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SPORT SCIENCES IN NORDIC COUNTRIES

EVALUATION REPORT

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EVALUATION REPORT

Evaluation panel

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DESCRIPTION

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Title	Sport Sciences in Nordic Countries. Evaluation Report	

Abstract	The report presents the results of an international evaluation of sport sciences in the Nordic countries in 2006–2010. Altogether 97 units (departments or research groups) performing sport sciences-related research at universities, hospitals or research institutes in the Nordic countries (Norway, Finland, Sweden, Denmark and Iceland) participated in the evaluation. For evaluation purposes, sport sciences were divided into three main domains: basic and applied sciences; medical and health sciences; and social and behavioural sciences. In the report, the panel concludes that the quality of Nordic sport and exercise sciences research is excellent. However, there are major differences in quality between countries, domains and research units. Each country has its own strong fields, medical and health sciences being the strongest at the Nordic level when estimated by publication volume. Country-wise, strong research areas include traumatology, social sciences, basic and applied exercise research, prevention of chronic diseases, and public health research. The panel says that the innovativeness of Nordic sport sciences research has decreased from its traditionally high level. The impact of research was not evaluated as such, but it can be recognised especially in the support systems for and training of elite athletes. In addition, Nordic musculoskeletal research has improved injury prevention and treatment also at the international level. The report lists several recommendations that should be implemented to improve the competitiveness of sport sciences research in the Nordic countries. These include continuing and strengthening Nordic collaboration, supporting collaboration of multidisciplinary research projects, bringing genomics and proteomics into basic sport sciences research, focusing on the decrease in physical activity, aiming at publishing in higher-impact journals also outside the field of sport sciences, maintaining high-quality research on elite athletes, promoting systematic use of existing databanks, and re-establishing Nordic postgraduate training programmes. To support collaboration and multidisciplinarity, the panel recommends that a specific funding instrument to enhance the formation of new research networks be established. The panel was delighted to observe an increase in the research and postgraduate training in physiotherapy, and recommends that it be further developed. PhDs and senior researches should be encouraged to seek further research training in universities abroad. Postgraduate training lasting more than five years markedly decreases research productivity, according to the panel. The panel also suggests that funding agencies evaluate the researcher training in sport sciences in the future. In addition, the panel sees that Nordic sport sciences researchers have good possibilities to establish a Nordic centre of excellence in the field.

Keywords	sport sciences, sports, elite sports, health, nutrition, funding, researcher training, research career, healthcare, mobility	
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Tekijä(t)	Arviointipaneeli	
Julkaisun nimi	Sport Sciences in Nordic Countries. Evaluation Report	
Tiivistelmä	Raportti esittelee yhteispohjoismaisen liikuntatieteellisen tutkimuksen tieteenala-arvioinnin. Arviointiin osallistui Pohjoismaissa (Norja, Suomi, Ruotsi, Tanska ja Islanti) yhteensä 97 liikuntatieteellistä tutkimusta harjoittavaa yksikköä (laitosta tai tutkimusryhmää) korkeakouluista, sairaaloista ja tutkimuslaitoksista. Arviointia varten tutkimusalat jaoteltiin kolmeen pääryhmään: perus- ja soveltavaan tutkimukseen, lääke- ja terveystieteisiin sekä yhteiskunta- ja käyttäytymistieteisiin. Arviointipaneeli toteaa raportissaan, että liikuntatieteellinen tutkimus on Pohjoismaissa korkealuokkaista, mutta tutkimuksen laatu vaihtelee merkittävästi tutkimusyksiköiden, maiden ja tutkimusalojen välillä. Eri maiden todetaankin olevan vahvoja eri aloilla, lääke- ja terveystieteellisen tutkimuksen ollessa julkaisumäärillä mitattuna yhteispohjoismaisesti vahvin tutkimusalue. Maittain vahvaa tutkimusta tehtiin mm. traumatologiassa, sosiaalitieteissä, perus- ja soveltavassa liikuntatieteessä, kroonisten sairauksien tutkimuksessa ja kansanterveystieteissä. Paneeli toteaa raportissaan, että pohjoismainen liikuntatieteellinen tutkimus ei nykyisin ole enää niin innovatiivista ja uraauurtavaa kuin minä sitä on perinteisesti pidetty. Liikuntatieteellisen tutkimuksen vaikuttavuutta ei suoraan arvioitu, mutta sen katsottiin edistäneen erityisesti huippu-urheilun tukea. Lisäksi pohjoismainen lihas- ja luustotutkimus ovat edistäneet loukkaantumisilta suojautumista ja niistä parantumista kansainväliselläkin tasolla. Raportissa esitetään useita suosituksia, joiden avulla pohjoismaista liikuntatieteellistä tutkimusta voidaan kehittää entistä kilpailukykyisempään suuntaan. Näihin ehdotuksiin kuuluvat pohjoismaisen tutkimusyhteistyön jatkaminen ja vahvistaminen, monitieteisten tutkimusryhmien yhteistyön edistäminen, genomiikan ja proteomiikan tuominen liikuntatieteelliseen perustutkimukseen, liikunnan määrän vähenemisen tutkimukseen panostaminen, pyrkiminen julkaisemaan korkeampitasoisissa, myös muissa kuin liikuntatieteellisissä julkaisusarjoissa, kansainvälisesti korkeatasoisen huippu-urheilututkimuksen ylläpitäminen, olemassa olevien tietokantojen suunnitelmallinen käyttö, sekä pohjoismaisen jatkokoulutusyhteistyön uudelleenkäynnistäminen. Yhteistyön ja monitieteisyyden edistämiseksi paneeli esittää erityisten rahoitusinstrumenttien perustamista uusien monitieteisten projektien rahoittamiseen. Lisäksi paneelia ilahdutti fysioterapian jatkokoulutuksen ja tutkimuksen lisääntyminen, ja sen edelleen kehittämistä tulisi tukea. Valmistuvia tohtoreita ja senioritutkijoita tulee rohkaista hankkimaan lisäkoulutusta ulkomaisissa yliopistoissa. Yli viisi vuotta kestävän jatkokoulutuksen katsottiin merkittävästi heikentävän tutkimuksen tuottavuutta. Katsottiin, että rahoittajien tulisi tulevaisuudessa arvioida tohtorikoulutuksen laatua liikuntatieteen alalla. Paneeli katsoo, että pohjoismaisilla liikuntatieteen tutkijoilla on hyvät mahdollisuudet yhteispohjoismaisen tutkimuksen huippuyksikön saavuttamiseen.	
Asiasanat	liikuntatiede, urheilu, huippu-urheilu, terveys, ravitsemus, rahoitus, tutkijakoulutus, tutkijanura, terveydenhuolto, liikkuvuus	
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PRESENTATIONSBLAD

Utgivare	Finlands Akademi	Datum 4.1.2012
Författare	Utvärderingspanel	
Publikationens namn	Sport Sciences in Nordic Countries. Evaluation Report	
Sammandrag	Rapporten presenterar resultaten från en internationell utvärdering av nordisk forskning kring gymnastik- och idrottsvetenskap. I utvärderingen ingick 97 forskningsenheter från högskolor, sjukhus och forskningsinstitut i de fem nordiska länderna (Danmark, Finland, Island, Norge och Sverige). Forskningsområdena indelades i tre huvudgrupper: grund- och tillämpad forskning, medicin och hälsovetenskaper samt samhälls- och beteendevetenskaper. Utvärderingspanelen konstaterar att den nordiska forskningen kring gymnastik- och idrottsvetenskap håller hög kvalitet, men att kvaliteten varierar mycket mellan enheter, länder och forskningsområden. Olika länder är starka inom olika områden. Mätt med antalet publikationer är medicinsk och hälsovetenskaplig forskning det starkaste forskningsområdet i hela Norden. Enskilda länder är också starka bl.a. inom traumatologi, socialvetenskap, grundläggande och tillämpad gymnastik- och idrottsvetenskap, forskning i kroniska sjukdomar samt folkhälsovetenskap. Panelen hävdar att den nordiska forskningen inom gymnastik- och idrottsvetenskap inte längre är lika nyskapande och banbrytande som man tidigare konstaterat. Utvärderingen gällde inte direkt forskningens genomslag, men panelen konstaterar att effekterna särskilt syns i främjandet av toppidrott. Dessutom har den nordiska forskningen om muskler och benbyggnaden på en internationell nivå hjälpt i att skydda sig mot och återhämta sig från skador. Rapporten presenterar flera rekommendationer för att vidareutveckla den nordiska forskningen inom gymnastik- och idrottsvetenskap samt för att ytterligare förbättra dess konkurrenskraft. Till exempel föreslår panelen att de nordiska länderna ska fortsätta och stärka forskningssamarbetet, främja samarbetet mellan mångvetenskapliga forskargrupper, utnyttja genomik och proteomik inom grundforskningen på området, öka forskningen om varför man motionerar allt mindre, publicera artiklar i tidskrifter av högre kvalitet, också inom andra områden, idka internationellt högklassig forskning inom toppidrott, systematiskt utnyttja existerande databaser samt återuppliva det nordiska samarbetet inom fortsatt utbildning. För att främja samarbete och mångvetenskaplighet föreslår panelen nya finansieringsinstrument för mångvetenskapliga forskningsprojekt. Panelen gläder sig åt ökningen av den fortsatta utbildningen och forskningen inom fysioterapi och föreslår att de stöds även framöver. Nya doktorer och äldre forskare ska uppmuntras att vidareutbilda sig vid utländska universitet. Panelen anser att forskningens produktivitet betydligt försämras om den fortsatta utbildningen räcker längre än fem år. Därtill anser panelen att finansiärerna i framtiden borde utvärdera kvaliteten på doktorsutbildningen inom området. Avslutningsvis påpekar panelen att de nordiska forskarna inom gymnastik- och idrottsvetenskap har bra möjligheter att få till stånd en samnordisk spetsforskningsenhet.	
Nyckelord	gymnastik- och idrottsvetenskap, idrott, toppidrott, hälsa, näring, finansiering, forskarutbildning, forskarkarriär, hälso- och sjukvård, mobilitet	
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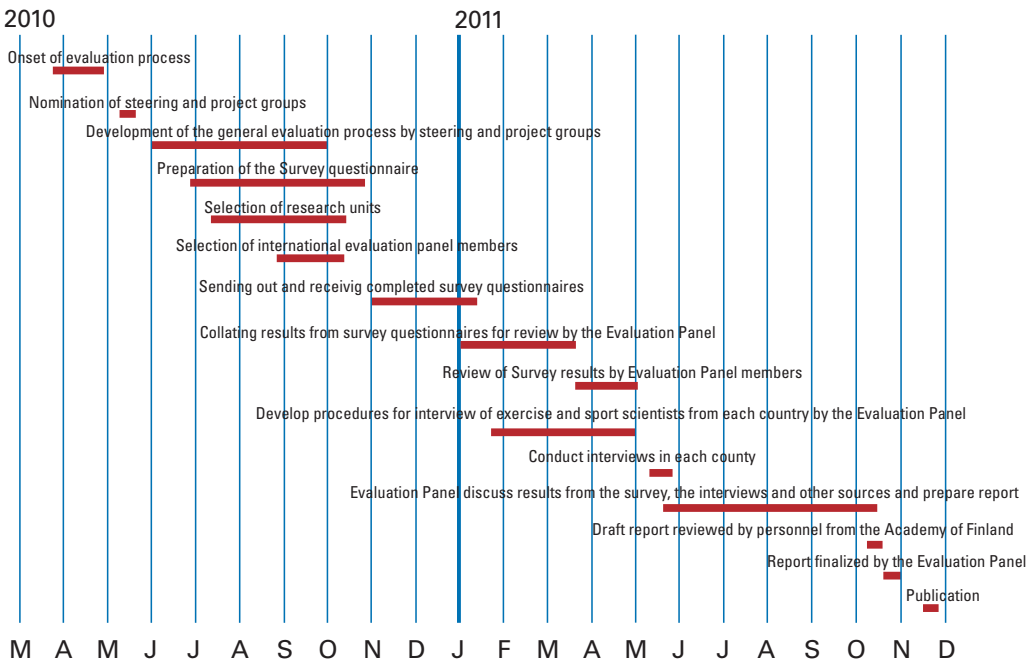
1 PREFACE

The idea for an evaluation of sport sciences in the Nordic countries came from the Academy of Finland in 2009. Together with Vetenskapsrådet, the Swedish Research Council, the Academy had completed a joint Finnish-Swedish evaluation of clinical medicine. After this project was completed, there was an interest in finding a suitable research discipline as a pilot project for an entire Nordic evaluation.

There seemed to be a general interest among the Nordic countries for a Nordic-wide evaluation on sport sciences. The discipline was considered important but small enough for a joint evaluation, although the widely scattered research units were immediately regarded as a challenge. Sport sciences also have an important societal role in all Nordic countries, which was considered to be an additional reason for conducting an evaluation.

The Nordic evaluation of sport sciences was a project by NORIA-net, which enhances coordination and cooperation between national research funding agencies and policy-makers in the Nordic region. The evaluation was funded by NordForsk (an organisation under the Nordic Council of Ministers that provides funding for Nordic research cooperation as well as advice and input on Nordic research policy). The management of the project was arranged into a project group, chaired by Dr Mikael Fogelholm from the Academy of Finland, and a steering group, chaired by Professor Michael Kjær from

Figure 1. Flowchart of evaluation process



the University of Copenhagen. The Academy of Finland was the project coordinator and responsible for the overall evaluation process and financial administration.

The evaluation was conducted by an international evaluation panel that had access to the results of an extensive written questionnaire completed by individual research units in each of the five Nordic countries and the opportunity to interview a representative sample of sport sciences researchers in each country. The objective was not to evaluate the status or accomplishments of any individual scientist or research unit, but to obtain a general understanding of the status of sport sciences in each Nordic country and the region as a whole. The evaluated subject areas included basic and applied biological sport sciences, sports medicine, sport sciences in health and disease, and humanistic and social sport sciences. The time frame for the evaluation period was 2006–2010. Evaluation was carried out during 2010–2011 (Figure 1).

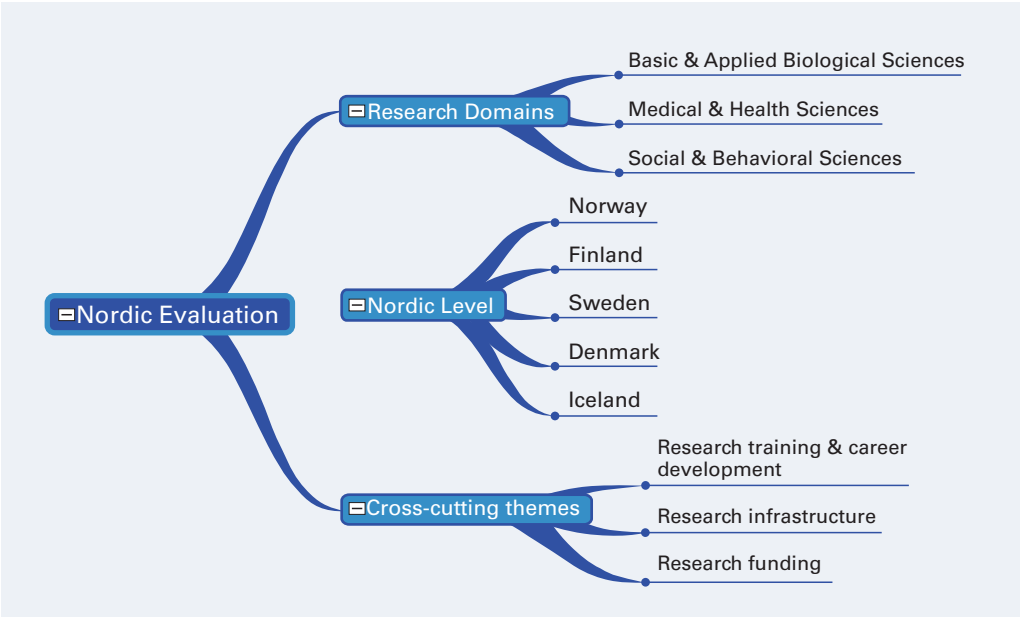
2 EXECUTIVE SUMMARY

Throughout much of the 20th century, sport and exercise scientists conducting research in the Nordic countries established excellent reputations for their highly innovative basic and applied research. This rich history has provided a fertile yet challenging milieu for the current scientific community attempting to extend knowledge through their exercise and sport sciences research that will benefit various subsets of the population – from patients to elite athletes and from toddlers to octogenarians. The major purpose of the present evaluation was to determine the effectiveness of the cadre of present-day sports and exercise scientists in meeting these challenges, the strengths and weaknesses of the existing research and research training environments, the opportunities for the future and how best to achieve them, and the key threats or barriers to achieving long-term success.

Evaluation process

The evaluation was a team effort involving many scientists and administrators in each of the Nordic countries who supported the work of the international evaluation panel. The primary sources of information used by the panel in preparing this report included an extensive written survey completed by 97 research units and in-person, group-based interviews of a representative sample of 107 exercise and sport scientists working in research units throughout the Nordic countries. To facilitate the evaluation, the steering group organised the participating research units into three major domains: basic and applied biological sciences, medical and health sciences and social and behavioural sciences. The panel used a similar organisation for its report. In completing the written survey, units were requested to assess their current status and future plans

Figure 2. Overview of evaluation process



using a SWOT analysis, considering the current strengths and weaknesses/limitations as well as the key opportunities and threats for the future. Analyses were undertaken at both Nordic and individual country level. Individual research units or scientists were not assessed explicitly (Figure 2).

Research units and personnel

Of the 97 units participating in the survey, 16 were in Norway, 22 in Finland, 41 in Sweden, 15 in Denmark and three in Iceland (Tables 1, 2 and 3). The major domain focus of these units was basic and applied biological sciences (27 units), medical and health sciences (32), and social and behavioural sciences (26). Twelve units were classified as conducting substantial science in two or more domains (combined units). Units in Denmark reported having the greatest number of appointed professors (expressed as full time equivalents, FTEs) (93.1), followed by Norway (73.1), Sweden (66.95), Finland (42.43) and Iceland (15.0). However, Sweden reported the greatest number of other senior researchers (98.7), followed by Finland (60.0), Denmark (50.7), Norway (16.1) and Iceland (15). Along with having the greatest number of appointed professors, Denmark also reported the largest number of PhD students (132.1 FTEs), followed by Finland (120.7), Sweden (114.9), Norway (71.91) and Iceland (2.25). All personnel numbers reported are for 2010. As can be seen in Table 4, the number of research personnel within specific domains varied substantially from country to country. For example, in medical and health sciences, Finland reported the greatest number of personnel at all levels – from PhD students to appointed professors.

Scientific publications

One generally agreed upon indicator of the ongoing success of a research unit is the number of manuscripts published in high-quality, peer-reviewed scientific journals. As part of the survey, each research unit was asked to provide the number of various types of manuscripts (e.g., original article, review article, monograph or book) published during each year for the period 2006–2010. For this report, articles published in the following types of journals were considered: international peer-reviewed journals, other international journals and national journals (Table 5). Over the five-year reporting period, Nordic scientists in the 97 participating research units reported 4,829 articles in peer-reviewed international journals, for an average of 80 articles/month. Units in Finland reported the greatest number of publications in international peer-reviewed journals (1,593), followed by Denmark (1,396), Norway (917), Sweden (877) and Iceland (46). When units are classified by major research domain, 2,041 of the articles published in peer-reviewed international journals were in medical and health sciences, 1,232 in units classified as combined, 1,086 in basic and applied biological sciences, and 470 in social and behavioural sciences.

Each participating unit provided a list of the ten most important exercise and sport sciences publications produced by their scientists during 2006–2010. These lists, along with the lists of publications in the curriculum vitae of key personnel in the units, provided the panel with an overview of which topics were being investigated and where the results were being published. The panel made no systematic tabulations of these publications, but the review did reveal well-defined areas of

concentration for each country in the three major domains. For example, in Finland, where 64% (14 of 22) of the participating units were classified in the medicine and health domain, topics on which substantial research had been conducted included: the effects of exercise on bone health (bone strength, osteoporosis, fracture prevention, lower back pain), muscle function and health, metabolic health (diabetes, obesity, metabolic syndrome, insulin resistance), cardiovascular health (coronary heart disease, stroke, blood pressure, lipids and lipoproteins) and successful ageing (maintaining or enhancing physical and mental functioning and independence).

To obtain an independent evaluation of the productivity of exercise and sport sciences researchers in the Nordic countries during 2006–2010, a search was made on the Web of Science to determine the number of articles published by Nordic scientists in leading peer-reviewed sport and exercise sciences journals, as determined by their impact factor. Overall, many Nordic scientists appear highly productive based on these criteria (Tables 6 A and 6 B). Despite the fact that the five Nordic countries have a total population of approximately 26 million, in the biological and medical sciences they published about 9.3% of all articles published in six of the top sports biology and medical journals worldwide, not including the Scandinavian Journal of Medicine and Science in Sport (in this journal, they authored 54% of all publications). Because of the greater diversity in the types of publications considered of high value in the social and behavioural sciences (e.g., monographs, reports, chapters and books), the Web of Science data for these domains is not as well defined. However, the data do indicate that the prevalence of publications by Nordic scientists in eight highly regarded journals in the social and behavioural sciences is good but not great (Tables 6 C and 6 D). For example, scientists in Australia, with a population of approximately 22 million, published articles in the leading social and behavioural sciences journals on average 3.4 times more frequently than Nordic scientists during 2006–2010 (199 vs 59 publications). Part of this might be explained by language constraints in the Nordic countries, but it also suggests room for improvement.

Elite sport research

Both the written responses to the survey and the interviews showed that there was a limited amount of recent or ongoing basic or applied research dealing with the performance of elite athletes, much less than the panel expected. The sport and exercise sciences across the Nordic countries have historically embraced the issues that are relevant to the performance of elite athletes. With very few exceptions, there was little evidence of integration of elite athlete research with more resource-intensive basic and applied science research. The panel thought that this change in focus was likely a reflection of the availability of funding in this area. It appeared that any funding currently available for research into elite athletes was devoted mostly to athlete monitoring and support rather than research. There were, however, some examples of the provision of funding from industry and regional government sources. The current picture may also reflect the geography of sports-related research facilities. It seems that there are good opportunities in Norway, where the Olympiatoppen centre is located immediately adjacent to the sport sciences university and some staff have joint appointments. Elsewhere, there seems to be a clear separation between athlete

support services and clinical and laboratory research facilities. The world of elite sports provides some good research opportunities, and here the basic sciences have much to offer. A closer integration, including perhaps the identification of some specific funding mechanisms that would encourage greater communication and collaboration, should be considered.

There were clearly different perspectives on how to approach the balance between basic and applied research, and on how efforts should be distributed across the field to balance the needs of public health and elite sport constituencies. In the elite sport arena, the need for coach education was emphasised, even if this required the investment of resources that would otherwise be directed towards research and the generation of new knowledge.

Research training and career development

Generally, the panel considered the training of exercise and sport scientists in the Nordic countries as very good to excellent. However, some deficiencies were identified that caused significant concern among panel members when looking to the future. The quality of PhD training varies quite substantially among research units across the Nordic countries and across domains. The panel attempted to determine if PhD students and postdoctoral fellows had access to forward-looking scientific thinking by mentors and colleagues, sufficient time to be personally immersed in the research process (e.g., designing and planning projects, conducting the research in a timely manner, analysing data, preparation of reports and proposals) for an extended period of time and exposure to scientists from other disciplines and fields of research. Strengths in PhD training include the process of scientific writing and the opportunity to participate in international conferences. From comments made during interviews, the panel interpreted that many supervisors were fully engaged with other responsibilities, limiting their time to provide guidance to PhD students in the early stages of their studies. The panel concluded that the presence of more junior staff with a full-time research commitment would enhance the effectiveness of training in a variety of research methods.

During the interviews, a strong opinion was expressed by scientists across Nordic countries and domains that postdoctoral training has become essential for obtaining an academic research position. MDs who also had a PhD degree were a possible exception. Generally in hiring, greater value is given to scientists who have acquired postdoctoral training in strong academic institutions outside the Nordic countries, especially in the UK and the US. Obtaining postdoctoral training in selected European countries, including other Nordic countries, is considered more useful than obtaining postdoctoral training in a postdoctoral researcher's own country. Some exceptions to this opinion existed, especially in Denmark. The added value of obtaining research experience outside the broad discipline of exercise and sport sciences during postdoctoral training was expressed during some interviews. The panel concurred with this opinion.

Major concerns by the panel regarding training and career development in the exercise and sport sciences included the possible training of too many PhDs given the limited number of funded postdoctoral positions. However, some of the senior scientists interviewed indicated that the pool of good PhD candidates has been

decreasing, whereby some reduction in the funding of PhD training might be considered. While the average time spent in obtaining a PhD was reported to be decreasing in each of the Nordic countries (target appears to be 4 years), a number of recent or current candidates spend at least 6–8 years, in part due to their financial needs to perform other paid employment such as teaching or in having a family. Also, it seems that a number of PhD students delay obtaining a degree because of limited research positions in academic research units.

Another issue of some concern to the panel regarding career development was the number of professors and other senior scientists near, at or over retirement age and, in many cases, the apparent lack of specific plans for leadership transition. In some cases, the replacement of a professor is made by a senior official or committee in the academic institution who may decide to redirect the mission or focus of a research unit to scientific issues outside the discipline of exercise and sport sciences. The likelihood of this happening is reduced if the research unit is highly productive, routinely obtains funding from outside sources and if its research is innovative, making the unit an international leader in its domain.

Mobility of researchers

The panel considered the general lack of mobility among Nordic sport sciences researchers to be a subject of concern for the future. Nordic-wide, nearly 75% of the units reported no visits to another unit or less than one each year of up to three months by one of their researchers. Also, except for Denmark, only about 50% of units reported any scientists visiting their unit between 2006 and 2010. The panel feels that the lack of national and international mobility of sport scientists to and from many of the research units restricts the development of new ideas and contributes to the lack of innovation and major collaborations.

Based on information provided in their *curriculum vitae*, questions were raised by panel members about an apparent lack of mobility over the careers of some current senior researchers. In many cases, these researchers have spent most of their careers in the same institutions where they received their education. The issue here is the apparent benefit of the cross-fertilisation of ideas leading to innovation when researchers who have trained and worked at different institutions join together.

Research funding

During 2006–2010, the 90 participating units in all five Nordic countries providing funding data in their survey responses reported receiving in excess of EUR 47 million for conducting research or research training (seven units did not provide data on funding). Approximately 43% of this amount was internal funding (primarily provided by the institution) and 57% came from external funding sources (Table 7). A majority of the external funding was provided by the national governments. Units in Finland reported receiving 81.5% of their external funding from their government while units in Denmark received only 45% from their government (Sweden 76.9%, Norway 72.6% and Iceland 61.5%). Units in Denmark reported receiving 30.2% of their external funding from private foundations, which is much more than in any of the other Nordic countries, and overall in Denmark, approximately 10% of all external funding came from international sources.

Much of the external funding, regardless of source, is provided in response to investigator-initiated grant proposals where the awarding of funds is highly competitive. The review process for research proposals submitted to the main government funding agencies in each country is well established and considered to be of high quality by the panel. Despite the general decline in funding for biomedical, social and behavioural research from most sources, following the recent general economic decline, no evidence was provided to the panel that there was a significant decline in the funding of sport sciences research in the Nordic countries during 2006–2010. During this period, and it seems sometime before as well, there has been a general shift in research priorities in the sport sciences through most of the Nordic countries, from less elite athlete and sport performance research to more research on the health risks of inactivity and the benefits of being physically active throughout life. This shift appears to have been driven, at least in part, by public policy and a public health agenda directed at the prevention and treatment of chronic degenerative diseases.

During the interviews and discussions, the panel members also considered the funding distribution among the sources and generally agreed that concerted efforts should be made to obtain an increase in funding from international sources, especially from European agencies. Multidisciplinary research collaboration among countries was considered a priority for this effort. Also, discussions were held regarding different funding strategies, including the value of funding small units that work very independently on relatively small but highly targeted issues versus large multidisciplinary units (possibly "centres of excellence") that are designed to facilitate collaboration and see their mission as solving large, complex problems. No final conclusion was reached but the prevailing opinion favoured both approaches: small units with a history of high productivity and innovation should be encouraged as well as large, effectively directed, multidisciplinary units (centres that could be either physical or virtual).

Research infrastructure

The survey sent to research units did not include any questions on infrastructure availability or needs for the future. During the interviews, investigators did not indicate that a lack of research infrastructure was a major impediment to being more productive or innovative in the future. However, well-thought-out and well-funded facilities would likely lead to greater and more effective collaboration. All Nordic countries considered large national medical and mortality databases and the ready access to them to be valuable infrastructure resources. However, the panel concluded that these databases have been underused by sport sciences researchers. For example, very few plans to take advantage of these opportunities were evident during the interviews. Researchers indicated that materials in biobanks (e.g., blood, muscle biopsies and DNA) are not often available to investigators from other institutions due to issues over ownership of biobank materials which limit collaborations. How better to share samples and enhance collaboration in this area should be a target for the near future.

In Denmark, there was general agreement among the interviewed scientists on the need to focus on areas of strength where major infrastructure investment would help develop centres of national and international excellence. It was acknowledged that this would require strategic planning and the identification of relevant research questions.

Limitations of the evaluation

- The panel did not conduct site visits to any of the research units.
- Not all research units conducting exercise or sport sciences research in the Nordic countries participated in the survey or the interviews. The exact under-representation was not well established but appears to be 20% or less in each of the countries. In Denmark it appears that most of this nonresponse to the survey was in the basic sciences.
- A standardised approach was not used across countries in assigning research units to primary domains. In two countries, each participating unit was assigned a specific domain (Finland and Sweden), and in three countries, some units were listed as conducting research in two or three domains (Norway, Denmark and Iceland).
- Some large institutions with multiple departments/divisions/institutes responded to the survey as a single unit while other institutions had multiple units individually respond to the survey. This was especially true in Sweden so they generally had more but smaller units reporting than in other countries.
- The panel had limited access to standardised information on the funding of research from each of the countries, which limited commentary on various issues of research funding.
- The interview groups were too large and the interview methods not well developed. However, the panel did consider the interview process to be of value since visits by the panel to individual units were not possible due to the logistics of such visits.

3 PANEL CONCLUSIONS AND RECOMMENDATIONS

3.1 Major conclusions

The panel came to these general conclusions in response to the following questions. For more detailed information by country and domain, see Section 7.

1. What is the international quality and status of sport sciences in the Nordic countries?

Taken as a whole, the quantity of sport sciences conducted in the Nordic countries during 2006–2010 was considered excellent but with substantial variability across units, domains and countries. The overall rate of publication reported by scientists working in the participating units in international peer-reviewed journals was 80 articles/month during the five-year evaluation period. A review of articles published in six of the highest-impact sports medicine and biology journals by scientists from countries throughout the world during 2006–2010 indicated that 9.3% of the articles were authored by scientists from the Nordic countries (Note: The origin of all authors of a particular paper was included in this search. This means that the Nordic authors could be only co-authors and the first or senior author could be from another country). This rate is somewhat higher than for countries with reasonably comparable populations and active exercise and sport sciences research programmes, such as Australia (8.2%) and Canada (8.9%). Also, some Nordic exercise and sport sciences research units have had success in the publication of articles in high-impact journals outside the exercise and sport sciences realm, including publications in *The Lancet*, *BMJ*, *The Journal of the American Medical Association*, *Circulation*, *European Heart Journal* and *Diabetes*.

2. Is the research in sport sciences creative, innovative and likely to produce new lines of thinking?

Historically, major areas of exercise and sport sciences research conducted by scientists in the Nordic countries have been considered ground-breaking and highly innovative in both the disciplines of exercise for physical performance and physical activity for public health and welfare. For example, innovation in the Nordic countries was made possible by the collaboration of physicians and exercise physiologists developing new laboratory methods or applying methods from other disciplines to study responses to exercise in elite athletes, the public and patients. Also, our understanding of the negative health impact of too much inactivity and the health benefits of being physically active has been significantly enhanced by research conducted in all of the major domains of sport sciences in the Nordic countries.

The panel's conclusion is that some of this innovative quality of past research has been lost in the Nordic countries. Staying innovative is a constant challenge and exploring new ideas and the freedom to take chances (and fail as well as succeed) requires time, resources and facilities. Innovation is greatly facilitated by the successful recruitment and training of talented young scientists and transdisciplinary collaboration. Little evidence was presented to the panel of innovative research regarding elite athletes, except in the prevention and treatment of some sports-related injuries. It appears that a majority of the resources and efforts spent in the area of elite athletes is used for athlete evaluation. Good examples of

research on sports-related injury prevention and treatment can be found in Norway, Sweden and Denmark, with less apparent examples in Finland and Iceland.

One way to increase the likelihood of significant innovation is to develop collaborative programmes of research that have basic and applied sport scientists working closely with coaches and athletes at elite training centres. Research on the relationships of exercise and sports and the development and progression of atherothrombotic vascular disease and metabolic disorders such as obesity, metabolic syndrome and type 2 diabetes remains important and reasonably innovative, especially in Finland and Denmark. However, the extensive scientific emphasis placed on describing the relationship between physical activity, sports participation or physical fitness and the prevalence of these disorders (descriptive epidemiology) does not leave much room for continued innovation when the question being asked is just about *what* this relationship is. Innovation is much more likely to occur if the key questions deal with the *why* or *how*. What we need are better-designed experiments that provide biological mechanisms for the associations or causal links between behaviours and clinical outcomes. Similarly, we need more well-designed and innovative behavioural interventions.

3. Which research fields/areas are strong/weak in each country?

In the Nordic countries, in terms of research productivity based primarily on publications in high-impact journals, the domain of medicine and health (including sport/exercise traumatology) was greatest in 2006–2010, followed by basic and applied biological sciences and social and behavioural sciences. This ranking partly reflects the number of scientists working in each domain (Table 4). None of the three major domains were considered weak by the panel, but there were specific areas of concentration within the domains that were much stronger than others. In Norway, strengths are apparent in applied biology, sports medicine (especially sports traumatology) and the social sciences, with less of a focus on basic biology and the behavioural sciences. The dominant strength in Finland, based on the number of units conducting research and production in terms of manuscripts, is the domain of medicine and health, with a major focus on the prevention of chronic diseases. Sweden continues its history of being strong in basic and applied biological sciences and in social and behavioural sciences. Much of its research in the medicine and health domain is in sports traumatology. Sport sciences research in Denmark is quite diverse across all three domains in the participating units, but overall continues to remain exceptionally strong in the basic and applied exercise sciences. Recently, major research domains in the participating units in Iceland have been public health (especially obesity-related chronic disease), sports traumatology and the social sciences.

4. What are the differences between successful and non-successful domains/areas?

One key factor in the success of a research domain is the availability of adequate and well-placed long-term financial support. The panel was informed that in much of the Nordic region over the past several decades, there has been a funding shift by national government funding agencies, moving away from elite sport research and towards research in the medical and health sciences (including research in health-related behaviour change). Another factor contributing to a decrease in the strength of elite sport research is the difficulty, if

not failure, of demonstrating the relevance of this research to the general population. How does this research influence the health, wellbeing or quality of life of various segments of the general population?

Successful research units have a clear and continued focus on important questions they want to answer, develop the expertise (including collaboration) needed to conduct the research, design appropriate studies and effectively conduct the studies. To operate in this manner, units need high-quality research training programmes, long-term institutional commitment and appropriate facilities and equipment. However, if the scientists are not innovative in their thinking and are unwilling to explore new ideas and approaches, even well-organised and well-funded units will not produce innovative research.

During the interviews with scientists from the various Nordic countries and domains, there was no consensus regarding the issue of centralisation versus regionalisation of research facilities in the exercise and sport sciences. Centralisation allows for better access to collaborators and expensive facilities or equipment, but regionalisation provides greater independence, which in turn may help achieve enhanced innovation.

5. Which are the most successful research units/groups in each country and why?

The panel was instructed not to attempt to evaluate or report on specific investigators or research units. No site visits were made to the units. Throughout the Nordic countries, successful research units in the sport sciences come in all sizes, shapes and locations. There are some large centralised units such as the Institute of Sports Science and Clinical Biomechanics (ISSCB) at the University of Southern Denmark, the Norwegian School of Sport Sciences (NSSS), the Norwegian University of Science and Technology (NTNU) and the combined units at the University of Jyväskylä in Finland that have made highly significant research contributions over the years and continue to do so. Also, all these institutions play a very important role in the training of young scientists. However, there are small units spread throughout Norway, Finland, Sweden and Denmark that continue to produce significant and innovative research. A variety of factors seem to contribute to the success of these units, including talented leadership, collaboration with other units in the region or throughout the country and internationally (especially transdisciplinary collaboration) and local funding, usually the result of the unit's demonstrated value to the community.

6. What has been the societal impact of exercise and sport sciences research in the Nordic countries?

The issue of impact was not addressed in the survey sent to the research units. During the interviews, however, the impact of research in each country was discussed briefly. In most cases, this is not an issue frequently addressed by exercise and sport sciences, except where the research is linked to a specific population such as elite athletes or people with diabetes, or in dealing with issue of public health. However, the panel concluded that it is likely to be an area of increasing importance in the future.

It was generally felt that the development of knowledge by the sport sciences research community has been widely applied in elite sports in the form of

support services at training facilities. However, there seemed to be little or no systematic evaluation of whether this research has had any effect on sports performance. This may be reflected in funding and in a limited interaction between research scientists and coaches.

Research in the field of musculoskeletal health has had a substantial impact on the international scientific and therapeutic communities. Since it is a rapidly developing field the impact at an applied clinical level is still evolving, except for injury prevention and treatment in football and skiing where it has been adopted internationally. Research on the role of exercise in bone health, such as in the prevention of osteoporosis, has impacted public health and medical practice guidelines worldwide.

The panel felt that the opportunities offered by a strong exercise science community to the field of chronic disease prevention and rehabilitation were not fully appreciated by medical professionals in the Nordic countries – neither by those charged with implementation of lifestyle promotion activities nor by those engaged in research in these areas. However, a number of physical activity promotion campaigns and programmes in support of chronic disease prevention and healthy ageing have used, and are continuing to use, the results of exercise and sport sciences research conducted in the Nordic countries.

3.2 Major recommendations

The steering group requested that the panel make recommendations a) for developing sport sciences in the future, with special reference to Nordic collaboration and b) for organisations that provide funding to sport sciences research.

1. The panel recommends that all Nordic countries continue their history of success in the medical and health sciences with a major emphasis on enhancing collaboration within and between Nordic countries. The issues related to the role of physical activity in the prevention and treatment of major chronic diseases are similar across the Nordic countries and effective collaboration would enhance the opportunities for answering key questions related to causality, mechanisms, dose-response and behaviour change. Success in this area will be enhanced through more transdisciplinary research programmes.
2. Because of the complexity of exercise as a research topic, the panel recommends that incentives be provided for multidisciplinary teams of investigators to work closely together using systems-based approaches to address fundamental principles underlying adaptation to exercise training/physical activity. Such incentives could include special funding for integrative laboratories or centres and for transdisciplinary PhD training programmes. Collaboration is a learned research skill and early training at the PhD level should lead to more effective multidisciplinary research teams in the future.
3. Little discussion was held during the interviews with basic and applied biological scientists about inclusion of genomic/proteomic or metabolomic technologies in existing major human exercise intervention studies. The limited expertise in these areas, which are extremely demanding in terms of both human and physical resources, will reduce opportunities for innovative exercise-directed genetic as well as gene-environment research.

The panel recommends that consideration be given to the development of Nordic-wide programmes for exploring the genomic and genetic basis of performance and health responses to changing levels of physical activity and exercise training.

4. Research over the last 50 years has established the importance of being physically active throughout life. At the same time, however, daily requirements for physical activity continue to decrease across the Nordic countries. What has not been adequately documented are the major factors mediating or modifying this decline, and even more importantly, what strategies are needed to reverse this downward trend. Priority should be given to funding transdisciplinary research teams that involve at least exercise specialists, behavioural scientists, built environment scientists, social scientists and urban planners, to design and conduct studies for identifying effective programmes for enhancing the habitual physical activity of specific subsets of the population, including people with disabilities.
5. The panel recommends that scientists at all levels endeavour to submit more manuscripts to highly-rated journals within and outside the sport sciences discipline to help establish international recognition, to facilitate international cooperation and increase opportunities for obtaining collaborative research partners from other countries. This goal is especially important for Iceland. Achieving this goal will likely require a concerted effort to increase the quality and relevance to key issues of the research conducted in many of the units.
6. It is the opinion of the panel that the Nordic countries have and should continue to play a major international role in research on elite athlete performance including the prevention and treatment of sports-related injuries. However, for this research to be innovative, new collaborations need to be established between elite athlete testing and training centres and basic and applied scientists within and outside the exercise and sport sciences and across the major domains considered in this evaluation.
7. Nordic scientists primarily conducting health research in disciplines other than the exercise and sport sciences have developed a number of large databanks. The panel recommends that a systematic plan be developed in each country on how these databanks can be more effectively used to help address major unanswered questions dealing with the role of exercise and sports in major health and other societal issues. Also, it is very important for exercise and sport scientists to play a more active role in the development of new databanks to help insure the inclusion of appropriate measures of physical activity or exercise, sports participation and components of physical fitness as well as appropriate outcome measures.
8. The panel recommends that consideration be given to re-establishing annual Nordic-wide courses and workshops for PhD students and possibly postdoctoral fellows to enhance the development of links with faculty and students from other Nordic countries. Links with fellow PhD students working on similar problems in different environments provides valuable

experience in the implementation of innovative research. Consideration should also be given to a similar programme with non-Nordic countries.

9. The panel was favourably impressed by the recent increase in research training of physiotherapists in exercise and sport sciences, especially in Sweden. The panel also appreciated their potential to significantly increase research on the diversity of approaches for the prevention, treatment and rehabilitation of exercise-related injuries. The panel recommends that all Nordic countries seriously consider ways to involve more physiotherapists in their PhD and postdoctoral training programmes and to make senior research positions more readily available to them.
10. The panel recommends that Icelandic researchers in social and behavioural sciences look at the possibility of conducting more research in the field of leisure, exercise and tourism, and that they look for commercial sponsors who would have vested interests in these areas. Such research is suggested because of the importance of these topics to the Icelandic economy. Exercise- and sport-based tourism, including lifestyle sports, is a growing industry and Iceland is an ideal location for collaborative research in this area.
11. Trainees and faculty should be encouraged to pursue complementary research training as postdoctoral scholars in other parts of the Nordic countries or in the EU or North America. The research programmes will stagnate without the infusion of new ideas and technologies and the likelihood of this happening is diminished with trainees staying at the same institutions for their whole career. Funding agencies should give such training a higher priority.
12. There was substantial concern among the panel members that a long period of training for PhD students (> five years) creates a culture that leads to limited productivity. There are likely multiple factors that contribute to the slow progression of many students, so to address this will require more than just funding changes. This is an area in which team building around common research topics could provide a more active research (and training) environment with enthusiasm for pushing projects to an international scale.
13. To increase collaboration among research units the panel recommends that special funding programmes be established, only available to research proposals that include new collaborations between research units or new collaborations with scientists working outside the exercise and sport sciences. Joint Nordic funding should be considered for collaborations of scientists among the Nordic countries and other European countries. Such international collaborations already exist, but the panel thinks that an increase in such funding would increase the opportunity for research innovation and increase the competitiveness of Nordic sport sciences research in obtaining international funding.
14. The major organisations in each Nordic country that provide funding for the training of PhD students and the major institutions conducting this training should organise comprehensive evaluations of the PhD

training in exercise and sport sciences. The primary purposes of such evaluations would be to determine if appropriate research mentoring is provided, if financial support is available to fund a training programme that enables most students to obtain a PhD in no more than four years and whether funding mechanisms operate in a way that does not result in a funding gap between PhD completion and obtaining a funded postdoctoral position.

15. Collaboration among countries to achieve a major *Nordic Centre of Excellence* in a specific domain within the sport sciences should be considered by the sport science leadership in the Nordic countries. It should be determined whether such a proposal could be submitted to NordForsk, both for funding the development of a plan and to secure a lead funding organisation for such a centre.

4 EVALUATION BACKGROUND

Sports and exercise or being physically active play a significant role in the lives of many people throughout their lifespan. Moving about under one's own power is an essential element of daily living for most people to remain independent and productive members of society. Participating in sports or active recreation makes major contributions to the wellbeing and quality of life for people of all ages. Data collected in many populations over the past 60 years have demonstrated that the least active or least physically fit members of a society are at the greatest risk for disability or premature death from major chronic diseases and that the more physically active a person is the lower their risk. This protective effect of being physically active exists across both sexes, among different races and ethnicities around the world and for people with different personal characteristics (e.g., normal weight or overweight, non-smokers or smokers, healthy people or people with various diseases). Thus, it is becoming increasingly apparent that the habitual lack of physical activity and excessive sedentary behaviour are major clinical, public health and policy issues that need a more integrated and transdisciplinary science base.

Advances in technology in developed and developing countries continue to contribute to the decrease in energy expended in the performance of activities required for daily living. Increased use of various labour-saving technologies has reduced the physical activity required on-the-job, during commuting, while performing household chores and during recreation. Currently, we know enough about the negative health consequences of decreasing activity levels in an increasing percentage of the population to support public policies and programmes to try and counter the downward trends in daily activity. However, to successfully reverse continuing declines in physical activity, innovative research in the biological and social/behavioural sport and exercise sciences is needed.

Sport has played a critical role in the history and culture of many countries around the world and the Nordic countries are no exception. In addition to its recognised health benefits, sport as both a participatory and spectator activity has an important role in society. For example, support for elite athletes and teams at the local, regional or national level provides opportunities for companionship among people from different segments of society. Other important benefits that might assist researchers in demonstrating societal benefit include the mental wellbeing outcomes of physical activity (including its role in dementia), positive youth development through sport and physical activity, and community and environmental development through programmes of physical activity.

While the resources and personnel available to conduct sport sciences in the Nordic countries have historically been limited compared to those available in much more populated countries such as the US, Germany and the UK, Nordic researchers have made highly significant contributions in a variety of domains in the sport and exercise sciences. These contributions range from training techniques used to enhance the performance of elite athletes, methods to aid in the prevention of sports-related injuries, enhanced methods for teaching sport techniques to athletes or rehabilitation exercises to patients, describing molecular-level changes in skeletal muscle in response to different types or profiles of exercise, establishing the role of increasing physical activity in the prevention of coronary heart disease, hypertension and type 2 diabetes, and the role exercise plays in the physical and mental development of youth and their retention as a person ages. A goal for the future should be to continue to conduct innovative research that addresses key issues faced by society, to look for new opportunities to conduct transdisciplinary research that forces investigators in specific disciplines to "think outside their box", to take advantages of existing resources and expertise to build new research paradigms throughout the Nordic countries.

4.1 Definition of sport sciences

For the purpose of this evaluation, *sport sciences* were considered from a broad perspective, so that they include any research conducted to better define the human response to gross body movement (exercise or physical activity). This includes the general domains of basic biological sciences (e.g., genetics, molecular biology, physiology), applied sport and exercise sciences (e.g., performance responses to training in the general public as well as elite athletes, biomechanics, role of nutrition in athletic performance), sports medicine (e.g., exercise and sports traumatology, prevention of injuries during physical activity in the general public and athletes), the role of exercise and sports in health and disease (e.g., physical activity epidemiology, clinical research on selected patient populations), social sport sciences (e.g. sports history, humanities, sociology, philosophy, politics and economics, cultural and leisure studies, including relations of power, social divisions, diversity, discrimination, ethical issues, national/international perspectives and globalisation), as well as physical-activity-related behaviour change and the role of physical activity in mental health.

5 OBJECTIVES OF THE EVALUATION

The primary objective of the evaluation was to determine the strengths and weaknesses of sport sciences in the Nordic countries for the period 2006–2010. The evaluation panel was interested in obtaining a current and candid view of the research focus and productivity of units located in various types of institutions, how decisions were made regarding topics to explore, the nature of the collaboration within and between units, what factors most contributed to research productivity or lack thereof, and the amount of transdisciplinary research being performed. Given the importance of maintaining a cadre of well trained and motivated scientists and support personnel, the panel attempted to understand the strengths and weaknesses in the preparation of scientists at the PhD and postdoctoral levels, job opportunities for junior scientists, the process of mentoring for enhancing career development and the process for the replacement of professors and senior scientists at the time of retirement.

The evaluation panel wanted to gain information and insights on the following issues:

1. The focus and scattering of different scientific disciplines within sport sciences in the Nordic countries: Where is the work done? What is the focus? What is lacking? What are the structural weaknesses/strengths?
2. The overall quality of sport sciences and the recognition of strong and weak areas/disciplines (publication history, present activities)
3. Factors affecting the quality:
   a. Strategic issues (e.g. institutional research and publication strategies)
   b. Human resources (size and composition of research groups, multidisciplinary, national and international cooperation, etc.)
   c. Research infrastructure
   d. External funding
4. Funding of sport sciences in the Nordic countries: adequacy, allocation and process of funding; advantages and disadvantages of a decentralised funding system
5. Linkage between science and societal applications (science-society interaction)
6. Evaluation of future prospects of sport sciences in the Nordic countries

The results of the evaluation are intended to inform the sport sciences leadership and funding agencies in the Nordic countries as to current research strengths from a country- and Nordic-wide perspective, where significant opportunities and weaknesses exist when looking to the future, and to provide recommendations regarding enhanced collaboration among research units across the Nordic region.

6 DESCRIPTION OF THE EVALUATION PROCESS

The overall plans for the evaluation were developed under the guidance of project and steering groups (in charge of the substance and strategic issues of the evaluation). The steering group consisted of the following members:

Michael Kjær, Professor, Copenhagen, Denmark, chair

Erlingur Johannsson, Professor, Reykjavik/ Lagarvatn, Iceland

Pasi Koski, Adjunct Professor, Turku, Finland

Per Nilsson, Professor, Stockholm, Sweden

Sarianna Sipilä, Research Director, Jyväskylä, Finland

Mats Ulfendahl, Professor, Stockholm, Sweden

Nina Vøllestad, Professor, Oslo, Norway

The evaluation was coordinated by the Academy of Finland with the help of national working groups from the organising funding agencies. The project group consisted of representatives from the agencies and was to lead and support the execution of the evaluation. The project group consisted of the following members:

Mikael Fogelholm (Academy of Finland, Finland), chair

Riikka Pellinen (Academy of Finland, Finland, external coordinator)

Saara Leppinen (Academy of Finland, Finland)

Minna Paajanen (Ministry of Education and Culture, Finland)

Hilde Grindvik Nielsen (Forskningsrådet, Norway)

Magnús Lyngdal Magnússon (RANNIS, Iceland)

Christine Dartsch (CIF, Sweden)

Johan Dixelius (Vetenskapsrådet, Sweden)

Anne Christiansen (Danish Agency for Science, Technology and Innovation, Denmark)

Monica Lund/Hanne Silje Hauge/ Janina Lassila (NordForsk, Norway, external observer)

The contact details of the members are listed in Appendix E.

6.1 Evaluation steps

The evaluation process consisted of the following steps (see Figure 1):

- Development of general evaluation process by project and steering groups
- Preparation of survey questionnaire by steering and project groups
- Selection of research units to receive survey questionnaire
- Sending out and receiving completed survey questionnaires
- Collating results from survey questionnaires for review by panel
- Selection of international evaluation panel members
- Review of survey results by panel members
- Development of procedures for interview of exercise and sport scientists from each country by panel
- Conducting interviews in each county

- Panel discussion on survey results, interviews and other sources, preparation of report
- Draft report reviewed by personnel from organising funding agencies
- Report finalised by panel

6.2 International evaluation panel

The external evaluation was performed by an international evaluation panel of independent high-level experts. The steering group identified experienced scientists within the field of sport sciences and invited seven of them to be panel members. The panel consisted of four representatives from the sports biology and sports medicine fields and three representatives from the humanities, social and cultural sciences.

Chair

Professor William Haskell, Stanford University

Members

Professor Karyn Esser, University of Kentucky

Professor Peter Bärtsch, Heidelberg University

Professor Stuart Biddle, Loughborough University

Professor Jennifer Hargreaves, freelance author and consultant

Professor Ron Maughan, Loughborough University

Professor Bart Vanreusel, Katholieke Universiteit Leuven

Figure 3. Panel members at the Academy of Finland, 13 May 2011 (from the left: Ronald Maughan, Karyn Esser, William Haskell (chair), Stuart Biddle, Jennifer Hargreaves, Bart Vanreusel and Peter Bärtsch). Photograph by Anita Westerback.

6.3 Evaluation criteria

The panel was instructed to evaluate sport sciences in the five Nordic countries using a) data provided by the units responding to the survey, b) interviews with scientists from each country, and c) ancillary information provided by national coordinators in each country and published documents. Using this information, the panel prepared reports for each of the three major domains of exercise and sport sciences at 1) the country level and 2) the Nordic level. Evaluations were not provided for individual scientists or specific research units or institutions. However, the panel did take into consideration the features and performance of individual units in the preparation of their country-by-domain commentaries.

6.4 Preparation of survey questionnaire

The planning of the survey questionnaire was based on the aims and objectives defined in the Terms of Reference (see Appendix B). The external coordinator formulated draft versions of the questionnaire, which were then discussed in detail at project and steering group meetings in June and August 2010, and via email between and after meetings. Compromises had to be made, but a general agreement was reached on topics to be included in the questionnaire (personnel structure, funding, publication activity, collaboration and mobility). The format of the questionnaire was discussed and it was settled that mainly numerical data were to be collected. Publication data was collected using the questionnaire and not a bibliometric analysis, due to the diversity of disciplines and units included in the evaluation. Also, defining the journals to be included was challenging, as sport sciences research is published both in sport-sciences-related journals and in a wide variety of journals in more general fields of science. However, the panel decided to supplement the information from the surveys and interviews by conducting a bibliometric analysis. A copy of the questionnaire is included in Appendix C.

6.5 Selection of research units to receive survey

The research units to be evaluated were selected using the following criteria:

- Applied for a grant from a sports-relevant grant agency (governmental funding agency or large foundation)
- Identified by the national members of the project and steering groups, with possible consultation with selected researchers in the field.

The deadline for the selection of units was 15 October 2010. Responsibility for the selection was assigned to each national project group member with assistance from the steering group member.

6.6 Interview process

The national coordinators working with Academy of Finland staff and operating under the direction of the steering group invited scientists working in the participating units to attend an interview session with the panel. In Norway, Finland, Sweden and Denmark, scientists were invited to these interviews to represent each of the three major domains: a) basic and applied biological sciences, b) sports medicine and health sciences, and c) social and behavioural sciences. On average, nine scientists represented each domain for each of the four countries. Interviews were held in Oslo, Helsinki, Stockholm and Copenhagen. In Copenhagen, two scientists were invited from Iceland to represent all three domains and be interviewed by the panel. All

interview sessions lasted approximately two hours. The selection process was organised so that scientists at various stages in their scientific careers – from PhD student to professor – were invited to attend the interview sessions. Listings of who attended each interview session (by domain and county) are provided in Appendix D.

6.7 Evaluation overview

The steering group decided to organise the review of the research within each country into three major domains: a) basic and applied biological sciences, b) medical and health sciences, and c) social and behavioural sciences. After the survey questionnaires had been returned, national coordinators in each country were requested to have each research unit completing a questionnaire select a domain. In Finland and Sweden, each research unit selected only one domain, but in Norway, Denmark and Iceland, some units selected more than one domain. The panel decided to classify these units as 'combined research units' for the purpose of tabulating the number of research units reporting data (Table 3), the number of research personnel (Table 4) and the number of scientific manuscripts published in several categories during 2006–2010 (Table 5). However, the panel decided to provide reviews for all of the research reported in each of the three major domains within each country whether or not the research was conducted in a domain-specific research unit or a combined research unit.

Not included in the survey and interviews were research units in the Nordic countries that include exercise, sport or physical activity as a component of a more comprehensive agenda of basic science or chronic disease prevention or treatment. Researchers in these units do not view themselves as conducting sport sciences research but rather as conducting basic science or clinical research on specific medical disorders such as coronary heart disease, diabetes, metabolic syndrome or obesity. A review of the international literature has identified manuscripts by scientists working in these units reporting on exercise/sport or physical activity and specific performance or health outcomes. Such research and resulting publications were not directly assessed as part of the survey or interviews but need to be recognised as part of the research being conducted on the health and performance effects of exercise and sport. Included in Table 1 is a list of units participating and units not participating in the survey, by country. Table 2 shows a list of units participating in the survey by country and major domain.

In an attempt to obtain an independent evaluation of the research productivity of all scientists in the Nordic countries conducting exercise and sport sciences, a review was conducted using the Web of Science website. This identified the number of manuscripts published during 2006–2010 in international, peer-reviewed sport and exercise journals considered to be the top journals in their category based on impact factor. Journals were separated into two general categories: a) biological and medical sciences, and b) social and behavioural sciences. Calculated were the absolute number of publications by country and the rate of publication based on the population of the country and for the five Nordic countries combined.

7 DOMAIN-SPECIFIC ANALYSIS OF STRENGTHS AND WEAKNESSES BY COUNTRY

SWOT analysis

In one section of the survey questionnaire, each research unit was asked to summarise their status using a SWOT analysis. This is a strategic planning method used to evaluate the strengths, weaknesses, opportunities and threats involved in a project or venture. It involves specifying the objective of the project and then identifying the internal and external factors that are favourable and unfavourable to achieving that objective. The technique is credited to Albert Humphrey, who first used the process at Stanford University in the 1960s and 1970s to evaluate various business ventures. The SWOT analysis is often used in academia and has been particularly helpful in identifying areas for development. In this report, the panel also used a SWOT analysis to summarise its review of each major domain for each of the four larger Nordic countries and for the overall sport sciences research activities for participating units in Iceland.

7.1 Research in basic and applied biological sciences

7.1.1 Nordic level

Historically, the Nordic countries have had an outstanding reputation for conducting innovative exercise and sports research in the basic and applied biological sciences. This research has provided new insights into what limits physical performance in the young and old, the healthy and the sick and in the general population as well as elite athletes. Many of the new techniques for conducting these investigations were designed and implemented in the Nordic countries and in some areas this innovation continues.

Survey responses were received from a total of 39 research units conducting research in the basic and applied biological sciences among the five Nordic countries (27 units reporting basic and applied sciences as their only domain and 12 reporting basic and applied sciences as one of two or three domains) (Table 3). In the 27 units conducting primarily basic and applied biological research, appointed professors occupied 54 FTEs, while 53.1 FTEs were filled by other senior professionals and 79.6 FTEs were assigned to PhD students in 2010 (Table 4). In the twelve units with shared research concentrations (all indicated basic and applied biological sciences as one domain of concentration), appointed professors occupied 107.4 FTEs with 41.5 FTEs accounted for by other senior researchers and 127.08 FTEs by PhD students.

During 2006–2010, the 26 Nordic research units primarily conducting basic and applied biological research reported publishing 1,086 articles in international peer-reviewed journals with another 1,232 manuscripts published in these journals by investigators working in the combined research units, approximately 50% being in the basic and applied sciences. Of all the manuscripts published in 2006–2010 by the basic and applied biological and combined units, 67% were published in international peer-reviewed journals.

7.1.2 Norway

A number of key issues emerged from a review of the responses to the survey with clear areas of strength across the basic and applied biological sciences domain. Except for several larger research units, the size of

individual units was generally small. A disproportionate amount of the total research activity appeared to be contributed by a relatively small number of scientists. While Oslo clearly represents the largest fraction of the total research activity, excellent programmes exist elsewhere in the country. There appears to be untapped potential (in terms of both human resources and research opportunities) in some of the smaller institutions. Many academic positions were occupied by staff who do not have a PhD, with these individuals primarily having teaching responsibilities. In some units, the number of academic staff was greater than the number of PhD students (i.e., on average, staff were supervising less than one student). The average time from completion of a first degree to an MSc was long, typically 3–5 years, as was the average time from completion of an MSc degree to a PhD – typically 5–15 years. There seemed to be limited mobility, with many faculty members spending their entire working lives in the institution where they had been students.

SWOT analysis

Strengths

- The fact that Norway is a small country with a small pool of individuals engaged in the field of sport and exercise sciences was mentioned frequently as a major strength. Although a large part of the academic community can be traced to two major centres, Oslo and Trondheim, there was a feeling that most of those actively engaged in research were well known to each other.
- In general, the perception of the panel was that communication between institutions was well developed. This was identified as a strength, as it should allow them to be able to work together on targeted initiatives.
- The small size of the country, however, was also identified as a weakness, as there is a lack of critical mass in most areas. There is perhaps also a limited opportunity for the development of existing research directions and for the initiation of new ones.
- A recognised strength was that many groups had moved their focus towards topics associated with physical activity/exercise and its effect on human health. This is a transition in focus from their history in more traditional sports performance areas, but it is likely to have more potential for attracting funding because of the larger impact to a greater number of people.

Weaknesses/limitations

- The history of internationally recognised excellence in exercise physiology is seen as a major strength, but it may also be a limitation. The strength is obvious: there is a general acceptance that Norway can and should play a major role in the international research community in the basic and applied biological sciences as they relate to the sport and exercise sciences. However, the historical strengths in specific disciplines, most of which are rooted in whole-body cardiovascular and metabolic responses to exercise, may be limiting the inclusion of research at the molecular and cellular levels.
- Because of the complexity of exercise as a topic, there is a great need for teams of investigators to work together using systems-based approaches to address fundamental principles underlying adaptation to exercise/training.
- There was very little discussion during the interview about inclusion of genomic/proteomic or metabolomic technologies with the strong human intervention studies in place. The absence of expertise in these areas,

which are extremely demanding in terms of both human and physical resources, will limit opportunities.
- There is clearly a diverse structure in the various units, reflecting the different constituencies represented: basic science and applied science, but also physical activity and competitive sport at the elite level.

Opportunities

- The historical strengths of the exercise and sport sciences research community in Norway provides the fundamental platform required for systems-based research strategies.
- The fact that communication among investigators is good provides an opportunity to establish teams that could pursue targeted initiatives in the exercise and sport sciences. While this is viewed as an opportunity, success with new research objectives will not happen without investment of time and resources as well as a combined commitment across units within Norway and the Nordic countries.

Threats

- The limited mobility of graduate students/faculty in Norway is likely contributing to the limited development of new state-of-the-art technological approaches. This also limits competitiveness for grant funding from the EU.
- Trainees and/or faculty should be encouraged to pursue complementary research training as postdoctoral scholars in other parts of the Nordic countries or in the EU or North America. The research programmes will stagnate without the infusion of new ideas and technologies and the likelihood of this happening is very low with trainees staying at the same institutions for their whole career.
- The panel was concerned that the long training for students creates a culture that leads to limited productivity. There are likely multiple factors that contribute to the slow progression of the students, so to address this will require more than just funding changes. This is an area in which team building around common research topics could provide a more active research environment with enthusiasm for pushing projects to a more international scale.

Impact of research

- The impact of the research has been evaluated for some interventions, for example, in the area of cardiovascular health, but it appears not to have been formally evaluated in others.
- Although there was a strong claim for an increase in international standing in sport at the world level as a result of the activities of Olympiatoppen, it was not at all clear that the role – if any – of science had been considered.
- It seemed useful to better delineate targeted areas of impact for the research of the investigators.

7.1.3 Finland

Finland is amid an ongoing reorganisation of Finnish sport sciences aimed at, for instance, lowering the barriers between different institutions. Previously, there has been intense competition between the sport sciences units, but the situation has improved during the last couple of years. This development has been led partly by initiatives from funding agencies and partly by the spread and sharing of methodologies that have played a major role in the decrease of competition between institutions. The funding agencies have driven the focus of sport sciences

research towards health-related aspects rather than elite sport performance.

In the area of elite sports, there is now also generally a good level of collaboration between Finnish universities and sports bodies. This has taken account of the special demands of the application of science to elite sports and the particular issues involved in coach education. There is a concern within elite sports that the physical condition of children is decreasing, therefore reducing the material for elite sports. Housed at Verve, an occupational welfare services provider, the Department of Exercise and Medical Physiology provides training programmes in this context and has been collecting DNA samples to create a biobank for future studies.

The Turku PET Centre strategy is clinically orientated, focused on patients, and exercise physiology is only a very small part of the centre's activities. The strong international reputation of the centre has led to a number of international proposals for collaboration in the area of exercise physiology. The strategy in elite sports is to apply the knowledge of basic research provided somewhere else in the world rather than to support basic science in Finland.

Responses to the survey were received from four units conducting research concentrated in the basic and applied biological sciences (Table 3), with appointed professors filling 8.0 FTEs, 7.2 FTEs filled by other senior professionals and 23.7 FTEs assigned to PhD students in 2010 (Table 4).

Key issues that emerged from the submissions were that considerable pockets of strengths in the basic and applied sport sciences exist, substantial resources are available (both in terms of capital infrastructure and personnel) and significant collaborations exist among disciplines and between institutions. Some difficulties in early career development were apparent; the pathway from PhD student to professor seems uncertain.

During 2006–2010, the four research units primarily conducting basic and applied biological research reported publishing 317 articles in international peer-reviewed journals (Table 5). Of all the manuscripts published in 2006–2010 by the basic and applied biological units in Finland, 73% were published in international peer-reviewed journals, 36 in other international journals and 82 in Finnish national journals.

SWOT analysis

Strengths

- The close links within Finland between the basic and applied sciences was highlighted as a key strength.
- It was noted that all interviewees had received training at the University of Jyväskylä at some stage in their careers, and the networking that has resulted from this was seen as a major factor in promoting collaboration. There was a strong emphasis on cooperation and sharing of resources rather than on duplication.
- Cross-disciplinary work was not seen as being common, but examples of where this had been achieved successfully were cited to show that opportunities for such collaboration do exist.
- It was clear that a pragmatic approach to engagement in collaborative research was almost universal.
- There was no feeling that the country was too small to be a major player in the international research community, but a general recognition that this aim could

be achieved only by a cooperative approach. This has become increasingly common in recent years, and collaboration across disciplines and between institutions had been stimulated by strategic decisions on allocation of resources by the funding agencies.
- Some very good examples of interdisciplinary research involving multiple centres were cited, including one where expertise developed in a sport sciences setting was brought to bear on questions relating to basic cardiovascular, angiogenic and muscular research, but this appeared to be based largely on opportunistic contacts established at the University of Jyväskylä, rather than the result of a deliberate strategy.
- There were also good examples of interactive collaboration with Turku PET Centre, where projects were initiated by scientists at other centres, but also examples where projects were carried out at the centre with analysis of tissue samples completed elsewhere.
- Although most units across the country are small, the infrastructure in terms of capital facilities and methodological expertise around Finland means that research is not limited by these factors.
- Although the issue was not explored in detail, the concentration of sport sciences teaching, training and research at the University of Jyväskylä, which does not have a medical school, does raise some issues.

Weaknesses/limitations

- Although good examples of collaboration across disciplines and between centres are cited above, it was felt that there is less collaboration than there should be for these groups to be competitive for international/EU funding. Obstacles to effective collaboration include the geographical distribution of relatively small research groups.
- The lack of MDs in many research groups is seen as a weakness, limiting the opportunities to engage in certain types of research and perhaps also limiting access to some potential sources of research funding. Associations with medical centres provide additional technical and methodological opportunities that can greatly strengthen basic and applied research programmes on physical activity and health.
- It became apparent during the discussion that there is a perception that the medical community has limited awareness of the exercise physiology research taking place and of the potential for application of this research. This may in part reflect the low level of exercise physiology teaching for medical students, and this lack of grounding in basic exercise science may mean that exercise is underestimated and drugs are overestimated by the healthcare community.

Opportunities

- The availability of high-quality resources, in terms of both the physical infrastructure (both in Finland and in the other Nordic countries) and the availability of good, hard-working research staff and students, was seen as a major opportunity to increase both the quantity and quality of research.
- The established history of high-quality research has generated an environment where it is easy to recruit subjects for participation in research studies. It was recognised that there could be tremendous opportunities for generating highly annotated biobank samples (DNA, biopsies).
- Shifting the focus from methods to people could help increase the available

opportunities. There is some collaboration with industry, and some input of research funding from that source, and this is increasing. It was noted, though, that this can also be a threat.

Threats

- The primary threat was linked to the small groups working in isolation. This approach to research in the basic and applied sciences is very challenging and is not viewed by the funding agencies or the panel as the most competitive approach to generating new knowledge in areas of human health.
- As noted above, funding from industry can help with keeping projects going but it may also lead to limited competitiveness for larger funding agencies.

Impact

It was clearly felt that the application of knowledge within the research community was being widely applied in elite sports in the form of sport sciences support services at training camps. There appeared, though, to be little or no systematic evaluation of whether this had any effect on performance. This may reflect the limited interaction between research scientists and coaches.

In terms of impact, it was felt that the opportunities offered by a strong exercise science community to the field of disease prevention and rehabilitation was not fully appreciated by the medical profession – either by those charged with implementation of lifestyle promotion activities or by those engaged in research in these areas.

7.1.4 Sweden

Sweden, and especially the Karolinska Institutet (KI), has a long and distinguished history of high-quality research in exercise physiology. This was built on the use of invasive and novel techniques to address important questions in human volunteers. In the 1990s, the funding model, and again especially that of KI, changed to a more competitive environment, with the result that much of the infrastructure and continuity was lost. The tradition of strength and breadth was replaced by a move towards excellent science in a few topics. The sport sciences have found it difficult to survive in this environment. University strategy at the individual institution level directs the funding, and sports-related research is often not the area of focus, with a shift of funding towards lifestyle medicine.

There is much good sport sciences being carried out in the older universities, but this is often not identified as sport sciences; giving the same work a different label increases the chances of success in attracting funding. The sport sciences are more often located in the new universities, which have fewer funding opportunities.

There are plans to develop a new facility (the Women's Sport Village in central Malmö) that will combine research, clinical facilities and industry. This will be privately funded and will concentrate on athletes. There was a strong feeling that Sweden's excellent international reputation was built on a limited number of individuals who are now close to retiring or are no longer in Sweden, and this is a major threat in the near future. These professors have been active in promoting their research internationally, but young researchers are less willing to travel, usually for personal rather than professional reasons. The younger generation in general are perceived as not working as hard as the old professors, but there are also very hard-working, travelling young researchers. There are

good possibilities to get travel grants, so this is not an obstacle.

Responses to the survey were received from 18 units conducting research concentrated in the basic and applied biological sciences (Table 3), with appointed professors filling 26.1 FTEs, 31.7 FTEs were filled by other senior researchers and 38.4 FTEs assigned to PhD students in 2010 (Table 4). Key issues that emerged from the submissions included that many individual research units are extremely small, often with a single senior professor and a small number of junior staff and students. Several of the research unit leaders are close to, and sometimes well beyond, retirement age and the strategy for planning the future of these units is not clear. Generally, there seems to be a high level of satisfaction with the existing research environment, even though the average value of research grants is relatively small.

In elite sports, skiing research is strong, but the approach is both focused and more general in order to get more publications and additional funding. Research is conducted at all levels, including the national team: the more invasive the research, the lower the competitive level of volunteers. Some of the research carried out in the elite sport environment has had significant impact both on sports and on clinical practice, including high-intensity training research.

During 2006–2010, the 18 research units primarily conducting basic and applied biological research reported publishing 415 articles in international peer-reviewed journals (Table 5). Of all the manuscripts published in 2006–2010 by the basic and applied biological units in Sweden, 73% were published in international peer-reviewed journals, 61 in other international journals and 94 in Swedish national journals.

SWOT analysis

Strengths

- The Scandinavian heritage in exercise physiology is extremely strong. There is a strong tradition of invasive human experimentation. Sweden has also started the development of several data/biobanks with cohort data.

Weaknesses/limitations

- There is insufficient funding, such as for postdoctoral fellowships, to keep the best people in the field at the postdoctoral level. There is strong competition for the best minds from the medical sciences, which offers better funding and better career prospects.
- The fragmentation of the infrastructure into different units and disciplines does not support research collaborations among the different areas of sport sciences required today.
- There are different funding models in the different disciplines, and clinical physiology has lost its former pre-eminence. This was formerly the core of physical testing, and remains very important for sport sciences, but the future of the specialty is fading. This has happened during the last 10–15 years, and may have been influenced by the departure of key persons. However, there have also been structural changes, and clinical physiologists are now required to conduct radiology, which has caused people to lose interest in this speciality.
- There are a number of strong professors with international reputations who have been in their posts for a long time, and some have changed their speciality because of the perceived lack of opportunities for promotion.

- The mobility of academic staff is generally low, and people often return to the same institution from where they graduated once they have completed a postdoctoral position. Mobility funding for sabbatical periods or for study visits to learn new techniques is difficult to obtain.
- There are no university research positions (all supported by external funding). At some universities, lecturers can apply for research time to up to 65% ("development time"), but, in practice, seldom more than 20% of the total time is made available. Clinical research staff can get ALF funding for research time, but the high demands from the clinical services mean that there is no possibility to get time off from clinical duties, and this money is often not used at all.

Opportunities

- As with other Nordic countries, there is a significant opportunity to be at the forefront of the establishment of a well annotated biobank with muscle biopsy material, DNA and possibly blood that would be very attractive to an international research community. Particularly in Sweden, there are several cohorts and registries, including the notable twin registry. The LifeGene registry will include 500,000 Swedes recruited from birth. However, these databases are often not available to outsiders, and there are issues over ownership of biobank materials that limit participation. There are collections of samples in different units, but people do not want to put them into a database to protect the samples and to make the use easier, largely because sample ownership issues. This is a threat to the potential of this resource.
- It is quite easy to set up collaborations for multidisciplinary research. There are many examples where this has been done by combining questionnaires for social sciences and biomechanics, for instance. Questions on quality of life are often linked to biomedical testing, and data are available from large databases.
- There are several large projects starting (e.g., in women's health) and many fields have showed increasing interest in collaborating with the sport sciences to address specific questions. There is a growing recognition that inclusion of the social and behavioural sciences increases funding possibilities.
- It is recognised that research in the areas of both performance and health is important, and both should proceed in parallel. There is an opportunity to direct more funding towards performance-related research, because many other sources of funding are available in the area of health research. These opportunities should be promoted separately to gain the attention of policy-makers and to obtain more attention in general. Molecular biology may not be considered as relevant to sports in funding applications (e.g., analysis of blood doping by proteomics).

Threats

- The strength of basic and applied science units was largely dictated by a few individual laboratories, many of which were directed by individuals close to or past retirement. There was no discussion or indication of a plan for replacements.
- The limited number of successful junior faculty and postdoctoral fellows in obtaining faculty positions is seen as a significant threat.

Impact

- Several examples of the impact of research projects were cited. In particular, clinical research has been implemented in patients in various fields, including physical activity prescription and cardiac rehabilitation.
- Nordic collaboration currently exists in many fields, including research and teaching, and there is also European collaboration. In sports medicine, there is a Scandinavian congress every two years.

7.1.5 Denmark

The basic and applied biological sciences have a strong history in Denmark. Strengths in the basic sciences include genetics and muscle physiology and in applied sport sciences performance and nutrition. Aarhus University has good collaboration with other Danish universities and also with the local research hospital. Copenhagen is viewed as an international centre for basic and applied sport and exercise sciences.

Key features that emerged in Denmark from the written submissions include tremendous strengths in the basic and applied sciences. However, some of the key scientists recognised in this area do not self-report in sport or exercise sciences. Several of the research unit leaders are close to and sometimes well beyond retirement age and the strategy for planning the future of these units is not clear. There are no core facilities for large genetic studies in Denmark, which has led to collaborations with China, Sweden, etc., which has both weaknesses and strengths. There appeared to be strong collaborations across the country but maybe limited in Copenhagen, where there is much competition between units.

Responses to the survey were received from four units conducting research concentrated in the basic and applied biological sciences with another three units classified as 'combined' also conducting basic and applied biological sciences (Table 3). In units concentrating on basic and applied sciences, appointed professors accounted for 14.0 FTEs, 3.0 FTEs were filled by other senior researchers and 13.0 FTEs were assigned to PhD students in 2010 (Table 4).

During 2006–2010, the four research units primarily conducting basic and applied biological research reported publishing 264 articles in international peer-reviewed journals (Table 5). Of all the manuscripts published in 2006–2010 by the basic and applied biological units in Denmark, 88% were published in international peer-reviewed journals, 26 in other international journals and ten in Danish national journals. During this same period, researchers in the three combined units (all include basic and applied biological sciences as a major research domain) published 892 manuscripts in international peer-reviewed journals, which represented 61% of all articles they reported for 2006–2010.

SWOT analysis

Strengths

- A major strength is the history of research in this area, using basic human physiological techniques in combination with innovative technology. There is continued collaboration among MDs with exercise physiologists and basic researchers, allowing invasive studies that cannot be undertaken anywhere else in the world.
- In Copenhagen, there is good access to large capital infrastructures, such as

MRI scanners. There are also whole-body-level studies, in close combination with subcellular-level research.
- A particular strength is the application of sports research data to "normal" patients (e.g., fatigue, orthopaedics, neurology).
- The physical infrastructure, with a large concentration of expertise in Copenhagen, provides a strong base in terms of personnel and research facilities: Rigshospitalet and the medical school are connected with a tunnel and soon also by a bridge allowing good interaction between the research and clinical environments. The sport sciences institute with natural sciences is also close.

Weaknesses/limitations

- Exercise physiology has moved towards health physiology after a period during which the focus was on molecular physiology. With all of the significant research strength in Copenhagen, there has been limited collaboration across groups.
- If collaborations can be improved, this is a significant opportunity for Denmark. It is anticipated that integrated physiology will have a good position in the future and maintaining strength in this area is a challenge.

Opportunities

- One option would be to build a unit for exercise physiology combining sport sciences on a multidisciplinary platform. This might or might not be a physical structure: both a physical building that can be identified as a centre of excellence and a virtual Institute to promote collaboration have advantages. The only concern is that this approach runs the risk of isolation and duplication. It is noted that such an institute could operate on a Nordic level.

Threats

- New units tend to be quite small and have major challenges to obtain long-term funding in competition with larger established research units.
- The low level of researcher mobility in a number of units reduces opportunities for transdisciplinary approaches and cooperation between basic and applied clinical sciences.

Impact

- The impact of Denmark in the fields of basic and applied sport and exercise sciences is very high. Much of the work conducted in these areas is related to physical activity and human health. Even the work in the more classic sport performance areas, such as nutrition, has significance for the general population.

7.2 Research in medical and health sciences

7.2.1 Nordic level

In this report, the domain of medical and health sciences includes research conducted to shed light on issues related to medical conditions unique to sports participation or exercise training; exercise-related injury prevention, treatment and rehabilitation; health risks associated with exercise in the heat, cold and at altitude; the effects of exercise on the health-related structure and function of various tissues or systems of the body; the health benefits and risks of sedentary behaviour and physical activity in the general population and the tracking of physical activity participation in defined segments of the population. Of the 97 institutions that submitted completed surveys from all countries for all domains, 32 were conducting research primarily in the medical and health sciences, nine were conducting research in both medical and

health sciences and basic and applied biological sciences, and two were conducting research in all three domains (total = 43 units) (Table 3). In 2010, the units with a major focus on medical and health sciences listed in response to the survey a total of 67.9 FTEs of appointed professors, 79.9 FTEs of other senior researchers, 141.2 FTEs of PhD students and 115.4 FTEs of other research personnel (Table 4). In addition, approximately half of the personnel conducting research in the research units classified as 'combined' appear to have been conducting research in the medical and health sciences. At 50% of these units, there would be an additional 53.8 FTEs of professors, 20.7 FTEs of other senior researchers, 63.5 FTEs of PhD students and 54.3 FTEs of other personnel. Over the period 2006–2010, there were no observable trends in the number of personnel working in these units.

The 32 units assigned to the medical and health domain during 2006–2010 reported 2,041 articles in peer-reviewed international journals, while the units assigned to the 'combined' category reported 1,232 such publications, of which approximately 50% were in the medical and health area (Table 5). Based on these numbers, of the total of 4,829 articles published in international peer-reviewed journals by all reporting Nordic units in 2006–2010, approximately 2,151 (44.5%) were in the medical and health domain. Also, there was a substantial number of publications in the national journals reported by medical and health units (Table 5). As indicated in the country-specific reports below, a substantial amount of innovative research has been conducted in the areas of sports injury prevention, treatment and rehabilitation, especially in Norway and Sweden, with excellent research being conducted on musculoskeletal health including traumatology in Denmark and on bone health and prevention and rehabilitation of lower back pain in Finland. Each of the Nordic countries has been making major scientific contributions regarding the role of exercise training or daily physical activity in the pathophysiology of cardiovascular diseases and metabolic disorders such as type 2 diabetes, metabolic syndrome and obesity.

7.2.2 Norway

Norway has a long-standing tradition of research excellence in traumatology (football and skiing), physiotherapy and the promotion and monitoring of physical activity. There are two major centres in Oslo and Trondheim with tight connections to clinical medicine, while some other units are small, devoted mainly to teaching and located in remote areas. A few of these units have effective collaborations or are linked to the large centres by offering joint positions. Olympiatoppen is the Norwegian training and service centre for elite athletes located in Oslo. The Department of Physical Performance at the NSSS guides research in elite sports.

The evaluation of written submissions involved information from eight units: two units considered to be conducting primarily medical and health research and six units conducting both medical and health research as well as research in the basic and applied biological sciences (Table 3). These units were predominantly located in university departments and accounted for 67% of all publications in international peer-reviewed journals published by all participating units in Norway between 2006 and 2010 (Table 5). About half of the publications in medicine and health are produced at the NSSS and one third at the NTNU. A review of the ten most

important publications of each of these eight units published during the five-year period revealed that the majority of research was performed in the following areas: promotion of physical activity and its effects on various risk factors for cardiovascular disease particularly in children; training and improvement of performance in (elite) athletes as well as injury prevention in football and skiing. While the results of many studies were published in leading journals of the field of sport sciences, there are also several publications in leading international journals of general medicine including *The Journal of the American Medical Association*, *The Lancet* and *BMJ*.

SWOT analysis

Strengths

- There is remarkable research strength in injury prevention and rehabilitation of musculoskeletal injury. The small country and the Norwegian Health and Care Services facilitate cooperation among institutions for the recruitment and follow-up of patients.
- Long-term follow-up is possible because of the health service system, which assigns individuals to health centres and facilitates the formation and maintenance of registries.
- Researchers profit from the high standing that sport sciences have among a population that has a high affinity to physical activity in an environment favouring an active outdoor lifestyle.
- Large databanks and registries run or financed by the State are available for research. Teachers trained at university colleges facilitate interventional studies in schoolchildren.

Weaknesses/limitations

- Institutes of sport sciences do not seem to be very closely linked with biomedical and clinical institutions, except for traumatology (Oslo) and cardiology/physiology (Trondheim).
- There is a high teaching load and limited research possibilities in smaller institutions (universities compared to university colleges and institutes) outside the larger centres.

Opportunities

- Opportunities consist of the easy access to patients for studies, the potential for collaboration with clinical units in various locations, development of the science of physiotherapy with a total of 15 professors in the field. The major challenge is seen in applying the results of research to patients.
- Physical activity should be on the agenda of various ministries, not only of the health sector as at present. A ministry of physical activity could initiate or coordinate national initiatives.

Threats

- Increasing the number of marketing studies can harass people and may reduce their willingness to participate in scientific surveys, as the response rates for recruitment of subjects in population studies are already decreasing.
- There are only limited possibilities for collaboration with clinical medicine, except for traumatology, and in limited cases with cardiology and endocrinology. This may uncouple research from progress being made in biomedical science.

Impact of research

- The intervention studies on decreasing the injury rate in young football players has led to a prevention programme ("The Eleven") that is promoted worldwide by FIFA.

- Recommendations based on studies analysing injuries in alpine and free-style skiing are being implemented into the regulations for competitions at present.

7.2.3 Finland

Exercise and sport scientists and their colleagues in Finland have made substantial contributions to exercise- and health-scientific literature over the past 60 years. Much of the early and continued focus has been on the role of habitual physical activity or inactivity in chronic disease and injury prevention and the impact of exercise on various biomarkers considered to be in the causal pathways between greater amounts and intensities of physical activity and lower rates of specific clinical events. This work has included basic, applied, clinical and epidemiological research, including the role of genetics in the response to exercise, with target populations ranging from youth to the elderly and from patients to elite athletes.

During the period 2006–2010, research exploring various physical activity and health issues in Finland was performed by research groups located primarily in university departments and institutes, specialised research institutes, hospitals or clinics, and government agencies. In response to the survey, 14 research units (66% of the 22 units responding in Finland – Table 3) provided information indicating that the primary focus of their research in sport and exercise sciences was related to sports medicine or exercise and health, including sports traumatology. A review of the ten most important publications in the past five years published by each of these 14 units revealed that key health topics on which research was conducted included the effects of exercise on bone health (bone strength, osteoporosis, fracture prevention, lower back pain), muscle function and health, metabolic health (diabetes, obesity, metabolic syndrome, insulin resistance), cardiovascular health (coronary heart disease, stroke, blood pressure, lipids and lipoproteins) and successful ageing (maintaining or enhancing physical and mental functioning and independence). A variety of study designs were used ranging from cross-sectional or prospective observational studies in the Finnish population to randomised controlled trials in patients.

SWOT analysis

Strengths

- Excellent training and experience exists among a number of the research units for conducting both randomised controlled trials and prospective observational studies to determine the impact of different profiles of physical activity on chronic disease biomarkers as well as on chronic disease morbidity and mortality.
- Important single-site as well as multi-site trials have been successfully conducted with excellent subject retention rates. Overall research productivity in this domain has been high: during the five-year review period; the 14 research units published 1,185 original scientific articles in peer-reviewed international scientific journals and more than 1,000 articles in national journals (Table 5).
- Large databases collected over many years are available for new studies and a reasonably good research infrastructure exists to support such studies. Population databases can be linked to a national death registry and most of these data are available to investigators at no or low cost.

Weaknesses/limitations

- Scientists expressed concerns that there is currently little use of objective assessment of physical activity in studies involving either young people or adults. To stay current with research being conducted in other countries, more objective assessment methods will need to be validated in specific Finnish populations.
- Some concern was expressed during interviews about the competition among research units for subjects with selected health conditions and that in some segments of the population willingness to participate in both surveys and intervention studies has been declining (main reason given is that they are too busy).

Opportunities

- Finland has a highly educated and experienced cadre of both senior and junior scientists very interested and skilled in conducting new research on important health issues. Generally, there is a positive attitude about the health benefits of exercise and the need for exercise among a large portion of the Finnish population, creating a positive environment for applied research.
- With the Finnish national healthcare system open to all residents and data collected by this system available for research, there are good opportunities for identifying and recruiting target patient populations (as compared to countries without universal healthcare).
- Some discussion was held about a health and fitness-testing programme for schoolchildren (testing performed in schools) that would lend itself to a collaborative research project among the Nordic countries.
- There appeared to be a general consensus that the research environment in Finland was favourable for participation in Nordic-wide collaborative research to address specific exercise and health issues. Existing collaborations with Baltic countries was cited as an example of effective international collaboration.
- Given the growing expertise in evaluating exercise interventions for older populations in Finland and other Nordic counties, it seems very worthwhile to consider this as a possible target for inter-country collaboration.
- It appears that there is quite strong political support for health promotion and disease prevention research, including research on the benefits of physical activity throughout the lifespan.

Threats

- Some concern was expressed about the declining participation rates of Finnish citizens in various types of prevention studies investigating changes in health and performance as a result of physical activity (as well as sedentary behaviour) and the declining participation rates in selected patient populations. However, there was not a consensus about these issues among the scientists interviewed.
- There is a need to develop a more collaborative and less competitive environment among research units in Finland and to pursue more collaboration with scientists in other countries, especially other Nordic countries.
- While there are some units of adequate size and with a critical mass of investigators and facilities to conduct larger and more complex research projects, a number of the research units in Finland are small with limited personnel and facilities.
- It was reported that supervised cardiac rehabilitation has almost entirely ceased since the university hospitals have no

need for it. It was stated that nurses and physicians do not have time to advise patients to go to rehabilitation, with the consequence that only about 5% of patients attend such programmes.

Impact of research

- Political and health leaders in Finland have a very successful history of using the results of health research conducted in Finland as well as in other countries to implement effective population-based interventions to improve the nation's health (e.g., > 50% decline in death due to coronary heart disease).
- Results of exercise and clinical outcomes research has been used to inform a number of public health and medical practice guidelines in Finland for injury prevention (especially related to sports participation) and chronic disease prevention (e.g., coronary heart disease, diabetes, metabolic syndrome, osteoporosis).
- Generally, Finland has been successful in promoting physical activity among its population, but, as in other countries, the publication of guidelines has not resulted in substantial increases (or prevented decreases) in physical activity among all subsets of the population.
- There continues to be an increase in obesity in young people and adults in Finland, with the greatest risk among persons of low socio-economic status.

7.2.4 Sweden

Sweden has a long history of making substantial scientific contributions to various disciplines within exercise and sport sciences research. For example, starting in the 1950s, scientists at the Central Gymnastics Institute, Karolinska Institutet and other medical and sports research facilities conducted highly innovative research directed at defining exercise capacity throughout the lifespan and the physiological determinants of aerobic capacity in patients, the general public and elite athletes. This and related research contributed to a more comprehensive understanding of how exercise training contributes to improved cardiorespiratory capacity and health. Also, Swedish scientists made early contributions in determining the role of exercise in the development of obesity and diabetes and in sports injury prevention and treatment.

During the five-year period in Sweden, only six of the 38 research units responding to the survey were designated as primarily conducting research in the domains of sports medicine and health (Table 3). The number of scientists in Sweden who reported conducting sports medicine and health-related research in 2010 was quite limited compared to Denmark and Finland: there were 14.5 FTEs of appointed professors and 30.5 FTEs of PhD students (Table 4). In contrast to the other Nordic countries, physiotherapists in Sweden have a much larger role in sports medicine and health research, especially in sports traumatology. The number and role of PhDs in physiotherapy in sports medicine research is continuing to increase, especially in the evaluation of procedures to enhance recovery from sports injury. Based on key manuscripts published in 2006–2010, the focus of research in the domain of sports medicine and health was on the prevalence of injury during specific sports in elite and recreational athletes, strategies for prevention of sports injury, effects of different exercise training modalities on recovery from injury, rehabilitation of patients with lower back pain and rheumatoid arthritis, exercise-induced modification of telomere length in ageing

skeletal muscle, impact of physical activity on various measures of bone health, the growing prevalence of obesity in children and adults in Sweden, and physical activity and the genetics of obesity.

SWOT analysis

Strengths

- There is reasonable experience and a great deal of interest in the development of research collaboration within and across disciplines to address major sports medicine and health issues. Such collaboration would have access to a variety of resources including testing facilities in regional universities, hospitals and medical clinics, access to a variety of patient populations and use of existing registries of patients and subgroups of the general population.
- Umeå University provides a good example of successful local, national and international collaborations dealing with issues of musculoskeletal health and function.
- In Sweden, there has been increasing collaboration between physiotherapists and physicians and physiologists in transdisciplinary sports medicine and health research programmes, with a strong focus on injury prevention and sports injury treatment procedures.

Weaknesses/limitations

- A number of the research units have relatively few research personnel, which constrains the ability of these units to conduct adequately powered trials on their own to detect the effects of exercise on important clinical outcomes.
- The sports medicine and health research units reported 271 articles in peer-reviewed international journals in 2006–2010, which was significantly fewer than the number of publications from the other three larger Nordic countries (Table 5). This difference indicates less of an emphasis on this domain in Sweden, which is more of a limitation than a weakness.

Opportunities

- A number of existing health-related registries in Sweden should be considered for additional collaboration by sports medicine and health scientists in order to more effectively explore the health risks of inactivity and health benefits of being more physically active.
- As in other Nordic countries, the obesity rate among young people and adults in Sweden is relatively low (but increasing) compared to other developed and developing countries. This situation provides both a need and opportunity for collaborative research to better understand the reasons for the increase and its health impacts, especially the role that physical inactivity plays in this increase.
- Because of the multifactor nature of obesity, collaboration among medical, biological and social scientists will be needed to provide innovative and proven solutions.

Threats

- Based on the review of the CVs provided in the response to the survey, it is apparent that there are relatively few research units conducting sports medicine and health research in Sweden. Some of these units have a small number of researchers and the percentage of senior investigators who are near retirement age is high.
- There is the possibility that retiring professors will be replaced by scientists with research interests and expertise other than in sports and exercise medicine and health. Further loss of senior scientists without replacement with talented junior scientists who are

provided adequate time and resources could significantly reduce productivity in this domain.

Impact of research

- Over the past decade, the primary impact of sports medicine and health research conducted in Sweden appears to have been in the areas of prevention and treatment of exercise-related injuries and physical rehabilitation.
- Therapies developed initially for treatment of high-performance athletes are now available to the general public. A number of physical activity promotion campaigns and programmes targeted at the Swedish population of all ages have used the results of exercise and sport sciences research conducted in the various Nordic countries.
- Large surveys have documented the growing health risks of physical inactivity and obesity in specific subsets of the Swedish population.

7.2.5 Denmark

Research in sport sciences in Denmark has been renowned over many decades for its unique approach of applying new, often invasive technology to investigations on human exercise physiology. Health-related research and sports medicine continues this tradition. Institutions investigating this area of research are in general well-linked and often in close proximity to biomedical or clinical units. There is a strong focus on musculoskeletal health including traumatologic, rheumatologic, rehabilitation- and physiotherapy-based investigating mechanisms of injury and repair from the subcellular to the animal and human level. Sports medicine focusing on the performance and health of athletes is not a primary focus because there is no setting with elite athletes that allows for a rigorous scientific approach. In addition, elite, world-class athletes are rare in Denmark, except in a few sports. An institution called "Team Denmark" deals with these topics and works in close collaboration with a similar institution in Norway (Olympiatoppen). Some of the major groups that are involved in health-related research in other fields, such as cardiovascular disease, obesity and diabetes, were not present at the interview, because these researchers may work in basic science or clinical research units and do not consider themselves as belonging to the field of sport sciences, or because they chose not to participate in this evaluation for other reasons.

The written evaluation involved a total of 15 research units (Table 3), of which seven reported having a major focus in medicine and health, one unit reported having a research focus in both sports medicine and health as well as the basic and applied biological sciences domain, and one unit reported having a research focus in all three major domains. These units were predominantly located in university departments and accounted for about 80% of all publications in international peer-reviewed journals published by the participating units in Denmark between 2006 and 2010 (Table 5). A large percentage of the manuscripts published by scientists conducting sports medicine and health research were from three units in Denmark. Several smaller units were established during the period of evaluation. A review of the ten most important publications of each of these units published during the five-year reporting period revealed that the majority of research addressed questions relating to musculoskeletal health by investigations at the cellular and subcellular level, in animal and human models focusing on the biochemistry of muscle fatigue, the biology

and physiology of tendons, biomechanics and neuromuscular interactions. There are several studies on prevention and treatment of injury, predominantly of the lower extremity in football players. A few groups addressed questions related to cardiovascular or metabolic health such as training with heart failure patients, mechanisms of exercise-induced insulin sensitivity or cardiopulmonary diseases associated with exercise, such as sudden death, bronchial hyperresponsiveness or asthma. Most units publish predominantly in the leading journals of sport sciences or physiology and one unit has several papers in the leading Journal of Diabetology.

SWOT analysis

Strengths

- There is very good collaboration between researchers from basic and clinical sciences, for which the proximity of the cooperating units is very important.
- The tradition of invasive clinical and physiological approaches (tissue samples, invasive cardiovascular examinations and tissue dialysis) provides underlay and descriptive data on health aspects with potential mechanisms provided by basic scientific investigations in humans.
- The general interest in medical science and sports in the population facilitates recruiting of patients and subjects.

Weaknesses/limitations

- There are few major contributions in traumatology.
- Physiotherapy is less developed than in other Nordic countries and has just recently become an academic discipline.
- There is a low level of national, and particular international, mobility among senior academic personnel.
- Funding for projects can only be obtained through one source and cannot be co-financed by several grants. The label "sport sciences" or "sports medicine" is felt to have a negative impact on funding agencies as it is considered to be less "scientific".

Opportunities

- There is highly competitive know-how at all levels of physiology and biomedicine research at the leading scientific institutions in Copenhagen, and these institutions are very open to multidisciplinary collaboration. This gives possibilities to move – through cooperation – from primarily descriptive studies to investigations aimed at elucidating mechanisms.
- In addition, exercise is high on the agenda of the healthcare system and offers the opportunity to get involved in conducting studies on physical activity in public health and in establishing guidelines.

Threats

- Some of the recently founded units are very small and have uncertain perspectives. Funding possibilities have decreased due to the European financial crisis and there is a lack of long-term funding.
- The limited mobility of researchers and the reorganisations in universities and hospitals threaten interdisciplinary approaches and cooperation between basic and applied clinical sciences.

Impact of research

- The research of the groups in the field of musculoskeletal health has had a substantial impact on the international scientific community. Since it is a new and rapidly developing field, the impact at an applied clinical level is still limited, except for injury prevention in football.

- The impact in other research fields is insignificant at present, because many of these units have started operation only recently.

7.3 Research in the social and behavioural sciences

In this report, the term 'social and behavioural sciences' includes the following approaches to the study of exercise, physical activity, sports and human movement: psychology, sociology, history, philosophy, management, pedagogy, and other related subdisciplines (e.g., economics, geography, political science, cultural studies and women's studies).

7.3.1 Nordic level

In sport and exercise sciences research overall, there has been a paradigm shift from performance to health and wellbeing. This shift is also evident in the social and behavioural sciences. The expanding research focus on physical activity and public and personal health issues demands collaborative research designs that cover biomedical, psychosocial, social and policy perspectives. This interdisciplinary collaboration is not yet developed and supported at a sufficient level, neither by funding bodies nor by academia. As a consequence, the position of research on performance and elite sports now appears to be rather unstable. It is more difficult to obtain funding from research agencies for projects focusing on topics relating to performance and elite sports. The possibilities for private funding need to be discussed and developed.

In addition, there seems to be a conceptual crisis in research regarding the concept of sports, where other related concepts dominate (e.g., physical activity, physical culture, human movement, health, wellbeing, public health and kinesiology). Researchers find it difficult, and sometimes impossible, to indicate sports as a topic in grant applications. Traditional and established topics of research in human movement (e.g., organised sports, physical education, sports pedagogy, fitness) are now complemented by emerging topics of research in physical activity. These include health psychology, the sociology of physical activity, management and economics of physical activity, healthy lifestyle policy and politics, new media, and environmental issues. Funding agencies need to support innovative developments in the research agenda on sports and physical activity.

Researchers in the social and behavioural areas face a double output pressure. On the one hand, international peer-reviewed publications are required. On the other hand, local and national reports, policy documents and national-language publications are demanded. Researchers experience this double pressure as both difficult and frustrating. They feel pushed or punished in one or the other direction. Funding agencies need to address these approaches to research output in order to find a fair balance or to make a clear choice in this matter. Although all research domains should be aiming for publications in peer-reviewed international journals with the highest possible ranking, other forms of research output such as monographs, multi-editor books, and book chapters should not be marginalised or excluded. This comment is more relevant for study fields such as history, sociology, economics, policy, politics and pedagogy. The actual focus on peer-reviewed journal publications should not result in the demise of the research monograph. In some fields, major scientific works are published as monographs.

Research on history in sports and physical activity seems to have decreased in recent years. A critical mass of research in this field needs to be safeguarded. The mobility of researchers and students is not very high. Light, non-bureaucratic forms of cooperation need to be facilitated in order to increase Nordic cooperation. Researchers say that the competitive nature of funding also prevents more cooperation between research groups with similar objectives and topics. Social and behavioural issues and variables must be included in larger research databanks and in large intervention studies.

In the five Nordic countries, 26 of the participating research units considered the social and behavioural sciences to be their major domain, with another three units categorised as 'combined' having social and behavioural science as one of their domains (Table 3). Units that considered the social and behavioural sciences as their major domain in 2010 reported having 61.25 FTEs of appointed professors, 62.5 FTEs of other senior researchers and 87.93 FTEs assigned to PhDs. These numbers do not include an undetermined number of researchers, including PhDs, working in the combined units in Norway, Denmark and Iceland.

7.3.2 Norway

Norway has a good history in the sport and exercise sciences from a social and behavioural sciences perspective. There is diversity across the social and behavioural science disciplines, but many of the units are small and geographically dispersed. This demands initiatives for cooperation and support. Existing academic exchanges and collaboration need to be expanded.

There is innovative work in areas such as sociology, policy, politics and social inclusion related to sports and physical activity, some from a critical perspective. Moreover, there is strong communication with policy-makers, which requires a great deal of energy. This is a demanding task with limited academic resources and in competition with other academic expectations.

Responses to the survey were received from seven research units containing academics in the social and behavioural sciences (Table 3), with 23.9 FTEs of appointed professors, 2.0 FTEs of other senior researchers and 20.93 FTEs assigned to PhDs. One two-hour interview took place between the panel and nine researchers representing the social and behavioural sciences in Norway. The interviewees were from diverse academic areas across the social and behavioural sciences and with research interests spanning competitive sports, health and different populations. Health and children were the most prevalent themes.

SWOT analysis

Strengths

- The research has good social and policy-related impact.
- There are good links to different elements of sports and physical activity, such as sports organisations.
- Some excellent publications have been produced in recent years. There seems to be a growing momentum of activity in this field.
- The research is strongly applied and therefore has good potential for high impact and translation.

Weaknesses/limitations

- It is less clear if researchers interact well with colleagues from other disciplines, in particular with those in other domains of research in the sport and exercise sciences.

- In health-related research in particular, there is a perception that 'natural sciences' researchers are not receptive to the work of social and behavioural researchers and that they tend to work in isolation.

Opportunities

- There are opportunities for more intervention research and this may require more cooperation with other groups, and in particular international cooperation.
- Larger research groups within and between research institutions need to be formed.
- Researchers should submit articles to high-impact-factor journals in non-sport areas in order to gain more recognition.
- There is a need to convert PhD completions to postdoctoral positions, although more postdoctoral funding is needed.

Threats

- There is some perceived tension between the academic demands of producing refereed papers and the expectations of the wider sports community.
- Communication between politicians and sports professionals and organisations is not good.
- Government representatives tend not to look at the results of research when making sports policies.
- There is difficulty getting funding for research in the social and behavioural sciences. For example, youth sports appear to have no research funding at present.
- The Research Council of Norway defined and supported five key research areas focusing on the social sciences, leading to the creation of PhDs. The input ended in 2008, which has led to a production downturn. This now needs to be addressed.
- The up-keep of databases is expensive and cutbacks are occurring. The databases are, however, widely used and a significant aid to good research. Norway should find ways to keep these databases up-to-date and to share data with other institutions and among Nordic countries.

7.3.3 Finland

From a social and behavioural sciences perspective, Finland has a long and successful history in the sport and exercise sciences, and in particular in sports pedagogy/sociology. There is some diversity across the social and behavioural science disciplines and many of the groups are geographically dispersed. The University of Jyväskylä is the dominant institution.

Responses were received from four units containing academics in the social and behavioural sciences (Table 3), with approximately 9.0 FTEs filled by appointed professors, other senior researches filling 10 FTEs and PhD students filling 17 FTEs in 2010 (Table 4). One two-hour interview took place between the panel and eight researchers from diverse academic areas across the social and behavioural sciences and with research interests spanning competitive sports, health and different populations.

SWOT analysis

Strengths

- Sport pedagogy/sociology research is considered to be a strong area in Finland, with good collaboration among researchers and practitioners and excellent long-term follow-up data.
- The National Institute for Welfare and Health supports health-related research

that can pinpoint relevant inequalities caused by socio-economic factors. These can then be brought to the attention of policy-makers.
- The focus on health-related exercise in Finland is replicated in the other Nordic countries. This has been productive and has led to international research collaboration.
- There is a long history of social research, supported by the Ministry of Education and Culture, to produce sport- and exercise-related practices and policies.
- As with other Nordic countries, there has been strong public participation in research projects.

Weaknesses/limitations

- There is no professor in sports history and only one professor in sport sociology in Finland. The latter has twelve PhD students. This is quite an unacceptable workload and reflects the need for more senior professionals in the field.
- Links between academic units and the Research Institute for Olympic Sports have not been fully exploited.
- Funding is too dependent on the Ministry of Education and Culture and too few applications are submitted elsewhere.
- Too few international journal publications are evident given the amount of research funding.

Opportunities

- Psychology-based research in schools is a small field of research in Finland, but has important social and health-related implications.
- With the ongoing deterioration of children's health, it is of primary importance that cooperation be encouraged between researchers in the biomedical field and those in the social and behavioural sciences.
- There seems to be a need for the training of more PE teachers (115 each year), all of whom have a Master's degree, and for more professors in the field of pedagogy and teacher training. At present, there is little time for professors to conduct research, because of the high level of teaching and the time-consuming need for supervision.
- Although there is a great deal of health-related research, the academics who conduct it tend to be career researchers and their findings appear to have very little impact on society. This should be addressed and a reciprocal relationship between the Ministry and social and behavioural science researchers should be encouraged.
- For future research to materialise in a climate that is cutting back on funding, collaboration is essential.
- The Research Institute for Olympic Sports appears to be somewhat isolated from other research centres. This is a good opportunity for collaboration.
- Networking within and between universities at home and abroad is needed where there are shared interests and expertise.
- Emerging areas of research should be encouraged, including economics, management and policy-making.

Threats

- The demands placed on senior researchers for teaching, supervision, administration and department and university business, reduces the time available for research and increases the need for funding to pay for research support and free-up space for research procedures.
- Although the Ministry has provided most of the funding to social and behavioural science research, it has not had a noticeable impact.

- There has been an over-dependence on Ministry funding and researchers should now be systematic about searching for, and applying to, other funding bodies from the private and public sectors and finding effective ways of disseminating the social implications of their findings.
- There is very little funding for postdoctoral positions.
- Researchers feel that increasing administrative duties have a negative impact on their academic work capacity.

7.3.4 Sweden

Sweden has a long history in the sport and exercise sciences, especially in the natural sciences. However, alongside seminal early work in gymnastics and physical education, developments in social and behavioural science perspectives have also been significant. There is diversity across the social and behavioural science disciplines.

Responses were received from 14 units containing academics in the social and behavioural sciences (Table 3), with 26.35 FTEs filled by appointed professors, other senior researches filling 49 FTEs and PhD students filling 46 FTEs in 2010 (Table 4). One two-hour interview took place between the panel and nine researchers from seven units. The interviewees were from diverse academic areas across the social and behavioural sciences and with research interests spanning competitive sports, health and different populations.

SWOT analysis

Strengths

- Sport psychology has a good representation in various international organisations.
- The recent focus on health issues and disability sports is socially relevant.
- There are clear centres of excellence with strong and established groups.

Weaknesses/limitations

- There is very little research in the areas of sports management, economics, and law.
- Sport sciences research and research in public health seem to work separately. There is a need for more exchange between the two.

Opportunities

- The Swedish sports model is in transition, shifting away from voluntarism and towards greater influence from professionalism and commercialisation. This raises important questions for the social and behavioural sciences, such as: 'What will Swedish sports be like in ten years' time?' 'What will be happening in physical education in schools in the future?' 'Can research have an influence on future developments?' 'What do 'we' want sports to look like in years to come?' 'How can research help secure the 'best' future for Swedish sports?' These issues need exploring.
- There has been an explosion in PhD completion over the last ten years in pedagogy and physical education.
- Research tends to be dominated by pedagogy, psychology and sociology. Researchers in these fields say that they are approaching a critical mass of researchers.
- There is the difficulty in collaboration between paradigms, and a lack of expertise in some areas. Collaboration is complex with different languages to negotiate and different knowledge bases.
- There is clearly a need to be constructive, build bridges and develop productive networks.
- Organisations, study groups and seminars within Sweden, to extend to other Nordic countries, could be

organised. Such initiatives would provide links and possibilities to apply for funding for larger, multi-focused and multinational projects.
- Greater collaboration is needed between established research groups and smaller and less established ones.

Threats

- Results of important research often do not reach politicians and policy-makers and are not made public.
- There is very little funding for postdoctoral positions.

7.3.5 Denmark

Denmark has a good critical mass of researchers in the social and behavioural sciences and there is diversity across the social and behavioural science disciplines. he researchers interviewed by the panel were from diverse academic areas across the social and behavioural sciences and with research interests spanning competitive sports, health and different populations. Health and children were the most prevalent themes.

Responses were received from four units containing academics in the social and behavioural sciences, with one unit dedicated to this domain and three other units having a focus on this domain as well as one or two of the other major domains (Table 3). In the one unit focused mainly on social and behavioural sciences, appointed professors accounted for 2.0 FTEs, other senior researchers for 1.0 FTEs and PhD students for 4.0 FTEs in 2010. In the 'combined' units that included substantial research in the social and behavioural sciences, appointed professors filled 63.1 FTEs, other senior researchers 31.2 FTEs and PhD students 91.1 FTEs in 2010.

SWOT analysis

Strengths

- Work in environmental sciences related to physical activity and sports is growing fast.
- Sports policy and combined ecological approaches (biomedical, personal and social variables) are significant growth areas.

Weaknesses/limitations

- Producing papers for peer-reviewed journals with a 'scientific' format was sometimes perceived as restricting a critical, social analysis. It was recognised that success in the journal culture was essential in order to have impact and have a greater chance to obtain funding, but that monographs should not be excluded. It was argued that the death of the monograph would, in the long term, lead to the death of social analyses.
- Further, it was felt that international journal publications were replacing local, Danish-language publications, but both are needed and both should be credited.
- Collaboration between the Nordic countries has been somewhat informal and ad-hoc.
- There is very little communication with colleagues from Iceland

Opportunities

- The deterioration of children's health is seen as a crucial research area and some research has resulted in intervention projects. All Nordic countries are facing similar challenges and this could be addressed through collaborative research.
- There appears to be a greater interest in general social welfare rather than in the more specific focus on health alone. For example, researchers are looking for

funding to investigate social inequalities, which is a topic with a broad scope and takes account of more social variables.
- A strong interest has developed in a critical perspective concerning social distribution in relation to minority groups, deprived communities and ageing populations, and concerning gender and race issues.
- There is relatively easy access to national databases but not all have good quality data for research in the social and behavioural areas.

Threats

- The workload of senior staff is very high, with a large number of PhD students to supervise. After completion, there are limited postdoctoral positions. For this reason, very few scholars who are awarded doctorates remain in academia.
- Public funding is increasingly under scrutiny and there are cutbacks. Therefore, it is increasingly important for researchers to seek funding from private sources.

7.4 Research in the three domains in Iceland

Due to the logistics and expenses involved, the steering group decided not to have the panel travel to Iceland for the interview but instead invited sports and exercise scientists from Iceland to come to Copenhagen. Because of the small number of research units in Iceland participating in the survey (3) and the relatively small size of these units, two scientists from the University of Iceland attended the interview. The recent economic downturn in Iceland has been a major disruption to the financial status of the entire country and is likely to continue to affect the resources available for conducting research in the sport sciences, at least in the short term.

Questionnaires were sent to five units, of which three completed the survey. Two units were classified as conducting research in basic and applied biological sciences as well as medical and health sciences and one unit was classified as conducting research in all three major domains (Table 3). In the three units responding to the survey, there were 15.0 FTEs of appointed professors, 1.0 FTE of other senior researchers and 2.25 FTEs of PhD students in 2010 (Table 4). During 2006–2010, there were no trends across years for the number of research personnel working in the units or the number of manuscripts published. Studies seeking relationships between physical activity, physical fitness and health in young people and adults seem to be a major research theme in Iceland with a focus on obesity among the young. Another focus is the study of treatment modalities for sports injuries.

SWOT analysis (all three domains combined)

Strengths

- Icelandic researchers, as well as other Nordic researchers, have emphasised physical activity for health in society rather than conducting research that focuses on elite sports. It is recommended that this emphasis remain in the future.
- There is good access to the Icelandic population for conducting epidemiologic studies.

Weaknesses/limitations

- The key observation was that researchers in Iceland had difficulties specific to the ongoing financial crisis in the country and therefore were uniquely restricted in their quest to improve the opportunities and support available for their research. A major limitation is the

drop in R&D funding in relation to previous years.
- The focus has shifted away from sport sciences and more towards public health.
- Some research units lack laboratory space while others report substantial resources and equipment. Collaboration needs to be considered.
- The teaching and administrative responsibilities of existing research personnel continue to increase.
- Overproduction of PhDs has created a 'brain drain' and difficulties for postgraduates and postdoctoral researchers, many of whom do not return to Iceland after going abroad. Support for these researchers in different ways could help, especially tutoring in the choice of research subjects, in the writing of innovative but manageable research proposals, in searching for the most likely sponsors, and in the skills of producing persuasive arguments regarding potential social and national benefits resulting from the research.

Opportunities

- Icelandic researchers in the social and behavioural sciences are, in general, at an earlier stage in the development of a healthy national status than their Nordic neighbours. All Nordic countries are smaller than many other western European countries and Iceland has the smallest population and the smallest number of researchers of all. This involves both pros (e.g., relatively easy access to participants, high rates of participation in surveys) and cons (e.g., difficult to produce a critical mass within the country). Logistically, the scope of research development needs to be considered with these factors in mind.
- In spite of the financial crisis, Icelandic researchers remain active in an international context. For example, in terms of publishing in peer-reviewed international journals, serving as reviewers in peer-reviewed journals, and playing significant roles in international organisations, Iceland does well per capita.
- Building international research collaborations with other Nordic countries is an opportunity for Iceland.
- Icelandic researchers are enthusiastic and proactive in their quest for future improvements and want to find ways of negotiating and overcoming the difficulties they face.

Threats

- Because there is reduced government-based funding for research (the panel was told it is easier to get funds for equipment and other resources than for researchers – i.e. people to do the testing) and because of the general economic situation, there is an urgent need for more collaborative work with other Nordic countries, with other countries in Europe and with countries outside Europe.
- Too many PhDs are being trained with no or limited postdoctoral positions available.
- Importantly, the panel suggests that Icelandic researchers in the social and behavioural sciences look at the possibility of conducting research in the field of leisure, exercise and tourism, and that they look for commercial sponsors who would have interests in these areas.

- Icelandic researchers should submit more proposals to the EU – preferably in collaboration with other Nordic countries so that they share resources, e.g. databanks, whenever possible – and then look for international funding possibilities.

Impact

- The sport sciences research programmes have been small with some larger programmes having been funded, but the overall impact on the Icelandic population or its policies has been limited to date. Results of population surveys are being used to highlight the growing issue of childhood obesity and low fitness levels in Iceland. To help establish research reputation, a major focus has been on publishing in international journals.

8 RESEARCH TRAINING AND CAREER DEVELOPMENT

8.1 Nordic level

Generally, the panel considered the training of exercise and sport scientists in the Nordic countries to be very good to excellent, but with some deficiencies causing significant concern when looking to the future. The quality of PhD training varies quite substantially among research units across the Nordic countries and domains. The panel attempted to determine if PhD students and postdoctoral fellows had access to forward-looking scientific thinking by mentors and colleagues, sufficient time to be personally immersed in the research process (e.g., designing and planning projects, conducting the research in a timely manner, analysing data, preparing reports and proposals) for an extended period of time and exposure to scientists from other disciplines and fields of research. Strengths in PhD training include the process of scientific writing and the opportunity to participate in international conferences. From comments made during interviews, the panel interpreted that many supervisors were fully engaged with other responsibilities, limiting their time available to provide guidance to PhD students in the early stages of their studies. The panel considered that the presence of more junior staff with a full-time research commitment would enhance the effectiveness of training in laboratory methods.

In the recent past, PhD students in the Nordic countries could participate in courses and workshops that allowed the development of links with faculty members and students from other Nordic countries. Links with fellow PhD students working on similar problems in different environments were especially appreciated and provided valuable experience.

During the interviews, a strong opinion was expressed by scientists across Nordic countries and domains that postdoctoral training has become essential for obtaining an academic research position. MDs who also had a PhD degree were a possible exception. Generally in hiring, greater value is given to postdoctoral training acquired in strong academic institutions outside the Nordic countries, especially in the UK and the US. Obtaining postdoctoral training in selected European countries, including other Nordic countries, is considered more useful than obtaining postdoctoral training in a postdoctoral researcher's own country. Some exceptions to this opinion existed, especially in Denmark. The added value of obtaining research experience outside the broad domain of exercise and sport sciences during postdoctoral training was expressed during some interviews. The panel concurred with this opinion.

Major concerns by the panel regarding training and career development in the exercise and sport sciences included the possible training of too many PhDs given the limited number of funded postdoctoral positions. However, some of the senior scientists interviewed indicated that the pool of good PhD candidates has been decreasing, whereby some reduction in the funding of PhD training might be considered. While the average time spent in obtaining a PhD was reported to be decreasing in each of the Nordic countries (target appears to be 4 years), a number of recent or current candidates spend at least 6–8 years, in part due to their financial

needs to perform other paid employment such as teaching. Also, it seems that some PhD students delay obtaining a degree because of limited research positions in academic research units available after receiving their PhD, while for others, the reason may be related to childbirth, part-time employment and delays in the project.

Another issue of some concern to the panel regarding career development was the number of professors and other senior scientists near, at or over retirement age and, in many cases, the apparent lack of specific plans for leadership transition. In some cases, the replacement of a professor is made by a senior official or committee in the academic institution who may decide to redirect the mission or focus of a research unit to scientific issues outside the discipline of exercise and sport sciences. The likelihood of this happening is reduced if the research unit is highly productive, routinely obtains funding from outside sources and if its research is innovative, making the unit an international leader in its domain.

8.2 Norway

There seemed to be little evidence of a strategy to actively manage early career development of young scientists. Central funding (allocated to institutions and distributed within institutions according to a variable strategic plan) is available to support PhD student training. There seemed to be little evidence of industry or other funding for PhD positions, perhaps because of the relatively high costs. Salaries are high (students pay tax on their stipends) and the universities charge overhead costs on PhD positions (which is often not the case in other European countries), meaning that the total cost per PhD student is high. Multinational companies are therefore unlikely to fund research work that can be performed elsewhere at a far lower cost.

The PhD programmes appear to be rather diverse. A high proportion of PhDs are completed on a part-time basis by staff who have faculty positions, and, at least historically, 10–15 years often elapse between completion of a Master's degree and a PhD. This may reflect the limited academic appointment options after PhD completion and the limited advantages of having a PhD for those who already have an academic position, but it does not appear to encourage productivity. At present, there is a trend towards shortening PhD completion times. The current regulation for the duration of PhD employment is three years without and four years with a 25% teaching load.

The number of PhD graduates exceeds the number of available postdoctoral research positions manifold. The major exit routes for PhD graduates are the university colleges, universities and the institute sector with a junior faculty appointment. In most of these positions, the time allocation for research is nominally 20% but, in practice, the time available may be much less. At a time when the recent graduates should be at their most productive, there are some significant obstacles to the continuation of research activity. These include relative isolation, as part of an academic community where PhD graduates are in a small minority, and a lack of mentoring by established senior scientists.

Funding for postdoctoral positions is limited or entirely absent, and this is a clear weakness of the system. It does seem that there are several reasons for this, some of which reflect the social and structural issues referred to above. However, the few years after completion of a PhD can be the

most productive phase of a research career, at least in the laboratory-based sciences.

The unusual length of PhD training, which considerably exceeded four years in many curricula vitae of staff members, is explained by high teaching loads and long-lasting interventional studies that cannot be terminated after three years, by a lack of career perspectives and by the particular conditions 10–20 years ago. At present, there is a trend towards shortening PhD completion times. The current regulation for the duration of PhD employment is three years without and four years with a 25% teaching load.

8.3 Finland

There is only one institution in Finland, the University of Jyväskylä, that offers graduate training at MSc level in the sport and exercise sciences. PhD stipends are awarded primarily by the Ministry of Education and Culture, typically for four years and on a competitive basis. Some other funding opportunities exist (e.g., university grants, research grants), with a number of these positions including teaching responsibilities. Research groups that are successful in attracting external funding support for student training might expect to be rewarded by their institution with additional support from university funds. The expectation is that it will take about six years to complete a PhD in the basic and applied sciences: this time was felt to be essential for intervention studies. This makes for an interesting contrast with the views of the health-related and traumatology panel, where it was felt that four years was quite long enough to successfully complete a PhD programme. It was noted that funded students are required to undertake some teaching duties that may occupy 1–2 months per year.

Some candidates obtaining an MD also earn a PhD but do not have a designated PhD training position. To specialise in sports medicine, MDs complete a five-year programme after graduation. The total number of sports medicine specialists in Finland is low.

Relative to the number of PhD graduates, there are limited postdoctoral positions available in Finland and obtaining these positions is highly competitive. A lack of research appointments for PhDs was considered a bottleneck by the scientists interviewed. Since application for a postdoctoral position can occur only after obtaining a PhD, there is typically a 1–2-year gap between the two positions. Most postdoctoral positions are for four years, during which time the individual is expected to become an independent researcher. These positions are currently quite limited, especially at universities, with a number of scientists completing their postdoctoral training taking teaching positions or working in private industry.

The lack of postdoctoral positions was highlighted as a problem. Particularly, the PhD students seemed unsure as to how they could bridge the 10–20-year gap between PhD completion and appointment to a professor. However, it was also recognised that, although the number of such junior training posts is severely limited, there are some such opportunities and that persistence and industry were likely to be rewarded. The Academy of Finland does support a limited number of postdoctoral positions, but applying for one of these positions takes a lot of time. If successful, these funds can be used to support study outside of Finland.

It was highlighted that there are only two professorships in exercise physiology in

Finland, so the career options are severely limited. There are no assistant/associate professor positions in Finland.

8.4 Sweden

The opinion of the scientists interviewed was that there are good opportunities for well-qualified persons to obtain PhD positions and that the number of positions in the domain of medicine and health appears to be increasing.

There are some PhD positions funded by CIF, the Swedish National Centre for Research in Sports. PhD training often is conducted in departments that have no specialised sport sciences expertise, leading to a lack of collegial support for those beginning their research training. In some cases, the expertise is there, but the departments do not feature sports in their title. This is not a universal situation: in Linköping, there are many possibilities to have contacts with other sports researchers within the university.

Since June 2010, it has been possible to complete a PhD in sport sciences, whereas before, the positions were all within the parent disciplines. The number of PhD student positions funded by the research council within a research unit depends on the perceived quality of the research. At the Karolinska Institute, approximately 1% of PhDs completed are in sport sciences. Throughout the country, there is some concern about the overproduction of PhDs in terms of available postdoctoral positions and senior researcher positions.

In exercise or sports performance research, CIF is the only national funding source for postdoctoral positions. In addition, there is some regional funding for postdoctoral positions. In the basic sciences, some postdoctoral or senior positions are funded by industry. There was a feeling that opportunities for postdoctoral and early-career positions were generally reasonable, and that there was a shortage of good, diligent candidates rather than of positions. Nevertheless, the future is very uncertain for postdoctoral scientists, since there is no clear career path. Many MD PhDs find full-time posts in clinical medicine because of the job security that this offers. Many PhD graduates find teaching positions that leave no time for research.

One issue raised during interviews was that when scientists without clinical degrees are hired by medical institutions their full salary needs to come from research or teaching funds and cannot be temporarily compensated by institutional funding when there is a temporary gap in research funds. This is not necessarily the case for physicians or physiotherapists, which can give them a hiring advantage. The number of MDs that also get PhDs in the exercise and sport sciences is decreasing.

Postdoctoral scientists should play a major role in pushing the science forward, but this is difficult with short-term and part-time funding, especially when it is provided to support specific projects with a defined output. People from outside Sweden occupy a substantial proportion of the postdoctoral positions.

The major bottleneck in the career pathway is the step from postdoctoral scientist to senior researcher. Notwithstanding the large number of PhD completions annually, it can be difficult to find competent applicants for faculty positions in sport sciences. Also, given that a number of the professors in the sport sciences are near or at retirement age, additional opportunities for advancement

may be available if the institutions retain these positions in the various domains of sport sciences.

The regulations for the recruitment and hiring of professors have changed over time and now vary from one university to another. As a number of professor retirements will occur in the upcoming years, it will be important to work with university leaders to retain these positions within the sport sciences.

The Swedish Research Council is the most common funding agency of postdoctoral positions in general but funding may also come from CIF and other sources. Funding for postdoctoral positions in physiotherapy is more limited in sports medicine than is the case for physiologists and physicians.

8.5 Denmark

Denmark established PhD schools ten years ago and there is one in sport sciences. It is a salaried, full-time three-year programme. Many of the students are not in exercise but in the clinical or basic science fields. In Copenhagen, there has been a very large increase in the number of PhD students in recent years, driven by governmental funding, which is based on the number of PhD graduates. This increase has come from the idea that PhD graduates would be employed by industry. There are some opportunities for industrial funding, whereby a PhD can be undertaken in collaboration with a company, but it must be recognised that different training is required for research in industry because of the different skill sets required.

The sports and exercise field should somehow be protected to enable scientists to stay in that area rather than return to work in basic or clinical laboratories.

Many of the medical graduates who start in exercise medicine have a background in sports, but if there are no prospects of funding students lose their interest in the field. Education is free for the first degree, but there is a fee for any additional degree, which discourages science graduates from undertaking medical training. Sport sciences should be more multidisciplinary and not concentrate solely on MDs, though the role of medical researchers in developing the historical strengths of research in Scandinavia is readily acknowledged.

Research training for physiotherapists is now beginning, whereas previously it was necessary to travel to Sweden for such training. Denmark now also has MSc programmes in physiotherapy. Overall, the number of PhD places should probably be decreased.

The number of postdoctoral positions available from government or university funds is severely limited, but there are some posts available. There are also other possible sources of funding, including the private sector (pharmaceutical companies, etc.). Currently, a research career in the university sector is not a very attractive option, due to the low salaries and a lack of job prospects and job security.

After the first year of PhD studies, the search for funding begins, and it is possible to apply for funding, but applications are in competition with professors and all other researchers. The usual route is to look for a professor who has money, but then you must conduct research similar to what the professor is doing. This also applies partly to junior scientists who have their own funding, since there is a need for laboratory space and resources to carry out the research.

Postdoctoral positions usually last for three years. Teaching provides support while applying for postdoctoral funding, but it can destroy the research career, since no time is allocated to research and the individual can easily be left behind in areas where science is progressing rapidly.

PhDs have a full salary and are considered as colleagues rather than students. Teaching obligations may account for up to 50% of their working hours. Training courses for PhDs in sport sciences are in part offered at national level. There is an overproduction of PhDs, which leads to unrealistic career expectations, as the number of postdoctoral positions is very limited. Postdoctoral study periods abroad are highly appreciated. A period in a good Nordic laboratory is held in equal esteem as a position in the US, the UK or other European countries.

Politicians are trying to develop postdoctoral career opportunities, but there are very few signs of this. At the University of Southern Denmark (20,000 students), there are only five university-funded postdoctoral positions. Out of 43 postdoctoral positions funded by a research council, only 2–3 are in sport sciences.

Applications tend to fall somewhere between natural sciences and health research, and there is a perception of discrimination against the field of sport and exercise sciences. However, the success rate of sport sciences applications to the national research council in health is higher (20%) than the average (about 12%). There is a new initiative by the research council to create collaborations between different funders and research fields, to target specifically those disciplines that cross boundaries.

The major career step is from associate professor to professor. An additional "in-between" professor position has been created because not all associate professorships can be upgraded to full professorships. In medicine, there are longer permanent professorships: all are in five-year periods and their performance is evaluated regularly. The same situation applies in exercise physiology. During the interviews, the feeling was expressed that the decision-making process in filling professorships is very political.

8.6 Iceland

Because of their high number (500 vis-à-vis 12,000 undergraduates), many PhD students in Iceland across all fields of science who successfully complete their doctoral studies have no employment opportunities relevant to their research and therefore look for possibilities outside Iceland, especially in Europe and North America. Overproduction has created a 'brain drain' and difficulties for postgraduates and postdoctoral researchers, many of whom do not return to Iceland after going abroad. There are very few postdoctoral positions and new positions will not be funded until the economic situation improves.

9 RESEARCH FUNDING

9.1 Nordic level

Detailed data on research funding by major funding organisations in the Nordic countries were not provided to the panel. However, the survey did include questions about the funding received by the unit for sport sciences research from different sources during each year for 2006–2010 (in euros). Included were total research funding and the amount of funding from internal and external sources and the percentage of total external funding from public (governmental) sources, national private foundations, national industry and international sources. Panel members were not sure that all units used the same criteria for assigning funding sources to specific categories and not all units in a country participated in the survey. Thus, it is recognised that the funding reported by the participating units is not a full account of all funding for sport sciences research in the Nordic countries during 2006–2010. However, it does provide an indication of the range in the amount of internal and external funding for units in the different countries and a reasonably good indication of the distribution of external funding support from the government, foundations, industry and international sources.

Table 7 provides the following data: 1) the mean, median and range of internal, external and total annual funding for 2006–2010 in euros per unit per year for each country, 2) the average yearly total funding of all participating units combined in each country, and 3) the average annual percentage of external funding from difference sources for each country. The average annual total research funding for participating units (90 units reported funding data) in all five Nordic countries during 2006–2010 was nearly EUR 47 million. There is significant variation among units in the amount of internal and external research funding, largely related to the different sizes of the units. The relative amount of funding from internal versus external sources also varies substantially among units within countries (see range of funding from internal and external sources within countries in Table 7), but also across countries. For example, in Norway, on average 70% of the funding is internal with 30% from external sources, while in Denmark, 29% is internal funding and 71% is from external sources (in Iceland only 7% of funding came from internal sources). In Denmark, 45.1% of the external funding is from the national government, while in the other four countries this ranges from 61.5% (Iceland) to 81.5% (Finland). Next to funding from the national government, private foundations generally provided the most funds, with international funding accounting for about 10% of external funding Nordic-wide, ranging from 7.8% to 13% between countries. Again, it is important to emphasise that these figures are self-reported, without any assurance that the sources of this information were the same for different units within and between countries.

The sport and exercise sciences across the Nordic countries have historically embraced issues that are relevant to the performance of elite athletes. With very few exceptions, little evidence was provided to the panel during interviews of any integration of elite athlete research with the more resource-intensive basic and applied research. The panel's perspective

was that this change in focus was likely the reflection of the availability of funding in this area. It seems that funding currently available for research in this area of sport sciences is devoted to athlete monitoring and support rather than to research. There were, however, some examples of the provision of funding from industry and also from regional government sources. The current picture may also reflect the geography of the sports-related research facilities. It seems that there are good opportunities in Norway, where the Olympiatoppen centre is located immediately adjacent to the sport sciences university and some staff have joint appointments. Elsewhere, there seems to be a clear separation between athlete support services and hospital and laboratory research facilities. The world of elite sports offers some good research opportunities, and here the basic sciences have much to offer. A closer integration, including perhaps the identification of some specific funding mechanisms that would encourage greater communication and collaboration, should be considered.

During the interviews, questions were asked about the adequacy of funding, the sources of funding and what changes in funding, other than just increases, might improve research productivity and innovation.

9.2 Norway

In 2002, the Research Council of Norway introduced a new funding model with more performance-based awards. Grants to institutions were divided into a basic, an educational and a research component. The research component is further divided into strategic and results-based categories. The strategic research funding includes general funds for recruitment of personnel and scientific equipment. The performance-based portion is allocated to institutions based on indicators of research results. There is a separate indicator model for each of three institutional categories: universities, colleges and state colleges. Private colleges are also allocated funding for quantitative indicators of research results. The main objectives of this indicator model for the allocation of research funds are to stimulate research and allocate resources to institutions/units that demonstrate good research results.

From 1997 to 2007, the Research Council of Norway allocated funding for sport sciences within the programme "Sport, Society and the Voluntary Sector". The programme was intended to enhance the competency of researchers within the field and generate new knowledge about the interplay between the ongoing developments in society and the institutions of sports and the voluntary sector. Six areas were included for funding: sports within a socio-cultural perspective; organised sports; commercialisation of sport and its economic significance; sport facilities and participation in sports; and anti-doping. During its run, the programme funded 40 research projects with a total of about NOK 80 million.

The Research Council's independent project (FRIPRO) is a relevant funding source for researchers in sport sciences. It is an open national competition on the basis of scientific merit for all research areas and disciplines.

The 16 units participating in the survey from Norway reported an annual average total research funding of slightly more than EUR 13 million per year during 2006–2010, the average funding per unit per year being EUR 871,192, with 70% from internal sources and 30% from external sources (Table 7). Most of the external

funding came from the national government (72.6%), with only 8.6% from international sources.

There was a general feeling among the researchers that the field of sport and exercise sciences was generally disadvantaged when competing against the medical sciences for funding from the national funding agencies. Some capital equipment is available in most institutions, but recurrent funding for programme operating costs is largely absent. Increased collaboration with the medical sciences appears to be an enormous resource for the exercise and sport sciences that has not been harnessed.

9.3 Finland

Research on sport sciences in Finland is primarily administered by the Ministry of Education and Culture, with funding coming from three main sources: the Ministry's Department for Education and Science Policy, the Department for Culture, Sport and Youth Policy, and the Academy of Finland. The Academy operates within the administrative sector of the Ministry. However, Finnish sport sciences research also is funded by the European Union, Finland's Slot Machine Association, the Social Insurance Institution of Finland and numerous foundations. The Ministry's Department of Education and Science Policy is responsible for university core funding, part of which is allocated to basic research. Appropriations allocated by the Ministry to universities consist of core, performance-based and project funding. The core funding is intended for education as well as research.

The Academy of Finland is the prime funding agency for basic research in Finland. Other key agencies funding science and technology are the Finnish Funding Agency for Technology and Innovation (Tekes) and the Finnish Innovation Fund (Sitra). The Academy's funding is provided primarily for scientific research at universities and research institutes and the Academy has four research councils that cover all scientific disciplines. Most of the research funding for sport sciences by the Academy is through the Research Council for Health. During 2010, the Council made new funding decisions totalling about EUR 36 million, but sport sciences account for only about 1–2% of all funding allocated to health sciences. During 2006–2010, the Academy supported sport sciences with approximately EUR 2.8 million.

Each year, the Ministry of Education and Culture allocates discretionary government transfers and appropriations from pools and lottery proceeds to sport sciences research and communications. In 2010, the total transfers allocated by the Ministry for sport sciences research projects, research project collaboration of the Academy of Finland, sport sciences and public information communities as well as for international conferences amounted to about EUR 6.6 million. This funding support has risen approximately 30% between 2006 and 2010. A prerequisite for the research funding granted by the Ministry's Sports Division is that the research has to be focused on sports or physical activity. In addition to meeting the scientific criteria, the research should be innovative, easily applicable and have relevance, applicability and social significance to inform policy-making.

During 2006–2010, the support for sport sciences research rose from EUR 1.9 million to EUR 2.45 million, and 45–59 research projects were funded each year. Recently, there has been a trend to fund fewer projects but to target funding to

larger, high-level research groups and projects.

The 21 units reporting funding information in their survey response together reported an average annual research funding of EUR 14,229,027 during 2006–2010, with approximately 62% from external sources. The average funding per unit per year was EUR 674,709, with 38% from internal sources and 62% from external sources. A large portion of the external funding came from the national government (81.5%), with only 2.4% from industry and 7.8% from international sources.

During the interviews, the point was made that the funding structure has shifted in recent years, and it was felt that the reduced availability of funding from the Ministry of Education and Culture (due to a strategic shift in funding distribution in favour of the social sciences) has not been compensated for by an increased availability of funds from the Academy of Finland. This may be due to the greater competition from clinical medicine for these funds. It is also the case that there is a tradition to apply to the Ministry for support rather than to the Academy, and so there is clearly a need for researchers to recognise the change.

The opportunities of applying for EU funding should provide an impetus for the development of European collaboration, perhaps embracing a group of Nordic partners with others from further afield.

9.4 Sweden

The Swedish Research Council is the main national research funding agency in Sweden. It funds projects in a wide range of disciplines, with most of the funding provided for investigator-initiated proposals and very little funding via thematic programmes. In 2010, there were no programmes related to sport sciences and the Research Council's project database listed no programmes within sport sciences. However, there are projects funded dealing with responses to exercise of muscles, bones, the cardiovascular system, etc., but they are not considered to relate to sport sciences. However, the Research Council is co-funding a national research school in sport sciences (NIF) hosted by the University of Gothenburg.

The Swedish National Centre for Research in Sports (CIF) is the official national council for the funding of research in sports. It was established in 1988 to initiate, coordinate, support and inform about sports. In 2010, CIF was also assigned the task to follow-up the government's financial support to mainly the Swedish Sports Confederation and to perform an analysis of special areas of interest to the government: the 2010 theme was the rights of children and the 2011 theme the integration and the confirmation of elite sport funding in Sweden. In 2010, CIF had an income of EUR 2,524,000, an increase of about 16% on 2008 and 2009. During 2007–2010, CIF funded an average per year of EUR 1,059,000 for research projects, with human and social sciences receiving 34% of this funding, physiology, medicine and biomechanics 37%, traumatology and rehabilitation 26% and organisations 3%. During 2010, the average grant size was EUR 15,991 for human and social sciences, EUR 14,786 for physiology, medicine and biomechanics, EUR 10,624 for traumatology and rehabilitation, and EUR 5,476 for organisations. The panel questioned the wisdom of funding so many small grants given the costs of conducting innovative research. The evaluation of this funding strategy should be part of an ongoing evaluation process of sport sciences

research in each of the Nordic countries.

In the research units participating in the survey and completing the funding information (N = 36), the average total research funding per year during 2006–2010 was EUR 197,923 per unit, with 37% internal funding and 73% external funding. Of the external funding, 76.9% came from government sources, 11.4% from private foundations, 3.1% from national industry and 8.6% from international sources. The total research funding reported by the 36 units was EUR 7,125,228 per year.

CIF sponsors research positions for individuals preparing doctoral dissertations (PhD students) and for those who already have doctoral degrees (postdoctoral researchers). These grants are obtained for four years, and for a postdoctoral researcher this corresponds to about 50% of the salary per year. Some 24 positions (PhDs and postdoctoral researchers) are funded each year; in 2010, the cost of these positions was EUR 933,734.

During the interviews, various researchers indicated that there is a substantial number of CIF grants available each year, but they are small and impractical for most basic sciences (e.g., proteomics). Salary funding is often only provided part-time, and postdoctoral funding covers only salary, not any other costs for conducting the research. Researchers indicated that in addition to national funding sources, regional funding was available and important in some areas of the country, but not in others. University funding is one part of funding: funding used to be mainly by universities (75%), now university funding is approximately 30% of total funding.

There is substantial funding available for projects that are conducted in collaboration with industry: at the Karolinska Institute, approximately 5% of funding is from industry. There is more industry funding in projects that are conducted in international collaboration, but this is not very common in Sweden. Within the OECD, Sweden is competitive, but some Central and Eastern European countries are much less expensive.

There is money in the innovation field (sports industry, wellness industry, etc.). Universities are not allowed to profit from research, but this is technically possible by using holding companies. In the newer universities, it is easier to build new research units (e.g., research centre for skiing) than in the older universities. Performance in elite sports is often secured by identifying applications that are relevant to public health.

9.5 Denmark

The Danish Council for Independent Research is the prime funding agency for basic research in Denmark, with five councils that cover all scientific disciplines. Funding for sport sciences research is typically provided through the Research Council for Medical Sciences. The domain of sport sciences does not have its own code, thus it is not possible to determine exactly how much of the Council's funding goes to sport sciences each year (applications in the sport sciences can receive up to five different codes). It is estimated that 3–4% of funding from the Danish Medical Research Council goes to sport sciences research.

Other funding organisations in Denmark that fund research related to sport sciences include the Danish Elite Sports Institution

for Team Denmark (EUR 250,000), Anti-doping Denmark (EUR 130,000), and the Ministry of Culture: Research with Sports Sciences Board (EUR 650,000) (amounts are estimated annual funding).

In the Danish research units participating in the survey and completing funding information (N = 15), the average total research funding per year during 2006–2010 was EUR 853,722 per unit, with just 29% internal and 71% external funding. Of the external funding, 45.1% came from government sources (lowest percentage in the Nordic countries), 30.2% from private foundations, 9.2% from national industry and 15.5% from international sources (highest percentage in the Nordic countries).

Research directions are steered to some extent by the availability of funding, but it is recognised that the funding situation is perhaps not as acute as in many other countries. The documentation in the report of the impact of research in sport sciences would provide ammunition for Danish researchers to demonstrate to the politicians the benefits of the research that is currently being carried out. Strong Nordic collaboration already exists, but this could be further developed to help get funding from the EU and other external sources.

9.6 Iceland

The key observation by panel members was that exercise and sport sciences researchers in Iceland had funding difficulties that were not unique and that were primarily due to the ongoing financial crisis in the country. Because of the general downturn of the Icelandic economy, severe strain had been put on public and private research funding sources within the country and there was a strong stimulus to seek international funding, especially in close collaboration with scientists from other countries. At present, there is no funding for the social sciences or physiotherapy.

The three units participating in the survey together reported an average annual research funding of EUR 655,083 during 2006–2010, with approximately 93% coming from external sources. The average funding per unit per year was EUR 218,361, with 61.5% of the external funding provided by the national government, 10.3% by national foundations, 15.0% by national industry and 13.0% by international sources.

10 INVESTIGATOR COLLABORATION AND MOBILITY

To obtain some survey information on research or training collaborations during 2006–2010, researchers were asked to list their three main national partners and their three main international partners in sport sciences. Information regarding the aims of the collaboration was also requested. As an indicator of mobility, researchers were asked about visits to their unit by other sport scientists and visits by researchers from their unit to other units, the minimum length of a visit being three months. No information about the specific nature of the visits was collected.

Scientific collaboration

Based on the responses to the survey question on collaboration with researchers in their own country, approximately two out of three units Nordic-wide reported research collaboration with 1–3 scientists from other institutions, with only about 1% of units reporting no collaboration outside their unit. About 12–15% of units across the countries reported 4–6 collaborators and another 12–15% reported more than seven collaborators between 2006 and 2010. Regarding collaborations with researchers from other countries, less than 10% of the participating units reported no international collaboration, approximately 50% of units reported 1–3 collaborators, 30% reported 4–6 international collaborators, and approximately 10% reported collaborations with seven or more investigators, with eight units reporting more than ten collaborators. As for the number of countries represented by international collaborations, some 80% of units with international collaborators indicated collaboration with 1–3 countries, some 15% with 4–6 countries, and 5% with seven or more countries.

Overall, a reasonable amount of research collaboration among units in the same country was reported. However, given the five-year reporting period, the magnitude of collaboration among units was less than expected by the panel and could be considered suboptimal for maximising productivity and innovation. Much of the collaboration appeared to be relatively short-term, with the primary focus being on a single project or manuscript. During the interviews, the panel asked researchers about impediments to collaboration with other units, and no consensus was provided. Many researchers considered collaboration within their own country to be quite easy, since nearly all of the researchers within sport sciences, especially within a single domain, know each other well and there are no major administrative restrictions on collaboration. Some of the researchers indicated that competition between units still impedes collaboration, even though this problem appears to be decreasing. Much of the collaboration frequently reported by participating units was between investigators working in the same or similar domain, and fairly little transdisciplinary collaboration was reported, at both national and international level.

Researcher mobility

In the responses to the mobility question about international researches visiting the unit, approximately 50% of participating units in the Nordic countries other than Denmark reported no visitors, with about

30% of units in Denmark reporting no international visitors over the five-year period. Approximately 25–40% of all units in the Nordic countries reported visitors, but the average was under one per year. Between 10% and 20% of units in the different countries reported one or more visitors per year, with about half of these units reporting more than three visitors per year. In response to the question regarding the number of unit researchers who had visited other units for three months or longer, the responses were quite similar across countries, with approximately 45% of units reporting no visits by their researchers, 30% of units reporting less than one visit per year, 15% of units reporting 1–3 visits per year, and 10% of units reporting an average of more than three visits per year.

The panel considered the general lack of mobility among Nordic sport sciences researchers to be a subject of concern, both at present and in the future. Nordic-wide, nearly 75% of units reported no visits or under one each year of more than three months by one of their researchers to another unit. Also, except for Denmark, only about 50% of units reported any scientists visiting their unit between 2006 and 2010. The panel considered that the lack of mobility of sport scientists to and from many of the research units restricts the development of new ideas and contributes to the lack of innovation and major collaborations.

During the interviews, questions were raised by panel members about an apparent lack of mobility over the careers of many current senior researchers. These questions were based on information provided in the researchers' *curricula vitae*. In many cases, these researchers had spent most of their careers in the same institutions where they received their education. The response was that this was due to the small size of the countries and the limited opportunities for academic (faculty) appointments. The issue here is the apparent benefit of the cross-fertilisation of ideas leading to innovation when researchers who have trained and worked at different institutions join together. The researchers also indicated that PhD students and postdoctoral fellows were encouraged to obtain some of their research training by working with scientists in high-quality research units not only in other Nordic countries but also in other European countries, the US, Canada and Australia.

11 RESEARCH INFRASTRUCTURE

No questions were asked in the survey sent to research units regarding infrastructure availability or needs for the future. Some units did include information on infrastructure in the SWOT analysis of their unit and limited discussion was held during the interviews by the panel. Overall, investigators did not indicate that a lack of research infrastructure was a major impediment to being more productive or implementing more innovative research, except for some areas of investigation.

During the interviews, researchers commented on the strength of large national databases that exist in each country and the ready access to these databases by many investigators. In each Nordic country, access generally is available to the national healthcare system databases and the national death registry for research purposes. Investigators exploring the relations between levels of exercise or physical activity and various health outcomes have effectively used these databases, but a substantial amount of this research has not been conducted by sport sciences research units.

In addition to the national health and death registries, there is a number of existing health/medical/social databases that could be put to more use by exercise and sport scientists. For example, Sweden has an extensive twin registry and a new LifeGene registry that will include 500,000 Swedes recruited from birth. In Finland, Biobank Finland is currently being established, linked to clinical databases. Sport scientists could benefit tremendously from a greater use of these databases and biobanks, but very few plans to take advantage of these opportunities were evident during the interviews.

Norway has a number of biobanks, comprehensive national health registries and several large-scale population studies (e.g., CONOR/MoBa (Norwegian Institute of Public Health), The Nord-Trøndelag health study (HUNT) (NTNU). A very large number of blood samples, DNA samples and other biological material from the Norwegian population have been collected and now comprise a major national resource for research. Also in Norway, two infrastructure projects within the social sciences have recently received approval from the Research Council of Norway: ESS-S – Norwegian participation in the European Social Survey and ERIC and RAIRD – Remote Access Infrastructure for Register Data, which should provide better access to registry data. Improved national coordination and modern scientific equipment will support the research community in making full use of the substantial research potential of Norway's biobanks. The available biobanks, registries and large-scale population studies can strengthen future research within sport sciences. Some of the units in Norway (e.g., NSSS, NTNU) have already used the biobanks in several projects.

Discussions in several countries indicated that there is frequent access to large databases that contain participant records (e.g., data from medical charts, results of specific tests) but not so for materials in biobanks (e.g., blood, muscle biopsies,

DNA). Researchers indicated that biobank material is not often available to outsiders, and there are issues over ownership of biobank materials which limit collaboration. There are collections of samples in different units, but people do not want to place them into a biobank so as to protect the samples, largely because they would lose ownership of the samples. How better to share samples and enhance collaboration in this area should be a target for the near future.

One problem cited by the researchers was that funds are sometimes obtained to purchase expensive research equipment to support collaboration among units, but that it is difficult to find the money to fund the longer-term operation of this equipment. This cost can be eased by a collaborative approach, but funds are always required. It was suggested that there could be more collaboration in developing and using specialised equipment, such as that used for field monitoring of ambulatory individuals.

The Turku PET Centre in Finland is a major resource of international significance, and has the potential to attract research funding from various sources. The fact that exercise science is only a small part of the Centre's activities can be turned into an advantage as the expertise and techniques that exist in other disciplines can be applied to sport and exercise sciences.

In Denmark there was general agreement among the interviewed scientists on the need to focus on areas of strength where major infrastructure investment would help develop centres of national and international excellence. It was acknowledged that this would require strategic planning and the identification of relevant research questions. Collaboration among countries to achieve a major Nordic centre of excellence in a specific domain within the sport sciences should be considered by the sport science leadership in the five Nordic countries. It should be determined if such a proposal could be submitted to NordForsk.

TABLES

Table 1. Research units participating/not participating in survey, by country

Norway

Participated (16)	Invitation also sent to (21)
Norwegian School of Sport Sciences, Physical Performance	Research Centre for Exercise and Performance
Norwegian School of Sport Sciences, Sports medicine	Oslo Sports Trauma Research Centre
Norwegian School of Sport Sciences, Coaching and Psychology	Olympiatoppen
Norwegian School of Sport Sciences, Cultural and Social Sciences	Norwegian Social Research
Norwegian School of Sport Sciences, Physical Education	Oslo University Hospital
University of Agder	Centre for Sports and Physical Activity Research, Tromsø
University of Stavanger	University of Tromsø
Norwegian University of Science and Technology, Social Sciences	Nord-Trøndelag University College
Norwegian University of Science and Technology, Human Movement	Sør-Trøndelag University College
Norwegian University of Science and Technology, Medicine	Bergen University College
Sogn og Fjordane University College	Nesna University College
Finnmark University College	Hedmark University College
University of Nordland	Østfold University College
International Research Institute of Stavanger	Vestfold University College
Telemark University College	Stord/Haugesund University College
Institute for Social Research	Oslo University College
	Uni Research
	Telemarksforskning
	Norwegian Institute for Urban and Regional Research (NIBR)
	Institute for Research in Economics and Business Administration
	University of Oslo

Finland

Participated (22)	Willingness to participate was inquired (19)
University of Eastern Finland, Institute of Biomedicine	University of Tampere, School of Medicine
University of Helsinki, Hjelt Institute	University of Oulu, Institute of Health Sciences
University of Jyväskylä, Department of Biology and Physical Activity	University of Turku, Institute of Clinical Medicine
University of Jyväskylä, Department of Health Sciences	Aalto University, School of Science and Technology, Centre for Urban and Regional Studies
University of Jyväskylä, Department of Sports Sciences	University of Tampere, Department of History and Philosophy
University of Oulu, Institute of Biomedicine, Department of Medical Technology	University of Eastern Finland, Department of Physics and Mathematics
University of Tampere, School of Health Sciences	University of Turku, Department of Education
University of Turku, PET Centre	University of Turku, Institute of Biomedicine
Kuopio University Hospital (North-Savo Hospital District)	University of Turku, Research Centre of Applied and Preventive Cardiovascular Medicine
LIKES – Foundation for Sport and Health Sciences	Folkhälsan Research
Oulu Deaconesses' Institute, Department of Sports and Exercise Medicine	Hospital District of Helsinki and Uusimaa
Paavo Nurmi Centre	Hospital District of Southwest Finland
Kuopio Research Institute of Exercise Medicine	Pirkanmaa Hospital District
Helsinki Sports and Exercise Medicine Research and Education Centre	Northern Ostrobothnia Hospital District
Tampere Research Centre of Sports Medicine (TRCSM)	Central Finland Health Care District
Finnish Institute of Occupational Health, Physical work capacity team	Age Institute
National Institute for Health and Welfare	ORTON Foundation
UKK Institute for Health Promotion Research	Mehiläinen Sports Injury Clinic
Research Institute for Olympic Sports (KIHU), Bioscience	Diacor
Research Institute for Olympic Sports (KIHU), Human Behaviour	
Research Institute for Olympic Sports (KIHU), Social Sciences	
Department of Exercise and Medical Physiology (Verve)	

Sweden

Participated (41)	Invitation also sent to (15)
GIH Swedish School of Sport and Health Sciences	Arndt, Toni (traumatology, biomechanics)
Ekblom et al.	Börjesson, Mats (basic science)
Larsson	Dahlberg, Leif (traumatology)
Thorstensson	Dellborg, Mikael (basic science, heart physiology)
Blomstrand	Frändin, Kerstin
Sahlin	Henriksson, Jan (basic science, physiology)
University of Gothenburg	Hildingh, Cathrine (health)
Frisén	Rane, Anders (basic science, Professor Emeritus in Clinical Pharmacology)
IKI	Roos, Harald (traumatology)
Kartus	Sundstedt, Milena (basic science, heart physiology)
Karlsson	Tesch, Per (basic science, physiology)
Halmstad University	Tonkonogi, Michail (basic science, physiology)
Johnson	Werner, Suzanne (traumatology)
Brorsson	Wollmer, Per (basic science)
Karolinska Institutet	Zierath, Juleen (basic science, Professor of Clinical Integrative Physiology)
Jansson	
Westerblad	
Linköping University	
Aspenberg	
Ekstrand	
Timpka	
Klarbring	
Nylander	
Linnaeus University	
Lund University	
Apitzsch	
Sellerberg	
Arheden	
Karlsson	
Malmö University	
Mid Sweden University	
Schagatay	
Zackridsson	
Stockholm University	
Söderman	
Wiijk	
Swedish Winter Sports Research Centre	
Umeå University	
Alfredsson	
Forsgren	
Lorenzon	
Fahlen	
Hjelm	
Rönnqvist	
Hörnell	
Malm	
Thornell	
UFBI	
Örebro University	
Kadi	
Quennerstedt	

Denmark

Participated (15)	Invitation also sent to (13)
Aalborg University, Department of Health Science and Technology	Centre for Muscle Research, Rigshospitalet, Professor Emeritus Bengt Saltin (muscle physiology, cardiovas.)
Aarhus University, Department of Sport Science, Biomechanics Unit	Centre for Inflammation and Metabolism, Rigs-hospitalet, Professor Bente Klarlund Pedersen (myo/cytokines, health)
Aarhus University, Department of Sport Science, Physiology Unit	Institute for Biology, August Krogh Institute, Natural Sciences Faculty, Professor Carsten Juul (lactate metabolism)
Aarhus University, Department of Sport Science, Sport and Body Culture Unit	Laboratory for Movement and Biomechanics, University of Copenhagen, Assistant Professor Erik B Simonsen (running economy, gait)
University of Copenhagen, Department of Biomedical Sciences, Centre for Healthy Ageing	National Centre for Occupational Medicine, Copenhagen, Senior Researcher Lars Andersen (chronic muscle pain)
University of Copenhagen, Department of Exercise and Sport Sciences	Neuromuscular Research Unit, Rigshospitalet, Professor John Vissing (muscle mitochondr/metab disease)
University of Southern Denmark	Depart of Rheumatology, Rigshospitalet, Professor Henrik Galbo (horm-metab in muscle-rheum)
Aarhus University Hospital, Department of Endocrinology and Diabetes	University Centre for Nurse Research, Professor Lis Adamsen (exercise and cancer)
Bispebjerg University Hospital, Department of Cardiology	Department of Orthopaedic Surgery, Hvidovre Hospital, Assistant Professor Stig Sonne Holm (gait analysis, osteoarthritis)
Bispebjerg University Hospital, Department of Respiratory Diseases	Department of Orthopaedic Surgery, Aarhus University Hospital, Assistant Professor Martin Lind (ligament surgery, cartilage)
Bispebjerg University Hospital, Department of Rheumatology (Institute of Sports Medicine)	Department of Rheumatology, Silkeborg Hospital, Chief Physician Ulrich Fredberg (tendon and ultrason)
Copenhagen University Hospital, Department of Anaesthesiology	Department of Clinical Physiology, Bispebjerg Hospital, Professor Jens Bülow (fat metabolism)
Aalborg Hospital, Department of Rheumatology, Movement Science Laboratory	Institute of Biomedicine, Faculty of Health Sciences, Professor Bjørn Qvistorff (muscle metabolism)
Sports Orthopaedic Research Unit, Arthroscopic Centre Amager	
Steno Diabetes Centre	

Iceland

Participated (3)	Invitation also sent to (2)
University of Iceland, Research Centre in Sport and Health Sciences	University of Iceland, Unit for Nutrition Research and Dietetics
University of Iceland, Research Centre of Movement Science	University of Iceland, Department of Social Sciences
Reykjavik University	

Table 2. Research units participating in survey, by country and domain

Norway

Basic sciences	Exercise medicine	Social sciences etc.	Combined
Norwegian School of Sport Sciences, Physical Performance	Norwegian School of Sport Sciences, Sports Medicine	Norwegian School of Sport Sciences , Coaching and Psychology	University of Agder
	University of Nordland	Norwegian School of Sport Sciences , Cultural and Social Sciences	University of Stavanger
		Norwegian School of Sport Sciences , Physical Education	Norwegian University of Science and Technology, Human Movement
		Norwegian University of Science and Technology, Social Sciences	Sogn og Fjordane University College
		International Research Institute of Stavanger	Finnmark University College
		Telemark University College	Norwegian University of Science and Technology, Medicine
		Institute for Social Research	

Finland

Basic sciences	Exercise medicine	Social sciences etc.	Combined
University of Jyväskylä, Department of Biology and Physical Activity	University of Eastern Finland, Institute of Biomedicine	University of Jyväskylä, Department of Sports Sciences	
University of Turku PET Centre	University of Helsinki, Hjelt Institute	University of Tampere, School of Health Sciences	
Research Institute for Olympic Sports (KIHU), Bioscience	University of Jyväskylä, Department of Health Sciences	Research Institute for Olympic Sports (KIHU), Human Behaviour	
Department of Exercise and Medical Physiology (Verve)	University of Oulu, Institute of Biomedicine, Department of Medical Technology	Research Institute for Olympic Sports (KIHU), Social Science	
	Kuopio University Hospital		
	LIKES – Foundation for Sport and Health Sciences		
	Oulu Deaconesses' Institute, Department of Sports and Exercise Medicine		
	Paavo Nurmi Centre		
	Kuopio Research Institute of Exercise Medicine		
	Helsinki Sports and Exercise Medicine Research and Education Centre		
	Tampere Research Centre of Sports Medicine (TRCSM)		
	Finnish Institute of Occupational Health, physical work capacity team		
	National Institute for Health and Welfare		
	UKK Institute for Health Promotion Research		

Sweden

Basic sciences	Exercise medicine	Social sciences etc.	Combined
Ekblom et al. (GIH)	Kartus (Gothenburg)	Larsson et al. (GIH)	
Blomstrand et al. (GIH)	Karlsson (Gothenburg)	Frisén et al. (Gothenburg)	
Sahlin et al. (GIH)	Aspenberg et al. (Linköping)	IKI (Gothenburg)	
Thorstensson et al. (GIH) and traumatology	Ekstrand et al. (Linköping)	Johnson et al. (Halmstad)	
Brorsson et al. (Halmstad)	Timpka et al. (Linköping)	Linnaeus University (Fahlström, Andreasson, Larsson, Lund, Stark)	
Jansson et al. (KI)	Karlsson et al. (Lund)	Apitzsch (Lund)	
Westerblad et al. (KI)	Alfredsson (Umeå)	Sellerberg (Lund)	
Klarbring et al. (Linköping)	Forsgren (Umeå)	Malmö University	
Nylander et al. (Linköping)	Lorenzon (Umeå)	Zackrisson (Mid Sweden University)	
Arheden et al. (Lund)		Söderman (Stockholm)	
Schagatay et al. (Mid Sweden University)		Wiijk (Stockholm)	
Swedish Winter Sports Research Centre (Mid Sweden University)		Fahlén et al. (Umeå)	
Rönnqvist (Umeå) combined with social sciences (psychology)		Hjelm (Umeå)	
Kadi et al. (Örebro)		Quennerstedt (Örebro)	
Hörnell (Umeå)			
Malm et al. (Umeå)			
Thornell et al. (Umeå)			
UFBI (Umeå)			

Denmark

Basic sciences	Exercise medicine	Social sciences etc.	Combined
University of Copenhagen, Department of Biomedical Sciences, Centre for Healthy Ageing	Sports Orthopaedic Research Unit, Arthroscopic Centre Amager	Aarhus University, Department of Sports Sciences, Sport and Body Culture Unit	University of Southern Denmark
Copenhagen University Hospital, Department of Anaesthesiology	Bispebjerg University Hospital, Department of Rheumatology (Institute of Sports Medicine)		Aarhus University, Department of Sports Sciences, Physiology Unit
Aarhus University, Department of Sports Sciences, Biomechanics Unit	Aarhus University Hospital, Department of Endocrinology and Diabetes		University of Copenhagen, Department of Exercise and Sports Medicine
	Bispebjerg University Hospital, Department of Cardiology		Aalborg University, Department of Health Science and Technology
	Bispebjerg University Hospital, Department of Respiratory Diseases		
	Aalborg Hospital, Department of Rheumatology, Movement Science Laboratory		
	Steno Diabetes Centre		

Iceland

Basic sciences	Exercise medicine	Social sciences etc.	Combined
			Sport Science Department (Reykjavik University)
			Research Centre of Movement Science (University of Iceland)
			Research Centre in Sport and Health Sciences (University of Iceland)

Table 3. Number of participating units, by country and domain

Country	Basic and applied	Medicine and health	Social and behavioural	Combined*	Total
Norway	1	2	7	6a	16
Finland	4	14	4	0	22
Sweden	18	9	14	0	41
Denmark	4	7	1	3b	15
Iceland	0	0	0	3c	3
Total	27	32	26	12	97

* Country coordinators in Norway, Denmark and Iceland decided that these units were conducting significant research in more than one domain.

a = Six units reported conducting basic and applied research as well as medicine and health research.

b = One unit reported conducting basic and applied research as well as social and behavioural research, one unit reported conducting both basic and applied research and medicine and health research, and one unit reported conducting research in all three domains.

c = Two units reported conducting both basic and applied research and medicine and health research and one unit reported conducting research in all three domains.

Table 4. Research personnel in participating units 2010, by domain and country

A. Basic and applied	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
Appointed professors	4.9	9.0	26.10	14.0	0
Other senior researchers	1.2	7.20	31.70	3.0	0
PhD students	4.5	23.70	38.40	13.0	0
Other	6.63	20.50	36.90	8.0	0
B. Medicine and health	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
Appointed professors	15.0	24.43	14.50	14.0	0
Other senior researchers	3.6	42.80	18.0	15.5	0
PhD students	12.75	80.00	30.50	24.0	0
Other	7.1	72.0	17.25	19.0	0
C. Social and Behavioural	**Norway**	**Finland**	**Sweden**	**Denmar**	**Iceland**
Appointed professors	23.9	9.0	26.35	2.0	0
Other senior researchers	2.0	10.0	49.0	1.0	0
PhD students	20.93	17.0	46.0	4.0	0
Other	16.22	34.0	38.75	6.0	0
D. Combined*	**Norway[a]**	**Finland**	**Sweden**	**Denmark[b]**	**Iceland[c]**
Appointed professors	29.3	0	0	63.1	15.0
Other senior researchers	9.3	0	0	31.2	1.0
PhD students	33.73	0	0	91.1	2.25
Other	18.18	0	0	73.0	17.5
E. Total for all domains	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
Appointed professors	73.1	42.43	66.95	93.1	15.0
Other senior researchers	16.1	60.0	98.7	50.7	1.0
PhD students	71.91	120.7	114.9	132.1	2.25
Other	48.13	126.5	92.9	106.0	17.5

* Country coordinators decided that these units were conducting significant research in more than one domain.

a = Six units reported conducting basic and applied as well as medicine and health research.

b = One unit reported conducting basic and applied as well as social and behavioural research, one unit reported conducting both basic and applied and medicine and health research, and one unit reported conducting research in all three domains.

c = Two units reported conducting both basic and applied research and medicine and health research and one unit reported conducting research in all three domains.

Table 5. Publications by participating units 2006–2010, by domain and country

A. Basic and applied	Norway	Finland	Sweden	Denmark	Iceland
International peer-reviewed	90	317	415	264	0
International other	12	36	61	26	0
National	44	82	94	10	0
B. Medicine and health	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
International peer-reviewed	361	1,185	271	224	0
International other	48	141	52	24	0
National	47	1,018	22	73	0
C. Social and behavioural	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
International peer-reviewed	172	91	191	16	0
International other	84	91	142	20	0
National	207	415	393	23	0
D. Combined*	**Norway[a]**	**Finland**	**Sweden**	**Denmark[b]**	**Iceland[c]**
International peer-reviewed 294	0	0	892	46	
International other	52	0	0	226	15
National	89	0	0	342	32
E. All domains by country	**Norway**	**Finland**	**Sweden**	**Denmark**	**Iceland**
International peer-reviewed	917	1,593	877	1,396	46
International other	196	268	255	296	15
National	387	1,515	509	448	32
F. All Nordic countries by domain and publication type	**Basic and applied**	**Medicine and health**	**Social and behavioural**	**Combined**	**Total**
International peer-reviewed	1,086	2,041	470	1,232	4,829
International other	135	265	337	293	1,030
National	230	1,160	1,038	463	2,883
Number of units reporting	**26**	**29**	**25**	**12**	**92**

* Country coordinators decided that these units were conducting significant research in more than one domain.

a = Six units reported conducting basic and applied research as well as medicine and health research.

b = One unit reported conducting basic and applied research as well as social and behavioural research, one unit reported conducting both basic and applied research and medicine and health research, and one unit reported conducting research in all three domains.

c = Two units reported conducting both basic and applied research and medicine and health research and one unit reported conducting research in all three domains.

Table 6 A. Publications in biological and medical sciences 2006–2010, absolute numbers and percentages

Journal		General						Physiology				Orthopaedics			
		Medicine & Science in Sports & Exercise		Scandinavian Journal of Medicine & Science in Sports		British Journal of Sports Medicine		Journal of Applied Physiology		European Journal of Applied Physiology		American Journal of Sports Medicine		Gait & Posture	
Impact factor		3.399		2.264		2.126		3.658		1.931		3.646		2.743	
Country	Population (million)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
USA	310.4	776	49.46	55	9.42	265	22.51	1,736	52.27	295	20.88	779	60.76	315	35.16
Canada	34.0	145	9.24	22	3.77	97	8.24	352	10.60	120	8.49	50	3.90	96	10.71
Australia	22.3	141	8.99	29	4.97	217	18.44	204	6.14	113	8.00	49	3.82	72	8.04
			67.69		18.15		49.19		69.02		37.37		68.49		53.91
Germany	82.3	46	2.93	26	4.45	54	4.59	95	2.86	101	7.15	101	7.88	45	5.02
France	62.8	55	3.51	23	3.94	36	3.06	134	4.03	152	10.76	22	1.72	62	6.92
England	62.0	170	10.83	60	10.27	216	18.35	232	6.99	202	14.30	63	4.91	85	9.49
Italy	60.6	38	2.42	14	2.40	45	3.82	106	3.19	115	8.14	42	3.28	54	6.03
Netherlands	16.6	51	3.25	10	1.71	57	4.84	98	2.95	53	3.75	31	2.42	76	8.48
Switzerland	7.7	25	1.59	27	4.62	67	5.69	61	1.84	37	2.62	43	3.35	44	4.91
			24.54		27.40		40.36		21.86		46.71		23.56		40.85
Sweden	9.4	28	1.78	91	15.58	53	4.50	87	2.62	75	5.31	37	2.89	23	2.57
Denmark	5.6	24	1.53	116	19.86	12	1.02	152	4.58	64	4.53	8	0.62	5	0.56
Finland	5.4	35	2.23	52	8.90	14	1.19	35	1.05	37	2.62	18	1.40	5	0.56
Norway	4.9	33	2.10	58	9.93	44	3.74	29	0.87	48	3.40	38	2.96	14	1.56
Iceland	0.3	2	0.13	1	0.17	0	0.00	0	0.00	1	0.07	1	0.08	0	0.00
			7.78		54.45		10.45		9.12		15.92		7.96		5.25
Total		1,569	100.00	584	100.00	1,177	100.00	3,321	100.00	1,413	100.00	1,282	100.00	896	100.00

Table 6 B. Publications in biological and medical sciences 2006–2010 per million inhabitants

Journal		General			Physiology		Orthopaedics	
		Medicine & Science in Sports & Exercise	Scandinavian Journal of Medicine & Science in Sports	British Journal of Sports Medicine	Journal of Applied Physiology	European Journal of Applied Physiology	American Journal of Sports Medicine	Gait & Posture
Impact factor		3.399	2.264	2.126	3.658	1.931	3.646	2.743
Country	Population (million)							
USA	310.4	2.5	0.2	0.9	5.6	1.0	2.5	1.0
Canada	34.0	4.3	0.6	2.9	10.3	3.5	1.5	2.8
Australia	22.3	6.3	1.3	9.7	9.2	5.1	2.2	3.2
Germany	82.3	0.6	0.3	0.7	1.2	1.2	1.2	0.5
France	62.8	0.9	0.4	0.6	2.1	2.4	0.4	1.0
England	62.0	2.7	1.0	3.5	3.7	3.3	1.0	1.4
Italy	60.6	0.6	0.2	0.7	1.8	1.9	0.7	0.9
Netherlands	16.6	3.1	0.6	3.4	5.9	3.2	1.9	4.6
Switzerland	7.7	3.3	3.5	8.7	8.0	4.8	5.6	5.7
Sweden	9.4	3.0	9.7	5.7	9.3	8.0	3.9	2.5
Denmark	5.6	4.3	20.9	2.2	27.4	11.5	1.4	0.9
Finland	5.4	6.5	9.7	2.6	6.5	6.9	3.4	0.9
Norway	4.9	6.8	11.9	9.0	5.9	9.8	7.8	2.9
Iceland	0.3	6.3	3.1	0.0	0.0	3.1	3.1	0.0

Table 6 C. Publications in social and behavioural sciences 2006–2010, absolute numbers and percentages

Journal		Social/Education								Psychology							
		Sociology of Sport Journal		Journal of Sports Economics		Journal of Sport Management		Sport, Education and Society		Journal of Sport and Exercise Physiology		Psychology of Sport and Exercise		The Sport Psychologist		Journal of Applied Sport Psychology	
Impact factor		0.778		0.528		0.797		0.875		2.823		2.218		1.054		1.264	
Country	Population (million)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
USA	310.4	74	46.25	127	75.60	105	63.25	26	17.45	1,032	53.25	75	22.19	63	38.65	439	70.58
Canada	34.0	41	25.63	11	6.55	29	17.47	6	4.03	446	23.01	52	15.38	27	16.56	56	9.00
Australia	22.3	10	6.25	2	1.19	17	10.24	50	33.56	51	2.63	31	9.17	14	8.59	24	3.86
			78.13		83.33		90.96		55.03		78.90		46.75		63.80		83.44
Germany	82.3	0	0.00	8	4.76	3	1.81	0	0.00	119	6.14	21	6.21	1	0.61	21	3.38
France	62.8	0	0.00	3	1.79	2	1.20	1	0.67	45	2.32	28	8.28	8	4.91	2	0.32
England	62.0	27	16.88	6	3.57	6	3.61	48	32.21	201	10.37	95	28.11	44	26.99	39	6.27
Italy	60.6	0	0.00	1	0.60	1	0.60	0	0.00	2	0.10	5	1.48	1	0.61	0	0.00
Netherlands	16.6	1	0.63	1	0.60	2	1.20	0	0.00	25	1.29	7	2.07	1	0.61	36	5.79
Switzerland	7.7	1	0.63	6	3.57	0	0.00	1	0.67	8	0.41	6	1.78	1	0.61	3	0.48
			18.13		14.88		8.43		33.56		20.64		47.93		34.36		16.24
Sweden	9.4	0	0.00	0	0.00	0	0.00	6	4.03	1	0.05	6	1.78	2	1.23	0	0.00
Denmark	5.6	2	1.25	0	0.00	0	0.00	2	1.34	1	0.05	3	0.89	0	0.00	0	0.00
Finland	5.4	1	0.63	1	0.60	0	0.00	0	0.00	3	0.15	3	0.89	0	0.00	0	0.00
Norway	4.9	3	1.88	2	1.19	1	0.60	9	6.04	4	0.21	6	1.78	1	0.61	2	0.32
Iceland	0.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
			3.75		1.79		0.60		11,41		0.46		5.33		1.84		0.32
Total		160	100.00	168	100.00	166	100.00	149	100,00	1,938	100.00	338	100.00	163	100.00	622	100.00

Table 6 D. Publications in the social and behavioural sciences 2006–2010 per million inhabitants

Journal		Social/Education				Psychology			
		Sociology of Sport Journal	Journal of Sport Economics	Journal of Sport Management	Sport, Education and Society	Journal of Sport and Exercise Physiology	Psychology of Sport and Exercise	The Sport Psychologist	Journal of Applied Sport Psychology
Impact factor		0.778	0.528	0.797	0.875	2.823	2.218	1.054	1.264
Country	Population (million)								
USA	310.4	0.24	0.41	0.34	0.08	3.32	0.24	0.20	1.41
Canada	34.0	1.21	0.32	0.85	0.18	13.11	1.53	0.79	1.65
Australia	22.3	0.45	0.09	0.76	2.25	2.29	1.39	0.63	1.08
Germany	82.3	0.00	0.10	0.04	0.00	1.45	0.26	0.01	0.26
France	62.8	0.00	0.05	0.03	0.02	0.72	0.45	0.13	0.03
England	62.0	0.44	0.10	0.10	0.77	3.24	1.53	0.71	0.63
Italy	60.6	0.00	0.02	0.02	0.00	0.03	0.08	0.02	0.00
Netherlands	16.6	0.06	0.06	0.12	0.00	1.51	0.42	0.06	2.17
Switzerland	7.7	0.13	0.78	0.00	0.13	1.04	0.78	0.13	0.39
Sweden	9.4	0.00	0.00	0.00	0.64	0.11	0.64	0.21	0.00
Denmark	5.6	0.36	0.00	0.00	0.36	0.18	0.54	0.00	0.00
Finland	5.4	0.19	0.19	0.00	0.00	0.56	0.56	0.00	0.00
Norway	4.9	0.61	0.41	0.20	1.84	0.82	1.23	0.20	0.41
Iceland	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7. Research funding of participating units, reported for 2006–2010 (figures based on amount of funding given by individual units)

		Norway	Finland	Sweden	Denmark	Iceland
Number of units		15	21	36	15	3
EUR/unit/year						
Internal						
	Mean	611,713	257,149	72,288	251,832	15,754
	Median	588,600	60,000	39,500	50,000	8,249
	Range	0–	0–	0–	0–	0–
		1,277,200	1,805,920	262,704	1,633,000	39,013
External						
	Mean	259,479	417,560	125,635	601,890	202,607
	Median	111,380	319,100	53,600	193,000	138,441
	Range	20,160–	42,700–	0–	5,820–	24,666–
		1,474,200	1,534,143	586,671	2,640,385	444,714
Total						
	Mean	871,192	674,709	197,923	853,722	218,361
	Median	658,600	211,786	89,400	228,400	177,454
	Range	128,602–	42,700–	14,000–	19,870–	32,914–
		2,670,600	3,243,178	859,000	2,641,176	444,714
Total all units per year EUR		**13,067,880**	**14,168,889**	**7,125,228**	**12,805,830**	**655,083**

Sources of funding					
Percentage of external funding (average over five years)					
National government	72.6	81.5	76.9	45.1	61.5
Private foundations	11.9	7.9	11.4	30.2	10.3
National industry	6.8	2.4	3.1	9.2	15.0
International	8.6	7.8	8.6	15.5	13.0

APPENDIX A. Panel members

Name	**William L. Haskell, chair**
Degree(s)	1. BS, kinesiology 2. PhD, exercise physiology
Research field(s)	1. Exercise and cardiovascular disease prevention 2. Exercise and healthy ageing 3. Measurement of physical activity
Present position	Professor (Active Emeritus), Stanford University School of Medicine

Name	**Stuart Biddle**
Degree(s)	1. BEd 2. MSc 3. PhD
Research field(s)	1. Sedentary behaviour and health: measurement, correlates and interventions 2. Physical activity behaviours and health 3. Behavioural medicine and psychology, including mental health
Present position	Professor of Physical Activity and Health

Name	**Peter Bärtsch**
Degree(s)	1. MD
Research field(s)	1. High-altitude pulmonary oedema and acute mountain sickness 2. High-altitude training 3. Haemostasis during exercise in hypoxia
Present position	Professor and Chair of Sports Medicine, Department of Internal Medicine, Heidelberg University, Germany

Name	**Karyn Esser**
Degree(s)	1. BS, mathematics and biology, Wake Forest University 2. MEd, physical education, University of Nevada, Las Vegas 3. PhD, kinesiology, University of Michigan
Research field(s)	1. Skeletal muscle physiology 2. Skeletal muscle adaptation to exercise
Present position	Professor of Physiology, College of Medicine, University of Kentucky Director, Centre for Muscle Biology, University of Kentucky

Name	**Jennifer Hargreaves**
Degree(s)	1. PhD 2. MA
Research field(s)	1. Sociology of sport 2. Role of women in sport 3. Politics of the body
Present position	Freelance writer/consultant, Visiting Professor of Sport and Gender Politics

Name	**Ron Maughan**
Degree(s)	1. BSc 2. PhD
Research field(s)	1. Physiology, biochemistry and nutrition of exercise and sport
Present position	Professor Emeritus, Loughborough University

Name	**Bart Vanreusel**
Degree(s)	1. PhD, Doctor in physical education 2. Master's degree in sociology of sport, University of Massachusetts, USA
Research field(s)	1. Sociology of sport and physical activity 2. Sport policy
Present position	Full Professor, Head of the Department of Human Kinesiology, Faculty of Kinesiology, Katholieke Universiteit Leuven, Belgium

Terms of reference for the evaluation panel and the coordinators

This document sets out the standard Terms of Reference applicable to the evaluation panel and the coordinator. The contents of this document are relevant both to the evaluators and the units being evaluated.

Table of contents

1 Background and purpose

Discipline and research field evaluations are among the key elements in the long-term development of research and science policy. Research councils in all five Nordic countries, in collaboration with two other funding bodies, have decided on a joint effort to evaluate sport sciences simultaneously in Denmark, Finland, Iceland, Norway and Sweden.

Scientific research on physical activity, sports and health has touched on both biological (dose-response relations between physical activity and health) and psycho-social questions (how to change physical activity behaviour). The role of physical activity in health promotion during the next decades is evidently crucial. Unfortunately, physical activity at work, while commuting between home and work, and during most recreational hours, has decreased.

From a societal viewpoint, physical activity and sports are not only issues of health. Elite sports still play an important role in society and major sports events may "unite" a population. In Finland, for instance, some 40% of the population (i.e. 2 million) may watch the most exciting sports coverage on TV, such as the final game in the Ice Hockey World Championship between Finland and Sweden.

Besides sports on an elite level, sports-for-all and child and adolescent sports, for instance, are increasingly popular in the Nordic countries. The civic activity of sports is not limited to participation in competitions and training, since many individuals are involved in sports on a volunteer basis as trainers, officials, etc. Sports and physical activity therefore have a substantial cultural and societal significance, besides being related to human health.

Sport sciences is not a large field among health sciences, which is dominated by biomedical research, clinical research and epidemiology. There is usually an association between the number of researchers and the amount of funding. This makes it easy to understand that sport sciences is not a major field for funding in any of the Nordic countries. Nevertheless, in contrast to research, physical activity and sports have an important societal role as a cultural phenomenon and in health, education and recreation policies.

Research in exercise and sport sciences is dominated by the US. In relation to their

small population size, the Nordic countries have been relatively successful in sport sciences. Therefore, **sport sciences is a research niche in which the Nordic countries could excel**. However, new ways to organise research, to cooperate and to fund sport sciences may be needed to maintain the present level and be even more competitive and influential in the future.

There are several similarities between the Nordic countries that make increased networking and cooperation an attractive opportunity:

1. The cultural role of sports and physical activity (e.g. voluntary work, type of sports, etc.)
2. Values of both elite sports and health-enhancing physical activity
3. Trends of diseases connected to physical inactivity (e.g. obesity, type 2 diabetes, colorectal cancer)
4. Possibility to use patient registers etc. in epidemiological studies on physical activity and health

With a Nordic focus and Nordic cooperation, existing resources could be multiplied and a critical research mass reached. If done correctly and jointly, these measures have the potential to raise the quality of sport sciences. As a consequence, the Nordic countries have the potential to become an elite research area in Europe and to compete with the best laboratories internationally.

The present evaluation consists of an external assessment by an international evaluation panel performed with similar aims in all five Nordic countries. The primary objective of the evaluation is to determine the strengths and weaknesses of sport sciences. The evaluation also aims to form a strategy to develop the scientific quality, practical applications and cooperation of sport sciences in the Nordic countries.

2 Objectives of the evaluation

The primary objective of the evaluation is to determine the strengths and weaknesses of sport sciences. This will help form a strategy to develop the scientific quality, practical applications and cooperation of sport sciences in the Nordic countries. The present evaluation consists of an external assessment by an international evaluation panel performed with similar aims in all five Nordic countries. The Nordic joint evaluation can be used by the funding authorities as a tool in decision-making, and to develop research structures and the quality of scientific research in the five Nordic countries. It is also a way to improve the societal applications of sport sciences.

The evaluation will focus on the following issues:

1. The focus and scattering of different scientific disciplines within sport sciences in different Nordic countries: Where is the work done? What is the focus? What is lacking? What are the structural weaknesses/strengths?
2. The overall quality of sport sciences and the recognition of strong and weak areas/disciplines (publication history, present activities)
3. Factors affecting quality:
   a. Strategic issues (e.g. institutional research and publication strategies)
   b. Human resources (size and composition of research groups, multidisciplinarity, national and international cooperation, etc.)
   c. Research infrastructure
   d. External funding
4. Funding of sport sciences in the Nordic countries: adequacy, allocation and process of funding; advantages and disadvantages of a decentralised funding system

5. Links between science and societal applications (science-society interaction)
6. Assessment of future prospects of sport sciences in the Nordic countries.

3 Definition of sport sciences

The field to be evaluated consists of sport sciences in its widest sense: exercise biology, health-related issues, traumatology related to sports and exercise, pedagogy, sociology, psychology and cultural issues.

For this evaluation, the field of sport sciences is divided into the following seven subfields:

- Biological sport sciences (basic physiology, genetics, etc.)
- Applied sport sciences (performance, nutrition, etc.)
- Sports medicine (injuries, prevention of injuries, etc.)
- Sport sciences in health and disease (epidemiology, clinical research, etc.)
- Psychology and pedagogy
- Social sport sciences
- Humanities, culture and history.

The evaluation panel will consist of experts within the selected subfields. There is no intention to perform comparisons between the different disciplines. The evaluation will be carried out at two main levels: country and unit (department, institution, etc.). Individual researchers or research groups will not be evaluated.

4 Selection of units

The units to be evaluated will be selected using the following criteria:

1. applied for a grant from a sports-relevant grant agency (governmental funding agency or large foundation)
2. identified by the national members of project and steering groups, with possible consultation with selected researchers in the field.

The deadline for the selection of units is 15 October 2010 (responsibility: national project group member, with the help of the steering group member).

5 Organisation

The evaluation is commissioned by NORIA-NET project No. 19040, "Nordic Evaluation of Sport Sciences". The project group is chaired by Dr Mikael Fogelholm from the Academy of Finland. The Academy of Finland is also the project coordinator. Monica Lund from NordForsk will attend the steering and project group meetings as an active observer.

The project group has appointed a steering group to lead and support the execution of the evaluation.

The members of the steering group are:

Erlingur Johannsson, Professor, Reykjavik/ Lagarvatn

Michael Kjaer, Professor, Copenhagen

Pasi Koski, Adjunct Professor, Turku

Per Nilsson, Professor, Stockholm

Sarianna Sipilä, Research Director, Jyväskylä

Mats Ulfendahl, Professor, Stockholm

Nina Vøllestad, Professor, Oslo

6 International evaluation panel

The external evaluation will be carried out by an international evaluation panel of independent high-level experts. The project coordinators will invite seven renowned scientists within the field of sport sciences. The panel comprises four representatives from the sports biology field and three representatives within the humanities and social and cultural sciences.

Chair

Professor William Haskell, Stanford University

Members

Professor Karyn Esser, University of Kentucky

Professor Peter Bärtsch, Heidelberg University

Professor Stuart Biddle, Loughborough University

Professor Jennifer Hargreaves, University of Brighton

Professor Ron Maugham, Loughborough University

Professor Bart Vanreusel, Katholieke Universiteit Leuven

7 Evaluation criteria

The two levels to be evaluated are 1) the country level (comparison between the five Nordic countries) and 2) the unit level (identifying strong and weak units and fields within a country). The evaluation is based on the evaluation documents submitted by the units. The panel members will have the opportunity to complete this information during the interviews with researchers.

The evaluation panel will be asked to give a written statement on all six points mentioned above as the objectives of this evaluation. Moreover, the evaluation should lead to the following two statements:

- Recommendations for developing sport sciences in the future, with special reference to Nordic collaboration
- Recommendations for organisations that provide funding to sport sciences research.

7.1 Focus and scattering of research

The evaluation panel should describe the focus and scattering of different scientific disciplines within sport sciences (e.g. which areas/disciplines make up the bulk of the research; if any areas/disciplines are totally absent) in the different Nordic countries.

7.2 Quality and status of research

Important issues to be considered:

- What is the international quality and status of sport sciences in the Nordic countries?
- Is the research in sport sciences creative, innovative and likely to produce new lines of thinking?
- Which research fields/areas are strong/ weak in each country?
- What are the differences between successful and non-successful fields/ areas?
- Which are the most successful research units/groups in each country?

7.3 Factors affecting quality

Strategic issues

- What is the quality of the research strategy of the unit?

Human resources (e.g. size and composition of research groups, multidisciplinarity, national and international cooperation)

- What is the level and quality of national collaboration?
- What is the level and quality of international (with special reference to Nordic) collaboration?
- ls the research environment in a position to provide an appropriate critical mass (intellectual environment) to the research?

- Do members of the unit participate in international exchange (visits)? Are there visits abroad and visits to the unit?

Research infrastructure

- Do the units consider their infrastructure as a special strength or weakness?

External funding

- What is the quality of funding (national, international, competitive, highly competitive)?
- What is the relevance of the funding attracted (national and international) to the research strategy of the unit?
- What is the amount of national and international funding attracted?

7.4 Funding systems in the Nordic countries

- Which are the main funding agencies?
- Is the funding allocated in the best possible way?

7.5 Links between research and societal applications

The evaluation panel is asked to give feedback on the interaction between research and societal (practical) applications. The main issue is not to communicate results to a general audience or to decision-makers, but to look for actual applications. The feedback should be based on all evaluation documents as well as on the interviews.

Important issues:

- Have the results been applied by communities, sports federations, hospitals, NGOs, etc. to e.g. enhance physical activity in the population or among specific groups?
- Have the researchers/units been involved in practical development projects, campaigns, etc. with an aim to apply research to solve practical problems?
- How is the communication to the general public handled?

7.6 Recommendations for the development of sport sciences

The evaluation panel is asked to provide recommendations for the future development of the research field. The panel will need to consider that the recommendations should be focused mainly on the country level, not on individual units, research groups or researchers.

The key issues to be addressed are:

- What are the recommendations for developing research and Nordic collaboration in the next 5/10/15 years?
- What are the recommendations for the research councils and other funding agencies of sport sciences? What would be an optimal funding system?

8 Panel tasks, responsibilities and working arrangements

In conducting the expert evaluation, the panel members will base their examination on desk research at home on the basis of the background information provided. Ultimately, this will supplement their views during the interviews in Denmark (incl. Iceland), Finland, Norway and Sweden.

The panel members will set responsibilities within the panel and together with the coordinators. All evaluation documents are provided by the evaluation office.

8.1 Desk research

Desk research will be carried out before the interviews. The material includes:

- Description of the unit (incl. number of personnel)
- Funding
- Research status and strategy (incl. publication data)
- Collaboration and mobility
- Self-assessment in the form of a SWOT analysis

8.2 Interviews

The data received from the units to be assessed will be completed by country-wide interviews, held in Copenhagen, Helsinki, Oslo and Stockholm. The main purpose of the interviews is to improve and confirm the evaluation at country level. The interviews are not meant to address the unit or research group level.

The members of the project and steering groups, together with the evaluation panel, will decide who will be invited to the national interview. The objective is to get a group representative of different fields/ focuses of sport sciences, different geographical areas, different kinds of units and researchers at different career stages. The anticipated number of invitees is 20–25 for each country. Fewer researchers (e.g. 5) are invited from Iceland to the interview in Oslo or Copenhagen.

The evaluation panel will decide on questions to be asked and the way the interview will be conducted (all invitees present throughout the day, researchers divided into biology and society-humanities or even into smaller groups). The chair of the evaluation panel also acts as the chair of the interview workshop. Minutes will be taken by the external coordinator who will attend all interviews. The project group members are responsible for the practical arrangements. Any travel costs of the participants will be covered by the commissioning organisations. The specific timetable and instructions to the participants will be provided by the coordinators in due time.

8.3 Confidentiality and secrecy

The panel members undertake not to make any use of or divulge to third parties any public or non-public facts, such as information, knowledge, documents or other material communicated to them or brought to their attention during the performance of the evaluation. Confidentiality must also be maintained after the evaluation process has been completed.

Documents sent to public authorities are public documents. Working papers, however, are not public until the process is completed.

8.4 Publicity of evaluation material

The evaluation and the ratings are not public and for official use of the commissioning organisations. Once the evaluation has been completed, panellists are required to return all documents to the evaluation coordinators. The evaluation report is not public and only for official use until publication. The evaluation report including the main recommendations is based on the evaluation criteria. The evaluation report will be written and edited by the panel members (main responsibility of the chair) with the help of the evaluation coordinator. Prior to final editing and publishing, the units being assessed are given the opportunity to review the report to correct any factual errors. The final evaluation report will be published by the Academy of Finland. There are also plans on writing a condensed version to be published as an article in a scientific journal. The chairs of the project and steering groups are responsible for the scientific paper.

8.5 Conflicts of interest

The panel members are required to declare any personal conflicts of interest. They must disqualify themselves if they can in any way benefit from a positive or a negative statement concerning the unit

under evaluation. They must also disqualify themselves in the following circumstances:

- If they have close collaboration with persons working at the unit to be evaluated (e.g. significant co-authorship in a scientific article, research plans or funding applications during the past three years, or are planning to co-author one/some of these in the near future).
- If they have acted as a superior, subordinate or instructor of persons or research groups at the unit during the past three years
- If a person working at the institution is a close person to them. A close person is:
  - their spouse (also *de facto*), child, grandchild, sibling, parent, grandparent or a person otherwise especially close to them (e.g. fiancé/e or a close friend), as well as their spouses (also *de facto*),
  - a sibling of their parent or his/her spouse (also *de facto*), a child of their sibling, their previous spouse (also de facto),
  - a child, grandchild, sibling, parent or grandparent of their spouse as well as their spouses (also *de facto*), a child of a sibling of their spouse,
  - or a half-relative comparable to the above mentioned.

Panel members are also disqualified if their impartiality may otherwise be questioned, or if they feel that they have a conflict of interest and are therefore disqualified to evaluate the research group.

Therefore, if a panel member feels unable to evaluate a research group, he/she must notify the external coordinator Riikka Pellinen as well as the other panel members as soon as possible. The clarification of all conflicts of interest must preferably be done during the first panel meeting. Any conflicts of interest will be referred to and included in the evaluation report.

8.6 Declaration

Accepting the task as a member of the evaluation panel, I guarantee not to disclose the information I receive as panel member and not to use it for anybody's benefit or disadvantage, as stipulated under the paragraph "Confidentiality and secrecy". Further, I affirm that if I have a conflict of interest, I will immediately inform the Academy of Finland as well as the other panel members of it and step aside.

9 Timetable of the evaluation

Preparation of Terms of Reference for the evaluation group, including definition and restriction of the field and the units to be evaluated	06–09/2010
Forming the evaluation panel (invitations, acceptance of invitation)	07–10/2010
Information and hearing: national workshop with researchers in sport sciences	08/2010
Plan and distribution of evaluation documents to participating research units	08–10/2010
Collecting data from participating units	11–12/2010
Preparation of material (based on collected data) for evaluation panel	01–02/2011
Desk research of data collected by project group (bibliographic information and data enquired from units to be evaluated)	03–04/2011
Preparation of local interviews with research units. Centralised national interviews; the panel will not do any sight visits.	04/2011
Interviews with research units	05/2011
Writing evaluation report	06–08/2011
Printing evaluation report	09/2011
Release, final seminar	10/2011

10 Coordination of evaluation

The evaluation process is operationally coordinated by the project group with a member from all commissioning organisations:

Mikael Fogelholm, Director (mikael.fogelholm@aka.fi)
Saara Leppinen, Senior Science Adviser (saara.leppinen@aka.fi)
Riikka Pellinen, Coordinator (riikka.pellinen@uef.fi)
Academy of Finland

Minna Paajanen, Planning Officer, Ministry of Education and Culture, Finland (minna.paajanen@minedu.fi)

Anne Christiansen, Head of Secretariat, Senior Adviser (anch@fi.dk)
Danish Agency for Science, Technology and Innovation

Hilde Grindvik Nielsen, Senior Adviser (hgn@rcn.no)
Division for Science, Department for Clinical Medicine and Public Health
Research Council of Norway

Johan Dixelius, Coordinator Medicine, Research Officer (johan.dixelius@vr.se)
Department of Planning and Coordination
Swedish Research Council

Magnus Lyngdal Magnusson, Head of Research and Deputy Director (magnus@rannis.is)
Division for Science and Innovation
RANNÍS – The Icelandic Centre for Research

Christine Dartsch, manager, Swedish National Centre for Research in Sports (christine.dartsch@gih.se)

11 Funding

The evaluation receives funding from NordForsk (72.9% of total costs, excl. researchers' travel costs to the interview) and partly from the commissioning organisations, according to a scheme presented in the grant application.

All travel expenses related to the evaluation panel's visits and accommodation will be covered or reimbursed. The panellists will receive a fee. All panel costs are covered from the NordForsk grant.

APPENDIX C. Evaluation questionnaire

International evaluation of sport sciences in the Nordic countries in 2006–2010

EVALUATION QUESTIONNAIRE

1 DESCRIPTION OF RESEARCH UNIT

Short description of research unit

Describe the research unit and the ongoing research briefly in your own words (name, strategy, research topics, mission, main infrastructure, research management, key persons). The maximum length is one page. Enclose two-page CVs for the mentioned key persons as a PDF file (Appendix 1).

Research unit in numbers

Enter the number of research FTEs in sport sciences for the given personnel groups in Table 1.

Table 1. Number of research FTEs in sport sciences for different personnel groups in the unit, 2006–2010

Personnel group	2006	2007	2008	2009	2010
Appointed professors (incl. associate professors)					
Other senior researchers (with PhD but not professors)					
PhD students [a]					
Other (e.g. researchers without PhD, technical staff)					

[a] PhDs working at the unit

2 FUNDING

In Table 2, enter the total amount of research funding (incl. internal and external funding) in euros (€) for sport sciences in the unit in the given years. Specify the proportion of funding from public sources, national private foundations, national industry and international sources, as a percentage of total funding. If the internal research funding cannot be estimated precisely, please give your best estimate.

Table 2. Funding for sport sciences from different sources, 2006–2010

Source of funding	2006	2007	2008	2009	2010
Total research funding – internal – external	 € €	 € €	 € €	 € €	 € €
Funding from public (**governmental**) funding sources (% of total external funding)	%	%	%	%	%
Funding from national private **foundations** (% of total external funding)	%	%	%	%	%
Funding from **national industry** (% of total external funding)	%	%	%	%	%
Funding from international sources (EU and other foreign organisations) (% of total external funding)	%	%	%	%	%

3 RESEARCH STATUS AND STRATEGY

Publications

Enter the number of different publications in the given years in Table 3. Give the number of PhD theses produced in the given year separately.

Table 3. Number of publications in sport sciences, 2006–2010

Publication type	2006	2007	2008	2009	2010
Original articles in international peer-reviewed journals					
Review articles in international peer-reviewed journals					
Other international articles					
Book chapters (international)					
Monographs (international) [a]					
Original articles in national peer-reviewed journals					
Review articles in national peer-reviewed journals					
Other national articles					
Book chapters (national)					
Monographs (national) [a]					
Doctoral theses					

[a] published by an acknowledged research publisher, excluding theses

In Table 4, list the ten most important publications during the evaluation period. Indicate persons from your unit by underlining the author's name. Provide copies of listed papers as PDF files (Appendices 2–11).

Table 4. Ten most important publications in sport sciences, 2006–2010

Authors	Title	Journal and publication data

4 COLLABORATION AND MOBILITY

Collaboration

List the three most important national and international research partners and the major aims of collaboration (e.g. publications, graduated PhDs, researcher visits etc.) in Tables 5 and 6.

Table 5. Main national partners in sport sciences

Person at unit	National partner (name of person)	Partner's university/ institution	Aims of collaboration

Table 6. Main international partner in sport sciences

Person at unit	International partner (name of person)	Partner's university/ institution	Aims of collaboration

Mobility

In Table 7, indicate the number of researcher visits (in sport sciences) to and from your unit in the given years. The minimum length of a visit is three months. As regards the present situation, only include visits of personnel who at least have an intention to return to your or their own unit.

Table 7. Number of visits in 2006–2010

	2006	2007	2008	2009	2010
Outside researchers visiting your unit					
Researchers of your unit visiting another unit					

5 SWOT ANALYSIS OF SPORT SCIENCES RESEARCH AT THE UNIT

In the table below, please analyse the main strengths and weaknesses (present situation) and opportunities and threats (in the future) of your unit. The number of items in each field is limited to five.

STRENGTHS 1. 2. 3. 4. 5.	**WEAKNESSES** 1. 2. 3. 4. 5.
OPPORTUNITIES 1. 2. 3. 4. 5.	**THREATS** 1. 2. 3. 4. 5.

6 ADDITIONAL REMARKS

Other information relevant to the evaluation, no more than half a page.

APPENDIX D. Researchers (listed by domain and country) participating in interviews

Basic and applied biological sciences

Norway

Leif Inge Tjelta	University of Stavanger (UiS)	Associate Professor
Jan Helgerud	Norwegian University of Science and Technology (NTNU)	Professor
Øyvind Ellingsen	Norwegian University of Science and Technology (NTNU)	Professor
Stephen Seiler	University of Agder (UiA)	Professor
Truls Raastad	Norwegian School of Sport Sciences (NSSS)	Professor
Jørgen Jensen	Norwegian School of Sport Sciences (NSSS)	Professor
Gøran Paulsen	Norwegian School of Sport Sciences (NSSS)	Postdoctoral researcher
Nils H Kvamme	Norwegian School of Sport Sciences (NSSS)	PhD student
Andi Weydahl	Finnmark University College	Associate Professor
Christian Frøyd	Sogn og Fjordane University College	PhD student

Finland

Jukka Viitasalo	Research Institute for Olympic sports (KIHU)	Professor
Janne Avela	University of Jyväskylä, Sports Biology	Professor
Mikko Tulppo	Department of Exercise and Sports Physiology (Verve)	Senior Scientist
Kari Kalliokoski	University of Turku, PET Centre	Senior Scientist
Juha Hulmi	University of Jyväskylä, Sports Biology	Postdoctoral researcher
Riikka Kivelä	University of Helsinki	Post-doc
Jussi Peltonen	University of Jyväskylä, Sports Biology	PhD student
Marja Päivinen	Helsinki Sports and Exercise Medicine Research Centre	PhD student

Sweden

Carl-Johan Olsson	Umeå University	Postdoctoral researcher, PhD in 2008
Christer Malm	Umeå University	Associate Professor, Head of Sports Medicine
Joakim Holmberg	Linköping university	PhD student
C. Mikael Matsson	Swedish School of Health and Sport Sciences	PhD in Physiology in 2011
Carl-Johan Sundberg	Karolinska Institutet	Associate Professor, group leader
Jessica Norrbom	Karolinska Institutet	Project Coordinator
Karin Henriksson-Larsen	Swedish School of Health and Sport Sciences	Professor and Vice-Chancellor
Hans-Christer Holmberg	Mid Sweden University	Professor in Sport Science
Marko Laaksonen	Mid Sweden University	Lecturer in Sport Science
Lina Lundgren	Halmstad University	PhD student
Katarina Steding	Lund University, University of Copenhagen	Postdoctoral research fellow

Denmark

Per Aagaard	University of Southern Denmark	Professor
Ulrik Frandsen	University of Southern Denmark	Senior Researcher
Joachim Nielsen	University of Southern Denmark	PhD Student
Martin Gram	Department of Biomedical Sciences, University of Copenhagen	PhD Student
Pascal Madeleine	Aalborg University	Professor
Uwe Kersting	Aalborg University	Senior Researcher
Niels H. Secher	Department of Anaesthesiology, Copenhagen University Hospital	Professor
Kristian Vissing	Department of Sport Science, Aarhus University	Senior Researcher
Jørgen Wojtaszewski	University of Copenhagen	Professor
Martin Thomassen	University of Copenhagen	Postdoctoral Researcher
Peter Krustrup/ P. Jens Bangsbo	University of Copenhagen	Senior/Researcher Professor

Medical and Health Sciences

Norway

Thomas Dillern	University of Nordland (UiN)	Associate Professor
Sindre M Dyrstad	University of Stavanger	Associate Professor
Kari Bø	Norwegian School of Sport Sciences	Professor
Roald Bahr	Norwegian School of Sport Sciences	Professor
Elin Kolle	Norwegian School of Sport Sciences	Postdoctoral researcher
Bjørge H Hansen	Norwegian School of Sport Sciences	PhD student
Paul Jarle Mork	Norwegian University of Science and Technology (NTNU), Department of Human Movement Science	Associate Professor/ Department Deputy
Vegard Fusche Moe	Sogn og Fjordane University College	Research Manager/ Scientist

Finland

Olli Heinonen	Sports Medicine Centres – Paavo Nurmi Centre	Professor/Director
Urho Kujala	University of Jyväskylä, Sports Medicine	Professor/Director
Tommi Vasankari	UKK Institute for Health Promotion Research	Director
Tuija Tammelin	LIKES – Foundation for Sport and Health Sciences	Senior Scientist
Tomi Mäkinen	National Institute for Health and Welfare	Postdoctoral Scientist
Mikaela von Bonsdorff	University of Jyväskylä, Gerontology Research Centre	Postdoctoral Scientist
Tuomo Tompuri	University of Eastern Finland	PhD student
Taina Rantanen	University of Jyväskylä, Gerontology	Professor/Director

Sweden

Sture Forsgren	Umeå University, Department of Integrative Medical Biology, Anatomy Section	Professor of Anatomy
Per Aspenberg	Linköping University, Department of Clinical and Experimental Medicine, Orthopaedics	Professor of Orthopaedics
Pernilla Eliasson	Linköping University, Department of Clinical and Experimental Medicine	PhD student
Jenny Jacobsson	Linköping University, Department of Medical and Health Sciences, Section of Social Medicine and Public Health	PhD student
Martin Hägglund	Linköping University, Department of Medical and Health Sciences	University Lecturer
Anna Bjerkefors	Swedish School of Health and Sport Sciences, Laboratory of Biomechanics and Motor Control	Postdoctoral researcher, University Lecturer
Sofia Ryman Augustsson	University of Gothenburg, Institute of Clinical Sciences, Orthopaedics	Visiting Lecturer
Ninni Sernert	University of Gothenburg, Institute of Clinical Sciences, Department of Orthopaedics	Associate Professor

Denmark

Per Hölmich	Arthroscopic Centre Amager	Professor/Director
Peter Magnusson	Bispebjerg Hospital, University of Copenhagen	Postdoctoral researcher
Abigail Mackey	Centre for Healthy Ageing, Institute for Biomedicine, Faculty of Health Sciences, University of Copenhagen	Senior Researcher
Rie Harboe Nielsen	Institute for Sports Medicine, Bispebjerg Hospital, University of Copenhagen	PhD student
Ewa Roos	University of Southern Denmark	Professor/Director
Birgit Juul-Kristensen	University of Southern Denmark	Senior Researcher
Jonas Bloch Thorlund	University of Southern Denmark	PhD student
Shellie Boudreau	Aalborg University	Postdoctoral researcher
Kristian Overgaard	Department of Sport Science, Aarhus University	Senior Researcher

Social and behavioural sciences

Norway

Kari Steen-Johnsen	Institute for Social Research (ISF)	Researcher II
Nils Alse Bergsgard	International Research Institute of Stavanger (IRIS)	Senior Researcher
Jorid Hovden	Norwegian University of Science and Technology (NTNU), Department of Sociology and Political Science	Professor
Jan Ove Tangen	Telemark University College	Professor
Gunn Engelsrud	Norwegian School of Sport Sciences (NSSS)	Professor
Matti Goksøyr	Norwegian School of Sport Sciences (NSSS)	Professor
Yngvar Ommundsen	Norwegian School of Sport Sciences (NSSS)	Professor
Marte Bentzen	Norwegian School of Sport Sciences (NSSS)	PhD student
Mari Kristin Sisjord	Norwegian School of Sport Sciences (NSSS)	Associate Professor

Finland

Taru Lintunen	University of Jyväskylä, Sports Pedagogy	Professor/Director
Hannu Itkonen	University of Jyväskylä, Sports Sciences	Professor/Director
Pasi Koski	University of Turku	Senior Researcher
Katja Borodulin	National Institute for Welfare and Health	Senior Researcher
Hanna Vehmas	University of Jyväskylä, Sports Sciences	Postdoctoral researcher
Marko Kantomaa	LIKES – Foundation for Sport and Health Sciences	Postdoctoral researcher
Elina Hasanen	University of Jyväskylä, Sports Sciences	PhD student
Jussi Turtiainen	University of Helsinki	PhD student

Sweden

Mikael Quennerstedt	Örebro University	Associate Professor
Inger Eliasson	Umeå University	University Lecturer
Matthis Kempe-Bergman	Stockholm University/Swedish School of Health and Sport Sciences	PhD student
Suzanne Lundwall	Swedish School of Health and Sport Sciences	University Lecturer
Marie Hedberg	Linnaeus University	PhD student
Helena Tolvhed	Malmö University/Stockholm University	University Lecturer
Bo Carlsson	Malmö University	Professor
Joakim Åkesson	Malmö University	PhD student
Urban Johnson	Halmstad University	Professor

Denmark

Bjarne Ibsen	Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark	Professor/Director
Kirsten Kaya Roessler	Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark	Senior Researcher
Jasper Schipperijn	Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark	Postdoctoral researcher (defence 0–4 years ago)
Maja Kærup Pilgaard Jensen	Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark	PhD student
Ask Vest Christiansen	Department of Sport Science, Aarhus University	Senior Researcher
Helle Winther	Department of Exercise and Sports Sciences, University of Copenhagen	Senior Researcher
Laila Ottesen	Department of Exercise and Sports Sciences, University of Copenhagen	Senior Researcher

Iceland (all domains)

Erlanger Johansson	University of Iceland	Professor
Kristjan Tor Magnusson	University of Iceland	PhD student

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This report presents the results of an international evaluation of sport sciences in the Nordic countries in 2006–2010. The evaluation covered altogether 97 units performing sport sciences-related research at universities, hospitals or research institutes in the Nordic countries.

The objective of the evaluation was to obtain a general understanding of the status of sport sciences in each Nordic country and the region as a whole. The evaluated subject areas included basic and applied biological sport sciences, sports medicine, sport sciences in health and disease, and humanistic and social sport sciences. The evaluation was conducted by an international evaluation panel.

NORIA-net "Nordic evaluation of Sport Sciences"

Ministry of Education and Culture

The Research Council of Norway

Ministry of Science Technology and Innovation

Centrum för idrottsforskning

Vetenskapsrådet

ACADEMY OF FINLAND

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