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International consensus statement: methods for recording and reporting of epidemiological data on injuries and illnesses in golf

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ABSTRACT

Epidemiological studies of injury in elite and recreational golfers have lacked consistency in methods and definitions employed and this limits comparison of results across studies. In their sports-generic statement, the Consensus Group recruited by the IOC (2020) called for sport-specific consensus statements. On invitation by International Golf Federation, a group of international experts in sport and exercise medicine, golf research and sports injury/illness epidemiology was selected to prepare a golf-specific consensus statement. Methodological stages included literature review and initial drafting, online feedback from the consensus group, revision and second draft, virtual consensus meetings and completion of final version. This consensus statement provides golf-specific recommendations for data collection and research reporting including: (i) injury and illness definitions, and characteristics with golf-specific examples, (ii) definitions of golf-specific exposure measurements and recommendations for the calculation of prevalence and incidence, (iii) injury, illness and exposure report forms for medical staff and for golfers, and (iv) a baseline questionnaire. Implementation of the consensus methodology will enable comparison among golf studies and with other sports. It facilitates analysis of causative factors for injuries and illness in golf, and can also be used to evaluate the effects of prevention programmes to support the health of golfers.

INTRODUCTION

Golf is a sport played by more than 60 million people¹ of all ages and abilities. It is played in over two-thirds of the world's countries and in six continents.² The best available evidence suggests golf is associated with overall improved health, and has well-being benefits.^{3,4} Golf can provide moderate-intensity aerobic physical activity, can help decrease non-sedentary time, and may have muscle strengthening and balance benefits.^{5,6}

However, injuries and illnesses can occur. Systematic reviews describe golf as a moderate-risk activity for injury compared with other sports.^{7,8} Prospective longitudinal studies report low injury rates compared with other sports, at 0.28 to 0.60 injuries per 1000 hours in amateurs.^{9–11} Musculoskeletal injuries are the largest group of injuries according

to our scoping review of the associations between golf and health.³ Very few studies report on epidemiology of illness in golfers.^{12–15} A recent systematic review of professional golf injuries showed 60% of included studies failed to give a definition of injury and 80% did not report the mechanism of the injury.⁸

While epidemiological studies on golfers vary considerably in methods and quality,^{7,8} consensus statements on recording and reporting of injury/illness have been published for other sports^{16–24} and for multisport events^{25,26} since 2006. In 2020, the IOC published a consensus statement: Methods for recording and reporting of epidemiological data on injury and illness in sports 2020²⁷ (referred to now on as the '2020 IOC Consensus Statement') and called for "... sport-specific statements with more detailed recommendations relevant for the sports and/or setting(s)."²⁷

In 2019, the International Golf Federation (IGF) invited a working group to develop golf-specific guidelines based on the 2020 IOC Consensus Statement.²⁷ This consensus aims to guide and provide tools for researchers on how to collect data, and report injury and illness in golf. This will, in turn, help golfers, coaches, medical practitioners and policy makers to understand the typical pattern, severity and burden of health problems. It will provide a strong foundation for injury prevention programmes for golfers.

The objective of this consensus is to encourage consistency in recording and reporting epidemiological data on injury and illness in golf and to provide tools to assist in data collection and research. We reviewed the 2020 IOC Consensus Statement²⁷ and aimed to obtain consensus among IGF medical commission members and invited experts on: (a) how that IOC Consensus needed to be modified for golf, (b) golf-specific exposure measurements and calculation of prevalence, incidence and burden, (c) adapting the 2020 IOC Consensus Statement²⁷ medical report forms for golf and develop exposure report forms, (d) developing an athlete's weekly health complaints and exposure report form for recreational and elite golfers, and (e) developing a baseline questionnaire for recreational and elite golfers.



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METHODS

Our methods drew on those reported in the 2020 IOC Consensus Statement on injury and illness surveillance;²⁷ our process had six stages:

Selection of chair, working group and consensus group members

The IGF Medical Commission appointed AM to chair the consensus group. He worked with JD and commission members to purposively select a consensus group of 21 individuals that would span a variety of expert disciplines (online supplementary appendix 1). These included three authors (BC, JD and AJ) from the recent 2020 IOC Consensus Statement²⁷ with considerable experience regarding sports injury/illness epidemiology and prevention, nine further members (LG, CC, DC, TD, TH, AM, PR and MV) working primarily as researchers and practitioners within golf. In addition to the working group members, each IGF medical commission member was invited to the overall consensus group (RAH, TH, JL, AM, AS, PS, BT and MW). AB is a professional golfer, MB an experienced sports researcher, and FG and RN are technology and data management experts. This purposive method ensured the consensus group members included expertise with diverse research and practical experience. Group members had experience working with golfers from diverse geographical settings and of varying performance level, age group, gender and disability. Four members of the consensus group (AM, AJ, PR and JD) were selected as the working group.

Literature review, discussion and initial draft by the working group

The working group reviewed the 2020 IOC Consensus Statement,²⁷ all sport and setting-specific consensus statements,^{16–26} and other relevant literature. Key themes and needs were identified by this working group. The consensus statement was divided into subsections and each author from the working group was assigned one or more areas. They were then tasked with a further, more detailed literature review of the particular subject and construction of definitions and recommendations for the first draft. The working group collated the subsections, producing a complete initial draft of the text and report forms.

Review and feedback by consensus group members

The first draft of the consensus document and the related forms was shared with all consensus group members, who were asked to provide comments and potential modifications to the working group online and by conference call.

Revision and second draft by working group

The working group revised the text and related report forms based on the input and recommendations of the consensus group and produced a second draft.

Online consensus meetings and third draft

These meetings focussed on achieving consensus, and discussion regarding collaboration and practical implementation.

Final revision by the working group and approval by the consensus group

Following the online consensus meetings, the working group incorporated the feedback and remarks, and the consensus was assessed for overall consistency among each topic. The third draft was created and circulated. Everyone in the consensus group agreed to accept the finalised consensus.

Table 1A The mode of onset in golf injury

Trauma	Mode of onset	Examples
Acute	Sudden	A golfer hits a tree stump with immediate pain in ulnar side of wrist at impact (extensor carpi ulnaris subsheath tear)
Repetitive	Sudden	A golfer has acute wrist pain while playing a normal shot. MRI scan shows stress fracture of the hamate
	Gradual	A golfer experiences gradual lead shoulder pain. X-ray shows acromioclavicular joint arthritis

Table 1B The mode of onset of golf illnesses

Mode of onset	Examples
Sudden	A golfer suffers from diarrhoea and vomiting secondary to salmonella following poor food preparation
Gradual	A golfer suffers from excessive fatigue secondary to consecutive weeks of long-haul flights and poor sleep quality

REVIEW AND ADAPTATION OF THE 2020 IOC CONSENSUS STATEMENT RECOMMENDATIONS FOR GOLF

All consensus group members agreed that golf-specific adaptations of the 2020 IOC Consensus Statement²⁷ were necessary regarding the following domains: (1) definition and characteristics of injury and illness; (2) recording of exposure; (3) calculation of incidence, prevalence and burden of injury and illness; (4) study population characteristics; and (5) forms and data collection methods.

Definition and characteristics of injury and illness

The definitions of injury and illness, categories of location, type, and mode of onset for injury as well as organ system and aetiology for illness can be used for golf as described in the 2020 IOC Consensus Statement.²⁷ However, golf-specific examples are needed for some variables (tables 1–3).

Furthermore, as golf is an asymmetrical sport, and injury patterns are non-symmetrical,^{8, 28} we recommend recording the side of the injured body part as well as the handedness of the golfer. It can then be evaluated whether the injury occurs on the ‘lead’ or ‘trail’ side of the body. In a right-handed golfer, the left side is known as the lead side and the right side as the trail side. The opposite is true for a left-handed golfer.

Injury and illness surveillance programmes in golf may be broad, studying all injuries/illnesses or they may have a narrower scope, focussing on only specific types of health problems (eg, wrist injuries, mental health illness or time-loss injuries) in which case, data reporting and recording can be limited to specific and relevant data.

Table 2 Mechanism of injuries in golf

Type of contact	Examples
No identifiable single event	Pain in the left shoulder when swinging worsening over 4 weeks
Non-contact trauma (single event)	Golfer sustains a strain in the intercostal muscles while making a swing
Direct contact with an object	Golfer's hand hits a tree on backswing/downswing
Direct contact with the ground	Golfer stumbles and falls, inverting ankle.
Indirect contact with an object	Golfer hits a tree root with club and has acute wrist pain
Indirect contact with the ground	Golfer takes an intended divot and has acute wrist pain

Table 3 Definitions and golf-specific examples of new and subsequent injuries and illnesses

	Definition	Injury example	Illness example
New	First recorded injury/illness =index injury/illness	Golfer reports new right wrist pain after 4 days of competition and is diagnosed with dorsal rim impaction syndrome	Golfer develops a viral illness (influenza)
Subsequent	Any injury/illness occurring after the index injury/illness	Golfer develops lumbar back pain following swing changes secondary to right hip pain, which is due to femoroacetabular impingement syndrome	Golfer develops depression following a long absence from competition due to lead wrist pain
Recurrent	Injury to the same site and of the same type as the index injury or illness involving the same system and type as the index illness after full recovery and return-to-sport	Golfer recovers fully from rotator cuff tendinopathy and returns to play. However, later in the season has a repeat onset of the same symptoms	Golfer recovers from 2 days of migraine headaches; however, during the next competition, develops further migraines
Exacerbation	Worsening of a not fully recovered index injury/illness	Golfer returns to play or practice before finishing rotator cuff tear rehabilitation and causes an extension of the tear while hitting a shot	Golfer with generalised anxiety suffers with a worsening of the condition

The recently updated diagnostic coding systems for injury and illness in a sporting context can be used for the reporting and recording if medical staff are involved in the data collection and recording.²⁹

Mode of onset

The 2020 IOC Consensus Statement²⁷ suggests that the transfer of energy causing an injury be described as either acute or repetitive. Repetitive impacts can result in sudden, gradual or mixed onset of injury. The onset of illnesses can also be classified as sudden, gradual or mixed. Table 1A and B demonstrate golf-specific examples.

Mechanism of injury

Golf-specific modifications of the 2020 IOC Consensus Statement²⁷ were necessary for mechanism of injury. Golf is a non-contact sport, and contact with another athlete is very unlikely and was therefore not listed in the report forms. However, we distinguish between contact with an object and contact with the ground. Contact can be further subdivided in direct and indirect contact. Golf-specific examples are provided in table 2.

New and subsequent injuries and illnesses

New and subsequent injuries/illnesses are defined in the 2020 IOC Consensus Statement.²⁷ In golf, subsequent injuries are likely to be a common scenario. They can be divided into exacerbations or recurrent injuries. For definitions and golf-specific example see table 3.

Severity of injury and illness

The common method of recording/reporting 'time loss from training/competition' can be effective in the description of acute injuries; however, it may under-represent overuse injuries, chronic illnesses and in the context of a golfer being forced to retire.³⁰ Furthermore, it does not account for injuries that have an impact on a golfer's performance but do not stop him/her from practicing or competing; for example, 37% of professional golfers with wrist problems have continued to play while injured.²⁸

Therefore, we recommend recording (a) the number of days the player is unable to play and train as well as (b) the number of days from the onset of the injury or illness until full recovery. Following the 2020 Consensus Statement²⁷ the number of days should be counted from the day *after* the onset as day one through to the day before the athlete is fully available for training and competition. If one injury event results in multiple injuries,

the duration of the most severe injury should be recorded. The following categories can be used: 0 days, 1 to 7 days, 8 to 28 days and >28 days.

Athlete's answers to the four questions of the Oslo Sports Trauma Research Center (OSTRC) questionnaire on health problems³⁰ can be used as an additional tool to record severity of the health problem based on a score from 0 to 100. This can then be tracked over time to give a cumulative severity score. This questionnaire has been shown to be sensitive to overuse injuries.³¹

Recording of golf-specific exposure

Golf exposure can be divided into three categories: Competition, Golf practice and Training (table 4). Competition is defined as organised competitive rounds of golf. These include internal club competitions, interclub matches, collegiate/university matches, regional, national or international amateur events as well as any professional competitions on any tour. Golf practice includes playing golf on the course (excluding competitions), practising on the driving range and putting/short game. Training includes all aspects of strength and conditioning/physical preparation for golf, for example, resistance training, cardiovascular training, stretching or mobility.

Calculation of prevalence, incidence and burden of the injury/illness in golf

Prevalence is the proportion of *injured or ill golfers* at one point in time or in a defined period of time (eg, a golf season or a golf tournament) of all golfers in the study population, and can be expressed as percentage or as number of injured/ill golfers per 1000 golfers. Prevalence can be also calculated for specific groups, for example, male and female golfers, or golfers with a specific handicap or a certain injury.

Incidence describes the number of *new injuries/illnesses* within a specified period of time (eg, a season), and can be expressed as the number of new injuries/illnesses per golf exposure (eg, per holes played) or 1000 hours of playing golf. In principle, all injuries can be rated to the total number of golfers in the study population or the total time spent competing, playing, practicing and training golf (all injuries per 1000 hours or per season). Furthermore, injuries during specific activities can be related to the related exposure (table 4), for example, injuries while hitting the ball on the driving range per 1000 balls hit. Incidences can also be calculated for specific types of injury, for example, shoulder injuries or time-loss injuries, or a combination, such as number of injuries/illnesses during a tournament, to

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Table 4 Athlete exposure in golf

Type of exposure	Definition	Exposure data
Competition	Any on-course tournament play (excludes practice rounds)	Number, days and level of competitions, and holes played
Golf practice	On course practice, such as playing 9 or 18 holes	Holes played and hours (per practice session and total)
Golf course (excl. competitions)	Player hitting full swings on the range	Balls hit and hours (per practice session and total)
Driving range	Player practicing on the putting green or short game area	Hours (per practice session and total)
Putting/short game		Hours (per practice session and total)
Training	Lifting weights or performing aerobic exercise (eg, on stationary bike)	Hours (per session and total)
Fitness training	Stretching/mobility/proprioception exercises	Hours (per session and total)
Other training activities	Any warm-up prior to practice or playing, and/or cool-down	Hours (per session and total)
Warm-up and cool-down		Hours (per session and total)

specific incidence such as number of new wrist injuries incurred while practising on a driving range and resulting in time loss per 1000 balls hit on a driving range.

The preferred method for reporting of results depends on the research question and the available data. We recommend to relate competition injuries in golf to the number of holes played, and injuries during practice and training to hours or the specific exposure measures stated in table 4. For comparison with other sport, golf injuries during competition should be reported per 1000 rounds (starts)²⁵ or athlete competition days, and injuries in golf practise and training per total exposure hours of these activities. Illnesses can be best expressed in relation to athletes days, for example, of the competition or the season.

Burden of injuries/illnesses combines frequency and severity.^{32,33} We suggest using a visual aid such as a risk matrix to help communicate injury burden as described in the 2020 IOC Consensus Statement.²⁷

Study population characteristics

In addition to the basic population characteristics (age, sex, level of competition and disability) listed in the 2020 IOC Consensus Statement,²⁷ handicap (if applicable) and handedness are essential variables to be collected in golf.

The authors recognise the need for classifications and nomenclature of disability in golf. It is beyond the scope of this consensus to provide these; however, their future introduction would enable accurate and relevant reporting of injury and illness in the disabled golfer. Competition levels in golf can be described as 'elite', 'sub-elite' and 'recreational' based on the individual golf handicap and participation in different levels of competition (table 5). Based on the design and objectives of the study, player characteristics should include current and previous injuries/illnesses, any co-morbidities, surgeries, psychosocial variables, and if a touring professional, total travel time per year and the tour membership.

Table 5 Definitions of performance levels in golf

Classification	Description
Elite	Professional players competing on tour or amateurs competing in international/national amateur championships
Sub-elite	PGA teaching professionals, amateurs competing in regional/county/state tournaments or with handicap ≤5
Recreational	Handicap >5

PGA, Professional Golfers' Association.

Forms and data collection methods

Guidelines for data collection methods proposed by the 2020 IOC Consensus Statement²⁷ are generally appropriate for golf. Thus, the two Medical Report of Injuries and Illnesses Forms published with the 2020 IOC Consensus Statement²⁷ were modified for golf (online supplementary appendices 2 and 3) and a related exposure report form (online supplementary appendix 4) was developed. However, the report forms published with the 2020 IOC Consensus Statement²⁷ are for medical staff only and injuries/illnesses that do not receive medical attention might be under-reported. Therefore, a weekly report of health complaints and exposure form for recreational and elite golfers, and a baseline questionnaire were developed in addition (online supplementary appendices 5 and 6).

Daily medical report of injuries and illnesses during a golf tournament

The golf-specific modification of the IOC championships form²⁷ to be completed by medical staff is presented in online supplementary appendix 2. It is designed to facilitate standardised recording of the frequency and characteristics of golf-related injuries and illnesses during golf tournaments. It can be used for elite and recreational events, and enables comparison of data with other sport tournaments. Multiple players can be recorded on the one form which should aid in reduction of paperwork. The user should use the relevant codes on page 2 of the form and fill in the appropriate boxes on page 1.

In-season medical report for golf injuries and illnesses

The golf-specific modification of the IOC form for injuries and illnesses during the course of a season²⁷ is presented in online supplementary appendix 3. This form is ideally used as a data collection tool within prospective epidemiological studies following up a group of research participants, where medical staff are available to complete a weekly or otherwise regular medical report on the golfers they look after. This may, for example, be a college/university/national/elite squad.

Weekly registration of exposure to golf competition, practice and training

The 2020 IOC Consensus Statement²⁷ does not present an exposure report form, most probably because meaningful exposure measurements vary substantially between sports. Thus, a golf-specific exposure record form is presented in online supplementary appendix 4. This form is designed to measure the exposure

of a golfer to all activities related to golf and which are deemed to be relevant to load management. Ideally, the information in this form can then be used to correlate load to injury and/or illness.

Weekly self-report of health complaints and exposure to golf

For some elite golfers and the vast majority of sub-elite and recreational golfers, having researchers/medical staff available to conduct weekly monitoring is not practical. Furthermore, most injuries in golf are overuse in nature,^{7 8 10 34–37} and these usually fluctuate in severity of symptoms and impact on practice load and performance. Thus, we developed a report form to be filled in by the athlete regarding health complaints that affect the athlete but might not receive medical attention (online supplementary appendix 5). It includes the four questions of the OSTRC questionnaire on health problems³⁰ to help record and categorise severity of overuse injuries in golf. We recommend using an electronic questionnaire with logic as described in the online supplementary appendix 5.

Baseline questionnaire for golfers

We developed a comprehensive self-report baseline questionnaire to be used in epidemiological studies regarding injury and illness for golf players of all ages, gender and abilities (online supplementary appendix 6). It covers four main domains including: (1) athlete's characteristics, (2) golf participation and training characteristics, (3) medical history, and (4) current health status. The questionnaire can be used to correlate these variables with injuries and illness, and shortened or extended depending on the specific objectives of a research project. It is designed for self-report, obviating the need for a medical researcher to be present.

Data capture and electronic monitoring tools

The forms can be either used as paper version or internet-based electronic system. While hard copies of forms have been historically popular,³⁸ electronic data capture can help avoid duplication of data entry,³⁹ and has been shown to facilitate high levels of compliance in athletes.^{40 41} For individual golf event reports,

having both paper-based and electronic solutions available is advantageous; however, researchers should work with what is available to them. For weekly monitoring, electronic data capture, where possible, is recommended.³⁹

CONCLUSION

The international golf consensus should aid the development of prospective, epidemiological studies on injury and illness of male and female golf players of different ages and levels of skills worldwide. It enables consistent reporting and comparison between studies and facilitates the analysis of causative factors for injuries and illness in golf, and thus, supports the development of injury/illness prevention programmes. Finally, the presented methods can also be used to evaluate the effects of prevention programmes to support the health of golfers.

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What is already known?

- ▶ The IOC and other sports have recommended methods for recording and reporting epidemiological data on injury and illness in sport for medical staff.
- ▶ The IOC's consensus group called for sport-specific statements that should provide sport-specific recommendations.

What are the new findings?

- ▶ We present consensus recommendations for epidemiological study on the frequency and characteristics of injuries and illnesses of elite and recreational golfers.
- ▶ We provide an athlete's baseline questionnaire, as well as injury, illness and exposure report forms for golfers and their medical support teams.
- ▶ This can help inform future injury/illness prevention interventions, and are recommended by the International Golf Federation, and the constituent members of its medical and scientific commission.

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