Original Investigation
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Shoulder pain in badminton players and wrestlers

Dolor de hombro en jugadores de bádminton y luchadores

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Abstract

The purpose of the study was to study painful conditions in the shoulders among badminton players, to describe them and compare with wrestlers. Testing was conducted on 63 badminton players and 56 wrestlers with Constant Score and a shoulder injury questionnaire. Previous or on-going shoulder pain was reported by 29 (46%) of the badminton players - 24 (48%) male and 5 (38%) female and by 30 (54%) of the wrestlers - 20 (63%) male and 10 (42%) female. Three badminton players (5%) had on-going shoulder pain, while eighteen of the wrestlers (32%) had on-going shoulder pain (p=<0.001, φ=-0.36). More male than female wrestlers had on-going shoulder pain [14 (44%) vs. 4 (17%), (p=0.032, φ=0.29)]. In badminton players the shoulder pain was located to subacromial structures in the dominant shoulder, while the distribution of shoulder pain in wrestlers was widespread and included both dominant and non-dominant side on various locations. Male wrestlers with on-going shoulder pain had a higher BMI compared to male wrestlers without on-going shoulder pain [25.2±2.6, 25 kg/m² vs. 23±2.3, 23 kg/m² (p=0.011, r=0.44)], while female wrestlers with ongoing pain had a lower BMI compared to pain-free female wrestlers [19.4±2, 18.9 kg/m² vs. 21.7±2.1, 22.2 kg/m² (p=0.045, r=0.41)]. The badminton players in this study had a lower prevalence of on-going shoulder pain compared to in previous studies on badminton players. Wrestlers with on-going shoulder pain had lower scores for shoulder mobility in several directions compared to pain-free wrestlers. On-going shoulder pain is likely to affect sports performance and might lead to development of other injuries.

Keywords: *Badminton, wrestling, shoulder, pain, sports, constant score.*

Resumen

El propósito del estudio era analizar las condiciones dolorosas en los hombros entre jugadores de bádminton para describirlas y compararlas con las de los luchadores. Se realizaron pruebas en 63 jugadores de bádminton y 56 luchadores y un cuestionario sobre lesiones de hombro y el puntaje de Constant. Un total de 29 (46 %) jugadores de bádminton, que corresponden a 24 (48 %) hombres y 5 (38 %) mujeres, y 30 (54 %) luchadores, que corresponden a 20 (63 %) hombres y 10 (42 %) mujeres, manifestaron dolor de hombro en el pasado o actualmente. Tres jugadores de bádminton (5 %) tenían dolor de hombro en el momento, mientras que 18 luchadores (32 %) tenían dolor de hombro en el momento (p=<0,001, φ=-0,36). Había más luchadores que luchadoras con dolor de hombro en el momento; 14 (44 %) vs. 4 (17 %), (p=0,032, φ=0,29). En los jugadores de bádminton el dolor de hombro se localizaba en las estructuras subacromiales del hombro dominante, mientras que la distribución del dolor de hombro en los luchadores era generalizada e incluía tanto el lado dominante como el no dominante en varios lugares. Los luchadores hombres con dolor de hombro en el momento tenían un IMC más alto en comparación con los luchadores hombres sin dolor de hombro en el momento; 25,2±2,6, 25 kg/m² vs. 23±2,3, 23 kg/m² (p=0,011, r=0,44). Por otra parte, las luchadoras con dolor en el momento tenían un IMC más bajo en comparación con las luchadoras sin dolor; 19,4±2, 18,9 kg/m² vs. 21,7±2,1, 22,2 kg/m² (p=0,045, r=0,41). Los jugadores de bádminton de este estudio tenían una menor prevalencia de dolor de hombro en el momento en comparación con estudios anteriores sobre jugadores de bádminton. Los luchadores con dolor de hombro en el momento tenían puntuaciones más bajas en la movilidad del hombro en varias direcciones en comparación con los luchadores sin dolor. Es probable que el dolor de hombro afecte el rendimiento deportivo y pueda provocar la aparición de otras lesiones.

Palabras clave: *bádminton, lucha, hombro, dolor, deportes, puntaje de Constant.*

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Key points

- Previous or on-going shoulder pain is common was badminton players and wrestlers.
- On-going shoulder pain was more frequent in wrestlers.
- Badminton players seemed to mostly have subacromial pain, while shoulder pain in wrestlers was more of a widespread localization.
- Shoulder pain affects sports performance and might lead to development of other injuries and should therefore be well noticed by trainers and physios.

INTRODUCTION

Shoulder pain is common among athletes, both due to direct traumas, such as collisions in contact sports, and due to repetitive movements above shoulder height ("overhead"), that occur in racket sports (Anderson & Alford, 2010; Hulstyn & Fadale, 1997). The risk for an athlete to develop shoulder pain is closely related to the character of the sport and is highest in sports with overhead shoulder loading (Doyscher et al., 2014). Also, in throwing sports, such as baseball, shoulder pain is commonly occurring. During a season, half of young baseball pitchers had experienced shoulder pain (Lyman et al., 2002).

Badminton includes many repetitive overhead motions and previous studies have shown that up to 30% of players on both the highest elite level (Fahlström et al., 2006) and at recreational level (Fahlström & Söderman, 2007) suffer from shoulder pain that affects daily life. Young female elite badminton players have an imbalance in strength and mobility in the shoulder muscles (Couppé et al., 2014), which can contribute to painful subacromial conditions. Under-17 badminton players with a shoulder internal rotation range of motion of 55º or less, were shown to have increased risk of shoulder pain one year later (Cejudo, 2022) A study performed on 62 female overhead athletes on elite level and recreational level among different sports has shown larger acromio-humeral distance in the dominant side than in the non-dominant side. In addition, the elite level athletes had a larger dominant side acromio-humeral distance than the recreational level athletes (Maenhout et al., 2013). A larger acromio-humeral distance in overhead athletes means that the shoulder is less stable and the risk for pathologies in the area due to repeated subluxation is increased (Chambers & Altchek, 2013). It has also been suggested in a recent study on Danish elite badminton players that greater shoulder external rotational strength is strongly associated with an increased acromio-humeral distance. This suggests hypertrophy of the supraspinatus tendon which could lower the risk of injury (Schmidt et al., 2021).

Wrestling is among the oldest sports known to man (Martin & Margherita, 2021), it puts high demands on the shoulders, and wrestlers have a different type of loading on their shoulders compared to athletes with repetitive overhead shoulder loading. The wrestlers´ shoulder is affected by twisting and leverage, as well as falls, with sudden contact with the carpet. Shoulder injuries can occur when a wrestler is trying to escape a hold, which can force the shoulder joint past its normal range of motion (Halloran, 2008). An American study that followed 458 male high school wrestlers, aged 14-19 years, for a season found an incidence of 52 injuries/100 wrestlers/season. The most injured body part was the shoulder (rotator cuff, glenohumeral joint and AC-joint) (24%), followed by the knee (17%). The injured wrestlers were older on average and had been wrestling longer than other wrestlers participating in that study. The most common mechanisms of injury were found to be direct forces or blows (42%) and twisting forces (23%), while only 6% of all injuries were due to overuse or repetitive activity (Pasque & Hewett, 2000). A study comparing the prevalence of shoulder injuries for different sports at high school level found wrestling to have the second highest incidence for shoulder injuries behind American football. Wrestlers had more shoulder injuries than soccer, basketball and volleyball players (Bonza et al., 2009).

In badminton it is known that shoulder pain is common and affects sports performance (Fahlström et al., 2006). Imbalance in shoulder strength and a large acromio-humeral distance seems to be associated with a higher risk to develop shoulder pain in badminton players (Couppé et al., 2014; Chambers & Altchek, 2013). In wrestling fewer studies have been performed with the focus on shoulder pain compared to badminton. The knowledge about what consequences wrestlers suffer from their shoulder pain and how it affects their performance is not extensive. A direct comparison between badminton and wrestling, where the shoulder loading is of different character, has not been made.

The prevalence and the severity of injuries should be studied with the aim to prevent sports injuries (Van Mechelen, 1997). Therefore, comparing two sports with different injury mechanisms to the shoulder; repetitive overhead motion in badminton, and twisting, leverage and other direct forces for the wrestlers' shoulder could result in interesting findings.

The aim of this study was to study painful conditions in the shoulders among badminton players and wrestlers, to describe them and make a comparison between both sports.

MATERIALS AND METHODS

Participants

Testing was offered to badminton players and wrestlers in a local badminton club and a local wrestling club in Sweden, during competitions, training

camps and practice sessions. All athletes tested were warmed up and ready to compete. The participants filled in a questionnaire, that has previously been used on badminton players, handball players and flatwater kayakers (Fahlström et al., 2006; Myklebust et al., 2013; Johansson et al., 2016).

Materials and procedures

The questionnaire included questions about basic characteristics, such as age, length, weight and dominant hand, training habits in badminton/wrestling and other shoulder loading activities, such as strength training. There were also questions about prevalence of shoulder pain connected with badminton or wrestling, and questions about the onset and course of pain. The participants registered their shoulder pain on a scale between 0-100 mm (VAS), where 0 mm equals no pain and 100 mm equals maximum pain (Aicher et al., 2012). There were also questions whether the pain affected the practice of sports, activities of daily life and sleep. Those who had sought medical advice for their shoulder pain specified who they consulted (doctor, physiotherapist or other category) and what diagnose and/or what treatment they had received. Those who at some point (previous or present) had suffered from shoulder pain marked the location of their pain in a figure.

Then the shoulder mobility and strength of all participants were tested with Constant Score (Roy et al., 2010), a method usable to assess shoulder function (Constant & Murley, 1987). Constant Score contains a subjective and an objective part. The subjective part gives a maximum of 35 points and the objective part 65 points, which gives a total score of maximum 100 points for a trouble-free shoulder. In the subjective part participants were asked about the level of pain they experienced from the shoulder during daily activities, maximum pain resulted in 0 points and no pain in 15 points. The subjective part also included scoring concerning work ability, restricted leisure activities, disturbed sleep and at what level of elevation it was possible to work without shoulder pain. The objective part of Constant Score consisted of a test of pain free range of motion and muscular strength in the shoulders. Range of motion was tested in four directions: flexion, abduction, internal rotation and external rotation. Flexion and abduction were tested while sitting down and internal- and external rotation while standing up. The results for the mobility tests were translated into scoring points. Full pain-free mobility in one of the directions resulted in 10 points, while restricted or painful mobility resulted in point deduction.

Muscular strength was assessed with an Isobex dynamometer (Medical Device Solutions AG, Burgdorf, Switzerland). The dynamometer was attached to a table while the participant stood up with the torso in basic anatomical position and 90° flexion and 30° horizontal abduction in the shoulder, extended elbow and the back of hand facing upwards. A band between the wrist and the dynamometer was applied and the participant elevated the arm with maximum force for five seconds. The test was performed three times on each shoulder. The mean value of the three attempts was registered and used for calculations. All testing was conducted by two persons who had been trained together in conducting the tests and therefore the tests were performed and judged similarly. Muscular strength was translated from kg to points and each completed 0.5 kg was translated into one point. A maximum score of 25 points could be obtained from the strength test, hence a strength ≥12.5 kg resulted in the maximum number of points.

Ethics

All participants received written and verbal information about the study and provided written consent. The intervention did not put the participants at risk. The study had received ethical approval by the Regional Ethics Board in Umeå, Sweden, Dnr 09-148M.

Statistical analysis

IBM SPSS Statistics 28 was used for all calculations. Mean, median and standard deviation was used for describing the data. Mann-Whitney test was used to calculate differences between groups for continuous variables. Chi-Square test was used for categorical variables. A p-value ≤0.05 was considered to be statistically significant. Effect size was calculated for Mann-Whitney test (r) and Chi-Square test (φ).

RESULTS

123 athletes were asked to participate in the study of which 119 (97%) accepted. Sixty-three of the participants (53%) were badminton players (50 male, 13 female) and 56 of the participants (47%) were wrestlers (32 male, 24 female).

Basic characteristics of the participants are shown in Table 1. The male participants were older, had a higher BMI, were stronger and had a higher total Constant Score in both shoulders than the females. Apart from the difference in shoulder strength between male and female, the only difference in strength of same-sex participants was between male badminton players and male wrestlers in the dominant shoulder [15.8±4.4, 16 points vs 17.9±4.9, 18 points (p=0.035, r=0.23)].

Previous or on-going shoulder pain was reported by 29 (46%) of the badminton players - 24 (48%) male and 5 (38%) female and by 30 (54%) of the wrestlers - 20 (63%) male and 10 (42%) female.

Table 1.
Basic characteristics for the 119 participating athletes

Variable	Badminton players (n=63) (mean±SD, median)	Wrestlers (n=56) (mean±SD, median)	p-value*	Effect size (r)
Age (years)	25.7±12.3, 20.0	18.6±6.8, 16.0	<0.001	0.40
Time active in badminton/wrestling (years)	9.0±6.7, 7.0	9.6±5.9, 8.5	0.203	0.12
Badminton/wrestling per week (h)	5.0±2.3, 5.0	5.7±2.1, 5.0	0.070	0.17
Other shoulder training per week (h)	1.3±1.2, 1.0	2.8±2.5, 2.0	<0.001	0.40
Total shoulder training per week (h)	6.3±2.6, 6.0	8.5±3.7, 8.0	<0.001	0.36
Strength dominant shoulder (points)	14.6±4.7, 14.0	15.1±5.4, 15.0	0.584	0.05
Strength non-dominant shoulder (points)	14.3±4.9, 14.0	14.3±5.2, 13.5	0.900	0.01
Total Constant Score dominant side (points)	83.4±8.7, 85.0	84.6±7.8, 84.5	0.604	0.05
Total Constant Score non-dominant side (points)	87.9±6.0, 89.0	83.0±11.3, 86.0	0.005	0.26

* p-value: significant differences for values lower than 0.05.

A comparison of differences between badminton players with previous or on-going pain and other badminton players can be seen in Table 2. There were no differences in shoulder strength or mobility between the two groups of badminton players.

Table 2.
Comparison of significant differences between badminton players with on-going or previous pain and other badminton players

Variable	Badminton players with on-going or previous pain (n=29) (mean±SD, median)	Other badminton players (n=34) (mean±SD, median)	p-value*	Effect size (r)
Age (years)	28.8±13.0, 23.0	23.1±11.1, 18.0	0.046	0.25
Time active in badminton (years)	11.6±7.6, 10.0	6.7±4.9, 5.8	0.004	0.36
Total Constant Score dominant side (points)	78.1±8.6, 78.0	88.0±5.7, 88.0	<0.001	0.56

A comparison of differences between wrestlers with ongoing or previous pain and other wrestlers can be seen in Table 3.

Table 3.
Comparison of significant differences between wrestlers with ongoing or previous pain and other wrestlers

Variable	Wrestlers with ongoing or previous pain (n=30) (mean±SD, median)	Other wrestlers (n=26) (mean±SD, median)	p-value*	Effect size (r)
Age (years)	20.6±8.5, 17.0	16.4±2.6, 15.0	0.007	0.36
Time active in wrestling (years)	11.1±7.1, 10.0	7.8±3.6, 6.5	0.035	0.28
Other shoulder training per week (h)	3.4±2.9, 2.0	2.1±1.9, 1.8	0.005	0.38
Abduction in non-dominant shoulder (points)	9.2±1.6, 10.0	9.9±0.4, 10.0	0.035	0.28
Internal rotation in dominant shoulder (points)	7.8±1.8, 8.0	8.8±1.5, 10.0	0.028	0.29
Internal rotation in non-dominant shoulder (points)	8.3±1.9, 8.0	9.4±1.2, 10.0	0.011	0.34
Total Constant Score dominant side (points)	81.5±8.0, 82.5	88.0±6.0, 89.0	0.002	0.41
Total Constant Score non-dominant side (points)	78.8±13.5, 80.5	87.7±5.5, 87.0	0.003	0.40

* p-value: significant differences for values lower than 0.05.

In badminton players the shoulder pain was located to subacromial structures in the dominant shoulder, while the distribution of shoulder pain in wrestlers was widespread and included both dominant and non-dominant side on various locations, (Figures 1a and 1b).

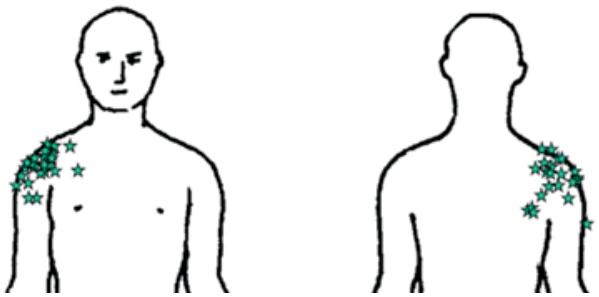

Figure 1a. Localization of pain in 29 badminton players, both with ongoing (n=3) and previous (n=26) shoulder pain.

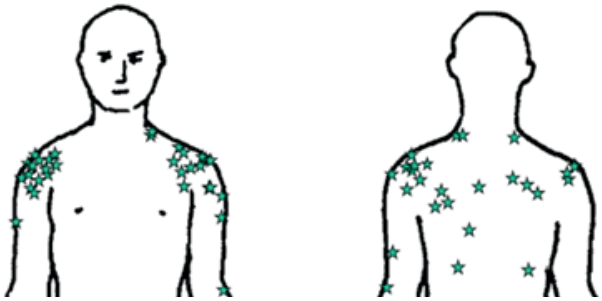

Figure 1b. Localization of pain in 30 wrestlers, both with ongoing (n=18) and previous (n=12) shoulder pain.

In Figure 1a and 1b the right side represents dominant side and the left side non-dominant side. Each participant may have marked more than one location for pain.

On-going shoulder pain was more frequent in wrestlers; 18 of the wrestlers (32%) had ongoing shoulder pain, while three badminton players (5%) had ongoing shoulder pain (p=<0.001, φ-0.36). Ongoing shoulder pain was registered by 14 (44%) of the male wrestlers, compared to three (6%) of the male badminton players (p=<0.001, φ=-0.45). More male than female wrestlers had ongoing shoulder pain, [14 (44%) vs 4 (17%), (p=0.032, φ=0.29)].

A comparison of differences between male wrestlers with ongoing pain and other male wrestlers can be seen in Table 4. Male wrestlers with ongoing shoulder pain had a higher body mass index compared to male wrestlers without ongoing shoulder pain [25.2±2.6, 25 kg/m² vs 23±2.3, 23 kg/m² (p=0.011, r=0.44)]. Similar differences as those presented in Table 4 could be seen comparing female wrestlers with ongoing pain and other female wrestlers, except for body mass index, where female wrestlers with ongoing pain had a lower body mass index compared to pain-free female wrestlers [19.4±2, 18.9 kg/m² vs 21.7±2.1, 22.2 kg/m² (p=0.045, r=0.41)].

No significant differences were found between badminton players and wrestlers with ongoing or previous pain regarding type of debut of pain (sudden or gradual). Also, no differences between the sports whether the pain affected competition and training habits were found.

Eight of the male wrestlers with ongoing pain (57%) had experienced a sudden onset of pain, while for female wrestlers none had experienced a sudden onset of pain (p=0.055, φ=0.48). Furthermore, seven (50%) of the male wrestlers with ongoing pain were forced to change their training- or competition habits, while for female wrestlers with ongoing pain there were none (p=0.070, φ=0.43). Four of the male wrestlers with ongoing pain (29%) experienced that their pain affected activities of daily life, while for female wrestlers with ongoing pain, one (25%) experienced affected activities of daily life (p=0.888, φ=0.033). Disturbed sleep due to ongoing pain was experienced by four of the male wrestlers (29%), and by one of the female wrestlers (25%) (p=0.888, φ=0.033). Looking at wrestlers with ongoing pain, eight male wrestlers (57%) had sought medical advice, while no female wrestlers had done so (p=0.043, φ=0.48).

DISCUSSION

The aim of this study was to study painful conditions in the shoulders among badminton players and wrestlers, to describe them and make a comparison between both sports.

Previous or on-going shoulder pain was common in both studied groups of badminton players (46%) and wrestlers (63%), even though more wrestlers than badminton players were found to suffer from on-going shoulder pain. Previous studies performed on competitive and recreational badminton players have shown that shoulder pain is a common problem with about 30% of players suffering from on-going shoulder pain (Fahlström et al., 2006; Fahlström & Söderman, 2007). Surprisingly few badminton players in this study (5%) suffered from on-going shoulder pain. This might be because they were relatively young and did not practice as much as the players in the previous studies. The badminton players' prevalence of shoulder pain in this study is comparable to the prevalence of shoulder pain in 9-12% among people aged 19-44 years old in the normal population (Urwin et al., 1998).

However, the localization of shoulder pain was very similar among the badminton players in this study and those in previous studies (Fahlström et al., 2006; Fahlström & Söderman, 2007), which indicates that the type and mechanism of injury is of a similar character. If this study had been conducted on badminton players who practiced more and competed at a higher level, it is likely that the prevalence of on-going shoulder pain would have been more similar to what has been found in previous studies.

Table 4.
Differences between male wrestlers with ongoing pain and other male wrestlers

Variable	Male wrestlers with ongoing pain (n=14) (mean±SD, median)	Other male wrestlers (n=18) (mean±SD, median)	p-value*	Effect size (r)
Age (years)	24.1±10.8, 19.0	16.9±3.4, 15.5	0.008	0.47
Body Mass Index (score)	25.2±2.6, 25.0	23.0±2.3, 23.0	0.011	0.44
Time active in wrestling (years)	13.6±8.2, 12.5	7.9±4.9, 6.0	0.010	0.45
Internal rotation in non-dominant shoulder (points)	7.3±2.0, 8.0	8.9±1.6, 10.0	0.027	0.41
Total Constant Score non-dominant side (points)	75.3±18.2, 80.5	88.4±7.8, 89.0	0.020	0.41

* p-value: significant differences for values lower than 0.05.

The prevalence of on-going pain was especially high among male wrestlers, where 44% suffered from on-going pain. Despite the on-going pain, the wrestlers were still participating in competitions and training sessions. Wrestling with on-going shoulder pain seems likely to inhibit the performance of the wrestler and may force them to utilize different techniques compared to if they weren't suffering from shoulder pain. This might contribute to the development of other injuries.

The male and female wrestlers in this study perform different styles of wrestling, the male Greco-Roman wrestling and the female Freestyle wrestling. In Greco-Roman wrestling it is only allowed to grapple the opponent from waist and above, while in Freestyle it is also allowed to grapple the opponent's legs. A previous study that compared the injuries of the two wrestling styles during a 2006 US national junior tournament, found that the overall injury rate was higher in Freestyle wrestling (7.0 injuries/1000 athlete-matches) than in Greco-Roman wrestling (4.6 injuries/1000 athlete-matches). Knee injuries were more common in freestyle while elbow and head/face/neck injuries were more common in Greco-Roman wrestling. Shoulder injuries in Greco-Roman wrestlers were found to be caused from being driven into the mat (70%) and by other physical contacts (30%) (Yard & Comstock, 2008).

Looking at the localization of pain, wrestlers had a more widespread localization than badminton players. This difference in localization of pain indicates that the shoulder loading within badminton and wrestling are of different characters, and that different mechanisms are responsible for causing shoulder pain in badminton players and wrestlers. This gives better insight in participants shoulder pain and is a strength of this study.

Male wrestlers with on-going pain had a higher BMI than other male wrestlers, while female wrestlers with on-going pain had a lower BMI than other female wrestlers. Perhaps in Greco-Roman wrestling, having a higher BMI (being relatively heavier) is a factor that increases the load on the shoulders that might result in pain. For the female wrestlers with pain, having a lower BMI might be related to less stabilizing musculature for the shoulder. No female wrestler in this study with on-going pain had experienced a sudden debut of pain, that might indicate that different mechanisms of injury occur in Greco-Roman and Freestyle wrestling.

In this study eight (57%) of the male wrestlers (who performed Greco-Roman wrestling) with on-going shoulder pain had experienced a sudden debut of their pain. Taking this together with the mechanisms of shoulder injuries found earlier by Yard & Comstock (2008) into consideration, it seems likely that many Greco-Roman wrestlers with shoulder pain have a sudden debut of their pain due to direct trauma.

Wrestlers with on-going or previous pain had lower scores in several directions of shoulder mobility compared to other wrestlers. (Table 3). This may be due to them suffering from shoulder pain during the testing (those with ongoing pain), or it may be because they, due to decreased mobility, were more susceptible to acquiring shoulder pain. It is generally not known if it is beneficial for wrestlers regarding shoulder pain and injuries to have a flexible or a more rigid shoulder. One previous study, however, showed that wrestlers with at least one positive test for general ligamentous laxity had only half the number of shoulder injuries compared to the other wrestlers in that study (Pasque & Hewett, 2000). Comparatively, for badminton players it is known that instability in the shoulder and an imbalance in shoulder strength for internal- and external rotation may contribute to painful conditions (Couppé et al., 2014; Chambers & Altchek, 2013; Stausholm et al., 2021).

Wrestlers seemed to suffer from more severe consequences from their shoulder pain compared to badminton players. Male wrestlers also seemed to suffer from more severe consequences of their pain compared to female wrestlers. For wrestling, the different prevalence of pain for male and female wrestlers and its consequences might be related to the difference in wrestling styles by male and female wrestlers.

Although this study was performed on badminton players and wrestlers, similar shoulder problems can

be expected in athletes who participate in other types of sports with shoulder loading of similar character.

Constant Score is an established method to assess shoulder function, it can be performed in a short amount of time, which was important in this study, since testing of each athlete was performed in a limited timeframe. The mobility and strength tests are measured in intervals that are translated into points. This does not give an exact measurement but on the other hand it is easier and quicker to conduct the tests.

CONCLUSION

The badminton players in this study had a lower prevalence of shoulder pain compared to in previous studies on badminton players. Many wrestlers in this study were suffering from shoulder pain, especially male wrestlers, of which several had experienced a sudden debut of pain. Wrestling with ongoing shoulder pain is likely to affect sports performance and could lead to development of other injuries. The badminton players had pain located to the subacromial area, while the wrestlers´ shoulder pain was of widespread location, which reflects the different loading between the two sports. The higher prevalence of ongoing shoulder pain in male than in female wrestlers indicates that the risk of injuries to the shoulder is higher in Greco-Roman than Freestyle wrestling.

Injury registration and analysis is valuable to gain more knowledge about injuries in sports with different shoulder loading.

PRACTICAL APPLICATIONS

Even though badminton players in this study practiced relatively few hours per week, shoulder pain was still prevalent. This indicates that specific training to prevent shoulder pain could be of value even in non-elite badminton players with a lower training load. Male wrestlers in this study had a high prevalence of shoulder pain, which may be related to wrestling Greco-Roman style. Injury preventive training focusing on strength and mobility of the shoulders could be useful to prevent shoulder injuries in both sports.

DECLARATIONS

Ethics approval and consent to participate

All participants received written and verbal information about the study and provided written and verbal informed consent. The intervention did not put the participants at risk. All methods were carried out in accordance with the Declaration of Helsinki. The study and all experimental protocols had received ethical approval by the Regional Ethics Board in Umeå, Sweden, Dnr 09-148M.

Consent for publication

Not applicable.

Availability of data and material

Data is available from the corresponding author upon reasonable request.

Competing interests

The authors, Anders Sundström, Conny Tärnklev and Martin Fahlström, declare that they have no competing interests.

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Authors' contributions

AS, CT and MF planned the study. AS and CT collected the data. AS analysed the data. AS wrote the article with support from MF and CT.

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