Examination of factors influencing the emergence and regulation of competitive anxiety in athletes

Abstract of PhD Thesis

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INTRODUCTION

In their meta-analysis, Ong and Chua (2021) emphasized that competitive anxiety is one of the most frequently studied constructs in sport psychology research. The evolution of theoretical models examining the relationship between athletic performance and anxiety clearly demonstrates a shift from early approaches focusing primarily on arousal levels (e.g., the inverted-U hypothesis, drive theory, catastrophe theory) toward more complex, multivariate frameworks that consider the multidimensional nature of anxiety and the role of individual differences. Martens and colleagues (1990) developed the multidimensional anxiety theory, which identifies three key components in the context of performance: cognitive anxiety, somatic anxiety, and self-confidence. Cognitive anxiety is defined by worry and negatively patterned thoughts, which show a negative association with performance — the higher the cognitive anxiety, the lower the expected performance. This supports the linear relationship previously proposed by Hull (1943) between cognitive anxiety and performance. Somatic anxiety includes autonomic, physiological symptoms such as sweating, nausea, and increased heart rate. In this case, the inverted-U relationship with performance, originally proposed by Yerkes and Dodson (1908), was confirmed — indicating that a certain level of somatic anxiety is necessary for optimal athletic performance. The third component, self-confidence, refers to an athlete's belief in themselves and their abilities, showing a positive relationship with performance. Thus, issues related to self-confidence are often associated with performance decline. Overall, according to the multidimensional anxiety theory, optimal athletic performance requires low levels of cognitive anxiety, moderate levels of somatic anxiety, and a high level of self-confidence (Martens et al., 1990).

Although the various models emphasize different aspects, there is consensus that anxiety related to competitive situations has a significant effect on athletic performance, which can be either facilitative or debilitative depending on individual characteristics, contextual factors, and response patterns. Hanton and colleagues (2008) systematized personality-related (e.g., trait anxiety, affectivity, cognitive distortions, coping strategies, self-confidence) and situational (e.g., sport type, competition experience) factors that predispose athletes to competitive anxiety over a decade and a half ago. However, irrational beliefs and perfectionism as influential variables have only recently become the focus of scientific attention. One of the most frequently examined personality traits in

athletes is perfectionism. Initially defined by Frost and colleagues (1990) as a personality trait characterized by excessively high personal standards and self-critical attitudes, regardless of actual performance, perfectionism is now considered a multidimensional construct. It is generally divided into two major components: perfectionistic strivings (PS) and perfectionistic concerns (PC) (Flett & Hewitt, 2002). While PS is often interpreted as adaptive due to its association with high internal standards, PC is typically maladaptive, linked to fear of failure, discomfort, and negative self-evaluation — especially in relation to athletic performance and mental health (Stoeber et al., 2007; Martinent et al., 2010; Burton et al., 2013; Mallinson-Howard et al., 2015; Jensen et al., 2018; Haraldsen et al., 2021). PC is frequently described using the concept of "discrepancy," referring to the tension between an individual's expectations and their perceived performance (Rice & Ashby, 2007). Although empirical findings on the role of PS are mixed, several studies suggest that excessive levels of either dimension — regardless of the nature of perfectionism — can lead to negative psychological outcomes in sport (Flett & Hewitt, 2005). According to Ellis (1958), perfectionism is an irrational belief suggesting that individuals must always be competent, intelligent, and successful, and that there is a perfect solution to every problem — failing to find it is catastrophic. These thoughts are often categorized as irrational beliefs because they are extreme, rigid, and illogical, and therefore inconsistent with reality (Ellis & Dryden, 1997). Four categories of irrational beliefs are typically identified: demandingness, awfulizing, low frustration tolerance, and depreciation. Previous research has consistently shown that irrational beliefs are associated with certain mental health issues among athletes, such as anxiety disorders, chronic stress, and dysfunctional attitudes (Turner, 2016, 2019, 2022). Although studies in athletic contexts remain limited, existing evidence supports a relationship between irrational beliefs and competitive anxiety levels in athletes (Chadha et al., 2019; Mansell, 2021; Michel-Kröhler & Turner, 2022). Furthermore, findings from non-athlete samples have also demonstrated a correlation between irrational beliefs and perfectionism (Ellis, 2002).

Furthermore, we considered it essential to investigate not only the two predictive phenomena (perfectionism and irrational beliefs) but also the impact of less widely used and adapted interventions in Hungary on athletes' competitive anxiety. Among interventions aimed at reducing competitive anxiety in athletes, psychological skills

training (PST), typically grounded in cognitive-behavioral therapy (CBT), is the most frequently applied (Weinberg & Gould, 2019). PST comprises adapted CBT techniques (e.g., goal setting, imagery, relaxation) designed to enhance mental health and optimize performance. In recent years, increasing attention has been paid to examining the isolated effects of specific techniques derived from different waves of CBT in athletic contexts — including Rational Emotive Behavior Therapy (REBT; Ellis, 1957) from the second wave, and mindfulness-based methods from the third wave. The core premise of REBT is that psychological problems stem from irrational beliefs, which — in contrast to external events — serve as the true source of distress (Dryden, 1995). Identifying irrational beliefs is a necessary but insufficient step toward positive change; they must be replaced with rational beliefs. This process is framed by the GABCDE model, which posits that cognitive, emotional, and/or behavioral consequences (C) arise from rational or irrational beliefs (B) triggered by goal-relevant (G) activating events (A) (Dryden & Branch, 2008). The effectiveness of REBT in sport psychology has recently been supported by a growing body of scientific research (Jordana et al., 2020; Turner, 2016, 2019, 2022). Third-wave CBT places increased emphasis on cognitive processes, emotion regulation, and acceptance beyond mere symptom reduction. This wave introduced mindfulness- and acceptance-based techniques, aimed at fostering the ability to tolerate distress and develop psychological flexibility. Mindfulness — a core product of this wave — refers to non-judgmental, present-moment awareness, contributing to both emotion regulation and cognitive change. Third-wave, process-oriented approaches associate negative emotional states with the individual's relationship to their experiences — for example, whether they accept or ruminate on them (Carona, 2023). Previous studies have often applied various mindfulness-based programs in combination and examined the effectiveness of such adapted interventions in athletic settings (Myall et al., 2023). The results of these studies indicate that combined mindfulness programs are effective in reducing distress and anxiety and in enhancing mindfulness skills among athletes (Mehrsafar et al., 2019; Rooks et al., 2017). While the effectiveness of these two approaches is supported by international research, their adaptation and empirical examination in Hungarian athletic populations remain lacking.

The present dissertation aims to investigate a complex model of the interrelationships among perfectionism, irrational beliefs, and competitive anxiety, as

well as to explore the applicability and mechanisms of REBT and mindfulness in sport psychology within a Hungarian athlete sample. Furthermore, it includes a psychometric evaluation of the Hungarian adaptation of the Competitive State Anxiety Inventory (CSAI-2-H).

AIMS

The primary aim of the first study was to investigate the predictive power of various forms of irrational beliefs and perfectionism on competitive anxiety, as well as to examine the complex mediating effects of these two constructs on cognitive and somatic competitive anxiety. Based on this, the following hypotheses were formulated (related publications: Tóth et al., 2022; Tóth & Szabó, 2019a, 2019b):

$H_{1/1}$: Irrational beliefs, both as a composite construct and in their four specific forms (demandingness, awfulizing, low frustration tolerance, and depreciation), significantly predict all three components of multidimensional competitive anxiety.

$H_{1/2}$: Maladaptive perfectionistic concerns are positive predictors of all three components of multidimensional competitive anxiety, whereas no predictive effect is expected from adaptive perfectionistic strivings.

$H_{1/3}$: Irrational beliefs predict both cognitive and somatic competitive anxiety, with both adaptive and maladaptive perfectionism mediating this relationship.

The main aim of the second study was to examine the effectiveness of Rational Emotive Behavior Therapy (REBT) and mindfulness-based interventions on cognitive and somatic competitive anxiety, as well as on related psychological constructs (irrational beliefs and perfectionism). The hypotheses for the second study (related publications: Tóth et al., 2023; Tóth & Tóth, 2022) were as follows:

$H_{2/1}$: It is assumed that athletes participating in the REBT and mindfulness interventions will show a reduction in levels of competitive anxiety, perfectionism, and irrational beliefs as a result of the intervention.

$H_{2/2}$: No significant changes are expected between the pre- and post-test scores in the waitlist control group, as these athletes receive no psychological intervention.

$H_{2/3}$: It is hypothesized that participants in the REBT intervention will show the greatest reduction in competitive anxiety, perfectionism, and irrational beliefs compared to both

the mindfulness and the waitlist control groups. Furthermore, the mindfulness group is expected to show greater improvements than the waitlist control group.

$H_{2/4}$: A correlation is expected between self-reported competitive anxiety scores and salivary cortisol levels across the full sample, and a reduction in cortisol levels is anticipated in both the REBT and mindfulness groups following the intervention.

Although the Competitive State Anxiety Inventory (CSAI-2) is one of the most widely used instruments for the assessment of competitive anxiety in athletes, its psychometric validation in Hungarian has not yet been conducted. Therefore, the third study aimed to validate the Hungarian adaptation of the CSAI-2-H (Sipos et al., 1999), assess its reliability, and determine normative values.

$H_{3/1}$: It is expected that the Hungarian adaptation of the CSAI-2 will demonstrate adequate levels of validity and reliability.

$H_{3/2}$: Female athletes are hypothesized to report higher levels of competitive anxiety than their male counterparts.

$H_{3/3}$: Individual athletes are expected to exhibit higher levels of competitive anxiety compared to team sport athletes.

METHODS

The first cross-sectional study involved 219 Hungarian athletes (M_{age} = 26.39, SD_{age} = 11.92), recruited through various sports clubs to complete online questionnaires. The sample consisted of 96 females and 123 males, including both amateur (N = 140) and professional (N = 79) athletes, as well as individual (N = 82) and team sport participants (N = 137).

In the second study, male and female athletes from a Hungarian youth ice hockey team participated. Due to incomplete tests and extreme outliers, 8 participants were excluded, resulting in a final sample of 46 athletes (N_{female} = 10, N_{male} = 36; M_{age} = 18.04, SD_{age} = 1.83). Twelve athletes took part in the REBT intervention (M_{age} = 18.17, SD_{age} = 1.40), fourteen in the mindfulness intervention (M_{age} = 17.36, SD_{age} = 2.10), and twenty in the waitlist control group (M_{age} = 18.45, SD_{age} = 1.79), all of whom attended all sessions and completed the assessments.

The third study initially involved 415 participants. However, 8 athletes were excluded due to extreme outlier values to ensure normality assumptions, leaving a final

sample of 407 athletes (M_{age} = 23.77, SD_{age} = 10.34), with 46.9% females (N = 191) and 53.1% males (N = 216). All participants were at least amateur-level athletes (N = 266), with a significant portion being professionals (N = 141). The sample included both individual (N = 176) and team sport athletes (N = 231). All three studies were approved by the Research Ethics Committee of the Hungarian University of Sports Science (TE-KEB/07/2022; TE-KEB/16/2022; TE/KEB/27/2023).

In the first study, three validated self-report instruments were employed. Competitive state anxiety was assessed using the Hungarian adaptation of the Competitive State Anxiety Inventory-2 (CSAI-2-H; Martens et al., 1990; Sipos et al., 1999), which consists of 27 items across three subscales: cognitive anxiety, somatic anxiety, and self-confidence. The Hungarian version demonstrated good internal consistency (Cronbach's α = 0.75–0.85). Irrational beliefs were measured using the Irrational Performance Beliefs Inventory (iPBI; Turner & Allen, 2018), comprising 20 items across four subscales: demandingness, awfulizing, low frustration tolerance, and self-downing. The original instrument showed good test-retest reliability and validity, while the Hungarian translation demonstrated adequate internal consistency (Cronbach's α = 0.70–0.90). Perfectionism was assessed using the revised Short Almost Perfect Scale (SAPS; Rice et al., 2014), adapted into Hungarian by Reinhardt et al. (2019). This instrument includes two subscales with 4 items each: standards (adaptive perfectionism) and discrepancy (maladaptive perfectionism). The Hungarian version demonstrated adequate reliability (Cronbach's α = 0.77–0.86) and validity.

In addition to the three self-report measures used in the second study, we also incorporated a more objective physiological indicator related to anxiety: cortisol assessment, as suggested by previous research. Athletes' anxiety levels may correlate with the activity of the hypothalamic–pituitary–adrenal (HPA) axis, which can be indicated by variations in cortisol levels (Gozansky et al., 2005). For sampling, athletes chewed specialized oral swabs designed for cortisol measurement for two minutes to collect sufficient saliva. These were then placed into specially designed containers for storage. Samples were transported to the laboratory immediately after collection, stored at the appropriate temperature, and analyzed within 24 hours. Cortisol levels were determined using the ECLIA (electrochemiluminescence immunoassay) method on a cobas® immunochemistry analyzer (Polat et al., 2018). Cortisol concentrations measured

from saliva were reported in nanomoles per liter (nmol/L). In the second study, participants took part in a pre–post measurement design, meaning that all instruments were administered both before and after the 8-week intervention across all three groups.

In the third study, we employed the previously described Hungarian adaptation of the Competitive State Anxiety Inventory-2 (CSAI-2-H; Sipos et al., 1999).

Statistical analyses in all three studies began with descriptive statistics and tests of assumptions for the chosen analyses. In the first study, data were analyzed using correlational, regression, and mediation models in IBM SPSS 27. For mediation, we used Hayes' (2022) Model 6 serial multiple mediation analysis (SAMM) via PROCESS version 4.1 to examine the direct and indirect effects of irrational beliefs on cognitive and somatic anxiety, mediated by perfectionism.

In the second study, analyses were also conducted using IBM SPSS 27. The final dataset contained no missing or extreme values, and assumptions of linearity and multicollinearity were met. Since the assumption of sphericity was not always fulfilled (based on Mauchly's test), we applied robust statistics: Pillai's Trace for interaction effects and Greenhouse–Geisser correction for simple main effects. The primary analysis was a repeated measures ANOVA comparing pre- and post-test results across groups. Effect sizes were estimated using partial eta squared (η^2), with thresholds defined as negligible (< 0.01), small (0.01–0.059), medium (0.06–0.139), and large (≥ 0.14) (Lakens, 2013).

For the third study, psychometric analyses of the CSAI-2-H were performed using IBM SPSS 27 and JAMOVI 2.4.11. Reliability was assessed via internal consistency (Cronbach's α) and test–retest reliability. A subgroup of participants ($N = 42$, $M_{age} = 17.98$, $SD_{age} = 1.83$) completed the questionnaire again four weeks later. Test–retest reliability was evaluated using intraclass correlation coefficients (ICC), interpreted as excellent (0.80–1.00), good (0.60–0.79), or unacceptable (< 0.60) (Nejati et al., 2022). For construct validity, we conducted confirmatory factor analysis (CFA) following the recommendations of Schutz and Gessaroli (1993). As there is no universal consensus on the optimal fit indices, we followed Kline's (2023) recommendation and reported a combination of indices: the chi-square/degrees of freedom ratio (χ^2/df), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), and the Comparative Fit Index (CFI). For criterion validity, we conducted one-

way and factorial ANOVA using participants' age, gender, sport type (individual vs. team), and level (amateur vs. professional) as independent variables. For one-way ANOVAs, effect sizes were calculated using omega squared (ω^2), considered small (< 0.01), medium (0.06–0.14), or large (> 0.14) as per Field (2013). For factorial ANOVA, we again used partial eta squared (η^2) following Lakens (2013).

RESULTS

The Role of Perfectionism and Irrational Beliefs in Predicting Competitive Anxiety

Adaptive perfectionism (STA) showed a significant but weak positive correlation with cognitive anxiety (CAN), explaining 7% of the variance in cognitive anxiety scores (R^2 = 0.07). Maladaptive perfectionism (DIS) demonstrated a significant positive relationship with cognitive anxiety, accounting for 21% of its variance (R^2 = 0.21). Overall, irrational beliefs (IBT) exhibited a moderate, significant positive correlation with cognitive anxiety, explaining 19% of its variance (R^2 = 0.19). When analyzing irrational beliefs individually, depreciation (DEP) showed a moderate, while low frustration tolerance (LFT) and awfulizing (AWF) showed weak, and demandingness (DEM) very weak, but significant positive relationships with cognitive anxiety. The explanatory power followed a similar pattern: R^2_{DEP} = 0.24, R^2_{LFT} = 0.14, R^2_{AWF} = 0.10, R^2_{DEM} = 0.03. The strongest predictors of cognitive anxiety were discrepancy (β = 0.46) and depreciation (β = 0.46). Somatic anxiety (SAN) also showed significant positive correlations with all variables of perfectionism and irrational beliefs. The relationship was very weak for adaptive perfectionism and weak for maladaptive perfectionism. Standards explained 3% (R^2 = 0.03), and discrepancy 5% (R^2 = 0.05) of the variance in somatic anxiety. Irrational beliefs overall, as well as depreciation and low frustration tolerance, had weak correlations, while awfulizing and demandingness had very weak correlations with somatic anxiety. The greatest explanatory power for somatic anxiety was found for depreciation (R^2 = 0.13, β = 0.36), though all other variables contributed to some extent (R^2_{IBT} = 0.08, R^2_{LFT} = 0.05, R^2_{AWF} = 0.03, R^2_{DEM} = 0.02). Discrepancy, total irrational beliefs, and depreciation showed significant weak negative correlations with self-confidence (SC), while low frustration tolerance had a very weak negative correlation. Depreciation explained 12% (R^2 = 0.12), discrepancy 8% (R^2 = 0.08), total irrational beliefs 4% (R^2 = 0.04), and low frustration tolerance 2% (R^2 = 0.02) of the decrease in

self-confidence, with depreciation again being the strongest predictor (β = -0.35). Other variables (adaptive perfectionism, demandingness, catastrophizing) were not significantly related to self-confidence.

A total of 10 mediation analyses were conducted to determine the direct and indirect effects of irrational beliefs on competitive anxiety (cognitive and somatic) through perfectionism (adaptive and maladaptive).

Total irrational beliefs, as well as demandingness, awfulizing, low frustration tolerance, and depreciation, had significant direct positive effects on cognitive anxiety when both forms of perfectionism (standards and discrepancy) served as mediators. Maladaptive perfectionism (DIS) showed a significant association with cognitive anxiety in all models, whereas adaptive perfectionism (STA) did not show a significant association in any model. For the effect of irrational beliefs on cognitive anxiety, partial mediation was confirmed in all models where both perfectionism types were mediators, since both direct and indirect effects were significant, with the direct effects explaining a higher proportion of variance than the indirect ones. Additional partial mediation was observed when low frustration tolerance, depreciation, and total irrational beliefs showed both direct and indirect significant effects on cognitive anxiety through discrepancy. No mediation was observed when only adaptive perfectionism (STA) was included as a mediator, as indirect effects were non-significant, indicating only a direct relationship between irrational beliefs and cognitive anxiety.

Total irrational beliefs and depreciation also had significant direct effects on somatic anxiety when both perfectionism types served as mediators. Similar to cognitive anxiety, adaptive perfectionism (standards) showed no significant relationship with somatic anxiety in any model. Maladaptive perfectionism significantly mediated the impact of demandingness and awfulizing on somatic anxiety. Full mediation was observed for demandingness and awfulizing, as significant indirect effects were found in the absence of direct effects, when both perfectionism types (DEM - STA - DIS - SA and CAT - STA - DIS - SA pathways) acted as mediators. For depreciation and total irrational beliefs, no mediation was confirmed, since only direct effects were significant.

Comparison of Pre- and Post-Test Results in the REBT, Mindfulness, and Control Groups

A significant interaction effect was found in the case of cognitive anxiety ($F(2,43) = 3.99$, $p = 0.03$, $\eta^2 = 0.16$), low frustration tolerance ($F(2,43) = 4.58$, $p = 0.02$, $\eta^2 = 0.18$), and maladaptive perfectionism ($F(2,43) = 3.61$, $p = 0.03$, $\eta^2 = 0.15$) between the pre- and post-test results across the three groups (REBT, mindfulness, and control). No significant interaction effects were observed for the remaining variables, including somatic anxiety, demandingness, awfulizing, depreciation, total irrational beliefs, and adaptive perfectionism. Main effect analyses revealed that athletes participating in the REBT program showed significant differences between pre- and post-intervention measurements in cognitive anxiety ($F(1,11) = 7.53$, $p = 0.02$, $\eta^2 = 0.41$), somatic anxiety ($F(1,11) = 6.99$, $p = 0.02$, $\eta^2 = 0.39$), total irrational beliefs ($F(1,11) = 6.43$, $p = 0.03$, $\eta^2 = 0.37$), specifically in low frustration tolerance ($F(1,11) = 8.13$, $p = 0.02$, $\eta^2 = 0.43$), as well as in both adaptive ($F(1,11) = 14.57$, $p < 0.01$, $\eta^2 = 0.58$) and maladaptive ($F(1,11) = 6.00$, $p = 0.03$, $\eta^2 = 0.35$) perfectionism. Effect size indicators (η^2) suggest that the most substantial change due to REBT occurred in adaptive perfectionism, followed by low frustration tolerance, cognitive anxiety, somatic anxiety, total irrational beliefs, and finally maladaptive perfectionism. In all cases, the significant differences indicated a decrease in scores from pre- to post-intervention. In contrast, no significant differences were found in the mindfulness or control groups for any of the variables between pre- and post-tests. Similarly, no significant changes were observed in salivary cortisol levels in any group when comparing pre- and post-intervention measurements.

Validity and Reliability Indicators of the Hungarian Version of the Competitive State Anxiety Inventory (CSAI-2-H), and Results of Comparative Analyses

The results of the confirmatory factor analysis indicate that the original 27-item Hungarian-adapted version of the CSAI-2-H demonstrates a significant model ($p < 0.001$); however, none of the fit indices reach acceptable thresholds ($\chi^2(321) = 1503$, $\chi^2/df = 4.68$, $CFI = 0.77$, $TLI = 0.75$, $SRMR = 0.08$, $RMSEA = 0.10$). Based on these findings, the original three-factor structure cannot be confirmed in our sample for the 27-item Hungarian version of the CSAI-2-H. Cox and colleagues (2003) later developed the CSAI-2-R questionnaire, a revised and shortened 17-item version of the original

instrument. The factorial structure of this revised scale was also tested via confirmatory factor analysis in our sample. Although the model was significant ($p < 0.001$) and the fit indices approached acceptable values, they did not reach the recommended thresholds ($\chi^2(116) = 519$, $\chi^2/df = 4.47$, $CFI = 0.87$, $TLI = 0.85$, $SRMR = 0.08$, $RMSEA = 0.09$). Considering these results, we examined the factor loadings and modification indices for each item of the original 27-item model and concluded that excluding nine items (three per subscale) was necessary to achieve an acceptable factor structure in the Hungarian version. The revised 18-item Hungarian Competitive State Anxiety Inventory we developed yielded a significant model ($p < 0.001$) with acceptable values for all fit indices in support of the three-factor theoretical model ($\chi^2(132) = 395$, $\chi^2/df = 2.99$, $CFI = 0.91$, $TLI = 0.90$, $SRMR = 0.06$, $RMSEA = 0.07$).

In assessing the reliability of the revised CSAI-2-HR, we first examined internal consistency. Each subscale met the acceptable threshold for Cronbach's alpha ($\alpha_{CAN} = 0.88$, $\alpha_{SAN} = 0.79$, $\alpha_{SFC} = 0.78$). To assess test-retest reliability, we conducted a retest procedure, which further supported the reliability of the CSAI-2-HR. All three subscales showed significant ($p < 0.001$) and acceptable intraclass correlation coefficients ($ICC_{CAN} = 0.89$, $ICC_{SAN} = 0.86$, $ICC_{SFc} = 0.66$). A positive correlation was found between cognitive and somatic anxiety ($r = 0.62$, $p < 0.001$), while self-confidence was negatively correlated with both cognitive ($r = –0.54$, $p < 0.001$) and somatic anxiety ($r = –0.52$, $p < 0.001$). Overall, the interrelations among the subscales showed moderate, significant associations, further supporting the reliability and validity of the CSAI-2-HR. These results are consistent with the theoretical framework, which posits that the three factors are related yet distinct constructs.

Significant differences were found in cognitive anxiety ($F(2,125) = 19.83$, $p < 0.001$, CI [95%] = 0.02–0.11) and self-confidence ($F(2,404) = 3.96$, $p = 0.02$, CI [95%] = -0.01–0.05) across age groups (adolescents under 18: $N = 152$; young adults aged 19–40: $N = 214$; middle-aged adults over 41: $N = 41$). Age had a moderate effect on cognitive anxiety ($\omega^2 = 0.06$) and a small effect on self-confidence ($\omega^2 = 0.01$), while no significant difference was observed in somatic anxiety between age groups. Games-Howell post hoc tests revealed that adolescent athletes showed significantly higher levels of cognitive anxiety ($p < 0.001$; $M = 2.12$, $SD = 0.71$) than middle-aged athletes ($M = 1.48$, $SD = 0.54$), and young adults also scored significantly higher ($p < 0.001$; $M = 1.95$, $SD = 0.72$) than

middle-aged athletes. Self-confidence was significantly higher among middle-aged athletes (M = 2.95, SD = 0.50) than among adolescents (M = 2.67, SD = 0.57, p = 0.01) and young adults (M = 2.71, SD = 0.61, p = 0.02). No significant differences were found between adolescents and young adults in any component of competitive anxiety, nor in somatic anxiety across any age category.

A factorial ANOVA was conducted to examine the effects of gender, sport type, and competitive level, with age entered as a covariate. The overall model showed a significant large effect on cognitive anxiety ($F(8) = 9.54$, $p < 0.001$, $\eta^2 = 0.16$), a significant moderate effect on self-confidence ($F(8) = 6.61$, $p < 0.001$, $\eta^2 = 0.12$), and a significant moderate effect on somatic anxiety ($F(8) = 4.56$, $p < 0.001$, $\eta^2 = 0.08$). As a covariate, age had a significant small effect on cognitive anxiety ($F(1) = 12.80$, $p < 0.001$, $\eta^2 = 0.03$) and self-confidence ($F(1) = 5.25$, $p = 0.02$, $\eta^2 = 0.01$), but no significant effect on somatic anxiety ($F(1) = 3.17$, $p = 0.08$, $\eta^2 = 0.01$). Gender had a significant moderate effect on cognitive anxiety ($F(1) = 27.85$, $p < 0.001$, $\eta^2 = 0.08$) and self-confidence ($F(1) = 33.47$, $p < 0.001$, $\eta^2 = 0.09$), and a significant small effect on somatic anxiety ($F(1) = 6.45$, $p = 0.01$, $\eta^2 = 0.02$). Male athletes exhibited lower levels of cognitive (M = 1.75, SD = 0.62) and somatic anxiety (M = 1.80, SD = 0.57), and higher self-confidence (M = 2.87, SD = 0.56) than female athletes (M_{CAN} = 2.22, SD_{CAN} = 0.76; M_{SAN} = 2.03, SD_{SAN} = 0.66; M_{SFC} = 2.55, SD_{SFC} = 0.58). Sport type had a significant small effect on somatic anxiety ($F(1) = 9.06$, $p < 0.001$, $\eta^2 = 0.02$) and self-confidence ($F(1) = 5.71$, $p = 0.02$, $\eta^2 = 0.01$), but no significant effect on cognitive anxiety. Individual athletes reported lower cognitive anxiety (M = 1.92, SD = 0.67) compared to team athletes (M = 2.01, SD = 0.76). Team athletes also reported higher self-confidence (M = 2.78, SD = 0.59) than individual athletes (M = 2.64, SD = 0.58). Competitive level had no significant effect on any scale.

A significant small interaction between gender and competitive level was found for self-confidence ($F(1) = 4.22$, $p = 0.04$, $\eta^2 = 0.01$), indicating that gender differences in self-confidence vary by athlete level. Amateur men reported higher self-confidence (M = 3.01) than amateur women (M = 2.73), with the difference even more pronounced among professionals (M_{men} = 2.97; M_{women}= 2.62). Sport type and competitive level had a significant small interaction effect on cognitive anxiety ($F(1) = 3.97$, $p = 0.05$, $\eta^2 = 0.01$). Among individual athletes, professionals exhibited significantly higher cognitive anxiety (M = 2.61) than amateurs (M = 2.28), whereas among team athletes, amateurs (M

= 2.32) reported higher cognitive anxiety than professionals (M = 2.15). A three-way interaction between gender, sport type, and competitive level significantly affected somatic anxiety ($F(1) = 6.27$, $p = 0.01$, $\eta^2 = 0.02$). Among women, the highest somatic anxiety was observed in professional individual athletes (M = 2.48), while professional team athletes scored significantly lower (M = 1.86). Among amateur women, team athletes reported higher anxiety (M = 2.10) than individual athletes (M = 2.05). In contrast, male athletes showed minimal variation in somatic anxiety across sport type and level: professional individual athletes (M = 2.09) and amateurs (M = 2.07); professional team athletes (M = 1.86) and amateurs (M = 1.85). This interaction suggests that professional female individual athletes experience the highest levels of somatic anxiety.

CONCLUSIONS

Findings from our first study indicate that irrational beliefs—both as a total construct and across all four categories—positively correlate with cognitive and somatic competitive anxiety and exhibit significant predictive power. Their predictive effect on self-confidence is negative in the case of low frustration tolerance and depreciation. The strongest predictor of cognitive anxiety is depreciation, which also shows the greatest explanatory power for somatic anxiety and self-confidence. These results are consistent with previous research suggesting that irrational, illogical thoughts in athletes can contribute to various psychological issues, such as increased levels of debilitating competitive anxiety (Chadha et al., 2019; Turner et al., 2019), highlighting the role of irrational beliefs in the rise of anxiety among athletes. Thus, the first hypothesis of our first study ($\mathbf{H_{1/1}}$) is supported: irrational beliefs significantly predict the components of multidimensional competitive anxiety. Both adaptive and maladaptive perfectionism showed positive associations and predictive power for cognitive and somatic anxiety. Maladaptive perfectionistic concerns negatively affected self-confidence, whereas adaptive perfectionism had no significant effect. Our findings reinforce the notion that all forms of perfectionism may pose a risk to athletes' wellbeing (Hill et al., 2020). Although literature suggests that adaptive perfectionistic strivings do not necessarily endanger athletes' mental health (e.g., Sagar & Stoeber, 2009), our results do not clearly support this claim. Therefore, the second hypothesis of our first study ($\mathbf{H_{1/2}}$) is only partially confirmed, and further research is needed to explore the effects of adaptive perfectionism more thoroughly in the context of sports. When irrational beliefs and perfectionism were

examined together, partial mediation was found between overall irrational beliefs (and all subtypes) and cognitive anxiety, mediated by perfectionism when both forms were entered into the model. For somatic anxiety, demandingness and awfulizing had indirect effects via perfectionism, indicating full mediation in these cases. However, low frustration tolerance and depreciation influenced somatic anxiety directly, without mediation by perfectionism. Adaptive perfectionism alone did not demonstrate significant mediating effects in any model; it became a mediator only when maladaptive perfectionism was also present. In contrast, maladaptive perfectionism independently mediated the effect of low frustration tolerance and depreciation on cognitive anxiety. These models confirm the third hypothesis of our first study (**$H_{1/3}$**): irrational beliefs predict competitive anxiety through perfectionism as well. Overall, our first study clearly demonstrated that maladaptive perfectionism and irrational beliefs—both independently and jointly—contribute significantly to athletes' competitive anxiety, particularly in the development of cognitive and somatic symptoms. Regarding adaptive perfectionism, our results align with international scientific findings suggesting that its role in competitive anxiety is ambiguous; however, an excessively high level may create internal discrepancy. This is evidenced by our full mediation result: dogmatic demandingness and awfulizing initially increase adaptive perfectionism (standards), which—though functional at first—may quickly turn into a maladaptive form (discrepancy) when expectations can no longer be consistently met. This sense of discrepancy ultimately leads to the emergence of somatic anxiety.

Based on the findings and conclusions of our first study, we designed and conducted the second study of this dissertation, which aimed to identify which psychological interventions are effective in regulating cognitive and somatic competitive anxiety, as well as in reducing associated cortisol levels. According to the results of the second study, the 8-week group-based REBT intervention led to a significant decrease in athletes' cognitive and somatic competitive anxiety, irrational beliefs, and both adaptive and maladaptive perfectionism. No such change was observed in either the mindfulness or the control group. These findings partially support the first hypothesis of our second study (**$H_{2/1}$**): the levels of competitive anxiety, perfectionism, and irrational beliefs significantly decreased after the intervention in athletes who participated in the 8-week REBT program. However, this cannot be confirmed for the hockey players in the

mindfulness group. Our results support the second hypothesis of the second study (**$H_{2/2}$**), which predicted that no significant difference would be observed between pre- and post-tests in the control group. The third hypothesis (**$H_{2/3}$**) was likewise confirmed: participants in the REBT group showed the largest decrease in competitive anxiety, perfectionism, and irrational beliefs compared to those in the mindfulness and control groups. However, no significant difference was found in salivary cortisol levels in any of the three groups—REBT, mindfulness, or control—thus our findings do not support the fourth hypothesis of the second study (**$H_{2/4}$**). In conclusion, the second study clearly demonstrated that recognizing and restructuring irrational beliefs into rational ones in a group setting can be an effective tool for regulating both cognitive and somatic anxiety, as well as for reducing perfectionism and irrational beliefs. Regarding mindfulness, several factors may explain the absence of significant changes following the intervention, such as openness to mindfulness, individual disposition, age, or level of commitment. Investigating these moderating factors could represent a valuable direction for further development, potentially yielding new and applicable scientific and practical insights for the field of sports.

Our first and second studies confirmed the impact of irrational beliefs and perfectionism on the development of competitive anxiety, as well as the effectiveness of identifying and restructuring irrational beliefs (REBT) in alleviating athletes' anxiety. However, throughout the course of our research, we also recognized that, despite competitive anxiety being one of the most extensively studied and treated psychological issues among athletes, no validated Hungarian-language instrument exists for its assessment. The first hypothesis of our third study (**$H_{3/1}$**) was not supported, as we were unable to confirm the validity of the original 27-item Hungarian adaptation of the Competitive State Anxiety Inventory (CSAI-2-H). After reviewing the items' modification indices and assessing their alignment with sport psychological terminology, we decided to exclude nine items and subsequently developed a revised Hungarian version of the inventory (CSAI-2-HR). This version may serve as a valid and reliable assessment tool for both researchers and practitioners working with athletes experiencing competitive anxiety. Similar to the age-related differences observed, we also identified significant differences by gender: female athletes reported higher levels of cognitive and somatic anxiety and lower levels of self-confidence compared to male athletes. These

findings support the second hypothesis of our third study (**$H_{3/2}$**). In conclusion, when interpreting the results of the CSAI-2-HR and constructing psychological development plans, it is essential to consider the athlete's age and gender, as these background variables showed significant effects on the outcomes. These values cannot be considered normative scores defined on standardized scales (e.g., Z- or T-scores), but rather descriptive statistical parameters specific to the given sample, providing a contextual frame of reference for interpreting athletes' psychological states. In practice, these values may be particularly useful in determining the extent to which an athlete's level of competitive anxiety deviates from the sample average. Based on the results, it is recommended that if an individual's score in any given dimension exceeds the mean (M) ± standard deviation (SD) threshold, psychological development plans should include targeted interventions for managing competitive anxiety, such as REBT-based programs. Since the CSAI-2-HR is not a clinical diagnostic tool, its application in sport settings should not focus on psychopathological classification, but rather on status assessment and the support of prevention and intervention planning. Regarding sport type, the third hypothesis of our third study (**$H_{3/3}$**) was only partially supported: no significant differences were found in cognitive anxiety; however, individual sport athletes exhibited higher levels of somatic anxiety and lower self-confidence than team sport athletes. While our findings did reveal certain significant differences based on sport type and competition level, we concluded that such differentiation lacks practical relevance in applied work. Therefore, we do not recommend tailoring psychological interventions based solely on these factors. Instead, we suggest that sport type and competition level be considered in conjunction with the athlete's age and gender, as our findings indicate that adolescent team athletes may be particularly vulnerable to cognitive anxiety, while female athletes in individual sports may be more prone to somatic anxiety.

We believe that the findings and conclusions derived from the three studies presented in this dissertation significantly contribute to a better understanding and effective management of competitive anxiety in athletes. Furthermore, the dissertation highlights future research directions that may offer additional relevant and practical insights into the emergence and regulation of competitive anxiety.

LIST OF OWN PUBLICATIONS

Publications Related to the Dissertation

Tóth, R. és Szabó, K. (2019a). Hivatásos magyar jégkorongozók stresszhelyzetének vizsgálata a motiváció tükrében. *Magyar Sporttudományi Szemle, 20*(82), 20-27.

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