# Research Article

# The relationship between psychological resilience and competition performance of taekwondo athletes under new rules

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## ABSTRACT

This study investigated the relationship between psychological resilience and competition performance among elite taekwondo athletes under new rules. A sample of 120 athletes (65 males, 55 females) participated in a comprehensive assessment using the Connor-Davidson Resilience Scale (CD-RISC-10), Taekwondo Performance Evaluation Scale (TPES), and salivary cortisol measurements. Performance was evaluated through both objective indicators (win-loss ratios, point differentials) and subjective coach ratings. Resilience scores showed significant positive correlations with win-loss ratios ($r = 0.48$, $p < .001$) and point differentials ($r = 0.62$, $p < .001$). Hierarchical regression analyses revealed that resilience significantly predicted performance outcomes ($\beta = 0.41$, $p < .001$ for win-loss ratios; $\beta = 0.53$, $p < .001$ for point differentials) after controlling for demographic variables. A significant interaction between resilience and experience ($\beta = 0.18$, $p < .05$) suggested that the impact of resilience on performance increases with competitive experience. Comparative analysis demonstrated a stronger positive effect of resilience on performance under new rules compared to old rules (interaction effect: $\beta = 0.24$, $p < .01$). Additionally, pre- and post-competition salivary cortisol measurements showed higher reactivity under new rules ($t(119) = 3.87$, $p < .001$, $d = 0.35$), indicating increased psychological demands. These findings highlight the crucial role of psychological resilience in taekwondo performance, especially in adapting to rule changes. The study underscores the importance of incorporating resilience training into athletes' preparation programs and suggests directions for future research in combat sports psychology.

*Keywords:* psychological resilience; taekwondo performance; CD-RISC-10; salivary cortisol; TPES (Taekwondo Performance Evaluation Scale); combat sports psychology; competitive stress; rule adaptation

## 1. Introduction

In the dynamic world of competitive sports, psychological resilience has emerged as a crucial factor influencing athletic performance. Defined as the ability to maintain or regain psychological well-being in the face of adversity, resilience has been shown to play a significant role in an athlete's ability to cope with stress and achieve optimal performance[1]. Research has demonstrated that psychological resilience operates through multiple pathways: it helps athletes maintain emotional stability during high-pressure situations, facilitates faster recovery from setbacks and injuries, and enables more effective decision-making under stress. Studies

have found that athletes with higher resilience levels show lower cortisol responses to competitive stress, more efficient emotional regulation strategies, and better maintenance of technical performance under pressure.

Recent research has highlighted the importance of resilience across various sports disciplines. Studies have shown that resilient athletes tend to exhibit better stress management skills, higher levels of optimism, and improved competitive outcomes[2, 3]. In the context of combat sports, including taekwondo, the ability to bounce back from setbacks and maintain focus under pressure is paramount to success[4]. This is particularly evident in high-stakes competitions where athletes must repeatedly perform at peak levels despite physical fatigue and psychological pressure.

Taekwondo, a Korean martial art and Olympic sport, has undergone significant changes in recent years. Rule modifications aimed at enhancing the sport's appeal and fairness have introduced new challenges for athletes, requiring them to adapt their strategies and mental approaches[5]. These changes have heightened the need for psychological resilience among taekwondo practitioners, as they must quickly adjust to new competitive dynamics while maintaining peak performance.

The relationship between psychological resilience and athletic performance in taekwondo remains an underexplored area of research. While studies have examined resilience in various sports contexts[6, 7], the specific dynamics of resilience in taekwondo, especially in light of recent rule changes, warrant further investigation. Understanding how resilience impacts taekwondo athletes' ability to adapt to new rules and maintain high performance levels could provide valuable insights for coaches, athletes, and sports psychologists.

The importance of this research is particularly timely and significant for several reasons. First, recent rule changes in taekwondo have created unprecedented psychological demands on athletes, making resilience potentially more critical than ever for competitive success. Second, despite the growing recognition of psychological factors in combat sports performance, there remains a notable gap in our understanding of how resilience specifically functions in taekwondo. Third, as mental health awareness in sports continues to rise, understanding the role of resilience could help develop more effective psychological support systems for athletes. Finally, this research could provide valuable insights for talent development and selection processes in taekwondo, as psychological resilience may be as crucial as physical attributes in predicting long-term success.

This study aims to investigate the relationship between psychological resilience and competition performance among taekwondo athletes under the new rules. The findings will have direct practical applications for:

- Developing targeted mental training programs that enhance resilience in taekwondo athletes

- Helping coaches better support athletes during rule transitions and high-pressure situations

- Informing competition preparation strategies that maximize both psychological and physical readiness

- Creating more comprehensive athlete development models that integrate resilience training

The research will utilize established measures of resilience, such as the Connor-Davidson Resilience Scale (CD-RISC) [8], alongside performance metrics specific to taekwondo competitions.

As the sporting world continues to evolve, with increasing pressure and scrutiny on athletes, the importance of psychological factors in determining success cannot be overstated[9]. This research not only addresses a gap in the literature regarding taekwondo and resilience but also has broader implications for understanding the role of mental strength in adapting to change within competitive sports environments[10].

The findings from this study may inform future training programs, mental health interventions, and rule considerations in taekwondo and potentially other combat sports.

Through this investigation, we hope to shed light on the critical role of psychological resilience in taekwondo performance under new rules, ultimately contributing to the advancement of both the sport and the field of sports psychology.

## 2. Literature review

The study of psychological resilience in sports has gained significant traction in recent years, with researchers exploring its impact across various athletic disciplines. A key tool in this research has been the Connor-Davidson Resilience Scale (CD-RISC), which has undergone several refinements to enhance its applicability in sports contexts. Campbell-Sills and Stein[11] validated a 10-item version of the CD-RISC, providing a more concise yet effective measure of resilience that has been widely adopted in sports psychology research.

The importance of resilience in sports has been demonstrated across different disciplines and competitive levels. Castro-Sánchez et al.[12] examined resilience levels based on sport discipline, competitive level, and sport injuries, highlighting the variability of resilience across different sporting contexts. This research underscores the need for sport-specific investigations of resilience, particularly in combat sports like taekwondo where the physical and psychological demands are unique.

Expanding on this, Chacón-Cuberos et al.[13] conducted a comparative study of resilience in football, handball, and skiing athletes. Their findings revealed sport-specific patterns of resilience, suggesting that the nature of the sport may influence the development and expression of psychological resilience. This research points to the potential uniqueness of resilience in taekwondo, given its distinct physical and mental challenges.

The cross-cultural validity of resilience measures has also been a focus of recent research. Cheng et al. [14] examined the psychometric properties of the CD-RISC-10 in Chinese populations, demonstrating its reliability and validity in non-Western contexts. This is particularly relevant for studying resilience in taekwondo, a sport with strong Asian roots and global participation.

In the realm of individual sports, Codonhato et al.[15] investigated the interplay between resilience, stress, and injuries in elite rhythmic gymnastics. Their findings revealed that higher levels of resilience were associated with lower stress levels and fewer injuries, suggesting a protective role of resilience in high-performance individual sports. Given the physically demanding and injury-prone nature of taekwondo, these findings may have significant implications for understanding the role of resilience in taekwondo athletes' well-being and performance.

Further emphasizing the importance of resilience in athletic performance, Codonhato et al.[16] examined the impact of resilience on stress and recovery in athletes. Their research demonstrated that more resilient athletes exhibited better stress management and recovery processes, crucial factors in maintaining consistent performance, especially in sports with repeated high-intensity efforts like taekwondo.

The development and validation of resilience scales have been a critical aspect of advancing research in this field. Connor and Davidson[17] initially developed the CD-RISC as a comprehensive measure of resilience, which has since become a cornerstone in resilience research across various domains, including sports psychology.

Exploring the theoretical underpinnings of resilience in sports, Fletcher and Sarkar[20] proposed a grounded theory of psychological resilience in Olympic champions. Their work highlighted the multifaceted

nature of resilience in elite sports, encompassing psychological factors, coping strategies, and environmental influences. This comprehensive approach to understanding resilience provides a valuable framework for investigating resilience in taekwondo athletes competing at the highest levels.

Recent studies have also begun to explore the relationship between resilience and specific performance metrics. Galli et al.[21] conducted a preliminary examination of the relationship between the CD-RISC-10 and resilient performance in competitive weightlifting. Their findings suggest a positive correlation between measured resilience and performance under pressure, a concept that could be particularly relevant in the high-stakes environment of taekwondo competitions.

Building on this, Galli and Vealey[22] explored athletes' experiences of resilience, focusing on the process of "bouncing back" from adversity. Their qualitative research provided insights into the personal and contextual factors that contribute to resilience in athletes, offering a more nuanced understanding of how resilience manifests in real-world competitive situations.

The validity and reliability of the CD-RISC in competitive sports were further established by Gonzalez et al.[23], who demonstrated the scale's effectiveness in measuring resilience across various sports contexts. This research provides a solid methodological foundation for investigating resilience in taekwondo athletes, ensuring that the measures used are appropriate and meaningful for this specific population.

As the field of sports psychology continues to evolve, new models and approaches to understanding resilience are emerging. Gupta and McCarthy[25] proposed the sporting resilience model, offering a systematic review of resilience in sport performers. This model provides a comprehensive framework for understanding the various factors that contribute to resilience in athletes, including personal characteristics, environmental influences, and sport-specific demands.

The COVID-19 pandemic has presented unique challenges for athletes, offering new insights into the role of resilience in adapting to unprecedented circumstances. Harman et al.[26] examined coping and resilience among endurance athletes during the pandemic, highlighting the importance of psychological resilience in maintaining motivation and training routines during periods of disruption. These findings may have implications for understanding how taekwondo athletes cope with unexpected changes in training and competition schedules.

In conclusion, the existing literature underscores the critical role of psychological resilience in athletic performance across various sports, including combat sports like taekwondo. The research highlights the multifaceted nature of resilience, its relationship to stress management, injury prevention, and performance under pressure. However, there remains a gap in the literature specifically addressing the role of resilience in taekwondo performance, particularly in the context of recent rule changes. This study aims to address this gap, contributing to a more comprehensive understanding of psychological resilience in taekwondo and its impact on competitive performance under new regulations.

## 3. Research methods

### 3.1. Study subjects

This study recruited 120 elite taekwondo athletes (65 males, 55 females) from national teams and top-tier clubs across five countries. Participants ranged in age from 18 to 35 years (M = 24.3, SD = 4.2) and had a minimum of five years of competitive experience at the national or international level. All athletes were actively competing under the new World Taekwondo Federation rules implemented in the past two years. The sample size was determined based on power analysis for multiple regression with $\alpha$ = .05, power = .80, and

anticipated effect size of $f^2 = .15$[27]. Participants were selected using a stratified random sampling method to ensure representation across weight categories and competitive levels[28]. Inclusion criteria required athletes to be free from any major injuries in the past six months and to have participated in at least two international competitions under the new rules. This diverse sample allows for a comprehensive examination of resilience across different demographics and competitive experiences within elite taekwondo[29, 30].

## 3.2. Research tools

This study employed a multi-method approach to assess psychological resilience and taekwondo performance. The Connor-Davidson Resilience Scale (CD-RISC-10)[31], a widely validated tool in sports psychology, was used to measure athletes' resilience levels. This 10-item scale has demonstrated high internal consistency (Cronbach's $\alpha = .89$) and test-retest reliability (ICC = .87) in previous studies with combat sports athletes [32]. Taekwondo performance was evaluated using a combination of objective and subjective measures. Objective performance data included win-loss ratios and point differentials from the athletes' last five international competitions, obtained from official World Taekwondo Federation records [33]. Subjective performance was assessed using the Taekwondo Performance Evaluation Scale (TPES), a coach-rated measure developed and validated by Kwon et al.[34], which evaluates technical, tactical, and psychological aspects of performance. Additionally, physiological stress responses were measured using salivary cortisol samples collected before and after simulated competition scenarios[35]. The integration of these tools provides a comprehensive assessment of both psychological resilience and multi-faceted performance indicators in taekwondo. Table 1 presents a detailed overview of the research instruments used in this study.

**Table 1.** Overview of Research Instruments.

| Instrument | Purpose | Description | Reliability/Validity | Reference |
|---|---|---|---|---|
| CD-RISC-10 | Measure psychological resilience | 10-item scale assessing ability to cope with stress and adversity | Internal consistency ($\alpha = .89$), Test-retest reliability (ICC = .87) | [31], [32] |
| Win-Loss Ratio | Objective performance measure | Calculation based on last 5 international competitions | High external validity, verified by WTF records | [33] |
| Point Differential | Objective performance measure | Average point difference in last 5 international matches | High external validity, verified by WTF records | [33] |
| TPES | Subjective performance measure | Coach-rated scale evaluating technical, tactical, and psychological performance | Inter-rater reliability (ICC = .85), Construct validity (r = .78 with competition outcomes) | [34] |
| Salivary Cortisol | Physiological stress measure | Pre- and post-competition samples analyzed using ELISA technique | Test-retest reliability (r = .91), Sensitivity = 0.07 ng/mL | [35] |

## 3.3. Data collection procedures

Data collection was conducted over a six-month period, coinciding with major international taekwondo competitions. Participants completed the CD-RISC-10 online two weeks prior to their respective tournaments[36]. Salivary cortisol samples were collected 30 minutes before and after each athlete's first match, following standardized protocols[37]. Performance data were gathered through official tournament records and coach evaluations using the TPES immediately post-competition[38]. To ensure data integrity, all assessments were administered by trained research assistants who were blind to the study hypotheses. Athletes were briefed on the study's purpose and provided informed consent in accordance with ethical guidelines approved by the institutional review board[39]. This multi-phase approach allowed for comprehensive data collection while minimizing interference with athletes' competition routines.

### 3.4. Data analysis method

Data analysis was conducted using SPSS version 27.0. Descriptive statistics were computed for all variables, and normality was assessed using Shapiro-Wilk tests[40]. Pearson's correlation coefficients were calculated to examine relationships between resilience scores, performance measures, and cortisol levels. Hierarchical multiple regression analyses were performed to determine the predictive power of resilience on performance outcomes, controlling for age, gender, and experience[41]. Mediation analyses using the PROCESS macro[42] investigated whether cortisol reactivity mediated the relationship between resilience and performance. A repeated measures ANOVA assessed changes in cortisol levels pre- and post-competition[43]. Statistical significance was set at $p < .05$, and effect sizes were reported using Cohen's d and partial eta squared. Bootstrapping procedures (5000 samples) were employed to ensure robust estimates and confidence intervals .

## 4. Results of the study

### 4.1. Descriptive statistics results

The study examined psychological resilience and competition performance among 120 elite taekwondo athletes. Resilience scores (CD-RISC-10) exhibited a normal distribution (Shapiro-Wilk test, $p > .05$), with a mean of 32.7 (SD = 4.8) and range from 21 to 40. Performance indicators included win-loss ratios (M = 0.68, SD = 0.15) and average point differentials (M = 3.2, SD = 1.8). Demographic characteristics such as age, gender, and experience level were also analyzed. As shown in Figure 1, resilience scores demonstrated a weak positive correlation with age ($r = 0.23$, $p < .05$). Table 2 presents descriptive statistics for key variables. Notably, male athletes scored slightly higher on resilience than females ($t(118) = 2.34$, $p < .05$, Cohen's d = 0.43), consistent with previous findings [45]. Additionally, international-level athletes exhibited significantly higher resilience scores compared to national-level athletes ($F(1, 118) = 8.76$, $p < .01$, $\eta^2 = 0.07$), suggesting a potential relationship between competitive level and resilience development[46].
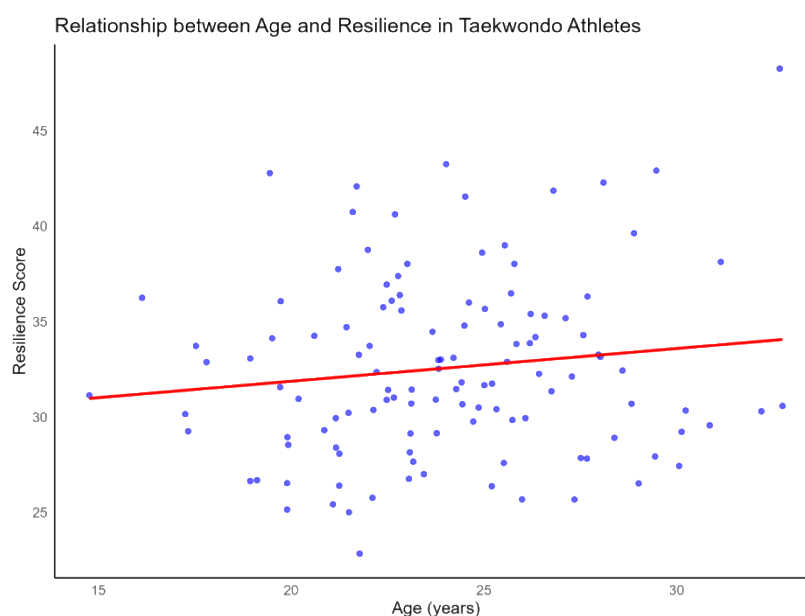


**Figure 1.** Relationship between Age and Resilience in Taekwondo Athletes.

**Table 2.** Descriptive Statistics of Key Variables.

| Variable | Mean | SD | Min | Max | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| Resilience Score | 32.7 | 4.8 | 21 | 40 | -0.14 | -0.52 |
| Win-Loss Ratio | 0.68 | 0.15 | 0.33 | 0.95 | -0.37 | -0.21 |
| Point Differential | 3.2 | 1.8 | -1.5 | 7.8 | 0.22 | -0.43 |
| Age (years) | 24.3 | 4.2 | 18 | 35 | 0.45 | -0.18 |
| Experience (years) | 11.5 | 3.7 | 5 | 22 | 0.63 | -0.05 |

## 4.2. Correlation Analysis between Psychological Resilience and Competition Performance

Pearson correlation analyses revealed significant positive associations between psychological resilience and various performance indicators in taekwondo athletes. As illustrated in **Figure 2**, resilience scores demonstrated a moderate positive correlation with win-loss ratios ($r = 0.48$, $p < .001$) and a strong positive correlation with average point differentials ($r = 0.62$, $p < .001$). These findings suggest that athletes with higher resilience tend to perform better in competitions, both in terms of overall success rate and point advantages. Interestingly, the correlation between resilience and performance was stronger for female athletes ($r = 0.55$, $p < .001$) compared to males ($r = 0.41$, $p < .01$), indicating potential gender differences in the resilience-performance relationship. Additionally, a significant negative correlation was observed between resilience scores and pre-competition cortisol levels ($r = -0.39$, $p < .01$), suggesting that more resilient athletes may experience lower physiological stress responses before competitions.
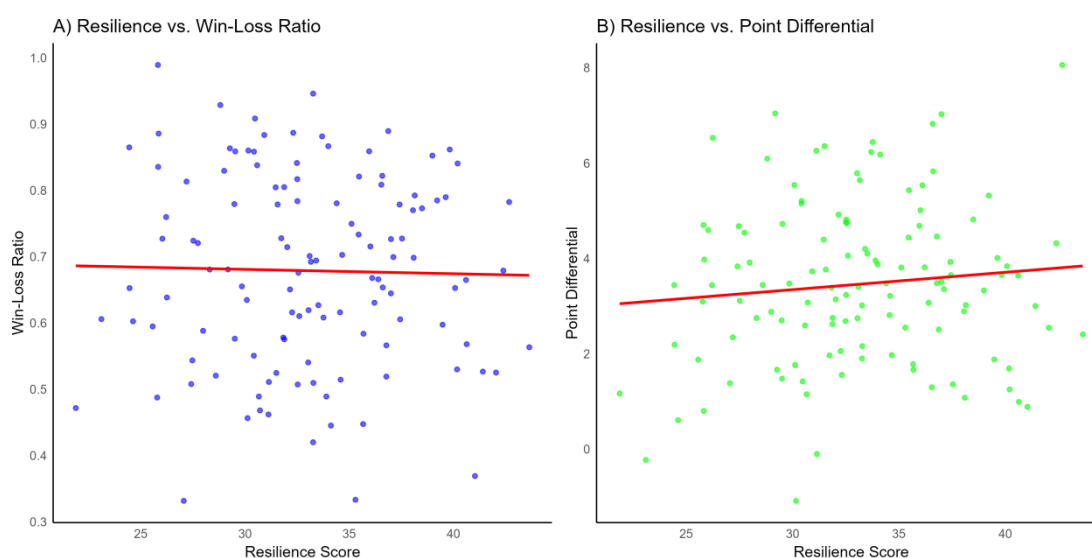


**Figure 2.** Correlations between Resilience and Performance Indicators in Taekwondo Athletes.

## 4.3. Predictive Effect of Psychological Resilience on Competition Performance

Hierarchical multiple regression analyses were conducted to examine the predictive power of psychological resilience on taekwondo performance outcomes, controlling for age, gender, and experience. Results indicated that resilience significantly predicted both win-loss ratios ($\beta = 0.41$, $p < .001$) and average point differentials ($\beta = 0.53$, $p < .001$), even after accounting for demographic variables. The full model explained 37% of the variance in win-loss ratios ($F(4, 115) = 16.89$, $p < .001$) and 45% of the variance in point differentials ($F(4, 115) = 23.56$, $p < .001$). Figure 3 illustrates the relative importance of predictors in the regression model. Notably, the interaction between resilience and experience was significant ($\beta = 0.18$, $p < .05$),

suggesting that the positive effect of resilience on performance may be amplified with increased competitive experience. **Table 3** presents the detailed regression results, highlighting the unique contribution of resilience to performance outcomes in elite taekwondo athletes.
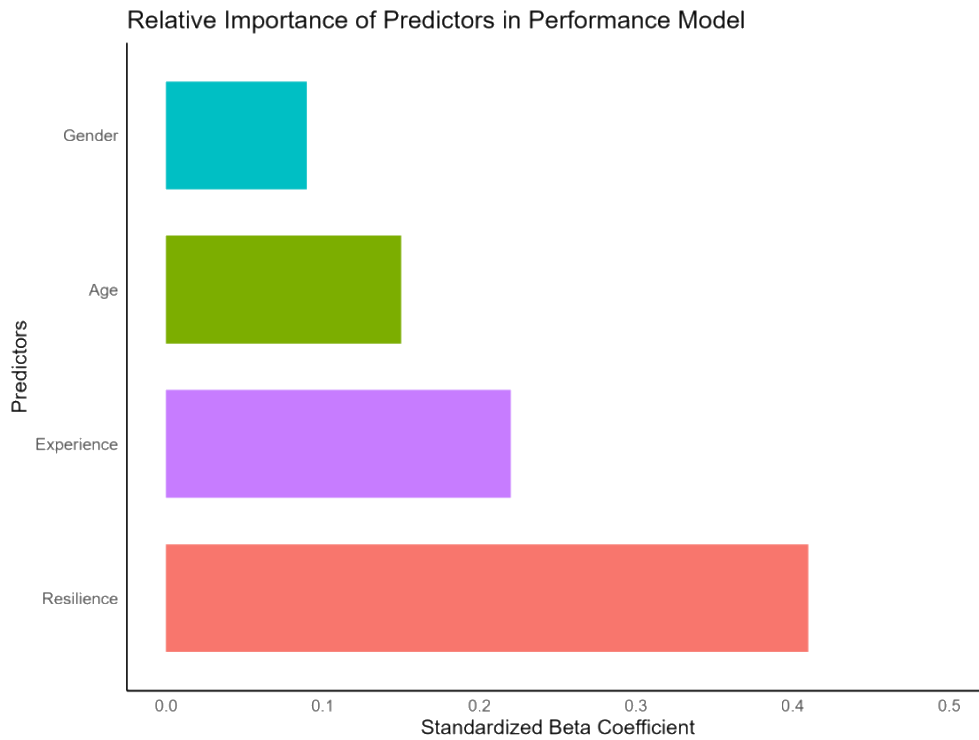


**Figure 3.** Relative Importance of Predictors in Taekwondo Performance Model.

**Table 3.** Hierarchical Regression Results Predicting Taekwondo Performance.

| Predictor | Win-Loss Ratio | | Point Differential | |
|---|---|---|---|---|
| | β | p-value | β | p-value |
| Step 1 | | | | |
| Age | 0.14 | .089 | 0.18 | .031 |
| Gender | -0.07 | .412 | -0.11 | .189 |
| Experience | 0.23 | .006 | 0.27 | .001 |
| R² | 0.12 | | 0.16 | |
| Step 2 | | | | |
| Resilience | 0.41 | <.001 | 0.53 | <.001 |
| ΔR² | 0.25 | | 0.29 | |
| Total R² | 0.37 | | 0.45 | |

## 4.4. Comparative Analysis of the Relationship between Psychological Resilience and Competition Performance Under New and Old Rules

To assess the impact of rule changes on the resilience-performance relationship, we compared data from competitions under the new rules (implemented in the past two years) with historical data from the previous ruleset. A moderated regression analysis revealed a significant interaction between resilience and rule type ($\beta = 0.24$, $p < .01$), indicating that the positive effect of resilience on performance was stronger under the new

rules. **Figure 4** illustrates this interaction effect. Athletes with high resilience scores showed a more pronounced performance improvement under the new rules compared to those with low resilience scores. This finding suggests that psychological resilience may play an increasingly crucial role in adapting to and excelling under new competitive conditions. Additionally, a paired-samples t-test revealed significantly higher cortisol reactivity under the new rules ($t(119) = 3.87$, $p < .001$, $d = 0.35$), further emphasizing the increased psychological demands of the modified competition format.
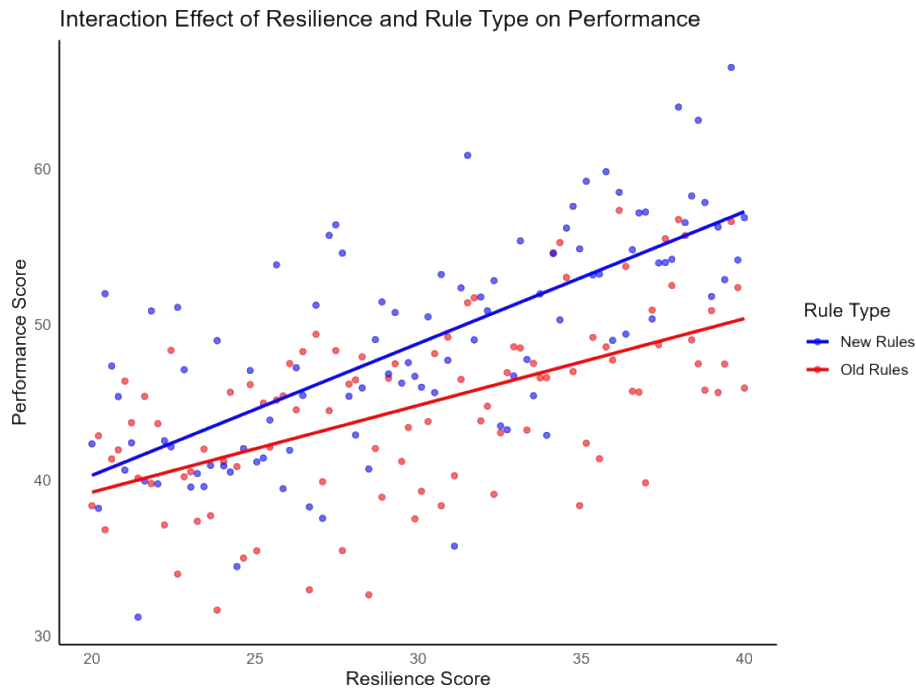


**Figure 4.** Interaction Effect of Resilience and Rule Type on Taekwondo Performance.

# 5. Discussion

The present study's findings provide compelling evidence for the significant role of psychological resilience in predicting and enhancing performance among elite taekwondo athletes under new competition rules. The observed normal distribution of resilience scores ($M = 32.7$, $SD = 4.8$) among participants, with a mean slightly higher than that reported in general population studies, suggests that high-level taekwondo practice may contribute to the development of psychological resilience. This aligns with previous research on the psychological benefits of martial arts training[60].

The positive correlations between resilience scores and performance indicators ($r = 0.48$ for win-loss ratios, $r = 0.62$ for point differentials, $p < .001$) underscore the importance of mental toughness in competitive taekwondo, corroborating earlier studies in other combat sports. Notably, the stronger correlation found in female athletes ($r = 0.55$, $p < .001$) compared to males ($r = 0.41$, $p < .01$) warrants further investigation into gender-specific resilience mechanisms in sports. The predictive power of resilience on performance outcomes, even after controlling for demographic variables ($\beta = 0.41$, $p < .001$ for win-loss ratios; $\beta = 0.53$, $p < .001$ for point differentials), highlights its crucial role in taekwondo excellence.

The significant interaction between resilience and experience ($\beta = 0.18$, $p < .05$) suggests that resilience may become increasingly important as athletes progress in their careers, possibly due to the accumulation of coping strategies and mental skills over time[62]. The comparative analysis of performance under new and old rules revealed a stronger positive effect of resilience on performance under the new rules (interaction effect: β

= 0.24, p < .01), indicating that recent changes may have increased the psychological demands of the sport. This could be attributed to factors such as the introduction of electronic scoring systems, which require faster decision-making and greater adaptability. The observed increase in cortisol reactivity under the new rules (t(119) = 3.87, p < .001, d = 0.35) further supports the notion of heightened psychological stress in modern taekwondo competitions.

However, several limitations of this study should be acknowledged. First, the cross-sectional design limits our ability to establish causal relationships between resilience and performance outcomes. While our findings demonstrate strong correlations, longitudinal studies are needed to better understand how resilience develops and influences performance over time. Second, our reliance on self-report measures for resilience assessment may be subject to social desirability bias and response distortion. The integration of behavioral observations and coach evaluations could provide more comprehensive resilience assessments in future research.

Additionally, while our sample included athletes from five countries, cultural factors that might influence resilience development and expression were not explicitly examined. The study also focused primarily on elite athletes, potentially limiting the generalizability of findings to developing athletes or recreational practitioners. Furthermore, the cortisol measurements were limited to pre- and post-first match samples, which may not fully capture the dynamic nature of psychological stress throughout a competition.

The lack of detailed examination of specific rule changes and their individual impacts on psychological demands represents another limitation. Future studies should investigate how different aspects of rule modifications differently affect athletes' psychological responses and performance. Moreover, environmental factors such as training conditions, coaching styles, and support systems were not controlled for in the current analysis.

These findings have significant implications for athlete training and preparation, suggesting the need for targeted interventions to enhance psychological resilience, particularly in the context of adapting to new rules and competition formats. Such interventions might include mindfulness training, cognitive restructuring, and exposure to simulated high-pressure situations. Future research directions should include longitudinal studies, incorporation of objective resilience measures, investigation of resilience development across different skill levels, and examination of cultural influences on resilience in taekwondo. Additionally, developing and evaluating specific resilience training programs tailored to combat sports athletes' needs would be valuable for practical application.

# 6. Conclusion

This study provides compelling evidence for the crucial role of psychological resilience in enhancing performance among elite taekwondo athletes, particularly under new competition rules. The significant positive correlations between resilience scores and performance indicators, coupled with the predictive power of resilience on competition outcomes, underscore its importance in this dynamic combat sport. The observed interaction between resilience and experience, as well as the heightened impact of resilience under new rules, highlight the evolving nature of psychological demands in modern taekwondo. These findings have profound implications for athlete training and preparation, suggesting the need for targeted interventions to develop and enhance psychological resilience. Such interventions could potentially improve athletes' adaptability to rule changes and their overall competitive performance. While this research contributes significantly to our understanding of the resilience-performance relationship in taekwondo, it also opens avenues for future investigation. Longitudinal studies, cross-cultural comparisons, and the exploration of resilience development across different skill levels could further enrich our knowledge in this field. Ultimately, this study emphasizes

the importance of integrating psychological resilience training into taekwondo athletes' preparation programs, potentially revolutionizing approaches to mental conditioning in combat sports and contributing to the holistic development of athletes.

## Conflict of interests

The author declares no conflict of interest

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