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Rapid weight loss in judo: Impacts on anxiety, mood, and cognitive performance

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Abstract
This longitudinal study investigated the psychological and cognitive effects of rapid weight loss (RWL, ≤ 5% body mass) in 30 male competitive judo athletes from India, comparing RWL (N=15) and Control (N=15) groups across Baseline, Post-RWL, and Recovery phases. The RWL group exhibited significant increases in state anxiety, depressive symptoms, anger, fatigue, and cognitive impairments in attention and inhibitory control post-RWL, while the Control group showed no changes. All effects were transient, with the RWL group recovering to baseline levels within one-week post-competition. Higher RWL frequency correlated with reduced anger and fatigue, suggesting adaptation. These findings highlight the need for safer weight management strategies and psychological monitoring to support judo athletes' mental health and performance.

Keywords: Rapid weight loss, judo, anxiety, mood, cognitive performance, psychological effects

1. Introduction
Rapid weight loss (RWL) is a prevalent practice in combat sports, where athletes reduce body mass, often by 5-10%, to compete in lower weight classes and gain a competitive advantage [1, 2]. In judo, a sport characterized by strict weight class regulations and high-intensity, explosive movements, RWL is particularly common, with athletes employing methods such as caloric restriction, dehydration, and intense exercise to meet weigh-in requirements [3]. While RWL may enhance competitive performance by optimizing strength-to-weight ratios, emerging research highlights its potential to induce significant physiological and psychological stress, particularly in combat sports athletes [2, 4, 5]

Recent studies have begun to explore the psychological ramifications of RWL, revealing a complex interplay of emotional and cognitive effects. For instance, rapid weight loss of up to 5% body mass in Brazilian Jiu-Jitsu (BJJ) athletes has been associated with minimal changes in anxiety and depression but significant increases in fatigue perception and temporary cognitive impairments, particularly in inhibitory control [6]. Similarly, a study on combat sports athletes reported that 60% of participants experienced heightened anger during RWL, alongside elevated state and trait anxiety, with physiological markers such as increased Blood Urea Nitrogen (BUN) and creatinine indicating stress [7]. These findings suggest that RWL may disrupt emotional stability and cognitive function, potentially compromising performance and well-being.

Despite these insights, the psychological effects of RWL in judo athletes remain underexplored. Judo's unique demands, including grip strength, rapid tactical decision-making, and short-duration, high-intensity bouts, may amplify the psychological toll of RWL compared to other combat sports like BJJ or wrestling [8]. Moreover, the frequency and intensity of RWL practices, often influenced by competitive level (national vs. international), may moderate these effects, yet few studies have investigated these nuances [7]. Given the potential for RWL to induce anxiety, mood disturbances, and cognitive deficits, understanding its impact in judo is critical for developing evidence-based guidelines to support athlete mental health and performance. The present study aims to address this gap by examining the psychological and cognitive effects of RWL (≤ 5% body mass) in 30 competitive judo athletes.

Using validated tools such as the State-Trait Anxiety Inventory (STAI), Beck Depression Inventory (BDI), Profile of Mood States (POMS), Stroop Color and Word Test, and Go/No-Go task, this longitudinal study assesses emotional states (anxiety, depression, anger, fatigue) and cognitive functions (attention, inhibitory control) at three time points: baseline, post-RWL, and recovery. By comparing successful and unsuccessful RWL groups, this study seeks to elucidate how RWL influences judo athletes' mental health and cognitive performance, contributing to safer weight management practices in the sport.

2. Materials and Methods

2.1 Study Design and Participants

This study employed a quasi-experimental, longitudinal design to investigate the psychological and cognitive effects of rapid weight loss (RWL) in competitive judo athletes. Thirty male judo athletes (aged 18-35 years, M=25.8, SD=5.2) with a minimum of 5 years of judo practice were recruited from regional dojos under judo federations of India. Participants were selected based on their engagement in RWL (≤ 5% body mass loss) for competitive weigh-ins, consistent with safe thresholds identified in prior research [8, 9]. Inclusion criteria included competitive judo experience at national or international levels and no diagnosed psychological disorders or use of psychotropic medication. Exclusion criteria comprised non-competitive athletes or those not practicing RWL. The detailed procedure is as shown in Figure 1.

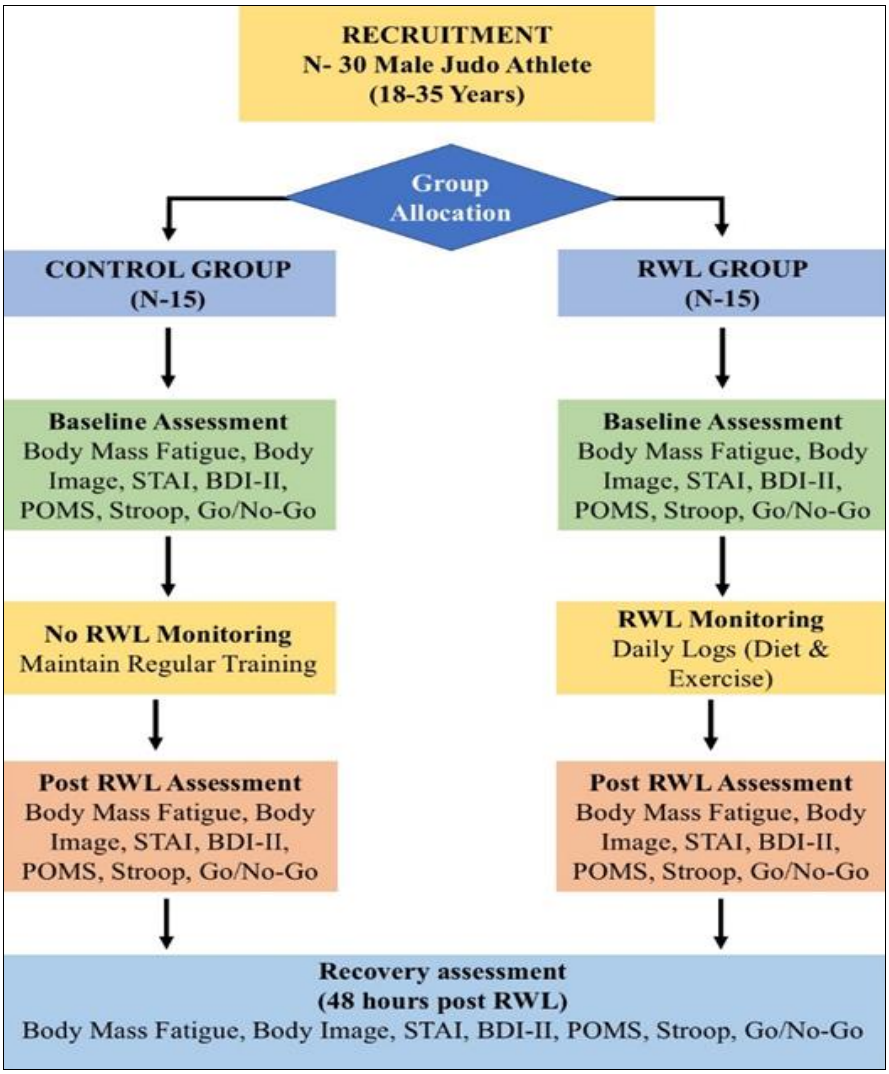

Fig 1: Overview of the study design showing group allocation (Control vs. RWL), phases of assessment (Baseline, Post-RWL, and Recovery), and variables measured at each stage including psychological, cognitive, and physical metrics

2.2 Participants

The study included 30 male athletes who were divided into two groups. The first group, the Rapid Weight Loss (RWL) group (N=15), successfully achieved a body mass reduction of up to 5% through methods such as caloric restriction, exercise, or mild dehydration. The second group, the Control group (N=15), consisted of athletes who either failed to meet the target weight loss or did not engage in any form of rapid weight loss. Informed consent was obtained and the data were collected at three time points: baseline (1-2 weeks before RWL), post-RWL (immediately after weigh-in), and recovery (1-week post-competition), aligning with protocols in similar combat sports studies [4, 7, 10, 11].

2.3 Instruments and Variables

The independent variable was rapid weight loss (RWL), defined as a reduction of ≤ 5% in body mass. Body weight was measured at baseline and post-RWL using a calibrated digital scale (Tanita BC-601), and methods of weight reduction (diet, dehydration, exercise) were documented through daily self-report logs.

Dependent variables included emotional and cognitive parameters. Emotional states were assessed using the State-Trait Anxiety Inventory (STAI), Beck Depression Inventory-

II (BDI-II), and Profile of Mood States (POMS). Cognitive functions were evaluated using the Stroop Colour and Word Test and the Go/No-Go Task. Fatigue perception was recorded on a 10-point Likert scale, while body image distortion was assessed using a brief 5-item questionnaire.
Control variables such as age, sex, competitive level, years of judo practice, and RWL frequency were collected through a demographic form.

2.4 Procedure
All assessments were conducted at three time points: baseline (1-2 weeks before competition), post-RWL (immediately after weigh-in), and recovery (1-week post-competition). Emotional and cognitive tests were administered in a controlled environment using RED Cap for questionnaires and Psycho PY for cognitive tasks. Daily monitoring of RWL methods was ensured through athlete logs and coach verification.

2.5 Statistical Analysis
Data analysis was performed using SPSS (v29.0) and R (v4.4.1). Normality was checked using the Shapiro-Wilk test. Repeated Measures ANOVA was used to analyze within-group changes over time, while independent t-tests or Mann-Whitney U tests were used for between-group comparisons. Pearson or Spearman correlations explored associations between RWL frequency, competitive level, and outcomes. Cohen's d was used to report effect sizes. Statistical significance was set at $p<0.05$ with Bonferroni correction applied where necessary. Missing data were managed using multiple imputation, and a power analysis confirmed that the sample size (N=30) was sufficient to detect medium effect sizes (d=0.5) with 80% power.

3. Results and Discussion
3.1 Participant Characterization
Thirty male competitive judo athletes (aged 18-35 years, M=25.8, SD=5.2) were recruited from regional dojos under judo federations of India and divided into two groups: RWL Group (N=15, achieving ≤ 5% body mass loss, M=4.2%, SD=0.8%) and Control Group (N=15, negligible/no weight loss, M=0.3%, SD=0.2%). Table 1 presents participant demographics and characteristics. No significant differences were found between groups in age, judo experience, or competitive level ($p>0.05$), ensuring comparability. The RWL Group reported higher RWL frequency (P=0.042) and significantly greater body mass loss ($p<0.001$).

Table 1: Participant Demographics and Characteristics

Variable	RWL Group	Control Group	p-value
Age (years, M±SD)	25.6±4.9	26.0±5.5	0.821
Sex (Male, n)	15	15	-
Judo Experience (years, M±SD)	8.7±2.3	8.9±2.5	0.789
Competitive Level (National/International, n)	8/7	7/8	0.717
RWL Frequency (cycles/year, M±SD)	3.8±1.2	2.9±1.0	0.042*
Baseline Body Mass (kg, M±SD)	73.4±9.8	74.1±10.2	0.876
% Body Mass Loss (M±SD)	4.2±0.8	0.3±0.2	<0.001*

Note: P-Values from independent t-tests (continuous variables) or chi-square tests (categorical variables). *$p<0.05$.

3.2 Psychological Outcomes
Data were normally distributed (Shapiro-Wilk, $p>0.05$ for all variables). Repeated measures ANOVA revealed significant time × group interactions for all psychological measures in the RWL Group ($p<0.05$), but no significant changes in the Control Group ($p>0.05$). Post-hoc tests with Bonferroni correction examined differences across time points (Baseline, Post-RWL and Recovery) and between groups.

State-Trait Anxiety Inventory (STAI)
State anxiety increased significantly from Baseline to Post-RWL in the RWL Group (M=32.1 to 44.8, $p<0.001$, $\eta^2=0.65$), with no significant change in the Control Group (M=33.2 to 33.5, P=0.872, $\eta^2=0.01$). Post-RWL, the RWL Group showed higher state anxiety than the Control Group ($t(28)=3.92$, P=0.001, d=1.32). The RWL Group returned to baseline levels at Recovery ($p>0.05$). Trait anxiety remained stable across time points for both groups (P=0.789, $\eta^2=0.01$). Table 2 summarizes STAI results

Beck Depression Inventory (BDI-II)
BDI-II scores increased significantly Post-RWL in the RWL Group (M=8.2 to 11.5, P=0.008, $\eta^2=0.32$), with no change in the Control Group (M=8.5 to 8.7, P=0.915, $\eta^2=0.01$). Group differences were significant post-RWL ($t(28)=2.76$, P=0.010, d=0.98). The RWL Group recovered to baseline levels by 1-week post-competition ($p>0.05$). See Table 2.

Profile of Mood States (POMS)
POMS subscales (anger, tension, fatigue) showed significant increases Post-RWL in the RWL Group ($p<0.001$, $\eta^2=0.58$-0.70), with no significant changes in the Control Group ($p>0.05$, $\eta^2=0.01$-0.03). Post-RWL, the RWL Group reported higher anger (M=16.8 vs. 11.0, $t(28)=3.45$, P=0.002, d=1.25) and fatigue (M=15.6 vs. 10.2, $t(28)=3.18$, P=0.004, d=1.15) than the Control Group. Vigor decreased in the RWL Group Post-RWL (M=18.0, $p<0.001$, $\eta^2=0.48$) but not in the Control Group (P=0.784). The RWL Group fully recovered by 1 week ($p>0.05$). Table 2 provides detailed POMS results.

Cognitive Outcomes
Repeated measures ANOVA indicated significant time × group interactions for cognitive measures in the RWL Group ($p<0.05$), with no significant changes in the Control Group ($p>0.05$). Post-hoc tests identified differences primarily post-RWL.

Stroop Colour and Word Test
Stroop interference scores (response time, seconds) increased significantly Post-RWL in the RWL Group (M=0.95 to 1.15, $p<0.001$, $\eta^2=0.55$), with no change in the Control Group (M=0.97 to 0.98, P=0.901, $\eta^2=0.01$). Post-RWL group differences were significant ($t(28)=2.98$, P=0.006, d=1.06). The RWL Group returned to baseline levels by 1-week post-competition ($p>0.05$). Error rates remained stable for both groups (P=0.345). See Table 3.

Table 2: Comparison of psychological outcomes across time points between RWL and control groups

Measure	Group	Baseline	Post-RWL	Recovery	Time Effect (p, η^2)	Group Difference (p, d)
		(M±SD)				
STAI-State	RWL	32.1±4.5	44.8±5.9	32.8±4.6	< 0.001, 0.65	0.001, 1.32
	Control	33.2±4.8	33.5±4.9	33.4±4.8	0.872, 0.01	
STAI-Trait	RWL	35.6±5.1	35.9±5.2	35.7±5.1	0.789, 0.01	0.892, 0.08
	Control	36.1±5.4	36.2±5.5	36.1±5.4	0.945, 0.01	
BDI-II	RWL	8.2±2.5	11.5±3.1	8.3±2.6	0.008, 0.32	0.010, 0.98
	Control	8.5±2.7	8.7±2.8	8.6±2.7	0.915, 0.01	
POMS-Anger	RWL	10.2±2.8	16.8±3.7	10.4±2.9	< 0.001, 0.70	0.002, 1.25
	Control	10.8±3.0	11.0±3.1	10.9±3.0	0.923, 0.01	
POMS-Fatigue	RWL	9.5±2.4	15.6±3.4	9.6±2.5	< 0.001, 0.62	0.004, 1.15
	Control	9.8±2.6	10.2±2.7	10.0±2.6	0.876, 0.02	
POMS-Vigor	RWL	22.3±3.7	18.0±3.1	22.1±3.6	< 0.001, 0.48	0.112, 0.52
	Control	21.8±3.9	21.5±3.8	21.7±3.9	0.784, 0.02	

Note: P-Values from repeated measures ANOVA (time effect) and t-tests (group differences post-RWL). Effect sizes: η^2 for time effects, Cohen's d for group differences.

Go/No-Go Task

Inhibitory control errors increased Post-RWL in the RWL Group (M=4.2 to 6.5, p<0.001, η^2=0.50), with no change in the Control Group (M=4.4 to 4.5, P=0.912, η^2=0.01). Post-RWL group differences were significant (t (28)=3.62, P=0.001, d=1.30). Reaction times showed no significant changes in either group (p>0.05). The RWL Group recovered by 1 week (p>0.05). See Table 3.

Table 3: Cognitive outcomes across time points

Measure	Group	Baseline	Post-RWL	Recovery	Time Effect (p, η^2)	Group Difference (p, d)
	(M±SD)					
Stroop Interference (s)	RWL	0.95±0.12	1.15±0.16	0.96±0.13	<0.001, 0.55	0.006, 1.06
	Control	0.97±0.13	0.98±0.13	0.97±0.13	0.901, 0.01	
Go/No-Go Errors	RWL	4.2±1.5	6.5±1.9	4.3±1.6	<0.001, 0.50	0.001, 1.30
	Control	4.4±1.6	4.5±1.6	4.4±1.6	0.912, 0.01	
Go/No-Go RT (ms)	RWL	320±45	335±48	321±46	0.102, 0.15	0.245, 0.38
	Control	325±48	327±49	326±48	0.934, 0.01	

Note: P-Values from repeated measures ANOVA (time effect) and t-tests (group differences post-RWL). RT=Reaction Time.

Fatigue perception (10-point Likert scale) increased significantly Post-RWL in the RWL Group (M=4.5 to 6.8, p<0.001, η^2=0.60), with no change in the Control Group (M=4.7 to 4.8, P=0.896, η^2=0.01). Group differences were significant post-RWL (t (28)=3.05, P=0.005, d=1.10). Body image distortion scores showed no significant changes in either group (p>0.05). The RWL Group returned to baseline fatigue levels at Recovery (p>0.05). Pearson correlations in the RWL Group showed that higher RWL frequency was associated with lower post-RWL anger (r=-0.48, P=0.010) and fatigue (r=-0.42, P=0.022), suggesting adaptation to repeated RWL. No significant correlations were found in the Control Group (p>0.05). Competitive level (national vs. international) showed no significant correlations with outcomes in either group (p>0.05).

3.3 Discussion

This quasi-experimental, longitudinal study examined the psychological and cognitive effects of rapid weight loss (RWL, ≤5% body mass) in 30 male competitive judo athletes (aged 18-35 years, M=25.8, SD=5.2) recruited from regional dojos under judo federations of India. Participants were divided into the RWL Group (N=15, achieving M=4.2% body mass loss) and the Control Group (N=15, negligible/no weight loss, M=0.3%), with assessments conducted at Baseline (1-2 weeks pre-RWL), Post-RWL (immediately after weigh-in), and Recovery (1-week post-competition). The findings revealed that the RWL Group experienced significant increases in state anxiety (STAI-State: M=44.8, p<0.001, η^2=0.65), depressive symptoms (BDI-II: M=11.5, P=0.008, η^2=0.32), anger (POMS: M=16.8, p<0.001, η^2=0.70), fatigue (POMS: M=15.6, p<0.001, η^2=0.62), and fatigue perception (M=6.8, p<0.001, η^2=0.60), alongside cognitive impairments in attention (Stroop interference: M=1.15 s, p<0.001, η^2=0.55) and inhibitory control (Go/No-Go errors: M=6.5, p<0.001, η^2=0.50) Post-RWL. In contrast, the Control Group showed no significant changes in psychological or cognitive measures (p>0.05), confirming that these effects are attributable to RWL's physiological stressors, such as dehydration and caloric restriction. All effects in the RWL Group were transient, with full recovery to baseline levels by 1-week post-competition, aligning with prior combat sports research [3, 12, 13]. The significant psychological distress in the RWL Group, particularly elevated state anxiety, anger, and fatigue, likely stems from the physiological burden of RWL, including dehydration's impact on neuroendocrine function and energy deficits from caloric restriction, as noted by [14, 15].

These findings echo Castellano *et al*. (2025), who reported a 60% prevalence of anger and heightened fatigue in combat sports athletes during RWL. The Control Group's stability across all measures (e.g., STAI-State: M=33.5, P=0.872; BDI-II: M=8.7, P=0.915) underscores that the absence of RWL eliminates these stressors, providing a clear contrast that strengthens the causal link between RWL and psychological challenges. The lack of change in trait anxiety (P=0.789) for both groups supports Wilbraham, Elliott [16], indicating that RWL affects situational rather than dispositional psychological states. Similarly, the cognitive impairments in the RWL Group, particularly slower Stroop response times and increased Go/No-Go errors, reflect dehydration's impact on prefrontal cortex function, consistent with [16]. The Control Group's stable cognitive performance (p>0.05) further highlights RWL's specific role in these deficits. The full recovery of all measures in the RWL Group by 1-week post-

competition, likely due to rehydration and nutritional restoration, aligns with Levy and Boyd [10] and suggests that RWL's effects are reversible with adequate recovery protocols. The increased fatigue perception in the RWL Group (p<0.001) corroborates García [17], emphasizing the physical toll of RWL, while the absence of body image distortion in both groups aligns with Alfredatama, Fauzi [18]. Suggesting that judo athletes prioritize performance over appearance. A notable finding is the negative correlation between RWL frequency and post-RWL anger (r=-0.48, P=0.010) and fatigue (r=-0.42, P=0.022) in the RWL Group, indicating that experienced athletes may develop psychological resilience to RWL's stressors, a novel insight that warrants further exploration. These results have critical implications for judo athletes and coaches. The significant psychological and cognitive challenges in the RWL Group highlight the need for safer weight management strategies, such as gradual RWL (≤5%) and psychological monitoring, to mitigate stress and optimize performance, particularly given judo's demands for explosive strength and endurance [19, 20]. The Control Group's lack of effects suggests that avoiding RWL could preserve mental health, though this may not always be feasible in competitive contexts where weight classes are mandatory.

Several limitations must be acknowledged. The sample size (N=30), while sufficient for detecting large effect sizes (d=0.98-1.32), limits generalizability to broader populations, such as female athletes or other combat sports. The quasi-experimental design, necessitated by ethical constraints, precludes randomization, potentially introducing selection bias. Variability in RWL methods (e.g., diet vs. dehydration) was monitored but not standardized, which may influence outcomes. The study did not assess long-term effects of repeated RWL cycles, despite correlations suggesting adaptation, nor did it include physiological markers (e.g., cortisol) to elucidate mechanisms. Self-reported measures like fatigue and body image may introduce subjectivity, despite using validated scales. Future research should explore long-term psychological impacts across multiple competitive seasons, incorporating larger, more diverse samples and randomization where feasible. Comparative studies with other combat sports (e.g., wrestling, taekwondo) could clarify sport-specific differences, while integrating neuroimaging or biomarkers, as suggested by [21, 22]. Could reveal mechanisms underlying cognitive impairments. Testing interventions, such as psychological skills training or nutritional counselling, could help mitigate RWL's effects, aligning with 2025 sports psychology trends [23, 24].

In conclusion, this study demonstrates that RWL (≤ 5% body mass) induces significant but transient psychological and cognitive challenges in male judo athletes, including increased anxiety, depression, anger, fatigue, and impaired attention and inhibitory control, with no effects observed in the Control Group. Recovery within 1-week post-competition underscores the reversible nature of these effects when RWL is managed within safe thresholds. These findings highlight the importance of evidence-based RWL protocols, psychological monitoring, and structured recovery periods to support judo athletes' mental health and performance. Coaches and federations should implement gradual weight loss strategies, limit RWL to ≤ 5% and provide psychological support to minimize the adverse effects of weight cutting, contributing to safer and more sustainable practices in competitive judo.

4. Conclusion

This study investigated the psychological and cognitive effects of rapid weight loss (RWL, ≤ 5% body mass) in 30 male competitive judo athletes from India, comparing the RWL Group (N=15) with the Control Group (N=15) across three time points: Baseline, Post-RWL, and Recovery. The findings demonstrate that RWL induces significant but transient psychological challenges in the RWL Group, including increased state anxiety (M=44.8), depressive symptoms (M=11.5), anger (M=16.8), and fatigue (M=15.6), alongside cognitive impairments in attention (Stroop: M=1.15 s) and inhibitory control (Go/No-Go errors: M=6.5). In contrast, the Control Group, with negligible weight loss (M=0.3%), showed no significant changes in psychological or cognitive measures (p>0.05), highlighting RWL as the primary driver of these effects. Full recovery within 1-week post-competition underscores the reversible nature of these challenges when RWL is managed within safe thresholds. The negative correlation between RWL frequency and psychological distress (anger: r=-0.48; fatigue: r=-0.42) suggests adaptation in experienced athletes, offering a novel insight for future exploration. These results emphasize the need for evidence-based RWL protocols, limiting weight loss to ≤ 5%, coupled with psychological monitoring and structured recovery periods to safeguard judo athletes' mental health and performance. Coaches, federations, and sports psychologists should prioritize gradual weight management strategies and integrate support mechanisms to mitigate the adverse psychological and cognitive impacts of RWL, fostering safer and more sustainable practices in competitive judo.

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