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Psychological skill configurations and rehabilitation readiness among injured pencak silat athletes: A person-centered analysis

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Abstract

Background: Psychological responses to sport injury critically determine rehabilitation engagement and return-to-sport outcomes. Existing research has predominantly employed variable-centered approaches that obscure heterogeneity in athletes' psychological adaptation, particularly within culturally embedded combat sports such as Pencak Silat.

Aims: This study aimed to identify distinct psychological profiles among injured Pencak Silat athletes empirically and to examine how these profiles relate to rehabilitation readiness, thereby advancing an evidence-based framework for psychological skills training in injury rehabilitation contexts.

Methods: A quasi-experimental pretest–posttest design combined with a person-centered analytical framework was employed. Data were collected from 108 injured Pencak Silat athletes across nine secondary educational institutions. Latent Profile Analysis (LPA) was conducted on five psychological domains: anxiety regulation, coping skills, self-confidence, motivation, and rehabilitation readiness, followed by MANOVA and hierarchical regression to examine profile-based differences and predictive relationships.

Results: Three distinct profiles, Vulnerable (n = 29), Adaptive (n = 46), and Resilient (n = 33), were identified. All psychological indicators differed significantly across profiles, with large effect sizes. Hierarchical regression demonstrated that psychological skills and profile membership accounted for significant variance in rehabilitation readiness beyond injury-related factors ($\Delta R^2 = .19$).

Conclusion: Psychological adaptation to sport injury is best conceptualized through profile-based configurations of psychological skills. These findings support the development of individualized, profile-informed psychological skills training to enhance rehabilitation readiness and sustainable return-to-sport outcomes in Pencak Silat athletes.

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INTRODUCTION

Sport-related injuries represent a critical disruption in athletes' careers, extending beyond physical impairment to encompass complex psychological challenges that influence rehabilitation trajectories and return-to-sport outcomes. A growing body of evidence has demonstrated that injured athletes frequently experience heightened anxiety, emotional distress, reduced self-confidence, fear of re-injury, and diminished psychological readiness to resume competitive participation (Mansell & Turner, 2022; Podlog et al., 2024; Sun et al., 2025; Tang et al., 2022). These psychological responses are not merely transient reactions to injury but are dynamically intertwined with athletes' motivation, adherence to rehabilitation programs, and long-term performance sustainability (Johnsson et al., 2025; Pepe et al., 2025).

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In response to these challenges, sport psychology research has increasingly emphasized the role of psychological skills and interventions in facilitating adaptive recovery following injury. Empirical studies and reviews have documented the use of psychological strategies such as guided imagery, relaxation, goal setting, acceptance and commitment therapy (ACT), micro counseling skills, and expressive writing to alleviate post-injury psychological distress and enhance coping capacities (Faulkner et al., 2025; Liu, Zhao, et al., 2025; Penubarthi et al., 2025; Pozzato et al., 2022). Comprehensive reviews have further suggested that guided imagery and relaxation techniques are consistently associated with improvements in psychological coping and reductions in re-injury anxiety (Lindsay et al., 2023; Wegner et al., 2025). In contrast, the effectiveness of goal setting and other techniques appears more variable and context dependent. Collectively, this literature underscores the importance of addressing psychological recovery as an integral component of injury rehabilitation.

Despite these advances, critical limitations persist within the existing body of research. Much of the literature has adopted a variable-centered perspective, focusing on isolated psychological outcomes, such as anxiety, mood, or self-efficacy, without adequately capturing how these dimensions co-occur and interact within injured athletes (Aldanyowi & AlOraini, 2024; Brooks et al., 2022; Liu, Yu et al., 2025). Furthermore, intervention studies are frequently constrained by small sample sizes, heterogeneous injury classifications, short follow-up periods, and fragmented analytical approaches, which collectively limit theoretical integration and empirical generalizability (Takáč, 2025; Tranaeus et al., 2024; Yuan et al., 2026). Notably, prior research has predominantly examined whether specific psychological interventions are effective, while offering limited empirical insight into how psychological skills are structured, patterned, and organized within injured athletes during rehabilitation.

This limitation is particularly salient when considered alongside contemporary theoretical models of sport injury response, which conceptualize psychological recovery as a dynamic, multidimensional process shaped by the interplay among cognitive appraisals, emotional regulation, coping strategies, and contextual demands (Chu & Myers, 2025; McHenry et al., 2022). From this perspective, psychological adaptation to injury cannot be fully understood through single-variable analyses alone (Bird, 2024). Instead, there is a growing need for person-centered approaches that empirically identify distinct psychological configurations through which injured athletes regulate distress, maintain motivation, and develop readiness to return to sport (Chen et al., 2022). However, empirical studies explicitly addressing these psychological configurations remain scarce.

The absence of such integrative analyses is even more pronounced in combat sports. Combat sport athletes face elevated injury risks due to high physical contact, repetitive impact, and intense competitive demands, while simultaneously maintaining strong athletic identities closely tied to bodily capability and resilience (Kuśnierz et al., 2025; Lee et al., 2025). Pencak Silat, a traditional martial art that has evolved into an internationally recognized competitive sport, exemplifies these challenges. Athletes must navigate injury-related vulnerability within a cultural and performance context that emphasizes discipline, endurance, and mental fortitude (Holmström, 2023). Despite its global expansion, Pencak Silat remains underrepresented in international sport psychology research, particularly in empirically grounded examinations of psychological skills during injury and rehabilitation.

Against this backdrop, the present study is grounded in the rationale that advancing injury-related sport psychology requires shifting analytical attention from evaluating isolated intervention outcomes to the empirical examination of psychological skill structures among injured athletes. Rather than asking whether a particular psychological technique is effective, this study seeks to identify how psychological skills coalesce into meaningful patterns that characterize athletes' psychological adaptation to injury. By adopting a person-centered, evidence-based analytical framework, this study aims to capture the complexity of injured athletes' psychological experiences in a manner that aligns more closely with contemporary theoretical models and the needs of applied rehabilitation.

Accordingly, the purpose of this study is to examine psychological skills among injured Pencak Silat athletes empirically and to identify distinct psychological profiles that reflect patterns of anxiety regulation, coping capacity, confidence, motivation, and rehabilitation readiness. Through multivariate statistical analyses complemented by advanced psychological visualizations, the study

seeks to provide empirical support for an evidence-based psychological skills training model grounded in observed psychological configurations rather than prescriptive assumptions. It is hypothesized that injured athletes will exhibit distinct psychological profiles characterized by differential combinations of psychological distress and adaptive skills, and that these profiles will be associated with indicators of injury-related adaptation and readiness to return to sport.

In pursuing this line of inquiry, the present study contributes to the sport injury psychology literature by offering a theoretically informed, empirically grounded, and contextually situated understanding of psychological skills among injured combat sport athletes, thereby informing more nuanced and evidence-based approaches to psychological skills training during injury rehabilitation.

METHOD

Research Design

This study employed a quasi-experimental pretest–posttest design combined with a person-centered analytical framework. The quasi-experimental design was selected to enable temporal measurement of psychological skill development across a structured psychological skills training program while accommodating the naturalistic constraints of school-based athletic settings. The pretest–posttest structure provided two measurement occasions that contextualized the posttest psychological configurations identified through Latent Profile Analysis within a framework of observable change from baseline. The primary analytical focus, however, was on identifying psychological profiles from posttest data collected following program completion, consistent with person-centered research objectives. Complementary multivariate analyses examined profile-based differences in psychological outcomes and predictors of rehabilitation readiness.

Participants

Participants were 108 injured Pencak Silat athletes recruited from nine secondary educational institutions with established competitive Pencak Silat programs: SMA Negeri 1 Bawang, SMA Negeri 2 Purbalingga, SMA Negeri 3 Purwokerto, MAN 1 Banyumas, SMA Negeri 2 Cilacap, SMA Negeri 2 Kebumen, SMA Negeri 1 Simo, MAN 2 Wonosobo, and SMA Negeri 2 Bae. Inclusion criteria required active engagement in competitive Pencak Silat training, a current sport-related injury resulting in restricted participation, and ongoing enrollment in supervised rehabilitation or modified training. Exclusion criteria comprised non-sport-related injuries and diagnosed psychological or neurological disorders that would confound psychological skill assessment. The sample size of 108 was deemed adequate for Latent Profile Analysis based on simulation evidence indicating acceptable classification accuracy for three-profile solutions with samples of 100 or more (Chrétien et al., 2024; Chu & Myers, 2025). For the hierarchical regression with six predictors, this sample size provides adequate statistical power ($1 - \beta > .80$) for a medium effect size ($f^2 = .15$) at $\alpha = .05$ (Faul et al., 2009).

Participant demographic and injury characteristics are summarized in Table 1. The sample was predominantly male (68.5%; n = 74), with most athletes aged 17–18 years (73.1%; n = 79). The largest training experience cohort reported 3–5 years of formal training (42.6%; n = 46). Lower-extremity injuries were most prevalent (47.2%; n = 51), and moderate injury severity (4–8 weeks restriction) was most common (45.4%; n = 49). At assessment, the majority of participants were in the recovery phase of rehabilitation (41.7%; n = 45).

Table 1. Demographic and Injury Characteristics of the Participant Sample (N = 108)

Variable	Category	n	%
Gender	Male	74	68.5
	Female	34	31.5
Age (years)	15–16	29	26.9
	17–18	79	73.1
Years of Training	< 3 years	24	22.2
	3–5 years	46	42.6
	> 5 years	38	35.2
Injury Type	Lower extremity	51	47.2
	Upper extremity	29	26.9
	Trunk/back	16	14.8

Variable	Category	n	%
	Multiple sites	12	11.1
Injury Severity	Mild (1–3 weeks)	32	29.6
	Moderate (4–8 weeks)	49	45.4
	Severe (> 8 weeks)	27	25.0
Rehabilitation Phase	Acute phase	34	31.5
	Recovery phase	45	41.7
	Return-to-training phase	29	26.9
Competition Level	Regional	61	56.5
	Provincial	35	32.4
	National	12	11.1

Note. Percentages may not total 100 due to rounding. Vul. = Vulnerable; Ada. = Adaptive; Res. = Resilient.

Sampling Procedure and Program Delivery

A purposive sampling technique was employed to ensure alignment with the injury-related inclusion criteria and institutional Pencak Silat program structures. At each of the nine sites, the study was implemented across 18 structured sessions: one pretest assessment session, 16 psychological skills training sessions, and one posttest assessment session. Training sessions were conducted three times per week according to fixed institutional schedules, ensuring standardized program exposure and equivalent recovery cycles across all research locations. Each session lasted approximately 60 minutes and included structured delivery of psychological skill modules covering anxiety management techniques, coping strategy development, self-confidence enhancement exercises, motivational goal-setting protocols, and preparation for rehabilitation readiness activities.

Instrumentation

Psychological data were collected at both assessment occasions using a composite self-report instrument assessing five core domains: (a) anxiety regulation, (b) coping skills, (c) self-confidence, (d) motivation, and (e) rehabilitation readiness. This composite instrument was developed by the research team, drawing on established theoretical frameworks in sport injury psychology and adapting items from validated scales in the sport psychology literature (e.g., the Athletic Coping Skills Inventory and the Psychological Readiness to Return to Sport measure). An additional subscale assessing emotional distress was included to serve as a psychological distress indicator in hierarchical regression analyses, enabling statistical control of distress-related variance when examining the incremental contribution of adaptive psychological skills. All items were rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating more adaptive psychological functioning. All subscales demonstrated acceptable internal consistency reliability (Cronbach's $\alpha > .70$) at both assessment occasions. Construct validity was supported through item–total correlations, confirmatory factor analysis indicating satisfactory model fit, and theoretically coherent inter-scale associations reflecting the expected positive relationships among adaptive psychological skills.

Analysis Plan

Data analysis was conducted in four sequential stages. First, descriptive statistics and bivariate correlations were computed to characterize the data distribution and to assess the suitability of indicators for person-centered analysis. Second, Latent Profile Analysis was conducted using the five posttest psychological indicator scores as manifest variables, with the number of profiles determined by comparing competing solutions based on the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), entropy, and smallest class proportion. Solutions that retained substantive interpretability and maintained adequate class size were prioritized. Third, MANOVA was employed to examine multivariate psychological differences across the identified profiles, with follow-up univariate analyses and partial eta-squared effect size estimates reported. Fourth, hierarchical regression analysis was conducted to examine the predictive utility of psychological skills for rehabilitation readiness, with injury-related variables entered in Step 1 (ΔR^2

contribution), psychological distress in Step 2, and psychological skills and profile membership in Step 3. The incremental R^2 at each step quantified the explanatory contribution of each variable set. All analyses were conducted using SPSS version 26.0 and Mplus version 8.8 for latent profile modeling.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Universitas Negeri Semarang before data collection. Informed consent was secured from all participants, and, given the involvement of minor-age athletes, written parental or guardian consent was obtained concurrently. Participation was entirely voluntary, and athletes were explicitly informed of their right to withdraw at any stage without academic or athletic consequence. Data confidentiality was maintained through de-identification before analysis, and all data storage complied with institutional data protection protocols. No financial compensation was provided to participants.

RESULTS AND DISCUSSION

Results

Pretest–Posttest Comparison by Profile

To contextualize posttest profile configurations within a framework of longitudinal psychological change, pretest and posttest means for all five psychological indicators are presented separately for each identified profile in Table 2 and illustrated in Figure 2. Consistent gains across all indicators and all profiles were observed following the 16-session psychological skills training program, with the magnitude of change varying systematically across profiles. The Resilient profile exhibited the largest absolute gains, while the Vulnerable profile demonstrated the most modest improvements despite beginning from the lowest baseline levels.

Table 2. Pretest and Posttest Mean Scores by Profile (N = 108)

Indicator	Vul. Pre	Vul. Post	Ada. Pre	Ada. Post	Res. Pre	Res. Post
Anxiety Regulation	2.18 (0.38)	2.62 (0.41)	2.73 (0.36)	3.21 (0.39)	3.12 (0.42)	3.89 (0.44)
Coping Skills	2.29 (0.35)	2.74 (0.38)	2.98 (0.34)	3.46 (0.36)	3.38 (0.41)	4.01 (0.42)
Self-Confidence	2.21 (0.41)	2.68 (0.45)	2.89 (0.39)	3.41 (0.40)	3.27 (0.40)	3.97 (0.43)
Motivation	2.47 (0.34)	2.93 (0.37)	3.09 (0.33)	3.58 (0.35)	3.44 (0.37)	4.05 (0.39)
Rehabilitation Readiness	2.24 (0.37)	2.71 (0.40)	2.95 (0.35)	3.44 (0.38)	3.33 (0.39)	4.02 (0.41)

Note. Values reported as Mean (SD). Vul. = Vulnerable (n = 29); Ada. = Adaptive (n = 46); Res. = Resilient (n = 33). Pre = Pretest; Post = Posttest.

As shown in Table 2, baseline scores indicated considerable psychological heterogeneity across future profile members before program delivery, with athletes subsequently classified into the Resilient profile exhibiting markedly higher pretest scores than those later assigned to the Vulnerable profile across all indicators. Following program completion, posttest scores demonstrated systematic elevation across all three profiles, with profile-based ordering preserved across all indicators. The Resilient profile recorded the highest posttest means across all five domains, while the Vulnerable profile recorded the lowest, with the Adaptive profile falling within the intermediate range throughout. These pretest–posttest patterns suggest that the three profiles identified through LPA reflect stable individual differences in psychological skill levels that are amplified rather than equalized by the training program.

Descriptive Statistics and Correlations

Posttest descriptive statistics and bivariate correlations among all five psychological indicators are presented in Table 3. Mean scores ranged from 3.21 (Anxiety Regulation) to 3.56 (Motivation), indicating moderate to moderately high average levels of adaptive psychological functioning at posttest. All inter-scale correlations were statistically significant ($p < .01$) and ranged

from moderate (.42) to moderately strong (.65), reflecting theoretically coherent relationships among the psychological skill domains.

Table 3. Descriptive Statistics and Bivariate Correlations of Posttest Psychological Variables (N = 108)

Variable	M	SD	1	2	3	4	5
Anxiety Regulation	3.21	0.62	—				
Coping Skills	3.45	0.58	.54**	—			
Self-Confidence	3.38	0.60	.49**	.61**	—		
Motivation	3.56	0.55	.42**	.58**	.63**	—	
Rehabilitation Readiness	3.41	0.59	.47**	.65**	.59**	.62**	—

Note. All correlations are significant at p < .01 (two-tailed). Higher scores indicate more adaptive psychological functioning on a five-point Likert scale.

The correlation matrix reveals that all five psychological indicators are positively and significantly interrelated, with the strongest association observed between coping skills and rehabilitation readiness (r = .65, p < .01). Motivation exhibited robust correlations with both self-confidence (r = .63) and coping skills (r = .58), consistent with theoretical propositions linking motivational resources to active coping engagement. Anxiety regulation showed the most modest correlations with motivation (r = .42) and rehabilitation readiness (r = .47), though both were significant and substantively meaningful. These coherent intercorrelation patterns confirm the suitability of the data for subsequent person-centered and multivariate analyses.

Latent Profile Analysis: Model Selection

LPA was conducted using posttest scores on all five psychological indicators as manifest variables. Table 4 presents fit indices for two- through five-profile solutions. The three-profile solution was selected as the optimal model based on its favorable balance of model parsimony, statistical fit, classification accuracy, and interpretability, as indicated by lower AIC and BIC values relative to the two-profile solution, acceptable entropy (.86), and substantively meaningful class sizes with the smallest class constituting 26.9% of the sample.

Table 4. Latent Profile Analysis Model Fit Indices for Two- Through Five-Profile Solutions

Profiles	AIC	BIC	Entropy	Smallest Class (%)
2-profile	2158.4	2212.7	.78	34.3
3-profile†	2074.6	2148.9	.86	26.9
4-profile	2068.9	2163.2	.79	11.1
5-profile	2061.2	2175.6	.72	6.5

Note. † Selected solution. AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion. Lower AIC and BIC values indicate a superior fit. Entropy values closer to 1.00 indicate stronger classification accuracy.

As indicated in Table 4, the three-profile solution achieved the most favorable combination of statistical and practical criteria. The four- and five-profile solutions yielded marginally lower information criteria but at the cost of substantially reduced smallest-class proportions (11.1% and 6.5%, respectively), introducing concerns about class stability and interpretive reliability. Entropy for the three-profile solution (.86) exceeded the accepted threshold for classification accuracy, supporting the reliability of profile assignments for subsequent analyses.

Psychological Profile Descriptions

The mean scores of each psychological indicator across the three identified profiles are summarized in Table 5 and visualized in Figure 1. Three theoretically coherent and empirically distinct profiles were identified and labeled according to their characteristic psychological configurations.

Table 5. Psychological Indicator Means Across Three Latent Profiles (N = 108)

Indicator	Profile 1: Vulnerable (n = 29)	Profile 2: Adaptive (n = 46)	Profile 3: Resilient (n = 33)
Anxiety Regulation	2.62 (0.41)	3.21 (0.39)	3.89 (0.44)
Coping Skills	2.74 (0.38)	3.46 (0.36)	4.01 (0.42)
Self-Confidence	2.68 (0.45)	3.41 (0.40)	3.97 (0.43)
Motivation	2.93 (0.37)	3.58 (0.35)	4.05 (0.39)
Rehabilitation Readiness	2.71 (0.40)	3.44 (0.38)	4.02 (0.41)

Note. Values reported as Mean (SD). Profile membership based on modal posterior probability assignment. Higher scores indicate more adaptive psychological functioning.

Table 5 reveals a systematic, interpretable gradient in psychological functioning across the three profiles. Profile 1 (Vulnerable; n = 29) was characterized by uniformly low scores across all five indicators, with means ranging from 2.62 (anxiety regulation) to 2.93 (motivation), consistently below the scale midpoint. Profile 2 (Adaptive; n = 46) exhibited moderate scores across all domains, with means ranging from 3.21 (anxiety regulation) to 3.58 (motivation), reflecting functional but not optimal psychological skill engagement. Profile 3 (Resilient; n = 33) demonstrated the highest scores across all indicators, with means ranging from 3.89 (anxiety regulation) to 4.05 (motivation), reflecting consistently high adaptive psychological functioning. These profile configurations are visually illustrated in Figure 1.

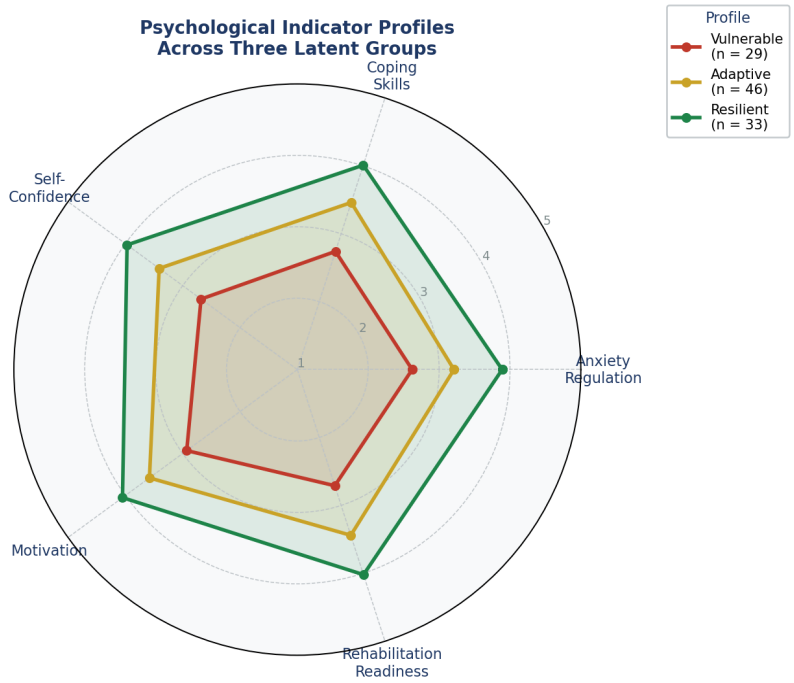

Figure 1. Radar Plot of Psychological Indicator Means Across Three Empirically Derived Profiles

Figure 1 visually confirms the systematic profile differentiation observed in Table 5. The Resilient profile polygon encompasses the full indicator space at elevated levels, whereas the Vulnerable profile is consistently compressed below the midpoint of the scale across all domains. The Adaptive profile occupies a clearly distinguishable intermediate position. Notably, the profiles are consistently differentiated across all five indicators rather than defined by variation in any single dimension, supporting the interpretation of these configurations as integrated psychological systems rather than single-trait differences.

Profile-Based Multivariate Differences (MANOVA)

MANOVA was conducted to examine the significance of profile-based differences across the combined set of psychological outcome variables. The multivariate test revealed a significant overall effect of profile membership, Wilks' $\Lambda = .41$, $F(10, 202) = 8.37$, $p < .001$, partial $\eta^2 = .29$. Follow-up univariate analyses for each psychological indicator are presented in Table 6.

Table 6. MANOVA Follow-up Univariate Results Across Psychological Profiles

Dependent Variable	F	p	Partial η^2
Anxiety Regulation	38.42	< .001	.42
Coping Skills	46.15	< .001	.47
Self-Confidence	41.27	< .001	.44
Motivation	35.08	< .001	.40
Rehabilitation Readiness	49.61	< .001	.49

Note. All F-statistics are significant at $p < .001$. Partial $\eta^2 > .14$ indicates a large effect size (Cohen, 1988). Multivariate test: Wilks' $\Lambda = .41$, $F(10, 202) = 8.37$, $p < .001$, partial $\eta^2 = .29$.

As presented in Table 6, all five psychological indicators differed significantly across the three profiles, with large effect sizes (partial η^2 range: .40–.49). Rehabilitation readiness demonstrated the largest effect size ($\eta^2 = .49$), followed by coping skills ($\eta^2 = .47$) and self-confidence ($\eta^2 = .44$). These large effects confirm that the identified profiles are empirically distinct and that the psychological differentiation between profiles is both statistically robust and practically meaningful. The pretest–posttest developmental trajectory is visualized in Figure 2.

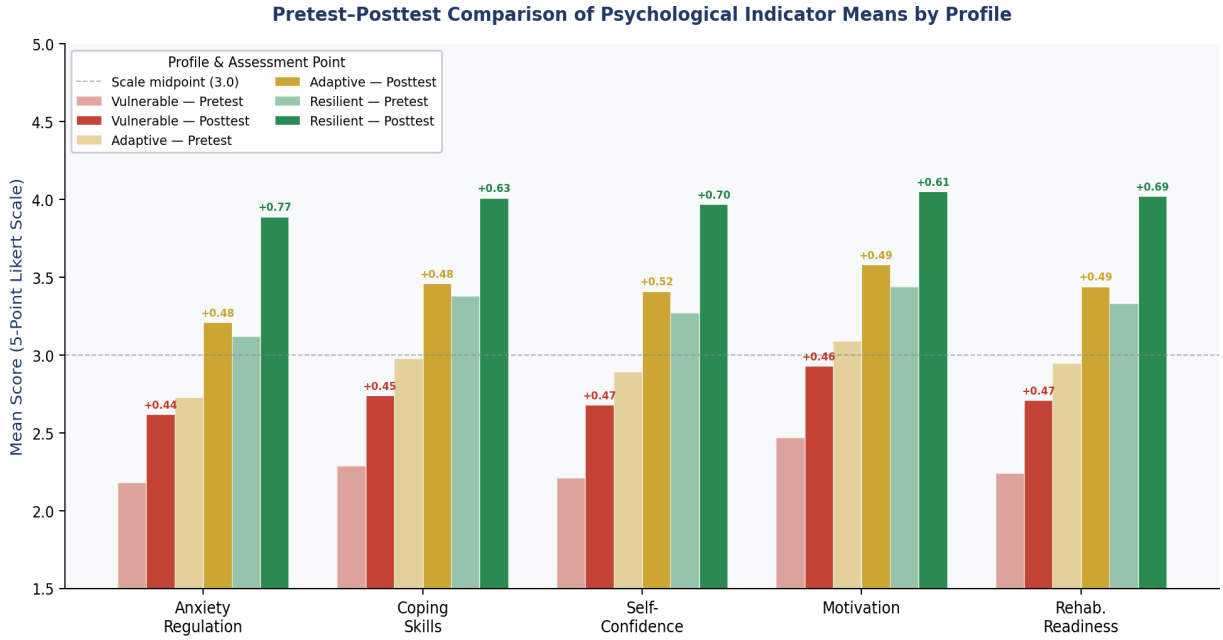

Figure 2. Pretest–Posttest Comparison of Psychological Indicator Means by Profile

Figure 2 confirms consistent positive gains across all profiles and indicators following the 16-session psychological skills training program. The Resilient profile demonstrated the most substantial absolute improvements, particularly in anxiety regulation (+0.77) and coping skills (+0.63), while the Vulnerable profile showed more modest gains (+0.44 to +0.46). The Adaptive profile exhibited intermediate gains, with the largest improvements in self-confidence (+0.52) and coping skills (+0.48). These patterns suggest that the psychological skills training program was broadly effective while simultaneously revealing that pre-existing individual differences in psychological skills were not eliminated but rather amplified by training.

Predictors of Rehabilitation Readiness: Hierarchical Regression

Hierarchical regression analysis was conducted to examine the incremental predictive utility of injury-related variables, psychological distress, and psychological skills for rehabilitation readiness. Results are summarized in Table 7.

Table 7. *Hierarchical Regression Analysis Predicting Rehabilitation Readiness (N = 108)*

Predictor	β	t	p	ΔR^2
Step 1: Injury-related Variables				.18
Injury Severity	−.31	−3.82	< .001	
Rehabilitation Phase	.26	3.14	.002	
Step 2: Psychological Distress				.11
Emotional Distress	−.29	−3.47	< .001	
Step 3: Psychological Skills				.19
Anxiety Regulation	.24	2.98	.004	
Coping Skills	.33	4.21	< .001	
Profile Membership (Resilient vs. Vulnerable)	.28	3.67	< .001	

Note. Final model: $R^2 = .48$, Adjusted $R^2 = .45$, $F(6, 101) = 15.62$, $p < .001$. β = standardized regression coefficient; ΔR^2 = incremental R^2 at each step. Profile Membership coded as Resilient = 2, Adaptive = 1, Vulnerable = 0.

Table 7 presents the hierarchical regression results predicting rehabilitation readiness. Injury-related variables entered in Step 1 accounted for a significant and practically meaningful proportion of variance ($\Delta R^2 = .18$), with injury severity (β = −.31) negatively and rehabilitation phase (β = .26) positively predicting rehabilitation readiness. The psychological distress indicator added significant explanatory power in Step 2 ($\Delta R^2 = .11$), confirming that emotional distress independently undermines rehabilitation readiness beyond injury severity considerations. Critically, the psychological skills block entered in Step 3 contributed the largest incremental variance ($\Delta R^2 = .19$), with coping skills (β = .33), profile membership (β = .28), and anxiety regulation (β = .24) all emerging as significant predictors. The final model explained 48% of total variance in rehabilitation readiness, underscoring the substantial explanatory importance of psychological skill configurations over and above injury-related factors.

Psychological Patterns Across Injury Phases

To examine the phase-specific patterning of psychological indicators, mean scores were computed separately for participants in the acute, recovery, and return-to-training phases. An empirically grounded psychological adaptation pathway synthesizing the mechanisms identified across analyses is presented in Figure 3. These phase-specific psychological indicator means are presented in the injury-phase psychological matrix (Table 8) and illustrated in Figure 4.

Table 8. *Psychological Indicator Means Across Injury Rehabilitation Phases*

Indicator	Anxiety Reg.	Coping	Confidence	Motivation	Rehab. Ready
Acute (n=34)	2.48	2.56	2.52	2.71	2.53
Recovery (n=45)	3.19	3.41	3.35	3.52	3.38
Return-to-Training (n=29)	3.84	3.97	3.92	4.01	3.98

Note. Values represent mean scores on a five-point Likert scale. Phase groupings based on clinician-categorized rehabilitation status at time of assessment.

Table 8 reveals a systematic and progressive elevation of all psychological indicator means from the acute phase to the return-to-training phase, reflecting the temporal dynamics of psychological adaptation during injury rehabilitation. Acute-phase participants showed the lowest mean scores across all indicators (range: 2.48–2.71), consistent with theoretical expectations of the emotional and regulatory demands of the immediate post-injury period. Recovery-phase participants demonstrated intermediate means (range: 3.19–3.52), whereas return-to-training participants recorded the highest scores across all domains (range: 3.84–4.01). These phase-specific patterns are visually presented in Figure 4.

Figure 3. Empirically Grounded Psychological Adaptation Pathway from Injury Severity to Rehabilitation Readiness

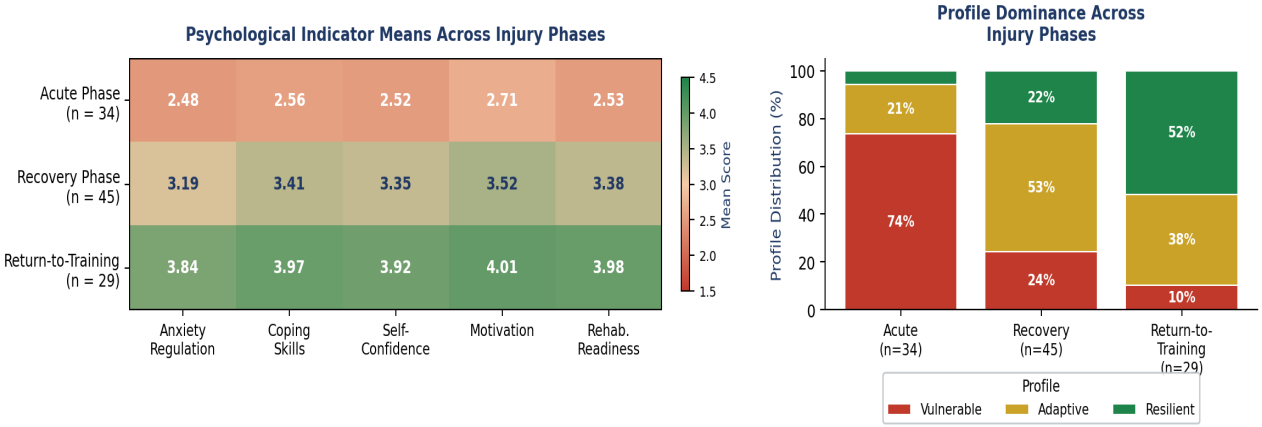

Figure 4. Injury-Phase Psychological Matrix and Profile Dominance Distribution

Figures 3 and 4 collectively illustrate the empirically grounded mechanisms through which injury severity, emotional response, and psychological regulatory capacity jointly determine rehabilitation readiness. The left panel of Figure 4 confirms the phase-specific elevation of psychological indicator means. In contrast, the right panel reveals a striking shift in profile dominance: the Vulnerable profile predominates during the acute phase (73.5%). In comparison, the Resilient profile becomes the dominant configuration by the return-to-training phase (51.7%). This temporal transition is consistent with theoretical expectations regarding the progressive accumulation of psychological regulatory capacities across rehabilitation phases. It supports the validity of the profile-based framework as a theoretically coherent account of psychological adaptation to injury.

Discussion

The present study advances the literature on sport injury psychology by providing an empirically grounded, person-centered account of psychological skill configurations among injured Pencak Silat athletes. Moving beyond variable-centered approaches that dominate injury rehabilitation research, the findings demonstrate that injured athletes do not respond to injury in a uniform psychological manner but instead exhibit distinct and systematic psychological profiles characterized by differentiated patterns of regulation, coping, confidence, motivation, and rehabilitation readiness (Chrétien et al., 2024; Ricketts, 2025). This profile-based differentiation offers a more nuanced understanding of psychological adaptation to injury and supports contemporary calls for individualized and context-sensitive models of athlete rehabilitation (Chu & Myers, 2025; Karababa, 2026; Wytykowska et al., 2022).

The identification of three psychologically meaningful profiles, Vulnerable, Adaptive, and Resilient, provides strong empirical support for integrative models of injury response that emphasize dynamic interactions between cognitive appraisal, emotional regulation, and behavioral engagement during rehabilitation (Calhoun et al., 2022; Dagnall et al., 2021; Gupta & McCarthy, 2022). Athletes classified as Vulnerable exhibited consistently low levels across all psychological indicators, suggesting limited regulatory resources and reduced capacity to engage adaptively with the rehabilitation process (Liu, Yu, et al., 2025; Newton & Chu, 2025; Purcell et al., 2023). This pattern aligns with stress–injury and cognitive appraisal frameworks, which posit that inadequate coping

resources amplify maladaptive emotional responses and undermine recovery-related behaviors (Arvinen-Barrow & Clement, 2024; Ulrich & Breitbach, 2022). In contrast, the Adaptive and Resilient profiles reflect progressively stronger psychological resources, indicating that psychological skills function as cumulative and mutually reinforcing capacities rather than isolated traits (Chu & Myers, 2025).

Significantly, the profile distinctions observed in this study extend theoretical models of sport injury psychology by empirically demonstrating that rehabilitation readiness is not merely a downstream consequence of injury severity but is substantially shaped by athletes' regulatory and coping capacities (Dai et al., 2025; Jarukasemthawee et al., 2025). The hierarchical regression results substantiate this claim, showing that psychological skills accounted for significant variance in rehabilitation readiness beyond injury-related factors (Balk & Englert, 2020; Guo et al., 2025). This finding corroborates prior research emphasizing the central role of psychological readiness in successful return-to-sport outcomes while extending it through a profile-based lens that captures heterogeneity in psychological adaptation (Anastasiou et al., 2024; Lundy et al., 2025). The emergence of coping skills and anxiety regulation as robust predictors further reinforces self-regulation theory perspectives, which conceptualize recovery as an active process requiring sustained psychological engagement and adaptive self-management (Balk & Englert, 2020).

The Latent Profile Analysis findings also offer a theoretically meaningful refinement of resilience constructs in sport injury contexts (Chrétien et al., 2024; Gucciardi et al., 2021). Rather than treating resilience as a static personality trait, the Resilient profile identified here reflects a configuration of psychological skills that collectively support adaptive functioning in the face of injury-related stress (Guo et al., 2025; Owiti & Hauw, 2025). This conceptualization resonates with contemporary resilience frameworks that define resilience as a dynamic process involving regulatory flexibility, motivational persistence, and context-sensitive coping (Chrétien et al., 2024; Ira et al., 2025). The clear separation between Adaptive and Resilient profiles further suggests that moderate psychological functioning may be sufficient for maintaining engagement during rehabilitation. In contrast, optimal recovery trajectories may require higher-order regulatory capacities to sustain motivation and confidence across injury phases.

The multivariate profile differences observed in the MANOVA provide additional theoretical insight by demonstrating that psychological indicators do not vary independently across profiles but instead cohere into integrated psychological systems (Bae, 2024; McClean et al., 2024). This systemic pattern supports biopsychosocial models of sport injury rehabilitation, which emphasize that emotional, cognitive, and motivational processes operate in concert rather than in isolation (Arvinen-Barrow et al., 2024; Takáč, 2025). The large effect sizes associated with profile membership underscore the practical significance of these differences and suggest that psychological profiling may offer a more sensitive diagnostic framework than single-variable screening tools commonly used in applied settings (Chu & Myers, 2025).

The integrative visualizations developed in this study further contribute to theory-building by translating statistical findings into conceptual mechanisms (Song et al., 2025). The psychological adaptation pathway diagram synthesizes evidence across analyses, illustrating how injury severity shapes emotional responses that, in turn, influence regulatory capacities and rehabilitation readiness (Pozzato et al., 2022). This pathway is consistent with transactional stress models and extends them by embedding psychological skills as modifiable mechanisms rather than fixed individual differences. Similarly, the injury-phase psychological matrix highlights the temporal dynamics of profile dominance across rehabilitation stages, reinforcing the notion that psychological adaptation evolves alongside the demands of physical recovery (Chrétien et al., 2024). This phase-sensitive perspective aligns with stage-based models of injury recovery and return to sport while offering a novel, profile-oriented framework for understanding psychological change over time.

From a cultural and contextual standpoint, the findings hold particular significance for combat sports such as Pencak Silat, where injury experiences are embedded within strong cultural, disciplinary, and identity-based frameworks(Lee et al., 2025; Tripathi, 2026). Psychological responses to injury in such contexts may be intensified by concerns related to competitive identity, honor, and physical mastery, which are central to martial arts traditions (Domaneschi & Ricci, 2022; Holt, 2023). The profile-based patterns observed here suggest that culturally situated psychological skills training may play a critical role in facilitating adaptive recovery, especially for athletes whose

identity investment in their sport amplifies emotional responses to injury. This insight extends the applicability of mainstream sport psychology theories to non-Western, culturally embedded sport contexts, thereby addressing a notable gap in the literature.

Collectively, the present findings advance sport injury psychology by demonstrating that psychological adaptation to injury is best understood as a profile-based, multivariate phenomenon shaped by interacting regulatory capacities rather than isolated psychological variables. By integrating person-centered analytics with theoretically informed interpretation, this study provides a robust empirical foundation for evidence-based psychological skills training models tailored to injured athletes. Such models hold promise not only for enhancing rehabilitation readiness but also for promoting sustainable return-to-sport trajectories that account for the complex psychological realities of injury recovery.

Implications

The findings of this study carry important theoretical, methodological, and applied implications for sport injury psychology and rehabilitation practice. Theoretically, the identification of distinct psychological profiles underscores the need to move beyond variable-centered models toward person-centered frameworks that capture heterogeneity in athletes' psychological adaptation to injury, thereby refining biopsychosocial and resilience-based theories of sport injury recovery. Methodologically, integrating Latent Profile Analysis with multivariate and regression-based approaches provides a robust analytical strategy for disentangling complex psychological configurations, offering a replicable model for future research in injury and performance contexts. Practically, the results highlight the value of profile-informed psychological skills training, suggesting that rehabilitation interventions should be tailored to athletes' psychological profiles rather than delivered as uniform programs. Such an approach enables practitioners to prioritize regulation and coping strategies for vulnerable athletes, consolidate adaptive skills for moderately functioning athletes, and optimize motivational and confidence-related resources for resilient athletes, ultimately supporting more efficient rehabilitation processes and psychologically sustainable return-to-sport outcomes.

Research contribution

This study makes a substantive contribution to the field of sport injury psychology by offering one of the first evidence-based, person-centered examinations of psychological skill configurations among injured combat sport athletes, specifically within the culturally embedded context of Pencak Silat. By applying Latent Profile Analysis to core psychological domains relevant to injury rehabilitation, the research advances existing theory by empirically demonstrating that psychological adaptation to injury is structured into distinct, interpretable profiles rather than linear or homogeneous processes. The integration of profile-based findings with multivariate and regression analyses further clarifies the mechanisms through which psychological skills influence rehabilitation readiness beyond injury-related factors alone. Moreover, the development of integrative visual frameworks extends the study's analytical contribution by translating complex statistical relationships into theoretically coherent and practice-relevant models. Collectively, these contributions not only deepen conceptual understanding of psychological adaptation following sport injury but also provide a scalable empirical foundation for individualized, evidence-informed psychological skills training approaches in high-risk and culturally specific sport environments.

Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, although the sample size was adequate for person-centered analyses, participants were drawn exclusively from school-based Pencak Silat programs, which may limit the generalizability of the identified psychological profiles to elite, professional, or adult athlete populations. Second, the reliance on self-report measures introduces the possibility of response bias, particularly in contexts where athletes may underreport psychological difficulties due to cultural norms surrounding toughness and resilience in combat sports. Third, while the quasi-experimental pretest–posttest design provided temporal organization, the present analyses primarily examined cross-sectional psychological configurations, precluding strong causal inferences about profile transitions over time.

Finally, injury severity and the rehabilitation phase were operationalized as categorical indicators, which may not fully capture the nuanced medical and functional variations inherent in injury recovery.

Suggestions

Future research should extend this line of inquiry by examining the longitudinal stability and transition dynamics of psychological profiles across different stages of injury rehabilitation, thereby enabling a more explicit modeling of psychological change over time. Expanding samples to include elite and professional athletes, as well as athletes from diverse cultural and sporting contexts, would further enhance the external validity of profile-based psychological frameworks. Integrating objective indicators such as physiological stress markers, clinician-rated recovery indices, or behavioral adherence data could complement self-report measures and strengthen inference. Finally, future studies may empirically test the effectiveness of profile-tailored psychological skills interventions through controlled experimental designs, thereby translating the present evidence-based profiling approach into targeted rehabilitation strategies with demonstrable performance and well-being outcomes.

CONCLUSION

This study provides compelling evidence that psychological adaptation to sport injury among Pencak Silat athletes is best understood through a person-centered, profile-based framework rather than through isolated psychological variables. By identifying distinct psychological profiles characterized by differentiated configurations of regulation, coping, confidence, motivation, and rehabilitation readiness, the findings demonstrate that psychological skills play a central role in shaping athletes' engagement in the rehabilitation process beyond injury severity alone. The integration of Latent Profile Analysis with multivariate and regression approaches, supported by theoretically informed visual syntheses, offers a robust and transferable analytical model for advancing research in sport injury psychology. Collectively, the results underscore the importance of evidence-based, profile-informed psychological skills training as a strategic component of injury rehabilitation, contributing to more adaptive recovery processes and psychologically sustainable return-to-sport outcomes.

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AUTHOR CONTRIBUTION STATEMENT

EP conceived the study, developed the research design, coordinated data collection, conducted the statistical analyses, and drafted the initial manuscript. HS & DWYK contributed to the development of research instruments, supervised data collection, and provided critical revisions on methodological rigor and psychological interpretation. AK & NIK contributed to the conceptual framework, supported the integration of sport science perspectives, and critically reviewed the manuscript for intellectual content and theoretical coherence. All authors reviewed and approved the final version of the manuscript.

AI DISCLOSURE STATEMENT

The author declares that this research was prepared, researched, written, and edited without the aid of artificial intelligence (AI) techniques. The author takes full responsibility for the content of the publication.

CONFLICTS OF INTEREST

There is no conflict in this article.

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