with this organization and collaboration. From outside, it is difficult to judge the possible benefits and drawbacks of the arrangement, and the role of different sources of funding (LIKES Foundation, MoE, others).On the basis of the reporting by LIKES for this evaluation group, the organization appears rather unclear. LIKES does not seem to have had a clear strategy and research program. For the coming years, three areas of biomedical research are planned, development of sports and medical clinic, development of evidence based testing services and exercise training programs especially for senior citizens, and molecular, cell and tissue, and functional muscle research. The two first lines appear to a great extent to be developmental projects with much practical relevance, and the third is an ongoing activity of top scientific relevance.

It might be worthwhile for the MoE to have a separate evaluation done of LIKES to clarify the role of institutional and project funding in its activities.

6.3.5. Unit for Sports and Exercise Medicine, Helsinki, (USEM)
The Finnish Foundation of Sports Medicine

Overview

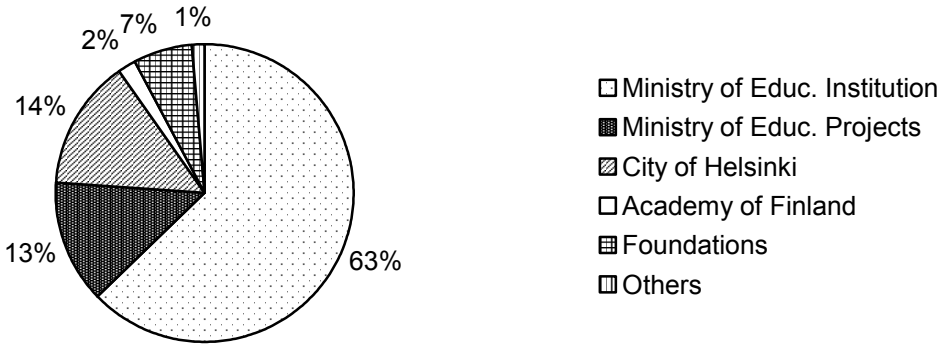
The Unit for Sports and Exercise Medicine is one of the six sports medicine centers supported by the Ministry of Education. The main tasks of this unit are: scientific research, medical care of athletes, and training physicians specializing in sports medicine.

USEM gets its core funding from the Ministry. The City of Helsinki also supports it annually. Additional funding comes from research grants (the Academy of Finland and foundations). The grant funding totaled about FIM 8 million in 1995-2000, of which 60 % was core funding, 4% was for equipment, and 12,5% was in the form of MoE project funding. Only 2% was project funding from the Academy of Finland.

The Unit is located in the city center of Helsinki. It has a small fitness laboratory, rooms for clinical work and office space.

The unit employs 4-5 persons. About 10 person-years were allocated to research in 1995-2000. The Director and Chief Physician of the Unit is Dr Urho Kujala DMedSc.

Sources of funding for USEM 1995- 2000 as estimated by the research unit itself.



Productivity and quality of research

Productivity was excellent. The number of publications was extremely high in proportion to the small size of USEM. This was made possible by extensive and productive national collaboration, while researchers at USEM have clearly had a significant role in the projects as indicated by the great number of papers with a USEM scientist as first author.

Scientific quality ranges from very good to poor.

A high proportion of the papers (28%) have been published in high-impact journals, including high-ranking general journals (Lancet, BMJ, JAMA, Am J Publ Health). The mean IF of all publications was 5.0, and of the 5 best rated 9.0. Impact in terms of citations is high, the average number of citations in the 5 best publications was 21. In 1995-2000, an investigation by the unit was twice rated as the best and four times as the second best research paper in the field of sports and exercise medicine in Finland.

Main areas of research at USEM:
1. Epidemiology studies relating physical activity and health
2. Physical loading, sports injuries and osteoarthritis
3. Effects of oxygen fraction in inhaled air on cardiorespiratory responses and exercise performance

The scientific quality of research areas 1 and 2 was rated very good. In epidemiology studies of physical activity and health, the investigators have access to unique cohorts, among them the Cohort of Finnish former athletes, the Finnish Twin Cohort, the Finnish Young Twin Cohort, the cohort of master orienteering runners and the cohort of former weightlifters. The investigators successfully utilized Finnish register data in the assessment of health outcomes. Studies have provided new information about the role of genetic constitution and physical activity in the development of various health outcomes, and the safety of sports as well as the stability of physical activity and its predictors among adolescents. USEM has plans to continue the follow-up and further studies of cohorts and subcohorts.

Investigating the adverse effects of sports is another focus of USEM (Area 2). This program involves a wide range of topics. It has provided information regarding the association between physical loading, injuries and osteoarthritis, injury profiles in commonly practiced sports, risk factors of pain syndromes, and chronic low back pain among adolescents. In the future, the Unit plans to study the interaction between genetic factors and physical exercise in the development of health outcomes in randomized controlled trials, and to identify genes predisposing one to the early onset of osteoarthritis. This is a huge and demanding goal because these genetic factors have not yet been identified. There was concern whether this unit has the expertise required for this goal, or a sufficiently strong commitment from their collaborators to do the work needed by them.

Research areas 1 and 2 are highly relevant from the standpoint of society and exercise culture. The results can be utilized in preventing the adverse health effects of sports by taking into account the future susceptibility of the individual.

Research in area 3 was rated as poor. It belongs to exercise physiology and is conducted in collaboration with RIOS. A novel finding of the cardiorespiratory response to exercise via skeletal muscle recruitment emerged, and in the future the goal is to study the mechanism. The results have been published in average level journals, but several papers by other groups disagree with the novel finding. This area of research is highly competitive, and the evaluation group had doubts about the potential of this small group to do well in this competition. One matter of concern was the lack of technical support for the maintenance of mass spectroscopy equipment.

The unit did not seem to have clear plans for the future, plans being decided on a "study to study basis".

Collaboration

Collaboration at national level is excellent. The Unit has a well-functioning and productive national collaboration network, including departments at the Universities of Helsinki and Turku and several other research units for exercise and sports medicine. International collaboration is limited to the Finnish Twin Study, in regard to which two senior scientists are

in Canada. On the other hand, the USEM research program has not required international collaboration.

Researcher training

USEM has been developing opportunities for post-graduate training. So far, only one doctoral thesis has been completed (in 2000), but currently seven doctoral students are affiliated to USEM. According to interviews with postgraduate students, their training does not seem to be sufficiently organized: study plans and plans for formal training are deficient, regular meetings are not organized. Most graduate students are enrolled in or partially funded by the graduate school Doctoral Programs in Public Health.

Conclusions and recommendations

- For a small unit, there is a very broad range of research topics. It would be advisable to focus on the research areas that have proven successful: follow-up of the unique cohorts, health effects of extreme exposure to physical activity. In addition, it would be interesting to study the mechanisms involved

- The small unit will hardly have sufficient resources to develop successful research in basic exercise physiology. Instead, it could be more fruitful to use expertise in physiology to strengthen the epidemiology projects.

- It is recommended that researchers be trained in close collaboration with the universities and/or graduate schools to guarantee proper mentoring and theoretical training of graduate students.

6.3.6. Tampere Research Center of Sports Medicine, TRCSM

Overview

Tampere Research Center of Sports Medicine (TRCSM) is one of the six sports medicine centers supported by the Ministry of Education. It is an independent unit of the UKK Foundation and operates in the UKK Institute's premises.

TRCSM research activities have concentrated on epidemiology, biomechanics, treatment and the rehabilitation of injuries occurring during leisure time, and recreational and competitive sports.

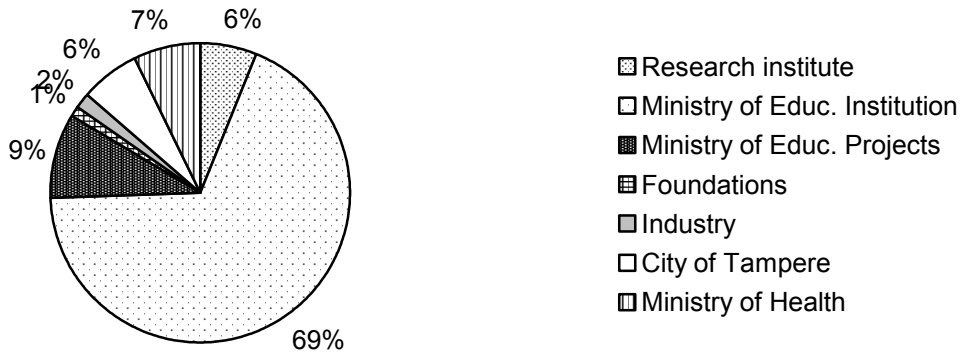
In addition to scientific research, TRCSM offers physical testing, medical services and educational courses and materials for physically active people. It also arranges specialization training in sports medicine and clinical physiology in cooperation with the Medical School of the University of Tampere. Over the last ten years, TRCSM has also actively participated in anti-doping work in both competitive and recreational sports.

The Ministry of Education is the main source of funding for TRCSM. Annual funding from the City of Tampere, research grants and funding from its own functions make up the rest.

Personnel consist of from 3 to 5 persons per year. The director and chief physician of the center is Dr Jari Parkkari DMedSc. TRCSM has been in operation since 1980. Although it has many ties to the UKK Institute, and it was very difficult at times to determine what research was done at the UKK Institute and what was done at TRCSM, it does operate as an independent unit.

TRCSM consists of three well equipped offices and has access to well equipped rooms for physiological testing with a treadmill, a bicycle ergometer, a rowing ergometer, an isometric muscle strength testing device, a spirometer, and a spiroergometer. Investigators at TRCSM also have access to the UKK Institute's facilities. Further, facilities are available at the University Hospital of Tampere for radiographic imaging (e.g. MRI, CT, X-ray, etc.), as well as biochemical analyses. The facilities at TRCSM were considered to be good for the purpose of doing musculoskeletal research.

Sources of funding for TRCSM 1995- 2000 as estimated by the research center itself.



Main Areas of Research

The research performed at TRCSM has been categorized into four separate areas. These are:

1. Epidemiology of domestic, leisure time, and sports injuries
2. Biomechanical studies
3. Treatment and rehabilitation of knee and ankle injuries
4. Exercise physiology

Productivity

The productivity of the research team at TRCSM has been very good. Each of the above mentioned areas of research have been well focused, and the investigators have published their work in well respected, and prestigious journals. The group has been very productive, having published many articles over the last five years.

Quality

The scientific quality at TRCSM is excellent. This is the case with regard to the studies of epidemiology of domestic, leisure time, and sports injuries, biomechanical studies, and investigations of the treatment and rehabilitation of knee and ankle injuries. All of this work has included original, innovative contributions that have made significant advances with regard to our knowledge of how to treat and rehabilitate knee and ankle injuries. A review of each of the publications cited by the investigators at TRCSM, revealed that they were based on clearly articulated hypotheses, used proper methodology, and proper statistical analyses. All the publications were well referenced and well written.

Collaboration

Currently, there is some evidence of collaboration with researchers in the United States (in particular WC Hayes), as well as other collaboration that is still evolving. The researchers are also developing a strong information services network, and this will certainly tend to establish more collaboration throughout Europe. At national level, there is good collaboration between the UKK Institute and TRCSM, almost to the extent that both institutions tend to blend together, and it is difficult at times to determine what research is done where. In part, this could be viewed as a strength, because it indicates a strong dedication to collaborative investigations between two separate institutions that house different facilities and equipment. Certainly, it would be to the advantage of the UKK Institute if it could gain access to image base modalities that are currently not available (for example MRI and CT scanning), and the same could be said about TRCSM and their ability to collaborate with investigators at the UKK Institute.

Researcher Training

Training of researchers takes place at TRCSM, but it does not seem to be solidly based on a formal structure, and does not involve didactic coursework. Students appear to have adequate supervision. However, it is unclear how often they interact with their mentors, and it is unclear how students are monitored throughout their studies and their research efforts. Research training appears to be strengthened by collaboration with the UKK Institute and

with investigators who have a diverse background in biology, biomechanics, and epidemiology.

Conclusions and Recommendations

TRCSM's strength lies with the investigators and their long tradition of collaboration on research that has an important impact on athletes and sports science. It is clear that this group has done an outstanding job pursuing research in areas that have received little attention (for example, knee and ankle ligament injury) and yet require a great deal of prior investigation to help understand the best way to treat these injuries.

It is recommended that TRCSM continue their research avenue in studying the enhancement of safety in sports and exercise. This is an important area that receives very little attention from researchers, and those at TRCSM are well qualified to carry out this work. In particular, these researchers are encouraged to continue to perform studies that determine the injury risks in recreational activity and competitive sports. This research is very important.

6.3.7. Foundation for Research in Health Exercise and Nutrition Kuopio Research Institute of Exercise Medicine (KRIEM)

Overview

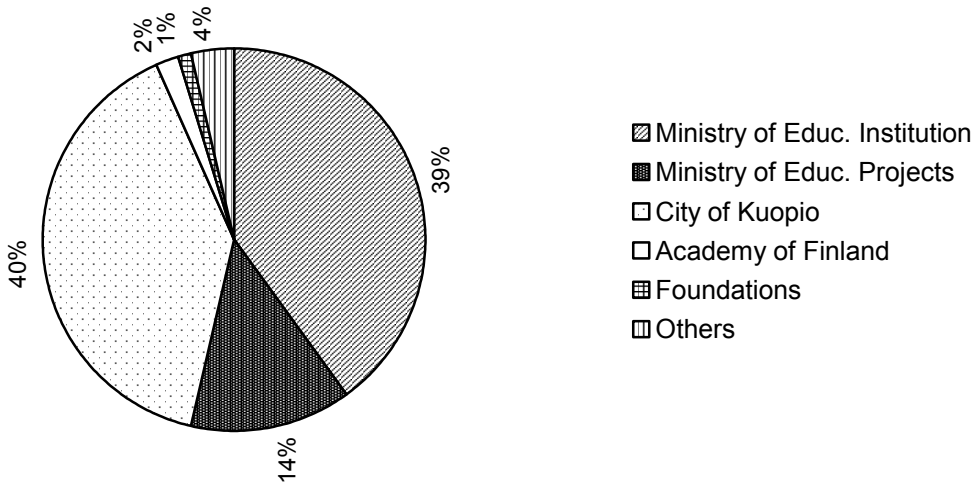
The Kuopio Research Institute of Exercise Medicine is one of the six sports medicine centers supported by the Ministry of Education. The main tasks of this unit are: scientific research, medical care of athletes and training physicians specializing in sports medicine.

The Ministry of Education is the main source of funding for KRIEM. Funding from the city of Kuopio is exceptionally high compared to the support other sports medicine centers get from cities.

The Kuopio Research Institute of Exercise Medicine is backed by the Foundation for Research in Health Exercise and Nutrition, the owner of the current research facilities. Following a two-phase restoration process, all 5,800 sq. ft. have been in KRIEM's use since December 2000. The facilities have ultrasound equipment and a respiratory gas analyzer, and a minimally equipped biochemical laboratory.

Employees number 23, including researchers, nurses, technicians and students. The Director and Chief Physician of the Institute is Dr Rainer Rauramaa DMedSc.

Sources of funding of the Kuopio Research Institute of Exercise Medicine 1995- 2000 as estimated by the research unit itself:



Scientific quality

KRIEM has two main research topics, the Kuopio ischemic heart disease risk factor study and DNA polymorphisms and carotid atherosclerosis. The first was initiated in 1984 and the second in 1992. These studies are difficult because they require careful long-term planning and follow-ups. Despite a number of difficulties associated with these types of long-term studies, KRIEM has shown its competence in conducting such research. This is mainly due to excellent leadership, a long research tradition, expertise, and well-established collaboration.

Kuopio Ischamic Heart Disease Risk Factor Study (KIHD)

The goal of this project is to study the role of physical activity and cardiorespiratory fitness in the prevention of cardiovascular diseases, metabolic diseases, and cancer. The study was initiated in 1984. The 11-year follow-up examinations was completed in 2001. This study produced several important observations, e.g. that physical inactivity and poor cardiorespiratory fitness are major risk factors for coronary heart disease, and that poor cardiorespiratory fitness is one of the key risk factors for cardiovascular and overall mortality. This study is extremely relevant and important, and its scientific quality is very good.

DNA Polymorphisms and Carotid Atherosclerosis (DNASCO) study

The goal of this study is to identify the genetic risk factors for common diseases such as atherosclerosis. Another goal of this study is to understand the role of genetic risk factors in modifying the health effects of regular physical activity. The goals are extremely important. The problem with this type of DNA study is that there are altogether about 30 000 to 50 000 genes, and the biological role of most of these genes is not understood. Selection of candidate genes for these kinds of studies is difficult. Even though the genes selected potentially have some role in cardiovascular diseases, it is quite possible that they are not the major players in this disease. Also, there is a tendency to overestimate the significance of the association between a single-nucleotide polymorphism and a disease (p-value <0.05 is not considered highly significant in association studies). KRIEM does not have the expertise in the molecular biology/genetics aspect of the study, and is mainly dependent on collaborators. Since the emphasis in the study is on molecular biology/genetics, the addition of a molecular biologist/geneticist to the group would strengthen this program. It is, however, important to continue this line of studies. The scientific quality of this study is good.

To summarize, the KRIEM projects are relevant and important. The unit has good leadership, the research goals are clear, and the research is long-term, high-impact, and generally well designed. The overall scientific quality was very good. A number or articles have appeared in journals with an impact factor of around 5.

Productivity and quality of research

The unit published 35 peer-reviewed research articles during 1995-2000. This is acceptable for this size of unit.

Collaboration

Collaboration is excellent both internationally and nationally. The unit has an active and productive collaboration network.

Researcher training

The number of doctoral theses is low, only two theses during 1995-2000. This is perhaps not surprising because KRIEM does not have direct contact/affiliation with the University. Formal training is appropriate.

Conclusions and Recommendations

About half the total funding is from the Ministry of Education. The other major funding source is the City of Kuopio. Only a minor part of funding comes from other grants. Because the research is of a high quality, more funding should be applied from other sources, such as the Academy and foundations.

Since it will focus on studies of the role of genetic risk factors in carotid arteriosclerosis, it is important that the unit also have "in-house" expertise in molecular biology/genetics. Even with good outside collaborators, it is possible that many important decisions about the direction of studies will be made by the collaborators and not by the unit.

KRIEM is encouraged to continue its well-focused line of research. It has accumulated valuable expertise.

6.3.8. Paavo Nurmi Center (PNC)

Overview

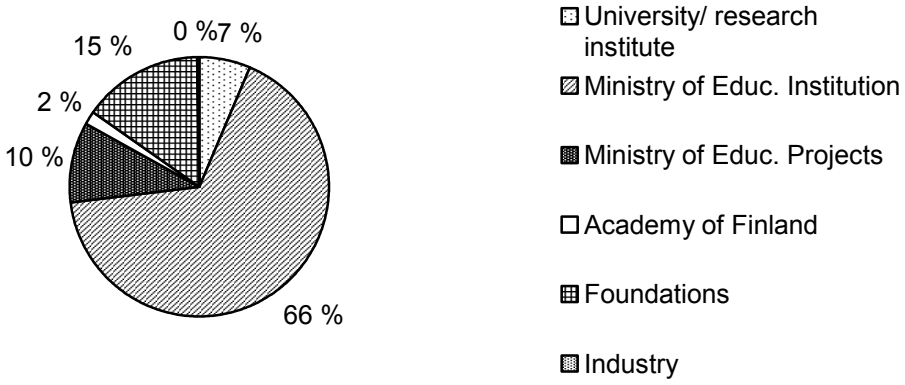
PNC is one of six sports medicine centers supported by the Ministry of Education. The main tasks of this unit are scientific research, medical care of athletes, and training physicians specializing in sports medicine.

In addition to the funding from the Ministry of Education, the activities of PNC are funded by research grants, support from the city of Turku, services and R&D projects from industry.

The center is located in the campus area of the University of Turku, next to the medical faculty, the university hospital, and Turku Science Park.

The entire personnel consisted of 10. The chief physician of the center is Olli J. Heinonen, MD PhD.

Sources of funding for the Paavo Nurmi Center 1995- 2000 as estimated by the research unit itself:



Main areas of research

The center has decided to focus on 5 main research lines:
1. Energy metabolism at cellular level
2. Exercise, oxidative stress and LDL-cholesterol
3. Health effects of sports and exercise in growing children
4. Regeneration of muscle injury
5. Health enhancing physical activity

Productivity

In all, 62 international peer-reviewed articles were published in 1995-2000. A clear upward trend can be seen in the number of PNC scientific publications from 1995 to 2000. In addition to these, PNC scientists have been active in the field of sports medicine, which is shown by the high number of media interviews, popular articles, and other national book chapters and reports, especially at the end of the period under evaluation.

However, it is difficult to define PNC's actual scientific productivity , because many of the articles were produced in collaboration with multiple centers. It also seems that some of the publications have very little connection to actual PNC activities. Despite this, PNC's scientific productivity is acceptable.

Scientific Quality

As mentioned above, the PNC group has a broad, national collaborative network which is also reflected in their diverse research areas. The areas clearly are not purely sports medicine, and are often unrelated to exercise physiology, which is almost non-existent.

In general, research into energy metabolism at the cellular level is rather limited in Finland. Internationally, the area is very competitive with many excellent units existing worldwide. The work done by PNC together with collaborating groups has been of good quality. The use of modern, non-invasive in vivo methods (e.g. PET) has provided the opportunity to study muscle function and biochemistry, even in exercising muscles. However, this work did not take place at PNC. Also, the focus at PNC was on creatine, which may serve as a model to study skeletal muscle metabolism, but in their work it is linked to a rare disease (creatine deficiency). This means that, for sports and exercise research, this area has not been very central so far.

Research into exercise, oxidative stress, and LDL-cholesterol is relevant to the field of atherosclerosis. This research resulted in many good publications during the period of evaluation. The research area is relevant to sports medicine because it examines mechanisms by which physical activity may improve antioxidant status, and thereby possibly hinder atherosclerosis from developing. A large network guarantees good quality research.

Research on the health effects of sports and exercise on growing children was carried out mainly as a doctoral thesis work at PNC. The focus was on Vitamin D, exercise, and bone mineral density. The work resulted in new findings that show the importance of physical activity on bone development in teenage girls. For sports medicine, this research is an interesting field which examines the interaction of nutrition and exercise.

In addition, researchers were involved in large-scale, multicenter studies where the focus was on other health issues in children, such as back pain and lipid metabolism. In Turku, a well-working network has been operating for several years to examine growth and health in children, and their determinants. The researchers at PNC have been actively involved in those projects.

A fair proportion of the peer-reviewed papers appeared in high impact journals. The general evaluation of PNC based on scientific quality was good.

Collaboration

PNC researchers have a functioning national network, especially locally in Turku. International contacts have been made, but they are just starting to be effective.

Researcher training

During the period under evaluation three doctoral students finished their work at PNC. Also, two students are affiliated with it through the Graduate School of Clinical Sciences. It seems that, for such a small unit, this is a good amount of researcher training. Mentoring and formal training were well organized.

Conclusions and recommendations

PNC went though organizational changes during the 1990s and the scope of research has started to take shape. The unit is small but has a large network nationally. This fact seems to be based on two very active individuals, which makes the unit vulnerable to changes in personnel.

It seems that PNC is a promising unit but much of its time is devoted to non-scientific activities.

Exercise physiology research in PNC has been very limited or non-existent. It seems that the exercise physiologist at the center carries out routine testing as part of different epidemiology projects.

PNC is encouraged to continue all three major research lines which seem to give many opportunities for collaboration, researcher training, and good quality research. Maybe the focus of strategy should be more clearly on the metabolic aspects of physical activity and exercise. For exercise physiology, the equipment should be of a high standard.

6.3.9. Oulu Deaconess Institute
Department of Sports Medicine (DSM*)*

Overview

The Oulu Deaconess Institute's Department of Sports Medicine (DSM) is one of the six sports medicine centers supported by the Ministry of Education. The main tasks of this unit are: scientific research, medical care of athletes and training physicians specializing in sports medicine.

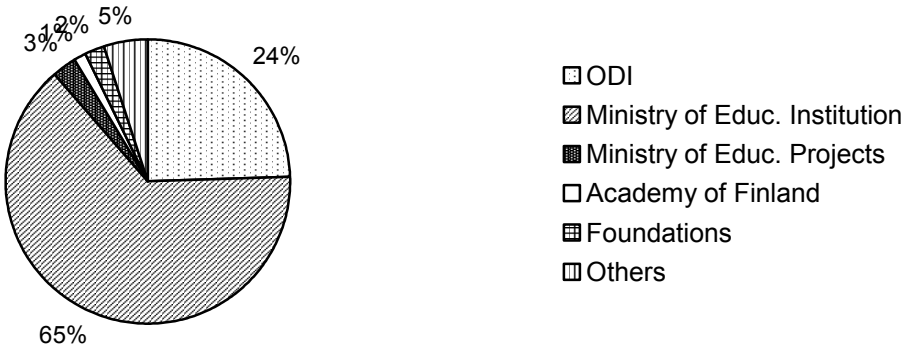
The DSM's facilities are located in the premises of Oulu Deaconess Institute. The Institute has an exercise laboratory, a laboratory and training facilities.

The DSM's funding consists of support from the Ministry of Education, the City of Oulu and Oulu Deaconess Institute, and income from sales. Project funding from the MoE was about FIM 300.000 in 1995-2000.

DSM's permanent staff consists of 8 persons, three of whom have an academic degree and participate in research work. For research work, DSM collaborates closely with the Department of Public Health Science and General Practice (DPH&GP), University of Oulu.

The director of DSM is Vesa Martikkala, MSc, and the chief physician is Tuomas Holma MD (not involved in research).

Sources of funding for the ODI's Department of Sports Medicine 1995- 2000 as estimated by the research unit itself:



The DSM seems to have been in a transition phase during the evaluation period. The Department has not played an active, independent role in research. It was difficult to distinguish between research work done by DPH&GP and DSM. Therefore, a full-scale evaluation is not presented.

The DSM reported two lines of research:

1. The effect of exercise on bone mineral density and geometry, muscle strength, and falls in home-dwelling elderly women with severe osteopenia.
2. The effectiveness of exercise and diet in preventing Type 2 diabetes in individuals with impaired glucose tolerance.

Another project, “Cellular and molecular adaptation of the musculoskeletal system to physical loading” received funding from the MoE in 1995, but it was not included in the report of the unit.

Research projects 1 and 2 are being done in collaboration with DPH&GP. The principal investigators are reported to be PhD students belonging to the permanent staff of DSM; their supervisor is Prof. Keinänen-Kiukaanniemi from DPH&GP. Project 2 is part of a large national multicenter study led by the National Institute of Public Health. In the DSM’s subproject, special emphasis is given to the assessment of physical activity.

The general impression is that DSM provides good facilities for DPH&GP research. With the current personnel structure, there will hardly be another opportunity to carry out independent research at DSM. Higher involvement of epidemiologists, biostatisticians and better knowledge of the subject matter is needed before starting clinical risk factor studies. A research unit should have a senior scientist appointed as leader. The newly appointed director of the ODI's hospital, Dr. Timo Takala, could help to create better research opportunities and a functioning research group.

6.3.10. Research Institute for Olympic Sports (RIOS)

Overview

RIOS is a multidisciplinary national center doing

1. Applied research
2. Providing services for top level athletes, coaches, and sports administrators
3. Developing new methods, devices, and products

for improving high-quality training and Finnish sporting success.

RIOS is owned by the RIOS-Foundation, a private foundation shared by the University of Jyväskylä, the City of Jyväskylä, and the Finnish Olympic Committee. The Ministry of Education nominates the chairman and one member of the foundation's board.

Research and services at RIOS focus on the analysis and development of coaching, training and testing methods and equipment, and finding ways to recognize overtraining, aptitude and talent. RIOS also examines the role of competition and of top sports in society. Through its research and practical work, RIOS aims to help solve problems related to the special field of competition and sports. RIOS has an important role as a ”special experts” team to the Finnish Olympic Evaluation Group and sports federations.

RIOS produces competition and training analyses, gives consultations, demonstrations and lectures as well as assistance in the planning and conducting of seminars and workshops in training centers, for example.

Cooperation with federations and companies has led to the development of several new products, such as an interactive video-computer game analysis system.

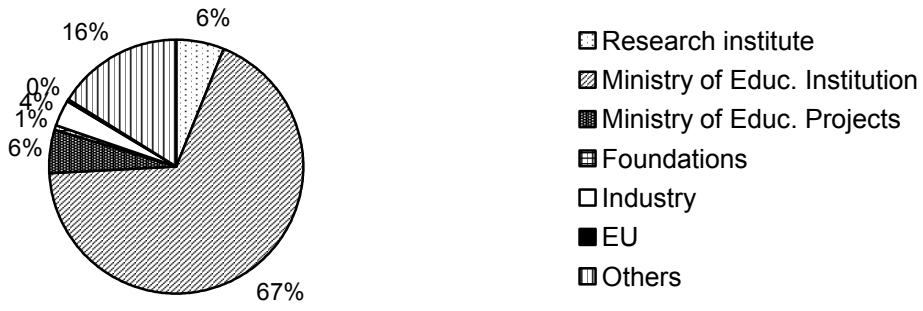
RIOS facilities include:

- Two exercise physiology laboratories; one small and one big treadmill, basic equipment for blood analyses and a small workshop, and a small room for additional measurements
- The Hippos sports and research complex of the City of Jyväskylä at the university campus, with office space, an indoor track facility, several ball game and gymnastic halls, two indoor ice-hockey rinks (all equipped for research, training, and games)
- Additional on-site research facilities in the City of Jyväskylä

The total number of personnel by institutional funding is 20. RIOS has 4 senior scientists with different specialization's. The director of RIOS is Dr Heikki Rusko, PhD.

Institutional funding from the Ministry of Education is the main source of funding for RIOS. In addition, other funding sources have been private companies, the Technology Development Center, the Finnish Olympic Evaluation group, sports federations, clubs, associations and public institutions.

Sources of funding of RIOS 1995- 2000 as estimated by the research unit itself.



Main areas of research at RIOS:
1. Endurance performance capacity
2. Over training, stress, burnout
3. Interaction of inhaled oxygen and training
4. Sports medicine projects
5. Sports biomechanics
6. Motor control and motor learning

Productivity

A total of 54 international peer-reviewed journal articles were published in 1995-2000. Considering the funding and number of personnel this is rather modest, but is acceptable scientific productivity.

On the other hand, RIOS produced a large amount of other material geared for the field of sports, for example books, videos, and reports. Senior scientists have presented several invited lectures in international meetings. This means that the total activity of RIOS is high but it is spread over many different functions, which is at the expense of scientific work. The seniors have published very little in scientific terms.

Scientific Quality

Most of the publications have an impact factor slightly over 1.0. Only 4 publications reached impact factor over 3, and they are related to sports medicine. Most of the articles produced by RIOS have been published in Eur J Appl Physiol and Int J Sports Med, which are well-known and widely circulated journals in the field of sports medicine and applied physiology, but they have a modest impact factor.

Endurance performance capacity

A large part of this work has been a doctoral work at RIOS. The researchers have examined the role of so-called muscle power factors in endurance performance capacity. The question is very basic in exercise physiology, and also has practical implications for endurance training. It was found that the muscle power factors have an important role in determining endurance performance. The work produced several publications of good quality.

As part of this project, RIOS developed a test for measuring anaerobic power, which is used today in testing athletes. It has been found to be reliable, valid, and sensitive to changes.

The quality of this area of research is good.

Over training, stress, burn out

This area of research relates to over training syndromes, which sometimes are a real problem for training athletes. As RIOS points out, it is somewhat similar to stress and burnout. The main part of the research was carried out as a thesis work, resulting in a series of good level publications. Several markers of overtraining were found, but no single indicator. This work has resulted in practical measures for sports.

As a continuation RIOS has started projects to develop a stress test based on heart rate variability, which supposedly could be used even in working life. A substantial financial support has been given to this project by the Technology Development Center (Tekes). The research area is very competitive, and fast developing. RIOS has produced very modest publications in this area. This area seems to be peripheral to the concept of RIOS. This research area is fair from the point of view of quality.

Interaction of inhaled oxygen and training

This research area examines the effects of varying concentrations of oxygen in inhaled air. The target populations have been patients, athletes, and healthy athletically untrained humans. The research line has produced 2 doctoral theses, both of which have been done mostly outside RIOS. The background for this research area is how altitude training can improve endurance performance, and what artificial means can simulate it for Finnish athletes. This has created the altitude house innovation. As a part of thesis work, research has resulted in a number of publications, which have only appeared in qualitatively moderate level journals.

The scientific quality of this research area is fair. The practical implications have probably had more impact.

Sports medicine

These projects relate to asthma in athletes and factors relating to coronary heart disease. The high impact publications from RIOS belong to this area of research, which is mostly carried out in collaborating centers outside RIOS. Both research lines have resulted in doctoral dissertations. In addition to these, a project on development of a hemoglobin test has been initiated.

This research area has not been central to activities at RIOS, but it has been of good quality with some excellent contributions. The research overlaps in many ways with the work done at sports medicine centers.

Sports biomechanics

Clearly, this research area has not been of a high quality in terms of publications. On the other hand, it surely has been valuable to the mission of RIOS in enhancing Finnish sports, and maybe even success in certain areas (javelin throwing, shot put). Research and development

has focused on different sport disciplines, where the respective associations have usually initiated the projects. The disciplines include, for example, javelin throwing, shot put, ski jumping, cross-country skiing, kayaking, pole vaulting and sprinting. The projects at RIOS have developed real time measurements in field conditions and development of concrete and simple feedback for the athletes and coaches. Extensive technical know-how has guaranteed a high quality development work.

The quality of this development and research work is excellent, but from a scientific publication point of view it is only fair.

Motor control and motor learning

This area of research is closely linked to sports biomechanics, and has been directed toward shooting performance. It is also an interesting joint effort with psychophysiologists in the University of Jyväskylä. It is also a PhD project, which is again reflected in the number of publications in sports-related journals. The focus has been narrow, but it has clear links to the research of motor control and learning in general. The research done in this area can be considered good.

The quality of the content of RIOS activities is quite variable, and not easy to assess, but generally it can be ranked as good in its domain, though the research parameters by publications yields the rank fair.

Collaboration

The scientific network of RIOS was not very large either nationally or internationally, but the joint work done with its few collaborators has been quite intensive and productive. Strengthening of networking is encouraged. Outside science, RIOS seems to have close relations with different sports associations, which is in line with their mission.

Researcher training

Nine doctoral and two licentiate theses have been completed at RIOS in 1995-2000. They have been prepared, supervised or done in cooperation with other units. Post-doctoral training is not organized at RIOS. Clearly, RIOS has been effective in the doctoral training process, which has produced most of their scientific publications also.

Conclusions and recommendations

RIOS is a unique institute devoted to top level sports. Because of this position, it is under a lot of pressures, when allocating time and other resources to services, teaching, development and research. This has led to a modest publication record compared to other comparable groups/units in Finland. The publications are almost solely based on doctoral students' work. RIOS is encouraged to continue hiring post-graduate students, and enhance collaboration with the Department of Biology and Physical Activity. At the moment it seems to be rather modest. Maybe a closer administrative link should be established between these two units, especially as they are physically located near each other.

The research lines in endurance performance capacity and sports biomechanics seem to be central elements of the mission of RIOS. RIOS is encouraged to concentrate more strongly on

these areas. As it now stands, there are research lines which are taken care of extensively by other centers of Finland (e.g. heart rate variability, sports medicine).

The services are an important part of RIOS, but should probably be separated into its own unit. It seems that steps have been already taken in this direction.

RIOS researchers have initiated many excellent research ideas, which are shown in the reports and abstracts. It seems that there has often been pressure timewise to put these ideas as quickly as possible into practice, and there has not been enough time to conduct thorough research resulting in high-quality scientific publications. Fluctuation of funding according to success in different sports makes long-term planning difficult. Thus, it is recommended that the strategic planning in research should have a longer perspective. The Board guides research, but there are only a few scientists on the Board. It would be beneficial to add expertise in scientific research to the Board of RIOS.

6.3.11. Research group on Articular Cartilage and Chondrocytes in Normal and Ostearthritic Joints. Prof. Heikki Helminen, Department of Anatomy, University of Kuopio

Overview

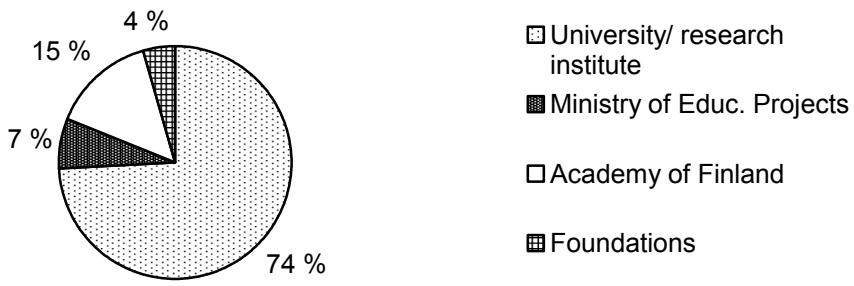
The research group consists of
Senior scientists:
Helminen Heikki J, MD, PhD, Professor; Leader of the Cartilage Research Group
Lammi Mikko, PhD (Biochemistry), Docent, Senior Lecturer
Jurvelin Jukka, PhD (Biophysics), Docent; Hospital Physicist, Kuopio University Hospital (KUH); and 20 junior scientists

The research work is conducted in the Department of Anatomy, Faculty of Medicine, University of Kuopio. The Department of Anatomy is located in the Snellmania Building of the University of Kuopio. The Department is furnished with histological, biochemical and biomechanical laboratories with working rooms for the researchers. The Department conducts basic biomedical research to solve cell and tissue responses that lead to osteoarthrosis. The approach covers various levels of molecular, cellular, and tissue research.

One of the Group's main goals is to solve the effects of joint loading on articular cartilage and joints, thus work with experimental animals is important. For this purpose, the University of Kuopio has excellent laboratory animal facilities (National Laboratory Animal Center). As study objects, the Group has also utilized cartilage explants (obtained from a local abattoir), chondrocyte, and continuous cell line cultures. The Department of Anatomy is well equipped for quantitative microscopic, cell and molecular biological, biophysical and biomechanical research work. Researchers of the Cartilage Research Group cooperate with researchers of the University of Kuopio and of other universities in Finland.

During the years 1995-2000, the research group on “Articular Cartilage and Chondrocyte in Normal and Osteoarthritic Joints” has consisted of 3 principal investigators, 4 thesis work instructors and 21 post-docs or students. The research is performed in the Department of Anatomy at the University of Kuopio. Three of four instructors have positions in other departments or institutions. The main funding for this group's work comes from the University of Kuopio.

Sources of funding of the Helminen research group 1995- 2000 as estimated by the research group itself.



Scientific quality

For a number of years, the Helminen group focused on biomedical research of cell and tissue responses that lead to osteoarthritis. The group has several main objectives. The Ministry of Education funds one of the projects, "Effect of joint loading on articular cartilage". Total funding for this project amounts to about FIM 5,500,000, of which about FIM 4,100,000 is from the University/Research Institute, FIM 240,000 from foundations and FIM 1,070,000 from the Ministry of Education (about 20%).
This project has two main focuses:
A. Biological properties of cartilage, loading effects on tissue, and mechanism of cartilage injury. (1995-1997).
B. Joint loading, genes, and osteoarthritis. (1998-2000).

Biological properties of cartilage, loading effects on tissue, and mechanism of cartilage injury

It is important to understand the consequences of loading on the biological properties of cartilage. The group has made several important observations: a) Long-lasting joint loading can induce osteoarthritis; b) Prolonged immobilization may also predispose to osteoarthritis; c) Importance of age in joint loading and development of osteoarthitis. The scientific quality was rated excellent.

Joint loading, genes, and osteoarthritis

This project is unique and is an excellent approach to studying the roles of the main components of cartilage protein and loading in osteoarthritis. This project is also an example of excellent international collaboration. Additionally, this approach fits well with the research goal and expertise of the research group. The scientific quality was rated excellent.

Many of the other projects were considered highly important, innovative and of excellent scientific quality, such as Project 4: Gene expression of chondrocytes exposed to hydrostatic pressure or cyclic mechanical stretch, and Project 5: Ultrasound and MR imaging as probes for the characterization of normal and osteoarthritic cartilage. (However, these projects were not funded as Ministry of Education research projects.)

In general, as this study is a long-term one, the group has developed new methods and adapted several approaches to study cartilage. Also, it has acquired excellent know-how in this field and enjoys good international collaboration. This group is unique in Finland, and it has made several important contributions to the field of cartilage biology.

The overall rating of the research was very good. The following aspects of the research are considered excellent: approach, facility, know-how, clear research goals, strong leadership, research progress and graduate student and post-graduate student training. The quality of research is considered to be good.

Relevance to the needs of sports culture and society was evaluated as excellent: The group is interested in the biological consequences of loading, mechanical injury, and genetic factors on cartilage. The goal is to gain a better understanding of the biology of cartilage. Our current knowledge of cartilage biology is rather poor, and this study should have a high impact in

developing early diagnostic measures for osteoarthritis, and means of preventing cartilage degeneration.

Productivity

Productivity was acceptable. The number of international peer-reviewed articles during 1995-2000 is 51. The impact factors are generally rather good. Most are between 1 and 2. There are only 4 publications with very good or excellent impact factor (Genes and Development, Arthritis Rheum, PNAS, J Bone Miner Res). There is a discrepancy between the quality of research and level of the publication forum.

Collaboration

International collaboration is very good. It has resulted in publications that are of good or even excellent quality. International collaboration could, however, be more active. Also national collaboration is excellent. The group enjoys active and productive national collaboration. There are a number of joint publications with collaborators.

Researcher training

The training of both graduate and post-graduate students is considered excellent. It is extremely well organized in this group (primary tutoring, courses, conferences, and an active graduate school program). The group has produced 8 doctoral theses during 1995-2000.

Conclusions and recommendations

Publications: The scientific quality is excellent, but the quality of the publications based on impact factors is only fair/good. This may be partially explained by the splitting of data into "smaller" publications, sacrificing quality for quantity, or due to it being "easier" to get manuscripts published in lower than higher impact journals. It is advisable to try to publish results in journals with higher impact factors. There is an obvious discrepancy between the quality and importance of the research and the level of the publication forum. Important results will get easily "lost" in low impact journals. This is an extremely important issue, because the publication forum level will also affect the funding level.

Funding: The group is heavily dependent on expensive equipment and reagents. The funding, however, comes mainly from one major source, the University/Research Institute. The quality of research should be good enough to seek more funding from other sources such as the Academy of Finland.

6.3.12. Orthopedic Sports Medicine research group of Markku Järvinen, University of Tampere

Overview

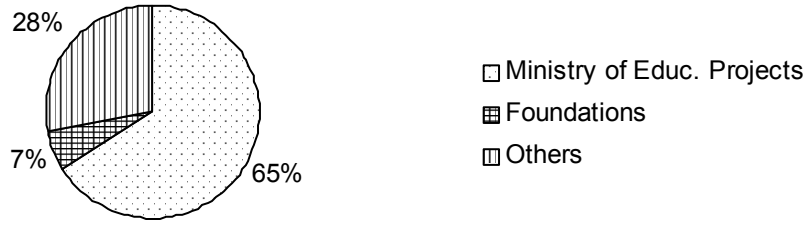
The research group consist of

Senior scientists:
Laszlo Jozsa, Professor (M.D., Ph.D.), senior scientist/pathological consultant
Hannu Kalimo, Professor (M.D., Ph.D.), co-leader (Muscle group)
Pekka Kannus, Professor (M.D., Ph.D.), co-leader (Osteoporosis, Knee and Tendon disorders groups)
Harri Sievänen, Docent (PhD., Lic. Tech.), co-leader (Osteoporosis group)
Teppo Järvinen, M.D., Ph.D., co-leader (Osteoporosis group)
Tero Järvinen, M.D., Ph.D., co-leader (Muscle group)
and 10 junior scientists.

Järvinen's group is divided into four sub-groups Osteoporosis, Knee, Tendon and Muscle group. The research work is mostly conducted in the University of Tampere and Tampere University Hospital. The group also collaborates closely with the University of Helsinki (Experimental animal laboratory), the University of Oulu (Histology/Morphometry) and the UKK Institute.

The group has adequate research facilities. Replacement of some older equipment is needed, and the establishment of its own research facilities in certain areas (such as histology, molecular biology) is needed.

Sources of funding of research by the Järvinen group 1995- 2000 as estimated by the group itself.



The group receives additional funding through the Academy of Finland for graduate school students. The group also gets some funding from industry and the EU. The amounts were not included in the report.

Scientific quality

Muscle group

The principal investigators of this study are Prof. Hannu Kalimo (University of Turku) and Prof. Markku Järvinen. The study was initiated in 1970. The goal of this project is to study the effects of altered mechanical loading on the recovery of injured skeletal muscle. The basic research approach has been recently introduced in the study, including characterization of integrin and dystrophin associated complexes and transgenic mouse studies. This research is done in collaboration with Prof. Jyrki Heino. This study produced five PhD theses during the 1970-2001. It has produced several important observations. The basic research approach is considered especially innovative. This study is relevant and important for sports medicine. The scientific quality is very good.

Osteoporosis

The principal investigators of this study are Prof. Pekka Kannus together with Docent Harri Sievänen and Dr. Teppo Järvinen. The osteoporosis study was initiated in 1992. The goal is mainly to characterize the role of mechanical loading, sex hormones, and age in osteoporosis. The goals are extremely important. This study has produced several important observations and publications. The finding that there are inaccuracies in DXA is highly important and relevant. However, there is a major problem with the study: the role of the Järvinen group vis-à-vis the UKK Institute in this study is not totally clear. The scientific quality of this study is good.

Tendon disorder group

The goal of this study is to characterize predisposing factors, diagnostic options and optimal treatment options for tendon problems, especially for Achilles tendinopathy. The project was initiated in 1975. The principal investigators of the study are Prof. Markku Järvinen and Prof. Pekka Kannus. This research has yielded only one PhD thesis (1975), the second thesis will be submitted in 2001. The topic is of current interest and is clinically important. However, research has not been very productive and is not considered highly innovative. The scientific quality of this study is fair**.**

Knee group

The goal of this study is mainly to evaluate and develop different treatment options to correct ACL injuries. The study was initiated in 1981, and has produced three PhD theses (1988, 1997 and 2000). The principal investigators are Prof. Markku Järvinen and Prof. Pekka Kannus. The research is clinically highly important. Collaboration with Prof. Törmälä and a local company in studying the use of biodegradable material is important. However, research has not been very productive and is not considered highly innovative. The scientific quality of this study is good.

To summarize: The projects are relevant and important for sports medicine. The group has good leadership, the research goals are clear; the research is long-term, and generally well designed. However, there is a considerable overlap with the other centers, and it is not clear if the Järvinen group is principally responsible for all the projects. This is especially true with Prof. Pekka Kannus. He is a member of the UKK Institute, but is one of the principal

investigators in three out of four projects. The overall scientific quality was rated good. All studies have an excellent relevance for sports medicine.

Productivity

Productivity was very good. The group published over 70 peer-reviewed research articles during 1995-2000. For the most part, the quality of the publications is good. Some have appeared in journals with high/very high impact factors.

Collaboration

International collaboration is good and considered relatively active and extensive. National collaboration is excellent; the group enjoys active and productive collaboration with several national collaborators.

Researcher training

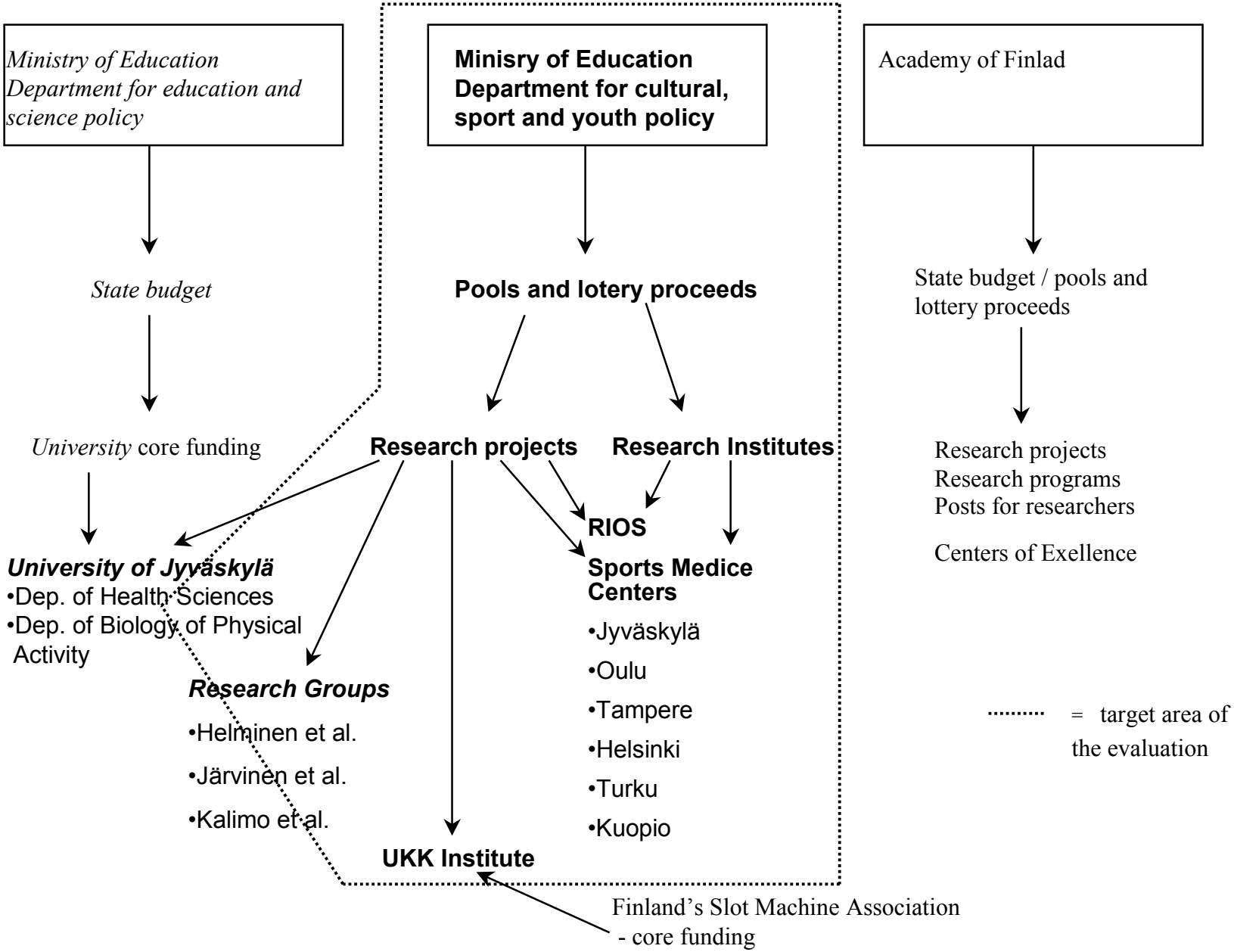
Researcher training in this group was rated fair. The number of doctoral theses is reasonably good, 6 theses during 1995-2000. The group should, however, establish more formal graduate student training.

Conclusions and recommendations

The total funding of the group is not adequate. Basic research, especially in the muscle group, will become more important in the future. This type of research is expensive, but the current budget will not allow for the development of a basic research sector. The group should apply for research grants. At the moment, the group is heavily dependent on funding from the University/Research Institute.

If the group will focus more on studies utilizing basic research, it is advisable to try to recruit basic scientists. Many of the current studies can, however, be done very effectively in collaboration, which is now very well organized by the group. Some future goals, such as transgenic mouse studies, are extremely demanding, and would require “in-house” know-how and expertise of this kind of work at least at some level.

The formal training of graduate students is only adequate at best. More attention should be paid to training.


Ministry of Education
Department for education and science policy
Minisry of Education
Department for cultural, sport and youth policy
Academy of Finlad
State budget
Pools and lotery proceeds
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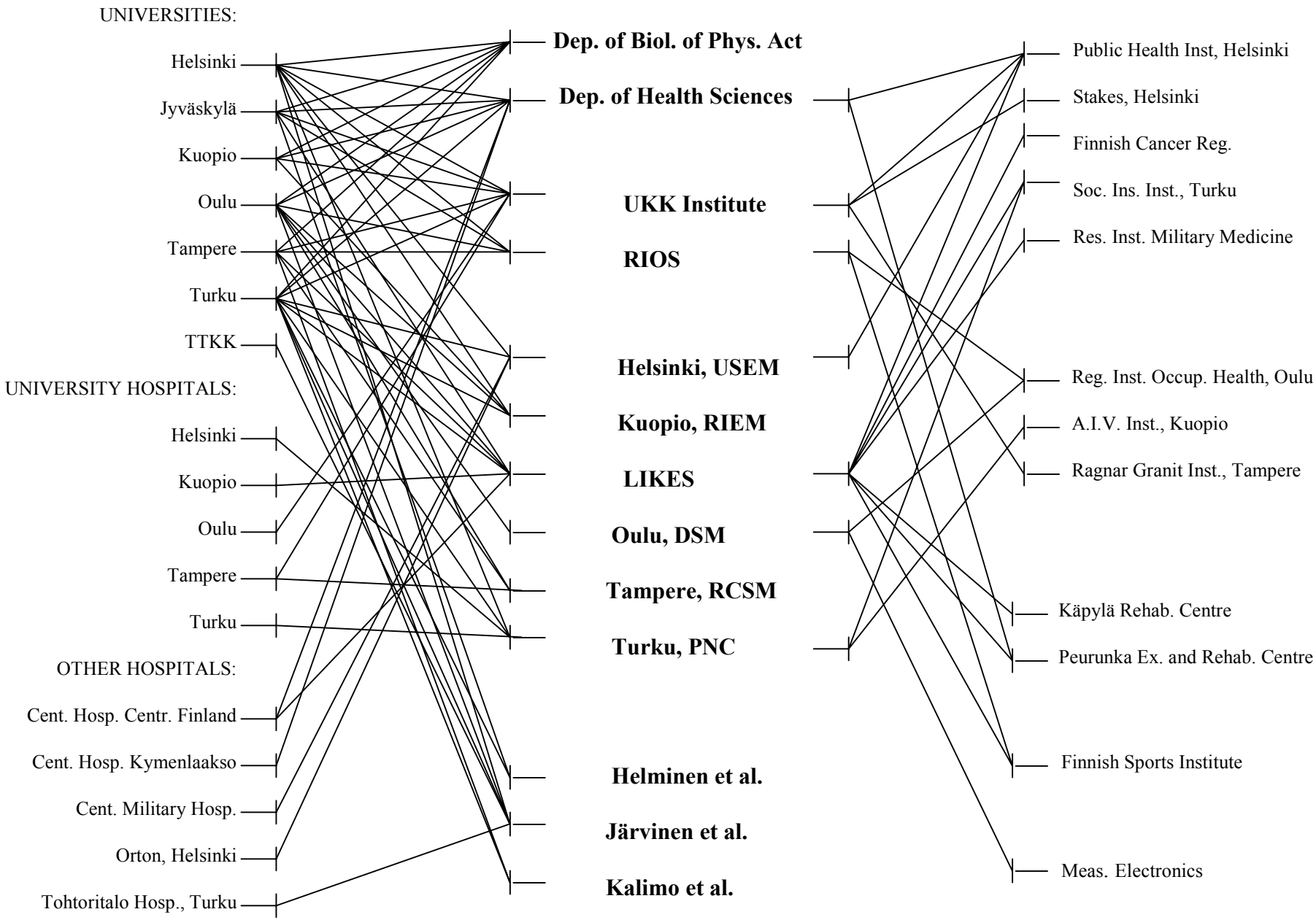
University core funding
Research projects
Research Institutes
Research projects
Research programs
Posts for researchers
Centers of Exellence
RIOS
University of Jyväskylä
•Dep. of Health Sciences
•Dep. of Biology of Physical Activity
Sports Medice Centers
•Jyväskylä
•Oulu
•Tampere
•Helsinki
•Turku
•Kuopio
Research Groups
•Helminen et al.
•Järvinen et al.
•Kalimo et al.
UKK Institute
..... = target area of the evaluation
Finland's Slot Machine Association
- core funding

Sources of funding of the research units/groups in years 1995- 2000 as estimated by the research units/groups themselve

	University/ research Institute	Ministry of Education, research projects	Ministry of Education, institution	Academy of Finland	Foundations	Industry	EU	Others	TOTAL
Univ. of Jyväskylä, DBPA	4 948 000	3 137 000	-	2 700 000	20 000	0	0	0	10 805 000
Univ. of Jyväskylä, DHS	3 297 169	2 040 885	-	3 349 892	960 000	2 394 000	0	5 415 000	17 456 946
	8 245 169	5 177 885	0	6 049 892	980 000	2 394 000	0	5 415 000	28 261 946
%of TOTAL	***29,17 %***	***18,32 %***	***0,00 %***	***21,41 %***	***3,47 %***	***8,47 %***	***0,00 %***	***19,16 %***	
Tampere, UKK -inst.	75 185 000	4 177 000	-	659 000	1 703 000	1 481 000	1 857 000	4 842 000	89 904 000
RAY basic funding	***83,63 %***	***4,65 %***	***0,00 %***	***0,73 %***	***1,89 %***	***1,65 %***	***2,07 %***	***5,39 %***	
RIOS, Jyväskylä	2 280 000	4 100 000	25 960 000	0	170 000	1 350 000	200 000	6 180 000	40 240 000
%of TOTAL	***5,67 %***	***10,19 %***	***64,51 %***	***0,00 %***	***0,42 %***	***3,35 %***	***0,50 %***	***15,36 %***	
Helsinki, USEM	0	1 000 000	5 420 000	150 000	500 000	0	0	1 180 000	8 250 000
Kuopio, KRIEM	0	1 940 000	5 647 000	250 000	180 000	110 000	0	6 990 000	15 117 000
LIKES Research Center	9 060 000	3 161 000	7 344 000	0	0	0	0	4 990 000	24 555 000
Oulu Deac.Inst. DSM	1 708 500	178 800	4 221 600	82 000	140 000	0	0	328 000	6 658 900
PNC, Turku	353 000	540 000	3 615 000	90 000	810 000	282 000	0	60 000	5 750 000
Tampere, TRCSM	346 000	510 000	3 837 000	0	70 000	100 000	0	758 000	5 621 000
	11 467 500	7 329 800	30 084 600	572 000	1 700 000	492 000	0	14 306 000	65 951 900
%of TOTAL	***17,39 %***	***11,11 %***	***45,62 %***	***0,87 %***	***2,58 %***	***0,75 %***	***0,00 %***	***21,69 %***	
Helminen et al.	11 727 100	1 070 000	-	350 000	690 000	0	0	1 965 000	15 802 100
Järvinen et al.	1 300 000	250 000	-	0	500 000	0	0	0	2 050 000
Kalimo et al.	0	405 000	-	0	40 000	0	0	170 000	615 000


UNIVERSITIES:
Helsinki
Jyväskylä
Kuopio
Oulu
Tampere
Turku
TTKK
UNIVERSITY HOSPITALS:
Helsinki
Kuopio
Oulu
Tampere
Turku
OTHER HOSPITALS:
Cent. Hosp. Centr. Finland
Cent. Hosp. Kymenlaakso
Cent. Military Hosp.
Orton, Helsinki
Tohtoritalo Hosp., Turku
Dep. of Biol. of Phys. Act
Dep. of Health Sciences
UKK Institute
RIOS
Helsinki, USEM
Kuopio, RIEM
LIKES
Oulu, DSM
Tampere, RCSM
Turku, PNC
Helminen et al.
Järvinen et al.
Kalimo et al.
Public Health Inst, Helsinki
Stakes, Helsinki
Finnish Cancer Reg.
Soc. Ins. Inst., Turku
Res. Inst. Military Medicine
Reg. Inst. Occup. Health, Oulu
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Peurunka Ex. and Rehab. Centre
Finnish Sports Institute
Meas. Electronics

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