

# Matching the choice of injury/illness definition to study setting, purpose and design: one size does not fit all!

Benjamin Clarsen, Roald Bahr

Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, Oslo, Norway

## Correspondence to

Benjamin Clarsen, Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, PB 4014 Ullevål Stadion, Oslo 0806, Norway; ben.clarsen@nih.no

Received 22 November 2013  
Revised 28 January 2014  
Accepted 6 February 2014

## INTRODUCTION

What constitutes a 'recordable event' is arguably the most critical methodological factor affecting the results of sports injury and illness surveillance studies. Although numerous consensus statements have attempted to standardise surveillance methodology,<sup>1–6</sup> there remains considerable variation in current definitions of injury.

Underlying the choice of definition are a number of practical and theoretical issues, including the duration and setting of surveillance, the available resources, the type of injuries and illnesses of interest, how data are to be collected and what they are to be used for. It is also highly desirable that results are comparable between studies; both within and between sports. Above all, however, surveillance data must be valid.

As no single definition is likely to suit all needs, the purpose of this article is to review the strengths and limitations of the three most commonly used definitions in sports epidemiology and to examine their appropriateness depending on the context and objectives of surveillance. We focus particularly on methods of data collection, as this may have important consequences on the reliability of data.

## REVIEW OF CONSENSUS-BASED DEFINITIONS

Consensus recommendations have been made for several sports, including cricket,<sup>1</sup> football (soccer),<sup>2</sup> rugby union,<sup>3</sup> tennis,<sup>4</sup> thoroughbred horse racing<sup>5</sup> and most recently, for athletics.<sup>6</sup> Earlier statements have focused solely on injuries, which may be defined as physical complaints resulting from the transfer of energy at a rate or in an amount that exceeds that tissue's threshold for damage.<sup>6–7</sup> Recently they have also been expanded to include illnesses, defined as physical or psychological complaints that are unrelated to injury.<sup>6</sup> However, common to all statements (with the notable exception of cricket) is the recommendation that a recordable incident should be defined as any physical or psychological complaint resulting from relevant sports participation regardless of its consequences, but that those that receive medical attention be recorded as 'medical attention' injuries/illnesses and those leading to inability to participate fully in training or competition be recorded as 'time-loss' injuries/illnesses. In effect, therefore, the consensus statements suggest that there is no, single 'one-size-fits-all' injury definition but rather offer three alternative definitions of recordable incidents for use: (1) *all complaints*, (2) *medical attention* and (3) *time loss*. These could be placed in a hierarchy ranging from broad to narrow, based on the number

of incidents they are likely to capture, as shown in figure 1.

In practice, there are few examples of studies employing a true *all complaints* definition, with a majority of studies choosing either to record *time-loss* or *medical-attention* conditions. While there has been some debate regarding the various strengths and limitations of broad (eg, all complaints, medical attention) and narrow (eg, time loss) definitions,<sup>8–9</sup> the discussion has been polarised with little consideration given to the context and aims of surveillance or methods of data collection.

## TIME LOSS

Time loss is the most commonly used definition, particularly in longer term surveillance programmes in team sports.<sup>10–13</sup> It represents the narrowest of the three consensus-recommended definitions—the one that is likely to record the fewest incidents. However, even narrower definitions exist; in cricket only injuries that limit match participation are recorded,<sup>1</sup> and in Australian football only injuries that lead to unavailability for match selection are recorded.<sup>14</sup> This is often called the *missed-match* definition (figure 1).

One of the assumed strengths of the time-loss definition is that an inability to fully participate in planned training and competition is relatively easy to identify. It is therefore considered to be relatively reliable, allowing for the comparison of data among different teams and across multiple seasons. This is particularly the case when a missed-match definition is used, as player availability often can be cross-checked with independent records. As no medical expertise is needed to apply a time-loss definition, injury occurrence (albeit not diagnosis) can be recorded by coaches, parents or other non-trained individuals. This may be of particular benefit in studies of young and recreational athletes.

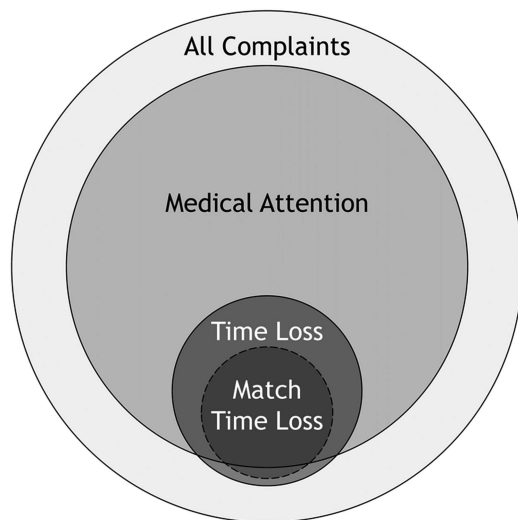
However, there are several limitations to the time-loss definition. First, athletes often continue to train and compete despite the existence of injury. Common management strategies, such as the use of analgesic medications and anesthetics, modification of the type or intensity of training and delaying treatment or rest until the off season may lead to a large number of injuries being missed when a time-loss definition is used. This has been thought to be particularly relevant for overuse injuries,<sup>15–16</sup> but recent evidence suggests that it may also be a problem for acute, traumatic injuries.<sup>17</sup>

A second limitation of the time-loss definition is that 'an inability to fully participate in training and/or competition' is difficult to apply in studies of



CrossMark

**To cite:** Clarsen B, Bahr R. *Br J Sports Med* 2014;**48**:510–512.



**Figure 1** Interactions between various definitions of injury and illness. Circle-size represents the relative number of incidents likely to be registered (not to scale).

individual sports. In team sports, this may be relatively straightforward; a player can either take part in planned training sessions or they cannot. In contrast, individual athletes have a far greater scope to modify their own training in response to injury or illness. For example the mode, intensity, frequency or volume of exercise can all be adjusted such that the question of whether 'normal' training has been maintained may be very difficult to answer. For example, a distance runner with iliotibial band (ITB) syndrome may avoid running hills, but can perform all their normal training on the flat. In fact, this is also becoming a problem in team sports, particularly at an elite level where it is increasingly common for players to have individualised training programmes with a blurred line between injury prevention training and rehabilitation. Consistent application of the definition may therefore be difficult in this setting, as well.

A third limitation which is particularly relevant for team sports is that the threshold for time loss varies according to the importance of the injured player and the time of the season in which the injury occurs. For example, star players are less likely to miss time due to minor injury during important phases of the season.

Nevertheless, despite its limitations the time-loss definition has proven to be feasible in many long-term and large-scale sports injury studies. The most severe injuries are likely to be captured, and when this is the goal of surveillance, its use is justified. However, if it is used, a clear definition of what constitutes 'normal training and competition' is of vital importance.

### MEDICAL ATTENTION

The reporting of medical-attention incidents is recommended in a majority of consensus statements as this is likely to capture a far greater number of conditions than time loss and will therefore provide a more complete picture of the true burden of injury and illness.<sup>8</sup> This may be of particular importance when the aim of surveillance is to assist in the allocation of medical resources within teams or organisations.<sup>18</sup> However, in many research contexts the potential for systematic bias makes this definition unreliable.<sup>9</sup> For example, in a study of World Cup alpine skiers a large proportion of medical-attention injuries were missed by team medical staff as skiers often travelled for

long periods without medical support or had to relate to a variety of different practitioners throughout their season.<sup>19</sup> Non-uniform and inconsistent access to medical support is also likely to be a problem in amateur and youth sports, preventing the reliable use of a medical-attention definition. Even in a professional team-sport environment there are likely to be systematic differences between recorders' interpretation of what constitutes medical attention. Furthermore, there may be differences in the interpretation of who is qualified to provide medical attention between different sports and cultures, where ancillary practitioners such as physiotherapists, chiropractors, athletic trainers and massage therapists have varying qualifications and statuses. The use of a medical-attention definition may also place large demands on team medical staff due to the large number of conditions likely to be recorded; this would likely compromise completeness and accuracy of the data.

Although the medical-attention definition is seldom used in prospective cohort studies, it is commonly used during major short-term sporting tournaments. In this setting, one of the main uses for surveillance data is to assist organisers to allocate sufficient health resources in future events.<sup>20</sup> For this reason the injury definition should reflect the full range of problems encountered by athletes during the tournament. A medical-attention definition is therefore appropriate, provided athletes have a relatively uniform access to medical care. In large tournaments, such as the Olympic and Paralympic Games, this is feasible because polyclinics are available to all participating athletes, who, in conjunction with team physicians from each country, are responsible for data collection.<sup>21 22</sup>

However, in tournaments which do not provide such services, but rely purely on team physicians for treatment and data collection, the use of a medical-attention definition may lead to a systematic under-reporting from athletes and teams with less intensive medical coverage. In this case it may be better to limit the definition to time loss, defined in this case as the inability to start or complete an event. While this would lead to an under-estimation of the true burden of illness and injury, particularly of overuse injuries and chronic illnesses, it would ensure adequate reliability of data while still capturing all major acute injuries and infectious diseases. Presumably, these are the two problems that event organisers are most concerned with, and able to prevent.

### ALL COMPLAINTS

'All complaints' is the most common consensus-recommended surveillance definition, but there are relatively few examples of it being used in its true form (ie, registration of *all* medical problems, including those that do not lead to medical attention). Because surveillance studies have traditionally used medical staff to record data, they are unlikely to be aware of conditions not needing medical attention. However, the strengths and limitations of this definition are similar to those of medical attention; data may be a good representation of the total burden of injury and illness, but their reliability may be suspect. One of the major problems is that data are subject to systematic bias due to each collector's interpretation of what constitutes a recordable complaint. For example, a physiotherapist on one team may consider delayed-onset muscle soreness as a recordable complaint whereas one on another team may not, considering it a normal response after heavy training.

### DATA COLLECTION METHODS MAKE A DIFFERENCE!

The major limitations of the reliability of broad surveillance definitions exist at the level of the data collector, where

differences in availability, interpretation of definitions or data completeness can lead to systematic bias between different groups of athletes. A potential solution to this problem is to allow athletes to record medical complaints themselves, rather than via third-party data collectors. While the threshold for what constitutes a recordable problem may also vary substantially between individual athletes when this approach is taken, the potential for systematic bias between teams or groups of athletes may be less.

These methods also involve certain challenges, such as the logistics of collecting and analysing information from a large number of individuals; however, recent technological advances such as internet-based surveys,<sup>16 23</sup> short message service (SMS) text messaging,<sup>24 25</sup> and smartphone applications have greatly improved the potential for this approach in large cohorts.<sup>26</sup> It is also possible to use 'low-tech' methods to collect data from athletes on the team level. For example, athletic trainers could administer daily or weekly questionnaires at training.

Missing data are also a major challenge when this approach is used, so careful follow-up by investigators is essential. Unlike medical personnel, athletes have little investment in recording their injuries and illnesses for research purposes. Therefore, much effort is required to ensure adequate participation. Nevertheless, there are similar challenges when conducting traditionally designed surveillance studies, which have also been shown to be prone to incomplete and inaccurate data collection even when a narrow (time-loss) definition is used.<sup>27</sup> In this regard, surveillance systems using direct-athlete reporting have an advantage, as the extent of missing data is easier to quantify.

## CONCLUSION

'One size does not fit all' when it comes to surveillance methods.<sup>18 28</sup> Although consensus-based recommendations for standardised methodology are available, the choice of definition should reflect the aims and context of surveillance. Investigators need to consider the strengths and limitations of each approach.

**Acknowledgements** The Oslo Sports Trauma Research Center has been established at the Norwegian School of Sport Sciences through generous grants from the Royal Norwegian Ministry of Culture, the South-Eastern Norway Regional Health Authority, the International Olympic Committee, the Norwegian Olympic Committee & Confederation of Sport, and Norsk Tipping AS.

**Contributors** BC was the primary manuscript writer. RB made substantial contributions to conception and design of the manuscript and revised it for important intellectual content.

**Competing interests** None.

**Provenance and peer review** Not commissioned; externally peer reviewed.

## REFERENCES

- Orchard J, Newman D, Stretch R, *et al.* Methods for injury surveillance in international cricket. *J Sci Med Sport* 2005;8:1–14.
- Fuller CW, Ekstrand J, Junge A, *et al.* Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med* 2006;40:193–201.
- Fuller CW, Molloy MG, Bagate C, *et al.* Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union. *Br J Sports Med* 2007;41:328–31.
- Pluim BM, Fuller CW, Batt ME, *et al.* Consensus statement on epidemiological studies of medical conditions in tennis, April 2009. *Br J Sports Med* 2009;43:893–7.
- Turner M, Fuller CW, Egan D, *et al.* European consensus on epidemiological studies of injuries in the thoroughbred horse racing industry. *Br J Sports Med* 2012;46:704–8.
- Timpka T, Alonso JM, Jacobson J, *et al.* Injury and illness definitions and data collection procedures for use in epidemiological studies in Athletics (track and field): Consensus statement. *Br J Sports Med* 2014;48:483–90.
- Finch CF, Cook J. Categorising sports injuries in epidemiological studies: the subsequent injury categorisation (SIC) model to address multiple, recurrent and exacerbation of injuries. *Br J Sports Med* Published Online First: 16 Mar 2013 doi:10.1136/bjsports-2012-091729.
- Hodgson L, Gissane C, Gabbett TJ, *et al.* For debate: consensus injury definitions in team sports should focus on encompassing all injuries. *Clin J Sport Med* 2007;17:188–91.
- Orchard J, Hoskins W. For debate: consensus injury definitions in team sports should focus on missed playing time. *Clin J Sport Med* 2007;17:192–6.
- Ekstrand J, Hagglund M, Walden M. Injury incidence and injury patterns in professional football: the UEFA injury study. *Br J Sports Med* 2011;45:553–8.
- Brooks JH, Fuller CW, Kemp SP, *et al.* Epidemiology of injuries in English professional rugby union: part 1 match injuries. *Br J Sports Med* 2005;39:757–66.
- Olsen OE, Myklebust G, Engebretsen L, *et al.* Injury pattern in youth team handball: a comparison of two prospective registration methods. *Scand J Med Sci Sports* 2006;16:426–32.
- Bjørneboe J, Bahr R, Andersen TE. Gradual increase in the risk of match injury in Norwegian male professional football: a 6-year prospective study. *Scand J Med Sci Sports* 2014;24:189–96.
- Orchard JW, Seward H, Orchard JJ. Results of 2 decades of injury surveillance and public release of data in the Australian Football League. *Am J Sports Med* 2013;41:734–41.
- Bahr R. No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *Br J Sports Med* 2009;43:966–72.
- Clarsen B, Myklebust G, Bahr R. Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) overuse injury questionnaire. *Br J Sports Med* 2013;47:495–502.
- Hammond LE, Lilley JM, Pope GD, *et al.* The impact of playing in matches while injured on injury surveillance findings in professional football. *Scand J Med Sci Sports* 2013; Published Online First: 10 October 2013. DOI: 10.1111/sms.12134.
- Meeuwisse WH, Love EJ. Athletic injury reporting. Development of universal systems. *Sports Med* 1997;24:184–204.
- Florenes TW, Nordsetten L, Heir S, *et al.* Recording injuries among World Cup skiers and snowboarders: a methodological study. *Scand J Med Sci Sports* 2011;21:196–205.
- Finch CF, Valuri G, Ozanne-Smith J. Injury surveillance during medical coverage of sporting events—development and testing of a standardised data collection form. *J Sci Med Sport* 1999;2:42–56.
- Derman W, Schweltnus M, Jordaan E, *et al.* Illness and injury in athletes during the competition period at the London 2012 Paralympic Games: development and implementation of a web-based surveillance system (WEB-IISS) for team medical staff. *Br J Sports Med* 2013;47:420–5.
- Junge A, Engebretsen L, Alonso JM, *et al.* Injury surveillance in multi-sport events: the International Olympic Committee approach. *Br J Sports Med* 2008;42:413–21.
- Clarsen B, Ronsén O, Myklebust G, *et al.* The Oslo Sports Trauma Research Centre questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes. *Br J Sports Med* 2013; Published Online First: 21 February 2013. doi:10.1136/bjsports-2012-092087
- Møller M, Attermann J, Myklebust G, *et al.* Injury risk in Danish youth and senior elite handball using a new SMS text messages approach. *Br J Sports Med* 2012;46:531–7.
- Nilstad A, Bahr R, Andersen T. Text messaging as a new method for injury registration in sports: a methodological study in elite female football. *Scand J Med Sci Sports* 2014;24:243–9.
- Verhagen EALM, Clarsen B, Bahr R. A glimpse at the future of sports medicine. *Br J Sports Med* 2013; Published Online First: 22 November 2013. doi:10.1136/bjsports-2013-093103
- Bjørneboe J, Florenes TW, Bahr R, *et al.* Injury surveillance in male professional football: is medical staff reporting complete and accurate? *Scand J Med Sci Sports* 2011;21:713–20.
- van Mechelen W. Sports injury surveillance systems. 'One size fits all'? *Sports Med* 1997;24:164–8.