

The relationship of knee function to psychological readiness in anterior cruciate ligament patients with non-operative and postoperative treatment: a literature review

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ABSTRACT

Background: There are two options for effective anterior cruciate ligament (ACL) injury treatment: conservative treatment and reconstructive surgery. Both options aim to restore optimal knee function without the risk of reinjury or degenerative changes to the knee. The success of both approaches depends on the recovery program and the commitment to performing recovery exercises. Positive psychological evaluation, subjective assessment, and objective evaluation of physical function are often used to assess a person's readiness to return to the same biological activity as before the injury.

Purpose: This study aimed to identify the correlation between knee function and physiological readiness in patients who sustained an ACL injury and underwent reconstructive surgery or conservative management.

Methods: This study used a literature review method or literature review. Journal search used databases via Google Scholar and PubMed. The keyword search used "injury," "anterior cruciate ligament," "knee functional," and "psychological readiness." Journals published in the last five years are included in this study. Based on the search results, five articles fit the inclusion criteria.

Results: The results of the review of 5 journals stated that no significant differences were found in the subjective scores of the International Knee Documentation Committee 2000 (IKDC 2000) and anterior cruciate ligament return to sport after (ACL-RSI) between patients with conservative treatment and reconstructive surgery.

Conclusion: There was no significant difference between the IKDC 2000 Score and ACL-RSI results in patients who received conservative treatment and reconstructive surgery.

Keywords: ACL injury, knee function, physiological readiness, return to sport.

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Introduction

An anterior cruciate ligament (ACL) is the most frequently injured ligament problem. ACL injuries can be contact or noncontact.^{1,2} ACL injury occurs when there is a twisting movement, where the shin bone rotates outward with the foot on the ground and as a result of sudden deceleration of the front shin bone, causing contraction of the thigh muscles maximum front. When the knee is hyperextended, the knee can tear the ACL.^{3,4} There are more than 250,000 ACL injuries in America every year, or one in every 3000 people. The incidence of ACL injury in women is 2 to 8 times higher than in men.⁵ The incidence of

ACL reconstruction was found to be 34 per 100,000 in Norway, 38 per 100,000 in Denmark, and 32 per 100,000 people in Sweden. In Indonesia, there was an increase in the incidence of ACL reconstruction by 22% per 100,000 people per year, from 61.4% in 2002 to 74.6% in 2014.⁶

There are two correct options for managing ACL injuries: non-operative and operative. Non-operative management is recommended for patients with good knee stability when carrying out daily activities or sports and with no functional limitations to the knee. On the other hand, reconstructive surgery is recommended for patients with

knee instability or complete rupture. Both options aim to restore optimal knee function without the risk of reinjury or degenerative changes. The ability of the knee joint to flex and extend for almost any sort of daily and sports activity (such as walking, running, stair climbing, and squatting) without difficulty is characterized as knee function.⁷ The success of treatment depends on the recovery program and the patient's level of commitment in carrying out the recovery exercises provided.⁸ Assessment of readiness to return to the level of physical activity before the injury can be related to factors such as positive psychological responses, subjective evaluations, and objective evaluations of physical function.⁹

Anterior cruciate ligament return to Sport after Injury (ACL-RSI) is a psychological assessment tool used to evaluate a person's ability to return to sport following ACL reconstruction surgery. It has been shown to have good reliability and validity. In addition, there is a positive relationship between ACL-RSI and the assessment of factors such as knee symmetry and the subjective score of the International Knee Documentation Committee 2000 (IKDC 2000), which describes general knee function.¹⁰ The IKDC 2000 subjective assessment form is a valid, reliable, and responsive tool for measuring knee function in patients with knee injuries.¹¹ The ACL-RSI is a specific instrument that measures psychological readiness to return to sports after an ACL injury. ACL-RSI are 12 questions based on three psychological responses related to the return to sport phase: confidence in performance, emotions, and risk assessment. Each question in the ACL-RSI has an 11-point Likert scale between 0 and 100.¹² In daily activities, and the knee is essential in carrying out movements for flexion, extension, internal rotation, external rotation, and supporting most of the body weight.¹³

Anterior cruciate ligament reconstruction (ACLR) is a surgical procedure to replace the ACL ligament with tissue grafting using tendons to restore knee stability and function after ACL rupture.¹⁴ The postoperative success rate three years after ACLR is as high as 96% to 98%.¹⁵ ACLR is a typical operation for people who experience ACL injury; 65% of patients could exercise at pre-injury levels, and 55% returned to competitive sports after ACLR.¹⁶ About 90% of patients undergoing ACLR showed normal IKDC 2000 survey scores for motion, long-term stability, and strength.¹⁷ More than 85% of people achieved clinically satisfactory knee laxity, muscle strength, and single-leg jump distance.¹⁸ However, despite successful ACLR techniques and functional outcomes, differences still exist between patients who recover and the rate of return to sport at or above the level of the sport before the injury.⁹ Psychological readiness is critical in determining athlete readiness.¹⁹ It is found that the cause of decreased psychological readiness after ACLR is fear of reinjury (19%), followed by decreased knee ability (18%), knee disorders (13%), and lifestyle changes (11%). Specific psychological factors influencing a patient's return to sport after ACLR include, but are not limited to, psychological readiness, fear of reinjury, and desire to return to sport.²⁰

Based on these problems, the author conducted a literature review regarding the relationship between knee function and physiological readiness in ACL patients with operative and non-operative injuries.

Methods

The research method used is a literature review study compiled using secondary data relating to non-op and post-op Anterior cruciate ligament, which was obtained through Google Scholar and Pubmed by searching "injury, anterior cruciate ligament, knee functional, psychological readiness". The inclusion criteria used in this literature review are 1) Literature with a publication period of the last five years, 2) using anterior cruciate ligament, knee functional, and psychological readiness variables, and 3) using cohort and cross-sectional methods. The authors independently determined the inclusion criteria. The author read the full text of all literature to choose and select literature that met the inclusion criteria. Of the 141 pieces of literature found, the author then filtered them to obtain five works of literature, which will be displayed in the results. Data will be extracted by summarizing the data, which will be grouped in a table containing the author, year, method, measuring instrument, and results, as shown in Figure 1.

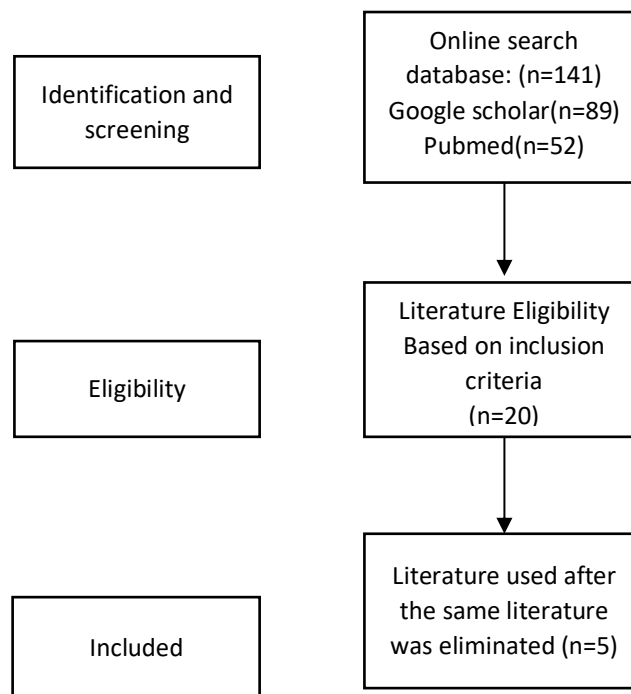


Figure 1. Flow chart of the search strategy

Results

From the literature results that the author has found, five journals are relevant to the title of this research, which have been included in Table 1. According to Yuliana et al. (2020)⁸, 7 found no significant difference ($p>0.05$) between operative and non-operative patients, with an average recovery of approximately 23 ± 0.06 months and 23.46 months. Patients who underwent operative and non-

operative treatment showed the same level of physical activity with higher IKDC 2000 and ACL-RSI scores than patients with less physical activity before surgery.

Research by Cheecharem et al. (2018)²¹ states that a lower IKDC 2000 score predicts a person will not return to normal physical activity. The mean IKDC 2000 scores of those who returned and did not return to sport showed that the IKDC 2000 scores for postoperative ($p<0.017$) and current knee use ($p=0.001$) differed significantly between groups, while no differences were found in pre-injury. In the return to sport group, there was a significant difference in mean IKDC 2000 scores between postoperative and current knee wear outcomes ($p=0.043$). For those who did not return to sport, there were substantial differences between pre-injury and post-surgery ($p<0.001$) and pre-injury and current knee use outcomes ($p=0.002$). Bachelor's education level, IKDC 2000 score, and monthly income of less than 10,000 Thai baht were factors associated with returning to sport.

Research by Sadeqi M et al. (2018)²² showed that 21 ACL-RSI scores were significantly higher in patients who had returned to sport and those who had returned to the same level of play. Mean psychological ACL-RSI scores regularly and gradually increased after ACL reconstruction. The greatest improvement occurred between preoperative and fourmonths postoperatively, then between 6 months and one year of follow-up. There was a slight improvement after the 1-year follow-up period. ACL-RSI scores were strongly associated with similar pre-injury running and exercise events, regardless of the follow-up period. Patients who performed the same sports at 2-year follow-up had significantly higher mean ACL-RSI scores than other patients before surgery ($p=.0002$) as well as at four months ($p<.00001$), six months ($p<.00001$), and one year ($p<.00001$) follow-up period. According to the receiver operating characteristic (ROC) curve, the threshold ACL-RSI score for the same preinjury sport at two years postoperatively was ≥ 65 . Patients who did not practice any sport at a 2-year follow-up had a mean ACL-RSI score of 53.2%, and those who exercised at the same level of play as before injury had a mean score of 81.6%. Patient satisfaction at the 2-year follow-up was significantly and positively related to ACL-RSI scores and the same pre-injury sport.

Research by Webster et al. (2018)¹² Self-reported symptoms and function were most associated with psychological readiness for return to sport (RTS) after anterior cruciate ligament reconstruction (ACLR) surgery. Male patients who frequently participated in sports before ACL injury had higher psychological readiness. In contrast, female patients have a more negative outlook and may, therefore, benefit more from interventions designed to facilitate a smooth transition back to sport. Only 158 patients (25%) returned to competitive sport. Based on univariate analysis, it shows that all of the following have a positive effect on psychological readiness: male gender ($\beta= 5.8$; 95% CI, 2-10), younger age ($\beta= -0.2$; 95% CI, -0.4 to 0.01), shorter interval between injury and surgery ($\beta= -0.1$; 95% CI, -0.1 to -0.02), higher pre-injury Frequency of sports participation ($\beta=$

5.4; 95% CI, 2-9), greater limb symmetry ($\beta= 0.5$; 95% CI, 0.3-0.6), and higher subjective knee scores (IKDC 2000: $\beta= 1.3$; 95% CI, 1.1-1.4). In multivariate models, personal knee scores (IKDC 2000: $\beta= 1.2$; 95% CI, 1-1.4), and age ($\beta= -0.3$; 95% CI, -0.4 to -0.1) When patients were grouped according to whether they had Returned to competitive sport or not, univariate analysis for the group who had not RTS showed that gender was male ($\beta= 5.1$; 95% CI, 1-9), greater limb symmetry ($\beta= 0.4$; 95% CI, 0.3-0.6), and a higher subjective knee score (IKDC 2000: $\beta= 1.2$; 95% CI, 1-1.3) had a positive effect on psychological readiness. In the multivariate model, only the subjective knee score remained significant ($\beta= 1.2$; 95% CI, 1- 1.4). For the group that had returned to competitive sport, greater limb symmetry ($\beta= 0.3$; 95% CI, 0.1-0.6) and higher subjective knee scores (IKDC 2000, $\beta= 1.2$; 95% CI, 0.9-1.5) have positively affected psychological readiness. Personal knee scores remained significant in the multivariate model ($\beta= 1.3$; 95% CI, 1-1.6).

Research by Faleide AGH et al. (2021)²³ ACL-RSI and age are predictors of 2-year RTS, while functional tests are not informative. The main finding was that none of the patients who passed the 85% RTS criterion had another knee injury. Measurements were taken on average 10.4 \pm 1.3 months after ACLR. Twenty-nine patients passed the RTS criteria $\geq 85\%$ in all three tests (hop test, strength test, and IKDC 2000). These patients were younger (26 versus 30 years; $p=.037$) and had higher ACL-RSI scores (69 versus 51 years ; $p<.001$) and IKDC 2000 scores (92 versus 77 years ; $p<.001$).

Discussion

An injury that occurs to a person does not only affect the person's physical abilities but can affect the psychological aspect. In some circumstances, damage can result in a person being separated from competition, increasing stress levels in daily life and causing anxiety about reinjury. The negative impact of injury depends on how often a person participates in high-level sports and is also related to a strong athletic identity. These people may feel greater loss and experience mood disorders. They can also better respond to injuries because they have greater psychological resources to cope. During the rehabilitation process, a person can benefit from the support provided by psychological intervention.²⁴

A previous study by Ardern et al. demonstrated a low ACL-RSI score indicates a more negative psychological response. There was a strong association between the IKDC 2000 score and ACL-RSI in patients undergoing ACL reconstruction surgery. Each one-point increase in ACL-RSI score doubles the likelihood of returning to pre-injury activity levels.⁹

The rehabilitation process for sports injuries begins when the damage occurs. Factors include location, type of physical injury, cause, severity, and injury history. Influences biological, psychological, and social contextual dimensions. These dimensions are also affected by sociodemographic factors such as gender, age, and socio-economic status. Several factors mentioned previously can influence

Table 1. Summary of journals relevant to the knee function to psychological readiness in anterior cruciate ligament patients with non-operative and postoperative treatment.

Authors	Title	Variables	Results
Yuliana E, Kushartanti DW. (2020) ⁷	“Knee functional and psychological readiness of post-ACL injury in operative and non-operative treatment”	Study design: cross-sectional. Sample size: 30 people. Independent variable: Preoperative and non-operative treatment, knee function, psychological readiness. Dependent variable: ACL-RSI score. And IKDC 2000. Statistical tests: Descriptive statistical tests, Independent t-test.	IKDC 2000 ; $p > 0.05$, ACL-RSI ; $p > 0.05$ Weaknesses of this journal: 1. There were 30 samples used in this research. This can affect the validity and generalization of research results. 2. This research was only conducted at one clinic in Yogyakarta, so the results may not generally apply to a wider population. 3. This study only used a questionnaire to measure knee functional ability and psychological readiness after ACL injury. The use of more objective measuring tools, such as physical tests and clinical evaluations, can provide more accurate results. 4. This study did not consider other factors influencing knee functional ability and psychological readiness after ACL injury, such as age, gender, and injury severity. 5. This study did not compare long-term results between the two ACL injury treatment groups, so it cannot provide information about the long-term effectiveness of the two types of treatment.
Sukrom Cheecharen (2018) ¹⁹	Return to sport and knee functional scores after anterior cruciate ligament reconstruction: 2 to 10 years follow-up.	Study design: cross-sectional. Number of samples: 110 people. Independent variables: knee pain during physical activity, education level. Dependent variable: return to sport, IKDC 2000 score. Statistical test: Test Fisher Exact test or Chi-square TEST, Mann-Whitney U-test/Student's t-test, ANOVA.	IKDC 2000 score without knee pain: Pre-injury ($p = 0.491$), Post-surgery ($p < 0.001$) IKDC 2000 score with knee pain: Pre-injury ($p = 0.228$), Post-surgery ($p = 0.017$) Factors associated with return to sport after ACL reconstruction: age ($p = 0.406$); OR= 1.03 (95% CI=0.96-1.10), gender ($p = 0.108$); OR= 7.60 (95% CI=0.64-9.94), bachelor's degree ($p = 0.015$); OR= 4.23 (95% CI=1.33-13.48), income ($p = 0.008$); OR= 5.97 (95% CI=1.59-22.47), no congenital disease ($p = 0.141$); OR= 5.50 (95% CI=0.57-53.19), IKDC 2000 score ($p = 0.002$); OR= 1.09 (95% CI= 1.03-1.15).
Sadeqi M, Klouche S, Bohu Y, Herman S, Lefevre N, Gerometta A (2018) ²⁰	Progression of the Psychological ACL-RSI Score and Return to Sport After Anterior Cruciate Ligament Reconstruction	Study design: Cohort study. Number of samples: 681 people. Independent variables: Type of sport before injury, Type of injury, Type of graft, IKDC 2000 score, KOOS score, and ACL-RSI score at six months postoperatively. Dependent variable: return to exercise at the same level as before and ACL-RSI psychological scores. Statistic test: Student t-test, Chi-square test, ANOVA, Logistic regression, ROC curve, Shapiro-Wilk test.	ACL-RSI scores and functional scores two years follow Up: IKDC 2000 subjective= $p < .00001$, KOOS symptoms= $p < .00001$, KOOS pain= $p < .00001$, KOOS function in daily life = $p < .00001$, KOOS sport= $p < .00001$, KOOS quality of life= $p < .00001$, Lysholm= $p < .00001$. ACL-RSI score returns to pre-injury sports at two years: pre-op (45.9±26.6 versus 37.5±22.5; p -value = 0.0002), four months (59.3±20.6 versus 49.8±20.8; $p < .00001$), six months (63.8±20.1 vs. 50.6±23.0; $p < .00001$), and one year (72.0 ± 20.4 vs. 53.1±25.3; $p < .00001$).

<p>Webster, KE, Nagelli, CV, Hewett, TE, & Feller, JA (2018)¹¹</p>	<p>Factors Associated With Psychological Readiness to Return to Sport After Anterior Cruciate Ligament Reconstruction Surgery</p>	<p>Study design: cross-sectional. Sample size: 635 people. Independent variables: Gender, Time between ACL injury and surgery, Frequency of sports before injury, knee stability, IKDC 2000 subjective score. Dependent variable: ACL-RSI score. Statistic test: Chi-square test, Independent t test, ANOVA.</p>	<p>Age: p-value = 0.04; β = -0.2 (95% CI = -0.4-(-0.01)), Gender: p-value = 0.002; β = 5.8 (95% CI = 2-10), time between ACL injury and surgery: p-value = 0.006; β = -0.1 (95% CI = -0.1-(-0.02)), Frequency of exercise before injury: p-value = 0.003; β = 5.4 (95% CI = 2-9), limb symmetry index: p-value = 0.001; β = 0.5 (95% CI = 0.3-0.6), Anterior-posterior laxity: p-value = 0.2; β = -0.6 (95% CI = -1.4-0.2), subjective IKDC 2000 (symptoms/function): p-value = 0.001; β = 1.3 (95% CI = 1.1-1.4). ACL-RSI: p-value = .003; (95% CI = -21.9-(-4.8)), IKDC 2000 : p-value = .099; (95%CI = -8.2-0.7), Jump test: p-value = .363; (95%CI = -4.9-1.8), Isokinetic strength test: p value = .324; (95%CI = -8.8-2.9).</p>
<p>Faleide AGH, Magnussen LH, Strand T, Bogen BE, Moe-Nilssen R, Mo IF, et al. (2021)²¹</p>	<p>The Role of Psychological Readiness in Return to Sport Assessment After Anterior Cruciate Ligament Reconstruction</p>	<p>Study design: Cohort study. Number of samples: 129 people. Independent variables: ACL-RSI score, IKDC 2000 score, Single limb performance test results, type of graft used in ACLR surgery, Age, Gender of the patient, Time from injury to ACLR surgery. Dependent variables: Patient's ability to return to sports at pre-injury level, Success rate of ACLR surgery. Statistical tests: Logistic regression test, ROC test, Testindependent t-test, chi-square test, and Mann-Whitney U test.</p>	

IKDC 2000, International Knee Documentation Committee 2000; ACL-RSI, Anterior Cruciate Ligament Return to Sport After Injury; ANOVA, Analysis of variance; KOOS, knee injury and osteoarthritis outcome score; ROC, receiver operating characteristics; ACLR, Anterior cruciate ligament reconstruction; ACL, Anterior cruciate ligament.

synergistic results, including range of motion, joint weakness, muscle strength, and pain perception. Outcomes influence rehabilitation outcomes such as function, quality of life after injury, satisfaction with treatment, and willingness and motivation to return to sport. Psychological factors play a role in this model because they interact with social contextual and biological factors as well as intermediate and final outcomes.²⁴

Previous research shows that gender differences are a risk factor for ACL injury.²⁵ Knee joint morphology between genders also plays an important role in injury risk. Women have 30% smaller knee flexor and 25% smaller knee extensor muscles than men but larger vastus lateral and biceps femoris morphologically, which is underlined as a trigger for decreased knee joint stability leading to the incidence of ACL injuries. Low muscle strength of the hamstrings to the quadriceps in women causes a reduction in knee muscle stability.²⁶ Strong hamstrings can counteract the sliding of the anterior tibialis muscle to protect the ACL by increasing joint stability. However, less stability of the knee joint in women causes contraction of the quadriceps, leading to anterior tibial translation, especially when the knee is fully extended, causing ACL rupture.²⁷ Therefore, the smaller size of the quadriceps and hamstrings in women is strongly associated with knee joint injury.²⁸ This balance difference in muscle morphology is the main reason for reducing the functional stability of the knee joint and the main factor of ACL injury in women.²⁶ The ratio of knee flexor and knee extensor muscle strength in women is 50%, while in men, it is 56%, indicating that women have less power. Additionally, Sartorius and gracilis are important in controlling knee valgus forces; A greater ratio of size to strength results in higher strength. These factors also underscore the incidence of ACL ruptures in women.²⁹

This study has several limitations. First, the primary outcome of return to sport is a discrete event that our respondents were aware of when it was accomplished; as a result, the subjects may be biased in their reporting. Second, this study did not look at the rate of return to sport based on sport type or reinjury rate after returning to sport. Future research can look into the rate of return to sport dependent on the kind of sport and the rate of reinjury after returning to sport. Furthermore, research should be conducted to evaluate the impact on treatment indications and rehabilitation.

Conclusion

There was no significant difference in scores between patients who were operated on and those who were not. Patients who received both treatments and had higher or equal physical activity after injury had higher IKDC 2000 and ACL-RSI scores than those with lower pre-injury physical activity. Psychological interventions can provide important assistance in the treatment process. It is important to understand how individuals respond to injury, the

motivations that influence recovery, and the impact of other factors in predicting recovery and implementing supportive measures.

Conflict of interest

This research is devoid of any conflicts of interest.

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Ethical consideration

The researchers did a review of previous literature on this subject. There was no requirement for ethical approval because the study just analyzed existing data and did not directly engage human subjects or acquire new data.

Author's contribution

NPAS and IPGSA conceptualized the research design, conducted a literature search, also prepared and edited the paper; GPK conducted a literature search and reviewed the article.

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