

***A User's Guide to:***  
**Knee injury and Osteoarthritis Outcome Score**  
**KOOS**

KOOS is developed as an instrument to assess the patients opinion about their knee and associated problems.

KOOS is intended to be used for knee injury that can result in post traumatic osteoarthritis (OA); i.e. ACL (anterior cruciate ligament) injury, meniscus injury, chondral injury, etc.

KOOS is meant to be used over short and long time intervals; to assess changes from week to week induced by treatment (medication, operation, physical therapy) or over years due to the primary injury or post traumatic OA.

KOOS can be used to assess groups and to monitor individuals.

KOOS content validity was ensured through literature search, a pilot study and an expert panel (US and Sweden); patients, orthopedic surgeons and physical therapists.

KOOS consists of 5 subscales; **Pain**, other **Symptoms**, **Function in daily living (ADL)**, **Function in sport and recreation (Sport/Rec)** and **knee related Quality of life QOL**. The last week is taken into consideration when answering the questions. Standardized answer options are given (5 Likert boxes) and each question gets a score from 0 to 4. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated *for each subscale*. The result can be plotted as an outcome profile.

KOOS is patient-administered, the format is user friendly, and takes about 10 minutes to fill out.

KOOS is self-explanatory and can be administered in the waiting room or used as a mailed survey.

KOOS has been used in patients 14-78 years old.

KOOS reference values from a group of 50 subjects (mean 53 years, 37-79) with no previous and no current clinical signs of injury to the ACL or menisci and no radiographic signs of OA has been established [1].

KOOS has high test-retest reproducibility (ICC >0.75).

KOOS includes WOMAC Osteoarthritis Index LK 3.0 [2] in its complete and original format (with permission), and WOMAC scores can be calculated. WOMAC is valid for elderly subjects with knee OA.

KOOS construct validity has been determined in comparison with SF-36 [3, 4] and expected correlations were found [5-7]. Moderates to high correlations were found when comparing to the Lysholm knee scoring scale [6].

KOOS subscales "Sport and Recreation function" and "Quality of Life" were more sensitive and discriminative than the WOMAC subscales "Pain", "Stiffness", and "Function" when studied in subjects meniscectomized 21 years ago and with definite radiographic signs of OA (mean 57 years, 38-76) compared to age- and gendermatched controls [8].

KOOS responsiveness has been determined in three separate studies. Significant improvement was found after reconstruction of the ACL [7], after physical therapy [7], three months after arthroscopic partial meniscectomy [6] and 6 months after total knee replacement [5]. High effect sizes (mean score change/preoperative SD) were found, indicating fewer subjects needed to yield statistically significant differences.

KOOS validation work is ongoing. KOOS is currently being used in several clinical studies involving patients with meniscus injury, ACL-injury, cartilage injury, and post-traumatic osteoarthritis (for current update search PubMed using "KOOS + knee"). Several methodological papers regarding the KOOS have been published [5-8].

KOOS is currently available in the following versions, American-English, Swedish, Danish, and German. Unvalidated versions in Italian and Russian are available. The validation work of French and Spanish versions are ongoing.

KOOS information can be required from:

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## REFERENCES

1. EM Roos, M Klassbo, LS Lohmander: **WOMAC osteoarthritis index. Reliability, validity, and responsiveness in patients with arthroscopically assessed osteoarthritis. Western Ontario and MacMaster Universities.** *Scand J Rheumatol* 1999, **28**:210-5.
2. N Bellamy, WW Buchanan, CH Goldsmith, J Campbell, LW Stitt: **Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee.** *J Rheumatol* 1988, **15**:1833-40.
3. JE Ware, Jr., CD Sherbourne: **The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection.** *Med Care* 1992, **30**:473-83.
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5. E Roos, S Toksvig-Larsen: **Knee injury and Osteoarthritis Outcome Score (KOOS) -validation and comparison to the WOMAC in total knee replacement.** *Health and Quality of Life Outcomes* 2003, **1**.
6. EM Roos, HP Roos, C Ekdahl, LS Lohmander: **Knee injury and Osteoarthritis Outcome Score (KOOS)--validation of a Swedish version.** *Scand J Med Sci Sports* 1998, **8**:439-48.
7. EM Roos, HP Roos, LS Lohmander, C Ekdahl, BD Beynnon: **Knee Injury and Osteoarthritis Outcome Score (KOOS)--development of a self-administered outcome measure.** *J Orthop Sports Phys Ther* 1998, **28**:88-96.
8. EM Roos, HP Roos, LS Lohmander: **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.

## KOOS Reference data - ACL-reconstruction, meniscectomy, and post-traumatic OA

KOOS has been used in studies of anterior cruciate ligament (ACL) injury, meniscus injury, and post-traumatic osteoarthritis (OA). KOOS scores from three of these studies are given to enable KOOS-users to get familiar with the score. **To make scientific comparisons, use to the original articles referred to in each section!** The data is visualized in graphs. The mean scores for all five subscales are given and connected with a line which gives a **KOOS Profile**. 0 indicates extreme problems and 100 indicate no problems.

### ACL data

(From: Roos E, Roos H, Lohmander LS, Ek Dahl C, Beynnon B. Knee injury and Osteoarthritis Outcome Score (KOOS) - Development of a self-administered outcome measure. *The Journal of Orthopaedic and Sports Physical Therapy* 78(2)88-96, 1998. In figure 1 data is given for 21 American subjects (9 males and 12 females) with ACL injury about to undergo reconstruction. Ten of the subjects had a combined meniscus injury. Their mean age was 32 (range 18 to 46). The majority had sustained their knee injury less than 6 months prior to operation. Ten subjects were competing in sports and nine were recreational athletes.

**Interpretation:** The Sport/Rec and Quality of Life subscales are the most sensitive subscales pre-operatively and changes the most post-operatively. ACL-injury affect daily life (ADL) little, and there is little room for improvement in this subscale. The Symptom score of 91 one year after reconstruction is primarily due to lack of full knee flexion. As known from clinical experience, pain is not a major symptom of ACL injury. The score of 80 pre-operatively can be due to ten subjects having an associated meniscus injury. When considering Pain, Symptoms, ADL and Sport/Rec the subjects can be considered having very little problems one year after surgery. They are mentally still aware of their knee though, as seen by a score of 75 in the subscale Quality of Life.

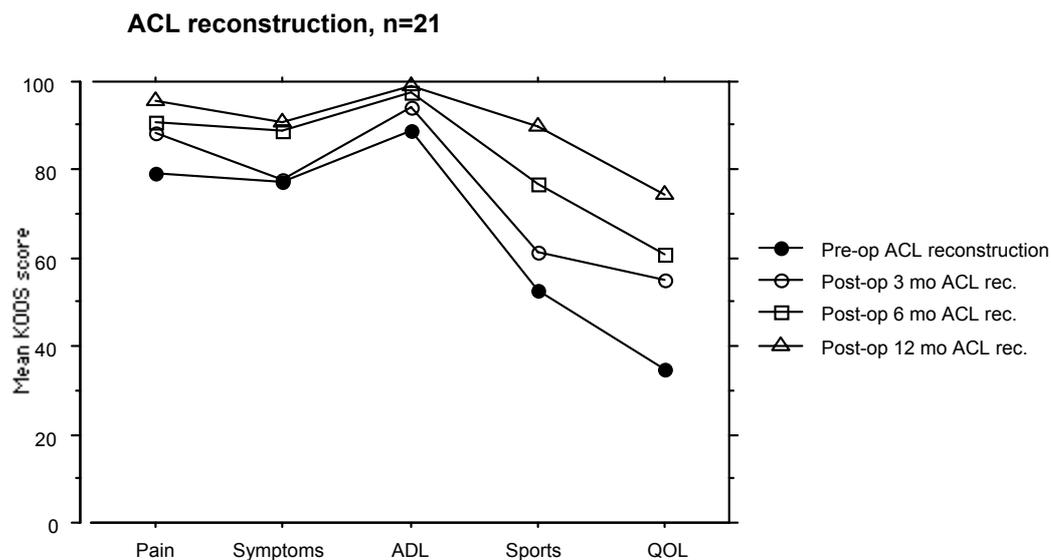


Figure 1. ACL reconstruction

## Meniscus data

(From: Roos E, Roos H, Ekdahl C, Lohmander LS. Knee injury and Osteoarthritis Outcome Score (KOOS) - validation of a Swedish version. *Scandinavian Journal of Medicine and Science in Sports*: 8, 439-448, 1998.

In figure 2, data from 95 Swedish subjects (33 females) having an arthroscopic partial meniscectomy is reported. Their mean age was 42, ranging from 14 to 75. Mean duration of symptoms was one year, ranging from three months to more than 10 years. Approximately 50% had isolated tears, 25% had an associated ACL-injury, and 25% had associated cartilage damage.

**Interpretation:** A meniscus injury is associated with pain and symptoms such as limited range of motion, swelling, noise and catching. Pre-operatively, low scores are seen in all scales. The KOOS profile 3 months post-operatively is comparable to the pre-operative profile of ACL reconstruction, with the exception of Quality of Life. It is surprising to see that the subjects still have significant problems three months after a meniscectomy. As previously seen in the ACL-group the subjects report more problems with Sport and Recreation Function and Quality of Life than with the other subscales. This is interesting since the other subscales (Pain, Symptoms and ADL) are the ones usually assessed clinically. When taking associated injuries into consideration, cartilage changes seen at arthroscopy was associated with generally lower scores, while an associated ACL injury was associated with generally higher scores. The pre- and post-operative profiles for isolated meniscus were very similar to the profiles in figure 2.

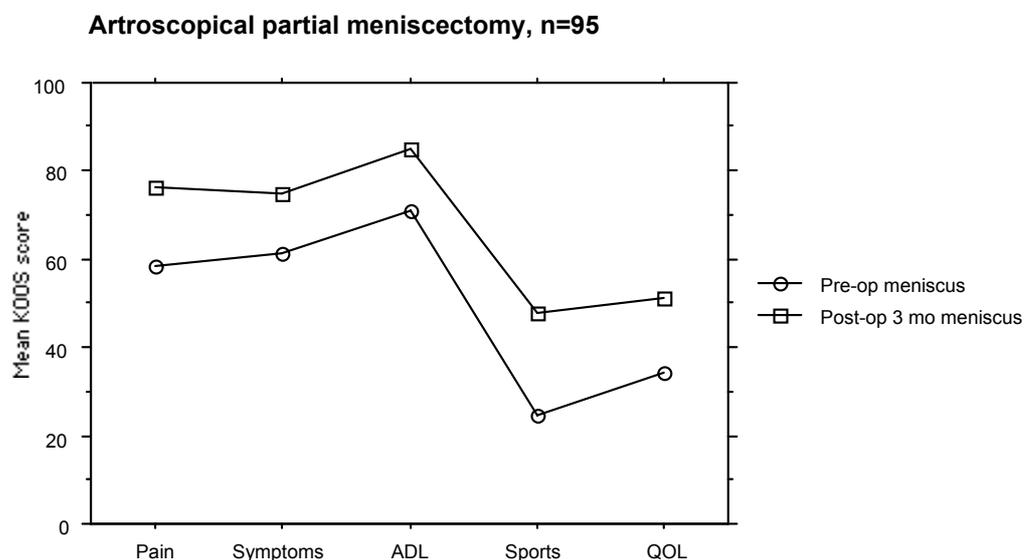


Figure 2. Meniscus data

**OA data**

*(From: Roos E, Roos H, Lohmander LS. WOMAC Osteoarthritis Index - additional dimensions for use in post-traumatic osteoarthritis of the knee. Osteoarthritis and Cartilage: 7(3),216-221, 1999.)*

A cohort operated on with open meniscectomy 21 years ago was asked to participate in a follow-up study. In figure 3 data from 41 subjects with radiological OA (defined as Kellgren and Lawrence  $\geq 2$ ) is compared to 50 subjects without radiographic OA from an age and sex-matched control group without known injury to the menisci or ACL, or radiographic OA. Mean age of the OA group was 57 years (range 38-76).

**Interpretation:** Statistical differences between the groups were found for all five subscales. However the Sport and Recreation and Quality of Life subscales are more discriminative than the other subscales. Symptom is the subscale scoring the lowest in the control group, primarily due to reported grinding, clicking or other noise from the knee. The profile of the post-meniscectomy OA group operated on 21 years ago can roughly be compared to the profile of the post-meniscectomy group operated on 3 months ago. It must be remembered that the subjects in the 21 year post-meniscectomy group were not patients seeking medical care for their knee problems but taking part in a follow-up study. The only criterion used to define OA was positive radiography (Kellgren and Lawrence  $\geq 2$ ).

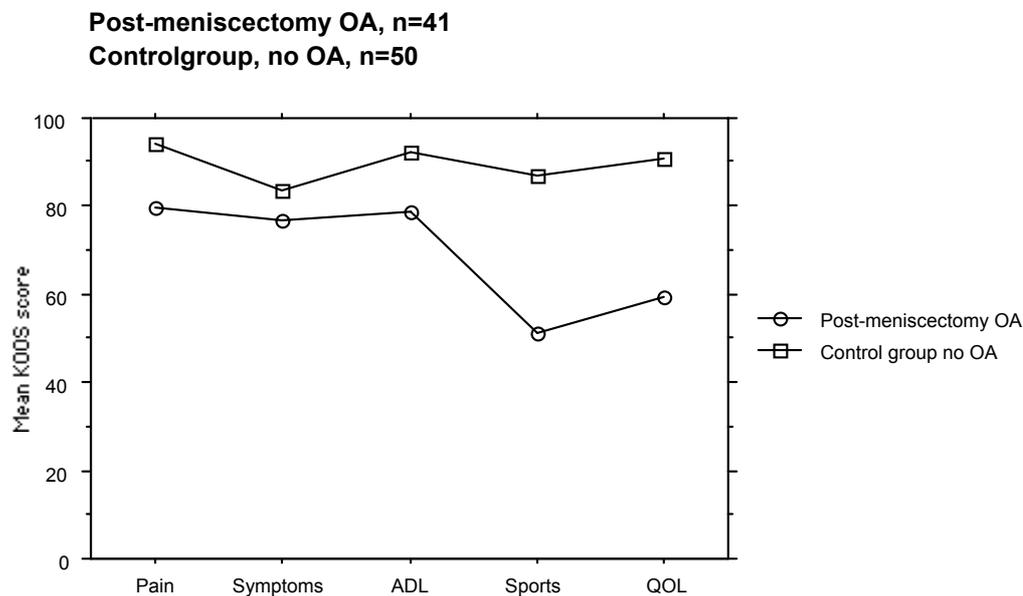


Figure 3. Post-traumatic OA versus an age and sex-matched control group without OA.

## KOOS *Manual scoring sheet*

**Instructions:**

Assign the following scores to the boxes!

None	Mild	Moderate	Severe	Extreme
<input type="checkbox"/>				
0	1	2	3	4

Missing data. If a mark is placed outside a box, the closest box is chosen. If two boxes are marked, that which indicated the more severe problems is chosen. Missing data are treated as such; one or two missing values are substituted with the average value for that subscale. If more than two items are omitted, the response is considered invalid and no subscale score is calculated.

Sum up the total score of each subscale and divide by the possible maximum score for the scale. Traditionally in orthopedics, 100 indicates no problems and 0 indicates extreme problems. The normalized score is transformed to meet this standard. Please use the formulas provided for each subscale!

$$1. \text{ PAIN} \quad 100 - \frac{\text{Total score P1-P9} \times 100}{36} = 100 - \frac{\quad}{36} = \underline{\quad}$$

$$2. \text{ SYMPTOMS} \quad 100 - \frac{\text{Total score S1-S7} \times 100}{28} = 100 - \frac{\quad}{28} = \underline{\quad}$$

$$3. \text{ ADL} \quad 100 - \frac{\text{Total score A1-A17} \times 100}{68} = 100 - \frac{\quad}{68} = \underline{\quad}$$

$$4. \text{ SPORT\&REC} \quad 100 - \frac{\text{Total score SP1-SP5} \times 100}{20} = 100 - \frac{\quad}{20} = \underline{\quad}$$

$$5. \text{ QOL} \quad 100 - \frac{\text{Total score Q1-Q4} \times 100}{16} = 100 - \frac{\quad}{16} = \underline{\quad}$$

## **WOMAC How to score from the KOOS**

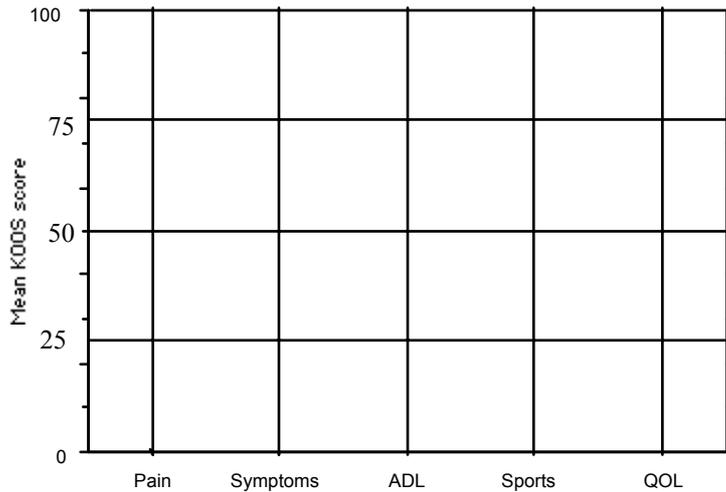
Assign scores from 0 to 4 to the boxes as shown above. To get original WOMAC scores sum the item scores for each subscale. If you prefer percentage scores in accordance with the KOOS, use the formula provided below to convert the original WOMAC scores.

$$\text{Transformed scale} = 100 - \frac{\text{actual raw score} \times 100}{\text{Possible raw score range}}$$

WOMAC subscores	Original score = sum of the following items	Possible raw score range
Pain	P5-P9	20
Stiffness	S6-S7	8
Function	A1-A17	68

## KOOS Profile

To visualize differences in the five different KOOS subscores and change between different administrations of the KOOS (e.g. pre-treatment to post-treatment), KOOS Profiles can be plotted.



**Legend**

Symbol/color	Description (pre-treatment, post-treatment etc)	Date

Name: \_\_\_\_\_