

Para sport translation of the IOC consensus on recording and reporting of data for injury and illness in sport

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ABSTRACT

In 2020, the IOC proposed a universal methodology for the recording and reporting of data for injury and illness in sport. Para sport is played by individuals with impairment, and they have a unique set of considerations not captured by these recommendations. Therefore, the aim of this addendum to IOC consensus statement was to guide the Para sport researcher through the complexities and nuances that should be taken into consideration when collecting, registering, reporting and interpreting data regarding Para athlete health. To develop this translation, experts in the field of Para sports medicine and epidemiology conducted a formal consensus development process, which began in March 2020 with the formation of a consensus group that worked over eight phases, incorporating three virtual consensus meetings to finalise the translation. This translation is consistent with the IOC consensus statement, yet provides more detailed Para athlete specific definitions and recommendations on study population, specifically, diagnostic and eligible impairment categorisation and recording of adaptive equipment, and defining and classifying health problems in the context of Para sport. Additionally, recommendations and Para athlete specific examples are described with regards to injury mechanism, mode of onset, injury and illness classification, duration, capturing and reporting exposure and risk. Finally, methods and considerations are provided to cater to the varied needs of athletes with impairment with respect to data collection tools. This harmonisation will allow the science to develop and facilitate a more accurate understanding of injury and illness patterns for tailoring evidence-informed prevention programmes and enabling better planning of medical services for Para sport events.

The collection and reporting of accurate health data constitutes the first step in this process and has been identified as a target for improvement in the Para sport setting.^{1 2 15}

To gain consistency in definitions, collection and subsequent reporting of injury and illness data, the IOC produced a consensus statement early in 2020,¹⁶ with several follow-up papers to detail sport specific nuances in data collection and reporting (tennis translation¹⁷; golf translation¹⁸). The translation of the IOC consensus statement guides the Para sport researcher through the complexities of describing athlete impairment types, classifications and the health problems associated with sport participation. This harmonisation will allow the science to develop and facilitate a more accurate understanding of injury and illness patterns for tailoring evidence-informed prevention programmes and enabling better planning of medical services for Para sport events.

METHODS

This translation was developed after the publication of the IOC consensus statement.¹⁶ This task was initiated by WD, who acted as chairperson of the consensus group. An initial group was selected from the medical committee of the International Paralympic Committee (IPC) and IPC Management Team (WD, CB, JK, JL, PVV, NW), who are academically experienced in Para sport epidemiology. This group was expanded to include authors from the IOC consensus statement (CE, BMP, MS) and additional authors with experience in this field (MB, KF, Y-HL, ISM, KS, RW) (online supplemental appendix 1). A formal consensus development process was conducted. This process was modified (online only), due to travel restrictions associated with the novel COVID-19 pandemic.

This process was conducted over nine phases: (1) initial discussions and selection of consensus group; (2) assignment of designated topic areas to seven working groups; (3) review of available literature and drafting of proposed definitions, recommendations and Para sport specific examples by working groups; (4) circulation of a draft with all contributions; (5) a 2-day consensus meeting held on the 29–30 June 2020, during which all contributions were discussed section by section; (6) revision

INTRODUCTION

In keeping with the increased popularity in Para sport over the past several decades, the number of publications regarding injury and illness in this population of athletes has increased significantly.^{1–4} Data from studies during this period have indicated that in many sport settings, rates of injury and illness are higher in Paralympic athletes than in their Olympic counterparts.^{5–14} Therefore, injury and illness prevention programmes are of importance.



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of drafts by working groups according to input received, and consensus reached during the meetings; (7) a final consensus meeting held on the 4 August 2020 to verify all changes; (8) final edits made by an editorial group (WD and MB); (9) review and approval of the final draft by all authors. In all instances, consensus was reached unanimously.

Throughout the document, unless otherwise stated, we are in accordance with the recommendations of the IOC consensus statement. However, certain definitions, parameters and examples that relate specifically to Para athletes must be highlighted. The current document has been specifically written to be read in parallel with the IOC consensus statement. The ordering of sections varies slightly given that defining the population of Para athletes is of critical importance and must be considered from the outset of any injury and illness surveillance work in this population.

Terminology

Some important terminology relating to Para sport must be understood. A *Para athlete* is the IPC's term for a sportsperson with an impairment.^{19–21} This term is used in this consensus statement as it applies to all athletes with an impairment partaking in sports that are recognised by the IPC. It is different from the term *Paralympian* or *Paralympic athlete*, which refers specifically to a Para athlete who has competed at a Paralympic Games. *Para sport* refers to sports that are played by individuals with impairment. Importantly, the term 'Para sport' should only be used to refer to sports that are recognised by the IPC,²⁰ and includes competitors who are affected by one or more of the 10 eligible impairment types.

Other often confused definitions include the terms *impairment*, *disability* and *wheelchair athlete*. The World Health Organization (WHO), in their International Classification of Functioning, Disability and Health, defines *impairment* as 'any loss or abnormality of psychological, physiological or anatomical structure or function'.²¹ As defined by the WHO, *disability* is considered 'an umbrella term for impairments, activity limitations, and participation restrictions' (p3).²² The term 'wheelchair athlete' has been used by some authors, broadly meaning athlete with spinal cord injury, as historically this was the only impairment at the early Paralympic Games. In the overall research context, this is now unhelpful as athletes with many different impairments use wheelchairs for their sport or participate in sports without wheelchairs, for example, swimming or sailing, but require one for daily use.²³ Instead, sport-specific and impairment specific terminology should be used.

CONSENSUS RECOMMENDATIONS

Study population characteristics

Defining diagnostic and associated impairment categories

As outlined in the IOC consensus statement,¹⁶ the athlete's impairment type and underlying diagnosis/medical condition must be considered as part of the minimum demographic information collected in Para sport injury and illness surveillance, given that the background diagnosis is often intrinsically related to injury and illness risk and is often poorly recorded or absent.²⁴ For example, an athlete with a complete spinal cord injury who uses a wheelchair daily, is at heightened risk of shoulder injury, whereas an amputee athlete is at increased risk for skin injury or illness at the residual limb -socket interface.^{10 24 25}

It is important to note that there remains significant confusion in the sports medicine and research community regarding the difference between diagnosis, eligible impairment category and

classification category (sport class). To be eligible to compete in Para sport, first, an athlete must have a diagnosis that could lead to an impairment. This impairment must be one of the 10 eligible impairment types as defined by the IPC classification code (impaired muscle power; impaired passive range of movement; limb deficiency; leg length difference; short stature; hypertonia; ataxia; athetosis; vision impairment and intellectual impairment).²⁶ For purposes of promoting fair competition in Para sport, athletes are grouped into functional categories, or classifications, based on the classification rules of the Para sport Federation, which in turn need to align with the IPC classification code (eligible impairment).²⁶ The aim of this classification is to determine how athletes should be grouped for competition, based on the degree of activity limitation resulting from the impairment. Additionally, each Para sport code has classification rules which describe the process by which eligible athletes should be classified.

To determine injury and illness risk, one must identify the underlying diagnosis or pathophysiological process that leads to the eligible impairment (eg, cerebral palsy, which causes athetosis). Whenever possible, information regarding the athlete's diagnosis should be collected directly via the assessment of a licensed/registered clinician or via evaluation of a clinically verified medical record that allows for this to be confirmed, in preference to athlete or staff self-report.

Since its inception in 1948, the Paralympic movement expanded from a small competition involving only athletes with spinal cord injuries, to include athletes with many different underlying diagnoses.²⁷ Although the range of potential diagnoses in Para sport is vast, for injury surveillance purposes, they must be grouped in a pragmatic way to be used in various global sport settings. This categorisation must be sufficiently specific to allow risk assessment and inform injury and illness prevention strategies. However, if diagnostic categories are divided into very detailed subcategories there is a risk that statistical power will be reduced, and the confidentiality of individuals may be compromised, particularly for those with a unique diagnosis (eg, rare genetic conditions). **Figure 1** depicts the current consensus recommendation of how to define and record diagnostic categories for injury and illness surveillance in Para sport.

Recording of adaptive equipment

Many Para athletes use adaptive equipment in both their daily lives as well as for sports participation. Yet athletes with similar impairment types may or may not elect to use the same kind of adaptive equipment. For example, a unilateral below-knee amputee may either ambulate with a prosthesis or use a wheelchair for daily mobility. Given the intimate athlete-equipment interface and its potential to impact loading and biomechanics, this may have a significant impact on injury or illness risk and should be accounted for in surveillance programmes. **Figure 2** depicts the minimum standard consensus recommendations of how to define and record adaptive equipment categories for injury and illness surveillance in Para sport. If an athlete reports using more than one type of adaptive equipment in daily life (eg, manual wheelchair and crutches), the equipment used most frequently should be reported. This scheme does not include various types of sport-specific adaptive equipment (eg, sport-specific prosthesis, mono ski, ice hockey sledge). However, these should be taken into account for research groups wishing to do detailed sport-specific injury and illness risk analyses. Finally, in athletes with vision impairment, the athlete's guide may also be implicated in the causation of the injury and in these instances,

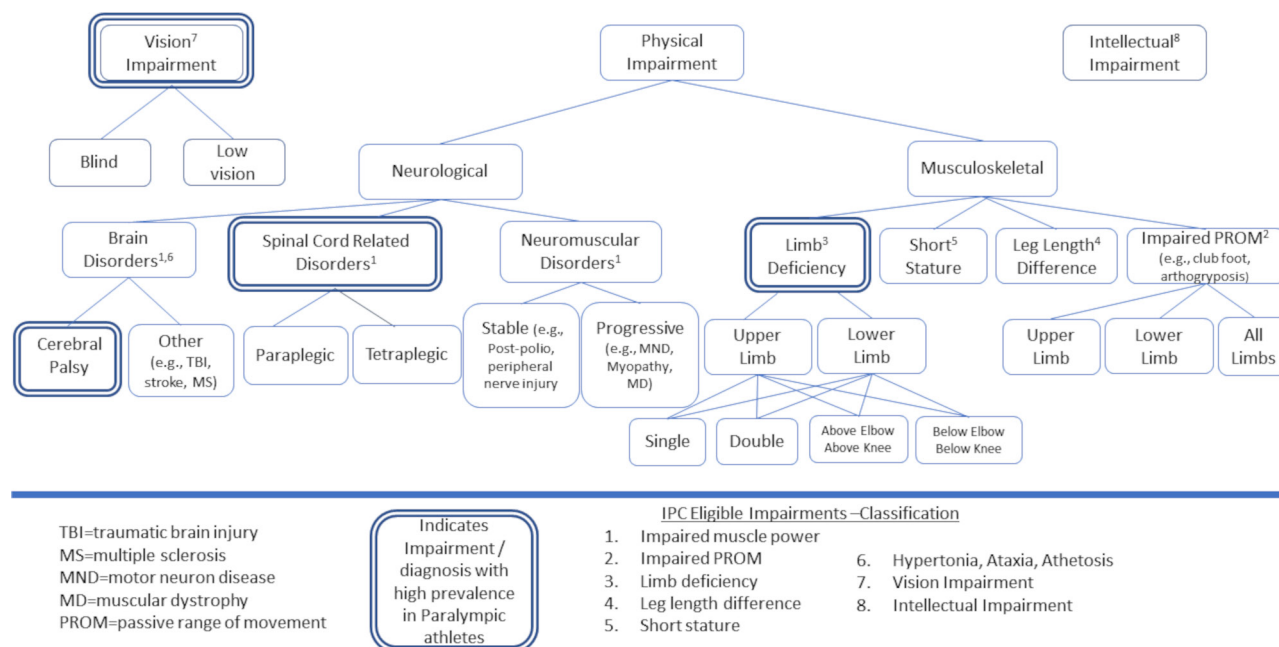


Figure 1 Schematic representation of suggested diagnostic categorisation and relation to International Paralympic Committee eligible impairments, for Para sport illness and injury surveillance and monitoring programmes.⁴⁶ It is recommended that at the very minimum, the large diagnostic or impairment groups as indicated in the double outlined boxes, should be recorded.

this should be recorded. The recommended categories represented in both figures 1 and 2 are also contained in the example of an injury and illness report from, located in online supplemental appendix 2.

Defining and classifying health problems in the context of Para sport

Terminology for health problems

Clarsen *et al* define an athletic health problem as ‘any condition that reduces an athlete’s normal state of full health, irrespective of its consequences for the athlete’s sports participation or performance or whether the athlete sought medical attention’.²⁸ In contrast, defining ‘health’ for the Para athlete is more complex. Para athletes constitute a heterogeneous population of people with diverse impairments. They do not conform to the WHO definition of health as ‘a state of complete physical, mental and social well-being’.²⁹ A Para athlete by definition, and by the requirement for participation by minimal eligibility criteria, will have an altered baseline state of ‘health’. Thus, an athletic health

problem should be recorded when an athlete moves from *any* state of health, to a ‘less-healthy’ state.³⁰

In the Para athlete, the impairment per se may have associated comorbidities that present in the sporting environment but are not a direct consequence of sport participation itself. While this remains valuable information for healthcare planning, it needs to be considered a confounder in terms of attribution from an epidemiological perspective. The nature of the Para athlete’s impairment may also result in a change in the baseline state of health over time, which might result in different levels of risk for injury or illness (see table 1 for examples of confounders). For these reasons, the consensus group strongly recommends the use of the pre-participation evaluation (PPE), periodic health evaluation and the collection of health data in the form of longitudinal studies.

Defining injury and illness

We concur with the IOC consensus statement’s definitions of injury and illness, but definitions require consideration of

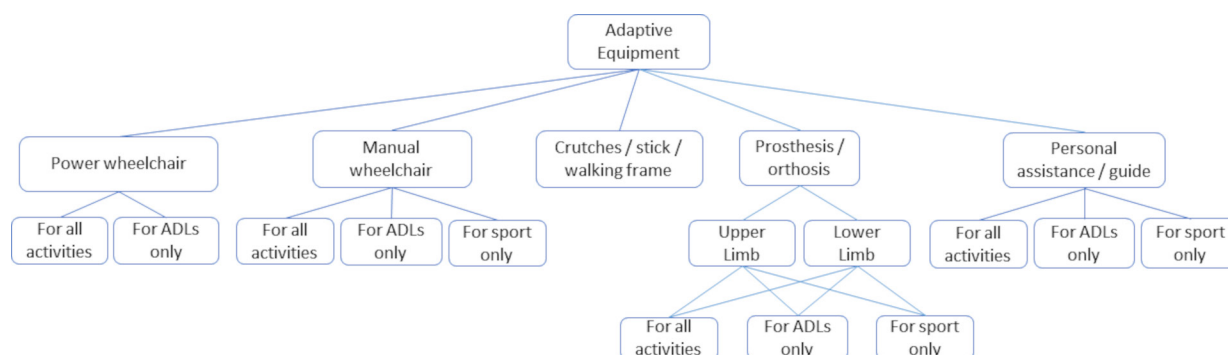


Figure 2 Schematic representation of suggested mobility aid categorisation for Para sport illness and injury surveillance. ADLs, activities of daily living.

Table 1 Examples of comorbidities associated with certain diagnoses

Diagnosis	Associated comorbidity	Comment
Spinal cord injury—wheelchair basketball	Urinary tract infection associated with neuropathic bladder	Not necessarily sport related
Neuromuscular disorder/muscular dystrophy—shooting Para sport	Decreasing muscle strength and/or cardiac function	Decreasing baseline of health over time and cardiac risk
Bilateral above knee amputee—handcycling	Phantom limb pain—athlete uses regular endurance exercise as a form of pain management	Increased risk of shoulder pain deemed necessary by the athlete to manage mental health
Vision impairment—Para swimming (eg, pseudoxanthoma elasticum, Stickler syndrome)	Collagen disorder causing sight loss but also affects soft tissue	Increased risk of injury and impaired healing of tissues

whether this relates to the existing impairment in a sporting or non-sporting context, as outlined below.

Relationship to sports activity

We concur with the IOC consensus statement that health problems may result either *directly*, *indirectly*, or *not at all related to participation in sport*. Examples within a Para sport context are shown in [table 2](#).

Mode of onset

Mode of onset: injury and illness

It is important to note that several studies in Para sports have focused on reporting acute injuries at short competitions (3–23 days), while there remains a lack of longitudinal studies that could allow a better understanding of the epidemiology of gradual onset injuries, and the occurrences of illnesses over time.^{1,2}

Classifying mode of onset

We concur with the IOC consensus statement that data collectors should consider whether a health problem results from a clear acute mechanism, clear repetitive mechanism or a mix of both elements. We have included Para specific examples in online supplemental appendix 3 table A.

Classifying the mechanism of injury

A similar classification system to the IOC consensus statement is applicable, with the subdivision of contact into fixed objects and moving objects, as in the tennis translation of the IOC consensus statement.¹⁷ This classification is relevant to various Para sport settings ([table 3](#)).

Multiple events, subsequent, recurrent and/or exacerbation of health problems in Para sports epidemiology

The IOC consensus statement emphasises that in sports injury and illness epidemiology, there is a relatively high likelihood

that an athlete will experience more than one health problem over a study period.¹⁶ Figure 3 of the IOC consensus statement depicts a classification tree for subsequent health problems (adapted from Hamilton *et al*³¹) that is particularly useful in the categorisation of these subsequent injuries/illnesses and exacerbations in sport. In Para sports injury and illness epidemiology, this categorisation is especially relevant. This is because Para athletes experience a higher number of injuries and illness per athlete and due to their health condition also can have a higher number of subsequent injuries, exacerbations, and recurrences of illness and injury.^{12,32} Therefore, in Para sports injury and illness epidemiology, the following should be recorded for any subsequent injuries: whether it is (1) subsequent recurrent (ie, same injury type as index injury, eg, a recurrent rotator cuff tear); (2) subsequent local injury affecting the same location as the index injury but other tissues (eg, shoulder, but acromioclavicular joint instead of the rotator cuff) or (3) subsequent but affecting other location to the index injury. Recurrent injuries are exacerbations if the index injury is not fully healed.

Similarly, for subsequent illnesses it should be recorded if the subsequent illnesses are (1) subsequent recurrent (ie, same diagnosis as index illness, eg, recurrent urinary tract infection); (2) subsequent local affecting the same system (eg, urogenital) but another diagnosis (eg, catheter site infection or cystitis) or (3) subsequent but other systems. Recurrent illnesses are exacerbations if the index illness has not fully recovered. Examples of subsequent health problems in Para sports injury and illness epidemiology can be found in [table 4](#).

Classifying sports injury and illness diagnoses

We recommend following the IOC consensus statement to classify injury and illness diagnoses. The diagnoses in the IOC consensus statement are based on the Orchard Sports Injury and Illness Classification System (OSIICS), the Sport Medicine Diagnostic Coding System (SMDSC) and the International Classification of Disease

Table 2 Relationship to sports activity within Para context

Health problems may result	Para translation
1. Directly from participation in competition or training in the fundamental skills of a sport (eg, players colliding in a match, a gradual onset injury from repetitive training or transmission of a skin infection from contact with another player)	<ul style="list-style-type: none"> ► A vision impaired athlete sustains a lower limb fracture in alpine skiing. ► An amputee snowboarder develops a skin infection in the residual limb. ► A football 5-a-side player sustains a concussion through a collision with another player.
2. Indirectly from participation in activities that relate to competition or training in a sport, but not during competition or a training session (eg, slipping, falling and sustaining an injury when in the Paralympic village, developing an illness following international travel to a competition or an illness deemed to be related to an increased training load over a few weeks)	<ul style="list-style-type: none"> ► A vision impaired athlete falls and sustains a laceration due to an unfamiliar environment. ► Para athlete with spinal cord injury develops a urinary tract infection after long-haul travel.
3. From activities that are not at all related to participation in sport and occur in the absence of participation during competition or training in the fundamental skills of a sport (eg, car crash, sudden cardiac arrest at home)	<ul style="list-style-type: none"> ► An athlete with cerebral palsy sustains an injury as a result of a seizure triggered by flickering lights in a shopping mall. ► An athlete with spinal cord injury experiences autonomic dysreflexia due to a urinary tract infection.

Consensus statement

Table 3 Examples: classification of contact as a mechanism for sudden-onset injury (adapted from Verhagen *et al*¹⁷)

Injury	Type of contact		Para translation
Non-contact	None	No evidence of disruption or perturbation	A wheelchair sprinter experiences sudden pain in the shoulder during a race.
Contact	Indirect	With another athlete	An outfield football 5-a-side player (football played by athletes with vision impairment who have very low visual acuity and/or no light perception) trips over another player's leg, causing a lateral ankle ligament sprain.
	Indirect	With a fixed object	A Para snowboarder loses control and accidentally hits a gate which causes him to tumble and sprain his wrist.
	Indirect	With a moving object	A wheelchair basketball player is hit on the head by a ball, causing her to lose balance and fall, spraining her wrist.
Contact	Direct	With another athlete	A vision impaired player sustains a concussion from a collision with another player in a football 5-a-side game.
	Direct	With a fixed object	A Para ice hockey player is checked into the boards and dislocates his shoulder.
	Direct	With a moving object	A sitting volleyball player is hit on the head by a spiked ball and sustains a concussion.

(ICD).^{33 34} These coding systems were recently updated to include some common Para athlete specific codes, for example, common amputation sites. For athletes with amputation or congenital limb anomalies, residual limb injuries can be recorded according to their primary anatomical area, for example, upper or lower limb. Researchers can choose to be more specific and add the specific amputation level, for example, above the knee (transfemoral) or the elbow (transhumeral). An expanded list of all amputations is shown in online supplemental appendix 3 table B.

It is noteworthy that some tissue types and pathology related to Para athletes' diagnoses are not included as Para athlete specific conditions in the existing systems (OSIICS and SMDCS).³³ For example, a pressure ulcer is a frequent and often severe tissue injury that affects athletes with reduced sensation. Among athletes with neurological impairment, joint contractures may be present as well as other nervous system-related injuries.^{12 35 36} Therefore, we recommend researchers to identify and record the impairment-specific tissue injuries and pathology that may be present in the Para athlete population. See examples in [table 5](#).

It is also possible to use diagnostic codes from the ICD-10 and ICD-11 in instances where diagnoses cannot be found.^{12 36}

Illness: categories for organ system and aetiology

Paralympic athletes have significantly higher rates of illness than their Olympic counterparts with unique medical conditions related to their type of diagnosis, such as autonomic dysreflexia, pressure

injuries, neurogenic bladder, premature osteoporosis and neuropathic pain.³ Para athletes also have more skin and subcutaneous lesions related to insensate skin and residual limb/prosthesis interface pathology.^{24 37 38} For example, non-traumatic skin lesions on the residual limb in amputees, or sunburn/frostbite on insensate skin, need to be categorised separately from other dermatological conditions, and a hypertensive crisis due to autonomic dysreflexia should be recorded separately from common neurological or cardiovascular conditions listed in ICD-10 and ICD-11.

We recommend adding these specific medical conditions in Para athletes as subcategories in existing categories of organ system/region in the IOC consensus statement. For example, insensate skin and/or residual limb can be included as a subcategory of the dermatological system. For cases of autonomic dysreflexia in spinal cord injury or seizure in brain injury, a subcategory of the central nervous system, peripheral nervous system, and autonomic nervous system can be added to the nervous system. We recommend adding a 'comorbidity of existing diagnosis' to the categories for aetiology of illness for these unique medical conditions in Para athletes as in [table 6](#).

Severity of health problems

Time loss from training and competition

We agree with the IOC consensus statement that investigators should consider the strengths and limitations of different

Table 4 Examples of subsequent health problems in Para sports injury and illness epidemiology

Index injury	Subsequent injury			
	Re-injury (same site and same type as the index injury, index injury was healed/fully recovered)	Recurrent injury Exacerbation (same site and same type as the index injury, index injury not yet healed/fully recovered)	Local injury (same location but different tissue type)	New injury (different location and tissue type)
Rotator cuff tendinopathy in an athlete with spinal cord injury using a wheelchair for racing	Acute rotator cuff tear in this athlete	Recurrent rotator cuff tear	Acromioclavicular joint sprain in this athlete	Acute wrist sprain in this athlete
Index illness	Subsequent illness			
	Repeated illness (same organ system and same type as the index illness, index illness fully recovered)	Recurrent illness Exacerbation of illness (same organ system and same type as the index illness, index illness not yet fully recovered)	Local illness (same organ system but different illness type)	New illness (different organ system and illness type)
Neurogenic bladder in an athlete with spinal cord injury	Urinary tract infection in this athlete	Pyelonephritis	Skin infection at the catheter site in this athlete	Upper respiratory tract infection in this athlete

Table 5 Examples of additional categories of tissue and pathology types for injuries in Para athletes

Tissue	Pathology
Nervous system	Hypertonia Central neurological pain Phantom pain
Ligament/joint capsule	Contracture
Superficial tissue/skin	Pressure ulcer

approaches and the objectives of their study or surveillance programme, when deciding which severity measures to use. Similarly, we agree with the IOC consensus statement that time loss is the most commonly used criterium for assessment of severity. Online supplemental appendix 3 table C gives practical examples of how to calculate time loss in the Para athlete setting. Using 'time loss' for Para athletes has the same limitations as for able-bodied athletes, yet, there are additional considerations and complexities. For example, athletes who use a wheelchair for their sport and sustain an injury to one functional arm may lose independence in daily life, making the impact of such an injury of greater severity than the number of days lost from sport or training alone.

The decision to monitor additional severity parameters, such as non-sport related functional limitations and pain, will depend on the aim of the research. For Para athletes with specific underlying diagnoses, there are outcome measures used in disability research that can be relevant, specifically for evaluation of the impact of the individual's impairment on their activities of daily living. One such example is the Wheelchair Users Pain Shoulder Index (WUSPI).³⁹ The WUSPI is a simple and effective self-reported questionnaire for rapid assessment of the functional impact of shoulder pain in wheelchair users. Another example is the Sports-related Injury and Illness in Paralympic Sport Study (SRIIPSS) that included self-reported injuries, illnesses, impairment related symptoms and other health parameters such as pain, anxiety, sleep and use of medications.

Para athlete reported symptoms and consequences

Existing tools for able-bodied athletes that allow self-reporting of data (eg, symptom recording and training exposure) require adaptation for the Para sport environment. For example,

Table 6 Examples of medical conditions specific to Para athletes as a result of existing diagnoses

Diagnosis	Medical problems
Spinal cord injury	Pressure ulcers Autonomic dysreflexia Urinary tract infection Premature osteoporosis Renal calculi Neuropathic pain Pulmonary dysfunction
Poliomyelitis	Premature osteoporosis Osteoarthritis Nociceptive pain
Amputee	Residual limb infection Phantom limb pain
Cerebral palsy/brain injury	Convulsive disorders Depression Fatigue

This table should be read in conjunction with table 7 of the IOC consensus statement.

reporting tools should allow vision impaired athletes and athletes with an intellectual impairment to respond and provide their data on the system. Specific accessibility considerations are described in detail under the section 'Data collection methods'. Also, some Para athletes with more severe impairments who have higher needs with respect to daily activities might require the assistance of another person to respond and provide data. It should also be possible to include other health symptoms and consequences such as pain, sleep, well-being, medications as well as functional and mental limitations if necessary. An example of one such electronic system is the SRIIPSS eHealth application, which has been specifically developed for all types of Para athletes.¹³

Recording the severity of health problems based on clinical assessment

As the athlete's health can fluctuate due to underlying medical conditions and changes in the impairment, we recommend that sufficient baseline data at the time of the PPE are gathered and recorded, to allow a point of reference for the assessment of subsequent health problems. As access to healthcare can vary considerably for Para athletes, the PPE is rarely conducted in some countries. Therefore, it is a challenge to report the subsequent severity of the athletes' current clinical assessment, as there is no initial benchmark. If baseline health state is unknown prior to the recorded injury or illness, this should be indicated in the injury report. If possible, patient interviews may help identify changes in health state in athletes who do not have well documented health histories. Furthermore, the advent of telemedicine and eHealth approaches might mitigate this particular challenge and may become increasingly popular as an assessment and data collection tool.

Other severity measures

It is important for researchers to consider that certain patient-reported outcome measures for able-bodied athletes cannot be readily used for Para athletes without specific development and testing. One such example is the sports concussion instrument, Sport Concussion Assessment Tool, which cannot be adopted for Para athletes without further development.⁴⁰ In these instances, we recommend the adaptation and validation existing sports-related outcome measures for Para athletes.

Capturing and reporting athlete exposure

Apart from the differences in types of sport for Para athletes compared with able-bodied athletes, the fundamental principles of capturing and reporting exposure, as described in the IOC consensus statement, remains the same. As Para sport types are varied and take place both in the winter and summer sport settings, we recommend exposure measures to be sport-specific (eg, total athlete distance covered, athlete time in competition, number of athlete bouts/fights, athlete days)(online supplemental appendix 3 table D). The context of recording training exposure in Para sport should be sport-specific and athlete-specific and consider categories of general strength and conditioning, and injury-specific rehabilitation targeting safe return to sport.

Expressing risk

While we agree with the recommendation of the IOC consensus statement regarding point prevalence and period prevalence, understanding of these requires a consideration of the complexity of Para sport taking into account the high prevalence of pre-existing medical conditions chronic pain, comorbidities

and prolonged use of adaptive equipment.³ Thus, injury and illness incidence rates may underestimate the true burden given the high prevalence of pre-existing repetitive gradual onset injuries and medical conditions. Also, when collecting data in multi-sport events, and when exposure data are incomparable between sports,^{25 36 41} we recommend expressing incidence as the number of new cases/number of athletes or athlete days. Sport-specific incidence rates may be more optimally expressed by number of health problems/1000 matches (eg, badminton, boccia, football, goalball, judo, sitting volleyball, table tennis, wheelchair basketball, wheelchair fencing, wheelchair tennis) or number of injuries/1000 competitions or events (eg, archery, athletics, canoe, cycling, equestrian, power lifting, rowing, shooting, swimming, taekwondo, dance).

Burden of health problems

Time loss-based severity measures also under-represent gradual onset injuries and illnesses, which are particularly prevalent in the Para sport population.^{12 14 36} In this context, we recommend the use of mean severity scores (measured as arbitrary units) by the Oslo Sports Trauma Research Center—Health questionnaire, instead of measuring only time loss from sports participation.⁴² This questionnaire has been used in Para sport health monitoring, with the exception of vision impaired athletes.¹⁴ New vs pre-existing morbidity must be clearly delineated in the Para sport population where exacerbations are prevalent.

Data collection methods

In Para sport, there are different factors relating to the Para athletes' impairment that should be considered when data are collected. As such, there is a need for flexibility regarding data collection methods in order to adapt to specific context and population differences that will improve validity and reliability.^{2 13 16} Various considerations in this regard are shown in table 7. We recommend that researchers think carefully about these, and other potential considerations that may be present with their own, specific research contexts.

For prospective data collection over time and throughout a season, methods adapted to Para athletes based on self-reports have successfully been developed and evaluated within the SRIIPSS and other longitudinal surveillance projects.^{13 14 43} An example of an injury and illness report form in Para sport, adapted from the IOC consensus statement and SRIIPSS, is provided in online supplemental appendix 2.^{12 13 16 44 45} eHealth based self-report data collection may be especially beneficial, as it can empower health efficiency and autonomy for persons with an impairment due to more accessible opportunities for communicating health parameters.⁴⁴ Digital data collection of other health parameters, such as heart rate and energy expenditure, could also be a feasible method among Para athletes due to a large variation in physiology and training.

Accessibility considerations

There are guidelines and regulations in various countries that may facilitate accessibility for web interfaces and mobile applications. In the USA, for example, researchers may collaborate with experts of the Americans with Disabilities Act (ADA), to ensure their surveillance tools meet ADA guidelines. However, to encourage uniformity and ensure accessibility and validity for all data collection methods for Para athletes, we recommended following the Web Content Accessibility Guidelines. To ensure accessibility for athletes with vision impairment, it is recommended to avoid using paper and pen for blind athletes,

Table 7 Para sport specific additions concerning data collection methods to the IOC consensus statement

Data collection concerns	Considerations
Data collected during competitions	<ul style="list-style-type: none"> ▶ Para athletes often do not have access to a team physician (and physician experience can vary greatly), consider whether data can be reported by other medical staff, coaches or athletes themselves. ▶ Consider how diagnosis is made (eg, with objective methods such as imaging). ▶ Consider collecting data in several languages.
Data collected during training seasons	<ul style="list-style-type: none"> ▶ A global injury/illness reporting app/software that allows each Para sport to record their data are preferable.⁴⁴ ▶ Prospective data collection of self-reports can be recommended where athletes do not have access to medical staff.³²
Accessibility concerns of impairment groups within the Paralympic movement	
Athletes with vision impairment	<ul style="list-style-type: none"> ▶ Adapt electronic reporting to different devices and speech synthesisers. ▶ Avoid pen and paper. ▶ Use large text and consider braille. ▶ Avoid pictures and scales.
Athletes with intellectual impairment	<ul style="list-style-type: none"> ▶ Use easy and understandable terminology. ▶ Provide free text options. ▶ Provide visual cues.
Athletes with (severe) physical impairment	<ul style="list-style-type: none"> ▶ Avoid pen and paper. ▶ Adapt electronic reporting to different devices and assistive writing technology.

and scales and pictures must be avoided. These methods can, however, be considered for partially sighted athletes if large text is used. eHealth based data collection can be used advantageously in this population, but it is important to ensure that the method is compatible with multiple devices, speech synthesisers and braille.^{43 44}

For athletes with intellectual impairment, it is important to use data collection methods containing easily understandable terminology and to allow visual cues and free text answers. For some athletes with more severe physical impairments, such as tetraplegia, it is recommended to avoid pen and paper and adapt eHealth based options with assistive technology for writing.⁴⁴ It is important to consider the provision of support personnel to assist with data collection among some athletes with impairment.⁴³

Finally, the IOC consensus statement highlights the importance of ethics in research and data security. In the context of Para sport, we urge researchers to carefully consider and ensure the protection of dignity and rights of participants, especially as some Para athletes may be considered persons at risk or vulnerable, due to their specific impairment.

CONCLUSION

Accurate and standardised use of specific definitions, methods and parameters to collect and report epidemiological data in the complex Para sport environment is an important step in the prevention of injury and illness and protection of health of the Para athlete. In response to the recent IOC consensus statement on methods for recording and reporting of epidemiological data on injury and illness in sport, experts in the field of Para sports medicine have translated this consensus statement into a Para

sport context. This Para sport translation offers more detailed impairment and sport specific information that will allow researchers in this field to better record and report both injuries and illness.

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Appendix 1**Consensus group composition.**

Member	Country	Profession	Field / Related expertise
Wayne Derman	South Africa	Sports medicine physician	<ul style="list-style-type: none"> - Director: Institute of Sport and Exercise Medicine (Stellenbosch University) and co-director IOC Research centre (South Africa) - IPC Medical committee member - IPC Research lead for Paralympic injury and illness surveillance (WEB-IISS) - CMO of South African Olympic team 1999-2005; South African Paralympic team 2008-2013 - Co-author of the IOC injury/illness consensus - Co-author of the tennis-specific extension of the IOC injury/illness consensus.
Marelise Badenhorst	South Africa	Physiotherapist	<ul style="list-style-type: none"> - Impairment Research associate: Institute of Sport and Exercise Medicine (Stellenbosch University) and IOC Research centre (South Africa)
Cheri A. Blauwet	USA	Sports medicine physician	<ul style="list-style-type: none"> - IPC Medical committee - IOC Medical & Scientific Commission - Co-author of the cycling-specific extension of the IOC injury/illness consensus - Athlete voice: Retired Paralympian
Carolyn A. Emery	Canada	Physiotherapist / Epidemiologist	<ul style="list-style-type: none"> - Co-author of the IOC injury/illness consensus. - Director IOC research centre Calgary, Canada
Kristina Fagher	Sweden	Certified Sports Physiotherapist	<ul style="list-style-type: none"> - PhD Sports-related Injuries and Illnesses in Paralympic athletes - Medical committee, Swedish Paralympic committee - Medical committee,

			International Blind Sports Association
Young-Hee Lee	South Korea	Sports and Rehabilitation medicine physician	<ul style="list-style-type: none"> - Chief Medical Officer, 2018 PyeongChang Winter Paralympic Games - Director, Institute of Sport Science and Exercise Medicine
James Kissick	Canada	Sports medicine physician	<ul style="list-style-type: none"> - IPC Medical committee - Former team physician Canadian Para Ice Hockey Team
Jan Lexell	Sweden	Rehabilitation medicine physician, Sports medicine physician	<ul style="list-style-type: none"> - IPC Medical committee - Former Chief Medical Physician, Swedish Paralympic Committee
I. Stuart Miller	UK	Sports medicine physician	<ul style="list-style-type: none"> - Chief Medical Officer to the British Paralympic Association
Babette Pluim	Netherlands	Sports medicine physician	<ul style="list-style-type: none"> - Co-author of the IOC injury/illness consensus. - Co-author of the tennis-specific extension of the IOC injury/illness consensus. - Co-author of the cycling-specific extension of the IOC injury/illness consensus. - International Tennis Federation Classification Consultant
Martin Schwellnus	South Africa	Sports medicine physician	<ul style="list-style-type: none"> - Director: Sport, Exercise Medicine and Lifestyle Institute (SEMLI) and IOC Research Centre (South Africa) - Co-author of the IOC injury/illness consensus - Member: IOC Medical and Science group - IPC Medical committee (Co-opted member at the 2012, 2014, 2016 and 2020 Paralympic Summer / Winter Games)
Kathrin Steffen	Norway	Epidemiologist	<ul style="list-style-type: none"> - IOC Medical & Scientific Commission - Para athlete health team, Norwegian Olympic Training

			Center
Peter Van de Vliet	Germany	Physiotherapist	- Former Medical & Scientific Director International Paralympic Committee
Nick Webborn	UK	Sports medicine physician	- IPC Medical committee - Athlete voice: Retired Para athlete
Richard Weiler	UK	Sports medicine physician	- PhD Para Sports Injuries - Medical committee, International blind sports association and Para football - Paralympics GB Medical officer

Appendix 2

An example of an injury and illness report form in Para sport, adapted from the IOC consensus statement of methods for recording and reporting of epidemiological data on injury and illness in sport and the Sports-related Injury and Illness in Paralympic Sport Study (SRIIPSS)[1–4]

Baseline information

1. Athlete information (e.g. gender, age, BMI, use of medications, impairment-related health concerns, previous sports injuries and illnesses, access to medical service, minutes of training per week/session, match exposure)

2. Impairment

☐ Vision impairment

☐ *Low vision*

☐ *Blind*

☐ Physical impairment ☐ ☐

☐ Neurological

☐ *Brain Disorder*

☐ *Cerebral Palsy*

☐ *Other (e.g. TBI, Stroke, MS)*

☐ *Spinal Cord Related Disorders*

☐ *Para*

☐ *Tetra*

☐ *Neuromuscular Disorders*

☐ *Stable (e.g., Post-polio, Peripheral nerve injury)*

☐ *Progressive (e.g. MND, Myopathy, MD)*

☐ Musculoskeletal

☐ *Limb Deficiency*

☐ *Upper Limb*

☐ *Single*

☐ *Double*

☐ *Above elbow*

☐ *Below elbow*

☐ *Lower Limb*

- ☐ *Single*
- ☐ *Double*
- ☐ *Above knee*
- ☐ *Below knee*
- ☐ *Short Stature*
- ☐ *Leg Length Difference*
- ☐ *Impaired Passive Range of Movement (e.g. club foot, arthrogyposis)*
 - ☐ *Upper Limb*
 - ☐ *Lower limb*
 - ☐ *All limbs*
- ☐ **Intellectual impairment**

3. Adaptive equipment

- ☐ **Power wheelchair**
 - ☐ *For all activities*
 - ☐ *For ADLs only*
 - ☐ **Manual Wheelchair**
 - ☐ *For all activities*
 - ☐ *For ADLs only*
 - ☐ *For sport only*
 - ☐ **Prosthesis**
 - ☐ *Upper limb*
 - ☐ *For all activities*
 - ☐ *For ADLs only*
 - ☐ *For sport only*
 - ☐ *Lower limb*
 - ☐ *For all activities*
 - ☐ *For ADLs only*
 - ☐ *For sport only*
 - ☐ **Crutches**
 - ☐ **Walking frame**
 - ☐ **Stick**
 - ☐ **Personal assistance /guide**
 - ☐ *For all activities*
-

☐ *For ADLs only*

☐ *For sport only*

4. Para sport

☐ Summer sport

Specific Summer Sport: _____

☐ Winter sport

Specific Winter Sport: _____

Injury report form

1. Did the athlete/you report any injury that reduced the 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?

☐ No

☐ Yes

☐ *Directly from participation in training or competition*

☐ *Indirectly from participation in training or competition*

☐ *From an activity that is not related to sports participation*

2. Mode of onset of injury

☐ Acute with a sudden onset

☐ Repetitive with a sudden onset

☐ Repetitive with a gradual onset

3. Injury mechanism

☐ Non-contact

☐ Contact

☐ *Indirect*

☐ *With another athlete*

☐ *With a fixed object*

☐ *With a moving object*

☐ *Direct*

☐ *With another athlete*

☐ *With a fixed object*

☐ *With a moving object*

4. Type of injury

- ☐ New injury
- ☐ Subsequent recurrent injury
- ☐ Subsequent local injury
- ☐ Subsequent new injury

5. Injured body region

- ☐ Head and Neck
 - ☐ *Head*
 - ☐ *Neck*
 - ☐ Upper limb
 - ☐ *Shoulder*
 - ☐ *Upper arm*
 - ☐ *Elbow*
 - ☐ *Forearm*
 - ☐ *Wrist*
 - ☐ *Hand*
 - ☐ Trunk
 - ☐ *Chest*
 - ☐ *Thoracic spine*
 - ☐ *Lumbosacral*
 - ☐ *Abdomen*
 - ☐ Lower limb
 - ☐ *Hip/Groin*
 - ☐ *Thigh*
 - ☐ *Knee*
 - ☐ *Lower leg*
 - ☐ *Ankle*
 - ☐ *Foot*
 - ☐ Unspecified
 - ☐ *Region unspecified*
 - ☐ Multiple regions
-

- ☐ *Single injury crossing two or more regions*

6. Tissue and pathology type for the injury

- ☐ **Muscle/Tendon**
 - ☐ *Muscle injury*
 - ☐ *Muscle contusion*
 - ☐ *Muscle compartment syndrome*
 - ☐ *Tendinopathy*
 - ☐ *Tendon rupture*
 - ☐ **Nervous**
 - ☐ *Brain/Spinal cord injury*
 - ☐ *Peripheral nerve injury*
 - ☐ **Bone**
 - ☐ *Fracture*
 - ☐ *Bone stress injury*
 - ☐ *Bone contusion*
 - ☐ *Avascular necrosis*
 - ☐ *Physis injury*
 - ☐ **Cartilage/Synovium/Bursa**
 - ☐ *Cartilage injury*
 - ☐ *Arthritis*
 - ☐ *Synovitis/Capsulitis*
 - ☐ *Bursitis*
 - ☐ **Ligament/Joint capsule**
 - ☐ *Joint sprain (ligament tear or acute instability episode)*
 - ☐ *Chronic instability*
 - ☐ *Contracture*
 - ☐ **Superficial tissues/skin**
 - ☐ *Contusion (superficial)*
 - ☐ *Laceration*
 - ☐ *Abrasion*
 - ☐ *Pressure ulcer*
 - ☐ **Vascular trauma**
-

- ☐ *Vessels*
- ☐ Residual limb
 - ☐ *Residual limb*
- ☐ Internal organs
 - ☐ *Organ trauma*
- ☐ Non-specific
 - ☐ *Injury without tissue type specified*

7. Diagnosis and diagnosis code*: _____

8. Involvement of adaptive equipment or the impairment

a. Did any adaptive equipment contribute to the injury?

- ☐ No
- ☐ Yes
- ☐ Unknown

Describe how: _____

b. Did the impairment per se contribute to the injury?

- ☐ No
- ☐ Yes

Describe how _____

- ☐ Unknown

9. Time loss from sport

Number of days lost: _____

10. Time loss category:

- ☐ 0 days
- ☐ 1-7 days
- ☐ 8-28 days
- ☐ >28 days

Illness report form

1. Did the athlete/you report any illness that reduced the 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?

- ☐ No
- ☐ Yes
 - ☐ *Directly from participation in training or competition*
 - ☐ *Indirectly from participation in training or competition*
 - ☐ *From an activity that is not related to sports participation*

2. Affected organ system/region

- ☐ Cardiovascular
 - ☐ Dermatological
 - ☐ *Infectious pressure ulcer*
 - ☐ Dental
 - ☐ Endocrinological
 - ☐ Gastrointestinal
 - ☐ Genitourinary
 - ☐ Haematological
 - ☐ Musculoskeletal
 - ☐ *Premature osteoporosis*
 - ☐ *Infectious residual limb injury*
 - ☐ Neurological
 - ☐ *Autonomic nervous system (i.e. autonomic dysreflexia)*
 - ☐ *Central nervous system (i.e. seizure, hypertonia or neuropathic pain)*
 - ☐ *Peripheral nervous system (i.e. phantom pain)*
 - ☐ Ophthalmological
 - ☐ Otological
 - ☐ Psychiatric/psychological
 - ☐ Respiratory
 - ☐ Thermoregulatory
 - ☐ Multiple systems
 - ☐ Unknown or not specified
-

3. Aetiology of illness

- ☐ Allergic
- ☐ Comorbidity of existing impairment
- ☐ Environmental—exercise-related
- ☐ Environmental—non-exercise
- ☐ Immunological/Inflammatory
- ☐ Infection
- ☐ Neoplasm
- ☐ Metabolic/nutritional
- ☐ Thrombotic/Haemorrhagic
- ☐ Degenerative or chronic condition
- ☐ Developmental anomaly
- ☐ Drug-related/Poisoning
- ☐ Multiple
- ☐ Unknown or not specified

4. Diagnosis and diagnosis code*: _____

5. Time loss from sport

Number of days lost: _____

6. Time loss category

- ☐ 0 days
- ☐ 1-7 days
- ☐ 8-28 days
- ☐ >28 days

*Provide diagnosis and diagnosis code from the Orchard Sports Injury and Illness Classification System (OSIICS), the Sport Medicine Diagnostic Coding System (SMDSC), and the International Classification of Disease (ICD).

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Appendix 3

Additional tables

Table A. Examples of mode of onset in Para athletes

Mechanism	Presentation	Para translation
Acute	Sudden	A Para snowboarder loses control, falls and collides with a safety netting pole, fracturing his tibia
Repetitive	Sudden	A single leg amputee sprinting for the finish line, suddenly falls and reports hearing a loud popping noise on her unaffected limb's side. Ultrasound reveals an acute Achilles tendon tear as well as long-standing Achilles tendinopathy
Repetitive	Gradual	A sitting volleyball player experiences a gradual increase in shoulder pain from chronic rotator-cuff tendinopathy

Table B. Recommended data collection categories of body regions and areas for injuries according to the IOC consensus and extended with body areas (stumps) that may be injured in amputee athletes.

Region	Body area
Head and neck	Head
	Neck
Upper limb	Shoulder
	Shoulder disarticulation
	Forequarter
	Upper arm
	Above elbow (transhumeral)
	Elbow
	Elbow disarticulation
	Forearm
	Below elbow (transradial)
	Wrist
	Wrist disarticulation
	Hand
	Partial hand (transcarpal)
Trunk	Chest
	Thoracic spine
	Lumbosacral
	Abdomen
Lower limb	Hip/groin
	Hemipelvectomy
	Hip disarticulation
	Thigh
	Above knee stump (transfemoral)
	Knee
	Knee disarticulation
	Lower leg
	Below knee stump (transtibial)
	Ankle
	Ankle disarticulation
	Foot
	Partial foot (Syme, Lisfranc, Chopart, transmetatarsal)
Unspecified	Region unspecified
Multiple regions	Single injury crossing two or more regions

Table C. Practical examples of how to calculate time loss

<i>Case</i>	<i>Time loss (days)</i>
A Para triathlete interrupts a training session due to a single episode of vomiting and returns to normal training the following day.	0
A wheelchair rugby player sustains a finger dislocation catching the ball. X-rays reveal a dislocated interphalangeal joint; the athlete agrees to having the finger reduced and strapped, and competes later that day.	0
'Intermittent' time loss: a track and field athlete with cerebral palsy hemiplegia reports an Achilles tendinopathy at the start of a training camp on Saturday. The Para athlete can train fully on Saturday, Sunday and Tuesday, but misses training on Monday and Wednesday (time loss counted as Monday and Wednesday only).	2
'Delayed' time loss: a visually impaired judoka sustains a quadriceps contusion on Saturday and is able to train on Sunday and Monday, unable to train on Tuesday, Wednesday and Thursday, but returns to training on Friday (time loss counted as Tuesday, Wednesday and Thursday).	3
A boccia player with cerebral palsy develops pneumonia during a competition and starts oral antibiotics. The Para athlete continues to compete, but two days later develops systemic symptoms and requires intravenous antibiotics in hospital. After two days hospital inpatient treatment the Para athlete is discharged home and takes 20 days to make a full recovery and be cleared by the general practitioner to start training again.	22
A visually impaired (blind) footballer sustains a head injury and is diagnosed with concussion. The team physician assesses the Para athlete to have returned to baseline after 15 days. The athlete is advised to commence a 'standard care setting graduated return to play' over the next 14 days after the footballer returns home from the tournament, before being cleared by the physician to commence full training/competition.	29
A Para alpine skier with one functioning arm falls and sustains mid-shaft fractures to their radius, ulnar and scaphoid, which require a total of 56 days in a cast. The orthopaedic surgeon recommends the Para athlete can safely return to training 10 weeks after removal of the cast with some additional protection. The skier becomes dependent on care with no functioning arms and struggles to access physiotherapy, not being able to get to the hospital and are left with persistent residual wrist stiffness. It takes 160 days for the Para athlete to get back to training after cast removal.	216

Table D. Recommendations for Para sport-specific exposure measures

Para sports (as per IPC)	Competition exposure measure(s))	Time exposure
Alpine Skiing	# of races	Minutes
Archery	# of shots	Hours
Athletics	# of competitions # of rounds Distance covered	Minutes
Badminton	# of matches	Hours
Boccia	# of shots	Hours
Canoe	Distance covered	Hours
Cycling		
Road Cycling	Distance covered	Hours
Track Cycling	# of races Distance covered	Minutes/Hours
Equestrian	# of rides	Minutes/Hours
Football 5 a side	# of matches	Hours
Goalball	# of matches	Hours
Judo	# of matches # of bouts/fights	Minutes
Nordic Skiing	Distance covered	Hours
Para Ice Hockey	# of matches	Hours
Powerlifting	# of lifts # of rounds	Minutes
Rowing	Distance covered	Hours
Shooting	# of shots	Hours

Sitting Volleyball	# of matches	Hours
Snowboard	# of races	Minutes
Swimming	Distance covered	Hours
Table Tennis	# of matches	Hours
Taekwondo	# of matches # of bouts/fights	Minutes
Triathlon	Distance covered (separately for the 3 disciplines)	Hours
Wheelchair Basketball	# of matches	Hours
Wheelchair Curling	# of matches	Hours
Wheelchair Fencing	# of matches # of bouts/fights	Minutes
Wheelchair Rugby	# of matches	Hours
Wheelchair Tennis	# of matches, sets, or games	Hours