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Badminton injuries – a prospective epidemiological and socioeconomic study

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During a 1-year period 100 badminton players were registered and treated in the casualty ward of Randers City Hospital, Denmark. The injuries to the badminton players constituted 5% of all sports injuries registered during the same period in the casualty ward[1,2]. At follow-up questionnaires were sent to all participants. Replies were received from 89 patients. Over the same period all sports participants in the hospital catchment area (30 254) were registered according to their sport affiliation (2620 badminton players – 1650 men and 970 women). Of those injured 58% were men (mean age 31 years) and 42% were women (mean age 25 years). Of the injuries 55% occurred in club players, the remainder occurring during company and school sports activities. The active players were classified into three groups according to age: Group 1 under 18 years (31%); Group 2 18–25 years (16%); Group 3 more than 25 years (53%). According to the Abbreviated Injury Scale (AIS) 17% of the injuries were classified as minor, 56% as moderate, and 27% as severe, respectively. Of the severe injuries (AIS = 3) 56% were found in the oldest age group. AIS correlated with time absent from sport ($P < 0.001$). Nine players (9%) reported that earlier injuries had influenced the actual accident. Most players (96%) trained one to three times a week. Sprains were the injury most commonly diagnosed (56%), fractures accounted for 5%, torn ankle ligaments were found in 10%, and 13% had ruptures to the Achilles tendon. Overall, 21% were admitted to hospital. None of the patients treated as inpatients was kept in hospital for more than 7 days. The injury caused 56% of players to be absent from work of whom 23% were absent for more than 3 weeks. After the injury 12% of the players gave up their sport, and only 4% restarted their training/sport within 1 week. As many as 28% had to avoid training and playing in matches for 8 weeks or more.

Keywords: Badminton injuries, prospective study, epidemiology, traumatology, Abbreviated Injury Scale, socioeconomic consequences

Participation in all kinds of sports activities has increased considerably during the past decade. In Denmark there is a long tradition of badminton. More than 170 000 players are organized into 650 clubs.

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Badmintoon is an indiviidual, non-contact sport requiring jumps, lunges, quick changes of direction and rapid arm movements. Most severe injuries are related to the lower limbs[3]. The aim of the present study was to describe the frequency, severity and pattern of badminton injuries in a population based study and to estimate the sports and socioeconomic consequences to the players.

Materials and methods

The study consisted of 100 badminton injuries registered during 1 year in the casualty ward, Department of Orthopedic Surgery, Randers city hospital, Denmark – the only hospital in a well defined geographical area representative of the country as a whole. Of the total sports injuries[1,2], 5% were due to badminton. During the same period the total number of injuries registered was 17 700 among a population of 124 321.

The standard record included: age; sex; time of trauma; type and anatomical location according to World Health Organization (WHO) international classification; injury mechanism; affiliation; severity of the injury (AIS)[4]; type of treatment. The trauma mechanism was investigated according to circumstances: during a tournament; while training or warming up; previous injuries; training condition.

The injuries were followed up at 1 week, 2 months and 2 years and 89% completed follow-up questionnaires. At follow-up we registered: length of absence from sport; length of stay in hospital; days absent from work; economic consequences and economic support.

Data were analysed using a computer. Statistical analysis was carried out using the χ^2 and t tests. Probability values less than 0.05 were considered to be statistically significant. To compare AIS with other established injury definitions, we used Kendall's TC test. Coefficients of rank correlation and probability values are stated. Results were considered to be statistically significant where $P < 0.05$.

Results

According to the Danish Sport Association (DIF) the number of registered active club players in the hospital's catchment area was 1650 men and 970 women, of whom 520 men and 293 women were

under 18 years of age (31%), 243 men and 179 women were between 18 and 25 years of age (16%), and 887 men and 498 women were above 25 years of age (53%). The sex and age distribution among the injured badminton players is seen in *Figure 1*. The mean (range) age of those injured was 28.2 (10–60) years, 30.6 years for men and 26.0 years for women. Those injured playing badminton had a higher mean age ($P < 0.001$) compared with the total combined sports injury data for which the mean (range) age was 21 (6–69) years[2]. Age distribution was representative of the local player age distribution. Correlating age and AIS, no significant difference was found (*Table 2*). Injury incidence was calculated as injuries per 1000 players per year. The incidence of injuries among players younger than 18 years old was 28 per 1000 per year. Players between 18 and 25 years old had an injury incidence of 45 per 1000 per year, and for those over 25 years old the incidence was 42 per 1000 per year. This was significantly lower in all three age groups if compared with soccer ($P < 0.001$)[5]. The injury incidence among the youngest age group was significantly lower ($P < 0.01$) than those for the older groups.

Table 1. Sex distribution according to AIS

AIS	*Male (No.)*	*Female (No.)*	*Total (No.)*
1 Minor	11 (19)	6 (14)	17
2 Moderate	31 (53)	25 (60)	56
3 Severe	16 (28)	11 (26)	27
Total	58 (100)	42 (100)	100

Numbers in parentheses are percentages

Table 2. Age distribution according to AIS

AIS	*Age (years)*			
	< 18 (No.)	*18–25 (No.)*	*> 25 (No.)*	*Total (No.)*
1 Minor	5 (22)	3 (16)	9 (16)	17 (17)
2 Moderate	12 (52)	10 (53)	34 (59)	56 (56)
3 Severe	6 (26)	6 (31)	15 (25)	27 (27)
Total	23 (100)	19 (100)	58 (100)	100 (100)
Active	813 (31)	422 (16)	1385 (53)	2620 (100)

Numbers in parentheses are percentages

Table 3. AIS compared with affiliation

AIS	*Club (No.)*	*Company (No.)*	*School (No.)*	*Others (No.)*
1 Minor	10 (18)	0 (0)	3 (25)	4 (22)
2 Moderate	29 (53)	9 (60)	8 (67)	10 (56)
3 Severe	16 (29)	6 (40)	1 (8)	4 (22)
Total	55 (100)	15 (100)	12 (100)	18 (100)

Numbers in parentheses are percentages

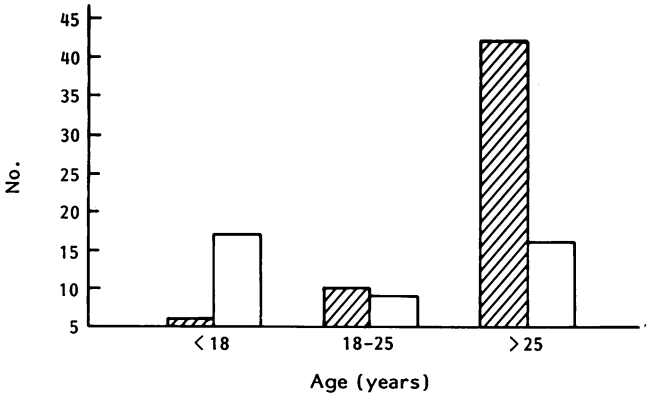

Figure 1. Age and sex distribution: ▨, male; □, female

Time of injury and training regimen

Of the one hundred players injured, 55% were members of a badminton club, 15% participated in companies' sports, 12% in schools' sports and 15% in recreational sports. Comparing AIS scores with affiliation, we found significant differences in the severity (*Table 3*). In spite of adequate warming up most players were injured during the game (72%). Only 8% of the injuries occurred during training before the game, and 16% reported that their injury occurred during a tournament, after insufficient warming up. On average the players trained twice a week, but 52% trained three times a week, and 4% did not train regularly. Comparing AIS scores to training regimen, no significant correlation was found. In the group with severe injury (AIS = 3), 96% trained between one and three times a week and 93% had trained regularly for more than 3 months. Most players in all AIS groups had trained for several months. The injuries happened continuously during the match. Earlier injuries were reported by 9% to have influenced the actual accident.

Diagnosis and localization

Severity classification of the injuries according to the Abbreviated Injury Scale (AIS) can be seen in *Tables 1* and *2*. The distribution of the injuries showed that the lower extremities were most commonly injured. The injury diagnosis can be seen in *Figure 2*. AIS scores correlated well with the time absent from training. Rank correlation was 0.43 ($P < 0.001$). The more serious the accident, the longer the absence from sport (*Table 4*).

Treatment

In most cases the injuries were minor and were treated only once at the casualty department. Admission to hospital was indicated where rupture of the Achilles tendon or total rupture of the ankle ligaments were diagnosed and 21% were treated as inpatients, giving a total of 70 days inpatient treatment. AIS correlated with admissions to hospital. Rank correlation was 0.35 ($P < 0.001$).

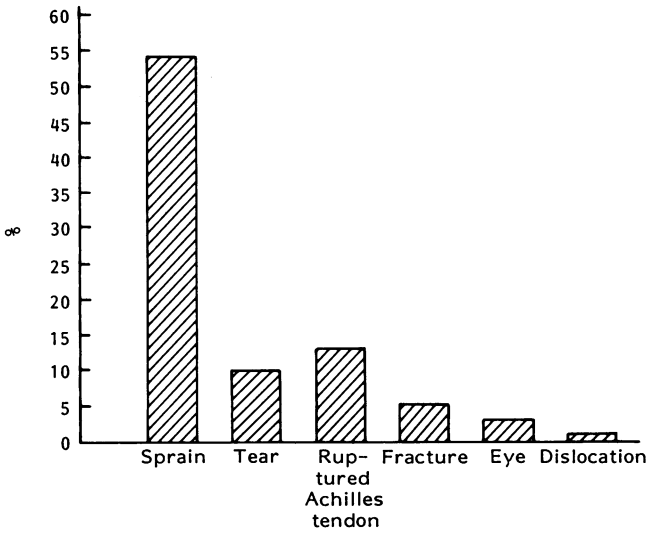

Figure 2. Diagnosis using WHO classification

Consequences for sports participation

After the accident, 12% gave up sport and 28% stopped training regularly and playing in matches for at least 8 weeks. Within the first week after injury 4% were able to return to sport. AIS correlated with time absent from sport. Rank correlation was 0.43 ($P < 0.001$).

Socioeconomic consequences

Of those injured, 23% were absent from work for 3 weeks or more. In total, 671 working days were lost, an average loss of 8 working days per injured per year, which is significantly higher compared with soccer ($P < 0.05$)[5]. AIS correlated with time absent from work. Rank correlation was 0.29 ($P < 0.001$). The financial loss is the difference between the usual wages and the financial aid granted from social security and/or grants from insurance. Two players experienced financial losses between US $1 and 100, two between US $100 and 200, two between US $200 and 700, and two above US $700. One person became unemployed as a result of the accident and another player was forced to change job because of the injury.

Table 4. AIS (Abbreviated Injury Scale) *versus* weeks absent from sport

Absence	*AIS**		
	1 Minor	*2 Moderate*	*3 Severe*
< 1 week	2	1	0
1–2 weeks	4	5	1
3–4 weeks	5	9	1
5–6 weeks	0	5	1
7–8 weeks	1	5	3
> 8 weeks	1	8	11
Gave up sport	0	6	3
Not stated	3	10	4
Total	16	49	24

*n = 89

Discussion

Studies reporting epidemiological data of badminton injuries are scarce[6–10]. Previous studies have shown that badminton related injuries are more severe than other kinds of sports injuries[6,9]. Only one other study is comparable to ours[6]. We present a population based study, with two defined measures of injury; time absent from practice or play and the Abbreviated Injury Scale[4].

We found that badminton injuries made up 5% of all sports related injuries seen in a casualty ward during one year[1,2]. This is slightly higher than the figure quoted by Axelsson *et al.*[7] and Lorentzon *et al.*[9], but correlates well with previous Danish studies[6,10]. The age distribution was significantly different from that for other sports, e.g. handball[11] and football[5]. This is consistent with the findings of Hensley and Paup[8] and Krøner *et al.*[6].

The injury rate in different sports can be expressed in various ways. In the present study, injured badminton players are compared with the background population of active badminton players in the area. The incidence of injury was significantly lower than for other sports, e.g. football[5]. We found that our injury incidence ratio revealed the true injury rate taking into consideration the number of people exposed to badminton injuries. Our study revealed a characteristic injury pattern, especially of soft tissue injuries to the lower limbs. The most common diagnoses were sprains in the lower limbs, which is similar to earlier reports[6,8,9,12].

Our study revealed a high percentage of serious tears (Achilles tendon, calcaneofibular ligament and anterior talofibular ligament). This figure is higher than that quoted in earlier reports[6,8]. The reason for this difference is obscure but a similar study from Sweden, showed that 17% of the injuries among badminton players were graded as severe (AIS = 3). Comparison of all sports in the severe injury group (AIS = 3) by Lorentzon *et al.* found that 25% of these injuries were due to badminton, although the sport only made up 3% of all sports[9]. Our findings seem to support the conclusions of Lorentzon *et al.*, that the injuries gained in badminton are not as frequent but are more severe than for other sports. The low incidence of Achilles tendon injury in the study of Hensley and Paup[8] is probably a reflection of their injury definition, since all injuries were recorded by the players and included all minor injuries such as blisters and muscle cramps. Our definition of injury was different: 'all players seen in the casualty ward because of a badminton injury'. Only a minimum, and often the more severe sports injuries, are seen in the casualty ward – approximately 20% as shown by Kristiansen and Andersen[13]. This must explain the four-fold rise of Achilles tendon tears compared with the earlier mentioned study[8]. Another explanation might be that Hensley and Paup only included competitive tournament badminton players in their study, whereas we included recreational players as well (45%), who might not be as fit and experienced as the competitive players.

According to Chandran[14] and Vinger and Tolpin[15] eye injuries caused by the shuttlecock as a result of smash hits present ocular hazards. Our study did not confirm these findings. During one year, among 2620 club players, we did not see any serious eye injuries such as hyphaemia or traumatic mydriasis in the casualty ward. We only found three cases of eye injury, all minor, which did not need further treatment. Therefore we do not find it necessary to recommend protective eye glasses in badminton.

The fracture morbidity was almost equal to the findings from an earlier Danish study[6]. Hensley's and Paup's[8] fracture morbidity was lower but this is explained by the fact that they used a different definition of injury as mentioned earlier.

Hospitalization rates of 7%, 17% and 6% were found by Krøner *et al.*[6], Lorentzon *et al.*[9] and Hensley and Paup[8] respectively. Our results showed a hospitalization rate close to that reported by Lorentzon *et al.*[9]

The severity of the injury can be expressed in many ways; we classified the injury according to the well known AIS[4]. The injury was also classified according to the length of time lost from practice or play. A significant correlation between all these parameters was found. We suggest that this scale (AIS) should become the international scale for evaluating the severity of sports injuries, along with the length of time lost from practice or play.

Although the accidents resulted in considerable absence from work, only 10% of the injured incurred financial losses because the Danish welfare system provides free hospital treatment and complete or partial compensation for financial loss, or full salary during absence, for all inhabitants.

In conclusion, the incidence of badminton injuries is significantly lower compared with other sports but the injuries are generally more severe. Badminton does not present ocular hazards. Significant correlation was found between AIS and time absent from sports.

Acknowledgements

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