

# Development of a Survey Instrument for Quantification of Sprain and Strain Injury Risk Among College Athletes

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## BACKGROUND AND PURPOSE

- Self-ratings of joint function and disability have primarily been used for documentation of treatment outcomes<sup>1-3</sup>
  - The reliability and validity of survey responses have been clearly established for each of the following:
    - International Knee Documentation Committee (IKDC) subjective knee form: knee function (18 items)
    - Oswestry Disability Index (ODI): low back dysfunction (10 items)
    - Foot and Ankle Ability Measure – Sport subscale (FAAM-S): foot and ankle function (8 items)
    - Kerlan-Jobe Orthopedic Clinic (KJOC) shoulder and elbow survey: shoulder /elbow function (10 items)
- Modified versions of these instruments can be used to quantify sports injury risk<sup>4,5</sup>
  - The 46 separate items of the 4 surveys present a substantial time burden that may affect response accuracy
- The purpose of this study was to reduce the set of 46 survey items to a smaller set of strongest injury risk predictors for development of a concise screening instrument that will discriminate high-risk from low-risk athletes

## PARTICIPANTS AND PROCEDURES

- Participants were 188 NCAA Division I athletes in basketball, football, soccer, volleyball and wrestling
  - 139 Males (basketball, football, & wrestling) and 49 Females (basketball, soccer, & volleyball)
- Completed modified versions of the IKDC, FAAM-S, ODI, and KJOC at pre-participation physical exam (PPE)
  - Survey responses were recoded to create 0-100 overall function or disability score
- Occurrences of sprains and strains documented from PPE to 7 months afterward
  - Cases categorized according to occurrence of Upper Extremity or Core/Lower Extremity injury
- Exclusionary criteria
  - Unavailability on date of team PPE
  - Discontinuation of participation in sport prior to end of season for reason other than injury
- Receiver operating characteristic (ROC) analysis performed for total scores (0-100) and individual survey items
  - ROC area under curve (AUC), cut-points for dichotomization, sensitivity, and specificity determined
  - Items with largest AUC selected from each survey to construct the injury risk screening instrument

Table 1

Sport	Gender	n	Age (yrs)	Height (cm)	Weight (kg)
Basketball	M	15	20.7 ± 1.8	192.2 ± 7.8	90.6 ± 12.2
Basketball	F	12	20.4 ± 1.4	180.3 ± 5.9	78.6 ± 22.5
Football	M	92	20.3 ± 1.4	184.4 ± 7.5	100.9 ± 19.8
Soccer	F	24	19.8 ± 1.3	164.8 ± 8.4	65.0 ± 9.1
Volleyball	F	13	19.6 ± 1.7	178.6 ± 8.0	71.2 ± 12.4
Wrestling	M	32	20.3 ± 1.6	174.7 ± 6.2	79.2 ± 15.7

Table 2

Category	Sprain/Strain
Upper Extremity	9
Core/Lower Extremity	41

## RESULTS

- Results of multiple ROC analyses presented in Table 3
    - Each survey score and each individual survey item demonstrated much greater specificity than sensitivity
    - Each item selected demonstrated AUC near or above total score AUC for respective survey
  - Concepts included in selected items (e.g., giving-way, pain, endurance) integrated to develop screening instrument
    - Risk screening instrument designed to generate 0-100 score through simple addition of values for 10 items
      - Pre-participation Assessment of Functional Status (PAFS) survey (Figure 1)
        - Item 1: IKDC 8\*, 10\*; ODI 10\*; KJOC 10\*
        - Item 2: IKDC 17; ODI 3; KJOC 7, 8
        - Item 3: FAAM-S 3, 4, 5
        - Item 4: FAAM-S 7\*; IKDC 1\*; ODI 10\*; KJOC 10\*
        - Item 5: IKDC 1\*; ODI 1; KJOC 2
        - Item 6: IKDC 4, 5\*; KJOC 1\*
        - Item 7: IKDC 6
        - Item 8: IKDC 10, 11, 12, 14; ODI 4, 7
        - Item 9: FAAM-S 3, 4, 5; IKDC 17; ODI 3; KJOC 7
        - Item 10: KJOC 5\*
- \* Items not selected from ROC analyses that best represent concepts relevant to injury risk screening

Table 3

Surveys & Items	AUC	Sensitivity	Specificity	Cut-Point (Range)
FAAM-S Total	.55	20%	91%	≤ 98 (0-100)
FAAM-S Item 3	.54	15%	93%	≤ 3 (0-4)
FAAM-S Item 4	.53	12%	94%	≤ 3 (0-4)
FAAM-S Item 5	.53	15%	91%	≤ 3 (0-4)
IKDC Total	.52	27%	85%	≤ 91 (0-100)
IKDC Item 4	.55	24%	84%	≤ 4 (1-5)
IKDC Item 6	.56	17%	95%	≤ 1 (1-2)
IKDC Item 10	.54	12%	95%	≤ 4 (1-5)
IKDC Item 11	.54	20%	88%	≤ 4 (1-5)
IKDC Item 12	.54	22%	86%	≤ 4 (1-5)
IKDC Item 14	.54	12%	95%	≤ 4 (1-5)
IKDC Item 17	.54	17%	92%	≤ 4 (1-5)
KJOC Total	.66	67%	72%	≤ 98 (0-100)
KJOC Item 2	.55	33%	78%	≤ 9 (0-10)
KJOC Item 4	.59	33%	84%	≤ 9 (0-10)
KJOC Item 7	.62	33%	91%	≤ 9 (0-10)
KJOC Item 8	.57	22%	92%	≤ 9 (0-10)
ODI Total	.53	20%	85%	≥ 4 (0-100)
ODI Item 1	.52	24%	80%	≥ 2 (0-5)
ODI Item 3	.53	17%	88%	≥ 2 (0-5)
ODI Item 4	.52	5%	99%	≥ 2 (0-5)
ODI Item 7	.52	5%	99%	≥ 4 (0-5)

Figure 1

## CLINICAL RELEVANCE

- Surveys that quantify joint function and disability have been shown to have value for categorization of injury risk<sup>4</sup>
  - An excessively large number of survey items imposes a burden that does not necessarily improve accuracy
- 10-item PAFS survey was developed from analysis of 46 FAAM-S, ODI, IKDC, and KJOC items
  - Item 1 constructed to obtain information relating to history of injury and impact on sport participation
  - Items 2-9 primarily derived from results of analysis
  - Item 10 constructed to obtain information relating to psychosocial aspects of sport-related injury
    - Acquisition of information similar to that derived from 69-item Life Events Survey for Collegiate Athletes<sup>6</sup>
- Assessment of internal consistency of PAFS survey items and validation of prediction accuracy is needed
  - The PAFS survey could prove to have great utility for injury risk screening as a part of the PPE process

## REFERENCES

- Alberta FG, et al. The development and validation of a functional assessment tool for the upper extremity in the overhead athlete. *Am J Sports Med.* 2010;38:903-11.
- Irrgang JJ, Anderson AF, Boland AL, et al. Responsiveness of the International Committee Subjective Knee Form. *Am J Sports Med.* 2006;34:1567-73.
- Martin RL, Irrgang JJ, Burdett RG, et al. Evidence of validity for the Foot and Ankle Ability Measure. *Foot Ankle Int.* 2005;26:968-983.
- Wilkerson GB, Giles JL, Seibel DK. Prediction of core and lower extremity strains and sprains in college football players: a preliminary study. *J Athl Train.* 2012;47:273-281.
- Cosby N, Hertel J. Clinical assessment of ankle injury outcomes: case scenario using the Foot and Ankle Ability Measure. *J Sport Rehabil.* 2011;20:89-99.
- Sibold J, Zizzi S. Psychosocial variables and time to injury onset: a hurdle regression analysis model. *J Athl Train.* 2012;47:537-540.