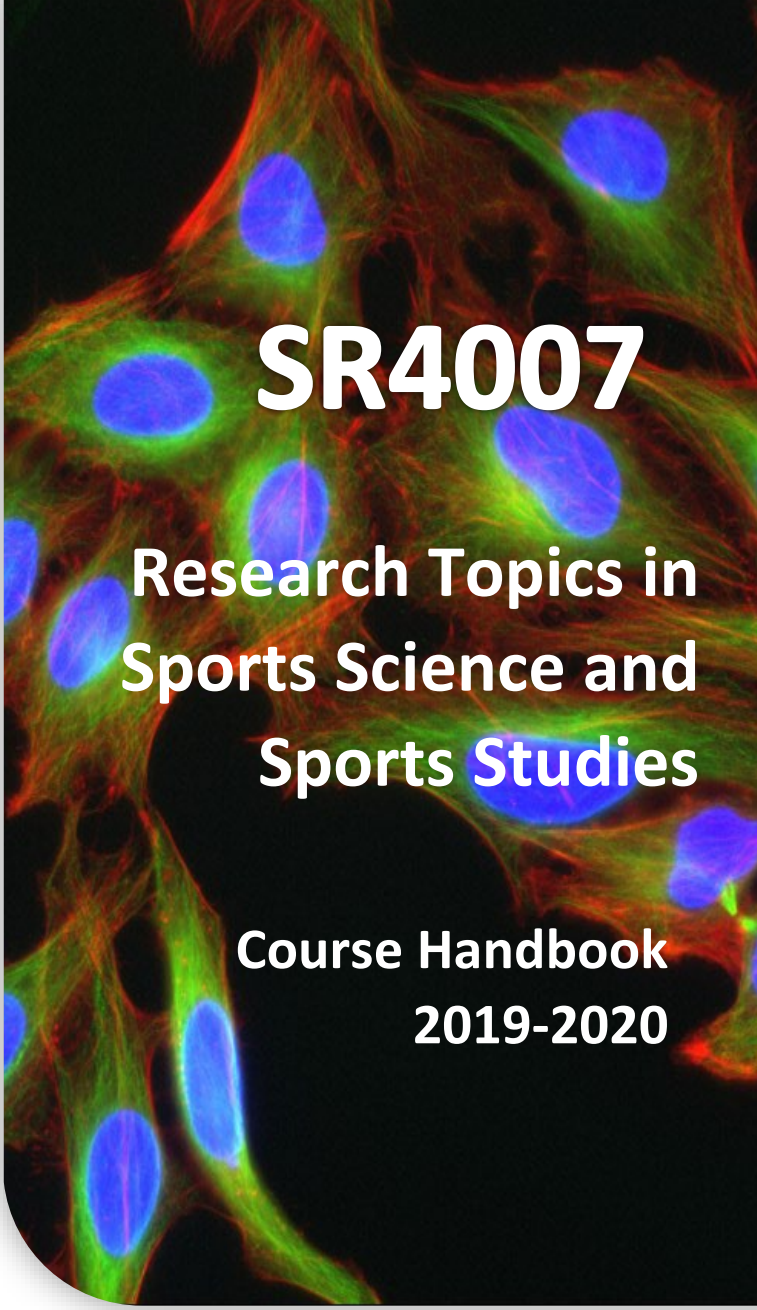
School of Medicine, Medical Sciences & Nutrition



SR4007

Research Topics in Sports Science and Sports Studies

Course Handbook
2019-2020

UNIVERSITY OF ABERDEEN

Contents

Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences University
of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology

Course Summary

This course provides a detailed coverage of research topics in Sport Science and Exercise and Health Science. It will emphasise different factors, which contribute to overall health, sport, exercise performance, and consider any relevant adaptations that occur in response to different types of training. It will include a detailed consideration of seven research topics, and focus on the factors particular to each.

Course Co-ordinator: Dr Derek Ball (ext. 7456) derek.ball@abdn.ac.uk

Course Aims & Learning Outcomes

To enable students to be able to:

- Demonstrate relevant literature search skills and techniques.
- Demonstrate relevant presentation skills and techniques.
- Demonstrate relevant writing and abstract preparation skills.
- Demonstrate critical thinking and analysis of scientific papers
- Develop a detailed understanding of research topics and literature relevant to Sports Science and Exercise and Health in areas of physiology, nutrition, exercise, health, fitness and performance.

Other topics will be included to reflect the up-to-date research interests within the School of Medical Sciences.

Course Teaching Staff

Course Co-ordinator(s):
Dr Derek Ball (DB), Medical Sciences

Other Staff:
Ms Mel Bickerton (MB), Med Lib

Dr Jenny Gregory, (JG), Medical Sciences

Professor Alison Jenkinson (AMJ), Medical Sciences

Dr Nimesh Mody (NM), Medical Sciences

Dr Michael E Scholz (MES), Medical Sciences

Professor Derek Scott (DAS), Medical Sciences

Dr Derryck Shewan (DS), Medical Sciences

Assessments & Examinations

Students are expected to attend all lectures, tutorials, and presentation sessions and to complete all class exercises by stated deadlines. It is imperative that any reasonable excuses for the late handing in of work are made to the course organiser (Dr Derek Ball) before the deadline date. Otherwise the work will not be marked and the class certificate, which is required to sit the examination, may be withheld. The minimum performance acceptable for the granting of a class certificate is attendance at all the presentation sessions, and presentation of all set course work, both written and oral.

Continuous assessment: 30% of the course assessment is based on material to be submitted and/or presented during the course. Each student will complete the following continuous assessments: one oral presentation, two questioning the presenter and three abstracts. Continuous assessments will thus be divided as: a grade for the oral presentation 25% and questioning (2*12.5%) and separate grades for the two best written assignments (50%). Oral presentations will be recorded using Panopto, however, these recordings will only be made available to the external examiner.

Written Examination: 70% of the course assessment is based on one three-hour written paper. Students will answer **three** essay questions from a choice of **six**.

Common grading scale (CGS) grade: The overall performance of the student is expressed as a grade awarded on the common spine marking scale (see attached sheet).

The degree examination for this course will be held in the May/June examination diet.

Class Representatives

We value students' opinions in regard to enhancing the quality of teaching and its delivery; therefore in conjunction with the Students' Association we support the Class Representative system.

In the School of Medical Sciences, we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the class, representative system visit **www.ausa.org.uk** or email the VP Education & Employability **vped@abdn.ac.uk**. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: **www.abdn.ac.uk/careers**.

Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with, alone they should notify the course coordinator immediately. If the problem relates to the subject matter general, advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (**medsci@abdn.ac.uk**) in the School Office (based in the Polwarth Building, Foresterhill), or Mrs Sheila Jones (**s.jones@abdn.ac.uk**) in the Old Aberdeen office associated with the teaching laboratories, to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

Lecture Synopsis

All teaching will take place at the University's Medical School site. In each of the following modules, each class member will be assigned to cover one of the listed topics. A short presentation on this topic should be prepared for the seminar session on the last day of the module. This should be planned to last not more than 10 min and should include suitable visual aids. All members of the class and the Module Tutor will be expected to contribute to this discussion. The aim of the presentation is to begin the discussion by highlighting the key areas. A brief written summary (abstract) of the topic (not to exceed one A4 page) should be prepared and submitted online through TurnitinUK on the SR4007 MyAberdeen course page by 2.30pm, on either the Monday or Wednesday, of each module as indicated in the timetable. This should highlight the key issues to be covered. Electronic copies of all original abstracts will be posted on MyAberdeen at the end of the course.

Module 1: Nutrition – Prof A Jenkinson

Module 2: Sport & Exercise Pharmacology - Prof D Scott

Module 3: Satellite Cells – Dr M Scholz

Module 4: Exercise, Inflammation and Cardiovascular Health - Dr N Mody

Module 5: Mechanisms of fatigue – Dr D Ball

Module 6: Applied Physiology – Dr M Scholz/Dr J Gregory

Module 1

Nutrition

Tutor: Prof A Jenkinson

Learning Outcomes

To understand the role of nutrition in high performance level and consider how specific nutrients might enhance performance. Specifically, to:

1. Understand the effects of macronutrient intake on elite performance
2. Understand the effects of micronutrient intake on elite performance
3. To assess whether different forms of nutritional supplementation can affect health or performance.

Topics to be discussed in detail:

1. Power athletes and protein requirements
2. Iron depletion in athletes
3. Caffeine and sports performance or health
4. Bicarbonate or citrate loading – effects on sports performance
5. HMB (β-hydroxy- β- methylbutyrate) and sports performance or health
6. Glutamine supplementation and sports performance or health 7. Fatty acid supplementation and sports performance or health
8. Vitamin D – a cause for concern for athletes?

Reading list

General Reading:

- Clinical Sports Nutrition by Louise Burke and Vicki Deakin 5th edition, 2015. ISBN 9781743073681

Research papers and related material

- Campbell B et al, International Society of Sports Nutrition position stand: protein and exercise. . J Int Soc Sports Nutr. 2007, 4-8
- Cannell JJ, Hollis BW, Sorenson MB, Taft TN, Anderson JJ. Athletic performance and vitamin D. Med Sci Sports Exerc. 2009 May; 41(5):1102-10. Ivy, JL et al Early post exercise muscle glycogen recovery is enhanced with a carbohydrate-protein supplement J Appl Physiol 2002 93: 1337-1344
- Maughan RJ, Greenhaff PL, Hespel P. Dietary supplements for athletes: emerging trends and recurring themes. J Sports Sci. 2011; 29 Suppl 1:S57-66.
- McClung JP. Iron status and the female athlete. J Trace Elem Med Biol. 2012 Jun;26(2-3):124-6
- Pickering C, and Kiely J. Are the Current Guidelines on Caffeine Use in Sport Optimal for Everyone? Inter-individual Variation in Caffeine Ergogenicity, and a Move Towards Personalised Sports Nutrition. Sports Med 2017
- Powers S, Nelson WB, Larson-Meyer E. Antioxidant and Vitamin D supplements for athletes: sense or nonsense? J Sports Sci. 2011; 29 Suppl 1:S47-55.
- Spriet, LL (2014) Recent advances in sports nutrition. Sports Med. 2014, 44 Supplement 1:1-111.
- Spriet, LL (2014) Nutrition for training and performance. Sports Med. 2014, 44 Nov Supplement 2:113-194.
- Wilson J, Wilson GJ. Contemporary issues in protein requirements and consumption for resistance trained athletes. J Int Soc Sports Nutr. 2006 Jun 5; 3:727.

Module 2

Sport & Exercise Pharmacology

Tutor: Prof D Scott

Learning Outcomes

In recent years, drug and supplement use have increased substantially in athletes and patients, so an understanding of how these substances affect their health and exercise capacity is essential. We need to understand how certain drugs might impact on exercise capability and performance and thus, recommend the best forms of exercise for a person taking medication. Since some medications can be viewed as “performance-enhancing”, it also allows us to know when medications can be reasonably taken by athletes to treat a condition before it could be considered that they are receiving an unfair advantage.

This module aims to provide a brief introduction to how some of the more commonly prescribed drugs can affect exercise performance in patients and athletes. Students will receive some basic instruction in pharmacology, and we will mainly focus on drugs acting

upon the cardiovascular and respiratory systems. We will NOT be considering steroids in this module.

Topics to be included are:

1. Outline of the most commonly-used and abused drugs in cardiovascular and respiratory disease.
2. Who decides which drugs can be used to treat patients and athletes?
3. How do drugs affect physical activity in patients?
4. How do drugs affect physical activity in athletes?
5. How can exercise change the effect of drugs?
6. How can exercise reduce the need for drug therapy for many chronic medical conditions?

Topics to be discussed in detail:

1. What are the challenges of using heart rate as a measure of exercise intensity/capacity in patients taking cardiovascular drugs?
2. Do certain types of sports have higher rates of abuse of certain prescription drugs than others?
3. Define a general exercise and drug regime for a white, male, 24 year old student who has had a blood pressure of 150/90mmHg for a period of several months. Provide experimental or peer-reviewed evidence for your regime.
4. Define a general exercise and drug regime for a black, female, 60 year old doctor who has had a blood pressure of 150/90mmHg for a period of several months and arthritis that causes her severe pain. Provide experimental or peer-reviewed evidence for your regime.
5. What advice regarding exercise, training and medication would you give to a professional triathlete who says they are asthmatic?
6. Using the some of the prescription drugs discussed in the lecture, explain who decides on what is legal to use by athletes during sports events and what the legislation is regarding these medications. You should give some explanation of how athletes prove that they really require drug treatment for a medical condition and are not cheating.
7. Physical activity and cardiovascular drugs in patients
8. Physical activity and respiratory drugs in patients
9. Discuss the effects of diuretics on exercise performance.

<u>Reading list</u>

General Reading:

- Kayne, S.B. (2006) Sport and exercise medicine for pharmacists. London: Pharmaceutical Press.
- Reents, S. (2000) Sport and exercise pharmacology. Champaign, IL: Human Kinetics.

Reviews:

- Davis, E., Loiacono, R., Summers, R.J. (2008) The rush to adrenaline: drugs in sport acting on the beta-adrenergic system. Br J Pharmacol. 154(3):584-97.
- Skinner, J.S., Cooper, A., Feder, G.S.; Guideline Development Group. (2007) Secondary prevention for patients following a myocardial infarction: summary of NICE guidance. Heart. 93(7):862-4.
- Ellender, L., Linder, M.M. (2005) Sports pharmacology and ergogenic aids. Prim Care. 32(1):277-92.
  Niedfeldt, M.W. (2002) Managing hypertension in athletes and physically active patients. Am Fam Physician. 66(3):445-52. Summary for patients in: Am Fam Physician. 2002 Aug 1;66(3):457-8.
- Pescatello, L.S., Franklin, B.A., Fagard, R., Farquhar, W.B., Kelley, G.A., Ray, C.A.; American College of Sports Medicine. (2004) American College of Sports Medicine position stand. Exercise and hypertension. Med Sci Sports Exerc. 36(3):533-53.
- Anderson, S.D., Sue-Chu, M., Perry, C.P., Gratziou, C., Kippelen, P., McKenzie, D.C., Beck, K.C., Fitch, K.D. (2006) Bronchial challenges in athletes applying to inhale a beta2-agonist at the 2004 Summer Olympics. J Allergy Clin Immunol. 117(4):76773. Epub 2006 Mar 3.
- Alaranta, A., Alaranta, H., Helenius, I. (2008) Use of prescription drugs in athletes. Sports Med. 38(6):449-63.

Students who wish to find out more about the official guidelines on how we treat patients who suffer from asthma and cardiovascular problems can access them at www.sign.ac.uk. SIGN (and other organisations such as NICE in England and Wales) review all of the available information to determine what the most effective treatments are for various conditions. The references at the end of the guidelines may be very useful to you. Please note that some of these guideline documents are very large, so avoid printing the whole document. Some of them have summary statements and diagrams that can simplify things for you.

Module 3

Satellite cells: muscular stem cells in sport, exercise and regeneration

Tutor: Dr M Scholz

The adult muscle is terminally differentiated, multinucleated and mitotically inactive. Adult skeletal muscle cells are in the G0-Phase of the cell cycle and incapable of re-entering the cell cycle and starting to proliferate again.

Satellite cells are stem cells of the adult muscle, resting inactively between the muscle fibre and the basal lamina. They are activated by exercise, overload or injury. Once activated, they start to proliferate and, after some cycles of division, they differentiate and fuse to the existing myotubes and to each other.

A small proportion becomes quiescent again and replenishes the stem cell pool. Reduced activity and numbers of satellite cells are related to atrophy and ageing. Thus, they are important for maintenance, growth (hypertrophy) and regeneration of the muscle during sport and exercise, diseases or injury.

Learning Outcomes

To understand the role of satellite cells in sport, exercise and regeneration. More specifically, to investigate:

1. Understand the cell cycle and its regulation in stem cells.
2. Understand what stem cells are, and how are they characterised.
3. Understand what muscle satellite cells are.
4. Understand the concept of the myonuclear domain.
5. Assess the importance of satellite cells in muscle regeneration and maintenance.
6. Assess the importance of satellite cells in exercise-induced adaptation and muscle hypertrophy.
7. Understand regulation of satellite cells under different conditions

Topics to be discussed in detail:

1. What makes a satellite cell a satellite cell?
2. Satellite activation, control and self-renewal – why do we not run out of muscle stem cells?
3. Myonuclear domains in muscle adaptation
4. Satellite cells and hypertrophy.
5. Satellite cells and doping – steroid effects and testosterone
6. Satellite cells, atrophy and aging
7. Satellite cells, hypertrophy and hyperplasia – an ongoing controversy
8. Stem cells: regulation of cell cycle – “awakening”, proliferation, differentiation

<u>Reading list</u>

Research papers and related material

- Allen, D. L., Roy, R. R. and Edgerton, V.R. (1999) “Myonuclear domains in adaptation and diseases”. Muscle Nerve 22: 1350–1360
- Bischoff, R. (1990). "Cell cycle commitment of rat muscle satellite cells." J Cell Biol 111: 201-207.
- Chen,Y., Zajac J. D. and MacLean, H. E. (2005) “Androgen regulation of satellite cell function.” Journal of Endocrinology 186: 21–31
- Collins, C. A., Olsen, I., Zammit, P. S., Heslop, L., Petrie, A., Partridge, T. A. and Morgan, J. E. (2005) “Stem Cell Function, Self-Renewal, and Behavioral Heterogeneity of Cells from the Adult Muscle Satellite Cell Niche” Cell 122: 289-301.

- Cossu, G. and Tajbakhsh, S. (2007) “Oriented Cell Divisions and Muscle Satellite Cell Heterogeneity” Cell 129: 859-861
- Gallegly, J. C., Turesky, N. A., Strotman, A. S., Gurley, C. M., Peterson C. A. and Dupont-Versteegden E. E. (2004) “Satellite cell regulation of muscle mass is altered at old age”, J Appl Physiol 97: 1082–1090
- Hawke, T. J. and Garry, D. J. (2001) “Myogenic satellite cells: physiology to molecular biology.” J Appl Physiol 91: 534–551
- Kadi, F., Ericsson, A., Holmner, S., Butler-Browne, G. S. and Thornell, L. E. (1999). "Cellular adaptation of the trapezius muscle in strength-trained athlets." Histochem Cell Biol 111: 189-195.
- Kadi, F., Schjerling, P.,Andersen, L. L., Charifi, N., Madsen, J. L. Christensen L. R. And Anderson, J. L. (2004) “The effect of heavy resistance training and detraining on satellite cells in human skeletal muscle” J Physiol 558(3): 1005-1012
  Kadi, F. (2008) “Cellular and molecular mechanisms responsible for the action of testosterone on human skeletal muscle. A basis for illegal performance enhancement” British Journal of Pharmacology 154: 522–528
- Pardee, A. B. (1989). "G1 events and regulation of cell proliferation." Science 246: 603-608
- Potten, C. S. und Loeffler, M. (1990). "Stem cells: Attributes, cycles, spirals, pitfalls and uncertainties." Development 110(4): 1001-1020.
- Roy, R. R., Monke S.R., Allen D.L. and Edgerton V. R. (1999) “Modulation of myonuclear number in functionally overloaded and exercised rat plantaris fibers”. J. Appl. Physiol. 87(2): 634–642
- Seale, P., Luc A. Sabourin, L. A., Girgis-Gabardo, A., Mansouri, A., Gruss, P. and Rudnicki, M. A. (2000) “Pax7 Is Required for the Specification of Myogenic Satellite Cells” Cell 102: 777–786
- Seale, P. and Rudnicki, M. A. (2000) “A New Look at the Origin, Function, and “StemCell” Status of Muscle Satellite Cells” Developmental Biology 218: 115–124
- Smith, H. K., Maxwell, L., Rogers, C. D., McKee, N. H. and Plyley, M. J. (2001) “Exercise-enhanced satellite cell proliferation and new myonuclear accretion in rat skeletal muscle” J Appl Physiol 90: 1407–1414
- Zammit, P.S. and Beauchamp, J. R. (2001) “The skeletal muscle satellite cell: stem cell or son of stem cell?” Differentiation 68:193–204

Module 4

Exercise, Inflammation and Cardiovascular Health

Tutor: Dr N Mody

Learning Outcomes

To understand the role of physical activity/exercise in reducing markers of chronic low grade inflammation, thus improving cardiovascular health. More specific outcomes are to:

1. Consider the burden of excess adiposity
2. Assess the importance of fat depot location
3. Understand the role of inflammatory cytokines in cardiovascular health
4. Investigate the effect of exercise on these cytokines
5. Analyse the importance of exercise intensity in health

Topics to be discussed in detail:

1. The role of TNF-alpha and IL-6 in metabolic health - circulating markers of systemic inflammation have been shown to predict future cardiovascular disease. TNF-alpha and IL-6 from multiple tissues and cell types e.g. macrophages, adipocytes and skeletal muscle, play a complex role in regulating inflammation and insulin sensitivity. Discuss.
2. The role adiponectin in metabolic health - adiponectin is hormone secreted mainly by adipose tissue, but its levels are inversely proportional to adiposity. Studies have shown that adiponectin administration in humans and rodents has insulin-sensitizing, anti-atherogenic, and anti-inflammatory effects. Discuss.
3. The role leptin in metabolic health - leptin is an adipose secreted hormone first implicated in the regulation of food intake, energy expenditure and metabolism. However, leptin has also been shown to have a myriad of other effects in many tissues. How can changes in circulating leptin levels directly affect the cardiovascular system.
4. The effect of exercise on chronic low-grade inflammation - There is no doubt that physical activity/training offers protection against and is effective in the treatment of heart disease and diabetes. Public health recommendation: that we participate in 30 mins moderate intensity exercise, 5 times a week. Describe how epidemiological (human observation) studies and intervention studies have offered lots of evidence (typically changes in systemic inflammatory/anti-inflammatory markers TNF-alpha, IL-6, CRP and IL-10) and also provide critical analysis of how they have characteristic deficits associated with them.
5. The effect of exercise intensity on chronic low grade inflammation and metabolic health - low intensity exercise, moderate intensity aerobic exercise and high-intensity training (HIT) offer different opportunities to increase physical activity but it has been difficult to dissect the beneficial effects of distinct exercise regimens to ameliorate chronic low grade inflammation in cardiovascular disease independently of body weight loss, fat loss or improvements in glucose homeostasis. Discuss.

<u>Reading list</u>

Research papers and related material

Body mass index, adiposity, subgroups, caveats and paradoxes

- Deurenberg-Yap M, Deurenberg P. *Nutr Rev.* 2003 May;61 (5 Pt 2) : S80-7. **http://onlinelibrary.wiley.com/doi/10.1301/nr.2003.may.S80-S87/epdf**
- Bowman K, Atkins JL, …… Ferrucci L, Melzer D. 2017 Jul; *Am J Clin Nutr.* 106(1):130-135. doi: 10.3945/ajcn.116.147157.

Portal theory (visceral fat, increased free fatty acid)

- Björntorp P. Arteriosclerosis. 1990 Jul-Aug;10(4) :493-6. http://atvb.ahajournals.org/content/10/4/493.long
- Lafontan M, Girard J. *Diabetes Metab.* 2008 Sep;34(4 Pt 1) :317-27.

Chronic low-grade inflammation and inflammatory cytokines in cardiovascular health / the anti-inflammatory effect of exercise.

- Petersen AM, Pedersen BK.; 2005 Apr *J Appl Physiol.* 98(4):1154-62. PMID: 1577205
- Pedersen BK, Bruunsgaard H. 2003 *Scand J Med Sci Sports.* 13(1):56-62. PMID: 12535318.
- Bruunsgaard *J Leukoc Biol* 2005 78:819-835; doi:10.1189/jlb.0505247

These three are reviews on the anti-inflammatory effect of exercise.

TNF-alpha

- Hotamisligil GS, et al Science. 1993 Jan 1;259(5091) :87-91.
- Bhagat K, Vallance P. Circulation. 1997 Nov 4;96(9) :3042-7.
- Osborn L, Hession C, Tizard R, Vassallo C, Luhowskyj S, Chi-Rosso G, Lobb R. Cell. 1989 Dec 22;59(6):1203-11. PMID: 2688898
- MacHaul KL, Hutchinson NI. Biochem Biophys Res. Comm. 1993 Nov 15;196(3) :1330-4.
- Schreyer SA, et al J Biol Chem. 1996 Oct 18;271(42) :26174-8.
- Zhang H, Park Y, …… Dellsperger KC, Zhang C. Clin Sci (Lond). 2009 Feb;116(3):219-30. doi: 10.1042/CS20080196. Review.
- Gao X, Belmadani S, Picchi A, Xu X, Potter BJ, Tewari-Singh N, Capobianco S, Chilian WM, Zhang C. Circulation. 2007 Jan 16;115(2):245-54. PMID: 17200442

IL-6 (and interaction with TNF-α)

- Mohamed-Ali V, et al. *J Clin Endocrinol Metab.* 1997 Dec;82(12) :4196-4200.
- Carey AL, Febbraio MA. Diabetologia. 2004 Jul;47(7) :1135-42.

J Tzoulaki I,……Foukes FG. *Circulation*. 2005 Aug 16;112(7) :976-83. Fontana L,……Klein S. *Diabetes*. 2007 Apr;56(4):1010-3.

PMID: 17287468 Fried SK, Bunkin DA, Greenberg AS. Clin Endocrinol Metab.1998 Mar;83(3):847-50. PMID: 9506738 Fain JN, Madan AK, Hiler ML, Cheema P, Bahouth SW.
Endocrinology. 2004 May;145(5):2273-82. PMID: 14726444

- Mauer J, Chaurasia B, ……Wunderlich FT, Brüning JC. Nat Immunol. 2014 May;15(5):423-30. doi: 10.1038/ni.2865. PMID: 24681566
- Steensberg A, Fischer CP, …… Febbraio MA, Pedersen BK.
  J Physiol. 2003 Apr 15;548(Pt 2):631-8. PMID: 12640021

Wallenius V, et al Nat Med. 2002 Jan;8(1) :75-9.

Leptin

- Tartaglia LA, et al Cell. 1995 Dec 29;83(7) :1263-71. Frühbeck G, et al FASEB J. 2001 Feb;15(2):333-40 Zhang Y, et al Nature. 1994 Dec 1;372(6505):425-32. Halaas JL, et al Science. 1995 Jul 28;269(5223):543-6
- Farooqi IS, et al J Clin Invest. 2002 Oct;110(8):1093-103
- Farooqi IS, et al Nature. 2001 Nov 1;414(6859):34-5.
- Van Heek M, et al J Clin Invest. 1997 Feb 1;99(3):385-90.
- Steinberg GR, et al Am J Physiol Endocrinol Metab. 2002;283(1):E187-92 Knudson JD, et al Am J Physiol Heart Circ Physiol. 2005 Jul;289(1):H48-56. Rainwater DL, et al Atherosclerosis. 1997 Jul 25;132(2):237-43.

Adiponectin

- Berg AH, Combs TP, Du X, Brownlee M, Scherer PE. Nat Med. 2001 Aug;7(8):947-53. PMID: 11479628
- Combs TP, Berg AH, Obici S, Scherer PE, Rossetti L.
- J Clin Invest. 2001 Dec;108(12):1875-81. PMID: 11748271 Fruebis J, Tsao TS, …… Bihain BE, Lodish HF.
- Proc Natl Acad Sci U S A. 2001 Feb 13;98(4):2005-10. PMID: 11172066 Maeda N, Shimomura I, …… Funahashi T, Matsuzawa Y.
  Nat Med. 2002 Jul;8(7):731-7. PMID: 12068289
- Holland WL, Miller RA, …… Birnbaum MJ, Summers SA, Scherer PE.
  Nat Med. 2011 Jan;17(1):55-63. doi: 10.1038/nm.2277. PMID: 2118636
  Tao L, Gao E, …… Goldstein BJ, Ma XL.
  Circulation. 2007 Mar 20;115(11):1408-16. PMID: 17339545
  Chen H, Montagnani M, Funahashi T, Shimomura I, Quon MJ
  J Biol Chem. 2003 Nov 7;278(45):45021-6. PMID: 12944390
  Okamoto Y, Kihara S, ……, Funahashi T, Matsuzawa Y.
  Circulation. 2002 Nov 26;106(22):2767-70. PMID: 12451000

 Shibata R, Sato K, ……, Ouchi N, Walsh K.

Nat Med. 2005 Oct;11(10):1096-103. PMID: 16155579

- Shibata R, Ouchi N, Murohara T.
- Circ J. 2009 Apr;73(4):608-14. Review. PMID: 19261992
- Vaiopoulos AG, Marinou K, Christodoulides C, Koutsilieris M.
- Int J Cardiol. 2012 Mar 8;155(2):188-93. doi: 10.1016/j.ijcard.2011.07.047. Review.

Exercise

- Haskell WL, et al Med Sci Sports Exerc. 2007 Aug;39(8):1423-34.
- Goldhammer E, et al Int J Cardiol. 2005 Apr 8;100(1):93-9.
- Dekker MJ, et al Metabolism. 2007 Mar;56(3):332-8.
- Kohut ML, et al Brain Behav Immun. 2006 May;20(3):201-9.
- Starkweather AR. Biol Res Nurs. 2007 Jan;8(3):186-94.
- Gray SR, et al Prev Med. 2009 Jan;48(1):39-44.
- Burgomaster KA, et al J Appl Physiol. 2005 Jun;98(6):1985-90.
- Babraj JA, et al BMC Endocr Disord. 2009 Jan 28;9:3.

Module 5

Limitations to physical capacity and exercise as a consequence of fatigue

Tutor: Dr Derek Ball

Learning Outcomes

The overarching theme for this topic is to explore the concept of fatigue in relation to muscle and nerve function. It will examine whether the fatigue experienced by an athlete is mainly a central signal generated in the CNS, or a peripheral failure of motor nerves and/or muscle fibres in their attempt to continue function appropriately to entirely normal CNS signals. The content will range from the phenotype of muscle fibre types related to their contractile and metabolic profile, central control of motor unit recruitment, normal synaptic function and reflexes, the metabolic processes activated to meet ATP turnover, the accumulation of by-products of metabolism and substrate depletion.

At the end of the presentations on all the topics, you will have an understanding of:

1. Muscle fibre type and myosin expression determine the contractile characteristics.
2. The importance of the CNS in the control of movement.
3. The importance of reflexes in the control of movement.
4. Neuromuscular transmission and muscle contraction in different fibre types.
5. How the elements of muscle recruitment, muscle energetics contribute to and are affected by fatigue.

6. Explore other aspects of fatigue that are not directly related to muscle metabolism for example, cardiac function as a consequence of prolonged sustained activity.

Topics to be discussed in detail:

1. A sprint athlete decides to complete a bout of resistance exercise consisting of 4 sets of 10 repetitions with a weight equal to 90% of their one rep maximum and finds that they can only complete one set before fatiguing, explain the possible underlying mechanism(s) of fatigue.

2. An elderly patient attends a clinic at your surgery, although they appear frail, they have little problems in walking into your office. However, they require your help to get them from a sitting to standing position; discuss the reasons why they appear to be able to complete locomotion but cannot generate the required power to lift their own body mass.

3. An athlete has entered the Marathon des Sables and based on their training (with temperatures of 20°C) they plan to run at a pace of 4:00 min/km. On the first day they find they can run only at a pace of 4:30 min/km, the average temperature is 40°C, discuss the impact of the environmental stress on neuromuscular performance.

4. A father attends their child's sports day at school and is talked into completing the parents race of 1 lap of the track (400 m). Wishing to impress his child the father sprints off at the start but halfway begins to rapidly fatigue to the point of feeling nauseated, explain the possible mechanisms for the inability to maintain sprinting speed.

5. During the course of an intense period of training, a middle-distance athlete (5000m) observes that after a day's rest they can complete the first day of training but by day 5 they feel constantly heavy legged. Their coach notices that they rarely consume any food before, during or after training. Discuss the possible mechanism(s) for the inability to maintain their training load.

<u>Reading list</u>

Research papers and related material

- Fatigue versus activity-dependent fatigability in patients with central or peripheral motor impairments. Dobkin BH (2008) Neurorehabil Neural Repair 22:105-110. Review.
- Clinical neurophysiology of fatigue. Zwarts MJ, Bleijenberg G, van Engelen BG. (2008) Clin Neurophysiol. 119:2-10. Review
- Is fatigue all in your head? A critical review of the central governor model.Weir JP, Beck TW, Cramer JT, Housh TJ. (2006) Br J Sports Med. 40:573-586. Review.
- Molecular regulation of individual skeletal muscle fibre types. Spangenburg EE, Booth FW. (2003) Acta Physiol Scand. 178:413-424. Review.
- Cellular mechanisms of fatigue. Fitts RH (1994) Physiol Reviews 74:49-94. Review.

- Metabolic and endocrine response to exercise: sympathoadrenal integration with skeletal muscle. Ball D (2015) J Endocrinol. 224:79-95. Review
- Knicker AJ, Renshaw I, Oldham AR, Cairns SP. Interactive processes link the multiple symptoms of fatigue in sport competition. Sports Med. 2011 41:307-28. Review

Module 6

Applied Physiology

Tutor: Dr M Scholz/J Gregory

Learning Outcomes

Establish the link between fundamental physiology and experiments and measurements to assess characteristics and performance of organ systems important for exercise. The neuromuscular system and endurance will be the main focus.

Topics to be discussed in detail

1. Mechanical components of the skeletal muscle - Passive versus active force production
2. Dependencies of muscle force and power
3. Dependencies of muscle contraction velocity
4. Cross innervation and its influence on fibre types
5. Endurance fitness – direct versus indirect assessment
6. Measurements to assess neuro-muscular performance – direct assessments
7. Assessment of muscle performance – 1 rep max, MVF production
8. Assessment of neuro-muscular performance using stimulation
9. Comparison of contraction types
10. Determinants of endurance
11. Skeletal muscle fibre type determination

<u>Reading list</u>

- Skeletal Muscle (2nd Edition), Form and Function, Brian MacIntosh, Phillip Gardiner, Alan McComas, Human Kinetics © 2006
- Textbook of Work Physiology-4th Edition, Physiological Bases of Exercise, Per Olof Åstrand, Kaare Rodahl, Hans Dahl, Sigmund B. Strømme Human Kinetics © 2003
- Cross-innervated mammalian skeletal muscle: histochemical, physiological and biochemical observations. Victor Dubowitz J Physiol. 1967 Dec; 193(3): 481–496.3.

- C57BL/6 life span study: age-related declines in muscle power production and contractile velocity. Graber TG1, Kim JH, Grange RW, McLoon LK, Thompson LV. Age (Dordr). 2015 Jun;37(3):9773. doi: 10.1007/s11357-015-9773-1. Epub 2015 Apr 17.
- Influence of different shortening velocities preceding stretch on human triceps surae moment generation in vivo. Gianpiero De Monte, Adamantios Arampatzis, Journal of Biomechanics Volume 41, Issue 10, 19 July 2008, Pages 2272–2278
- Defining muscle elastance as a parameter. Joseph L. Palladino, Senior Member, IEEE and Abraham Noordergraaf, Life Fellow, IEEE Proceedings of the 29th Annual International Conference of the IEEE EMBS Cité Internationale, Lyon, France August 23-26, 2007
- Validity of 20-MST for predicting VO_{2max} of adult Singaporean athletes" J Sproule, C Kunalan, M McNeill, H Wright, *Br J Sports Med 1993;27:202-204*
- Measurement of physical activity" Rod K. Dishman, Richard A. Washburn & Dale A. Schoeller, pages 295-309, Quest Volume 53, Issue 3, 2001
- The measurement of maximal (anaerobic) power output on a cycle ergometer: a critical review. Driss T, Vandewalle H, Biomed Res Int. 2013; 2013:589361
- Developing maximal neuromuscular power: Part 1--biological basis of maximal power production. Cormie P, McGuigan MR, Newton RU, Sports Med. 2011 Jan 1;41(1):1738
- Developing maximal neuromuscular power: part 2 - training considerations for improving maximal power production. Cormie P, McGuigan MR, Newton RU, Sports Med. 2011 Feb 1;41(2):125-46.
- Advances in surface EMG: recent progress in detection and processing techniques. Merletti R1, Aventaggiato M, Botter A, Holobar A, Marateb H, Vieira TM, Crit Rev Biomed Eng. 2010;38(4):305-45.
- Changes in the force-velocity relationship of fatigued muscle: implications for power production and possible causes. Jones DA, J Physiol. 2010 Aug 15;588(Pt 16):2977-86.
- Calcineurin regulates slow myosin, but not fast myosin or metabolic enzymes, during fast-to-slow transformation in rabbit skeletal muscle cell culture Joachim D. Meißner*, Gerolf Gros, Renate J. Scheibe, Michael Scholz and Hans-Peter Kubis, The Journal of Physiology, Volume 533, Issue 1, pages 215–226, May 2001

Practical/Lab/Tutorial Work

Abstract Guidelines

An abstract for an Oral, Poster or Demonstrated Communication is intended to provide a means of communicating new work in progress, as well as completed work. The following guidelines are adapted from those used by the Physiological Society for Meetings Abstracts. Some of the advice they give on their website (www.physoc.org) is not as relevant to you since you are not presenting your own original data but summarising the research findings of others.

- The text allowance for an abstract for this course is one side of A4 paper, with line and a half spacing, and your font size should not be less than 10 pt (your reference list may be in a slightly smaller size font as long as it is still legible). Use a clear font that is easy to read.
- There is no requirement to include full experimental protocols in your abstract. However, sufficient information must be given within the text, or by reference to published work, to indicate how the experiments were performed.
- The authors must include within the abstract a clear description of the results and all the appropriate data to support any conclusion they wish to make.
- Where references are included in the text, the author should make sure that these are listed correctly at the end of the abstract. If you are unsure as to how to cite references properly, please obtain a copy of Journal of Physiology to find out.
- If numerical data are presented as mean values, the standard deviation or standard error must be given, stating which is used; n values must also be given. If statistical significance is stated, then the statistical test must be named.
- All abbreviations must be explained within the text, except those that are listed in the online version of the Instructions to Authors for The Journal of Physiology (http://www.jphysiol.org/misc/abbreviationslist.pdf). Abbreviations should be those accepted in the field; new abbreviations should be avoided whenever possible. Authors are reminded that a large number of abbreviations within an abstract can detract from the sense.
- Tables and figures should be no larger than 8 cm X 8 cm. Please indicate the approximate position of the table or figure within the text, and also include an informative table heading or figure legend. Tables should not normally contain more than 30 values and graphs should not normally contain more than three curves
- Figures must be fully labelled. Axis labels and lettering on figures should be in a lower case sans serif typeface (8 point); use capital, italic letters (A, B, etc.) to
- If you have any queries about the layout/content of your abstract, then ask!

Practical/Lab Work

There will be two practical classes in the Health Science Building Applied Physiology research labs

1. Indirect VO_2max testing and
2. Strength and Power Assessment

Practical classes will be assessed within Module 7: Applied Exercise Physiology.

University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (**https://abdn.blackboard.com/bbcswebdav/institution/Policies**). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the **University's Infohub webpage** or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum

Medical Sciences Common Grading Scale

Grade	Grade Point	Category	Honours Class	Description
A1	22	Excellent	First	• Outstanding ability and critical thought • Evidence of extensive reading • Superior understanding • The best performance that can be expected from a student at this level
A2	21			
A3	20			
A4	19			
A5	18			
B1	17	Very Good	Upper Second	• Able to argue logically and organise answers well • Shows a thorough grasp of concepts • Good use of examples to illustrate points and justify arguments • Evidence of reading and wide appreciation of subject
B2	16			
B3	15			
C1	14	Good	Lower Second	• Repetition of lecture notes without evidence of further appreciation of subject • Lacking illustrative examples and originality • Basic level of understanding
C2	13			
C3	12			
D1	11	Pass	Third	• Limited ability to argue logically and organise answers • Failure to develop or illustrate points • The minimum level of performance required for a student to be awarded a pass
D2	10			
D3	9			
E1	8	Fail	Fail	• Weak presentation • Tendency to irrelevance • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts
E2	7			
E3	6			
F1	5	Clear Fail	Not used for Honours	• Contains major errors or misconceptions • Poor presentation
F2	4			
F3	3			
G1	2	Clear Fail/ Abysmal	-	• Token or no submission
G2	1			
G3	0			

Course Timetable SR4007: 2019-2020

Date	Time	Place	Subject	Session	Staff
			Week 7		
Mon 9 Sep	13:00-14:00	1.154	Introduction to course: Introduction to Honours	Lecture	DB
	14:00-14:30	FHLT3	Honours Project discussion	Lecture	DS
	14:30-17:00	1.154	Introductory Lecture - Module 1: Nutrition	Lecture	AMJ
Tue 10 Sep					
Wed 11 Sep	09:00-10:00	1.032/33	Literature search skills and techniques	Tutorial	MB
Thu 12 Sep					
Fri 13 Sep	13:00-14:00	Polwarth auditorium	Citing and Referencing	Lecture	DAS
	14:00-17:00	1.147	Interim report and troubleshooting	Tutorial	AMJ
			Week 8		
Mon 16 Sep	14:00- 15:00	FLT	Citing and Referencing (Re-scheduled)	Lecture	DAS
	15:00-16:00	1.143/44	Unsupervised talk rehearsal	Study	
	16:00-17:00	1.143/44	Research Methods: Experimental design and analysis	Lecture	DB/JG
Tue 17 Sep					
Wed 18 Sep	by 14:30		Submit abstract Online	n/a	n/a
Thu 19 Sep					
Fri 20 Sep	14:00-17:00	1:032/033	Seminar presentation and discussion (1)	Tutorial	AMJ/DAS
			Week 9		
Mon 23 Sep	15:30-17:00	1.143/44	Introductory Lecture - Module 2: Pharmacology	Lecture	DAS
Tue 24 Sep					
Wed 25 Sep					
Thu 26 Sep					
Fri 27 Sep	14:00-16:00	1.032/1.033	Interim report and troubleshooting	Tutorial	DAS
			Week 10		
Mon 30 Sep	15:00-17:00	1.143/44	Unsupervised talk rehearsal	Study	
Tue 1 Oct					
Wed 2 Oct	by 14:30		Submit abstract Online	n/a	n/a
Thu 3 Oct					
Fri 4 Oct	14:00-17:00	1.032/1.033	Seminar presentation and discussion (2)	Tutorial	DAS
			Week 11		
Mon 7 Oct	15:00-17:00	1.143/44	Introductory lecture - Module 3: Satellite Cells	Lecture	MES
Tue 8 Oct					

Wed 9 Oct					
Thu 10 Oct					
Fri 11 Oct	14:00-16:00	1.032/1.033	Interim report and troubleshooting	Tutorial	MES
Week 12					
Mon 14 Oct	by 14:30		Submit abstract Online	n/a	n/a
	15:00-17:00	1:143/1.44	Introductory lecture - Module 4: Exercise, inflammation and CVD	Lecture	NM
Tue 15 Oct					
Wed 16 Oct					
Thu 17 Oct					
Fri 18 Oct	13:00-14:00	1.032/1.033	Interim report and troubleshooting (4)	Tutorial	NM
	14:00-17:00	1.032/1.033	Seminar presentation and discussion (3)	Tutorial	MES
Week 13					
Mon 21 Oct	by 14:30		Submit abstract Online	n/a	n/a
	15:00-17:00	1:154	Module 5: Mechanisms of fatigue	Lecture	DB
Tue 22 Oct					
Wed 23 Oct					
Thu 24 Oct					
Fri 25 Oct	13:00-14:00	D2 workshop	Interim report and troubleshooting (5)	Tutorial	DB
	14:00-17:00	D2 workshop	Seminar presentation and discussion (4)	Tutorial	NM
Week 14					
Mon 28 Oct	by 14:30		Submit abstract Online	n/a	n/a
Tue 29 Oct					
Wed 30 Oct					
Thu 31 Oct					
Fri 1 Nov	14:00-17:00	1.154	Seminar presentation and discussion (5)	Tutorial	DB
Week 15					
Mon 4 Nov	15.00-17.00	BMP D2 workshop	Introductory lecture - Module 6: Applied Physiology	Lecture	MES
Tue 5 Nov	09:00-12:00	Polwarth auditorium	Indirect VO2max testing practical	Practical	JG
	13:00-16:00	Polwarth Auditorium	Indirect VO2max testing practical	Practical	JG
Wed 6 Nov					
Thu 7 Nov					
Fri 8 Nov					
Week 16					

Mon 11 Nov					
Tue 12 Nov	09:00-12:00	Polwarth Auditorium	Strength and Power Assessment practical	Practical	JG
	13:00-16:00	Polwarth Auditorium	Strength and Power Assessment practical	Practical	JG
Wed 13 Nov	09:00-11:00	FHLT3	Honours Project Allocations		DS
Thu 14 Nov					
Fri 15 Nov	14.00-16.00	1.032/1.033	Interim report and troubleshooting	Tutorial	MES
Week 17					
Mon 18 Nov	by 14:00		Submit abstract Online	n/a	n/a
Tue 19 Nov	09:00-10:00	1.032/1.033	Practical Tutorial	Tutorial	JG
Wed 20 Nov					
Thu 21 Nov					
Fri 22 Nov	14.00-17.00	1.032/1.033	Seminar presentation and discussion	Tutorial	MES
Week 18 - No teaching during this week REVISION WEEK					
Mon 25 Nov	14.00-17.00	1:154	Wash Up/Exam Preparation	Tutorial	DB
Tue 27 Nov					
Wed 28 Nov					
Thu 29 Nov					
Fri 30 Nov					

Staff

Dr Derek Ball (DB), Medical Sciences (Course Co-ordinator)
Ms Mel Bickerton (MB), Med Sch Lib
Dr Jenny Gregory (JG), Medical Sciences
Prof Alison Jenkinson (AMJ), Medical Sciences
Dr Nimesh Mody (NM), Medical Sciences
Dr Derryck Shewan (DS), Medical Sciences
Dr Michael E Scholz (MES) Medical Sciences
Prof Derek Scott (DAS), Medical Sciences