ORIGINAL ARTICLE

Validity and Reliability of the Indonesian Version of Anterior Knee Pain Scale in Measuring Functional Limitations of Army Soldiers with Anterior Knee Pain

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ABSTRACT

Introduction: Anterior knee pain (AKP), also referred as patellofemoral pain, commonly affects physically active individuals. The underreporting of AKP in the military necessitates the need for reliable clinical outcome evaluation instruments, especially for military personnel. The Anterior Knee Pain Scale (AKPS) or Kujala Score is an instrument devised for assessing functional limitations in AKP sufferers. AKPS has been proven to be valid and reliable in Bahasa Indonesia for assessing functional limitations in patients with patellofemoral pain syndrome. This study aims to test the validity and reliability of the Indonesian version of AKPS in measuring functional limitations of Army soldiers suffering from AKP.

Methods: Cross-sectional study, validity assessment using Pearson correlation and reliability testing by assessing internal consistency and test-retest reliability. A total of 34 male soldiers with AKP who fulfilled the inclusion and exclusion criteria. Subjects provided informed consent, underwent history taking and physical examination, then completed the AKPS. Three day interval for test-retest.

Results: Correlation coefficient range: 0.423-0.779, overall Cronbach's alpha: 0.806, ICC: 0.993 at 95% confidence level, $p<0.05$.

Conclusion: The Indonesian version of the AKPS was valid and reliable for assessing functional limitations in Army soldiers with anterior knee pain.

Keywords: Kujala score, AKPS, patellofemoral pain.

ABSTRAK

Latar Belakang: *Anterior knee pain* (AKP), juga dikenal sebagai patellofemoral, sering dialami oleh individu yang aktif secara fisik. Pada populasi militer, kejadian AKP sering tidak terlaporkan sehingga diperlukan instrumen evaluasi luaran klinis khususnya pada populasi militer. *Anterior Knee Pain Scale* (AKPS) atau Skor Kujala adalah sebuah instrumen untuk mengukur keterbatasan fungsional pada penderita AKP. AKPS sudah diterjemahkan ke Bahasa Indonesia dengan validitas dan reliabilitas yang tinggi dalam mengevaluasi keterbatasan fungsional pada pasien umum dengan diagnosis *patellofemoral pain syndrome.* Penelitian ini bertujuan untuk menguji kesahihan dan keandalan kuesioner AKPS versi Bahasa Indonesia dalam menilai keterbatasan fungsional yang dialami prajurit Angkatan Darat dengan AKP.

Metode: Studi potong lintang yang menilai kesahihan menggunakan korelasi Pearson serta uji keandalan dengan menilai konsistensi internal dan *test-retest reliability.* Total 34 tentara laki-laki dengan AKP yang memenuhi kriteria inklusi dan eksklusi. Subjek melakukan pengisian *informed consent*, menjalani anamnesis dan pemeriksaan fisik, kemudian mengisi kuesioner AKPS. Pengisian ulang kuesioner dilakukan tiga hari setelah pengisian pertama.

Hasil: Rentang koefisien korelasi: 0.423-0.779, *Cronbach's alpha* keseluruhan: 0.806, ICC: 0.993 pada tingkat kepercayaan 95%, $p<0.05$.

Kesimpulan: AKPS versi Bahasa Indonesia terbukti sahih dan andal digunakan sebagai alat ukur keterbatasan fungsional penderita nyeri lutut anterior pada prajurit militer.

Kata kunci: Skor Kujala, AKPS, nyeri patellofemoral.

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INTRODUCTION

Anterior knee pain (AKP) is a common complaint in physically active individuals. AKP is a diagnosis that covers a wide range of conditions with similar symptoms and worsening of complaints during physical activity, including patellofemoral pain syndrome (PFPS).[1] A total of 25% to 40% of knee problems found in gym clinics are classified as anterior knee pain.[2] In the United States, 1.5% to 7.3% of patients treated for knee pain are diagnosed with PFPS.[1] The consensus of patellofemoral pain in 2018 stated the annual prevalence of AKP to be 23% in adults and 29% in adolescents, with persistent pain in 50% of individuals.[3] Approximately 25% of athletes diagnosed with PFPS discontinue sports due to knee pain.[4]

Military personnel are at risk of knee pain, especially in new recruits undergoing training.[2] A meta-analysis of patellofemoral pain in 2018 reported an annual incidence of 13.5% for AKP

in the military.[5] The incidence of reported cases of AKP was found to be 8.7% in the British Army, and this figure ranges from 5% to 15% in militaries outside of the UK. AKP is a leading cause of decreased soldier participation during training and results in impediments or even inability in performing required activities.[2] According to studies on troops, knee pain is primarily caused by overuse of the patellofemoral joint, which also accounts for soldiers' absence from training.[6] Patellofemoral joint overuse is linked to weight-bearing activities that involve the knee joint in flexion, such as squatting, jumping, and carrying load while running.[7]

Soldiers of the Indonesian Army participate in regular drills and exercises in order to keep the troops mentally and physically prepared. All recruits have passed a comprehensive health screening as part of the military's recruitment process,[8] indicating that complaints of knee pain typically arise due to training.[9] Knee pain is underreported among military personnel, partly due to dismissal by troops who consider the issue trivial and partly to avoid leaving health records with potential negative impacts on career.[10] Soldiers who seek medical evaluation are also met with barriers to obtain appropriate treatment as knee pain is frequently undertreated due to lack of data regarding the impact of AKP in military troops.[6]

The International Classification of Functioning, Disability and Health (ICF) concept states that anterior knee pain significantly contributes to difficulty in performing daily activities, which in turn limits soldier participation in drills.[3,6,11] In addition, pain during walking and sitting presents challenges in socialization and recreational activities, leading to decreased quality of life and eventual depression in armed forces. Early treatment of AKP is critical to prevent physical and mental deconditioning, along with improving knee function to enable soldiers for their eventual return to combat.[11,12] In order to assist in diagnosis and monitoring of treatment outcomes, an instrument with verified validity and reliability to measure significance of complaints and limitations in military personnel due to AKP is required.

Several instruments have been developed to assess the effects of AKP on daily living, including Lysholm score, Knee Injury and Osteoarthritis Outcome Score (KOOS), and Anterior Knee Pain Scale (AKPS or Kujala score). AKPS, launched in 1993, was developed as an index to evaluate the impact of anterior knee pain as well as to differentiate AKP and other knee pathology.[13] AKPS has been translated to several languages and was found to be valid, reliable, and highly responsive.[14] A comparison of scores designed to assess anterior knee pain by Bennell et al. revealed that subjects preferred AKPS to visual analog scale (VAS)-based scores due to ease of use and comprehension.[15] AKPS was also rated as easily comprehensible by 66% of subjects in a study conducted by Myer et al., and was shown to accurately predict patellofemoral pain (AUC=0.95).[16] An Indonesian translation of the Kujala Score has been validated for use in the general public, with high internal consistency (α=0,74), outstanding test-retest reliability (ICC 0,996), and highly correlates with 36-Item Short Form Health Survey (SF-36) as a measure of quality of life.[17] Ease of use, validity and reliability of AKPS enables its potential use as an outcome measurement tool in military personnel with AKP to evaluate functional limitation and treatment progress. However, lack of research on knee pain

in military populations, elevated risk of anterior knee pain, and barriers to care uniquely found in soldiers present challenges in evaluation of troop members presenting with anterior knee pain. This article aims to evaluate the validity and reliability of AKPS in measuring functional limitations in Indonesian Army soldiers with AKP.

METHODS

A cross-sectional study was conducted after obtaining ethical clearance from the Research Ethics Committee, Faculty of Medicine, University of Indonesia. The Indonesian version of Kujala Score was translated and validated by Mustamsir et al. to be used on patellofemoral pain outpatients, and was reproduced with permission from the translators to be used in this study.[17] Subject recruitment and data collection were performed from March 2021 to July 2021 in the Army 1st Division Clinic, with subjects being military personnel with anterior knee pain stationed in the first division. The minimum sample size was determined at 32 individuals using correlation sample size formula with an expected correlation coefficient of 0.5 and dropout rate of 10%.[18] Samples were obtained using consecutive sampling with the inclusion criteria being male soldiers aged 19-32 years who had undergone standardized training of the Army with complaints of knee pain or discomfort felt in the anterior region during prolonged sitting with flexed knees, squatting, stair climbing and descending, jumping, running, and/or walking with a duration of more than 3 months. The exclusion criteria were soldiers with a history of severe injury, knee surgery, patellar subluxation, fracture and/or tendonitis; painful neurologic conditions such as referred pain from hips or spine; positive Lachman test, posterior drawer test, McMurray test, and/or varus and valgus stress tests; soldiers previously diagnosed with osteoarthritis or other knee conditions besides PFPS; and previous abnormal knee X-rays.

Eligible subjects signed a written informed consent before history taking and physical examination was performed. Subjects then completed the Indonesian version of AKPS on the day of examination and three days afterward to assess test-retest reliability. Three days were chosen as the test-retest interval to prevent significant changes in subject condition as subjects were still on active duty and had to participate in drills during the study.

Statistical analysis was performed with SPSS version 20. Univariate analysis was performed to determine the characteristics of study participants. Validity was determined with Pearson Product-Moment Correlation by correlating item score with total score as described by Sugiyono. The instrument is considered valid if the calculated r score is greater than the Pearson critical value table score at the specified degree of freedom (df=n-2).[19] Reliability was determined by assessing internal consistency reliability and test-retest reliability. Internal consistency was measured by Cronbach's alpha. A Cronbach's alpha coefficient of greater than 0.60 was considered acceptable, and a test is reliable if α is greater than 0.7.[20] Test-retest reliability was assessed with intraclass correlation coefficient (ICC) with values between 0 and 1. An ICC value below 0.5 is considered poor reliability, between 0.5 and 0.75 indicates moderate reliability. A value between 0.75 and 0.9 is categorized as good reliability, while above 0.9 is interpreted as excellent reliability.[21]

RESULTS

Thirty-four soldiers stationed in the first division participated in the study. All of the subjects were males aged 19-32 years, with most serving the lower ranks of the Army (Table 1).

Validity of AKPS was assessed with Pearson Product-Moment Correlation to determine the correlation between each item score and the total score of the research instrument. The calculated r values are displayed in Table 2. The Pearson critical table value used in this study with df=32 and significance level of 0.05 was determined to be 0.338. The calculated r values of each item, indicating moderate to strong correlation for all items of the AKPS. All of the r values exceeded the Pearson critical table value of 0.338 and were considered valid.

Validity of each subdomain of AKPS was assessed with Pearson Product-Moment Correlation. The AKPS is divided into four subdomains. Each item score in a subdomain was correlated with the total subdomain score to assess subdomain validity (Table 3). The r values of each item in the subdomains exceeded the Pearson critical table value of 0.338 and thus considered valid.

Reliability was determined by evaluating internal consistency and test-retest reliability of AKPS. Internal consistency was assessed with Cronbach's alpha for the entire instrument and each subdomain, while test-retest reliability was assessed for each subdomain with intraclass correlation coefficient (ICC) (Table 4). The Cronbach's alpha coefficient of the entire instrument was determined to be 0.806, which is considered highly reliable. ICC values for each subdomain ranged from moderately reliable to very reliable (r=0.671 - 1.000), while the ICC value for the entire instrument was 0.993 (confidence interval 95%), categorized as excellent reliability.

DISCUSSION

This study, at the time of writing, is the first attempt to evaluate validity and reliability of the Indonesian version of Kujala Score in the military population. Translation was performed by Mustamsir et al. using a forward-backward translation protocol. This version of AKPS has been validated for use in the general population with excellent validity and reliability.[17] Further validation of AKPS before application in military clinics is required to ensure that the scoring system can accurately measure functional limitations and treatment outcome without being affected by the unique properties of the military population.

This study was conducted on 34 subjects with anterior knee pain symptoms stationed in the first division of the Army, which is consistent with the validation of the German version of Kujala score conducted by Dammerer et al. with a sample size of 30 individuals.[14] **Table 1** The range of age for AKP in the Indonesian Army is in line with research by Kaufman, Roush and Curtis at the age of 19-25 years old.[22,23] Another validity study of the Kujala score, this time using the Persian version, reported subjects with an average age of 25 years as their study participants.[24] The comparatively low age of participants in research on AKP in military personnel may be explained by the demographics of armed forces. A descriptive study by Iqbal et al. on 268 male troops in the Indonesian Army reported a mean participant age of 27.6 years, indicating that younger soldiers outnumber senior personnel in the Army.[25]

From Neal et al[26] said that enlisted personnel (privates) have a greater risk of anterior knee pain compared to officers, due to privates engaging in more physical activities and serving as frontline troops in conventional warfare. Enlisted service members also make up the majority of participants in this study due to military structure, in which officers are proportionally fewer in number than enlisted personnel, and lack of officers present in the base during the study period. However, both enlisted service members and officers are at risk of anterior knee pain when performing their respective duties, as evidenced by Glaviano et al. who found that officers in certain specialties were found to have a relative risk of AKP similar to enlisted service members.[27]

Body mass index (BMI) from this study differs from a study involving Turkish version of AKPS subjects, where the average BMI category was overweight (23.7 ± 4.6 kg/m2).[28] Neal et al. stated in their systematic review of patellofemoral pain risk factors that BMI is not a risk factor of AKP in the military population, but rather, the occurrence of patellofemoral pain may lead to an increase in BMI due to reduction of physical activity in order to avoid pain.[26]

Participants of this study still performed routine physical activity despite experiencing pain. The types of physical activity performed outside of drills and duty shifts include running, football and volleyball. When running, participants typically covered a distance of 5-10 km within 30-60 minutes. This distance is similar to the data used in the development of the original Kujala score, which studied female runners participating in a 10 km race in Helsinki, Finland.[13] In another study of validity and reliability of the Spanish version of the Kujala score, 103 subjects reported that 58.5% engaged in 3-6 hours of physical activity per week, 30% engaged in over 10 hours per week, 8.5% engaged in 3-5 hours per week, 2.3% engaged in only 1 hour per week, and 0.8% did not engage in physical activity.[29] In this study, the most common types of sports were found to be running in accordance with an article by Mellinger stating that knee pain is the most frequent injury among runners.[30]

The degree of knee pain among the study subjects was classified as mild and moderate, with no cases classified as severe, which differs from the Turkish version with an average VAS score of 6 among 40 subjects with a mean age of 33 years.[28] This may be due to differences in pain tolerance among military personnel. However, when asked about activity limitations, it is easy to identify the limitations due to the pain experienced. The validity of this study was measured by correlating the item score of each question in the scoring with the total score of the questionnaire as described by Sugiyono to ensure that the same construct measured by the whole questionnaire is also measured by each of the questions comprising the questionnaire.[19]

AKPS consists of thirteen items divided into four subdomains, each measuring either functional limitation ("Impairment" and "Activity Limitation due to Pain") or symptom severity ("Pain" and "Clinical Symptoms").[13] The correlation coefficients in this study indicating moderate to strong correlation, and all items were found to be valid as they exceeded the Pearson critical value table of 0.338. Similarity in the r values was found between the Indonesian version and the German and Arabic versions during the validation process. The number of research subjects also showed similarities between the German and

Indonesian versions, although the German version included subjects who had undergone medial patellofemoral ligament reconstruction.[14,17] In performing validity assessment, construct validity was typically determined by measuring convergent validity and discriminant validity with the help of a previously validated instrument or a "gold standard" used to measure the same construct as the questionnaire that is being validated.[31] However, there are currently no gold standard tests available for patellofemoral pain syndrome or anterior knee pain, and only two scoring systems have been developed to assess patellofemoral pain, being the Kujala score and Survey Instrument for Natural History, Etiology, and Prevalence of Patellofemoral Pain Studies (SNAPPS) questionnaire. To date, the authors have not been made aware whether SNAPPS has been translated to Bahasa Indonesia, and using an English version might introduce errors in measurement associated with poor participant comprehension. Hence, the sole validity measured in this study is internal validity; defined as determining whether each question in the AKPS measures the same construct as the entire AKPS questionnaire, with the construct in this context being functional limitation and symptom severity pertaining to anterior knee pain.[17]

Question 1 had the best discriminative value out of the three questions in the subdomain.[13] Patients are able to accurately determine the extent of impairment they experience, which translates to accurate measurement of limitation in when the AKPS was administered. Fatigue is often underestimated by soldiers, resulting in overexertion during drills to achieve optimal training results and giving rise to the noticeable symptoms of limping and flexion deficiency in personnel with established AKP. The high demand imposed on the knee joint in the military population further highlights the importance in obtaining objective impairments experienced by military personnel due to AKP, as impaired soldiers are unable to benefit from training and may experience physical deconditioning.[6]

Question 7 displayed the highest correlation coefficient compared to other items within the subdomain. This finding differs from what Kujala et al. reported in their original study.[13] In general patient populations, jumping is not considered a routine movement, while military training involves various high-impact drills such as jumping from vehicles, parachute jumps, and obstacle courses. The lower limbs act as shock absorbers as the body contacts the ground when landing from a jump, whose efficiency varies depending on joint position and muscle fatigue.[32] Landing with knee flexion of less than 45 degrees results in reduced energy absorption and increases the risk of injury.[33]

The Pain subdomain consists of only one question, question 9 demonstrated moderate correlation with the entire score. This is supported by a finding encountered by the authors when performing history taking and physical examination: the majority of subjects reported occasional pain in the front of their knees, with no study participant reporting severe pain. This suggests that pain might be chronic but only felt intermittently by the participants. Participants most often reported knee pain on the peripatellar or retropatellar region during exercises involving walking or squatting, without instability. One of the drills performed, an endurance march termed Hanmars, has participants traverse long distances on foot across a variety of terrain types and contours. When encountering a downhill slope

during marches, the leg is not fully extended during each step, causing the knee to move closer to the body's center and creating a significant mechanical load which potentially increases pain in AKP. However, this pain tends to be intermittent in nature and subsides with rest and knee extension, resulting in non-continuous pain complaints.[25]

Question 12 is inconsistent with findings reported by Kujala et al. The presence of thigh atrophy indicates that the perceived pain is chronic, leading to the shrinking of thigh muscles due to disuse. Out of the study participants, four individuals reported subjective thigh atrophy, while no objective measurement to quantify thigh muscle atrophy was performed. Atrophy of the thigh in AKP may be related to weakening of the vastus medialis oblique (VMO) muscle, as some patients with chronic AKP or a history of chronic subluxation or dislocation experience reduction in VMO muscle mass and strength.[35]

Of all the questions in the AKPS, Question 5 ("Squatting") had the highest number of responses indicating presence of limitation. Squat jumps are no longer performed in military drills due to a high risk of injury. Similarly, squatting in female military personnel has been reduced in frequency due to the high incidence of femoral neck fractures. Squatting increases the load received by the patellofemoral joint up to 6.0-7.8 times body weight, before addition of carried load. Soldiers may assume the squatting position for long periods, increasing their risk of AKP. Therefore, it is not unusual for squatting to be the most commonly reported activity which limits the sufferers of AKP. High correlation coefficients do not necessarily provide information on which of the functional limitations measured is most commonly encountered by patients. Rather, the correlation coefficients are a measure of how a question can accurately measure the extent of limitation, or the severity of pain, experienced by a patient by providing answers that best represent the patient's condition at the time of answering.[36]

The reliability of the Indonesian version of AKPS in this study was evaluated by testing internal consistency with Cronbach's alpha and test-retest reliability with ICC. The ICC score of the overall instrument was 0.993 with a Cronbach's alpha value of 0.806, higher than the validity study conducted by Mustamsir et al. in Indonesian but lower than the reliability of the Thai version.[13,37] The high reliability values of the overall score and all subdomains signify that the AKPS is a reliable measurement tool for military personnel with AKP.

The test-retest reliability in this study was conducted over a 3-day interval, similar to the Greek version.[38] This was done to avoid drastic changes in the subjects' physical condition as participants were not excluded from training and drills, both of which may influence the severity of symptoms. The questionnaire was completed in approximately 2-5 minutes, as subjects were instructed to refer to the current symptoms and limitations experienced. All of the questions were answered easily and unambiguously by participants, without the need for clarification of question items by the researchers.

This study has several limitations. AKP is more commonly found in females than males, but the researchers could not procure a representative sample of female soldiers from the study population. This is due to the small number of female military personnel in the Indonesian

Army, and most are not stationed as first-line combatants in warfare. Participants of this study did not undergo further investigation beyond history taking and physical examination, and some patients may experience another underlying knee condition such as osteoarthritis of patellar tendonitis, which present with similar symptoms as AKP. Another limitation arises during validity testing, as construct validity is difficult to establish in the study owing to a lack of gold standard for AKP and the other instrument often employed in assessing AKP, the SNAPPS questionnaire, being unavailable in Bahasa Indonesia. Nevertheless, this study is the first study to report the validity and reliability of the Indonesian version of the AKPS in a military population, and highlights that the questionnaire is a valid and reliable tool for measuring functional limitations and symptom severity not only in the general population, but also in special populations like an Army soldier.

TABLES

Table 1. Characteristics of the study subjects

Characteristics	Sample size, n=34 (100%)
Age	
19-25 years	27 (79.4)
26-32 years	7 (20.6)
Rank	
Second Private (Prada)	19 (55.9)
First Private (Pratu)	4 (11.8)
Chief Private (Praka)	3 (8.8)
Second Sergeant (Serda)	7 (20.6)
First Lieutenant (Lettu)	1 (2.9)
Nutritional status	
Normal	27 (79.4)
Overweight	3 (8.8)
Obese I	4 (11.8)
Type of physical activity	
Running	31 (91.2)
Football	2 (5.9)
Volleyball	1 (2.9)
Frequency of physical activity	
1-3 times per week	20 (58.8)
>3 times per week	14 (41.2)
Location of knee pain	
Right leg	12 (35.3)
Left leg	22 (64.7)
Degree of pain	
Mild pain	29 (85.3)
Moderate pain	5 (14.7)

Table 2. Pearson correlation coefficient values for all AKPS items with the total score

Question number	Question item	Pearson Correlation Coefficient (r value)
Q1	Limp	.470
Q2	Support	.500
Q3	Walking	.423
Q4	Stairs	.540
Q5	Squatting	.753
Q6	Running	.559
Q7	Jumping	.779
Q8	Prolonged sitting with the knees flexed	.707
Q9	Pain	.511
Q10	Swelling	.446
Q11	Abnormal painful kneecap (patellar) movements (subluxations)	.699
Q12	Atrophy of thigh	.537
Q13	Flexion deficiency	.745

Table 3. Pearson correlation coefficient values for each AKPS subdomain with the total score of the subdomain

	Question item	Pearson Correlation Coefficient (r value)
Impairment		
Q1	Limp	.768
Q3	Walking	.528
Q13	Flexion deficiency	.719
Activity Limitation due to Pain		
Q2	Support	.440
Q4	Stairs	.693
Q5	Squatting	.762
Q6	Running	.638
Q7	Jumping	.802
Q8	Prolonged sitting with the knees flexed	.741
Pain		
Q9	Pain	1.00
Clinical Symptoms		
Q10	Swelling	.753
Q11	Abnormal painful kneecap (patellar) movements (subluxations)	.682
Q12	Atrophy of thigh	.797

Table 4. Cronbach's alpha values for AKPS subdomains

Subdomain	Cronbach's Alpha	ICC (95% CI)
Impairment	0.745	.745 (0.569-0.861)
Pain	1.000	1.000 (1.000-1.000)
Activity limitation	0.758	.763 (0.610-0.864)
Clinical symptoms	0.671	.671 (0.444-0.820)

Cronbach's Alpha for Reliability = 0.806

Note: Confidence Interval (CI)

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