

Injuries and Illness during the 2019 Gwangju FINA and Masters World Championships in Elite and Amateur Athletes

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Comparative analysis of injury and illness prevalence in elite and amateur athletes provides the basis for the development of tailored prevention programs. The authors analyzed the differences in frequency and characteristics of injuries and illnesses which occurred in elite and amateur athletes during the 2019 Gwangju Federation Internationale de Natation (FINA) and Masters World Championships. The 2019 FINA World Championships hosted 3095 athletes in the disciplines of swimming, diving, high diving, artistic swimming, water polo, and open water swimming. While the 2019 Masters World Championships hosted 4032 athletes in swimming, diving, artistic swimming, water polo, and open water swimming. All medical records were electrically recorded in every venue as well as the central medical center located at the athlete's village. More elite athletes visited clinics than amateur athletes during the events (15.0 vs 8.6%, $p < 0.05$) despite the ages of amateur athletes being higher than elite athletes (41.0 ± 15.0 vs 22.4 ± 5.6 years, $p < 0.01$). Elite athletes complained mainly of musculoskeletal problems (69%), while amateur athletes complained of both musculoskeletal (38%) and cardiovascular (8%) problems. The most frequent injury in elite athletes was due to overuse in the shoulder joints, while that of amateur athletes was traumatic injuries involving feet and hands. The most common illness was respiratory infection in both elite and amateur athletes, while cardiovascular events occurred only in amateur athletes. As the risk of injury varies in elite and amateur athletes, tailored preventive measures should be prepared. Furthermore, preventive measures of cardiovascular events should focus on amateur sports events.

Key Words: Athletic Injuries; Cardiovascular Diseases; Athletes

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INTRODUCTION

The Federation Internationale de Natation (FINA) Masters Championships (FINA-Masters) was first held in 2015 in conjunction with the Kazan 16th FINA World Championships (FINA-Championships).¹ Competition groups are divided into five year age groups which start from 25-29 to as high as are necessary according to the Masters swimming rules.^{2,3} The FINA-Masters programme includes swimming, diving, water polo, open water swimming and artistic swimming. The FINA-Championship has high diving in addition to the five disciplines, which

was first introduced at the 20th FINA Technical Congress and was officially included in the programme of the 2013 FINA World Championships in Barcelona.⁴ There are many differences in training and usage of muscles between elite and amateur athletes. Thus, it is expected these groups will experience different injuries and illnesses during the competitions.

Accurate surveillance of injuries is an essential component of effective risk management in sport.⁵ FINA implemented its first injury surveillance protocol at its World Championships in Rome 2009.⁶ There was no comparative surveillance of injury and illness in either elite and amateur aquatic athletes. Gwangju hosted both the FINA-

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Championships and FINA-Masters from July to August, 2019.⁷ Athletes from both events shared the same athletes village and medical facilities. Authors joined the medical services of both events as medical officers, and had the chance to observe the injuries and illnesses of both elite and amateur athletes. We retrospectively analyzed the medical records of injuries and illnesses of elite and amateur athletes who visited medical facilities during the events.

MATERIALS AND METHODS

The medical services were prepared in accordance with the FINA Medical Rules and Practices & Procedures. A total of 20 medical facilities were operated in the competition and training venues. A medical center in the athletes' village was operated 24 hours a day, while other facilities were operated only during the training and competition. Medical records from all medical facilities were saved on the server of the medical center. Only patients with severe injury or illness were transferred to the university hospitals in Gwangju. Medical information of transferred patients was recorded by medical staff when they came back to the athletes village. A total of 707 staff members, including 557 medical personnel and 121 volunteers, participated in the medical services group during the FINA-Championships and FINA-Masters period.

We retrieved all medical records of both elite and amateur athletes who were treated for injuries and illnesses in the medical facilities. Demographic information including age, sex, home country, sports/events, main symptoms, history, illness or injury diagnosis, and treatment were recorded. Injury and illness were classified according to the guidelines of the FINA medical committee. Every medical record was verified by the Chief Medical Officer (CMO) each evening. The injury and illness surveillance was based on the IOC protocols,⁸ previously implemented at the 2009 FINA World Championships.⁶ Briefly, an injury was defined as new or recurring musculoskeletal symptoms, concussions, or internal organ injuries. Injury included musculoskeletal complaints, concussions and other trauma. An illness was defined as any physical complaint newly developed and not related to injury that required medical attention. Every injury/illness was separately recorded and analyzed when one participant suffered injuries involving multiple body parts, multiple types of injuries occurred in the same body part, or if different body parts were affected by illnesses. We analyzed only the most severe diagnosis when there was a single incident that cause multiple injury types, which was determined by a consensus of all authors. Cases were analyzed by date and category. A discipline was defined as one of the six aquatic sports (swimming, diving, high diving, open water swimming, artistic swimming or water polo). In addition, we analyzed the number of injury encounters by body part, number of illness encounters by organ system, as well as symptoms and causes. Descriptive statistics were also used for this study. Data were processed using Excel for Windows, and

statistically analyzed using SPSS for Windows. All information was treated with strict confidence, and our medical database was anonymized for use in this study. This study was approved by the Chonnam National University Hospital Institutional Review Board (IRB No: CNUH-2019-286).

RESULTS

A total of 3095 athletes (1514 males, 1581 females) from 194 countries registered for the 2019 FINA-Championships, and a total of 4032 athletes from 84 countries registered for the 2019 FINA-Masters. Most athletes competed in more than one event except for the high divers and water polo players.

There were 1,064 medical visits by elite athletes and 360 by amateur athletes. More elite athletes visited clinics than amateur athletes during the events (15.0 vs 8.6%, $p < 0.05$) despite the ages of amateur athletes which were higher than elite athletes (41.0+15.0 vs 22.4+5.6 years, $p < 0.01$).

Elite athletes complained mainly of musculoskeletal problems (69%), while amateur athletes complained of both musculoskeletal (38%) and cardiovascular (8%) problems (Table 1). The most commonly reported illness was respiratory infection in both elite and amateur athletes, while cardiovascular events were only recorded in amateur athletes.

The most frequent injury in elite athletes was due to overuse of the shoulder joint, while that of amateur athletes was traumatic injuries involving feet (Fig. 1). Athletes of water polo had more injuries to the head and shoulders, while those of swimming mostly complained of finger injuries, and those of diving had more head injuries.

A total, 48 (6.3%), among 765 visitors to medical facilities were transferred to hospitals who included 27 males and

TABLE 1. Comparison of illness between the FINA-Championship and FINA-Masters athletes

	World Championship (%)	Masters Championship (%)
Musculoskeletal	614 (69.0%)	70 (38.5%)
Upper respiratory tract	61 (6.9%)	35 (19.2%)
Dermatological	40 (4.5%)	18 (9.9%)
Neurological	15 (1.7%)	16 (8.8%)
Cardiovascular	2 (0.2%)	15 (8.2%)
Gastrointestinal	38 (4.3%)	10 (5.5%)
Ophthalmological/otological	59 (6.6%)	9 (5.0%)
Lower respiratory tract	2 (0.2%)	3 (1.7%)
Dental	39 (4.4%)	2 (1.1%)
Psychiatric	5 (0.6%)	2 (1.1%)
Urogenital/gynaecological	11 (1.2%)	1 (0.5%)
Other	2 (0.2%)	1 (0.5%)
Metabolic/endocrinological	1 (0.1%)	0 (0%)
Haematological	1 (0.1%)	0 (0%)
Total	890 (100%)	182 (100%)

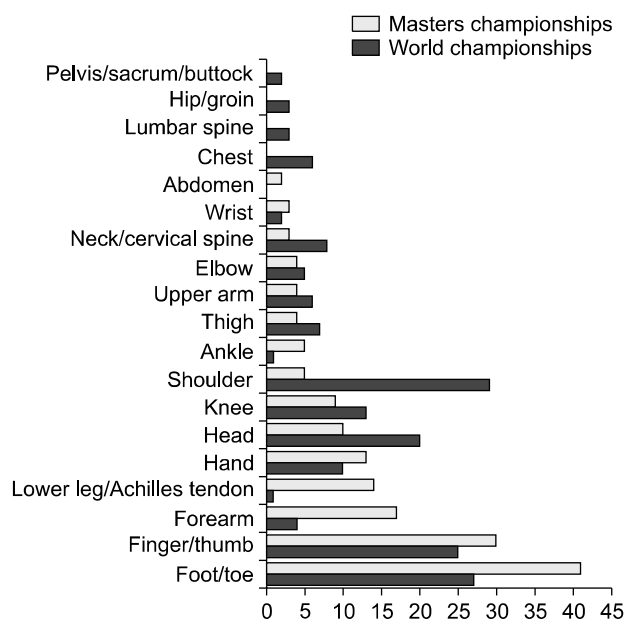


FIG. 1. Comparison of injury location between the World Championship and Masters Championships athletes.

21 females. Illness was the more frequent reason (33 persons, 68.8%) than injury (15 persons, 31.2%). Febrile disease (13) was the most common cause of transfer followed by extremity injuries (12), painful diseases (7) and head injuries (3). Transfer was more frequent in the last days of competition. There were two emergency transports for cardiac arrest during the FINA-Masters. One patient was successfully resuscitated and one died.

DISCUSSION

Authors observed and compared characteristics of injury and illness of elite and amateur athletes during the 2019 Gwangju FINA-Championship and FINA-Masters. The direct comparison of injury and illness during the two mega aquatic sports events was not done previously. A significant difference of injury patterns was found. The elite aquatic athletes commonly had shoulder injuries due to overuse, while amateur athletes had traumatic injuries in their feet and hands. Cardiovascular illness was found only in amateur athletes. This difference could have resulted from the age difference between the two groups: age of amateur athletes being higher than that of elite athletes. As the risk of injury varied in elite and amateur athletes, corresponding, tailored preventive measures should be prepared.

After FINA implemented its first injury surveillance at its World Championships in Rome 2009,⁶ two more studies have been published from the FINA-Championships.^{9,10} Results from the 2009 survey revealed that overuse (37.5%) was the most common mechanism for injury.⁶ Similarly, at the 2012 Olympic Games, diving was found to have the highest incidence of overuse injuries (73%) compared to all sports.¹¹ Severe injuries of athletes who are subsequently unable to qualify for FINA-Championships and

FINA-Masters were not captured in this study. Acute illness such as acute appendicitis and febrile respiratory and gastrointestinal diseases caused no attendance to the competitions.

The injury rate is lower in aquatic disciplines than other sports. Junge et al.¹² reported 9.6 injuries per 100 athletes across all Olympic disciplines while 4.4 injuries per 100 athletes in aquatic sport in 2008. Engebretsen et al.¹³ reported an incidence of 12.9 injuries per 100 athletes across all Olympic disciplines and 7.6 injuries per 100 athletes in aquatic sport in 2012.¹⁴ At the FINA World Championships 2009 and 2013, incidence rates were 6.6 and 8.3 injuries per 100 athletes.^{6,9} We observed 172 injuries among 3095 athletes (5.6%) during FINA-Championships, and 164 injuries among the 4032 athletes during the FINA-Masters (4.1%). The injury rate was lower than previously reported because some injured athletes were treated by their team doctors.

Overuse was a major cause of injuries in elite aquatic athletes in this study. It was also reported to be between 27.4 to 37.5%.^{6,9} Mountjoy et al.⁹ found that many elite athletes suffered from injuries caused by heavy training which still continued even after the start of the competition. More efforts such as athletes education should be done to prevent overuse injuries in elite aquatic athletes.

An average of 2 patients were transferred during the training and competition periods of FINA-Championship, which is much lower than the number of patients (average of 10) transferred during the previous Championships (personal communication). This is considered to be a result of having equipped sufficient facilities and personnel to provide adequate treatment within in the medical center. Therefore, considering the busy schedules of athletes and officials during the Championships period, it is advisable to have a separate medical center fully equipped with necessary medical personnel and facilities.

Febrile illness was the most common cause of hospital transfer to do laboratory examinations for infectious diseases. There were strong preventive actions for infectious diseases taken during the 2019 FINA-Championships and FINA-Masters. In order to block the spread of measles, a worldwide contagious disease, athletes were encouraged to take vaccines. A headquarter for infectious disease control was operated at the medical center of the athletes' village. It was required to examine all the febrile patients following strict regulations of the Korean government and the local organizing committee.

Cardiovascular problems in athletes were only acknowledged during FINA-Masters and not during FINA-Championships. There were two emergency transports for patients of cardiac arrest during FINA-Masters. One was successfully resuscitated while the other died. There were 98 emergency transports for cardiac disorders during 1996 Olympic games including three sustained cardiac arrests, one of whom died.¹⁴

There are several limitations in this study. As this paper analyzed only athletes visits to medical facilities the num-

ber of exact injury or illness was not fully analyzed. According to the previous reports, almost 70% of athletes complained of symptoms at the commencement of the Championships.⁹ Only 15% of athletes visited medical facilities during the 2019 FINA-Championships and only 8.6% of athletes during the 2019 FINA-Masters. Team doctors provided more medical services for most athletes. Prospective and retrospective surveillance performed by FINA medical committee has provided more complete information on the injury/illness of elite athletes. It was more difficult to do this during the FINA-Masters as there was no active surveillance during the event.

Diagnosis was not perfectly accurate for many athletes as medical records were not fully described and laboratory examinations were not done in the medical facilities. Only plain radiographic and ultrasonographic examinations were provided at the medical center of the athletes' village.

In summary, this paper shows that there was a difference of injury and illness types and frequencies between elite and amateur aquatic athletes. Elite athletes had more overuse injuries while amateur athletes had more traumatic injuries. Amateur athletes may have had cardiovascular disease while elite athletes did not report any. Both elite and amateur athletes complained of respiratory symptoms during the events. Therefore, we conclude that as the risk of injury varied in elite and amateur athletes, tailored preventive measure should be prepared. Furthermore, preventive measure of cardiovascular events should especially focus on amateur sports events.

CONFLICT OF INTEREST STATEMENT

None declared.

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