The American Journal of Sports Medicine

http://ajs.sagepub.com/

The Effect of Hypermobility on the Incidence of Injuries in Elite-Level Professional Soccer Players: A Cohort Study

Matt D. Konopinski, Gareth J. Jones and Mark I. Johnson

Am J Sports Med 2012 40: 763 originally published online December 16, 2011
DOI: 10.1177/0363546511430198

The online version of this article can be found at:
http://ajs.sagepub.com/content/40/4/763

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
American Orthopaedic Society for Sports Medicine
AOSSM

The Effect of Hypermobility on the Incidence of Injuries in Elite-Level Professional Soccer Players

A Cohort Study

Matt D. Konopinski,* MSc, BSc Hons, Gareth J. Jones,*† MSc, BSc Hons, Cert Ed, and Mark I. Johnson,*‡ PhD, BSc (Hons), PGCHE
Investigation performed at Leeds Metropolitan University, Leeds, United Kingdom

Background: A recent meta-analysis found that generalized joint hypermobility is a risk factor for knee injuries during contact sports. The effect of hypermobility on the incidence of injuries in elite-level professional soccer players is not known.

Purpose: To compare the incidence of injury between hypermobile and nonhypermobile elite-level male professional soccer players.

Study Design: Cohort study; Level of evidence, 2.

Methods: Fifty-four players from an English Premier League soccer club were assessed for hypermobility, using the 9-point Beighton scale (threshold, 4 points or above), at the start of the 2009-2010 season. Time-loss injuries and individual exposure times were recorded during all club training sessions and matches throughout the entire season.

Results: Mean ± standard deviation incidence of injuries was 11.52 ± 11.39 injuries/1000 h, and the prevalence of hypermobility was 33.3% (18 of 54 players). There were 133 injuries during 13 897.5 hours of exposure. During the season, hypermobile participants had a higher incidence of injuries (mean [95% confidence interval] difference, 15.65 [9.18-22.13] injuries/1000 h; P = .001) and were more likely to experience at least 1 injury, a reinjury, and a severe injury compared with nonhypermobile participants. There were 9 severe knee injuries in hypermobile participants, of which 6 were cartilage injuries.

Conclusion: There was an increased incidence of injury in hypermobile elite-level professional soccer players from an English Premier League club, resulting in more missed days from training and match play. These findings suggest a need for routine screening for hypermobility in professional soccer.

Keywords: hypermobility; soccer; prevalence; injury

Hypermobility is a genetically determined condition that affects multiple joints and is characterized by joint range of motion that exceeds normal limits, taking into account an individual's age, sex, and ethnicity.[21] Hypermobility is a feature of several heritable disorders of connective tissue (HDCT) including Marfan syndrome, Ehlers-Danlos syndrome, osteogenesis imperfecta, and benign joint hypermobility syndrome.[22] Individuals with joint hypermobility have generalized joint laxity, commonly in the absence of musculoskeletal pain or rheumatological disease.[21,22] There are a variety of tools used to quantify hypermobility status,[19] although the Beighton scale has been validated and is recommended by the British Society of Rheumatology.[4,5,20] Individuals are assessed on a 9-point system for excessive joint laxity at the following anatomic sites: fifth finger, thumb, elbow, knee, and trunk. Although variations exist in the threshold scores used to categorize hypermobility, the British Society of Rheumatology recommends a threshold of 4 and above.[20]

Studies have found that hypermobility may be a risk factor for injuries when participating in rugby[25] and soccer.[18] In contrast, some studies have failed to detect differences in the incidence of injuries between hypermobile and nonhypermobile lacrosse players[8] and netball players.[23] A recent systematic review with meta-analysis[19] concluded that there was an increased risk of knee injury in sports participants with generalized joint hypermobility. Interestingly, there was no increased risk of ankle joint injury. Two studies within the review focused on soccer players as the sample group[18,24]; both studies were conducted over

†Address correspondence to Gareth J. Jones, Faculty of Health and Social Sciences, Leeds Metropolitan University, Civic Quarter, Leeds, LS1 3HE United Kingdom (e-mail: g.j.jones@leedsmet.ac.uk).

*Faculty of Health and Social Sciences, Leeds Metropolitan University, Leeds, United Kingdom.

‡Leeds Pallium Research Group, Leeds, United Kingdom.

The authors declared that they have no conflicts of interest in the authorship and publication of this contribution.

The American Journal of Sports Medicine, Vol. 40, No. 4
DOI: 10.1177/0363546511430198

TABLE 1
The Beighton Scale

Test	Criteria	Right	Left
Fifth finger extension test	Passive extension >90°	1	1
	Passive extension ≤90°	0	0
Wrist flexion thumb abduction test	Passively abduct the thumb to appose the flexor aspect of the forearm	1	1
	Unable to passively abduct the thumb to appose the flexor aspect of the forearm	0	0
Elbow extension test	Hyperextension >10°	1	1
	Hyperextension ≤10°	0	0
Trunk and hip flexion test	Knees fully extended, forward flexion of the trunk, able to place the flat of the hand on the floor	1	
	Knees fully extended, forward flexion of the trunk, unable to place the flat of the hand on the floor	0	
Knee extension test	Hyperextension >10°	1	1
	Hyperextension ≤10°	0	0
Total		9	

a decade ago using 123 and 146 female soccer players, respectively, and found that hypermobility was a risk factor for injury. More recently, a preliminary study found that hypermobility was not associated with an increased risk of injury in 33 male soccer players from a second-tier professional club in England.[7]

It is estimated that the incidence of injury in professional soccer is 24 to 30 per 1000 match hours and 3 to 5 per 1000 training hours,[9,14,26] with hamstring and knee ligament injuries being most common.[14,15,26] There is limited evidence about the risk factors for injury in elite-level male soccer, although previous injury[1,13,27,30] and increasing age[9,14] have been identified. The aim of our study was to compare the incidence, severity, location, and nature of injuries in hypermobile and nonhypermobile professional soccer players from the English Premier League.

MATERIALS AND METHODS

Participants, Recruitment, and Selection

A prospective cohort study was designed. Participants were professional soccer players signed to an English Premier League soccer team for the 2009-2010 season. Musculoskeletal screening and injury audit, including assessment of hypermobility using the Beighton scale, are routinely conducted by medical staff at the soccer club. All players with a professional contract were invited to take part in the study; any existing injuries at enrollment were not included in the study. All study data were anonymized. Ethical approval was obtained from the Faculty of Health and Social Sciences Ethics Committee at Leeds Metropolitan University.

Procedure

On day 1 of preseason (July 5, 2009), hypermobility and knee and elbow extension were measured by the principal investigator (M.D.K.), who is a physical therapist. Measurements were taken before training to avoid potential changes in the viscoelastic properties of the soft tissues that occur following ballistic activity.[29] Hypermobility was measured using a 9-point Beighton scale[3] (Table 1), and a threshold cut-off point of 4 of 9 was used to categorize participants as hypermobile, in line with previous studies on soccer players.[7,18]

Elbow and knee extension were measured using a standard clinical goniometer using good practice guidelines described by Norkin and White.[17] Goniometric measurement of knee extension has been shown to have good intrarater and interrater reliability,[28] and goniometric measurement of elbow extension has been shown to have moderate intrarater and interrater reliability.[6] On days 2, 3, and 4 of the preseason period, the height and body weight of participants were measured, and they completed a self-administered questionnaire to gather demographic information including age, ethnic background, and playing position. A self-reported history of details of previous or current injuries was recorded as an addendum, and this information was cross-checked with club medical records for accuracy.

Guidelines set out in the Union of European Football Associations (UEFA) Consensus Statement were used to determine exposure, severity of injury, reinjury, and return to play.[12] A time loss definition of injury was used where an injury was defined as that sustained by a player during training or match play that resulted in the player being unable to participate fully in the subsequent training session or match. The severity of injury was calculated as slight (0 days), minimal (1-3 days), mild (4-7 days), moderate (8-28 days), severe (>28 days), or career ending.[12]

Absence because of sickness or other circumstance was not included in the injury audit. Diagnosis of injury was made by the club doctor, who was blind to the hypermobility status of individual players. Type and location of injury were recorded by the club doctor on a standard injury report form and classified according to body side and whether the injury was a recurrence (ie, a reinjury). A free-text section enabled the recording of a specific diagnosis. Players who experienced more than 1 injury during the

TABLE 2
Demographics[a]

	All Participants	Hypermobile	Nonhypermobile	P
No. of participants	54	18	36	
Beighton score	2.46 ± 2.345	5.39 ± 1.14	1.0 ± 1.04	<.001[b,c]
Age, y	22.5 ± 4.17	22.4 ± 3.82	22.5 ± 4.39	.409[d]
Height, cm	182.96 ± 5.93	182.2 ± 5.7	183.3 ± 6.1	.517[d]
Weight, kg	77.94 ± 6.68	76.9 ± 5.3	78.4 ± 7.3	.053[b,d]
Training exposure, h	229.53 ± 54.29	183.20 ± 58.98	252.70 ± 33.42	.013[b,d]
Match play exposure, h	27.83 ± 23.79	23.50 ± 21.50	29.99 ± 24.85	.678[d]
Total exposure (training + match play), h	257.36 ± 58.28	206.70 ± 63.04	282.69 ± 35.11	.005[b,d]

[a]Mean ± standard deviation summary data (unless otherwise stated). P represents comparisons between hypermobile and nonhypermobile participants.
[b]Statistically significant at $P \leq .05$.
[c]Mann-Whitney.
[d]Unpaired t test.

course of the season were recorded as sustaining a multiple injury. A reinjury was defined as an injury that was the same type and at the same anatomic site irrespective of when it occurred over the season.[12] Injury report forms were completed on the day that the injuries were sustained. If obtained, any additional information was updated at a later date, for example, from diagnostic imaging.

Training and match exposures were recorded by video analysts, employed by the club but independent to the investigating team and blind to the study protocol. Exposure was recorded on a monthly form of attendance, to the nearest minute, on the day that the exposure occurred. Absence from soccer participation because of injury, international duty, or any other reason was recorded on the exposure form. A participant was considered injured until he was able to participate fully in the team's training session or was available for match selection. On the basis of the exposure record, the incidence of injury was calculated as the number of injuries per 1000 hours of exposure, inclusive of multiple injuries over the season.

Data Analysis

Comparisons between hypermobile and nonhypermobile participants were made using t tests (normally distributed continuous data), Mann-Whitney tests (ordinal data), and Fisher exact tests, using the Freeman-Halton extension where appropriate (nominal data). The incidence of injuries per 1000 hours of exposure was computed for hypermobile and nonhypermobile participants and compared using t tests. Relative risks and odds ratios were calculated, and Fisher exact tests were used to compare the likelihood of injury between groups. Mann-Whitney tests were used to compare frequency of injuries, as these data included multiple injuries over the season (ie, some participants had more than 1 injury) and therefore could be managed as ordinal data. Within-participant comparisons of the number of injuries in training and match play were made using Wilcoxon signed-rank tests on pairwise differences. Analyses were performed using SPSS for Windows, version 17.0 (SPSS Inc, Chicago, Illinois), with statistical significance set at $P \leq .05$.

RESULTS

Characteristics of the Study Group

Fifty-four male participants (mean ± standard deviation [SD] age, 22.5 ± 4.17 years) were enrolled in the study and completed baseline assessment. There were 6 goalkeepers, 17 defenders, 17 midfielders, and 14 attackers of mixed ethnicity (43 white, 5 black, and 6 mixed race). Forty-two participants were right leg dominant. Median (Q1, Q3) Beighton score was 2.0 (0.0, 4.25) of a possible score of 9. Two participants, from the nonhypermobile group, went on loan to different teams during the course of the study period after baseline measurements had been taken. Baseline measurements, injuries, and exposure data for dropouts were included in the analysis up until the day the participant left the study.

The prevalence of hypermobility was 33.3%, with 18 participants scoring 4 or more on the Beighton scale. There were no statistically significant differences between hypermobile and nonhypermobile participants in age or height, although hypermobile participants weighed less than nonhypermobile participants (Table 2). There were no differences in the frequency of hypermobility according to playing position (hypermobile goalkeeper = 0, defender = 6, midfielder = 5, attacker = 7; P = .185, Fisher exact test with Freeman-Halton extension for 2 × 4 contingency table) or ethnicity (hypermobile white = 15, black = 0, mixed = 3; P = .251, Fisher exact test with Freeman-Halton extension for 2 × 3 contingency table).

Analysis of Injuries

A total of 133 injuries, including multiple injuries, were recorded for the 54 participants during the season. There were more injuries for hypermobile participants (n = 72) compared with the nonhypermobile participants (n = 61)

TABLE 3
Analysis of Injuries[a]

	All Participants	Hypermobile	Nonhypermobile	P
Total no. of injuries during training and match play (tally)	2.46 ± 1.97 (133)	4.00 ± 1.88 (72)	1.69 ± 1.52 (61)	<.001[b,c]
No. of injuries during training (tally)	1.17 ± 1.31 (63)	2.05 ± 1.47 (37)	0.72 ± 0.97 (26)	.001[b,c]
No. of injuries during match play (tally)	1.30 ± 1.35 (70)	1.94 ± 1.47 (35)	0.97 ± 1.18 (35)	.013[b,c]
Proportion of participants with at least 1 injury	27/54	17/18	10/36	.077[c] (RR, 1.31; 95% CI, 1.04-1.64)
Incidence injuries during training + match play (per 1000 h)	11.53 ± 11.39	21.97 ± 12.50	6.31 ± 6.06	<.001[b,e]
Incidence injuries during training (per 1000 h)	6.44 ± 8.25	13.25 ± 10.07	3.04 ± 4.26	<.001[b,e]
Incidence injuries during match play (per 1000 h)	77.88 ± 142.09	160.64 ± 217.47	36.51 ± 48.14	<.001[b,e]
Total days missed because of injury (training + match play)	35.07 ± 44.67	76.22 ± 50.76	14.25 ± 20.78	<.001[b,c]
Training days missed because of injury	30.31 ± 41.19	68.28 ± 49.90	11.33 ± 15.76	<.001[b,c]
Match days missed because of injury	6.50 ± 9.00	14.00 ± 10.10	2.75 ± 5.44	<.001[b,c]
Incidence of reinjury (per 1000 h)	1.68 ± 3.75	4.08 ± 5.26	0.48 ± 1.87	<.001[b,e]

[a]Mean ± standard deviation summary data (unless otherwise stated). *P* represents comparisons between hypermobile and nonhypermobile participants. RR, relative risk; CI, confidence interval.
[b]Statistically significant at $P \leq .05$.
[c]Mann-Whitney.
[d]Fisher exact test.
[e]Unpaired *t* test.

(Mann-Whitney test, $P < .001$) (Table 3). The mean ± SD incidence of injuries in the total sample was 11.53 ± 11.39 injuries/1000 h. There was a higher mean ± SD incidence of injuries in hypermobile participants (21.97 ± 12.50 injuries/1000 h) compared with nonhypermobile participants (mean ± SD = 6.31 ± 6.06 injuries/1000 h), with a mean (95% confidence interval [CI]) difference of 15.65 (9.18-22.13) injuries/1000 h ($P = .001$, *t* test) (Table 3).

There was a tendency for hypermobile participants to experience at least 1 injury compared with nonhypermobile participants, although this just failed to reach statistical significance (17/18 hypermobile participants, 26/36 nonhypermobile participants; $P < .077$, Fisher exact test). The relative risk of a hypermobile participant sustaining at least 1 injury was 1.31 (95% CI, 1.04-1.64), with an odds ratio of 6.55 (95% CI, 0.76-55.83). Only 1 hypermobile participant did not sustain an injury over the season compared with 10 nonhypermobile participants who did not sustain an injury over the entire season.

There were no differences in the number of injuries sustained during training (n = 63) compared with match play (n = 70) in the total sample ($P = .662$, Wilcoxon signed-rank test on pairwise difference), in hypermobile participants ($P = .799$), or in nonhypermobile participants ($P = .456$) (Table 3). Hypermobile participants sustained more injuries in training (37 injuries in 18 participants) compared with nonhypermobile participants (26 injuries in 36 participants) ($P = .001$, Mann-Whitney test). Hypermobile participants sustained more injuries in match play (35 injuries in 18 participants) compared with nonhypermobile participants (35 injuries in 36 participants) ($P = .013$, Mann-Whitney test).

Participants sustained a higher incidence of injuries during match play (mean ± SD, 77.88 ± 142.09 injuries/1000 h) than during training (6.44 ± 8.25 injuries/1000 h), with a mean (95% CI) difference of 71.43 (33.42-109.46) injuries/1000 h ($P < .001$, paired *t* test). The mean ± SD incidence of injuries during training was higher for hypermobile participants (13.25 ± 10.07 injuries/1000 h) compared with nonhypermobile participants (3.04 ± 4.26 injuries/1000 h), with a mean (95% CI) difference of 10.21 (5.04-15.38) injuries/1000 h (unpaired *t* test, $P < .001$) (Table 3). The mean ± SD incidence of injuries during match play was higher for hypermobile participants (160.64 ± 217.47 injuries/1000 h) compared with nonhypermobile participants (36.51 ± 48.14 injuries/1000 h), with a mean (95% CI) difference of 124.14 (15.06-233.21) injuries/1000 h ($P = .001$, unpaired *t* test). The hypermobile group missed more days of training (mean ± SD, 68.28 ± 49.9 days) than the nonhypermobile participants (11.33 ± 15.76 days) and of match play (14.0 ± 10.1 days) than the nonhypermobile participants (2.75 ± 5.44 days), with a mean (95% CI) difference of 56.94 (31.69-82.19) days for training ($P < .001$, unpaired *t* test) and 11.25 (5.96-16.53) days for match play ($P < .001$, unpaired *t* test).

Twenty-three participants sustained multiple injuries without reinjury. The greatest number of injuries sustained by a single participant over the season was 8, which included 2 reinjuries (1 hypermobile participant). Three hypermobile participants and 2 nonhypermobile participants sustained 5 injuries. Only 1 of these 5 participants, who was categorized as hypermobile, sustained a reinjury (Table 4).

Twelve participants (22.2%) sustained at least 1 reinjury during the season, and they contributed to 56 of the 133 (42%) injuries sustained over the season (30 injuries during training, and 26 injuries during match play). Nine of these 12 players were hypermobile. Hypermobile participants

TABLE 4
Frequency of the Number of Injuries Including Multiple Injuries Experienced for Hypermobile and Nonhypermobile Participants During the Season

	Hypermobile (Reinjury)	Nonhypermobile (Reinjury)	All Participants (Reinjury)	Total Injury Count
0 injuries	1	10	11	
1 injury	0	8	8	8
2 injuries	2	9	11	22
3 injuries	5	3	8	24
4 injuries	3	4	7	28
5 injuries	3	2	5	25
6 injuries	3	0	3	18
7 injuries	0	0	0	0
8 injuries	1	0	1	8
Total no. of participants	18	36	54	133 injuries

TABLE 5
Tally of Injury Severity[a]

	Training and Match Play			
Injury Severity	Hypermobile	Nonhypermobile	P	Total Injuries
Minimal (1-3 d)	12	22	.512	34
Mild (4-7 d)	19	12	.011	31
Moderate (8-28 d)	25	24	.02	49
Severe (>28 d)	16	3	<.001	19
Total	72	61		133

[a]P = Mann-Whitney tests.

were more likely to experience a reinjury (hypermobile, n = 9/18; nonhypermobile, n = 3/36; Fisher exact test, P = .0011), with a relative risk of 0.545 (95% CI, 0.34-0.87) and an odds ratio of 11.0 (95% CI, 2.45-49.31).

Severity, Type, and Location of Injuries

There were 49 moderate and 19 severe injuries in the sample population, although none of these were career ending (Table 5). Two participants experienced at least 1 moderate injury, and 12 participants experienced at least 1 severe injury. Hypermobile participants had more severe (P < .001), moderate (P = .02), and mild injuries (P = .011), including reinjuries, compared with nonhypermobile participants (Mann-Whitney tests) (Table 5). Hypermobile participants were more likely to experience at least 1 severe injury (12/18 hypermobile participants, 2/36 nonhypermobile participants; P < .001, Fisher exact test), with a relative risk of 12.0 (95% CI, 3.00-47.98) and an odds ratio of 34.0 (95% CI, 6.025-191.85). Hypermobile participants were also more likely to experience at least 1 mild injury (11/18 hypermobile participants, 10/36 nonhypermobile participants; P = .0365, Fisher exact test) but not more likely to experience a moderate injury (12/18 hypermobile participants, 17/36 nonhypermobile participants; P = .249) or a minimal injury (9/18 hypermobile participants, 13/36 nonhypermobile participants; P = .386). Nine of the severe injuries sustained by the hypermobile group were located at the knee and consisted of 6 cartilage injuries and 3 ligament injuries.

Injuries in the lower body predominated, with the most frequent location of injury during training and matches being the thigh (34/133, 25.6%) and ankle (25/133), with similar distributions between hypermobile and nonhypermobile participants. Injuries categorized as muscle rupture/tear/strain/cramp were most common (53/133, 39.1%), with similar distributions between hypermobile and nonhypermobile participants.

DISCUSSION

The prevalence of hypermobility in a sample of 54 soccer players signed to an English Premier League soccer team for the 2009-2010 season was 33.3%, with a mean ± SD incidence of 11.52 ± 11.39 injuries/1000 h. The findings provide evidence that hypermobile participants had a higher incidence of injuries and were more likely to experience a severe injury, experience a reinjury over the season, and miss more days from training and matches. There was a tendency for hypermobile participants to experience at least 1 injury, although this just failed to reach statistical significance. These findings suggest a need for routine screening for hypermobility in professional soccer.

Previously, Collinge and Simmonds[7] found that the prevalence of hypermobility was 42% in 33 male second-tier professional soccer players and that hypermobility was not a risk factor for injury. They categorized hypermobility using the same Beighton scale cut off point as we did. The reason for the lower prevalence in our study may be differences in the timing of the baseline hypermobility assessment, as we conducted baseline assessments before training to avoid any potential changes in the viscoelastic properties of the soft tissues,[29] whereas Collinge and Simmonds[7] performed baseline assessment after training. Collinge and Simmonds[7] did not record injuries that lasted less than 48 hours, and there were differences in sample size and ethnicity between studies. The lack of association between hypermobility and injury by Collinge and Simmonds[7] may be because of low statistical power, calculated post hoc as 0.69. A post hoc calculation for our study using incidence of injury data found power to be 0.99 and 0.85 for incidence of injury in training and matches, respectively ($P < .05$; G*Power, 3.1).

The finding that one third of our sample was hypermobile suggests that hypermobility is common in professional soccer players. Whether this prevalence is higher than in other sports, or even the general population, remains uncertain because it falls within the prevalence in the general adult population of 5% to 43% and is comparable with other sporting populations.[9,25] There is no clear reason why soccer players may be more hypermobile than the general or sporting populations. In gymnasts, repeated progressive stretching programs make the soft tissue more extensible, leading to increased range of motion at joints. It is possible that the high training volumes coupled with regular stretching may be a contributing factor in soccer players.

Our finding that mean $\pm$ SD incidence during training was 6.44 ± 8.25 injuries/1000 h was similar to previous estimates of 3 to 5 per 1000 training hours by Hawkins and Fuller,[14] Walden et al,[26] and Ekstrand.[9] However, we found that the mean $\pm$ SD incidence during match play of 77.88 ± 142.09 injuries/1000 h was higher than previous estimates of 24 to 30 per 1000 match hours. This may be explained by differences in injury definition and reporting procedures. Inconsistencies in injury definition across previous studies are a major shortcoming of the evidence base to date. We followed the consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries produced by Fuller et al,[12] although the previous study on professional soccer players did not.[7] Likewise, a systematic review of 18 studies identified 7 different objective measures of hypermobility involving 10 different methods of measurement.[19] Clearly, there is a need to standardize operational definitions for future studies.

Our findings are consistent with a meta-analysis that provided strong evidence that generalized joint hypermobility increased the risk of lower limb joint injury at the knee in a wide range of contact sports including soccer, rugby, field hockey, American football, and basketball.[19] The review included 18 studies of variable quality, which utilized a variety of tests and threshold scores to assess generalized joint hypermobility. The reviewers found an increased risk of knee joint injury for hypermobile participants but no increased risk for ankle joint injury during contact activities. In our study, 9 of the severe injuries sustained by the hypermobile group were located at the knee and consisted of 6 cartilage injuries and 3 ligament injuries. This finding may be interpreted in terms of increased ligamentous laxity at the knee, reducing passive stability and predisposing damage to the load-bearing structures because of greater shear forces. We found that injuries in the lower body resulting from muscle ruptures, tears, and strains were most common and consistent with previous studies on professional soccer players.[14,26] A recently published large-scale prospective study on male professional soccer players[10] found that 92% of all injuries recorded affected the large muscle groups of the lower limb.

There were no differences in age, height, playing position, and ethnicity between hypermobile and nonhypermobile participants, although hypermobile participants weighed less than nonhypermobile participants. There is no evidence to our knowledge to suggest the latter finding has any relevance on incidence of injury.

Study Shortcomings

We used a 1-season prospective study design, and as a consequence, we had few dropouts from in-season transfers. However, it is possible that the findings may be a random occurrence for that particular season, and therefore, a prospective study over a number of seasons or exploration of retrospective data would be worthwhile in the future. We were unable to estimate with any certainty the proportion of injuries that were directly related to hypermobility because it was not possible to classify the cause and pathophysiology of the injuries that the players sustained because of logistical difficulties in accessing data. Studies vary in their selection of an appropriate threshold to identify hypermobility using the Beighton score,[19] and we used a threshold of 4 points as recommended by the British Society of Rheumatology.[20] Five of the 18 hypermobile participants scored 4 points on the Beighton scale, although recategorizing these participants as nonhypermobile did not alter the main findings of our study.

Injury and injury severity were defined in terms of time lost from soccer participation. Consistent use of the time-loss injury definition permits comparability between epidemiological studies of injury in professional soccer. However, time loss is a consequence of injury rather than a measure of tissue damage. A major weakness of the time loss definition is the strong subjective component associated with injury. A physical complaint may cause one player to cease participation, whereas another player will continue. Additionally, psychosocial issues may influence individual return-to-play time scales. Utilization of a time-loss injury definition is not free from error. Furthermore, we were unable to acquire exposure data for those players selected for national team training or matches.

Confounding variables such as injury prevention programs were not considered in the inferential statistical analyses. Univariate inferential statistical analyses were used to establish whether hypermobility increases the incidence of injury in professional soccer. Univariate tests analyze the effect of each variable separately.[16] A multivariate statistical approach would have controlled for interactions and confounding risk factors.[2] The small sample size and single-site data collection may reduce the external validity of the findings. A large multisite study utilizing a multivariate statistical approach to evaluate hypermobility as a predictor variable for injury is warranted.

Implications of Findings

Our findings that hypermobility contributes to increasing incidence of injury in professional soccer suggest that professional soccer players should be screened for hypermobility. Identifying hypermobility is important, as it provides clinically relevant information and allows suitable prehabilitative and rehabilitative strategies to be implemented by health care professionals. Exercise programs inclusive of closed kinetic chain movements and enhanced proprioceptive input have been shown to reduce the symptoms of hypermobility.[11] Such an approach may reduce the incidence of injuries in sports participants categorized as hypermobile.

CONCLUSION

There was an increased incidence of injury in hypermobile elite-level professional soccer players from an English Premier League club, resulting in more missed days from training and match play. These findings suggest a need for routine screening for hypermobility in professional soccer.

ACKNOWLEDGMENT

The authors thank the Club Doctor for his assistance in diagnosing participants and the media team for the video analysis of all training sessions and matches.

REFERENCES

1. Arnason A, Sigurdsson S, Gudmundsson A, Holme I, Engebretsen L, Bahr R. Risk factors for injuries in football. *Am J Sports Med.* 2004;32(Suppl 1):5S-16S.
2. Bahr R, Holme I. Risk factors for sports injuries: a methodological approach. *Br J Sports Med.* 2003;37:384-392.
3. Beighton P, Solomon L, Soskolne C. Articular mobility in an African population. *Ann Rheum Dis.* 1973;32:413-418.
4. Boyle K, Witt P, Rigger-Krugh C. Intrarater and interrater reliability of the Beighton and Horan joint mobility index. *J Athl Train.* 2003;38:281-285.
5. Bulbena A, Duro J, Porta M, Faus S, Vallescar R, Martin-Santos R. Clinical assessment of hypermobility of joints: assembling criteria. *J Rheumatol.* 1992;19:115-122.
6. Chunang Y, Chang Y, Hshiao Y, et al. Test-retest reliability and interrater reliability of elbow range of motion measurement. *J Biomech.* 2007;40(Suppl 2):630.
7. Collinge R, Simmonds J. Hypermobility, injury rate and rehabilitation in a professional football squad: a preliminary study. *Phys Ther Sport.* 2009;10:91-96.
8. Decoster LC, Bernier JN, Lindsay RH, Vailas JC. Generalized joint hypermobility and its relationship to injury patterns among NCAA lacrosse players. *J Athl Train.* 1999;34:99-105.
9. Ekstrand J. Epidemiology of football injuries. *Sci Sports.* 2008;23:73-77.
10. Ekstrand J, Hagglund M, Walden M. Epidemiology of muscle injuries in professional football (soccer). *Am J Sports Med.* 2011;39:1226-1232.
11. Ferrell WR, Tennant N, Sturrock RD, et al. Amelioration of symptoms by enhancement of proprioception in patients with joint hypermobility syndrome. *Arthritis Rheum.* 2004;50(10):3323-3328.
12. Fuller CW, Ekstrand J, Junge A, et al. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Scand J Med Sci Sports.* 2006;16:83-92.
13. Hägglund M, Walden M, Ekstrand J. Previous injury as a risk factor for injury in elite football: a prospective study over two consecutive seasons. *Br J Sports Med.* 2006;40:767-772.
14. Hawkins RD, Fuller CW. A prospective epidemiological study of injuries in four English professional football clubs. *Br J Sports Med.* 1999;33:196-203.
15. Hawkins RD, Hulse MA, Wilkinson C, Hodson A, Gibson M. The association football medical research programme: an audit of injuries in professional football. *Br J Sports Med.* 2001;35:43-47.
16. Hicks C. *Research Methods for Clinical Therapists: Applied Project Design and Analysis.* 4th ed. London: Churchill Livingstone; 2005.
17. Norkin C, White D. *Measurement of Joint Motion: A Guide to Goniometry*. Philadelphia: FA Davis; 1995.
18. Östenberg A, Roos H. Injury risk factors in female European football: a prospective study of 123 players during one season. *Scand J Med Sci Sports.* 2000;10:279-285.
19. Pacey V, Nicholson LL, Adams RD, Munn J, Munns CF. Generalized joint hypermobility and risk of lower limb joint injury during sport: a systematic review with meta-analysis. *Am J Sports Med.* 2010;38:1487-1497.
20. Remvig L, Jenson DV, Ward RC. Are diagnostic criteria for general joint hypermobility and benign joint hypermobility syndrome based on reproducible and valid tests? A review of the literature. *J Rheumatol.* 2007;32:798-803.
21. Russek L. Hypermobility syndrome. *Phys Ther.* 1999;79:591-599.
22. Simpson M. Benign joint hypermobility syndrome: evaluation, diagnosis, and management. *J Am Osteopath Assoc.* 2006;106:531-536.
23. Smith R, Damodaran A, Swaminathan S, Campbell R, Barnsley L. Hypermobility and sports injuries in junior netball players. *Br J Sports Med.* 2005;39:628-631.
24. Soderman K, Alfredson H, Pietila T, Werner S. Risk factors for leg injuries in female soccer players: a prospective investigation during one out-door season. *Knee Surg Sports Traumatol Arthrosc*. 2001;9:313-321.
25. Stewart DR, Burden SB. Does generalised ligamentous laxity increase seasonal incidence of injuries in male first division club rugby players? *Br J Sports Med.* 2004;38:457-460.
26. Walden M, Hägglund M, Ekstrand J. Injuries in Swedish elite football: a prospective study on injury definitions, risk for injury and injury pattern during 2001. *Scand J Med Sci Sports.* 2005;15:118-125.
27. Walden M, Hägglund M, Ekstrand J. High risk of new knee injury in elite footballers with previous anterior cruciate ligament injury. *Br J Sports Med.* 2006;40:158-162.
28. Watkins MA, Riddle DL, Lamb RL, Personius WJ. Reliability of goniometric measurements and visual estimates of knee range of motion obtained in a clinical setting. *Phys Ther.* 1991;71:90-97.
29. Wilson GJ, Elliott BC, Wood GA. Stretch shorten cycle performance enhancement through flexibility training. *Med Sci Sports Exerc.* 1992;24:116-123.
30. Woods C, Hawkins RD, Maltby S, Hulse M, Thomas A, Hodson A. The football association medical research programme: an audit of injuries in professional football. Analysis of hamstring injuries. *Br J Sports Med.* 2004;38:36-41.