Significant association between fluctuations in serum urate and high density lipoprotein cholesterol during exhaustive training

Physical training is generally considered to increase serum high density lipoprotein cholesterol (HDL-C) levels. However, how exhaustive training influences serum HDL-C levels remains unknown. Intense exercise increases oxygen consumption and free radical formation, and induces oxidation of low density lipoprotein (LDL). HDL plays an important protective role in LDL oxidation. An imbalance between free radical production and antioxidants is considered to lead to oxidation of LDL and subsequent alterations in serum HDL metabolism. This study investigates changes in serum urate, which is the most important intrinsic antioxidant, and serum lipids in male athletes after three weeks of exhaustive training.

We measured fasting serum lipids and urate in 11 male athletes (mean (SD) age 21.2 (2.2) years; height 168.3 (4.2) cm; body weight 65.4 (3.7) kg) before and after three weeks of exhaustive training. All the subjects performed the same intensity exercise, which consisted of a 20 (3) km run and isometric training for two hours every day for three weeks. The daily diet provided 9802 (209) kJ and consisted of about 12–15% protein, 55–65% carbohydrate, and 25–30% fat over the study period. None were taking drugs known to affect lipid and lipoprotein metabolism. Special care was taken to exclude athletes using anabolic drugs, vitamins, or other antioxidants or who were smokers. Serum lipids were measured by automated enzymatic means using Determiner TC (Kyowa Medex Co, Tokyo, Japan) for total cholesterol, AutoSera S TG-N (Daichi Pure Chemicals, Tokyo, Japan) for triglycerides, Determiner HDL-C (Kyowa Medex) for HDL-C, and Cholestest LDL (Daichi Pure Chemicals) for LDL-C. Serum urate was measured using the uricase calorimetric method (Fuji Co, Tokyo, Japan).

After three weeks of training, serum HDL-C levels increased in six subjects, and decreased in five (fig 1A). As expected, the changes in serum LDL-C levels were inversely associated with the change in serum HDL-C levels (data not shown). However, serum triglyceride levels were not significantly different after training in all participants (data not shown). Unexpectedly, serum urate levels decreased in all subjects with increased HDL-C levels, but increased in all with decreased HDL-C levels (fig 1B). The change in serum urate levels correlated significantly and inversely with the change in serum HDL-C levels (fig 2).

Physical activity is a widely accepted means of increasing serum HDL-C levels, and it represents a metabolic adaptation that contributes to a reduced risk of coronary heart disease. However, the influence of exhaustive training on serum HDL-C levels remains obscure. Our data show that the effect of the same conditioned exhaustive training on serum HDL-C levels varies greatly among individuals.

Furthermore, we identified a significant inverse correlation between the changes in serum urate, which is the most important intrinsic antioxidant, and HDL-C levels, indicating the close association between urate and HDL metabolism during exhaustive training. However, we should mention that the number of participants was limited and the detailed mechanisms underlying this phenomenon remain to be elucidated.

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References

Are Reliable Change (RC) calculations appropriate for determining the extent of cognitive change in concussed athletes?

Reliable Change (RC) indices are a group of statistical techniques used in many areas of
Step 3: Calculate the RC score

This has led to the description—preseason) and after a concussion. Numerous authors have advocated the application of RC analyses to neuropsychological test data collected at baseline (preseason) and after a concussion. The authors have stated that the results of RC analyses provide the best means for guiding decisions about whether or not true change in cognitive function has occurred after a concussion, and can therefore assist the return to play decision making process. Although we support the use of RC techniques to guide decisions about concussion, we have concerns about the statistical computation and interpretation of various RC indices.

RC techniques were first described by Jacobson and Traux, and were designed to aid decision making about the significance of cognitive changes in patients in whom an injury or intervention had taken place. These and subsequent authors proposed that the most efficient way of determining whether an individual's scores on a specific cognitive measure had changed was to express the magnitude of change—that is, a change score—as a function of the normal variation found for that measure. Normal variation in performance on the cognitive measure was estimated from a group of similar subjects in whom no injury or intervention had occurred. Mathematically, the individual's change in performance is expressed in the numerator of the test-retest difference score, and the normal variation in performance on that measure is expressed in the denominator as follows.

Step 1: Calculate the standard error of measurement (SE)

\[ S_e = \frac{r_{12}}{\sqrt{1-r_{12}}} \]

Step 2: Calculate the standard error of difference (SEdiff)

\[ SE_{diff} = \sqrt{S_e^2 + \sigma^2} \]

Step 3: Calculate the RC score

\[ RC = \frac{X_2 - X_1}{SE_{diff}} \]

where \( X_1 \) is the participant's baseline score, \( X_2 \) is the participant's follow up score, \( SE_{diff} \) is the standard error of the difference, \( S_e \) is the standard error of measurement, \( r_{12} \) is the standard deviation of the control group at baseline, and \( \sigma \) is the test-retest reliability.

Clinicians, neuropsychologists, and statisticians working with RC techniques soon realised that “true” changes in test scores could be obscured by performance changes due to practice—that is, prior exposure to a test leads to improved performance on a subsequent assessment—and also by statistical phenomena such as the reliability of the test itself and the related regression to the mean. This has led to the description of the phenomenon called “perceptual learning” and the related regression to the mean. The RC technique can be interpreted as a z score, with a change of greater than 1.65, indicating significant decline from baseline using a one tailed hypothesis. Such RC scores may also be interpreted as “effect size” calculations, very similar to Cohen’s d scores as described by Zakian. Our research group applies this calculation to neuropsychological test data gained in concussed athletes in many sports worldwide and in many other medical applications where issues of change in an individual's cognitive status are pertinent. Corrections for practice effects and other confounding variables may also be included in this calculation as per current RC techniques.

Summary

RC analyses have the potential to inform return to play decision making in cases of sports related concussion, when applied to serially acquired neuropsychological test data. However, to be applied appropriately, such calculations should endeavour to assess the magnitude of change in an individual’s test score relative to change in a control group assessed at similar test-retest intervals. Previously described RC calculations do not meet this basic criterion, despite such control data being available.

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References


PostScript
Accessory nerve injury during amateur wrestling: silent but not overlooked

A 17 year old youth presented complaining of vague chest and back pain. His medical history was unremarkable except for a sports injury three to four months previously. The injury occurred during wrestling when his opponent had fallen on his chest and neck region. On physical examination, we noted an asymmetric neckline on the right, the result of atrophy in the lower portion of the right trapezius muscle. Neck and bilateral shoulder movement, both passive and active, were not limited and were painless. There were no functional deformities such as winging scapula or drooping shoulder. No loss of motor function was detected in the right sternocleidomastoid muscle or during right shoulder elevation. Radiographic examination produced no relevant findings. We next performed electromyography (EMG), the likely diagnosis being an injury to the right accessory nerve. The needle EMG was consistent with an almost completely regenerated upper portion of the trapezius muscle compared with the contralateral side. The patient was given a regimen of shoulder strengthening exercises and followed up.

The superficial course of the spinal accessory nerve along the posterior cervical triangle makes it susceptible to injuries. The most common cause is an iatrogenic injury during surgery. Donner et al., in a series of 83 patients with extracranial spinal accessory nerve injuries, reported the underlying causes to be lymph node biopsy in 42 cases, tumour excision in 14 cases, and carotid endarterectomy, face lift surgery, and irradiation (one case each). They also summarised the other causes as: traumatic, 13; stretch/contusion, 6; stab or glass wound, 1; shotgun, 1; compression, 1; weight lifting, 1; Hansen’s disease, 1; mononeuritis, 1.

The accessory nerve is a motor nerve which innervates the trapezius and the sternocleidomastoid muscles. Interestingly, injury to this nerve does not usually result in functional loss of the latter muscle. This is usually attributed to the fact that the nerve is usually injured in the posterior triangle after it has innervated the muscle and/or the observation that the muscle receives dual input from the accessory nerve and the cervical roots. Consequently, patients present with an ipsilateral trapezius palsy—that is, an asymmetric neckline, a drooping shoulder, winging of the scapula, and weakness of forward elevation—immediately after or within one week of the trauma.

Patient evaluation entails electrodiagnostic studies in addition to the clinical findings. EMG often showing an increase in polyphasic waves and decreased recruitment. Ultrasoundography has recently been proposed as an adjunct in the diagnosis. Because of unoward consequences in chronic cases, surgery is recommended if patients fail to improve after one year of conservative treatment.1, 2

We consider this case to be noteworthy in certain aspects. Firstly, the patient did not present with a trapezius palsy; it was a late silent physical finding that we uncovered. Secondly, as in a few of the cases in the above series,3 only the upper trapezius atrophy was present which did not produce a shoulder function. This is usually because there are other innervation sources or because of the presence of a divided accessory nerve.4 Thirdly, we believe that our case implies the likelihood of a relatively benign cause in younger patients. Lastly, together with another case report of a wrestler,5 the possibility of this type of injury occurring during sporting activity is highlighted. We therefore alert sports physicians to such a clinical scenario, for which prompt evaluation and management should always be the prerequisite.

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References


Applying elite research to the general population

We are writing in response to the letter by Dr Webborn about our circuitan research on competition swimmers.6 His first comment, namely that the media may wrongly slant a “take home message”, is understandable. Had he read our message more carefully, he would have seen that we noted that our observation—that there is a morning lowering of IGA and an increase in cortisol)—“might not be acceptable to elite competitors” as “the strongly question it by considering that early morning sessions should: perhaps be avoided by those returning to training after injury or illness, those close to periods of important competition (which are more associated with the underperformance syndrome) and possibly those at altitude, which itself imposes a degree of immunosuppression”.7 All very carefully displayed in the take home message. We three authors have been involved in the preparation of elite competitors collectively for many years, and we stand by those cautionary statements.

Dr Webborn is, importantly, interested in the potential health benefits of recreational exercise to an “active population”, and makes the very valid point that trivial signs and symptoms might be investigated in elite athletes, should not deflect exercise for the vastly greater public. However, our work was concerned with well trained competition swimmers, a point that we emphasised to the media. A major thrust of sports medicine is that it sometimes looks at clinically trivial conditions—for example, ankle or wrist sprains—which may be anything but trivial to the sports competitor. More specifically, modest levels of weekly exercise may be immunoenhancing, whereas there is much evidence that elite levels of endurance training may be immunosuppressive,8 so one always has to be careful which message applies to whom.

In his second comment, Dr Webborn reasonably queries the hydration status of our subjects. Naturally, on working with salivary flow, we had considered this also, in terms of subject behaviour at 24, 12, and 8 hours before testing, as is indicated in our experimental design. There were no “dry mouths”.

However, overall, Dr Webborn has a possible point about media misuse of take home messages, and perhaps the editorial board could discuss this, if it is felt to be an issue.

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References


Editor’s response

The role of the Journal’s “take home message” had been under review for some time before this correspondence. It has already been decided that it will be changed to a highlighted box encapsulating “what is known about the topic” and “what this paper adds to the body of knowledge”. This will be similar to the current layout of the British Medical Journal, and our technical editors have been developing a format to suit the Journal style. This correspondence has simply highlighted an important consideration of the Journal, namely how we deal with the media in a clear, concise, and appropriate way.

Response to “Berger in retrospect: effect of varied weight training programmes on strength”

I would not have believed in 1962 that my study would have created such a furore in...
the 21st century. Dr Carpinelli’s paper credits my study as “the genesis of the unsubstanti-
ated belief that multiple sets are required for optimal gains in strength”. His opinion is com-
plimentary in one respect, but I cannot take full credit for it. Most professionals in the field
of progressive resistance exercises in multiple sets and six reps resulting in the
6, and 10 across all levels of sets. When this
levels of repetitions, and among repetitions 2,
valid for critiquing my study. When a factorial
between subgroups I-2, III-6, etc were not
acceptable statistical protocol. Comparisons
study, were inappropriately used according to
li’s paper, which were used to critique my
reviewers.
the exception. So Berger is not as one “crying in
the desert”. There are many more therapists
and coaches flinging down the gauntlet in
support of multiple sets.
A person who comes to my mind as one
having recognized that my paper was reviewed by several
second time, well beyond 12 weeks, under con-
trained to “simplify the game without altering
necessary for attackers to stop the ball before
the taking of short corners. The new rule now
reads “Penalty corner: no shot at goal shall be
made until the ball has travelled outside the
circle”. This change means it will no longer be
necessary for attackers to stop the ball before
taking a shot at goal as was previously the
case. The reason given for introducing the rule
was to “simplify the game without altering
the overall nature of something which is
unique to hockey”.

The authors cover the theory
and coaches flinging down the gauntlet in support of multiple sets.
A person who comes to my mind as one
having recognized that my paper was reviewed by several
second time, well beyond 12 weeks, under con-
trained to “simplify the game without altering
necessary for attackers to stop the ball before
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necessary for attackers to stop the ball before
taking a shot at goal as was previously the
case. The reason given for introducing the rule
was to “simplify the game without altering
the overall nature of something which is
unique to hockey”.

The data in tables 1, 2, and 3 of Dr Carpinel-
lie’s paper, which were used to critique my
study, were inappropriately used according to
acceptable statistical protocol. Comparisons
between subgroups I-2, III-6, etc were not
valid for critiquing my study. When a factorial
design is used, as in my study, and no signifi-
cance is found between factors of sets
and repetitions, then the only legitimate
analysis to make is on main effects—that is,
comparisons among sets 1, 2, and 3 across all
levels of repetitions, and among repetitions 2,
6, and 10 across all levels of sets. When this
was done, significant differences were found,
with three sets and six reps resulting in the
greatest improvement. I spoke to Dr Carpinelli
earlier (1998 communication) about his mis-
use of statistics and suggested he consult a
statistician. If this had been done, there would
not have been a critique of my study, nor a
need for one. I must admit, though, that I
made the same mistake as Dr Carpinelli in my
study. In table 4 of my study, I erroneously
made comparisons among subgroups of sets
and repetitions. However, as a neophyte in
1962 I accept the blame. Being wiser today
than 40 years ago, and even considering Dr
Carpinelli’s critique, I unequivocally support
multiple sets over single sets for optimising
strength. I would suggest to Dr Carpinelli that
he conduct research of his own in the hope of
attaining support for his position. His
zealousness, which is commendable, was
redirected to research rather than to criti-
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Will the new field hockey rules
lead to more injuries?
On 1 January 2003, the International Hockey
Federation introduced a mandatory experi-
mental amendment to the rules pertaining to
the taking of short corners. The new rule now
reads “Penalty corner: no shot at goal shall be
made until the ball has travelled outside the
circle”. This change means it will no longer be
necessary for attackers to stop the ball before
taking a shot at goal as was previously the
case. The reason given for introducing the rule
was to “simplify the game without altering
the overall nature of something which is
unique to hockey”.

Short corners present a good opportunity to
score a goal and are practised routinely in
training. The new ruling was introduced on 1
March 2003 by the Ulster Branch of the Irish
Hockey Association in whose leagues I play. I
have now played three games under the new
ruling, and the danger of this rule has been
brought sharply into focus. In two of the three
games, players required hospital attention
because of knee and ankle injuries as a result
of defending short corners. It is normal prac-
tice that the defenders advance from the
goal line to prevent the attacking team shooting,
once the ball has been hit. The twin effect of
running towards the striker and the de-
creased time required to take a shot, as a
result of the attacking team not being
required to stop the ball, leaves defenders
with very little reaction time to avoid been
struck by an incorrectly hit ball which may
rise off the ground. In lower leagues, hitting
technique is often less well developed and it is
common for the ball to be little lifted during a
shot.

Concern has been expressed at the number
of facial injuries in hockey,” and it is my belief
that the rate of injuries (both facial and other)
will increase as a result of this new rule, some
of which may be severe.

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PostScript

Br J Sports Med: first published as 10.1136/bjsm.37.4.373 on 31 July 2003. Downloaded from http://bjsm.bmj.com/ on September 18, 2023 by guest. Protected by copyright.
books, unpublished reports, or publications in obscure journals. This was disappointing. In fact in chapter 4, “Healing by intention: a research-based overview”, any references to trials of this form of healing were in other than mainstream medical journals. This form of referencing makes a fair assessment of the evidence frustratingly difficult.

This book is useful mainly as an introduction to the very theoretical but generally very poorly researched field of complementary therapies in physical therapy. The basic problem is that it is heavy on theory, mainly unsubstantiated, and light on evidence of efficacy. It did not convince me to recommend the majority of the therapies to my patients.

More positively, this book is well written and easy to read. I clearly learned much about the subject matter, the validity of much of which I found questionable. However, it would be useful in educating physical therapists about treatments that they may be asked about or choose to trial. As it appears to be the only book of its kind, it should be held as a reference text at institutions involved in the teaching of physical therapies.

Analysis
Presentation 16/20
Comprehensiveness 17/20
Readability 15/20
Relevance 6/20
Evidence basis 3/20
Total 57/100

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The Cutting Edge: Joint Conference of The British Association of Sport and Exercise Sciences and The British Association of Sport and Exercise Medicine in association with the National Sports Medicine Institute
3–7 September 2003, Sheffield
Further details: R.M. Bartlett. Email: t.m.bartlett@shu.ac.uk

Football Australasia Conference
23–25 September 2003, Melbourne, Australia
Further details: Football Australasia Conference, PO. Box 235, North Balwyn, Victoria 3104, Australia

Congress for Science and Medicine in Cricket
25–26 September 2003, Loughborough, UK
Further details: Julie Page, ECB. Tel: +44 (0)207 432 1261; email: julie.page@ecb.co.uk

17th Congress of the European Society for Surgery of the Shoulder and the Elbow (ESSSE)
24–27 September 2003 at the Convention Hall “Stadthalle” Heidelberg, Germany
Congress Chairman: Professor Dr med. habil. Peter Habermeyer; President of the Society: University-Professor Dr. Herbert Rosch. Ab-stract deadline: 31 March 2003
Further details: INTERCONGRESS GmbH. Tel: +49 61 917716-35; fax: +49 61 917716-16; email: kattrin.volkland@intercongress.de; website: www.intercongress.de

The 5th British Musculoskeletal ultrasound course
1–3 October 2003, Leeds, UK
Musculoskeletal sonologists from the UK and mainland Europe will cover all aspects of musculoskeletal ultrasound in lectures and tutorials. The course is open to radiologists, radiographers, and clinicians with a US imaging interest.
Further details: Gill Bliss, MR Department, Clarendon Wing, Leeds General Infirmary, Great George Street, Leeds LS1 3EX. Tel: +44 (0)113 392 3768; fax: +44 (0)113 392 8241; email: gillian.bliss@leedsth.nhs.uk

Back Pain Prevention and Rehabilitation
5 October 2003, Glasgow, UK
A study day with Professor Stuart McGill. Further details: Yvonne Gilbert, BASEM Secretary, Royal College of Surgeons of Edinburgh. Nicolson Street, Edinburgh EH8 9DW. Tel: +44 (0)131 527 3409; email: y.gilbert@rcsed.ac.uk. Organised by BASEM Scotland.

Congress of Sports Medicine of the AZ Sint-Jan AV
24–25 October 2003, Bruges, Belgium
Further details: Congress Centre, OUD SINT-JIN, Mariastraat 38, B-8000, Brugge, Belgium; email: brucosport@azbrugge.be; website: www.brucosport.be

International Conference on the Science and Practice of Rugby
5–7 November 2003, Brisbane, Australia
Further details: Kerry Williams, Conference Organiser, QUT, GPO Box 2434, Brisbane, QLD 4001, Australia. Tel: +61 7 3864 2220; fax: +61 7 3864 5160; website: www.rugbystudies.com/conference

The Fifth International Conference on Sport, Leisure and Ergonomics
19–21 November 2003, Burton, Cheshire, UK
A three day conference in affiliation with the Ergonomics Society.
Further details: Congress Secretariat, Sport, Leisure and Ergonomics, Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Henry Cotton Campus, 15–21 Webster Street, Liverpool L3 2ET, UK. Tel: +44 (0)151 231 4088; email: K.George@livjm.ac.uk

Medicare India
6–8 April 2004, New Delhi, India
This exhibition and conference will be held for the first time, following India’s ambitious “health for all” programme launched in 2002. Further details: Congress Secretariat, Sport, Leisure and Ergonomics, Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Henry Cotton Campus, 15–21 Webster Street, Liverpool L3 2ET, UK. Tel: +44 (0)207 723 8020; fax: +44 (0)207 723 8060; email: rob.grant@kinexlog.com; website: www.medicare-expo.com and www.kinexlog.com
The 6th STMS World Congress on Medicine and Science in Tennis in conjunction with the LTA 2004 Sports Science, Sports Medicine and Performance Coaching Conference
Keynote speakers include Professor Per Rentstrom (SWE), Professor Peter Jokl (USA), Professor Savio Woo (USA), Dr Carol Otis (USA), Dr Mark Safran (USA), Dr Ben Kiber (USA), Prof Bruce Elliott (AUS), and Professor Ron Maughan (UK).
Further details: Dr Michael Turner, The Lawn Tennis Association, The Queen’s Club, London W14 9EG, UK. Email: michael.turner@LTA.org.uk

NOTES AND NEWS

The Paul West Memorial Grant for Sport and Exercise Medicine Research in Scotland
BASEM and the family of Paul West are pleased to announce the above grant which will be awarded annually. The award will be approximately £350. The research must be carried out in Scotland and concern the physically active population. Applications must be submitted to the Award Committee by 31 October 2003 for the inaugural award in January. Further details: Yvonne Gilbert, BASEM - Scotland Administrator, Royal College of Surgeons of Edinburgh, Nicolson Street, Edinburgh EH8 9DW, UK. Tel: +44 (0)131 527 3409; fax: +44 (0)131 527 3408; email: y.gilbert@rcsed.ac.uk

Intercollegiate Academic Board of Sport and Exercise Medicine Diploma Exam
The following were successful diplomates in the Intercollegiate Academic Board of Sport and Exercise Medicine Diploma Exam, the two exams held in 2001 and 2002:
- Dr Andrew J Adair
- Dr Abimola Afolabi
- Dr Sienead M Armstrong
- Dr Terence J R Babwah
- Dr Catriona E L Boyle
- Dr Susan J Brick
- Dr Lawrence J Conway
- Dr Alan J Dawson
- Mr Patrick D Dissmann
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- Dr Roger K Goulds
- Dr Niall A Hogan
- Dr James R Hopkinson
- Mr Ananta K Jayanti
- Dr Michelle Jeffrey
- Mr S P Kale
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- Dr Martin O Rochford
- Dr Hungerford A T Rowley
- Dr Shaun A Sexton
- Dr Jason E Smith
- Dr Aravinthan Suppiah
- Dr James A Thomas

For further information contact: Mrs Yvonne Gilbert, Administrative Secretary, Intercollegiate Academic Board of Sport and Exercise Medicine, Royal College of Surgeons of Edinburgh, Nicolson Street, Edinburgh EH8 9DW, Tel: +44 (0)131 527 3409; fax: +44 (0)131 527 3408; email: y.gilbert@rcsed.ac.uk

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Details for the above exam can be found on the Royal College of Surgeons of Edinburgh Website at http://www.rcsed.ac.uk alternative applicants can write to: The Royal College of Surgeons of Edinburgh, Eligibilities Section, Careers Information Services, 3 Hill Place, Edinburgh, UK; tel: +44 (0)131 668 9222 or Mrs Yvonne Gilbert, Intercollegiate Academic Board for Sport and Exercise Medicine, Royal College of Surgeons of Edinburgh, Nicolson Street, Edinburgh EH8 9DW, UK; tel: +44 (0)131 527 3409; email: y.gilbert@rcsed.ac.uk

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Web site: www.med.unsw.edu.au/sportsmed

NCPAD NEWS
A monthly publication of the National Center on Physical Activity and Disability. NCPAD is the leading source for information about organisations, programmes, and facilities nationwide providing accessible physical activity and recreation. NCPAD also has a large and growing online library of fact sheets, monographs, and contact information on physical activity and recreation for people with disabilities. Sign up for this free monthly electronic newsletter by sending an email to: Listserv@listserv.uic.edu, with this message in the body of the e-mail: SUBSCRIBE NCPAD-NEWS yourfirstname yourlastname. If you have any difficulty, you can also sign up for the newsletter by going to http://www.ncpad.org/signup

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www.basem.co.uk. The site provides information about the educational opportunities in sport and exercise medicine and advice to those wishing to become involved in this area.
or the Postgraduate Certificate in Physiotherapy (Sports Physiotherapy of the Spine, Shoulder and Upper Limb).

The School of Physiotherapy at the University of Melbourne now has approval for these courses and applications are open to international students for full time study.

- Master of Physiotherapy by Coursework (Sports Physiotherapy) NOW CLOSED.
- Postgraduate Certificate in Physiotherapy (Sports Physiotherapy of the Spine, Pelvis and Lower Limb) NOW CLOSED.

Please check the website for updates and information about the courses: www.physioth.unimelb.edu.au/postgrad.html