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Tennis-specific extension of the International Olympic Committee consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020

Evert Verhagen [1,2,3,4] Benjamin Clarsen [5,6] Jamie Capel-Davies,[7] Christy Collins,[8] Wayne Derman [9,10] Don de Winter,[11] Nicky Dunn,[7] Todd S Ellenbecker,[12] Raymond Forde,[13] Brian Hainline [14] Jo Larkin,[15] Machar Reid,[16] Per AFH Renstrom,[17] Kathleen Stroia,[18] Sue Wolstenholme,[19] Babette M Pluim [1,20,21]

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For numbered affiliations see end of article.

Correspondence to
Professor Evert Verhagen, Amsterdam Collaboration on Health & Safety in Sports, Department of Public and Occupational Health, Amsterdam Movement Sciences, Amsterdam UMC, Amsterdam 1081BT, The Netherlands; e.verhagen@amsterdamumc.nl

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ABSTRACT

The IOC has proposed standard methods for recording and reporting of data for injury and illness in sport. The IOC consensus statement authors anticipated that sport-specific statements would provide further recommendations. This statement is the tennis-specific extension of the partner IOC statement. The International Tennis Federation Sport Science and Medicine Committee, in collaboration with selected external experts, met in June 2019 to consider athlete health monitoring issues specific to tennis. Once the IOC consensus statement was finalised, the tennis-specific consensus was drafted and agreed on by the members over three iterations. Compared with the IOC consensus statement, the tennis consensus contains tennis-specific information on injury mechanism, mode of onset, injury classification, injury duration, capturing and reporting exposure, reporting risk and study population. Our recommendations apply to able-bodied as well as wheelchair tennis players. Where applicable, specific recommendations are made for wheelchair tennis.

INTRODUCTION

Athlete health monitoring has many benefits. There is an immediate value in identifying those interventions that could protect or improve the athletes' current health via feedback to the athletes and their support staff. Also, there is long-term value in serial health assessments to monitor injuries, load, maturation and ageing. In addition, athlete health data can help tournament staff better organise and prepare for medical problems during competition and support athletes and their medical teams. Consistency in reporting and using a standardised methodology is also the aim of all research on athlete health and injury and illness prevention programmes. Therefore, the IOC published a consensus statement for sport.[1 2]

The IOC consensus statement offers recommendations to standardise the reporting of athlete health across sports. However, there were 28 sports involving 41 disciplines in the 2016 Summer Olympics,[3] seven sports involving 15 disciplines in the 2018 Winter Games,[4] and it is anticipated that 33 sports with a total of 50 disciplines will participate in Tokyo 2021.[5] Each of these sports poses a unique challenge to their athletes. The IOC consensus recommendation authors anticipated that subsequent sport-specific statements would provide more detailed recommendations relevant for the sport and setting. Here we update the 2009 consensus statement on medical conditions in tennis[6] as a partner document to the 2020 IOC consensus statement.[1 2]

METHODS

In February 2019, EV and BMP reviewed the previous tennis consensus statement[6] and compared this with other published consensus statements.[7–14] In June 2019, the International Tennis Federation (ITF) hosted a tennis consensus meeting in London with the eight ITF medical committee members and five external experts (EV, BC, DdW, TE and CC). Three tennis consensus group members were also part of the IOC consensus group (EV, BC and BMP). During the London meeting, the tennis consensus group members agreed on which of the previous recommendations needed to be updated and which tennis-specific athlete health monitoring issues to consider. Once the IOC consensus statement was accepted for publication, EV and BP prepared a draft of the additions based on the tennis consensus group's discussions. During this final phase, an additional expert was recruited to ensure that the proposed tennis-specific consensus also applied to wheelchair tennis (WD). All tennis consensus group members reviewed the draft and reached a consensus over three iterations. This tennis-specific extension of the IOC consensus statement follows the primary document's format but provides tennis-specific details. All recommendations apply to able-bodied as well as wheelchair tennis players, and, where applicable, specific recommendations are made for wheelchair tennis.

CONSENSUS RECOMMENDATIONS

Table 1 summarises the tennis-specific additions to the IOC consensus statement: methods for recording

Table 1 Tennis and wheelchair tennis additions to the IOC consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020

Topic	Additions
Defining and classifying health problems	Mode of onset. (Wheelchair) Tennis examples are provided. Classifying the mechanisms of injury. Tennis-specific examples are provided.
Classifying sports injury and illness diagnoses	Common injury types and diagnoses for shoulder injuries are added.
The severity of health problems	The duration of time loss of health problems sustained during a tournament should be confirmed.
Capturing and reporting athlete exposure	Exposure in hours should be registered separately for tennis practice, tennis matches, and strength and conditioning. Internal and external load may be monitored using session-Rate of Perceived Exertion. Match exposure should be recorded in terms of the number of matches, sets, games and/or points. Additional measures for tennis load are recommended, including distance covered, changes of direction, acceleration and number and velocity of strokes.
Expressing risk	For tournaments, the number of injuries per 1000 hours and per 1000 games played should be reported.
The burden of health problems	No additional recommendations made.
Study population characteristics	(Wheelchair) Tennis population characteristics of interest are provided.
Data collection methods	Tennis and wheelchair tennis templates for baseline information, injury and illness registration, and training and match exposure have been developed.

and reporting of epidemiological data on injury and illness in sport 2020.[1]

DEFINING AND CLASSIFYING HEALTH PROBLEMS

We adopt the definition of an athlete's health problem as stated by the authors of the IOC consensus statement as any condition that affects an athlete's normal state of full health, irrespective of its consequences on the athlete's sports participation or performance, or whether the athlete sought medical attention.[15] Such a broad definition is crucial for tennis, a sport where non-time-loss problems dominate the injury and illness spectrum.[16 17]

The IOC consensus statement recommends implementing methods that capture relevant subtleties of injury onset, rather than using sudden and gradual onset as a dichotomy only. In table 2, we provide tennis-specific examples for this classification.

CLASSIFYING SPORTS INJURY AND ILLNESS DIAGNOSES

The IOC consensus statement provides a standard format for reporting injury characteristics, based on a template used by rugby. Unfortunately, for tennis, such detailed information is currently unavailable. We included examples of shoulder injuries and diagnoses to illustrate the potential format of standard reporting in tennis (table 3). Studies can expand or collapse tables to highlight specific diagnoses in any way they choose.

Table 2 Tennis-specific examples for a mode of onset

Mechanism	Presentation	Example
Acute	Sudden onset	The player twists his ankle while sliding towards the ball and tears the ankle's lateral ligament(s).
Repetitive	Sudden onset	The player feels a sudden, acute pain at the back of the shoulder after a serve. X-ray of the thoracic spine is negative, but MRI shows a stress fracture of the second rib.
Repetitive	Gradual onset	The player experiences gradually increasing pain below her kneecap. Initially, the player only feels some slight stiffness and pain at the beginning of the play, but eventually, the pain is so severe the player is no longer able to push off or land after the serve. Ultrasound imaging confirms patellar tendinopathy.

In wheelchair tennis, upper limb injuries are common, as well as injuries to stumps and insensate upper and lower limbs. These include lacerations, contusions and abrasions to the stump skin as well as insensate pressure areas. Stump injuries should be recorded according to their anatomical location and have associated Orchard Sports Injury and Illness Classification System and Sport Medicine Diagnostic Coding System codes.[18]

SEVERITY OF HEALTH PROBLEMS

The duration of time loss is often used to capture severity. The IOC consensus statement defines time loss as *the number of days that the athlete is unavailable for training and competition, from the date of onset until the athlete is fully available for training and competition*. Although time loss is generally considered easy to capture, it is difficult to operationalise in tennis where systematic data collection is only available at tournaments. Even though it is possible to register a time-loss problem that occurs during a tournament, it is challenging to track the duration of every time-loss injury afterwards. Therefore, we recommend that the injury's time-loss be confirmed at a later stage through the player or their doctor, if feasible. Be aware that there are inherent difficulties with this approach. Inability to contact players out-of-competition, recall bias, technological issues (ie, multiple athlete management systems are in use) and variations in medical personnel (ie, other medical support provided at each event) may affect the ability to capture this information.

Depending on the research question, it may be more appropriate to express the severity of the health problem in tennis by (1) the nature of the sports injury or illness (eg, stress fracture, rotator cuff tear), (2) the OSTRC severity score or (3) the outcome of the injury (eg, retirement from tennis).[15 19]

CAPTURING AND REPORTING ATHLETE EXPOSURE AND EXPRESSING RISK

Tennis is a sport that demands a variety of training methods to improve and optimise performance. Therefore, training exposure in hours should be registered separately for tennis practice (skills and drills), and strength and conditioning. When monitoring load in high-performance tennis and wheelchair tennis players, a further subdivision of strength and conditioning into strength training, conditioning, movement/speed/agility and body management skills is recommended (online

Table 3 Proposed standard reporting format for the shoulder injury pattern in tennis

Region	Tissue type	Diagnosis	SMDCS code	OSIICS 13 code
Shoulder				
	Muscle/tendon	Rotator cuff strain	SH.12.07	ST1
		Rotator cuff tear	SH.12.09	ST1
		Rotator cuff tendinopathy	SH.12.28	ST1
		Long head of biceps tendinopathy	SH.13.28	ST2
		Long head of biceps tendon rupture	SH.14.09	SR2
	Nervous	Suprascapular nerve entrapment	SH.24.39	SN4
	Bone	Clavicular fracture	SH.32.13	SFC
		Distal clavicular osteolysis	SH.32.33	SAO
		Humeral proximal growth plate/physeal injury	SH.34.20	UZX
	Cartilage/synovium/bursa	Adhesive capsulitis/frozen shoulder	SH.40.30	SQF
		Shoulder osteoarthritis	SH.40.34	SAX
		Impingement/subacromial impingement	SH.41.30	STD
		Acromioclavicular degenerative/ joint arthritis	SH.42.34	SAA
		Bankart lesions	SH.44.17	SCL
		Glenoid labrum tear	SH.46.21	SCL
		Slap lesion	SH.47.21	SCS
	Ligament/joint capsule	Multidirectional laxity	SH.55.12	SU1
		Multidirectional instability	SH.56.12	SU1
	Superficial tissues/skin	Shoulder contusion	SH.60.24	SH1
		Shoulder laceration	SH.60.25	SKXS
		Shoulder abrasion	SH.60.26	SIX
	Non-specific	Scapulothoracic dysfunction	SH.90.42	NZX

OSIICS, Orchard Sports Injury and Illness Classification System; SMDCS, Sport Medicine Diagnostic Coding System.

supplemental appendix 1). In high-performance tennis, monitoring the response to training and matches is essential to optimise training programmes and mitigate the risk of injury, and the Rate of Perceived Exertion per session can be used as a measure of internal and external load (online supplemental appendix 1).[20 21]

However, specific to tennis, simply measuring exposure in terms of time may be insufficient because time and actual 'workload' do not correlate well. Workload does not equal time played because the game of tennis poses several factors that may make an hour of play more or less demanding for a player. This is especially true for exposure during competition because there is no time limit on the duration of a match. Tennis matches can last less than 30 min (3-set match) to more than 11 hours (5-set match).[22] Therefore, for competition, we recommend registering exposure in time, as well as recording the number of matches, sets, games and/or points played.

We recommend expressing risk as the number of injuries per 1000 hours and per 1000 games played (ie, the games from a match) as this will allow for comparison between sexes and playing surfaces. It may not be feasible to collect such detailed data at the community level of play, and then injuries per 1000 sets or matches may suffice.

Additionally, tennis involves the loading of the upper and lower body, in marked contrast to sports like soccer, running and skating, where loading mainly affects the lower body. Because both the upper and lower limbs are involved, it is crucial to monitor the load on both the upper and the lower body to make meaningful inferences about the actual 'load' and subsequent health outcomes.[23] This monitoring is an enormous challenge in practice, but the future sensor and video technology may well prove beneficial.

For specific research questions (eg, risk factors for calf muscle strains and the influence of serving load on shoulder injuries) it may be useful to collect data on:

- The total distance covered, running speed, total (sum of) whole-body acceleration and the number of changes of direction.[24–27]
- The number, velocity and type of strokes (eg, serves, forehands and backhands) (online supplemental appendix 1).[27–29]

The following tools are already available to capture some or all of these data, although with different accessibility, precision, reliability, ease of use and cost:

1. Optical tracking systems, for example, Hawk-Eye or Playsight.[30 31]
2. Global positioning system (GPS) systems, for example, Catapult.[32]
3. Inertial measurement unit (IMU) sensors, for example, Movesense[33] or next-generation IMUs.[34]

To capture the distance covered in wheelchair tennis, we recommend using IMUs, because they are ubiquitous, low-cost, non-invasive, valid and reliable for wheelchair court sports.[35 36]

Because tennis is most commonly played outdoors, the environment changes continuously and the playing surface changes from tournament to tournament. There may be extreme heat in Atlanta, Miami and Australia (on hard courts), whereas it may be cold in Northern Europe (it snowed during the Munich 2016 Association of Tennis Professional (ATP) event on clay).[37] Environmental factors, including court surface (eg, clay, grass, hard courts and synthetic turf), heat and humidity (eg, temperature, heat index and wet bulb globe temperature (WBGT)) and variations in air quality (air pollution, pollen and nitrogen dioxide) are all useful to add context to injury and illness surveillance. This information will help to answer specific research questions

Table 4 Tennis-specific population characteristics to be reported

Mode	Category	Age group	Level[42]
Men's and women's singles	Able-bodied	Junior (18 and under)	Beginner/WTN
Men's and women's doubles	Wheelchair Open	Adult (19–49)	Intermediate/WTN
Mixed doubles	Wheelchair Quad	Seniors (50 and older)	Advanced/WTN Elite/High Performance/WTN

WTN, World Tennis Number

(eg, injury incidence on various playing surfaces, association between heat illness incidence and WBGT, incidence of asthma and air quality index) (online supplemental appendices 2–5).[38–40] Recording of the environmental conditions is vital in wheelchair tennis. Some athletes with disabilities can have impaired thermoregulatory systems that lead to increased susceptibility to heat illness (eg, spinal cord injury with less or no sweating below the level of the lesions).[41]

STUDY POPULATION CHARACTERISTICS

Tennis is a sport with a wide variety of participants in terms of sex, age, disability and skill level. The amount of money and human resources available for data capture and analysis will vary based on factors including, but not limited to:

- The level of participation (professional/elite junior/community).
- The wealth and medical systems of the country in which it is taking place.

Tennis consists of singles and doubles, can be played from youth to seniors and can be played at many levels of expertise, each with a distinct risk for adverse health effects. Table 4 provides the minimum population characteristics to be reported in tennis-specific health monitoring. For the level of play, we recommend using the World Tennis Number as soon as it becomes available.[42] Also, the discrete categories beginner, intermediate, advanced and elite/high performance can be used. However, researchers are encouraged to provide additional demographic information relevant for their studies, such as Women Tennis Association (WTA), ATP or ITF ranking; national, regional or club level; or high school or college athlete.

We recommend collecting the following data at baseline and annually: sex, date of birth, country of residence, level of play, dominant hand, regular playing surface, competition, training volume per week (tennis and strength and conditioning), other sports per week and current injuries.

Additional data (that might be omitted at community level surveillance if resources are limited) include:

- Starting age at tennis.
- Height, weight.
- Single-handed or double-handed backhand.
- Previous injuries.
- Number of singles and doubles tournaments per year.
- Number of singles and doubles matches per year.
- The highest level of education.

With reference to wheelchair tennis, there are currently seven eligible impairment types. These include impaired muscle power, athetosis, impaired passive range of movement, hypertonia, limb deficiency, ataxia and leg length difference. There are two classes in wheelchair tennis. The 'Open' Class is for athletes with permanent impairment of one or both legs, but with normal arm function. The 'Quad' Class is for athletes with additional restrictions in the playing arm, limiting the ability to handle the racket or manoeuvre the wheelchair. Both the impairment type and the class should be recorded in injury and illness surveillance to determine risk profiles.

DATA COLLECTION METHODS

The two governing bodies for professional tennis, the Association of Tennis Professionals (ATP, men) and the WTA (women), currently use electronic in-competition registrations. The ITF (world tennis, wheelchair tennis and beach tennis) has recently started an electronic collection of injury data at the men's and women's world tennis tour. Many national federations have their own athlete health management systems, with more emphasis on out-of-competition data collection. However, because the data collected by these diverse electronic registration systems are not publicly available or compatible, we have developed templates for (1) the collection of baseline information in tennis and wheelchair tennis, (2) injury reporting, (3) illness reporting, and (4) match and training exposure (online supplemental appendices 1–5).

CONCLUSION

We believe that monitoring the health of tennis athletes in a reliable, valid and scalable way is essential for their welfare, playing longevity and the popularity of the sport. In response to the 2020 IOC-led consensus statement on athlete health monitoring, tennis experts offer sport-specific details on medical data collection and tennis-related analysis. This 2021 guideline updates the 2009 consensus statement on tennis medical conditions.[6] It should contribute to injury and illness reduction in tennis.

Author affiliations
[1]Amsterdam Collaboration on Health & Safety in Sports, Department of Public and Occupational Health, Amsterdam Movement Sciences, Amsterdam UMC, Amsterdam, The Netherlands
[2]UCT/MRC Research Unit for Exercise Science and Sports Medicine (ESSM), Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa
[3]School of Physical Education, Faculty of Physical Therapy & Occupational Therapy, Universidade Federal de MinasGerais, Belo Horizonte, Brazil
[4]Amsterdam Institute of Sport Science, Amsterdam, The Netherlands
[5]Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo Sports Trauma Research Center, Oslo, Norway
[6]Centre for Disease Burden, Norwegian Institute of Public Health, Oslo, Norway
[7]International Tennis Federation, London, UK
[8]Datalys Center for Sports Injury Research and Prevention, Indianapolis, Indiana, USA
[9]Institute of Sport and Exercise Medicine, Division of Orthopaedic Surgery, Department of Surgical Sciences, Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, South Africa
[10]IOC Research Center, Cape Town, South Africa
[11]KLM Health Services, Schiphol-Oost, The Netherlands
[12]ATP Medical Services, Ponte Vedra Beach, Florida, USA
[13]Barbados Tennis Association Inc, Bridgetown, Barbados
[14]National Collegiate Athletic Association (NCAA), Indianapolis, Indiana, USA
[15]Lawn Tennis Association, London, UK
[16]Tennis Australia, Melbourne, Victoria, Australia
[17]Stockholm Sports Trauma Research Center, Department of Molecular Medicine and Surgery, Karolinska Institutet, Stockholm, Sweden
[18]Women's Tennis Association, St Petersburg, Florida, USA
[19]Tennis Foundation, London, UK
[20]University of Pretoria Faculty of Health Sciences, Pretoria, South Africa
[21]Medical Department, Royal Netherlands Lawn Tennis Association (KNLTB), Amstelveen, The Netherlands

Twitter Evert Verhagen @Evertverhagen, Benjamin Clarsen @benclarsen, Wayne Derman @wderman and Babette M Pluim @docpluim

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ORCID iDs
Evert Verhagen http://orcid.org/0000-0001-9227-8234
Benjamin Clarsen http://orcid.org/0000-0003-3713-8938
Wayne Derman http://orcid.org/0000-0002-8879-177X
Brian Hainline http://orcid.org/0000-0002-0233-2434
Babette M Pluim http://orcid.org/0000-0003-0655-8980

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