

The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes

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ABSTRACT

Background Little information exists on the illness and injury patterns of athletes preparing for the Olympic and Paralympic Games. Among the possible explanations for the current lack of knowledge are the methodological challenges faced in conducting prospective studies of large, heterogeneous groups of athletes, particularly when overuse injuries and illnesses are of concern.

Objective To describe a new surveillance method that is capable of recording all types of health problems and to use it to study the illness and injury patterns of Norwegian athletes preparing for the 2012 Olympic and Paralympic Games.

Methods A total of 142 athletes were monitored over a 40-week period using a weekly online questionnaire on health problems. Team medical personnel were used to classify and diagnose all reported complaints.

Results A total of 617 health problems were registered during the project, including 329 illnesses and 288 injuries. At any given time, 36% of athletes had health problems (95% CI 34% to 38%) and 15% of athletes (95% CI 14% to 16%) had substantial problems, defined as those leading to moderate or severe reductions in sports performance or participation, or time loss. Overuse injuries represented 49% of the total burden of health problems, measured as the cumulative severity score, compared to illness (36%) and acute injuries (13%).

Conclusions The new method was sensitive and valid in documenting the pattern of acute injuries, overuse injuries and illnesses in a large, heterogeneous group of athletes preparing for the Olympic and Paralympic Games.

INTRODUCTION

In recent years, the value of regular monitoring in protecting the health of athletes has received increasing recognition.^{1 2} The International Olympic Committee, together with several major International Federations and National Olympic Committees, has developed a surveillance system designed to record injuries and illnesses in major championships,³ and this has been successfully implemented in several Olympic Games, World Championships and other major sporting tournaments.^{4–11} Similarly, the International Paralympic Committee has conducted systematic injury surveillance at the 2002, 2006 and 2010 Winter Paralympic Games.^{12–14} However, with the exception of certain sports such as football,¹⁵ there are few prospective studies of health problems among Olympic-level athletes outside of the brief period in which they are competing in major championships. Little is known, therefore, about their

patterns of illness and injury in their normal training and preparation phases.

Among the possible explanations for this lack of knowledge are the methodological challenges faced when conducting longer term studies in this group of athletes. The methods currently employed in a majority of prospective surveillance studies are based on those developed for recording football injuries,¹⁶ and while they may work well for team sports, they are difficult to implement among groups of individual athletes or those without a centralised team structure.¹⁷ Standard methods of injury surveillance may also be poorly suited to collecting information on overuse conditions, which represent the predominant injury type in many Olympic sports.^{10 18–20} We have recently discussed these limitations in detail,²¹ made general recommendations for more appropriate methodology²¹ and developed new tools that are better suited to the study of overuse injuries.²²

Our first aim in the present study was therefore to modify our new method²² such that it can be used to record not only overuse injuries but also all types of health problems in studies of large, heterogeneous groups of athletes. Our second aim was to apply the method to analyse the patterns of illness and injury in the Norwegian Olympic and Paralympic teams during their preparations for the 2012 games in London.

METHODS

Recruitment

During the summer of 2011, the coaches of the Norwegian national teams in all candidate sports for the London Olympic or Paralympic Games were asked to provide a list of athletes who had the potential to qualify. The final list included 143 athletes, 142 of whom gave their consent to participate in the project. This included 116 Olympic candidates (54 male and 62 female) and 26 Paralympic candidates (15 male and 11 female). The Olympic sports in the study included archery (n=1), athletics (n=22), beach volleyball (n=6), boxing (n=2), cycling (n=12), handball (n=24), kayak (n=7), rowing (n=13), sailing (n=8), shooting (n=5), swimming (n=10), taekwondo (n=3), weightlifting (n=1) and wrestling (n=2). The Paralympic sports included archery (n=1), athletics (n=1), boccia (n=1), cycling (n=2), equestrian (n=4), sailing (n=4), shooting (n=7), swimming (n=3) and table tennis (n=3). The medical personnel that participated in classifying and diagnosing illness and injuries included all the

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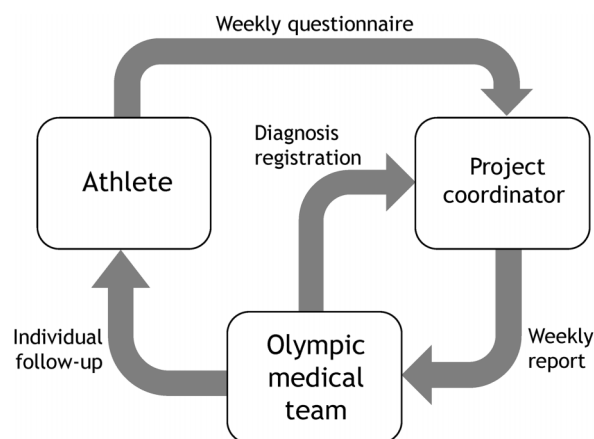


Figure 1 Diagram showing the procedures used to collect data on health problems.

doctors (n=7) and physiotherapists (n=13) who were selected to travel with the Norwegian athletes to the Olympic or Paralympic Games. The study was approved by the Norwegian Data Inspectorate and reviewed by the South-Eastern Norway Regional Committee for Research Ethics. Informed consent was obtained from the athletes at the first registration.

Data collection procedure

Every Sunday for the duration of the project, we used online survey software (Questback V9692, Questback AS, Oslo, Norway) to send all athletes an email linking them to an internet-based questionnaire on health problems, with an automatic reminder email 3 days later if needed (figure 1). Each Thursday, the project coordinator (BMC) compiled a report based on the questionnaire responses from that week and sent it to the relevant team medical staff. They were then expected to follow-up each case and, in addition to providing normal clinical management or advice to the athlete, to fill in a report classifying the type and diagnosis of each health problem. These reports were sent back to the project coordinator on a monthly basis.

The Oslo Sports Trauma Research Center (OSTRC) questionnaire on health problems

We developed the Oslo Sports Trauma Research Center (OSTRC) Questionnaire on Health Problems based on the OSTRC Overuse Injury Questionnaire.²² The four key questions on the consequences of health problems on sports participation, training volume and sports performance as well as the degree to which they have experienced symptoms were modified to capture all types of health problems including illness and acute injuries (figure 2). If the athlete answered the minimum score for each of these questions (full participation without problems/no training reduction/no performance reduction/no symptoms), the questionnaire was finished for that week. However, if the athlete reported anything other than the minimum value for any question, the questionnaire continued by asking them to define whether the problem they referred to was an illness or an injury. In the case of an injury, they were asked to register the area of the body in which it was located, and in the case of an illness, they were asked to select the major symptoms they had experienced. For all types of problems, the number of days of complete time loss, defined as the total inability to train or compete, was also registered. Athletes were also asked whether or not the problem had been reported previously, whether the

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Please answer all questions regardless of whether or not you have experienced health problems in the past week. Select the alternative that is most appropriate for you, and in the case that you are unsure, try to give an answer as best you can anyway.

Question 1

Have you had any difficulties participating in normal training and competition due to injury, illness or other health problems during the past week?

- ☐ Full participation without health problems
- ☐ Full participation, but with injury/illness
- ☐ Reduced participation due to injury/illness
- ☐ Cannot participate due to injury/illness

Question 2

To what extent have you reduced your training volume due to injury, illness or other health problems during the past week?

- ☐ No reduction
- ☐ To a minor extent
- ☐ To a moderate extent
- ☐ To a major extent
- ☐ Cannot participate at all

Question 3

To what extent has injury, illness or other health problems affected your performance during the past week?

- ☐ No effect
- ☐ To a minor extent
- ☐ To a moderate extent
- ☐ To a major extent
- ☐ Cannot participate at all

Question 4

To what extent have you experienced symptoms/health complaints during the past week?

- ☐ No symptoms/health complaints
- ☐ To a mild extent
- ☐ To a moderate extent
- ☐ To a severe extent

Figure 2 The four key questions asked at the beginning of the weekly online Oslo Sports Trauma Research Center (OSTRC) Questionnaire on Health Problems. If the athlete answered the minimum value in each of the four questions, the questionnaire was finished for that week.

problem was already being treated (and by whom) and whether they had any further comments for their Olympic medical team. These three questions were included for use in the weekly reports rather than for epidemiological data collection purposes. Finally, athletes were asked whether the problem they had been referring to was the only health problem they had experienced during the preceding 7 days or whether they had experienced several problems. If they had only had one problem, the questionnaire was finished, whereas if they reported several problems, the questionnaire returned to the four key questions and repeated itself for each subsequent problem reported. The

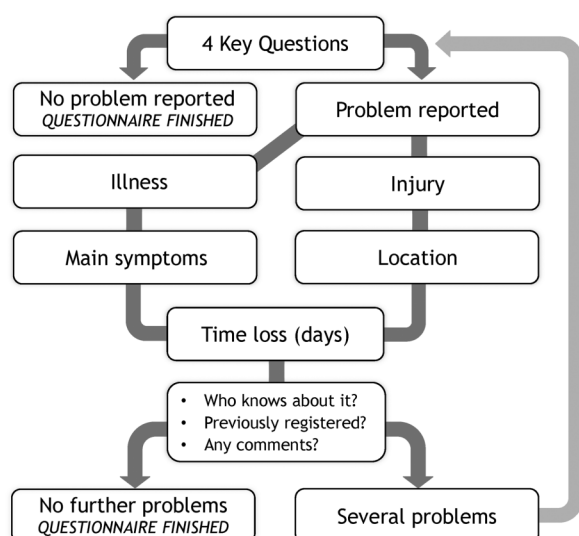


Figure 3 Diagram of questionnaire logic showing how the length of the questionnaire varied according to the number of health problems the athlete reported. Up to four health problems could be reported per week.

questionnaire logic is summarised in figure 3, and the complete OSTRC Questionnaire is available as an online supplement appendix 1.

Classification and diagnosis of reported problems

Team medical personnel were asked to classify each problem reported as an illness, acute injury or overuse injury, based on their clinical interview. In accordance with the International Olympic Committee surveillance system,³ health problems were classified as injuries if they were disorders of the musculoskeletal system or concussions. They were classified as illnesses if they involved other body systems, such as (but not limited to) the respiratory, digestive and neurological systems, as well as non-specific/generalised, psychological and social problems. Injuries were further subcategorised into overuse and acute injuries. Acute injuries were defined as those whose onset could be linked to a specific injury event, whereas overuse injuries were those that could not be linked to a clearly identifiable event. The medical team was also asked to provide a specific diagnosis for each event. For illnesses, the International Classification of Primary Care, V2 (ICPC-2) was used,²³ and for injuries the Orchard Sports Injury Classification System, V10 (OSICS-10), was used.²⁴ The first tier of the OSICS-10 code was used to determine the location, and the second tier was used to determine the type. The first letter of the ICPC-2 code was used to determine the body system affected by illness.

At the conclusion of the project, the project coordinator manually went through each athlete's questionnaire responses and cross-checked all reported health problems with the classifications and diagnoses made by the medical team. All cases were checked twice for accuracy, and in 16 cases where information was missing or conflicting, medical personnel were contacted for clarification. In injury cases where the same diagnosis was interspersed with periods of apparent recovery, medical personnel were consulted in order to classify subsequent events as exacerbations of unresolved problems or recurrences of fully recovered problems (reinjuries), in accordance with the definitions outlined by Fuller *et al.*²⁵ Illnesses were treated in a similar fashion, with repeated episodes of chronic conditions treated as a single case for the purposes of analysis.

Prevalence calculations

Prevalence measures were calculated for all health problems, illnesses, injuries, overuse injuries and acute injuries for each week that the project was conducted. This was performed by dividing the number of athletes reporting any form of problem by the number of questionnaire respondents. The prevalence of substantial problems was also calculated for each of these measures, with substantial problems defined as those leading to moderate or severe reductions in training volume, or moderate or severe reductions in sports performance, or complete inability to participate in sport (ie, problems where athletes selected option 3, 4 or 5 in either Questions 2 or 3). All prevalence measures were also calculated for the four different subgroups of athletes: (1) team athletes (n=30), consisting of handball and beach volleyball players; (2) endurance athletes (n=53), consisting of athletes from cycling, kayak, rowing, swimming as well as the middle-distance and long-distance runners from athletics; (3) tactical/technical athletes (n=36), consisting of athletes participating in archery, boxing, sailing, shooting, taekwondo, weightlifting and wrestling, as well as the sprint and field athletes from athletics and (4) paralympic athletes (n=26). All prevalence measures were presented as averages, together with a 95% CI. Data from the first week the project was conducted were excluded from all calculations, as per our previous recommendations.²²

Severity of health problems

Each week, a severity score was calculated for all reported health problems based on an athlete's responses to the four key questions.²² The severity score was plotted in order to track the progression of each health problem, such as in the example shown in figure 4. The *cumulative severity score* was then calculated for each case by summing the severity score for each week that it was reported. The *average weekly severity score* was calculated by dividing the cumulative severity score by the number of weeks the problem was reported. The total amount of complete *time loss* was also calculated for each problem by summing the weekly reported time loss. For all the above calculations, recurrent problems were counted as the same event if they were deemed by the medical staff to be exacerbations of an unresolved injury or a chronic illness.

Relative burden of illness, overuse injury and acute injury

The cumulative severity scores for all health problems were summed, and the proportion of the total number made up by illness, overuse injury and acute injury was determined. This

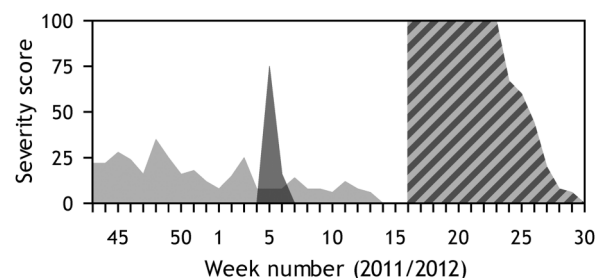


Figure 4 Example of the severity score being used to track the consequences of three 'typical' health problems. The light grey area represents a mild overuse injury (cumulative severity score: 352), the dark grey area represents a short duration illness (91) and the area with diagonal lines represents a severe acute injury (1005).

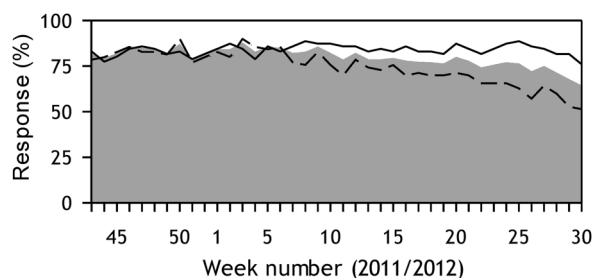


Figure 5 Response rate (%) to the weekly health questionnaires for the whole group (solid grey area), for the athletes selected for the Olympic and Paralympic Games (n=71, solid line) and for the athletes not selected for participation in the games (n=71, dashed line).

was performed in order to estimate the relative burden of these different types of health problems.

Statistical analyses

In order to analyse differences in the various prevalence measures between subgroups of athletes, Kruskal-Wallis non-parametric analysis of variance (ANOVA) tests were applied, using SPSS statistical software (SPSS V18, IBM Corporation, New York, USA).

In order to analyse differences in the duration, cumulative severity and average weekly severity scores between different types of health problems, as well as between diagnosed and undiagnosed health problems, regression analyses were made. The repeated nature of measurements was taken into account by applying the robust option in the xtreg command in STATA statistical software (STATA V12.0, StataCorp LP, Texas, USA). The significance level (α) was set at 0.05 for all tests.

As the original OSTRC questionnaire was developed for recording injury consequences,²² it was necessary to reanalyse the psychometric properties of the four key questions when they were applied to illnesses. In order to do this, all questionnaires that did not report an injury (n=3384) were analysed using SPSS software to determine internal consistency (Cronbach's α). A factor analysis was also performed using a principle component analysis extraction method. Additionally,

in order to assess the effects of sampling less frequently, the primary outcome measures were recalculated using only information from every second and fourth questionnaires.

RESULTS

Response rate to the weekly health questionnaires

The average weekly response rate to the health questionnaires was 80% (SD 5). The rate was 84% (SD 3) among athletes that were eventually selected for participation in London, while it was 75% (SD 10) among those that were not selected. Figure 5 shows the response rates for each of these groups during the course of the 40-week project. As illustrated, the response from non-selected athletes fell during the second half of the project.

Classification of problems reported

A total of 617 health problems were reported by 132 athletes over the course of the 40-week project, including 329 illnesses and 288 injuries. Of these, 582 cases (94%) were followed up by medical staff and classified with an ICPC-2 or OSICS-10 code. A majority of the 35 unclassified cases were brief and of mild severity, with their average duration being shorter than that of classified health problems (1 week (95% CI 1 to 2) vs 3 weeks (95% CI 3 to 3), $p=0.03$), and with their average cumulative severity being substantially lower (51 (95% CI 34 to 67) vs 118 (95% CI 99 to 137), $p<0.01$).

Prevalence of health problems

The average weekly prevalence of health problems reported was 36% (95% CI 34% to 38%), with 15% of athletes reporting substantial health problems each week (95% CI 14 to 16). As shown in table 1, overuse injury was the most prevalent type of health problem, and there was a variation in the prevalence of health problems between the various subgroups of athletes.

Over the course of the 40-week project, there was a general decline in the prevalence of illness, substantial illness, overuse injury and substantial overuse injury (figure 6), while the prevalence of acute injury increased slightly over the same period.

Injury data

A total of 288 injuries were reported by 115 athletes over the course of the study. Of these, 202 were classified as overuse

Table 1 Average weekly prevalence (percentage of athletes affected) of all health problems and substantial problems reported, as well as the prevalence of the subcategories illness, injury, overuse injury and acute injury in the whole group and each of the four subgroups of athletes

	Team n=30	Endurance n=53	Tactical/technical n=36	Paralympic n=26	Total cohort n=142
<i>Health problems reported</i>					
All	45 (42–48)****	30 (27–32)****	25 (21–28)***	29 (26–33)*	36 (34–38)
Illness	6 (5–8)****	16 (13–18)****	10 (9–12)****	16 (14–19)****	13 (12–14)
Injury	42 (39–45)****	17 (16–19)*	18 (14–22)*	19 (17–21)*	25 (24–27)
Overuse injury	31 (29–33)****	15 (13–17)*	16 (13–18)*	13 (12–14)**	20 (18–21)
Acute injury	10 (8–12)****	2 (1–2)*	3 (2–4)*	2 (1–3)*	4 (3–5)
<i>Substantial problems</i>					
All	16 (14–17)***	14 (13–16)***	11 (9–13)****	16 (14–19)***	15 (14–16)
Illness	2 (1–3)****	8 (6–10)*	6 (5–8)*	8 (6–10)*	6 (6–7)
Injury	14 (13–16)****	7 (6–7)*	5 (4–7)****	11 (9–12)****	9 (9–10)
Overuse injury	9 (8–11)****	6 (5–6)*	4 (3–5)****	10 (8–11)****	7 (6–8)
Acute injury	5 (4–6)****	1 (0–1)*	2 (1–2)*	1 (0–2)*	2 (2–3)

$p<0.05$ vs *team group, **endurance group, ***tactical/technical group, ****paralympic group.

All data are mean values with 95% CI in parenthesis. Substantial problem: causing moderate/severe reductions in training volume or sports performance, or complete inability to participate in training or competition.

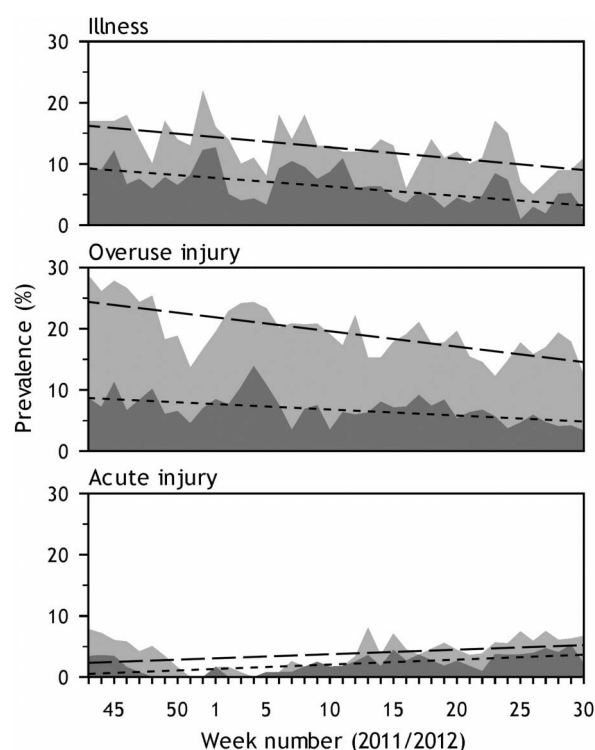


Figure 6 Prevalence of illness, overuse injury and acute injury over the 40-week study. Light grey area: all complaints (linear regression line=long dashes), dark grey area: substantial problems (linear regression line=short dashes).

injuries, 60 as acute injuries and 26 were unclassified. The average duration, average weekly severity score and average cumulative injury score for acute and overuse injuries are shown in table 2. As shown in the table, there were no significant differences between the average duration, average weekly severity score or average cumulative severity score between overuse and acute injuries, although overuse injuries tended to last longer ($p=0.055$).

Of the 288 injuries reported, 122 were substantial problems, including 86 overuse injuries and 27 acute injuries (9 were unclassified; average duration: 1.3 weeks, SD 0.5).

The location of acute and overuse injuries and their severity measured by time loss are shown in table 3. The most common overuse injury types were unspecified pain (29% of cases), muscle injury (25%), tendon injury (16%) and synovitis/impingement/bursitis (15%), while the most common types of acute injury were joint sprains (48%), muscle injury (15%) and bruising/haematoma (12%).

Table 2 Average duration, weekly severity score and cumulative severity score of illnesses, overuse injuries and acute injuries

	Illness n=329	Overuse injury n=202	Acute injury n=60
Duration (weeks)	2 (2–2)	5 (4–6)*	3 (2–4)*
Average weekly severity score	45 (42–47)	32 (29–34)*	35 (30–40)
Cumulative severity score	78 (69–87)	169 (125–214)*	153 (66–240)*

*Significantly different to illness ($p<0.03$).

Data are mean values with the 95% CI in parenthesis.

Illness data

A total of 329 illnesses were reported by 106 athletes over the course of the study, and 97% of cases were classified with an ICPC-2 code. Of the 329 illnesses reported, 198 represented substantial problems. The average weekly prevalence of illness and of substantial illness for the whole group and for each subgroup of athletes is shown in table 1. As shown in table 2, illnesses had a higher average weekly severity score than injuries. However, as their average duration was shorter, their average cumulative severity score was significantly lower. The most commonly affected systems were the respiratory system (68% of cases) and the digestive system (16%).

Relative burden of illness, overuse injury and acute injury

When the cumulative severity score of all health problems was summed, overuse injuries represented 49% of the total number, illnesses represented 36% and acute injuries represented 13%. The remaining 2% consisted of unclassified injuries.

Psychometric questionnaire properties

The questionnaire had high internal consistency when all questionnaires were analysed, as well as for non-injury cases (Cronbach's α of 0.96 and 0.97, respectively). This was not improved by removing items in either case (table 4). The factor weighting was relatively even for all four questions in both cases.

Effects of different sampling frequencies on outcome measures

Sampling less frequently led to fewer cases being identified and a reduction in the average cumulative severity score and duration. However, the average prevalence and average weekly severity measures were not affected (table 5).

DISCUSSION

This paper describes a new approach to monitor athletes' health, and presents the first prospective data on the illness and injury patterns of Olympic and Paralympic athletes preparing for the games. The main findings were that, at any given time, 36% of athletes had some form of health problem, and 15% had a substantial illness or injury. The new method was able to show that overuse injuries represented the greatest burden on the group, owing to the large number of cases and the relatively long duration of consequences they had on the athletes' participation and performance. In contrast, illnesses were of significantly shorter duration and there were far fewer cases of acute injury.

The methods used in this study represent a modification of those we developed for recording overuse injuries in predefined anatomical areas,²² such that they can be used to monitor all types of health complaints. Although the previous approach is more appropriate for the study of specific problems, such as shoulder problems, the current approach is better suited to general surveillance studies, particularly when the cohort is heterogeneous and a wide variety of complaints is expected. In both approaches, the methods differ considerably from those typically used in prospective surveillance studies as health problems are reported directly by athletes through regular online questionnaires, rather than via team medical staff. We have previously discussed the benefits and limitations of this approach in detail^{21 22}; therefore, this discussion will focus primarily on the modifications made in the current study.

One of the principal modifications was to restructure OSTRC questionnaire: The four key questions were made more general

Table 3 Location and degree of time loss for acute and overuse injuries

Location	Acute injuries					Total	Overuse injuries					Total
	Slight (0 days)	Minimal (1–3 days)	Mild (4–7 days)	Moderate (8–28 days)	Severe (>28 days)		Slight (0 days)	Minimal (1–3 days)	Mild (4–7 days)	Moderate (8–28 days)	Severe (>28 days)	
Head	1	2	1	–	–	4	–	–	–	–	–	–
Neck	1	–	–	–	–	1	5	2	2	1	–	10
Shoulder	–	1	1	1	–	3	22	3	1	–	4	30
Upper arm	–	–	–	–	–	–	1	–	–	1	–	2
Elbow	1	–	1	–	–	2	3	1	1	–	1	6
Forearm	–	–	–	–	–	–	3	–	1	–	–	4
Wrist and hand	10	6	–	1	–	17	3	2	1	–	–	6
Chest	–	–	–	–	–	–	1	1	–	–	–	2
Trunk and abdomen	–	–	–	–	–	–	–	1	1	–	–	2
Thoracic spine	1	–	–	–	–	1	6	2	–	1	–	9
Lumbar spine	–	–	–	–	1	1	14	6	4	3	–	27
Pelvis and buttock	–	–	–	–	–	–	3	1	2	–	–	6
Hip and groin	2	2	–	–	–	4	7	–	–	1	–	8
Thigh	1	5	1	2	–	9	10	3	1	–	–	14
Knee	2	–	1	–	1	4	19	9	3	3	2	36
Lower leg	–	1	–	1	–	2	3	2	3	1	–	9
Ankle	6	4	1	1	–	12	8	5	1	–	–	14
Foot	–	–	–	–	–	–	5	7	1	2	–	15
Disabled	–	–	–	–	–	–	–	2	–	–	–	2
Total	25	21	6	6	2	60	113	47	22	13	7	202

(referring to *any health problem or complaint* rather than a specific anatomical area) and logical functions were used to register multiple problems. These changes were made to allow for the registration of all types of problems and to minimise the time burden of completing the questionnaire. However, in our experience, one of the limitations of trying to capture all problems is that fewer are identified than when specific questioning is used.¹⁹ To combat this, we structured the questionnaire such that all athletes had to complete the four key questions regardless of whether or not they had any health problems to report. This prompted the athlete to consider the question *have you had any health problems* in several different ways.

A second modification was the use of team medical staff to classify and diagnose each health problem reported by athletes, allowing for the prospective collection of exact diagnoses, as well as a comprehensive subclassification of each case. As this

method records all physical complaints, a considerable proportion of minor and transient cases are likely to be non-specific or difficult to diagnose. This was the case in the current study, where the most common type of overuse injury was ‘unspecified pain,’ representing 29% of all cases. Nevertheless, monitoring the prevalence of specific injury types, such as tendinopathy or stress fractures, becomes possible using this approach. In addition, the system of weekly feedback reports to team medical staff established to facilitate data collection (figure 1) also served as a practical tool to optimise medical coverage for the teams. This was important, as the athletes involved spent most of the preparatory period with their club, relying upon local/external medical support. The weekly reporting enhanced the Olympic medical team’s awareness of health problems among their athletes, and in many cases this led to earlier and more comprehensive intervention. This is one potential explanation for the reduction in the prevalence of overuse and illness problems throughout the course of this study. However, it must be taken into consideration that by improving athletes’ medical coverage, the system inherently affects its own data.

A third modification is that, in addition to the average weekly severity score, an additional measure of severity, the cumulative severity score, was calculated for each health problem. This provides information on the relative impact each case has on the athlete, as it takes into account the degree of consequences and the duration of the problem. Summing cumulative severity scores also enables an estimation of the total burden of different types of problems, or within different groups of athletes. One important finding in the current study was that overuse injuries placed a much greater burden on the athletes than illnesses and acute injuries (49%, 36% and 13%, respectively, of the summed cumulative severity score), in contrast to what is typically found using standard surveillance methods.^{7 9 15 26–29}

For acute injuries, we consider standard surveillance methods to be a satisfactory alternative to the new method, as it was

Table 4 Interitem and item–total correlations and effects of removing items on internal consistency

	Interitem correlation matrix				Cronbach's α if item deleted
	Question 1	Question 2	Question 3	Item–total correlation	
All questionnaires (n=4470)					
Question 1	–			0.92	0.94
Question 2	0.87	–		0.90	0.94
Question 3	0.89	0.88	–	0.92	0.94
Question 4	0.85	0.80	0.84	0.87	0.95
Non-injury cases (n=3384)					
Question 1	–			0.94	0.95
Question 2	0.91	–		0.91	0.96
Question 3	0.90	0.91	–	0.94	0.95
Question 4	0.87	0.82	0.88	0.88	0.96

Table 5 Variations in outcome measures with different sampling frequencies

	Sample Weekly	Sample every 2 weeks	Sample every 4 weeks
Number of completed questionnaires	4469	2244	1124
Number of health problems identified	617	428	294
Illnesses	329	216	132
Injuries	288	212	162
Number of substantial problems	320	220	131
Illnesses	198	129	71
Injuries	122	91	60
Average prevalence (all health problems)	36 (34–38)	36 (34–38)	37 (34–40)
Average prevalence (substantial)	15 (14–16)	16 (14–17)	16 (14–17)
Average weekly severity score	40 (38–42)	40 (38–42)	38 (35–41)
Average cumulative severity score	114 (96–132)	83 (71–95)	60 (51–69)
Average duration of problems (weeks)	3 (3–3)	2 (2–2)	2 (1–2)

arguably for this purpose that they were developed.^{16 21} However, data collected by medical staff may not always be complete and accurate,^{30 31} and systematic bias may be introduced when broad definitions are used.³² As the methods used in this study do not rely on medical staff as the means of determining the occurrence of a case, a major source of systematic bias is eliminated. Therefore, the novel methodology may be a preferable alternative, particularly as recording all complaints is desirable in many instances.³³ It should be noted that data collected using the new method can also be presented according to consensus guidelines,¹⁶ as demonstrated in table 3.

Although illnesses are increasingly being included in surveillance studies,^{6–8 10 11 26 34} there is a wide variation in the way in which they are recorded and reported. Similar to injuries, issues are likely to arise when recording illnesses using standard prospective methods, particularly as athletes with mild or chronic conditions are likely to continue to participate in sport. The methods used in this study may therefore be a good option when these problems are of interest. Although OSTRC Questionnaire was first developed for the study of injuries, our analyses of its psychometric properties suggest that it may also be appropriate to monitor illness consequences.

It must be acknowledged that the success of this method of data collection is entirely dependent on a good response from athletes, as well as a thorough follow-up from team medical staff to record diagnoses. In the current study, the average response rate of 80% was high, as was the percentage of cases successfully diagnosed (94%). However, this was a study of highly motivated elite athletes in a well-organised Olympic team structure, and it is not yet known how these methods will function in other settings.

Finally, as in our previous paper, we performed data simulations of the effects of administering questionnaires every second and fourth week, rather than weekly. The results indicate that, in future epidemiological studies using this method, it is possible to sample less frequently as the primary outcome measures, average prevalence and severity are unchanged. However, the data simulations highlight the fact that cumulative severity scores are not comparable between studies unless the studies are of the same duration and use the same sampling frequency. Also, as fewer problems are identified and the frequency of reporting to the medical team is reduced, administering questionnaires less frequently would comprise this method's value as a practical health monitoring tool.

CONCLUSION

This paper presents a new approach to recording all types of health problems in sport, showing that the method is sensitive and valid in documenting the pattern of acute injuries, overuse injuries and illnesses in a large, heterogeneous group of athletes during a 40-week preparatory period before the Olympic and Paralympic Games. Overuse injuries represented a much greater burden (49%) on the athletes than illnesses (36%) and acute injuries (13%), in contrast to what is typically found using standard surveillance methods.

What are the new findings?

- ▶ A new approach to monitor athletes' health using regular online questionnaires enables valid and reliable registration of all types of problems, including illness, overuse injury and acute injury.
- ▶ At any given time, more than one in three athletes preparing for the Olympic or Paralympic Games had health problems.
- ▶ Overuse injuries represented the greatest burden on athletes' health, in comparison to acute injuries and illnesses.

How might it impact on clinical practice in the near future?

- ▶ This paper may lead to a change in the methods used in surveillance studies of athletes, particularly when overuse injuries and illnesses are of interest.

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Original article

Contributors All authors were involved in planning the project, data collection and preparing the manuscript. BMC was responsible for co-ordination of the data collection and for data analysis. BMC is responsible for the overall content as the guarantor.

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REFERENCES

- Rogge J. An ounce of prevention? *Br J Sports Med* 2009;43:627.
- Steffen K, Soligard T, Engebretsen L. Health protection of the Olympic athlete. *Br J Sports Med* 2012;46:466–70.
- 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.
- Alonso JM, Junge A, Renstrom P, et al. Sports injuries surveillance during the 2007 IAAF World Athletics Championships. *Clin J Sport Med* 2009;19:26–32.
- Alonso JM, Tscholl PM, Engebretsen L, et al. Occurrence of injuries and illnesses during the 2009 IAAF World Athletics Championships. *Br J Sports Med* 2010;44:1100–5.
- Alonso JM, Edouard P, Fischetto G, et al. Determination of future prevention strategies in elite track and field: analysis of Daegu 2011 IAAF Championships injuries and illnesses surveillance. *Br J Sports Med* 2012;46:505–14.
- Engebretsen L, Steffen K, Alonso JM, et al. Sports injuries and illnesses during the Winter Olympic Games 2010. *Br J Sports Med* 2010;44:772–80.
- Edouard P, Depiesse F, Hertert P, et al. Injuries and illnesses during the 2011 Paris European Athletics Indoor Championships. *Scand J Med Sci Sports*. Published Online First: 28 November 2012. doi: 10.1111/sms.12027
- Junge A, Engebretsen L, Mountjoy ML, et al. Sports injuries during the Summer Olympic Games 2008. *Am J Sports Med* 2009;37:2165–72.
- Mountjoy M, Junge A, Alonso JM, et al. Sports injuries and illnesses in the 2009 FINA World Championships (Aquatics). *Br J Sports Med* 2010;44:522–7.
- Ruedl G, Schobersberger W, Pocecco E, et al. Sport injuries and illnesses during the first Winter Youth Olympic Games 2012 in Innsbruck, Austria. *Br J Sports Med* 2012;46:1030–7.
- Webborn N, Willick S, Reeser JC. Injuries among disabled athletes during the 2002 Winter Paralympic Games. *Med Sci Sports Exerc* 2006;38:811–15.
- Webborn N. ICP Injury Survey Torino 2006. *Paralympian* 2007;2:11.
- Webborn N, Willick S, Emery CA. The injury experience at the 2010 Winter Paralympic Games. *Clin J Sport Med* 2012;22:3–9.
- 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.
- 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.
- Jacobsson J, Timpka T, Ekberg J, et al. Design of a protocol for large-scale epidemiological studies in individual sports: the Swedish Athletics injury study. *Br J Sports Med* 2010;44:1106–11.
- Bahr R, Reeser JC. Injuries among world-class professional beach volleyball players. The Federation Internationale de Volleyball beach volleyball injury study. *Am J Sports Med* 2003;31:119–25.
- Clarsen B, Krosshaug T, Bahr R. Overuse injuries in professional road cyclists. *Am J Sports Med* 2010;38:2494–501.
- Jacobsson J, Timpka T, Kowalski J, et al. Prevalence of musculoskeletal injuries in Swedish elite track and field athletes. *Am J Sports Med* 2011. Published Online First: 3 November 2011. doi:10.1177/0363546511425467.
- 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. *Br J Sports Med* 2012. Published Online First: 4 October 2012. doi:10.1136/bjsports-2012-091524
- World Health Organization. International Classification of Primary Care, Second edition (ICPC-2). <http://www.who.int/classifications/icd/adaptations/icpc2/en/index.html> (accessed Oct 2011).
- Rae K, Orchard J. The Orchard Sports Injury Classification System (OSICS) version 10. *Clin J Sport Med* 2007;17:201–4.
- Fuller CW, Bahr R, Dick RW, et al. A framework for recording recurrences, reinjuries, and exacerbations in injury surveillance. *Clin J Sport Med* 2007;17:197–200.
- Dvorak J, Junge A, Derman W, et al. Injuries and illnesses of football players during the 2010 FIFA World Cup. *Br J Sports Med* 2011;45:626–30.
- Hagglund M, Walden M, Ekstrand J. UEFA injury study—an injury audit of European Championships 2006 to 2008. *Br J Sports Med* 2009;43:483–9.
- Hagglund M, Walden M, Ekstrand J. Injuries among male and female elite football players. *Scand J Med Sci Sports* 2009;19:819–27.
- 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* 2012. Published Online First: 15 May 2012. doi:10.1111/j.1600-0838.2012.01476.x
- 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* 2012. Published Online First: 27 April 2012. doi:10.1111/j.1600-0838.2012.01471.x
- Bjørneboe J, Flørenes 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.
- 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.
- 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.
- Sell K, Hainline B, Yorio M, et al. Illness data from the US Open Tennis Championships from 1994 to 2009. *Clin J Sport Med* 2012. Published Online First: 24 September 2012. doi:10.1097/JSM.0b013e31826b7e52



The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes

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