Self-reported activity level and knee function in amateur football players: the influence of age, gender, history of knee injury and level of competition.

Frobell, Richard; Svensson, E; Göthrick, M; Roos, Ewa

Published in:
Knee Surgery, Sports Traumatology, Arthroscopy

DOI:
10.1007/s00167-008-0509-y

2008

Self-reported activity level and knee function in amateur football players: the influence of age, gender, history of knee injury and level of competition

RB Frobell[1,2], E Svensson[3], M Göthrick[3], EM Roos[1,4]

[1] Dept. of Orthopedics, Clinical Sciences Lund, Lund University, Sweden

[2] Dept. Orthopedics, Helsingborg Hospital, Helsingborg, Sweden

[3] Dept. of Health sciences, Lund University, Lund, Sweden

[4] Institute of Sports Science and Clinical Biomechanics, University of Southern Denmark, Denmark

Corresponding author:

Richard B Frobell

Clinical Sciences Lund, Dept. of Orthopedics

Lund University hospital

221 85 Lund, Sweden

Phone: +46-708-507882, Fax: +46-46-176102

richard.frobell@med.lu.se

Keywords: Soccer, knee injuries, activity level, knee function

ABSTRACT

OBJECTIVE: To investigate if self-reported activity level or knee function are influenced by subject characteristics, level of competition and history of knee injury.

DESIGN: Cross-Sectional study using questionnaires distributed at a personal visit.

PARTICIPANTS: 188 (65 women) amateur football players in 10 football clubs from each division below national level.

MAIN OUTCOME MEASURES: Self-reported Tegner Activity Scale and the Knee injury and Osteoarthritis Outcome Score (KOOS)

RESULTS: Older age, female gender and lower level of competition (football division) were independently associated with lower self-reported Tegner Activity Scale ($p<0.001$). Subjects reporting history of knee injury had significantly worse KOOS scores ($p<0.001$ for all subscales).

CONCLUSIONS: In future studies, a clear description of how the Tegner Activity Scale was administered is recommended. We suggest that self-reported Tegner Activity Scale scores should be adjusted for age, gender and level of competition. In amateur football players, KOOS scores do not need adjustment for age and gender.

INTRODUCTION

There are numerous scales and tools to assess activity level and the most frequently used in the assessment of knee injured subjects is the Tegner Activity Scale.[28] This scale was published in 1985 as an assessor-reported outcome for evaluation of activity level in subjects suffering from anterior cruciate ligament (ACL) injury, and has been widely used also in evaluation of other knee injuries. Increasingly, the Tegner Activity Scale is used as self-reported by patients,[12, 16, 19, 31] and several recent publications did not describe the collection mode.[4, 5, 10, 15, 17, 18, 29] We could however not find any study supporting the use of the Tegner Activity Scale as a self-reported outcome. Football is represented at three different levels of this scale: 10 is equivalent to national level; 9 to competitive level; and 7 to recreational level. Competitive football (level 9) is a wide concept including all divisions below the national league and individual interpretation of this level could vary. Thus, self-reported Tegner Activity Scale scores could be influenced by level of competition but we have not found any studies evaluating this possibility. It has however been suggested that knee-related activity level decreases with increasing age, both in injured subjects and in healthy controls, but adjustment for age in longitudinal studies is currently not recommended.[1, 2, 16, 27]

Patient-reported outcomes are frequently used to assess the patient's perspective of consequences after knee injury and several instruments have been validated during the last decades.[13, 20, 24] One such instrument is the Knee injury and Osteoarthritis Outcome Score (KOOS), validated for ACL reconstruction, meniscectomy and osteoarthritis (OA) after meniscectomy.[24-26] It is known that patient-reported outcomes assessing knee problems vary with age and gender in the general population.[7, 14, 22] However, only 6% of all Swedish football players were over 40 years of age in 2005 (http://www.svenskfotboll.se) and

the influence of age in the age group of 15-40 years have not been sufficiently assessed. Football players are physically active and may thus have better knee function compared to inactive individuals. On the other hand, football players are prone to knee injury and may as a result thereof have worse knee function. Thus, it may not be appropriate to use data from population based studies for physically active young adults.

The objective of this cross sectional study of amateur football players was to investigate if self reported activity level or knee function was influenced by subject characteristics such as age, gender, and Body Mass Index (BMI), level of competition and self-reported history of knee injury. We hypothesized that: 1) Self-reported activity level or knee function are not influenced by person characteristics; 2) Self-report of prior knee injury is associated with lower self-reported activity level and/or worse knee function than a self-report of no prior knee injury in competitive football players.

MATERIAL AND METHODS

Study design

Subjects included in this study form the reference group for comparison of self-reported outcomes in an ongoing randomized controlled trial (RCT) on treatment after acute ACL injury (ISRCTN 84752559, http://www.controlled-trials.com).[8] The study was approved by the Research Ethics Committee at the Faculty of Medicine, Lund University, Sweden (LU 535-01). Signed informed consent was collected prior to inclusion of subjects. Questionnaires were distributed and collected at personal visits during the pre-season of 2005. At the personal visit, performed by two of the authors (ES, MG), all subjects were given the same information verbally and in writing.

Subjects

We sought to include only currently active amateur football players and thus players active in organized competitive football on a sub-professional level were approached (Tegner Activity Scale 9). Consequently, national league (Allsvenskan) football players (Tegner Activity Scale 10) were not eligible for inclusion. Amateur football in Sweden is organized in divisions although the range of divisions differs between geographic regions depending on the number of teams per region. The 1st division represents the highest level. In this study the 6th division was the lowest for men and the 4th division the lowest for women. Teams from each eligible division (1 and lower), finishing on 4th – 8th place the previous season were eligible for inclusion. One team from each division was included and all team members presented by each coach were eligible for inclusion. Teams close to Lund University were prioritized for geographic reasons. Ten teams were contacted by the investigators and all teams accepted to participate. A total of 235 subjects were eligible for inclusion and 188 (80%) attended the personal visit, table 1.

Table 1. Mean age and BMI, self-reported history of knee injury, and median self-reported Tegner Activity Scale scores given by football division and gender.

Division	Gender	Subjects	Age	BMI	History of knee injury n (%)		Tegner score (Range)
		n	years (SD)	kg/m^2 (SD)	Minor	Severe	
1	Male	18	24.0 (5.1)	23.8 (1.5)	4 (22)	4 (22)	9 (8-10)
2	Male	18	19.7 (3.2)	23.3 (2.1)	2 (11)	3 (17)	9 (7-10)
3	Male	19	22.6 (3.6)	23.4 (1.7)	3 (16)	5 (26)	9 (7-9)
4	Male	25	21.5 (4.5)	24.1 (2.0)	2 (8)	8 (32)	9 (7-10)
5	Male	26	22.6 (4.4)	23.4 (1.7)	3 (12)	11 (42)	9 (6-10)
6	Male	17	22.7 (3.4)	24.1 (1.9)	0	4 (24)	9 (4-10)
Σ	Males	123	22.2 (4.0)	23.7 (1.8)	14 (11)	35 (29)	9 (4-10)
1	Female	20	20.0 (3.3)	22.5 (2.1)	2 (10)	6 (30)	9 (7-9)
2	Female	14	15.9 (1.0)	21.5 (1.5)	2 (14)	2 (14)	10 (8-10)
3	Female	15	24.5 (3.5)	22.7 (2.4)	4 (27)	1 (7)	9 (7-9)
4	Female	16	22.5 (5.6)	21.4 (2.2)	4 (25)	0	7 (3-9)
Σ	Females	65	20.9 (3.4)	22.2 (2.1)	12 (19)	9 (14)	9 (5-10)
Total		**188**	**21.6 (3.7)**	**23.0 (2.0)**	**26 (14)**	**44 (23)**	**9 (3-10)**

The Tegner Activity Scale

The Tegner Activity Scale was developed for assessment of activity level with regard to knee function.[28] It is a numeric scale ranging from 1 to 10 where 1 is the least strenuous activity for the knee and 10 is the hardest. This scale was initially developed as an assessor-reported scale although in this study self-reported scores were obtained in conformity with some previous publications.[12, 16, 19, 31] Subjects were instructed, both verbally and in writing, to mark the Tegner Activity Scale score best describing their current level of activity.

Knee injury and Osteoarthritis Outcome Score (KOOS)

Self-reported knee function was obtained by the KOOS.[24, 26] The KOOS is a 42-item self-administered questionnaire with five separate sub-scales: pain, symptoms, activities of daily living (ADL), sport and recreation function (Sport/Rec), and knee-related quality of life (QOL). Standardized answer options are given in Likert boxes and each answer is scored from 0 to 4. Sub-scale scores are calculated (www.koos.nu) and given separately, ranging from 0 to 100 where 100 is the best possible result. The KOOS has among other interventions been validated for use in patients having ACL-reconstruction and arthroscopic surgery.[24, 26]

Previous knee injury

A history of previous knee injury (lifetime) was self-reported and registered with a previously published 'injury card'.[3, 11, 30] Information about year, type, injured side, diagnostic method, and treatment was collected. One 'injury card' per injury was used and consequently more than one card could be registered for each individual. Information about year and type of injury (diagnosis) was collected as well as diagnostic assessment tool and treatment. Traumatic injuries, such as anterior- and posterior cruciate ligament injuries (ACL/PCL), meniscal injuries and medial- and lateral collateral ligament injuries (MCL/LCL) were classified as severe knee injuries.[3, 11, 30] In addition, we classified patellar dislocations and patellar fractures as severe knee injuries. Contusions, wounds and overuse injuries, such as runner's knee, patello-femoral pain syndrome, tendonitis etc., were classified as minor knee injuries.

Height, weight, age, and gender were self reported. Body Mass Index (BMI) was calculated using the formula: Weight (kg) / (Height (m))^2.

Statistical analysis

For continuous variables, mean and standard deviation (SD) were reported and for the Tegner Activity Scale, a nominal scale, median and range were given. The KOOS was calculated according to the principles in the user's manual (available at www.koos.nu) and given as mean (SD). Comparisons of KOOS data between those reporting a history of minor- and severe knee injury was made using the T-test. Independent associations were made using General Linear Models.

.

RESULTS

Self-report of knee injuries

We registered 81 self-reported knee injuries in 188 individuals, 11 subjects reported two knee injuries. The majority of injuries (88%) were diagnosed by a medical doctor (n=42), arthroscopy (18) or magnetic resonance imaging (MRI) (11). Fifty-five knee injuries, reported by 44 subjects, were classified as severe and 26 injuries, reported by 26 subjects were classified as minor knee injuries.

A history of severe knee injury was associated with worse KOOS scores than a history of minor knee injury and no history of knee injury (Figure 1). However, there was no statistically significant difference in KOOS scores between subjects with a prior severe or minor knee injury ($p>0.073$) and thus history of knee injury, severe or minor, was used as one single variable in the further analyses.

Tegner Activity Scale scores

For the entire group a median Tegner Activity Scale score of 9 (3-10) was found, reflecting the expected average score for amateur football players. In a first multivariate model including age, gender and BMI, age ($p<0.001$) and gender ($p=0.019$) were found to be associated with self reported Tegner Activity Scale score. Thus, age and gender were, included in a second multivariate model with level of competition and history of knee injury. We found older age, female gender and lower level of competition, adjusted for each other, to be associated with significantly worse self-reported Tegner Activity Scale scores ($p\leq0.001$ for all variables). Twenty one percent of the variation in Tegner Activity Scale score was explained by this model (R^2=21%). There was no association between Tegner Activity Scale score and the history of knee injury ($p=0.962$). A decrease of 0.8 (95%CI 0.4, 1.1) on the Tegner Activity Scale was seen for each ten year period of older age. Females scored 0.7 (0.4, 1.0) lower than males and each step lower in division was associated with a 0.2 (0.1, 0.3) decrease in Tegner Activity Scale score. Unadjusted self-reported Tegner Activity Scale scores for men and women and by division are given in figure 2.

KOOS

For future use as reference data, KOOS scores are given in table 2.

Table 2. KOOS scores given as mean, standard deviation (SD), median, (95% confidence interval (CI) of the mean) for men, women and the total study population.

KOOS subscales	Mean score, SD, median (95% CI of the mean)		
	Men	Women	Total
Pain	n=123	n=65	N=188
	93.2	94.1	93.5
	11.2	9.7	10.7
	100	100	100
	(91.1-95.2)	(91.9-96.6)	(92.0-95.1)
Symptoms	n=122	n=65	N=187
	86.6	90.5	87.9
	14.8	11.2	13.8
	89.3	92.9	92.9
	(83.9-89.2)	(87.7-93.2)	(86.0-89.9)
ADL	n=122	n=65	N=187
	95.6	96.5	95.9
	9.3	7.2	8.6
	100	100	100
	(93.9-97.2)	(94.8-98.3)	(94.7-97.1)
Sports & Recreation	n=123	n=65	N=188
	88.5	89.2	88.7
	17.1	16.3	16.8
	95	100	97.5
	(85.4-91.5)	(85.3-93.3)	(86.4-91.2)
QOL	n=123	n=65	N=188
	86.5	89.7	87.7
	18.2	15.1	17.2
	93.8	93.8	93.8
	(83.3-89.8)	(86.2-93.6)	(85.3-90.2)

In a first multivariate model including age, gender and BMI we found no influence on any of the KOOS subscale scores ($p>0.073$) and this model explained less or equal to 3% of the variation in any of the five KOOS subscales ($R^2 \leq 0.03$). Thus, only level of competition (football division), history of knee injury and self-reported Tegner Activity Scale score were included in the second multivariate model. Self-reported history of knee injury was associated with significantly worse scores of all five KOOS subscales ($p<0.001$) and alone explained 32.6% of the variation in knee related QOL. The KOOS sub-scale 'symptoms' was reduced by 1.4 points for each step lower in division ($p=0.014$) and division explained 2.5% of the

variation in this model. The self-reported Tegner Activity Scale score did not influence any of the KOOS subscale scores (Table 3).

Table 3. Potential factors influencing self reported knee function (KOOS). All variables are adjusted for each other and coefficient of determination (R^2) is given for each model (N=188)

	Level of competition (Division 1-6)	History of knee injury (yes/no)	Tegner Activity Scale (0-10)	R^2 (%)
KOOS				
Pain	0.12 (-0.77, 1.0)	-10.4 (-13.3, -7.6) †	-0.13 (-1.4, 1.1)	22
Symptoms	-1.4 (-2.5, -0.3) *	-13.3 (-16.9, -9.7) †	- 0.1 (-1.7, 1.5)	24
ADL	-0.2 (-0.9, 0.6)	-5.5 (-8.0, -3.0) †	-0.3 (-1.4, 0.8)	10
Sports & Rec	0.3 (-1.1, 1.7)	-15.9 (-20.3, -11.4)†	0.4 (-1.6, 2.4)	21
QOL	-0.2 (-1.5, 1.1)	-20.4 (-24.6, -16.2)†	0.8 (-1.1, 2.6)	33

† = $p \leq 0.001$
* = $p<0.05$

DISCUSSION

In this cross sectional study on amateur football players we found that self-reported activity level was influenced by age, gender, and level of competition (football division) but not by history of knee injury. Self-reported KOOS scores on the other hand were dependent on history of knee injury but not on age, gender, or level of competition.

The Tegner Activity Scale was developed and validated as an assessor-reported outcome, [28]although an increasing use of self-reported Tegner Activity Scale scores was found. [12, 16, 19, 31] Further, several publications failed to report how the Tegner Activity Scale score was administered, [4, 5, 10, 15, 17, 18, 29] and a recent report on reliability, validity and responsiveness of the Tegner Activity Scale did not clearly state if the score was assessor- or patient-administered. [6] We show that older age, female gender and lowered level of competition, adjusted for each other, were associated with worse self-reported Tegner

Activity Scale scores. Identical instructions to mark the score best describing the individual current level of activity were given to all subjects, both verbally and in writing. Thus, incomplete instructions to the users were not likely to explain associations found in this study. Since self-report of the Tegner Activity Scale seems to be associated with altered measurement properties, the results of this study suggest that comparison of cross-sectional studies where different administration modes have been employed cannot be performed without adjustments. This is important as the Tegner Activity Scale is frequently used to describe study populations. However, the scale is also used to assess treatment effect after knee injury. In our study, longitudinal information was not obtained although, most likely, adjustments are needed also in longitudinal studies when comparing treatment effects to allow for different administration modes between studies. Another implication for longitudinal studies is the importance of keeping the same administration mode at all time points. On common scenario, a baseline clinical visit followed by mailed questionnaires, may yield a worse treatment outcome compared to if all assessments were performed by an assessor.

Self-reported knee function according to KOOS was not influenced by age, gender or BMI contradicting previous reports where age and gender related differences have been reported.[22] Our population was young and homogenous with regard to physical activity with a mean age of 22 years, ranging from 14 to 39 years, and large variations in knee function within this group may thus not be likely. However, knee injuries are common in football and thus a worse than population norm knee function may be possible.
We found a decrease of 1.4 points in the KOOS subscale symptoms for each step lower in division. However, the minimal clinically important difference for the KOOS was suggested to be 8-10 points, [23] and thus this decrease was clinically non-significant for small changes in division. However, large changes in division (i.e. division 1 to 6) could possibly result in a

clinically significant difference (8.4 points) in the symptoms subscale although this would only be applicable in men since women were only assessed in the division range 1-4. We did not find any association with gender and thus these findings need to be confirmed in future studies with larger sample size.

Amateur football players report better KOOS scores in some subscales compared to age and gender matched groups from a previously published population based study.[22] This indicates that KOOS scores from a population-based sample are not comparable to KOOS scores derived from persons of the same age group but with a physically active lifestyle. Normative data for different groups of people needs to be presented and KOOS data presented here should be used for comparison in studies assessing knee injuries in physically active young adults.

In addition, the results from this study suggest that the ability to participate in amateur football after knee injury may not automatically reflect symptom relief. On the other hand, poor knee function may not necessarily reflect inability to participate in amateur football. Thus, it could be emphasized that return to amateur football play, a commonly used outcome in sports medicine, does not necessarily reflect treatment success with regard to knee function or knee symptoms. The assessment of treatment effect after knee injury remains a challenge and we suggest the use of separate outcomes to assess activity level and self-reported knee function in studies on treatment effects after knee injury. Our cross-sectional design prevents us from making more firm recommendations and we suggest future longitudinal studies to further explore this area.

This study, based on a large sample of amateur football players, has several limitations. Firstly, the cross sectional design prevented us from conclusions referable to longitudinal studies. Secondly, the history of knee injury was self-reported and recall bias was likely introduced. Recent reports suggest that the recall of injuries is good up to 12 months after injury although minor injuries were most likely underestimated.[9, 21] Here, we present the recall of lifetime injuries and thus our findings were likely underestimated. However, the self-report of severe injuries were more likely to be less underestimated than the frequency of minor knee injuries. In consistency with these limitations, the results from this study needs to be confirmed in prospective longitudinal studies.

CONCLUSION

In future studies, a clear description of how the Tegner Activity Scale was administered is recommended. We suggest that self-reported Tegner Activity Scale scores should be adjusted for age, gender and level of competition. In amateur football players KOOS scores do not need adjustment for age and gender.

ACKNOWLEDGEMENTS

The authors are grateful to the Thelma Zoegas foundation, Stig & Ragna Gorthon Research foundation, the Swedish National Centre for research in Sports and the Swedish Research Council for supporting this study. We would also like to acknowledge Jan-Åke Nilsson for his contribution in the statistical analysis of this report.

COMPETING INTEREST

Nothing to declare

REFERENCES

1 Ageberg E, Zatterstrom R, Friden T, et al. Individual factors affecting stabilometry and one-leg hop test in 75 healthy subjects, aged 15-44 years. *Scand J Med Sci Sports*. 2001;**11**:47-53.

2 Andersson-Molina H, Karlsson H, Rockborn P. Arthroscopic partial and total meniscectomy: A long-term follow-up study with matched controls. *Arthroscopy*. 2002;**18**:183-9.

3 Arnason A, Sigurdsson SB, Gudmundsson A, et al. Risk factors for injuries in football. *Am J Sports Med*. 2004;**32**:5S-16S.

4 Asik M, Sen C, Tuncay I, et al. The mid- to long-term results of the anterior cruciate ligament reconstruction with hamstring tendons using Transfix technique. *Knee Surg Sports Traumatol Arthrosc*. 2007.

5 Barrett G, Stokes D, White M. Anterior cruciate ligament reconstruction in patients older than 40 years: allograft versus autograft patellar tendon. *Am J Sports Med*. 2005;**33**:1505-12.

6 Briggs KK, Kocher MS, Rodkey WG, et al. Reliability, validity, and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. *J Bone Joint Surg Am*. 2006;**88**:698-705.

7 Demirdjian AM, Petrie SG, Guanche CA, et al. The outcomes of two knee scoring questionnaires in a normal population. *Am J Sports Med*. 1998;**26**:46-51.

8 Frobell RB, Lohmander LS, Roos EM. The challenge of recruiting patients with anterior cruciate ligament injury of the knee into a randomized clinical trial comparing surgical and non-surgical treatment. *Contemp Clin Trials*. 2007;**28**:295-302.

9 Gabbe BJ, Finch CF, Bennell KL, et al. How valid is a self reported 12 month sports injury history? *Br J Sports Med*. 2003;**37**:545-7.

10 Gobbi A, Francisco R. Factors affecting return to sports after anterior cruciate ligament reconstruction with patellar tendon and hamstring graft: a prospective clinical investigation. *Knee Surg Sports Traumatol Arthrosc*. 2006;**14**:1021-8.

11 Hagglund M, Walden M, Bahr R, et al. Methods for epidemiological study of injuries to professional football players: developing the UEFA model. *Br J Sports Med*. 2005;**39**:340-6.

12 Herrlin S, Hallander M, Wange P, et al. Arthroscopic or conservative treatment of degenerative medial meniscal tears: a prospective randomised trial. *Knee Surg Sports Traumatol Arthrosc*. 2007;**15**:393-401.

13 Irrgang JJ, Snyder-Mackler L, Wainner RS, et al. Development of a patient-reported measure of function of the knee. *J Bone Joint Surg Am*. 1998;**80**:1132-45.

14 Jinks C, Jordan K, Croft P. Measuring the population impact of knee pain and disability with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). *Pain*. 2002;**100**:55-64.

15 Karataglis D, Bisbinas I, Green MA, et al. Functional outcome following reconstruction in chronic multiple ligament deficient knees. *Knee Surg Sports Traumatol Arthrosc*. 2006;**14**:843-7.

16 Kostogiannis I, Ageberg E, Neuman P, et al. Activity Level and Subjective Knee Function 15 Years After Anterior Cruciate Ligament Injury: A Prospective, Longitudinal Study of Nonreconstructed Patients. *Am J Sports Med*. 2007.

17 Laxdal G, Sernert N, Ejerhed L, et al. A prospective comparison of bone-patellar tendon-bone and hamstring tendon grafts for anterior cruciate ligament reconstruction in male patients. *Knee Surg Sports Traumatol Arthrosc*. 2007;**15**:115-25.

18 Marder RA, Hopkins G, Jr., Timmerman LA. Arthroscopic microfracture of chondral defects of the knee: a comparison of two postoperative treatments. *Arthroscopy*. 2005;**21**:152-8.

19 Mithoefer K, Williams RJ, 3rd, Warren RF, et al. High-impact athletics after knee articular cartilage repair: a prospective evaluation of the microfracture technique. *Am J Sports Med*. 2006;**34**:1413-8.

20 Mohtadi N. Development and validation of the quality of life outcome measure (questionnaire) for chronic anterior cruciate ligament deficiency. *Am J Sports Med*. 1998;**26**:350-9.

21 Moshiro C, Heuch I, Astrom AN, et al. Effect of recall on estimation of non-fatal injury rates: a community based study in Tanzania. *Inj Prev*. 2005;**11**:48-52.

22 Paradowski PT, Bergman S, Sunden-Lundius A, et al. Knee complaints vary with age and gender in the adult population. Population-based reference data for the Knee injury and Osteoarthritis Outcome Score (KOOS). *BMC musculoskeletal disorders*. 2006;**7**:38.

23 Roos EM, Lohmander LS. The Knee injury and Osteoarthritis Outcome Score (KOOS): from joint injury to osteoarthritis. *Health Qual Life Outcomes*. 2003;**1**:64.

24 Roos EM, Roos HP, Ekdahl C, et al. Knee injury and Osteoarthritis Outcome Score (KOOS)--validation of a Swedish version. *Scand J Med Sci Sports*. 1998;**8**:439-48.

25 Roos EM, Roos HP, Lohmander LS. WOMAC Osteoarthritis Index--additional dimensions for use in subjects with post-traumatic osteoarthritis of the knee. Western Ontario and MacMaster Universities. *Osteoarthritis Cartilage*. 1999;**7**:216-21.

26 Roos EM, Roos HP, Lohmander LS, et al. Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure. *J Orthop Sports Phys Ther*. 1998;**28**:88-96.

27 Roos H, Ornell M, Gardsell P, et al. Soccer after anterior cruciate ligament injury--an incompatible combination? A national survey of incidence and risk factors and a 7-year follow-up of 310 players. *Acta Orthop Scand*. 1995;**66**:107-12.

28 Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop*. 1985;43-9.

29 Thomee P, Wahrborg P, Borjesson M, et al. Self-efficacy, symptoms and physical activity in patients with an anterior cruciate ligament injury: a prospective study. *Scand J Med Sci Sports*. 2007;**17**:238-45.

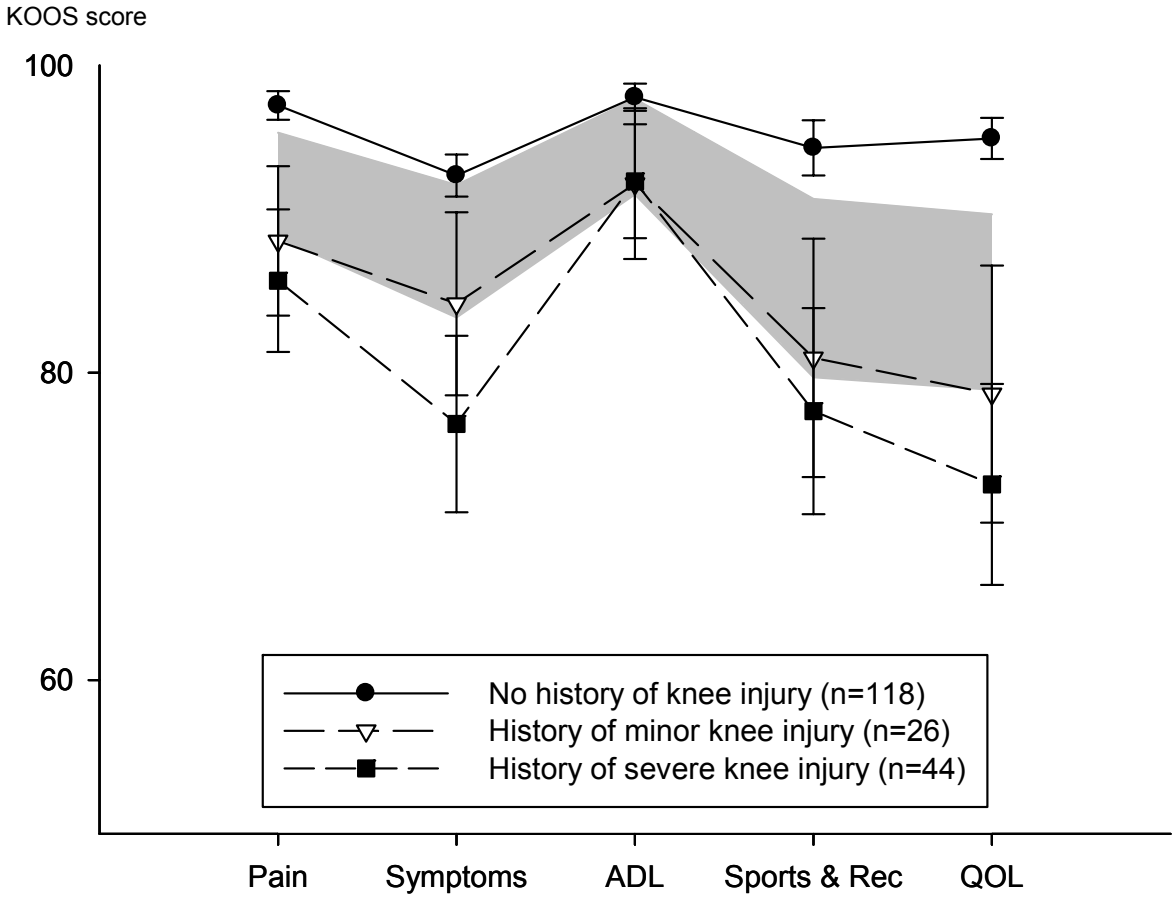
30 Walden M, Hagglund M, Ekstrand J. UEFA Champions League study: a prospective study of injuries in professional football during the 2001-2002 season. *Br J Sports Med*. 2005;**39**:542-6.

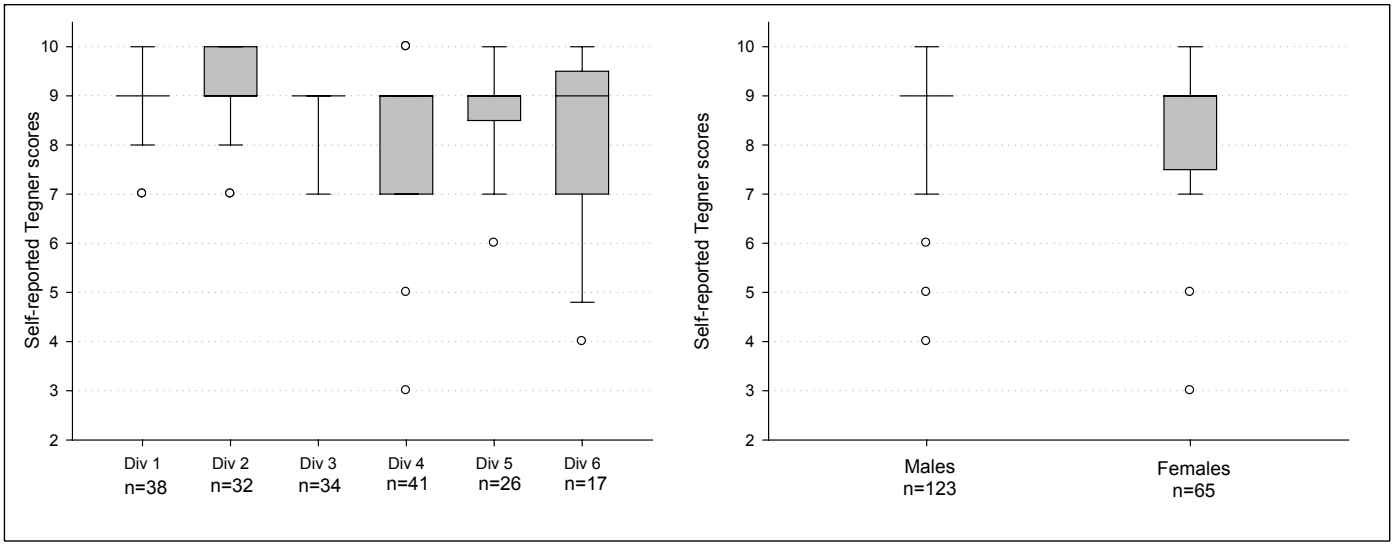
31 Voloshin I, Schmitz MA, Adams MJ, et al. Results of repeat meniscal repair. *Am J Sports Med*. 2003;**31**:874-80.

Figure legends

Figure 1. Mean KOOS scores (95% CI) of the subscales pain, symptoms, activities of daily living (ADL), Sports and Recreation (Sports & Rec) and knee related quality of life (QOL). Shadowed area (grey) represents 95% CI of a previously published population based reference group (age 18-34).[23]

Figure 2. Self-reported Tegner activity level by football division (left) and gender (right) (N=188). Box area represents 25^{th} and 75^{th} quartile separated by a line representing the median value. Whiskers represent the 10^{th} and 90^{th} percentile and circles represent subjects outside this interval.


KOOS score
100
80
60
Pain
Symptoms
ADL
Sports & Rec
QOL
No history of knee injury (n=118)
History of minor knee injury (n=26)
History of severe knee injury (n=44)


Self-reported Tegner scores
10
9
8
7
6
5
4
3
2
Div 1
n=38
Div 2
n=32
Div 3
n=34
Div 4
n=41
Div 5
n=26
Div 6
n=17
Self-reported Tegner scores
Males
n=123
Females
n=65