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Training Sports Trainers:
What is enough and what is too much?

Gary Moorhead

Over recent years, members and staff of Sports Medicine Australia responsible for the Safer Sport Program (the Sports Trainer program) have felt torn in different directions by conflicting demands placed on the program. In essence, these conflicting demands are to do the training cheaper and quicker, but also to produce a better trainer at the end.

Sporting organisations are feeling the pressure of increased accountability and the need to respond to calls for a higher level of risk management so, in regard to sports injury prevention, there is a growing demand for sports trainers. This adds to the costs of running sport, both through the cost of the education of the trainer and through payments made to the trainers for attending events. Though most trainers are volunteers, many sports make an effort to cover their basic expenses and pay them a small hourly fee. Thus sport is incurring additional costs for trainers' education and payment to attend events while there is additional pressure on sports administrators to find trainers willing to work when needed.

Some sports administrators have questioned whether or not sports trainers can't be produced more cheaply and more quickly to help ease these pressures. As more and more learning is adapted for on-line, self-paced, distance-style delivery, sports are asking why these approaches can't be taken to reduce the time and cost of producing trainers.

In fact, SMA has responded to these requests by producing new resources and developing new approaches that have reduced the number of face-to-face hours required for the Sports Trainer Level One course. A major factor in this has been the production of an interactive DVD that covers sections of the course and can be studied outside of set course times. The DVD (produced with financial assistance from the Commonwealth Department of Education, Science and Training) was part of the outcome of a major review of Level One that saw changes to the curriculum and a substantial investment in new resources, including a new full colour manual, student workbook and presenter kits.

The review of Level One curriculum and the production of new Level One resources is part of an on-going process of continuous monitoring and improvement that SMA applies to the entire Safer Sport Program. The next areas scheduled for review are Level Two and the next area for specific action is the reaccreditation process.

Despite the work undertaken to improve the program, SMA recognises that educating enough trainers to meet the growing needs of sport in Australia is a serious issue. In fact, a closer examination reveals that there is a massive problem with retention of trainers in sport.

Simply stated, the problem is that, though SMA has managed to increase the numbers doing sports trainer courses in recent years (in 2005-2006, the increase was 17%), there is still a massive

drop-out rate. Only 16% of those who complete a Level One Course re-accredit after three years. This means that a staggering 84% of those trained are lost after three years. Though a substantial drop-out rate is to be expected in a volunteer group, if some improvement could be made in the numbers re-accrediting, this would be of great benefit to sporting organisations seeking trainers. To address the problem, SMA plans a substantial change to the re-accreditation process, moving it closer to the medical/health professional model so that trainers can accumulate continuing education points and make the actual re-accreditation process part of the on-going activity of being a sports trainer.

Level Two presents different challenges: only 8% of trainers go on to qualify as Level Twos; however, once there, they tend to remain in sport with a reaccreditation rate of over 80%. The issue for SMA with Level Two is ensuring that the skills taught are meeting the needs of those playing sport – and this is not necessarily the same as meeting the needs of sports administrators!

While sports need to meet risk management requirements by providing trainers, SMA's concern is that the trainers provided actually know something about preventing injury and looking after those who are injured. In the same week that SMA received requests from a sporting association for a dumbing down of the trainer syllabus as a means of pushing through more trainers, two separate sports trainer conferences requested that the bar be raised to provide higher minimum standards and higher levels of training for trainers.

At the end of the day, the concerns of SMA members – and sports trainers –must be for the well-being of the athletes. While many compromises, shortcuts and clever ways can be found in training, when a sports trainer attends a sporting event, there is a basic level of knowledge required. Ironically, this level of knowledge required may be higher in lower levels of sports or in regional and remote areas. In these situations, the attendance of medical practitioners and other health professionals is less likely and the sports trainer on the spot has to cope with whatever situation arises.

It is in recognition of this fact that SMA is currently developing a new spinal management module for sports trainers. There has been considerable debate among SMA members as to whether the unit should be offered as a separate and optional module or whether the skills should be taught to all Level One trainers and above. Some of the discussion by senior SMA medical members in this debate highlights the issues around appropriate levels of training and care:

> "Although the incidence of spinal injury in sport is not that high, given the potential devastating consequences of such an injury, I strongly believe that first responders (ie, sports trainers) must be equipped to identify and deal with such a presentation."
>
> "…as professional SMA members, we have an obligation to ensure that people providing on-field assistance at sporting events are adequately trained. Not only do we need to prepare them for the common, but we absolutely have an obligation to prepare them for the uncommon events which have the potential for significant morbidity or mortality."
>
> "… I feel that first responder spinal management should be a basic skill expected of any person delegated the task of managing an event where a spinal injury has the potential to occur."
>
> "…I feel our obligation as sports medicine professionals is to prepare someone who can act safely and proficiently as a first aider; strapping and rubbing skills would be the add-on and not the other way around."

The doctors went on to discuss the teaching of other skills such as oxygen delivery, defibrillation and the medico-legal perceptions of what society expects from a first responder; however, they were emphatic in their belief that the most basic role of sports trainers is to save lives and minimise harm from injuries and it is SMA's duty to provide the skills and training necessary. **SH**

SPORTS MEDICINE AUSTRALIA
South Australia Branch

2007 State Conference

Sunday 25th February

The 2007 SMA-SA State Conference will run from 9am - 4pm.

Conference Breakfast and Registration, 9am - 10am.

The Keynote Address is to be delivered by Dr David Martin (Senior Sports Physiologist, Australian Institute of Sport)

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- the multi-disciplinary sports medicine team
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The sports science you won't find on PubMed

Dr J

How long is it going to be before Google Scholar is considered to be a more important resource than PubMed? Or, given that PubMed listings already come up in Google Scholar searches, is it already the case? The peer review system is always going to have a major place in scientific research, but internet publishing is getting more and more user friendly while the peer review system is tending to head in the other direction. There has never been a shortage of papers for the peer review journals to publish and, until there is, there won't be any reason for the journals to continue their trend towards becoming more difficult for authors [1], based on simple supply and demand economics. And even though the number of sports medicine and science journals is expanding, the amount of articles written in these fields is expanding even faster. Some will make it through to the peer-review system, whereas other important articles will not, often through choice of the editors and reviewers but increasingly through a decision of the author.

So you are a scientific researcher and you need to decide whether or not you will publish or submit a paper to a peer review PubMed-listed journal or elsewhere (including posting it on an internet website). I am someone who publishes a lot in both sectors (peer-review and non-peer-review) so can give a viewpoint on the advantages of each. Table 1 is a list of reasons why you might want to choose one or the other, but the peer-review advantages list basically comes back to 'because you have to.

If you are an Associate Professor at Yada Yada University then you have to publish x many articles in refereed journals over a certain time period or you will get demoted back to Senior Lecturer. If you a sports physician registrar, they won't even give you a Fellowship unless you get a first author paper accepted in a PubMed-listed journal. But what else? You can say the research is more credible in a PubMed-listed journal, but is a crap paper listed by PubMed suddenly a good paper because it appears in a good journal? Would groundbreaking research not published in the peer review system suddenly be bad work? Admittedly, most of the time anyone publishes a blockbuster study outside the peer review system they get a tap on the shoulder from a suddenly friendly editor asking whether they would like to have it fast-tracked through their journal. One of my all time favourite research stories is that of Barry Marshall and Robin Warren getting knocked back as a podium presentation at the Gastroenterological Society of Australia annual meeting for suggesting that *Helicobacter pylori* caused stomach ulcers. Soon after they submitted to *The Lancet* and were recommended for rejection by the reviewers but the editor took the rare but masterly step of holding on to the paper and sending out to different reviewers until he could find some who would agree that the paper should be published [2].

Table 1 – Why choose PubMed journals?

ADVANTAGES OF CHOOSING A PUBMED-LISTED PEER REVIEW JOURNAL	ADVANTAGES OF PUBLISHING ELSEWHERE	ADVANTAGES OF NOT PUBLISHING AT ALL
Maintaining academic tenure	Keep your own copyright	Don't share business secrets
Achieving FACSP or some other hurdle requirement	Avoid page and colour charges	More time to do other things
Stamp of credibility to research	Avoid pedantic reviewers	Don't have to work out why your version of EndNote isn't compatible with your version of Word
Appearing in hard copy	Avoid even more pedantic ethics committees	
Ego, not that there's anything wrong with that	Keep your own profits	
????Wider readership	No word limits	
	Get published faster	

1 To be fair, the biggest improvement of the peer-review in recent years has been turn around time for rejecting papers. They used to take months to reject your paper, now they can do it in weeks.

2 Van Der Weyden MB, Armstrong RM, Gregory AT. The 2005 Nobel Prize in Physiology or Medicine. MJA 2005; 183 (11/12): 612-614 http://www.mja.com.au/public/issues/183_11_051205/van11000_fm.html

Since they give me a page limit for Dr J articles, I won't get started on some of the crap papers that I've seen appear in the peer-review system, but it wouldn't take you too long in your local library to find a few particularly bad ones that never should have seen the light of day.

Down the bottom left of Table 1, I've listed "Wider readership" preceded by a few question marks. It goes without saying that' if you publish in the *Am J Sports Med* or the *Br J Sports Med*, you'll be read by more people, doesn't it? Maybe it does in 2006, but, as Google marches on, you'll eventually want to be free full text on the internet if you really want to reach the biggest audience.

I've not only threatened for many years to publish outside the peer review system, but I've put my money where my mouth is (on occasions) by sending actual papers (not just rants like this one) to *Sport Health, New Zealand Journal of Sports Medicine, Sportslink* and publishing on my own website injuryupdate.com.au. Of course I still use the majors and the sceptics will of course argue that my 'good' work goes in to peer review and the 'rest' which wouldn't or didn't get accepted goes elsewhere. That may be true to an extent, but I wouldn't be too surprised if it wasn't completely true in the future.

I recently submitted a paper to the BJSM and it bounced back straight away, being ineligible because it didn't have ethics committee approval. I can't complain at all about this decision itself because it is clearly spelt out in the terms on their website, but would like to point out that it wasn't rejected because it was an unethical study without ethics committee approval, but simply because it didn't have ethics committee approval full stop. This has prompted me to submit a detailed opinion piece to the *Journal of Science and Medicine in Sport* hoping that it doesn't follow along the same lines as the BJSM. But if it does, c'est la vie, and if you want to read John Orchard's best recent work a few years down the track, you might have to subscribe to *Sport Health* or log in to my website. That's if they don't throw me in jail for daring to send a patient a follow-up questionnaire without asking for ethics committee approval first.

Hopefully my detailed argument soon makes it in to JSAMS, so I won't repeat it here, but I'd like to include the phrase "pack of wankers" here as it wouldn't be appropriate to describe most ethics committees as such in the peer review system. (Note to editor: please go back to table 1 and in column 2 add "you can write what you really think".). To summarise, I've submitted enough studies for ethics approvals to make the following observations:

(1) Their primary purpose is to obstruct and/or delay the research process;

(2) Submissions are almost always required to be more than five times longer than the paper which will eventuate from the study;

(3) Like reviewers, they will always insist on changes to your study. Unlike reviewers, none of these changes will result in your paper being any better.

Some of the classic suggestions I have received or heard from ethics committees include "you should get your subject information form translated into 25 languages before the study starts so that you don't unfairly discriminate against any ethnic groups" and "you should send out a preliminary questionnaire to all potential subjects asking them whether they object, in advance, to receiving the actual questionnaire". If publishing in the peer-review system of the future means putting up with this crap, then the salaried academics at the universities can have it all to themselves.

Table 2 is a list of some of the good stuff that you can find on the internet, which includes a lot of interesting sports medicine publications that haven't been through peer review. Most of it is free, but of interest is that I recently found, by subscribing to Baseball Prospectus, articles on the relationship between pitching workload and susceptibility to injury that were way more advanced than anything that has ever appeared on the topic in the peer review system. The reason why it isn't published in the peer-review – they're Americans – if you've just done some work which people might pay to view, why give it away to someone else for free? *Baseball Prospectus* are part of a new field of sports science called sabermetrics which is the analysis of sports performance through objective evidence (esp. statistics), a field which exists almost entirely outside the peer-review science sphere. The question is whether they are an outlier or the start of a new trend. **SH**

Table 2 – Twelve resources on the internet which might surprise you

WEB ADDRESS	COMMENT
http://www.baseballprospectus.com/	The best studies done on the link between loading in baseball and injury (but you'll have to pay)
http://www.sportsci.org/index.html	Only one edition per year but as good as any one journal edition
http://coachesinfo.com/category/cricket/44/	Tell me whether you can find a better description of bowling mechanics in the peer-review than this
http://www.injuryupdate.com.au/images/research/QuadsBiomechreportUNSW.pdf	A detailed report of mine on mechanism of quadriceps strains in kicking that is only published on the internet
http://www.acc.co.nz/	They're the best in the world at universal sports insurance so check out their site
http://www.ostrc.no/ostrc.asp?s=main&lang=en	Perhaps the best non-government institution in the world - they publish in peer review but also here
http://www.ausport.gov.au/nsic/	Our own national sports library is no slouch either
http://www.injuryupdate.com.au/forum/index.php	Read what the patients think about their injuries (you can learn something here)
http://www.nlm.nih.gov/medlineplus/sportsinjuries.html	OK this is associated with Pubmed but there are lots of good non-Pubmed links
http://www.physsportsmed.com/	Back issues still online
http://www.orthosupersite.com/	Some good scientific articles mixed in with some lay ones
http://www.stms.nl/	Great for tennis, which is neglected in the peer review literature in general

OBESITY WARS

Tim Olds

Professor Olds' article is based on his keynote Refshauge Lecture at this year's Australian Conference of Science and Medicine in Sport. The two articles following – by Erin O'Keeffe and Les Podlog – are also based on presentations at the conference.

Perhaps the only thing increasing faster than the prevalence of childhood obesity is the rate at which we are talking about it. According to LexisNexis, the number of articles dealing with obesity which have appeared in major world dailies increased fivefold between 1999 and 2003. Concurrent with increases in the number of media reports of childhood obesity, there has been a tremendous upsurge of academic interest in the subject. A scan of the PubMed database shows that the number of articles appearing with the words "child(hood)" and "obesity" as search terms increased from an average of 389 between 1982 and 1993, to 1200 per annum between 1999 and 2003.

The volume of commentary on childhood obesity has generated a lot of background heat and noise, and has created a polarising and sometimes vituperative debate. Issues surrounding the causes of the 'obesity epidemic', who is 'responsible', and the best ways to deal with it have been vigorously debated in media, political and academic forums. Schisms have emerged between those who advocate individual responsibility, such as Australian Health Minster Tony Abbott, and those who argue that interventions must be at the level of the entire built and social environments. Dietitians blame an increased intake of energy-dense foods, while exercise scientists point to declines in physical activity and increased sedentary behaviours. This article aims to present available evidence on historical trends in children's fatness, fitness, food intake and energy expenditure. The picture which emerges in not as clear-cut as many would like us to believe, nor are the solutions obvious.

1 Trends in the fatness of children

There is absolutely no doubt that children are getting fatter, no matter how fatness is measured. We have recently gathered data on the skinfold thicknesses in young people aged 0-18 years, covering a total of 116 studies and including data on 364,077 young people from 24 developed countries. Percentage body fat (%BF) was estimated using the Slaughter equations. There have been increases in triceps and subscapular skinfold thicknesses, at the rate of 6%-8% per decade since the 1950s. Estimated percentage body fat has been increasing at the rate of 1% body fat per decade (equivalent to a relative increase of 6%-7% per decade). Your children are therefore likely to be about 20% fatter than you were when you were their age. There are also distinctive patterns in the ways in which children are getting fatter.

1.1 Boys are getting fatter faster than girls

The ratio of the median percentage body fat of boys to that of girls has risen from 58% to over 75% between 1950 and 2005, at an average rate of over 2% per decade. At this rate, boys and girls will be equally fat in the year 2111.

1.2 The fatter are getting fatter faster

There has been an increasing positive skew in the distribution of subcutaneous fat thickness in children. We compared the distribution of triceps skinfold thicknesses of Australian children from the 1985 Australian Health and Fitness Survey, and data collected using identical methodologies between 1997 and 2002. The leanest children today are as lean as their counterparts 15 to 20 years ago. However, there are more fat children in the recent cohort, and these children are much fatter than their counterparts in 1985. The gap between the "fat-rich" and the "fat-poor" is increasing, and there are more 'Rupert Murdochs of adipose tissue'.

1.3 Body shape is changing

The distribution of fat on the body, as indexed by the triceps:subscapular (T:S) ratio, has become more centrally located since the 1950s. Fat is moving from the arms and legs to the trunk. Waist-hip ratio (WHR) is also increasing, even in children from different cohorts matched for fatness. Australian children aged 10 to 12 years tested in 1985 and 1997-2004 were matched for age, sex, height, weight, body mass index (BMI) and triceps skinfold thickness. Even in this group matched for overall fatness, waist girths and waist-hip ratios were significantly greater in the children from 1997-2004. Boys' WHRs had increased from 0.85 to 0.88, and girls' from 0.82 to 0.87 (Dollman and Olds, 2006). These trends describe very unfavourable changes in the body composition of young people, foreshadowing a potential increase in the incidence of cardiovascular and metabolic disease. They also suggest that BMI does not tell the whole story.

2 Tends in children's aerobic fitness

At the same time as children's fatness has been increasing, fitness performance has been declining, particularly on tests of aerobic fitness. We have collected data on the fitness performance of more than 50 million children from more than 50 countries, reaching back almost 100 years. From at least 1960 until

1970, there was a clear improvement in aerobic performance, at which point it plateaued and started to fall. It is now declining at the rate of about 4%-5% per decade. Your children are likely to be 10% to 15% less fit than you were when you were their age (Tomkinson, Léger, Olds and Cazorla, 2003). Furthermore, Australian children are nowhere near as fit as their northern European counterparts. The fittest children in the world are in Estonia and Iceland, and the least fit in Singapore and the United States (Olds, Tomkinson, Léger and Cazorla, 2006; Figure 1). Changes in other types of fitness performance — strength, speed and power — have been less marked, with trends towards recent declines.

It would not be surprising to find that decrements in aerobic test performance are largely due to increases in fatness — children are carrying much more ballast on those running tests. However, it turns out that only about 50% of the decline in performance is due to increased fatness. We tested this by again matching children from 1985 and 2000 for fatness (sex, age, BMI and skinfold thickness) and comparing their run performances. Even when matched for fatness, children in 2000 performed worse than their counterparts in 1985. So other factors appear to be involved in declining performance — lower activity levels, less familiarity with maximal exertion, perhaps a cohort effect when competing against generally less fit kids.

3 Trends in children's food intake

Johnson: *He eats too much, sir.*

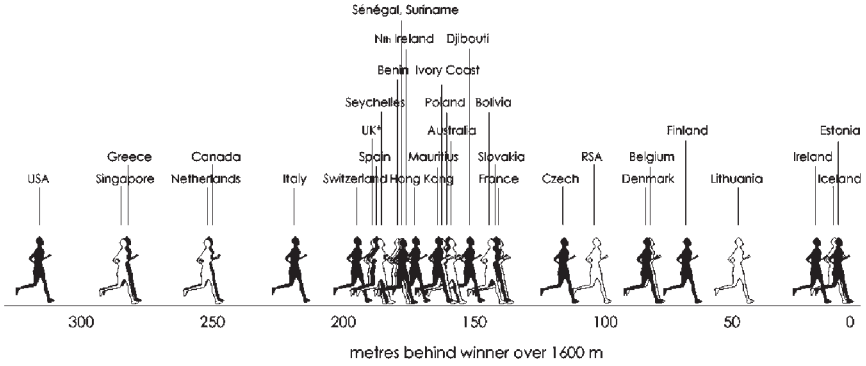
Boswell: *I don't know, sir. You will see one man fat, who eats moderately, another lean, who eats a good deal.*

Johnson: *Nay, sir, whatever may be the quantity a man eats, it is plain that if he is too fat, he has eaten more than he should have done.*

Boswell. *The Life of Johnson* (1791).

One thing which is certain is that people will only get fatter if there is an energy imbalance — too much energy in, too little out. There is strong prima facie evidence to suggest that children are eating more, and that what they eat is higher in energy, sugar and fat, and lower in fibre and micronutrient density. The number of fast-food restaurants has been increasing exponentially in Australia. In Adelaide, for example, the number of KFCs, Hungry Jacks, MacDonalds and Pizza Hut restaurants rose from just two in 1972 to 60 in 1997. Portion sizes have been increasing. Between 1987 and 2005 the number of kilojoules in standard portions of flavoured milk, cup cakes, scones, soft drinks and dinner rolls has on average doubled. In the last 50 years, the volume of Coca-Cola bottles has also increased dramatically: from 200 ml to 675 ml for the standard size bottle, and from 375 ml to 1 L for the king size bottle.

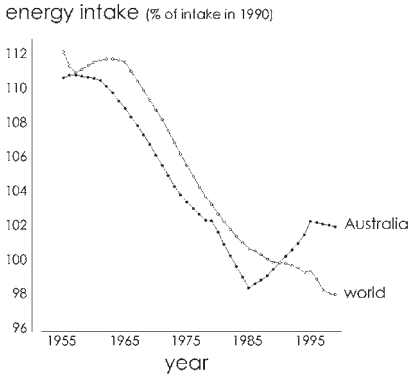
Figure 1. Performance in a putative race over 1600 m between children from different countries. The fittest children are from Northern Europe (Estonia and Iceland), and the least fit from the USA and Singapore. Australian children finish in the middle of the field.



However, it is easy to be misled by anecdotal evidence. In an attempt to address the question of whether children really are eating less than they used to, we attempted to locate every study ever done on the energy intake of children. Thus far, we have located about 200 articles dating from the mid-1800s. They come from 24 countries classified by the World Bank as 'high-income' or 'upper-middle income'. They are all countries of Europe or the developed Pacific Rim. The studies provide data on more than 250,000 children and young people aged between 0 and 18, collated into 1800 age X sex X country slices. Surprisingly, these data clearly show declines in reported energy intake for both boys and girls across most age bands since 1955 (Figure 2).

When analysed at the age X sex X country level, the data also show declines in reported energy intake over the period 1950-2000 in 75% of cases. Most declines are in the 3%-6% per decade range. All countries show overall declines, ranging from 1.8% per decade for France to 7.9% per decade for Germany. The data can be combined across all countries using special statistical techniques. The overall average rate of decline is about 4% per annum. If these reported data reflect actual intakes, it is likely that your children will be consuming about 10% fewer kilojoules than you did when you were their age.

Figure 2. Trends in reported energy intake of young people aged 2-18 in developed countries, and in Australia. Energy intake is expressed as a percentage of average intakes in 1990.



3.1 Under-reporting

These results are very surprising, and we should be systematically sceptical. What else could explain these changes? One possibility is under-reporting. Most people under-report energy intake, either because they forget what they have eaten or because they don't want to appear to be gluttonous. We know this because there are objective ways of measuring actual food intake (for

example, through observation or — most commonly — doubly-labelled water). A number of studies have compared actual and reported food intakes. We have reviewed 68 such studies, covering a total of 7,350 subjects.

Under-report increases with age and percentage body fat. The latter is a concern when we are trying to decide whether children are eating more, because children have become fatter over time. This may mean that the apparent decline in children's energy intake is in fact merely a reflection of increasing under-reporting associated with increasing fatness. To correct for this, we would need to know:

(1) the relationship between percentage body fat and under-report, and

(2) the historical trend in the percentage body fat of children.

Fortunately, we do have data on both of these relationships. In children, under-report increases by about 1.4% with every 1% increase in body fat. Percentage body fat has been increasing at the rate of about 1% per decade in children, so the nett effect of fatness-related under-reporting would be to reduce the calculated rate of decline in energy intakes from about 4% to about 2.5%.

We don't know whether or not under-reporting really does increase with fatness over time (as opposed to within a cohort). There may be other factors which could explain the apparent decline in intake, but we don't have good data. A common objection is that it is not valid to combine data from studies which use different collection methodologies, sampling frames and food databases. However, methodological differences will only be relevant if (a) the different methods result in systematically different estimates of energy intake and (b) the methods show time-related variability (eg, if one method were consistently used in the early years, and another more recently). If these conditions are not met, then methodological differences will only serve to increase the scatter or variability of the data, and will not bias trend estimates.

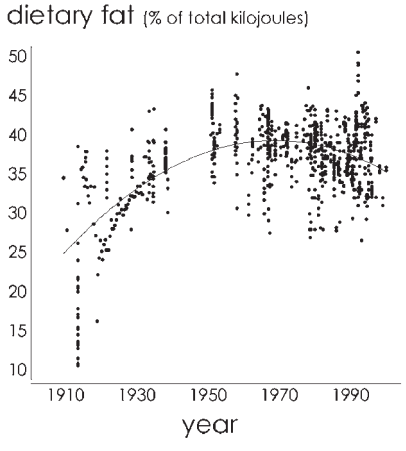
3.2 Trends in the consumption of specific types of food

It is often suggested that increases in fatness can result from increases in the consumption of particular types of food, such as fatty foods, high glycaemic index (GI) foods, soft drinks or confectionery. It is not at all clear that this can happen independently of increases in overall energy intake, but it is interesting to look at trends in intakes of some macronutrients and specific foods.

3.2.1 Dietary fat

Data were collated from 1,128 reports (at the age X sex X country level) of fat intake of children, expressed as a percentage of total energy intake. The data come from 180,472 children from 23 high-income countries, and were gathered between 1920 and 2003 using self- or proxy-report. The pattern was quite clear: fat intake peaked about 1965, at close to 40% of total energy intake, and fell thereafter, to about 35% today (Figure 3). If self-reports are to be believed, children's diets today contain less fat than they did 40 years ago. Similar patterns have been found for adult Americans. This may seem incomprehensible in the light of media reports of over-consumption of fat-rich fast food. However, it is easy to forget the increased consumption of rice, pasta and other "multicultural" foods; increasing availability of low-fat milk, cheese and other dairy products; and year-round availability of fresh fruit and vegetables.

Figure 3. Trends in reported fat consumption in young people aged 2-18, expressed as a percentage of total kilojoule intake. Each point represents a report at the age X sex X country level.



3.2.2 Soft drinks

Recently, much media attention has turned to soft drinks as the culprit in increasing pediatric obesity. Various mechanisms have been proposed, for example the low GI associated with corn syrup sweeteners. In the US, there has been a rapid increase in soft drink consumption amongst adolescents. However, data on the relationship between intake of soft drinks and overweight status are far from unequivocal. In Australia, apparent per capita soft drink consumption across the whole population rose rapidly from the 1970s until 1993, but has been relatively stable (at about 110-115 L per annum) for the last 12 years. The largest study ever done of the eating and activity patterns of children is the Heath Behaviours in School Children (HBSC) study, a multi-national study conducted in 34 (mainly European) countries. It asked a total of 137,953 children aged 11, 13 and 15 about their dietary, physical activity and sedentary behaviour patterns, and their height and weight (Jannssen et al, 2005). The authors attempted to find out which characteristics were best correlated with overweight and obesity. In 30 of the 34 countries, there was no relationship between soft drink consumption and overweight. In two countries (Belgium and Israel), there was a negative association (fatter kids consumed less soft drink). In only two countries (the Ukraine and Wales) was there a positive association between soft drink consumption and overweight.

3.2.3 Confectionery

The HBSC study also looked at the relationship between confectionery (sweets and chocolate) intake and overweight. Here the results were even more surprising: in 31 of the 34 countries, there was a significant negative correlation between intake of sweets and overweight. There are several possible ways of looking at these data. First, kids with a high intake of sugar may have a low fat intake. Second, overweight kids may deliberately restrict their intake of sweets to control their weight. It is possible that overweight kids will under-report their intake of "bad" foods. It is also possible that overweight use have larger portion sizes, as only the number of portions

was recorded. Finally, it is possible that more active kids eat more confectionery, because they are more active, and need more energy. Once again, the data are not unequivocal, and support many possible interpretations.

4 Trends in children's activity patterns

"Physical exercise, Epigenes, is of considerable importance for health. Its predominance over food was established in the past by the best philosophers and doctors."

Galen. *The exercise with the small ball.* c AD170.

Unfortunately, there are no good serial data on how children use their time. A wide variety of incommensurable instruments have been used over the last 100 years to capture children's activity patterns.

We do have good data on what Australian children do today. Using a computerised use-of-time instrument, the Multimedia Activity Recall for Children and Adolescents (MARCA), we have gathered more than 15,000 24 h recall profiles. These data allow us to map the breakdown of moderate-to-vigorous physical activity (MVPA) in peripubertal children.

MVPA can be divided into four main categories:

(1) locomotion (38% of all MVPA time)

(2) sport (35%)

(3) play (22%)

(4) other (11%)

Locomotion involves mainly walking (88% of time), with cycling contributing 9% and new locomotions 3%. The new locomotions are skateboarding (60%), scooter and rollerblading (about 20% each). The most popular *sports* (in order) are football (soccer), basketball, Aussie Rules, dancing, cricket, swimming and netball. Nine tenths of *play* is outdoor play. Outdoor play divides fairly evenly into playground games and just 'mucking around'. MVPA which is neither locomotion, sport nor play involves either schoolwork or chores, in roughly equal proportions. Most chores (a distressingly small component of children's overall time budgets) involve tidying the bedroom, with a smattering of garden work.

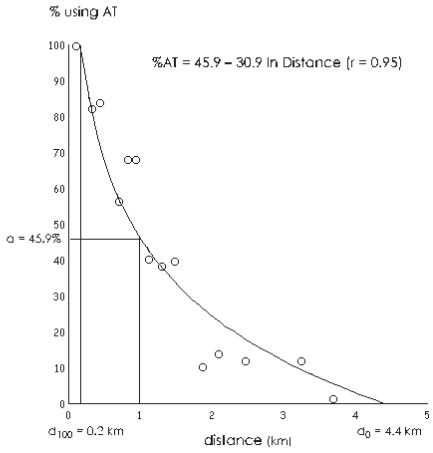
4.1 A window on the past

Occasionally we have data from very old studies on how children used their time in days gone by. In 1919 a young women, Miss E Bedale, was completing postgraduate studies in work physiology in England. As part of her work, she spent three years at a school in rural England, by happenstance called Bedales School. There she meticulously monitored the food intake and energy expenditure of the children, measuring energy costs using Douglas bags, and calculating the energy value of foods using a bomb calorimeter. The activity levels of the children are truly surprising. The average daily physical activity level (PAL) of these children was generally over 2 (ie, they required on average more than twice their basal metabolic rate). This compares to average values of about 1.6 for children of a similar age today. If the values Miss Bedale measured were typical of children of those times, then we have seen a reduction of 25% in overall energy expenditure, and a reduction of 40% in energy expenditure over and above resting values.

4.2 Active transport

One area in which good serial data exist is the use of active transport (walking and cycling) to school. Here studies from the US, Canada, the UK, New Zealand and Australia have shown systematic declines, at the rate of about 2% per annum. Each year, another 2% of children decide to get a lift with Mum or Dad rather than walking or riding (Harten and Olds, 2004). The main factor determining whether or not a child (or adult) will use active transport is the distance to destination. The probability of using active transport decreases with the log of distance. Almost every child will walk up to 200 m; almost no child will walk or ride 4.4 km (Figure 4). Trends towards declines in active transport are likely to be exacerbated in the future, as the distance between home and school, and home and the shops, increases. In the UK, for example, the average distance from home to school increased from just over 2 km to over 3 km between 1985 and 1998. At 2 km, about 25% of children will choose to walk or ride to school; at 3 km, fewer than 10% will.

Figure 4. The relationship between the probability of using active transport (Y-axis) and the distance to destination (X-axis) in 136 10-13 year old South Australian children. At a distance of 1 km, about 46% of children will walk or ride. All children will walk 200 m, but no children will actively travel 4.5 km.



4.3 Levine's solution

Perhaps we are focussing too much on moderate-to-vigorous physical activity in trying to understand how energy expenditure has changed. American researcher James Levine argues that non-exercise activity thermogenesis (NEAT) — the energy we expend by standing, fidgeting, shifting about — plays an important role in energy balance. He measured the time spent lying down, sitting and standing (including moving about) in 10 lean and 10 obese self-declared "couch potatoes". The obese volunteers spent 164 more minutes sitting each day, and 152 minutes less standing/walking each day, than the lean volunteers. This amounted to an energy difference of 1470 kJ each day. There was a strong inverse linear relationship (explaining 52% of the variance) between the amount of movement (determined by accelerometry) and percentage body fat determined by DXA.

To determine whether obesity led to differences in posture allocation, or vice versa, Levine then had his volunteers gain or lose weight (8 kg and 4 kg respectively). Weight gain and weight loss made no difference to posture allocation, suggesting that there are biological mechanisms driving

these behaviours. In an attempt to apply these findings to the childhood obesity problem, Levine has devised a 'classroom of the future' where there are no chairs. Children stand for several hours each day at benches containing laptops. There are cushions on the floor where they can sit occasionally. They may be following such "role models" as Donald Rumsfeld, who claims to stand for 10 hours each day.

5 Trends in sleep

There is mounting evidence that sleep deficits (low quantity, poor quality) are associated with obesity. This has been shown in studies on French and German 5 to 6 year olds, and American 11 to 16 year olds. The risk of obesity increases as sleep time decreases, rising to a fivefold increase in risk among those groups sleeping the least. In the German study, obesity increased in a dose-response fashion as sleep time decreased. In a recent analysis of the 1985 Australian Health and Fitness Survey data, similar trends were found in boys but not girls. There are a number of possible mechanisms, including disturbances to appetite-controlling (leptin and ghrelin) and glucoregulatory (cortisol) hormones. Alternatively, it may be that obesity leads to poorer sleep due to disorders such as sleep apnea, or that some third factor (perhaps television viewing) predisposes both to obesity and to poorer sleep.

We recently compared self-reported sleep time in 10-15 year old South Australian children in 1985 to their counterparts in 2004. Among girls, there was a reduction in total sleep time of approximately 28 minutes, while boys slept for 33 minutes less in the latter survey. Almost all of the reduction in sleep time is attributable to later bed-time. The reduction in sleep time was more pronounced in low SES boys (44 minutes) than high SES boys (23 minutes). There is, as far as we know, only one other study of secular trends in children's sleep, in Swiss children. Here too there were reductions in sleep time, though not as pronounced as in the Australian sample.

6 Is it such a bad thing to be overweight?

"The data linking overweight and death, as well as the data showing the beneficial effects of weight loss, are limited, fragmentary and often ambiguous."

Editorial, *New England Journal of Medicine* (1998).

It is popularly believed that fatter people have reduced life expectancy as a result of a greater likelihood of suffering from metabolic and cardiovascular disorders. In 2005, researchers at the Centres for Disease Control published an analysis of data from the NHANES surveys which challenged this belief. The data suggested that overweight people (BMI 25-30) actually live longer than people of normal weight (BMI 18.5-25). Relative to people of normal weight, the risk of death of overweight individuals was less than 80%. Furthermore, there has been an historical trend for the relative risk of death in overweight and moderately obese individuals to decrease since the 1970s. These results caused a great deal of surprise among public health researchers, but a number of researchers, among them Glen Gaesser and Ancel Keys, had previously questioned the link between moderate levels of overweight and increased mortality and morbidity.

These surprising findings may be due to the greater likelihood of targeted interventions for this group — greater use of statins and anti-hypertensives, for example, or more lifestyle interventions. However, they do show that the notion of a 'natural' ideal BMI is untenable: mortality curves are specific to a particular society, which chooses to treat certain groups in certain ways. They also suggest that while real risks exist for the grossly obese, moderate overweight may not pose such a public health problem.

7 Conclusion

"Better to walk in darkness than to follow a false light."

Voltaire

The received wisdom about the aetiology of childhood obesity is not unequivocally borne out by the evidence, and both media and academic sources are often abusively selective in their use of the literature, not infrequently with political ends in view. There is no doubt that children are getting fatter. It is likely that this is associated with reduced aerobic performance. An objective look at the evidence doesn't allow us to conclude with confidence that the historical reason for increased fatness has primarily been increased energy intake, or alternatively decreased energy expenditure. If energy expenditure has decreased, it may not be primarily due to reduced sport and play, but rather to increased sedentarism. Whatever the historical pattern of change, however, there are not necessarily any lessons here for interventions. Even if children have become fatter mainly due to decreases in energy expenditure without concomitant increases in intake, it may be impossible to recreate the social and built environments which made higher levels of energy expenditure possible or necessary decades ago. Furthermore, it would be a preposterously narrow point of view which would ignore the benefits of a healthy diet unrelated to obesity. So both energy intake and energy expenditure should remain as elements of any intervention strategy. In the meantime, politicians, the media and academics should be much less confident about ascribing blame to individuals, parents, corporations or governments. **SH**

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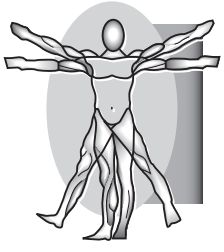

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SPORTS MEDICINE:
Why isn't it considered an important attribute for talented coaches?

Erin O'Keeffe

This article reports the outcome of part of a study conducted to investigate the concept of talent in sport coaching. One of the findings of the study was that sports medicine knowledge was not considered to be an important attribute of a talented coach.

The study was conceived by the Centre of Excellence for Applied Sport Science Research (CoE) at the Queensland Academy of Sport (QAS) as there was interest in investigating possible strategies for the attraction and retention of talented coaches to sport. One of the priority research areas for the CoE is coaching and the coaching process, and the lack of understanding of the attributes that identify a talented coach was seen as an important topic for investigation.

Since the completion of this project, the QAS, in partnership with Griffith University, has been awarded an Australian Research Council Linkage Grant to further investigate the issues surrounding the attrition and retention of coaches in sport.

The project adopted a multi-method approach, utilising interviews and questionnaires in two stages. The first stage was designed to develop a questionnaire that could be used to assess a sample of the Queensland coach population. Nine coaches, coaching administrators and athletes were interviewed and transcripts analysed along with the literature to structure a qualitative questionnaire designed to ascertain the attributes of a talented coach and how these can be identified.

The questionnaire provided 77 possible attributes of a talented coach arranged in six areas: personal background, characteristics, knowledge, operational practices, motivation and athlete-coach interaction. Eleven questions regarding how and where a talented coach could be successfully identified were also provided. Attributes were rated using a 5-point scale of agreement: 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree.

All the 82 State Sporting Organisations (SSOs) in Queensland were contacted and asked to contribute to a database of individuals for the survey. Names and contact details of individuals were provided in five categories: beginner coach, experienced coach (coaching for more than 2 years), lapsed coach (coaching but no longer accredited), retired coach (no longer coaching) and coaching administrator (involved in the supervision of a number of coaches). Individuals were also classified according to the highest level they had coached (club, state or national level). Three hundred of the individuals provided by the SSOs were selected at random for a subject sample and 162 returned completed questionnaires, 159 of which were usable.

The sample closely matched the wider population in terms of gender, experience and category (ie, beginner, experienced, retired, lapsed or administrator). Males represented just over two thirds (72%) of the sample which consisted of club- (38%), state- (28%), and national-level (34%) participants. Experienced coaches represented the majority of the coaches sampled (58%). Other types of coaches were represented as follows: coaching administrator (24%), retired (6%), lapsed (6%) and beginner (6%). Thirty-two sports were represented in the sample (athletics, baseball, BMX, canoeing, cricket, croquet, cycling, dancesport, equestrian, golf, gymnastics, handball, hockey, indoor cricket, lacrosse, little athletics, masters swimming, motorcycling, netball, rowing, rugby union, soccer, squash, surf life saving, swimming, synchronised swimming, tennis, touch football, triathlon, water polo, women's golf and yachting).

Mean scores for each of the items were ranked in order of the attributes identified by participants as important in a talented coach. 'Knowledge of sports medicine' was ranked 51 of the 77 attributes. This ranking was stable for different demographic groups (eg, age, category, experience, education, years coaching, gender, and level of accreditation). This result indicated that -- male and female, state and national, beginner and retired, old and young, registered and unregistered coaches -- all considered sports medicine knowledge to be relatively unimportant as an attribute of a talented coach.

This is a disturbing finding, given that more than 45,000 hospitalisations in Australia are sport-related (Flood and Harrison, 2006) and that in 2002/03 the greatest number of sport-related hospitalisations involved children under 14. The football codes are a major group in these hospitalisations (Flood and Harrison, 2006) and this statistic represents only those injuries requiring hospitalisation. Injuries not requiring hospitalisation were not included.

Further research was warranted and follow up interviews were conducted with an experienced coach, a beginner coach, a coach administrator and a sports medicine professional in order better to understand the finding. Interviewees were asked why they thought sports medicine was not considered important for coaches, what level of knowledge they thought was necessary in sport coaches, and what assistance coaches

should have if they had little or no knowledge of sports medicine.

Sports medicine was defined as encompassing those professions that service athletes when they are injured, ill or rehabilitating. They included massage therapy, medicine, nutrition, physiotherapy, podiatry and psychology.

The results of the interviews suggested that sports medicine was considered an important component of the sports team. However the coach was not considered the most appropriate person to hold this knowledge. A coach was considered to be employed because he or she possessed specialised knowledge of the sport and was able to perform three key tasks: introduction and encouragement in sport, teaching of sport specific skills and facilitation of the use of sport skills.

The interviewees considered that the value of sports medicine and the extent to which it is utilised would depend primarily on the culture of the sport and how important its inclusion was deemed by the coach. In most sports the coach has considerable input into the content of the program and, in general, if the coach does not consider sports medicine to be important or has poor knowledge and understanding of sports medicine, then its inclusion is likely to be minor.

The interviewees commonly agreed that coaches at all levels and in all situations required some knowledge of sports medicine. In the present sporting climate, the duty of care of the coach to conduct the sport practice in a safe manner is of utmost importance. In order to achieve this, the interviewees agreed that coaches should possess enough sports medicine knowledge to 'know what they don't know' and so be able appropriately to refer to a professional with the required knowledge and skills. A coach should therefore be able to identify situations that require professional input. All interviewees agreed that the coach should not be required to possess the skills and knowledge needed to treat injuries or deal with situations more appropriately handled by a specific sports medicine professional. Coaches should also recognise the responsibility that knowledge brings and their duty of care not to administer any type of treatment without having the appropriate qualifications.

The coach should know enough to understand when sports medicine preventative care is appropriate for inclusion in the training and competition schedule. Interviewees considered that coaches should understand the needs of the athlete, and particularly have the skills to adapt the training and competition program to an athlete who is injured or rehabilitating.

It was specifically noted by three of the four interviewees that, in general, coaches do not well understand the needs of athletes returning from injury, particularly the ramifications to athletes if they return to training or competition prematurely. It was suggested that coaches often do not well comprehend healing processes and return athletes too early. To help facilitate athlete rehabilitation from injury, coaches should better involve the appropriate sports medicine professional.

The question must be raised: if sports medicine knowledge is not an important attribute in a talented coach, what level of support from sports medicine professionals is required in order to conduct sport in a safe manner? It was not surprising that interviewees identified that the level of support required differed depending on the nature of the sport. High risk and high injury sports require different types and levels of services than low risk sports (typically sustaining few injuries). When considering sports medicine components, the coach should be aided by national sporting organisation (NSO) guidelines for safe sport.

In order to meet the guidelines for safe sport, it was considered that sports medicine professionals should be readily available. However, two of the four interviewees identified that, in general, coaches lacked knowledge regarding how to go about accessing sports medicine support. It was suggested that, in order to facilitate the introduction of sports medicine professionals to sport programs, the introduction of a contact network would be a useful tool. The extent and nature of this would depend on the sport involved. For example, many sports have a considerable number of doctors, physiotherapists, nutritionists, massage therapists, podiatrists and sport psychologists with specific knowledge of their sport. Coaches in these sports may indeed not need sports medicine knowledge as they have easy access to professionals with required knowledge and skills. However, all sports are not so fortunate and, for these coaches, SSOs and NSOs are able to assist by providing a contact network.

In answer to the original question (Why is sports medicine not considered an important attribute for talented sports coaches?), it appears that the sports medicine professional and not the coach, is considered to be the appropriate person to hold this knowledge.

The following two key recommendations from the interviewees may help to bridge the gap between the coach and the sports medicine professional:

- Coaches should know enough to know what they do not know, indicating that their knowledge need only be basic, but enough to recognise when it is prudent to involve a sports medicine professional.
- In order for the coach to involve sports medicine professionals, appropriate contact networks should be available. **SH**

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Returning to sport following injury

Key considerations for coaches and health practitioners

Leslie Podlog

Sport injury can have a profound physical and psychological impact on many high-performance athletes. In addition to the physical limitations of injury, the psychological demands and uncertainties associated with injury recovery and return to sport may prove equally challenging.

Coping with the emotions of physical incapacitations, feelings of alienation and isolation from teammates and coaches, anxieties associated with re-injury and concerns about performing to pre-injury levels may be common (Bianco, 2001). Injury occurrence may also prompt identity concerns or initiate questions about one's self-worth (eg, 'If I'm not an athlete then who am I?') as athletes contend with the physical limitations and demands of rehabilitation. Athletic injury therefore not only limits athletes' physical performance capabilities but also taxes their psychological health, well-being and ability to realise their full athletic potential.

A wide body of research indicates that psychological factors (eg, stress) may predispose particular athletes to a greater risk of injury occurrence (Williams and Andersen, 1998) and that injury may impact upon athletes' cognitive and emotional functioning (Brewer, 2001). Moreover, psychological factors have been found to play an important role in the recovery and rehabilitation process. For example, Ievleva and Orlick (1991) found that athletes who used mental imagery, set goals and used positive self-talk recovered more quickly than athletes who reported lower levels of the use of such psychological skills.

Though researchers have examined the psychological factors influencing injury onset and recovery, only recently has greater attention been given to the psychosocial processes involved in returning to sport following injury. Increasingly, there is recognition that athletes who are physically healed and ready to return to sport may not necessarily be psychologically prepared (Podlog and Eklund, 2006). An understanding of the psychosocial factors influencing the return-to-sport transition following injury would therefore appear to be a significant issue.

This article seeks to address some of the prominent psychosocial issues and concerns among returning athletes. Having a clearer understanding of these issues may enable coaches, sport scientists and health practitioners the better to assist athletes in their return to sport efforts. Following a discussion of some of the key considerations for those assisting returning athletes, a number of practical strategies designed to meet athletes' psychosocial needs are offered.

Key Considerations for Coaches and Practitioners Assisting Returning Athletes

Returning to sport following a serious injury is at its core a motivational issue. Overcoming the potential obstacles and hurdles associated with rehabilitation and return to sport (eg, physical pain, repetitive rehabilitation exercises, injury setbacks) may require a high level of desire, determination and commitment. A range of motivations including a love and passion for the game, an intense desire to improve one's skill level and the achievement of future goals and aspirations may energise athletes' return to sport following injury. Athletes are also commonly motivated to return to sport in order to maintain their athletic identity or to retain a sense of affiliation with coaches, team-mates or training partners. For many athletes, these return-to-sport motivations may also be a source of doubt, worry and apprehension. As discussed below, initial investigations into the return to sport following injury reveal that issues of competence, autonomy and relatedness may be prevalent (Podlog & Eklund, 2006).

Competence issues

For many athletes the achievement of particular levels of competence is of utmost importance to them. Not surprisingly, athletes often report feelings of apprehension on this account following what may have been a long lay-off due to injury. In particular, fears regarding the ability to return to pre-injury levels (eg, retaining a place on a team), to realise one's 'full potential (eg, achieving personal bests) and concerns about re-injury may be at the forefront of athletes' minds as they re-enter the competitive arena. A field hockey player who had recently returned to competition commented:

"Well, when I went out for the first couple of games and when I was at training, I felt quite apprehensive. Sure the hand was part of that – if it's going to get hit, there's that kind of aspect, the physical kind -- but then there's also the psychological side. I knew in my first two games that I wasn't anywhere near the capacity at which I could play. I wasn't playing my best hockey whatsoever and I guess you feel apprehensive. I keep asking myself will I get back to that next level, because I've been out for so long; can I mix it with the guys especially with the national league campaign this year; will I actually make a difference to the team and will

I be good enough to play with them? My confidence is down at the moment, there's no doubt about that, but I need to feel that I can go out there and actually make a difference [that] I'm not just another person on the team, if you know what I mean."

Concerns over reduced fitness levels may also be prevalent given that athletes may not have competed in intense 'game-like' circumstances for a prolonged period of time. Physical fitness concerns may be a normal preoccupation for elite level athletes but these concerns may be exacerbated after the time off due to injury. The athlete who has gained weight while injured or who has struggled to maintain an appropriately high level of physical fitness may experience doubts about his or her ability to sustain play at a high level of intensity throughout an entire match or competition. Such individuals may also be worried about how long it will take to regain a competitive level of fitness.

Ensuring good physical preparation and checking that athletes have passed both clinical and sport-specific functional tests prior to a return to competition have been cited as two important ways to help alleviate competence concerns and ensure readiness to return to competition (Cox, 2002). Athletes often gain a sense of competence through past performance accomplishments. It may therefore be important to provide athletes with adequate opportunities to achieve particular performance standards and to experience adequate levels of intense training prior to a return to competition. Athletes who have not had adequate time to do so have indicated diminished confidence and performance levels (Bianco, 2001; Podlog & Eklund, 2006).

Autonomy issues

Given their intense desire to achieve at the highest level, many elite athletes may put pressure on themselves to return to sport before the injury is completely healed. Athletes often feel that they are 'falling behind' their competitors or others who are training and competing during their absence (Podlog & Eklund, in press). As a consequence high performance athletes, particularly those who have experienced their first severe injury, may have a sense of urgency to return to sport before it is prudent to do so. A rower who was on the cusp of competing at the top senior level in Australia commented:

"I was just eager to get back doing things. That was during the period where I was just starting to row again and I was getting beaten by people that I would've beaten before so I thought: *Right, I've got to get back into it, get training and get in front of these people. They're beating me, it's crap, I don't want it to happen.*

Autonomy issues may also surface regarding decision-making processes about the timing of the return to sport from injury. Some athletes may experience a strong degree of independence in their decisions about when to return to training and competition. Others however may receive pressure from coaches, teammates or family members to return for a particular competition or an upcoming event. Research with elite skiers has indicated that athletes who returned because they felt pressure to meet the coaches' expectations or to compete in an important competition experienced poor performances and/or reinjury (Bianco, 2001).

Relatedness issues

Interviews with elite athletes have also revealed that relational issues may be significant during the return to sport transition. Athletes have discussed frustrations over not being able to be around teammates, missing bonding and competition experiences, and social support issues. For many athletes a primary motivational influence to return to sport is to be part of a team and to experience the strong bonds of camaraderie associated with such team membership. An important source of identity or belonging for many athletes centres around their sport participation. Athletes have described feelings of isolation from teammates during injury recovery as well as frustrations over missing out on important bonding opportunities during interstate and overseas trips. As one semi-professional soccer player stated:

"The most frustrating thing was actually watching the boys training and seeing them go through the hard work and it's hard, not being able to do it with them. I'm pretty lucky that I haven't missed any games but, in terms of missing the pre-season, a lot of team bonding happens in that early part of the season. We all go through a lot of hard yards together and I've missed that with the boys. I've had to do it [training] by myself…"

According to athletes, one of the most enjoyable and satisfying aspects of the return to sport may be interacting with teammates and competing alongside 'good mates'.

The importance of receiving social support from coaches, teammates and family members is another key relatedness issue regarding a return to sport from injury. Receiving support from coaches and teammates may be extremely helpful in assisting athletes in overcoming confidence difficulties, particularly in the initial phases of the return to sport. Athletes whose play is hesistant or who experience performance declines upon initial return have described the importance of receiving social support (eg, words of encouragement) from significant others. Coaches, family members and teammates may provide athletes with feedback to assist them in creating realistic performance expectations, in assisting them to make positive performance evaluations and to help build confidence through verbal persuasion.

An important issue that has been raised regarding the effectiveness of social support in injury recovery settings is that the type, amount and timing of the support offered has to match the needs of the support recipient. In other words, the social support offered to athletes may only be effective in so far as it meets the athlete's social support needs at a given point in time. If , for example, the athlete has experienced a poor performance following the return to sport, providing emotional support (eg, positive encouragement) may be more effective than telling him or her that further rehabilitation is needed on the injured limb or body part.

Despite the fact that coaches or team-mates often have the best of intentions in providing social support, some athletes have commented that the type of feedback they receive may be inappropriate or inadequate. As one athlete expressed it:

"I guess when I first came back at the start the feedback was mainly positive. The main thing people told me was, you know, no one expects you to play well, everyone's just happy you're out there and on the field again. To tell you the truth, that annoyed me a little bit, because I feel as though if you're actually back playing then you should be out on the field giving 100% and you shouldn't be someone who the rest of the team's carrying along…The main issue, as I said before, coming back from injury was that I don't like people to have lower expectations of how I play and that was mainly the feedback I got the first month or two of play."

Strategies for Assisting Returning Athletes

The experiences of elite athletes returning to sport from injury indicate that there may be a number of important considerations that health practitioners, sport scientists and coaches

working with recovering athletes need to address. Given the focus on competence, autonomy and relatedness issues raised in previous research on the return to sport transition (Podlog and Eklund, 2006) ensuring that these three psychological needs are satisfied may facilitate ameliorated recovery outcomes and post-injury performances. Competence-related issues may include concerns about regaining previous performance/skill levels, achieving future goals, fears of reinjury and diminished confidence about physical fitness.

Competence issues may be addressed in a variety of ways.

First, imagery can be an effective tool in having athletes rehearse performance situations they are likely to encounter upon their return to competitive activity. Research on imagery with injured athletes indicates that it is an effective means for building confidence and can be used to address re-injury fears (Green, 1993).

Second, encouraging athletes to establish realistic expectations for their initial performances and focusing on short-term process (ie, task-oriented goals) may be a useful way to help build competence in their physical and mental capabilities. Providing athletes with as many opportunities as possible to experience success may assist them in avoiding a sense of frustration and decreased confidence should they struggle to immediately return to pre-injury form (Gilbourne and Taylor, 1998).

Third, providing athletes with progressive physical challenges that they can successfully meet without physical pain can enhance their sense of competency regarding their capabilities and their bodies' ability to remain uninjured (Cox, 2002). Reassuring athletes that they have met all the physical requirements necessary for their return may help alleviate concerns about re-injury and performance issues. Discussion of return-to-sport fears or concerns can provide an opportunity to dispel irrational beliefs and to 'get out in the open' any issues the athlete might have (Cox, 2002; Taylor et al, 2003).

Finally, putting returning athletes in contact with other athletes who have experienced and overcome similar injuries (ie, establishing athlete mentoring systems) may be highly beneficial for returning athletes' confidence levels. Having role models who have come back from a similar injury may give athletes returning from injury a sense that if others can do it, so can they (ie, 'seeing helps believing') (Flint, 1993).

Meeting an athlete's relatedness needs may also be important in ensuring a safe and successful return to sport following injury. In particular, feelings of isolation from team-mates and coaches as well as social support issues may need to be addressed. In order to minimise the potential isolating effects of injury, it may be useful for coaches in particular to provide meaningful interaction opportunities for the returning athlete (eg, weight training sessions with team-mates, attending team meetings). Additionally, ensuring that athletes' social support needs are met may facilitate a smooth return to sport following injury.

As indicated, there may be occasions in which inconsistencies between the type of support offered and the type of support required occur. Ultimately, the effectiveness of social support networks may be maximised when the amount, type and timing of the support offered is consistent with the athlete's needs at a particular point in time (Bianco and Eklund, 2001). Enhancing social support relationships and ensuring effective coach/athlete and coach/physiotherapist communication may therefore be a key area to address during the return to sport transition.

Finally, autonomy issues have received scant attention in the sport psychology literature on injury recovery and return to sport. Information regarding decisions about the timing of the return to sport and who influences these decisions may be important considerations to address as athletes re-enter the competitive arena. The degree of autonomy that athletes have in making their return to sport may be an important factor influencing athletes' return to sport outcomes (eg, competitive anxiety levels, re-injury concerns, confidence in performance capabilities) (Podlog & Eklund, 2005).

Having a discussion with athletes prior to their return to training and competition about why they are returning may help the coach or practitioner establish which athletes are returning for the 'wrong' reasons (eg, pressure from a coach or team-mate; guilt about missing an important competition in which the athlete does not feel prepared to compete). Given that athletes may be susceptible to receiving pressure to return to sport (and that they typically want freedom from such pressure), coaches and medical practitioners need to ensure that athletes have the freedom to return at a time and manner of their own choosing (Bianco, 2001). Furthermore, coaches need to be aware of any personal tendencies toward pressuring the athlete or creating feelings of guilt during his or her return. Ultimately, rushing athletes into a return

to competition may only be doing a disservice to them. In these instances, physiotherapists, athletic trainers or medical practitioners may be ideally positioned to act as mediators between athletes and those encouraging them to return possibly before they are physically or psychologically prepared to do so.

Ultimately, the effectiveness of any rehabilitation program may depend upon the degree to which coaches, healthcare practitioners and sport scientists meet both the physical and psychological needs of athletes. Ensuring that athletes' needs for competence, autonomy and relatedness are satisfied may be important in ensuring that athletes make a safe and successful return from injury. Having discussed some key considerations regarding the return to sport transition following injury, I hope that the strategies provided help empower coaches, sport scientists and health practitioners to meet athletes' physical and psychological needs. **SH**

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CRICKET AUSTRALIA Injury Report 2006

By John Orchard, The University of New South Wales, Trefor James, Medical Director Cricket Australia, and Marc Portus, Sports Science Medicine Unit Manager - Commonwealth Bank Centre of Excellence.

Cricket is one of the world's major team sports and as of 2005 was the first sport to publish consensus international injury definitions [1-4]. Injuries in cricket are common, particularly to fast bowlers [5-12]. It is accepted that ongoing injury surveillance is the fundamental pillar of successful injury prevention [13]. Hence, there is general agreement internationally that cricket should follow the Van Mechelen paradigm of injury surveillance being the basis for risk factor and interventional studies which can ultimately lead to injury prevention [11]. Dr Caroline Finch, a leading Australia sports injury epimediologist, has recently published a further framework for injury prevention (TRIPP – Translating Research into Injury Prevention Practice) [14]. The TRIPP framework (Table 1) extends the Van Mechelen paradigm to include steps of applying the results of scientific study back into the 'real world'. Successful ongoing injury surveillance in even major sports has proven elusive, partially because of the difficulties in forming consistent injury definitions [15]. This lack of consensus has previously limited the ability to compare injury rates between countries and to ascertain risk factors for injury.

With the establishment by Cricket Australia of the Sports Science Medicine Advisory Group (SSMAG), the injury survey is now an ongoing core component of cricket research in Australia. It will not only continue to provide a framework to highlight the most important areas which need further study, but also, in the long-term, injury surveillance can follow trends in injury rates to test the interventions which are recommended by other studies. [13,16]

Results

Injury exposure calculations

Table 1 lists the number of players in each squad per season, and Table 2 lists the number of matches per team per season. Since 1998-99 the Australian team has contracted 25 players annually prior to the start of any winter tours (i.e. during late May or early June). The Australian squad for each subsequent season has been greater than 25 players, as it includes (from the date of their first match until the new round of contracts)

Table 1 - Squad numbers per season

SQUAD	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Australia	31	30	32	30	28	31	28	30
New South Wales	30	32	30	35	31	28	27	37
Queensland	20	23	26	28	27	30	30	31
South Australia	31	23	23	27	32	22	30	26
Tasmania	21	20	27	28	26	24	22	27
Victoria	26	23	27	31	30	29	26	36
Western Australia	23	26	30	30	29	30	30	37

Table 2 - Team matches under survey from 1998-99 to 2005-06

TEAM MATCHES PLAYED	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Domestic Twenty/20								14
Domestic One Day	42	42	62	62	62	62	62	62
Domestic First Class	62	62	62	62	62	62	62	62
International Twenty/20							1	2
One Day International	23	34	22	22	32	32	26	36
Test match	12	13	8	14	8	15	14	17
ALL MATCHES	139	151	154	160	164	171	165	193

Table 3 – Team days played under survey 1998-99 to 2005-06

COMPETITION	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Domestic Twenty/20								14
Domestic one day	42	40	62	62	62	62	60	60
First class domestic	222	232	228	228	220	242	234	228
International Twenty/20							1	2
One day international	23	34	22	21	32	32	24	36
Test cricket	53	53	33	61	32	69	58	78
TOTAL	340	359	345	372	346	405	377	418

Table 4 – Designated player hours of exposure in matches each season

COMPETITION	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	TOTAL
Domestic Twenty/20								242	242
Domestic one day	1819	1732	2685	2685	2685	2685	2598	2598	19485
First class domestic	8658	9048	8892	8892	8580	9438	9126	8892	71526
International Twenty/20							17	35	52
One day international	996	1472	953	909	1386	1386	1039	1559	9699
Test cricket	2067	2067	1287	2379	1248	2691	2262	3042	17043
	13539	14319	13816	14865	13898	16199	15042	16368	118047

any other player who tours with or plays in the Australian team. State teams can contract up to 20 other players on regular contracts (outside their Australian contracted players) and up to 5 players on 'rookie' contracts. As with the Australian team, any other player who plays with the team in a major match during the season is designated as a squad member from that time on.

The format of the Pura Cup (formerly Sheffield Shield) has consistently been that each of six teams plays ten matches each, one home and one away against each of the other teams (60 team matches), followed by a final (2 team matches) at the end of the season. The matches are all scheduled for 4 days, with the final being scheduled for 5 days. Since 2000-01, the domestic limited overs (one day) competition has followed the same home & away format as the Pura Cup.

The domestic limited over series (currently Ford Ranger and formerly both ING and Mercantile Mutual Cup) format from 1995-96 to 1996-97 was a single round of matches for the six teams (30 teams matches) followed by two semi-finals and then a Grand final (6 team matches). During the 1997-98 to 1999-00 seasons, a team from the ACT was entered in the competition, although not included in injury surveillance. Each of the teams played the ACT once in the regular season, adding another 6 team matches.

As seen from Table 3, in domestic limited overs (ING Cup) and One Day International (ODI) matches, the number of team days is generally the same as the number of team matches scheduled. In 1999-00, 2004-05 and 2005-06 there was a single ING match (two team matches) completely washed out and in 2001-02, there was one ODI match (one team match for Australia) completely washed out, so no days were played. There was also one Pura Cup game in 2000-01 completely washed out. The average number of team days played on average for Pura Cup games is between 3.5 and 4 each year, with the average number of team days in Test matches being between 4 and 5 each year.

Table 5 – Overs bowled in matches each season

MATCH TYPE	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	TOTAL
Domestic Twenty/20								241	241
Domestic one day	1874	1858	2690	2835	2697	2883	2729	2851	20419
First class domestic	9945	9729	9837	9833	9224	10311	9871	9612	78362
International Twenty/20							20	58	78
One day international	1061	1486	1052	980	1377	1417	1057	1577	10006
Test cricket	1910	1882	1347	2243	1271	2802	2159	2756	16369
TOTAL	14791	14955	14926	15891	14569	17413	15835	17094	125474

Table 6 – Average number of overs bowled each team day of play

MATCH TYPE	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVG.
Domestic Twenty/20								17.2	17.2
Domestic one day	44.6	46.5	43.4	45.7	43.5	46.5	45.5	47.5	45.4
First class domestic	44.8	41.9	43.1	43.1	41.9	42.6	42.2	42.2	42.7
International Twenty/20							20.0	19.4	19.6
One day international	46.1	43.7	47.8	46.7	43.0	44.3	44.0	45.0	44.9
Test cricket	36.0	35.5	40.8	36.8	39.7	40.6	37.2	35.3	37.5

Table 7 – Player days of exposure available (for prevalence calculations)[1]

TEAM	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	TOTAL
Domestic Twenty/20								439	439
Domestic one day	990	916	1495	1739	1675	1651	1564	1839	11869
First class domestic	5160	5343	5586	6435	5936	6477	6157	7189	48283
International Twenty/20							28	82	110
One day international	678	964	631	608	865	881	640	960	6227
Test cricket	1517	1444	947	1707	820	1906	1562	2095	11998
TOTAL	8345	8667	8659	10489	9296	10915	9951	12604	78926

Table 8 - Injury match incidence (injuries/10000 player hours)

MATCH TYPE	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVERAGE
Domestic Twenty/20								41.3	41.3
Domestic one day	55.0	34.6	48.4	22.3	37.2	67.0	42.3	57.7	45.7
First class domestic	32.3	24.3	22.5	45.0	24.5	23.3	23.0	15.7	26.3
International Twenty/20							0.0	192.7	144.5
One day international	80.3	61.1	52.5	33.0	72.2	57.7	67.4	19.8	54.9
Test cricket	24.2	62.9	23.3	29.4	24.0	44.6	8.8	23.0	30.5
ALL MATCHES	37.7	34.9	29.7	37.7	31.7	37.0	27.3	25.1	32.5

As per the new international formula [1-4], hours of player exposure in matches is calculated by multiplying the number of team days of exposure (Table 3) by 6.5 for the average number of players on the field and then multiplied by the number of designated hours in a day's play. For first class matches this is 6 hours per day and for one day matches this is 6.667 hours per day. This gives a designated exposure in terms of player hours (Table 4) which is used as the denominator for match incidence calculations. This exposure (in terms of match hours) has risen steadily over the period of the survey, with the highest level recorded in season 2005-06. As has been previously discussed, increased match exposure tends to increase injury prevalence, as when matches are scheduled closer together there is less recovery time between games.

Table 5 shows that workload in terms of number of overs bowled has stayed fairly steady in first class domestic cricket over the past ten years, but has increased in domestic one day cricket since 2000-01. The peak number of overs bowled by teams in the survey was in 2003-04.

Table 6 reveals that there have generally been fewer overs bowled by the Australian Test team in an average day's play than in other forms of cricket. Generally each team is bowling 40-48 overs per scheduled day, and is presumably in the field for half of each match. In first class cricket in recent seasons, the teams in domestic matches have been required to complete 96 overs per day compared to 90 overs per day in international matches.

Player days per team per season are calculated by multiplying the size of the squads (for each match) by the number of days for matches (Table 7). A vary minor variation from the international definition recommendations is that an uncontracted player was considered to have become part of the squad if he was selected as 12th man in the team

1 Seasonal incidence calculations use almost identical exposure data except that for prevalence calculations, a player who joins the squad mid-season is not considered to be exposed to missing his first game through injury. This is because an uncontracted player can only be considered to have joined a squad mid-season by playing a game, hence he cannot miss this first game through injury.

Table 9 - Injury seasonal incidence by team (injuries/team/season)

TEAM	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	TOTAL
Australia	18.4	15.5	18.0	15.5	22.2	18.3	15.0	15.7	17.1
New South Wales	14.2	11.7	16.3	18.5	9.2	19.9	5.8	8.1	12.8
Queensland	13.1	17.0	17.2	25.3	15.7	20.4	17.9	15.0	17.9
South Australia	24.3	13.5	23.1	17.6	17.9	20.3	9.7	17.3	17.9
Tasmania	17.7	13.9	18.4	16.9	20.5	13.2	19.7	21.9	17.9
Victoria	18.6	23.3	16.9	20.5	20.0	18.6	13.4	15.1	18.0
Western Australia	21.1	19.7	14.1	16.6	19.8	15.2	23.6	11.1	17.3
ALL TEAMS	18.4	16.2	17.5	18.3	17.8	18.1	15.1	14.6	16.9

Table 10 - Injury seasonal incidence by body area

INJURY TYPE	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVG.
Fractured facial bones	0.0	0.3	0.2	0.3	0.0	0.1	0.2	0.2	0.2
Other head and facial injuries	0.2	0.0	0.0	1.0	0.2	0.1	0.2	0.1	0.2
Neck injuries	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.2	0.1
Shoulder tendon injuries	1.2	1.4	0.5	0.9	1.1	0.0	0.2	0.8	0.7
Other shoulder injuries	0.0	0.0	0.5	0.7	0.3	0.4	0.9	0.8	0.5
Arm/forearm fractures	0.4	0.3	0.0	0.0	0.0	0.0	0.2	0.1	0.1
Other elbow/arm injuries	0.2	0.2	0.5	0.0	1.1	0.1	0.2	0.6	0.4
Wrist and hand fractures	1.1	0.7	1.7	1.7	1.1	1.0	1.2	0.8	1.2
Other wrist/hand injuries	0.5	0.7	0.5	0.1	0.6	0.7	1.2	0.4	0.6
Side and abdominal strains	1.6	1.0	2.1	1.8	0.5	1.1	1.4	0.6	1.2
Other trunk injuries	0.5	0.0	0.2	0.4	0.0	0.5	0.0	0.6	0.3
Lumbar stress fractures	0.2	0.5	0.5	0.7	1.4	1.0	0.2	0.4	0.6
Other lumbar injuries	1.8	1.0	1.4	0.9	1.9	1.8	1.1	1.5	1.4
Groin and hip injuries	2.0	0.7	1.0	0.9	2.2	2.2	0.8	1.1	1.3
Thigh and hamstring strains	3.2	1.6	2.6	2.6	1.9	2.9	2.6	1.3	2.3
Buttock and other thigh injuries	0.0	0.2	0.9	0.1	0.0	0.8	0.0	0.0	0.2
Knee cartilage injuries	0.7	0.9	1.5	1.4	0.6	0.4	0.9	1.8	1.1
Other knee injuries	1.6	1.4	0.9	0.6	0.3	0.4	0.0	0.6	0.7
Shin and foot stress fractures	0.2	0.2	0.3	0.3	0.8	0.3	0.6	0.1	0.3
Ankle and foot sprains	1.1	1.2	1.0	1.1	1.0	1.6	0.8	0.5	1.0
Other shin, foot and ankle injuries	1.1	1.2	0.5	2.0	1.6	1.8	1.8	0.5	1.3
Heat-related illness	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Medical illness	0.9	2.4	0.3	0.9	1.0	0.7	1.1	1.5	1.1
TOTAL	18.4	16.2	17.5	18.3	17.8	18.1	15.1	14.6	16.9

during season 2005-06. This change was made in response to the rule present in one day cricket during 2005-06 which allowed the 12th man to play as a substitute.

Injury incidence

Injury incidence results are detailed in Tables 7-9. Injury match incidence is calculated in Table 8 using the total number of injuries (both new and recurrent) as the numerator and the number of player hours of exposure (Table 4) as the denominator.

Injury match incidence in the units of injuries per 10000 player hours is higher in ODIs than Test matches. There is also a small difference in injury match incidence between domestic One Day matches and first class matches, although not to the same extent as in international cricket. Because first class matches are played over a much longer duration than limited overs matches (at both domestic and international level), they produce a higher number of injuries per match, even though the hourly rate is lower.

The matches with generally the highest incidence of injuries are ODIs played in Australia [5]. The majority of home ODIs are played in quick succession as part of a Tri-series (mainly during January and February each summer). From Australia's viewpoint, this is the most crowded time of the international cricket calendar, with the Tri-Series continuing on after back-to-back Test matches in Melbourne and Sydney over the Christmas and New Year period. Therefore, high recent workload is a relevant consideration for the Tri-series.

Seasonal incidence (Table 9 and Table 10) is calculated by number of injuries multiplied by 1500 (for a squad of 25 players over 60 days), divided by the number of player days of exposure (Table 7). Table 9 shows that over a eight season period, there is very little difference in injury incidence between the six Australian states, with the exception of New South Wales. NSW has a slightly lower seasonal incidence than the other states and Australian squad. Generally (Table 1) NSW has had higher squad numbers than the other

Table 11 - Comparison of injury prevalence between teams

	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	Average
Australia	8.6%	8.8%	11.1%	6.7%	6.8%	11.7%	5.7%	7.7%	8.4%
New South Wales	5.0%	5.6%	5.9%	5.4%	6.7%	15.1%	3.1%	5.7%	6.6%
Queensland	3.6%	5.2%	8.8%	16.6%	8.8%	14.5%	15.1%	7.3%	10.6%
South Australia	9.0%	9.8%	12.1%	14.5%	9.4%	10.1%	2.1%	9.0%	9.4%
Tasmania	7.1%	6.1%	6.5%	8.8%	8.7%	3.3%	12.1%	21.9%	9.6%
Victoria	8.0%	5.6%	14.3%	12.6%	9.9%	13.7%	7.5%	11.7%	10.7%
Western Australia	6.9%	9.3%	7.2%	6.9%	10.5%	9.1%	11.9%	9.2%	9.0%
AVERAGE	7.2%	7.5%	9.5%	9.7%	8.6%	11.4%	8.1%	9.7%	9.1%

Table 12 – Injury prevalence by match type

COMPETITION	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVERAGE
Domestic Twenty/20								10.9%	10.9%
Domestic one day	7.1%	7.0%	8.0%	11.3%	8.8%	11.9%	9.5%	10.3%	9.5%
First class domestic	6.6%	6.9%	9.5%	10.4%	9.0%	11.2%	8.6%	10.4%	9.2%
International Twenty/20							7.1%	2.4%	3.6%
One day international	13.7%	7.4%	10.5%	8.4%	7.5%	13.7%	3.8%	6.9%	8.9%
Test cricket	6.3%	9.8%	11.5%	6.2%	6.0%	10.7%	6.3%	8.2%	8.1%
AVERAGE	7.2%	7.5%	9.5%	9.7%	8.6%	11.4%	8.1%	9.7%	9.1%

Table 13 – Injury prevalence by player position

PLAYER TYPE	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVG.
Batsman	3.9%	3.4%	5.2%	4.7%	3.0%	7.1%	9.7%	6.1%	5.5%
Keeper	2.8%	1.5%	0.9%	0.6%	0.9%	3.7%	3.2%	2.9%	2.2%
Pace Bowler	11.5%	14.0%	15.0%	19.5%	16.6%	18.3%	9.4%	14.8%	15.0%
Spinner	4.9%	1.4%	10.0%	1.1%	3.8%	6.9%	4.2%	9.3%	5.2%
TOTAL	7.2%	7.5%	9.5%	9.7%	8.6%	11.4%	8.1%	9.7%	9.1%

Table 14 – Comparison of injury prevalence by body area

BODY REGION	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	AVG.
Fractured facial bones	0.0%	0.1%	0.2%	0.2%	0.0%	0.0%	0.1%	0.0%	0.1%
Other head and facial injuries	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%
Neck injuries	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Shoulder tendon injuries	0.6%	0.4%	0.8%	1.4%	0.7%	0.1%	0.1%	0.8%	0.6%
Other shoulder injuries	0.4%	0.0%	0.3%	0.6%	0.2%	0.4%	0.8%	1.0%	0.5%
Arm/forearm fractures	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.1%
Other elbow/arm injuries	0.0%	0.0%	0.7%	0.0%	0.6%	0.0%	0.1%	0.2%	0.2%
Wrist and hand fractures	0.1%	0.1%	0.9%	0.9%	0.3%	1.0%	0.7%	0.6%	0.6%
Other wrist/hand injuries	0.2%	0.3%	0.1%	0.0%	0.2%	0.1%	0.7%	0.1%	0.2%
Side and abdominal strains	0.4%	0.4%	0.4%	0.7%	0.2%	0.7%	0.8%	0.3%	0.5%
Other trunk injuries	0.4%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.3%	0.1%
Lumbar stress fractures	0.1%	0.8%	0.6%	1.1%	1.7%	2.4%	0.2%	0.9%	1.0%
Other lumbar injuries	0.7%	1.3%	0.9%	0.3%	0.6%	0.7%	1.0%	1.1%	0.8%
Groin and hip injuries	1.1%	0.1%	0.3%	0.8%	0.6%	0.9%	0.3%	0.6%	0.6%
Thigh and hamstring strains	0.9%	0.7%	0.6%	0.7%	0.8%	0.7%	0.7%	0.3%	0.7%
Buttock and other thigh injuries	0.0%	0.0%	0.2%	0.0%	0.0%	0.3%	0.0%	0.0%	0.1%
Knee cartilage injuries	0.4%	0.6%	1.1%	1.2%	1.2%	0.4%	0.5%	1.7%	0.9%
Other knee injuries	0.9%	0.4%	1.4%	0.1%	0.1%	0.2%	0.0%	0.6%	0.4%
Shin and foot stress fractures	0.0%	0.1%	0.2%	0.2%	0.5%	0.0%	0.5%	0.2%	0.2%
Ankle and foot sprains	0.4%	0.4%	0.5%	0.5%	0.3%	1.4%	0.2%	0.5%	0.6%
Other shin, foot and ankle injuries	0.1%	1.1%	0.1%	0.8%	0.5%	1.3%	0.6%	0.2%	0.6%
Heat-related illness	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Medical illness	0.2%	0.6%	0.1%	0.2%	0.2%	0.5%	0.6%	0.3%	0.3%
TOTAL	7.2%	7.5%	9.5%	9.7%	8.6%	11.4%	8.1%	9.7%	9.1%

Table 15 - Comparison of injury prevalence by both position and age group

AGE	BATSMEN	WICKET KEEPERS	PACE BOWLERS	SPIN BOWLERS
<=22	5.2%	1.4%	16.8%	3.9%
23-26	3.7%	2.3%	15.9%	3.0%
27-30	4.2%	0.8%	12.9%	4.7%
31+	11.6%	3.4%	15.8%	6.1%
ALL AGES	5.5%	2.2%	15.0%	5.2%

Table 16 - Key indicators for lumbar stress fractures over eight seasons

KEY INDICATOR	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Incidence	0.2	0.5	0.5	0.7	1.4	1.0	0.2	0.4
Prevalence	0.1%	0.8%	0.6%	1.1%	1.7%	2.4%	0.2%	0.9%
Recurrences (players who have previously suffered a lumbar stress fracture)	0/1	0/3	1/2	0/5	2/7	3/7	1/1	1/3
New injuries in players <=25 years age	0/1	3/3	1/1	2/5	4/5	3/4	-	2/2

Table 17 - Key indicators for abdominal strain injuries over eight seasons

KEY INDICATOR	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Incidence	1.6	1.0	2.1	1.8	0.5	1.1	1.4	0.6
Prevalence	0.4%	0.4%	0.4%	0.7%	0.2%	0.7%	0.8%	0.3%
Recurrences	2/13	2/12	3/17	3/14	0/5	3/8	1/10	1/4
Bowling nets & game	2 & 10	3 & 8	6 & 8	2 &11	2 & 3	2 & 5	3 & 6	0 & 2
Bowling injuries occurring pre-Xmas	6/12	8/12	9/14	9/13	3/5	5/7	6/9	0/2

Table 18 - Key indicators for preventable non-bowling injuries over eight seasons

MECHANISM	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Sliding into fence	2	2	1	0	0	0	0	0
Playing football	1	1	0	3	0	0	0	2

states due to a higher number of players being involved in the Australian squad. Although it may not necessarily be relevant, this would mean that the overs bowled by NSW teams during the season (similar in numbers to other states total overs bowled) may have been shared by a greater number of players, on average.

Table 10 reveals that seasonal incidence by body part has generally been consistent over the past eight seasons, although incidence has fallen in 2004-05 and 2005-06 compared to previous seasons. The injuries which have fallen slightly in incidence in recent seasons include shoulder tendon injuries, side strains and lumbar stress fractures. By contrast, there were more knee cartilage injuries occurring in 2005-06 than previous seasons.

Injury prevalence

Injury prevalence rates follow a similar pattern to injury incidence, although whereas incidence stayed constant over the past few seasons, prevalence has gradually increased (until 2003-04). The disparity between the two can be attributed to the increased number of matches, with the 'average' injury artificially becoming more severe over recent years because there are more matches to miss (injury prevalence = injury incidence x average injury severity).

Injury prevalence rates (Tables 11-13) in season 2005-06 were generally very close to the long-term average, which is a reasonable outcome given the higher amount of match exposure.

Age as a risk factor for injuries

Table 15 shows that for positions other than pace bowlers, there is increased injury prevalence with increasing age. This is similar to the trend observed in other sports [17]. However, pace bowlers suffer higher injury prevalence at the youngest ages (< 22 years), which is due to the prevalence of lumbar stress fractures in fast bowlers. The prevalence rate by age curve for pace bowlers is therefore slightly U-shaped. Lumbar stress fractures in young fast bowlers have long been identified as the highest priority for injury prevention in cricket [11,18].

Lumbar stress fractures

This report confirms that in terms of missed playing time over eight seasons (Table 14), lumbar spine injuries extract the greatest toll on cricketers, although their incidence and prevalence has fallen for the last two seasons. Stress fractures of the pars interarticularis of L4 and L5 on the non-bowling side are the largest culprits in terms of specific diagnosis. Given the severity of lumbar stress fractures, a high proportion of these are recurrent and affect younger players (Table 18). There are only a very small number of lumbar stress fractures occurring in non-bowlers (batsmen and wicket-keepers). There have generally been a greater number of younger 'rookie-listed' players with state contracts since 2001-02 and this may have accounted for an apparent increase in prevalence of lumbar stress fractures from that time.

Studies have previously associated a 'mixed' action with the development of lumbar spine injuries, particularly stress fractures [16,18,19]. There is still no published data to show that coaching intervention can prospectively lower the lumbar stress fracture risk for a player. The most difficult confounder to take into account is bowler speed. Speed is probably a risk factor for injury, although counter-rotation of the shoulders does not appear to be an important contributor to development of speed in studies published to date [20].

It is pleasing to report two consecutive seasons of fewer lumbar stress fractures in bowlers although due to the small numbers involved it is still too early to determine whether this trend is due to chance or intervention in the form of improved coaching, biomechanical assessment or workload management.

Side strain injuries in bowlers

Side strains appear to be a unique type of muscle strain 21,22. They are only reported in cricket and javelin throwers, who use a somewhat similar technique. By legend, they were seen as a 'rite of passage' injury.

Humphries and Jamison reported that side strains generally affected the

internal oblique muscle and could be recurrent 22. They occur on the non-bowling side of the body. Bony stress lesions have been observed. Although recurrences over a bowler's career are not excessively common (Table 17), they can and do occur. Most recurrences are non-acute (that is they occur in a subsequent season to the initial injury). It is quite possible that there are different varieties of side strain within the overall category, and that some of these varieties are highly recurrent and/or related to overuse, whereas others are related to speed and/or are a one-off injury. This analysis shows a drop in 2005-06 the incidence of side strains and that they are more likely in the early half of the season (Table 17). Significant proportions occur during bowling in the nets. Some side strains have been reported in players throwing the ball in the field, during spin bowling and even from impingement whilst batting, although the vast majority are acute injuries during fast bowling.

Preventable non-bowling injuries

It is again worth reporting that injuries from fielders sliding into the fence appear to be a relic of the past, with none of these injuries reported to the survey since 2000-01. The moving in of the boundary has changed the nature of the game, in that games are higher and faster scoring because of the increased number of boundaries. However, most cricket commentators feel that these changes have been for the better.

In 2005-06 there were two injuries from players performing football cross-training drills. Whilst football cross-training may always have some part in relieving the boredom from routine other drills, it is constantly worth mentioning that in cricketers this appears to be a high risk activity and hence should be kept to a minimum. It is worth noting that the Indian cricket team uses volleyball as their practice activity as an alternate sport, as this appears to have a lower injury risk than touch football.

Discussion

Bowling injury risk

Dennis has found a relationship between the overall bowler workload (matches and training) and risk of bowling injury in both adult [23] and junior [24] cricket. It appears from this work (although it is not clearly established) that number of bowling sessions per week (whether they are training or match) is the factor which most correlates with injury risk. In seasons prior to the workload study being implemented, it is not known what the extent of overall (match plus training) workload was, although it is very clear that match workload has increased over the years (see Table 5).

To date formal recommendations have not been set in stone regarding the maximum or optimal number of bowling sessions or overs per week in open age cricket. However, if any limits were suggested, further increases in match workload would make it harder for players and coaches to fall within the prescribed range. English county cricket surveillance reveals an even higher match workload (match wise) for first class bowlers in England than Australia [12]. However, injury prevalence appears to be higher in England than Australia, and our figure could be expected to rise if our match workload was also to rise. An appeal of the recent trend towards extra matches being of the Twenty/20 variety is that these games involve a very small bowling load per player and hence may, in the long term, contribute to a smaller injury risk.

Other ways workload in the future may be reduced:

(1) Scheduling changes – elimination of back-to-back games, institution of a forced off-season (i.e. maximum number of matches scheduled per year for national teams).

(2) Rule changes – allow 12th man to bowl for an injured player, which would reduce excess workload in the event of a team being a bowler short. However, this rule would be very difficult to enforce with respect to exploitation by a team wishing to use the rule as a form of interchange.

(3) Recommendation of tactical changes – avoiding enforcing the follow-on if upcoming matches are scheduled, deliberate rotation of bowlers etc.

It may be that it is safer to enforce the follow-on in a four-day game as there is usually insufficient time for the batting team to go on to bat for a marathon second innings, which has occurred on a few occasions to the Australian team and has led to high acute workloads amongst the bowlers, possibly leading to some of these injuries [25].

Comparison with other surveys

The only other recently published paper which adheres to the international consensus definitions comes from the West Indies 26. Mansingh et al. reported a mean match injury incidence of 48.7 per 10,000 player-hours in Test cricket, and 40.6 per 10,000 player-hours in one day international cricket, with injury prevalence of 11.3% and 8.1% respectively. In domestic West Indies cricket, the match injury incidence was 13.9 per 10,000 player-hours for first class cricket, and 25.4 per 10,000 player-hours in one day domestic competitions. The period studied was less than two seasons and hence the rates reflect small exposure. Certainly they are consistent with the figures in this report (although West Indies Test match rate is slightly higher than Australian whereas their domestic rates are lower than ours). It is noteworthy that the West Indies have reported more injuries on tour for the West Indies team than at home [26], which is the opposite to the trend seen by the Australian team [5]. All of the above findings would be consistent with the notion that cricket played in the West Indies has a slightly lower injury incidence than cricket played in Australia, although the sample sizes are probably too small to make this conclusion firmly. If it is a true finding, then pitch and weather conditions may need to be investigated further to see whether they have any correlation with injury risk.

Unfortunately there has been no injury surveillance published recently from other countries and it is apparent that ICC funding and/or sponsorship may

be required if international comparison studies are to occur on an ongoing basis.

Recommendations

Previous recommendations with respect to injury surveillance should continue to be considered, as follows:

1. It would assist both injury surveillance and the accuracy of injury payments for all teams to complete a player movement monitoring sheet (for all contracted players) at the commencement of each fixture. This should specifically contain a status for each contracted player at the time of commencement of the game indicating whether the player was (a) playing in the match in question (b) playing cricket but at a different (higher or lower) level at the time (c) not playing cricket due to injury (d) not playing cricket but not injured.
2. All countries should be encouraged to undertake injury surveillance and distribute reports to other countries. It is acknowledged that injury surveillance is expensive and is very unlikely to be successful in the long-term without adequate ongoing funding.
3. Further to item 2, it is worth seeking international funding, either through the ICC or a major corporate sponsor, to assist with the payment for injury surveillance in the Test-playing countries where it not currently being undertaken.
4. Cricket Australia could encourage our Federal government to develop a national injury surveillance system for injuries in all sports [27], which currently exists in New Zealand. This would assist with injury surveillance at amateur levels [25].
5. That the numbers of back-to-back matches be kept to a minimum when planning scheduling [25]. Where tradition and commercial factors preclude this from happening (eg, Boxing Day Test followed by New Year's Test) consideration be given to selecting teams with a minimum of five regular bowlers to guard against the risk of overuse.
6. That the captain and coach should not enforce the follow-on in Test cricket without serious consideration of the risk (which according to current data is very high) of excessive short-term workload on their bowlers [25].
7. That the concept of substitutes for injured bowlers in first class cricket be explored further nationally and internationally.
8. That priority areas for injury risk factor studies in Australia continue to be: (1) Workload studies for fast bowlers (2) Biomechanical studies for fast bowlers **SH**

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Happenings, Goings, Comings

First, for your 2007 diary: four concurrent events at the 2007 Australian Conference of Science and Medicine in Sport at the Adelaide Convention Centre:

13-16 October -- ACSMS

13-16 October -- 6th National Physical Activity Conference

14-16 October – 5th National Sports Injury Prevention Conference

14-15 October – 2007 Recreation and Sport Development Conference

Keep an eye on SMA's web page for more information as it becomes available.

* * * *

Another feather in SMA WA's cap.

SMA has won the Injury Control Council of Western Australia's award for "Outstanding Achievement in Injury Prevention", in recognition of the work that past and present SMA staff have done in the fields of education, health promotion and sports care.

The award criteria were:

- Quality of injury prevention programs,
- Demonstrated commitment to injury prevention,
- Strength of their community leadership and involvement, and
- Contribution to education, promotion, technology, public policy or research in the area of injury prevention in Western Australia.

* * * *

Certificates of Appreciation are awarded by the ASMF Fellows in recognition of service to SMA. This year, certificates have been awarded to:

- Dr John Hart, National President from 1985 to 1986,
- Dr Peter Larkins, National President from 1994 to 1997,
- Dr Paul McCrory, Editor of *Sport Health* from 1998 to 2002 and ACSMS Conference Co-Chair in 2002,
- Dr John Orchard, Editor of Sport Health from 2004 and Assistant Editor of the Journal of Science and Medicine in Sport from 2001 to 2004, and
- Dr Marg Torode, ACSMS Co-Chair in 1996 and 1997 and Chair of the Medicine and Science for Women in Sport Committee.

* * * * *

Big moves have been made at National and the New South Wales Branch.

National Office is now at 3 Cheney Place, Mitchell ACT 2911 (or PO Box 78 Mitchell ACT 2911). New contact details are (phone) 02 6241 9344 and (fax) 6241 1611. National's email address is unchanged at smanat@sma.org.au.

NSW has relocated to 1st Floor, Sports House at 6 Figtree Drive at Sydney Olympic Park (or PO Box 3176, Rhodes Shopping Centre, Rhodes NSW 2138). Contact details are (phone) 02 8116 9815 and (fax) 8732 1626. NSW's email address is also unchanged: admin@smansw.com.au.

* * * * *

Three newcomers were welcomed into the Australian Sports Medicine Federation Order of Fellows at the Fellows' AGM at this year's Asics Conference of Science and Medicine in Sport in Fiji.

They were Dr Shane Brun, Sports Doctor from Cairns, Dr Brendan de Morton, Sports Doctor from Melbourne, and Professor Kerry Mummery of Central Queensland University.

* * * * *

The 17th annual meeting of the International Association of Dance Medicine and Science (IADMS) will be held in Canberra from 25 to 27 October 2007, followed by a Special Interest Groups Day on 28 October and a Post-Conference Day (this time in Melbourne) on 29 October.

The conference is presented by a consortium of the Australian Sports Commission, the Australian Ballet School and the Australian Dance Council (Ausdance).

The Canberra venue is the AIS, whose collaboration in healthcare and research with the world of dance is widely acknowledged.

The Special Interest Groups Day will focus on particular groups such as dance teachers and others involved in dancers' health and wellbeing and the Post Conference Day in Melbourne will include open houses at The Australian Ballet, The Australian Ballet School and the Victorian College of the Arts.

For more information, go to www.iadms.org.

* * * * *

The 3rd edition of Peter Brukner and Karim Khan's Clinical Sports Medicine is now available from medical booksellers and McGraw-Hill, the publisher.

Totally revised and updated, the new edition offers the latest approaches to the problems that sports medicine practitioners will meet in clinical practice. New features include Practise Pearls, a CD-ROM of patient information sheets and six new chapters on current topics.

Vital statistics:

Title: Clinical Sports Medicine (Editors: Peter Brukner and Karim Khan)

ISBN: 0074715208

Price: $140 (inc. GST)

From: McGraw-Hill, Level 2, 82 Waterloo Road, North Ryde NSW 2113.

For more information, phone 02 9900 1836 or go to www.mcgraw-hill.com.au.

* * * * *

American Sports Data, Inc. has introduced a new website which could be interesting and helpful to SMA members, enables us to buy research by-the-slice!

The best possible deal at the moment is to buy ASD sports participation research by the entire sports or fitness collection. The next most economical is to buy research by the individual report.

Now, ASD says, for all ASD reports it has extracted choice elements which are now available for as little as $12 per page, depending on what's selected. "For those who continue to purchase the full reports, "slice" menus -- which represent pithy segments of other research you may be interested in -- are a handy way to organise your thinking on secondary subjects."

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