Depressive Symptoms in Icelandic Elite Athletes: A Prospective Examination Through the Lens of the Response Styles Theory

To-date, depression-related research in athletes has remained largely at a descriptive level (Nixdorf et al., 2020), describing overall prevalence rates and stressors that correlate with depressive symptoms in athletes **(Tahtinen et al., 2021;** Wolanin et al. 2015). While previous findings have provided important information concerning stressors that may be especially relevant in athletes (i.e., sport-specific) - current empirical knowledge concerning depressive symptoms in athletes is mostly based on cross-sectional findings (Golding et al., 2020; **Tahtinen et al., 2021**) and has lacked theoretically informed approaches to understanding depressive symptoms in this population (Nixdorf et al., 2020; Tahtinen **et al., 2021**). Therefore, there is currently little empirical evidence that explains how stressors or increased perception of stress over time may contribute to more severe depressive symptomatology in some athletes, while others seem less affected. This is a significant gap in the current literature on mental health issues in athletes - as identifying the underlying mechanism by which individual differences in depressive symptoms emerge, may allow for more systematic approaches to targeting factors that increase athletes' vulnerability to depression and elevated depressive symptoms.

Individual differences in vulnerability to depression **or elevated depressive symptoms** can be understood through the lens of cognitive vulnerability-stress (or diathesis-stress) theories of depression, which suggest that individual differences **may emerge from** the interaction between cognitive vulnerability and negative or stressful life-events (Abramson et al., 2002). Hence, the core assumption is that individuals' cognitive makeup influences how life-events are interpreted, and hence, the same event may pose different meanings to different individuals, leading to different psychological outcomes over time (Abramson et al., 2002). In one of the few longitudinal studies that have utilised theory-driven approaches to studying depressive symptoms in athletes, Gerber et al. (2018) explored the interaction between mental toughness and, depressive and burnout symptoms

in young elite athletes. Their study was informed by the cognitive-transactional model of stress **(Lazarus & Folkman, 1987)**, which suggests that a mismatch between environmental demands and the individual's cognitive (coping) resources influences the level of distress they may experience. Gerber and colleagues (2018) found that perceived stress significantly predicted depressive symptoms over time, **and that** mental toughness buffered these stress-related negative outcomes. While Gerber and colleagues' findings provide important information of potential targets for mental health promotion, understanding the potential mechanisms contributing to elevated psychological distress is also essential, as mental ill-health may pose significant barriers to the optimal promotion of mental health (Lamers et al., 2015).

In a recent prospective study, Nixdorf et al. (2020) utilised the general diathesis (vulnerability) - stress model to predict depressive symptoms and burnout in junior elite athletes. Nixdorf and colleagues assessed athletes at three-time points, at pre-season, in-season, and post-season. The strength of this prospective study was that diatheses or vulnerability factors were assessed at pre-season, stressors during in-season, and outcomes at post-season, therefore testing the temporal progression of relationships as postulated by the diathesis-stress model. Nixdorf and colleagues found that pre-season depressive symptoms, dysfunctional attitudes, (negative) coping strategies, and recovery-stress state significantly predicted depressive symptoms at post-season. It is interesting to note, however, that, while differences in recovery-stress state significantly predicted post-season depressive symptoms, chronic stress measured during in-season was not a significant predictor of depressive symptoms at post-season. As discussed by the authors, these findings highlight the relevance of sport-specific stress-recovery states on depressive symptoms in elite athletes. Assessing recovery-stress state may also be beneficial in that it is not limited to mean ratings of overall levels of stress, but also considers individuals' perceived ability to cope with stressors (Beckmann & Kellmann, 2004). It is hence possible, that the relationship between stress-recovery and depressive symptoms observed by Nixdorf and colleagues (2020) was not necessarily due to levels of stress per se, but due to trait-level differences in how athletes coped with the stress

they were experiencing (i.e., recovery). Furthermore, in terms chronic stress in the Nixdorf et al. (2020) study, it is plausible that the effects of chronic stress on depressive symptoms were not captured due to the time delay between the assessment of chronic stress (time two) and the assessment of depressive symptoms (time three). Vulnerability-stress models of depression are inherently theories of stress-reactivity – explaining how stable individual differences in vulnerability moderates the influence of stress on depressive symptoms (Abela et al., 2012; Spasojević & Alloy, 2001). Therefore, to test a vulnerability-stress model of depression, it is important that fluctuations in perceived stress are measured in temporal proximity to fluctuations in symptoms of depression (Abela et al., 2012).

Understanding the Underlying Process

An important dimension to understanding the development of individual differences in depression or elevated depressive symptoms is the process by which an initial negative affect in response to a negative event or a stressor translates into more severe forms of distress. While cognitive vulnerabilities such as dysfunctional attitudes or negative cognitive styles may underlie the emergence of negative thought content in response to a negative or stressful event, depressive rumination (Nolen-Hoeksema, 1991), explains the underlying cognitive processes (e.g. attention) by which negative affect is further escalated and maintained (Hankin & Abramson, 2001). According to the response styles theory (Nolen-Hoeksema, 1991), which is based on the vulnerability-stress account of depression, depressive rumination is defined as a relatively stable, cognitive information processing style which is activated in response to negative mood. Depressive rumination has been defined as a two-factor construct including reflective and brooding rumination (Treynor et al., 2003). While reflective rumination has been characterized as a more adaptive (goal-directed) response to negative mood, brooding is characterized as a more maladaptive (passive, abstract, and evaluative) processing style that focuses specifically on the symptoms, causes and implications of ones' negative mood (Treynor et al., 2003). Longitudinal studies have suggested that while reflective rumination

may be linked to concurrent depression, it may not be a strong predictor of depression over time when the influence of brooding is factored in (Treynor et al., 2003). This assumption has also been supported by Lo et al. (2008) who demonstrated that brooding, but not reflection, mediated the effects of negative cognitive style on depression. Overall, there is robust empirical support for the response styles theory indicating that depressive rumination is central in the onset (Just & Alloy, 1997; Nolen-Hoeksema, 2000), maintenance (Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 1997; Spasojević & Alloy, 2001), and recurrence of depression and depression symptomatology (Michalak et al., 2011).

Recent Developments in the Response Styles Theory

As proposed by Nolen-Hoeksema (1991), for individuals who develop a ruminative response style, negative mood has a strong attentional valence that triggers maladaptive habitual thought processes which are difficult to disengage from. As mentioned by Watkins and Nolen-Hoeksema (2014) although the original RST and previous empirical research has identified depressive rumination as a habitual response (e.g., automatic, lacking conscious control) to negative or depressed mood, the original RST does not explicitly elaborate on the processes by which this habit may develop (Ólafsson et al., 2020). In recent reforms of the RST, however, a theoretical extension to the original RST has been proposed by Watkins and Nolen-Hoeksema (2014). The habit-goal framework is a theoretically informed and empirically tested extension to the original response styles theory in which ideas from RST (depressive rumination as a stable trait) and control theories (rumination as a goal-oriented state) are merged to provide a more elaborate account of how depressive rumination (as described by the RST) may develop into a mental habit (Watkins & Nolen-Hoeksema, 2014). According to control theory accounts of rumination, a perceived goal-discrepancy (i.e. failure to reach a desired goal) triggers goal-oriented (intentional) state rumination, defined as repetitive thoughts focused on the discrepancy in one's goal progress towards desired goals (Watkins & Nolen-Hoeksema, 2014). If this state rumination consistently involves brooding qualities (abstract,

passive, and evaluative) contingent on same or similar contexts (e.g. depressed/negative mood) it may develop into a habitual trait over time (Watkins & Nolen-Hoeksema, 2014). However, if an individual also uses different, more adaptive approaches to resolve their goal-discrepancy (e.g., reflective, goal-oriented thought processes leading to more constructive and concrete action-oriented responses), rumination may not necessarily develop into a habitual response. Hence, this theoretical elaboration can better explain why individuals may sometimes engage in maladaptive (brooding) rumination in response to negative life events, without developing a trait habit of depressive rumination (Watkins & Nolen-Hoeksema, 2014). In a recent study by Ólafsson et al. (2020), formerly depressed and non-depressed University students were assessed on the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) to assess the habitual characteristics of participants' rumination. Ólafsson and colleagues (2020) found that the SRHI significantly predicted brooding, but not reflective, rumination - suggesting that brooding was associated with greater habitual characteristics (e.g., automaticity and a lack of conscious control) than reflective rumination. As discussed by the authors, the findings support the habit-goal framework (Watkins & Nolen-Hoeksema, 2014) – in that brooding rumination may be characterised by habitual and abstract thought processes that emerge in response to salient negative stimuli, before more adaptive goal-oriented responses can be generated.

Relevance of Depressive Rumination in Elite Athletes

As noted in a recent consensus statement by the International Society of Sport Psychology, increasing training loads and performance pressures may increase athletes' susceptibility to experiencing negative mental health outcomes (Henriksen et al., 2020). These types of stressors may be especially prevalent in the elite sport contexts where the performance of the athlete may not only influence the athlete themselves, but also others that are invested in the athlete's performance (e.g. coaches, the club, fans, parents; Gervis & Dunn, 2004). Subsequently, in addition to more general life stress (Beable et al., 2017), sport-specific stressors such as performance failure (Hammond et al.,

2013), injury, and significant career transitions (Henriksen et al., 2020) may have especially harmful impact on elite athletes' mental health. Due to its highly competitive nature, the elite sport environment may also expose individuals regularly to negative events or situations such as performance failures, that elicit mood fluctuations (Jones & Sheffield, 2007), but may also contribute to negative mood following positive events, such as achieving a long-term athletic goal (Howells & Lucassen, 2018). Subsequently, elite athletes with underlying cognitive vulnerabilities may be in a heightened risk for experiencing more severe distress than less vulnerable elite athletes (Nixdorf et al., 2020) when faced with stressful life-situations (Beable et al., 2017; Gerber et al., 2018).

Although rumination has been previously highlighted as an important vulnerability factor in the athlete mental health literature (Uphill & Dray, 2009), and often appears in texts where various research findings are discussed, rumination itself has rarely been empirically tested in athletes (Kröhler & Berti, 2019). To-date only one study has explicitly tested depressive rumination in relation to depressive symptoms in athletes. In a study by Tahtinen et al. (2020), findings suggested that athletes with high levels of brooding rumination were significantly more likely to exhibit clinically significant depressive symptoms than athletes with low levels of brooding. Reflective rumination, however, increased the likelihood of experiencing clinically significant depressive symptoms only in athletes with high, but not low, levels of brooding. While these findings were largely supportive of findings in non-athlete samples, the study did not explore the effects of brooding and reflection on depressive symptoms over time and did not take into consideration that athletes may have experienced different levels of stress at the time of the assessment. The response styles theory postulates that an initial negative mood is more likely to trigger ruminative responses in individuals with a high tendency to ruminate than in individuals with a low tendency. Subsequently, this increased susceptibility to engage in depressive rumination in response to a negative mood or other depressive symptoms, may then further escalate these symptoms, potentially evolving into a full-blown episode of major depression in the future (Nolen-Hoeksema et al., 2008). Hence, according to the response styles theory, the effects of stress on depressive symptoms would depend

on (e.g., be moderated by) individuals' tendency to ruminate. As shown in previous prospective studies in adolescents (Abela et al., 2012; Mezulis et al., 2010; Paredes & Zumalde, 2015), brooding rumination has shown to moderate the effects of stress on depressive symptoms. For example, in a study by Bastin et al. (2015), brooding rumination measured at baseline (beginning of the study) moderated the prospective relationship between interpersonal stress and depressive symptoms in an adolescent sample.

Although trait or habitual rumination remains relatively stable over time, like other cognitive vulnerabilities, depressive rumination is amenable to change through therapy or interventions (Ingram et al., 2006). Recently, sport psychology scholars have underlined the need for more research on cognitive vulnerability in elite athletes to develop more targeted prevention and intervention within this population (Elbe & Jensen, 2016; Nixdorf et al., 2016, 2020; Tahtinen et al., 2021). As shown in a study by Donohue et al. (2018) treatment or prevention approaches designed to target performance and mental health outcomes may be highly appealing to athletes, potentially leading to higher engagement in the program. Donohue and colleagues (2018) showed that a treatment program that addressed both performance and mental health-related issues in university athletes, led to better athlete engagement and mental health outcomes when compared to a traditional non-sport-specific (on-campus) counselling program. Considering that similar attentional processes may contribute to the onset and maintenance of depression (Koster et al., 2011) as well as poor performance outcomes (Bennet et al., 2016) – exploring depressive rumination in athletes is highly relevant as it could open new avenues for targeting both mental health and performance-related outcomes.

The Current Study

The current study aimed to validate the vulnerability-stress account of depression through the lens of the response styles theory in Icelandic elite athletes using a longitudinal research design. The first aim of this study was to test whether perceived stress over the study period (fluctuations around

athlete´s personal average stress score) contributed to differences in depressive symptoms over time (measured at each time point). It was hypothesised that increases in athletes' perceived stress level would significantly predict increases in depressive symptoms over the study period. The second aim of the study was to explore whether brooding and reflective rumination (measured at the beginning of the study) predicted differences in depressive symptoms over time. It was hypothesised that both brooding and reflective rumination would be correlated with depressive symptoms when tested cross-sectionally, but only brooding would predict depressive symptoms over time. The third and final aim was to test the validity of the vulnerability-stress account of the response styles theory. More specifically, the objective was to test whether the potential prospective relationship between stress and depressive symptoms was dependent on (moderated by) athletes' tendency to brood and/or to reflect in response to negative mood as measured at the beginning of the study. As predicted by the response styles theory (Abela et al., 2012; Nolen-Hoeksema, 1991; Treynor et al., 2003; Watkins & Nolen-Hoeksema, 2014), it was expected that increases in perceived stress scores would relate to significantly higher depressive symptom scores in athletes with a high tendency to brood compared to athletes with a low tendency to brood.

Methods

Participants

To be included in the study, participants needed to have responses to rumination, perceived stress, and depressive symptoms items at least at two points, including time 1 (T1) and at least one other occasion either at first or second follow-up (T2 and/or T3). Of the total 111 participants who responded to questionnaires at T1, 79 athletes (71.1%) participated in at least one follow-up assessment and were thus included in the final study sample. Athletes who were excluded from the study (participated only in T1 assessment) showed higher levels of stress (M=6.13, SD=2.89) than athletes that were included in the study (M=4.94, SD=2.68) [$t(105) = 2.04$, $p = .04$]. The groups did not significantly differ across depressive symptoms, or depressive rumination. The male-to-female ratio differed significantly between the excluded sample (42.4% male) and the included sample

(24.1% male) [X2 (1, N = 111) = 4.23, p = .40], and there was a significant age difference with the excluded athletes having a higher mean age (M=26.16, SD= 5.04) than the included sample (M=23.46, SD=4.82)) [t(108) = 2.61, p =.01]. The final sample included in the current longitudinal investigation consisted of 79 elite and national team athletes (M_{age}= 23.5, SD=4.8, age range 18-37), with the majority being female athletes (n=60, 75.9%). Athletes competed in handball (n=22, 27.8%), football (n=14, 17.7%), basketball (n=26, 32.9%), Icelandic equitation (n=8, 10.1%), and mixed martial arts and/or Brazilian jiu-jitsu (MMA/BJJ; n=9, 11.4%). The term "elite" was defined as being selected in the national team or being selected in the highest competition group within the athletes' respective sport and age group in Iceland. Athletes in MMA/BJJ were all members of an elite competition group, and all other athletes were either members of the Icelandic junior (≥18 years old) (n=33, 41.8%) or the A-squad national team (n=37, 46.8%) at the beginning of the study (T1).

Measures

Depressive Symptoms

Depressive symptoms were assessed by the Patient Health Questionnaire 9 (PHQ – 9; Kroenke & Spitzer, 2002), which assesses the presence of the nine depressive symptoms listed in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) during the past two weeks. Each item is scored on a range from 0 to 3, where 0 = "not at all", 1= "several days", 2 = "more than half the days", and 3 = "nearly every day". The summed symptom scores on the PHQ-9 can range from 0 to 27 with higher scores representing higher symptom severity. The psychometric properties of PHQ-9 have shown to be good among the clinical (Kroenke & Spitzer, 2002) and the general populations (Martin et al., 2006), including the Icelandic population (Palsdottir, 2007). The internal consistency of the scale across time points in the current sample was α=.68 (T1), α=.78 (T2), and α=.79 (T3).

Perceived Stress

The 4-item Perceived Stress Scale (PSS-4) was utilized to assess athletes' overall perception of stress within the past month. The PSS-4 is an adaptation of the original 14-item Perceived Stress Scale (PSS; Cohen et al., 1983). The PSS-4 assesses individuals' appraisal of feelings and thoughts of stress within the past month, including items such as *'[i]n the last month, how often have you felt that you were unable to control the important things in your life?*' and *'[i]n the last month, how often have you felt difficulties were piling up so high that you could not overcome them?*' Each item on the scale is scored from 0=never to 4=very often, and the summed symptom scores can range from 0-16 with higher scores representing higher perceived stress. Cohen et al. (1983) reported internal consistency of the PSS-4, which was α=.72, and the test-retest reliability over two months was α=.55. In the current sample, the internal consistency of the scale across the three time points was α=.57 (T1), α=.49 (T2), and α=.56 (T3).

Depressive Rumination

Ruminative Responses Scale - short form (RRS-short form) was utilised to assess brooding and reflective rumination. This version of the RRS is a 10-item scale adapted from the original 22-item RRS to measure rumination in response to depressed or negative mood (Treynor et al., 2003). The 10-items in the RRS-short form consist of five reflective pondering (reflection) items, and five brooding items. Respondents rate all items from 1 (almost never) to 4 (almost always). A summed score is then calculated separately for the five-item reflection and the five-item brooding rumination subscale, with higher scores representing higher tendency to engage in reflective and brooding rumination when feeling low, sad or depressed. The internal consistency of the scales in the current sample were α= .80 for brooding and α= .70 for reflection.

Procedures

Recruitment of participant was conducted within an ongoing project at the Department of Sport Science at Reykjavik University, Iceland. The ongoing project was a collaboration between

Reykjavik University and selected national sports associations, where psychological skills and physiological assessments were conducted with national teams bi-annually. For the current longitudinal study, questions concerning mental health issues were added to the existing survey. The first assessment (T1) was conducted at the time when teams participated in their on-site assessment within the larger ongoing project. Therefore, athletes from different sports initiated the study at different times. However, all athlete responses were acquired in late fall or winter months with 39.2% initiating in September-November and 60.8% of athletes initiating in January-March (during years 2018 and 2019). The follow-up surveys were conducted six months (T2) and 12 months (T3) following the initial assessment. A link to the follow-up surveys were sent via personalised emails directly to each athlete. Athletes were also informed about the follow-up assessments through gatekeepers within the national teams and the elite training group (i.e., in MMA/BJJ). Email reminders were sent to athletes who had not responded to the follow-up survey approximately two and four weeks after the initial emails were sent.

Ethical Considerations

Athletes were informed that individual data relating to the mental health survey would only be available for the principal investigators of this study and would not be shared with coaches or other staff. It was also underlined that answering the mental health module was voluntary and that athletes could withdraw from the study at any time. Athletes were informed that all personal information would be coded by key-linking ID numbers and that any personal identifiers would be omitted once data collection had been finalised. Participants were also provided with contact information for psychological support and encouraged to seek help if they were experiencing any type of distress. Participants did not receive any form of compensation for their participation. Permission for the study was obtained from the National Bioethics Committee in Iceland (application number: VSNb2018050001/03.01) and the Icelandic Data Protection Authority.

Statistical analyses and Multilevel Models

First, a missing values analysis was conducted to explore any potential systematic patterns across all study variables. The Little's test of Missing Completely at Random (MCAR) was non-significant [χ^2 (986) = 509.28, p= 1.00], suggesting that data were missing completely at random. Across all time points, athletes with only one missing response on the PHQ-9, PSS, and rumination items were included in the analyses by averaging the scores on the non-missing items and multiplying this by the total number of items on the scale (Schafer & Graham, 2002). For example, for athletes with one missing item on the PHQ-9 scale, the mean of the eight non-missing items was multiplied by 9 (Löwe et al., 2006). Three athletes had one missing item on the PHQ-9 scale, one athlete had one missing item on the PSS scale, six athletes had one missing item on reflective rumination, and one athlete had one missing item on brooding rumination.

Main analyses testing the contribution of brooding, reflective rumination, and stress on depressive symptoms, and the vulnerability-stress model (i.e., rumination-stress-depressive symptoms) over time, were conducted in SPSS through the "mixed" function. Multilevel modelling allows for testing the main and interaction effects of stable between-individual characteristics (level two factors, e.g., depressive rumination) and time-varying within-individual covariates (level 1 factors, e.g., perceived stress) on the dependent variable (e.g., depressive symptoms; Abela et al., 2012; Aguinis et al., 2013; Bastin et al., 2015; Cox et al., 2012; Paredes & Zumalde, 2015). Perceived stress was included as a level one within-individual time-varying factor. Brooding and reflective rumination were included as stable between-subject factors with scores reported at T1 held constant across time T2 and T3. Brooding and reflective rumination were grand-mean-centred by deducting sample mean from the individual's score. Perceived stress scores at each time point were, however, mean centred by deducting each athlete's own overall average stress score across the study period, from athlete's summed stress score at each specific time point. By centring brooding and reflection concerning individual differences, and by centring stress scores around the athletes' average level of stress - predictors were standardised to test the cross-level interaction effects

between individual differences (vulnerability) and within-individual change (stress) on the outcome over time (depressive symptoms; Bell et al., 2018).

Multilevel models were conducted utilising maximum likelihood estimates. The heterogeneous first-order autoregressive (ARH1) covariance structure was chosen for repeated measurements and random-effects models to allow for heterogeneous variances and correlated observations across adjacent time points (Field, 2013). In building the models, a random-effects model for time at the level of the athlete was included. This inclusion allowed for between-participant differences in depressive symptoms to be accounted for at time T1 (random intercept) and over the study period (random slope).

Results

Descriptive statistics

Table 1 shows the correlations across the main study variables. Apart from the lack of significant correlation between age and the main study variables, and a lack of significant correlation between reflective rumination at T1 and depressive symptoms at T3; brooding and reflective rumination, perceived stress, and depressive symptoms were positively and significantly intercorrelated at all time points.

Independent samples t-tests showed no significant differences in brooding, reflection, or stress at T1 between male and female athletes. Junior national team athletes (M=9.1, SD=2.8) had significantly higher brooding scores than A-national team and MMA/BJJ athletes (M=7.7, SD=2.3) [$t(77) = 2.4$, p=.02], but did not significantly differ on reflective rumination, stress or depressive symptoms.

Main effect of Time and Perceived Stress

Before conducting the main analyses, demographic factors (age, sex, type of sport and national team) were tested for main effects on depressive symptoms. However, none of these factors

showed a significant relationship with depressive symptoms over time and hence, were not included in further analyses. As can be seen in Table 2, model 1 included random effects to account for individual differences in depressive symptoms at T1 (intercept) as well as over the study period (slope). Depressive symptoms scores at T1 (intercept) varied significantly across athletes. However, the trajectory of depressive symptoms across the study period (slope) did not significantly vary across athletes. Hence, while athletes varied significantly in their depressive symptom scores at T1, changes in mean symptom scores during the study period did not significantly differ between athletes. Fixed effects model 1 showed that perceived stress (b=.38, t=4.42, $p< .001$) and time (b=.43, t=2.54, p=.01) independently contributed to differences in depressive symptoms over the study period. Hence, there was an overall mean increase in depressive symptoms in the sample over the study period. Also, an increase in athletes' perceived stress (changes in each athletes' mean stress levels) was related to an increase in depressive symptom scores across the study period.

Brooding and Reflective Rumination and Interaction with Perceived Stress

Considering that variance in depressive symptom trajectories during the study period (random slope) did not significantly differ between athletes in model 1, the random slope was not included in model 2 (Table 2). Furthermore, when brooding and reflective rumination were included as fixed factors, reflective rumination did not significantly explain variance in depressive symptoms over time (b=.14, t=1.29, p= .20). Therefore, reflective rumination was not included in the final model (model 2). As can be seen in Table 2, the random intercept remained significant in model 2, but variance was noticeably attenuated compared to model 1 (i.e., Model 1 variance= 6.09, model 2 variance = 3.50). This finding suggests that some of the random error variances in depressive symptom scores across athletes at T1 were explained by brooding rumination and perceived stress (model 2). There was a significant interaction effect between brooding scores measured at T1 and fluctuations in athletes' perceived stress scores on depressive symptoms (b=.06, t=2.15, p=.03). This

finding suggested that changes in depressive symptoms were dependent on the interaction between brooding rumination at T1 and changes athletes' perceived stress across the time points.

To explore more visually the significant moderation effect observed across the study period in our multilevel analyses, we conducted additional univariate analyses separately for each time point (i.e., T1, T2, and T3, Figure 1). Athletes were dichotomised into high vs. low brooding groups based on median sample score on brooding rumination at T1. Athletes were further categorised into two groups based on their perceived stress at each time point (high stress = score above athletes' average stress score, low stress = score at or below athletes' average score). A visual examination of the interaction between perceived stress and brooding rumination on depressive symptoms suggested that there was a trend towards a higher increase in depressive symptoms in athletes with high, compared to athletes with low, brooding tendency when stress increased (Figure 1). However, these univariate interaction effects at T1 and T2 were statistically non-significant. Nevertheless, the univariate analyses showed that the main effect of brooding on depressive symptoms was significant both at T1 [$F(1, 73) = 27.8$, $p < .001$, adjusted $R^2 = .27$] and T2 [$F(1, 62) = 23.3$, $p < .001$], adjusted $R^2 = .24$]. This suggests that athletes with high brooding tendency exhibited consistently higher depressive symptom scores at T1 and T2 independent of current levels of stress. When T3 was explored, univariate analyses showed that there was a significant interaction effect between brooding and stress scores on depressive symptoms [$F(1, 54) = 4.0$, $p = .05$, adjusted $R^2 = .25$)]. This finding indicated that at T3, when perceived stress increased, athletes with a high tendency to brood reported significantly higher depressive symptom scores than athletes with a low tendency to brood.

Discussion

Depressive rumination has been identified as a central cognitive vulnerability factor in the onset (Just & Alloy, 1997; Nolen-Hoeksema, 2000), maintenance (Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 1997; Spasojević & Alloy, 2001), and recurrence of depression and depression symptomology (Michalak et al., 2011). However, to-date longitudinal investigations especially in

relation to cognitive vulnerability have been largely non-existent in athletes. Therefore, in this study the vulnerability-stress account of depression was tested prospectively through the lens of the response styles theory, by testing the relationship between depressive rumination, perceived stress and depressive symptoms.

Perceived stress and Depressive Symptoms

It was found that increases in athletes' perceived stress (measured in relation to athlete's own mean stress score), was related to increases in depressive symptom scores over the study period. This finding is in line with some previous studies in athletes (Beable et al., 2017; Gerber et al., 2018) suggesting that levels of perceived stress or daily life-stress (Beable et al., 2017) are related to increased levels of depressive symptoms. Hence, although stress is inherent in competitive sports at the highest level, there may be a need for identifying and targeting "unnecessary" stressors as an early prevention strategy when optimising mental health in elite athletes (Purcell et al., 2019). For example, Beable et al. (2017) found that negative thoughts about the future and worry about meeting high standards were the most prevalent life stressors in athletes' lives. This finding suggests that interventions aiming to help athletes to deal with worry and stress are important. Nevertheless, in some situations the source of stress may systematically emanate from the athletes' proximal environment (e.g. pressure from parents/coaches) or the larger sports ecology (e.g., gender inequality), over which the individual athlete may have limited control. Hence, interventions targeting only athletes at the individual level may not always be sufficient, in which case multilevel approaches to prevention may also be needed (Purcell et al., 2019).

Brooding, Reflection, and Depressive Symptoms

While both reflective and brooding rumination were correlated with depressive symptoms at T1, only brooding predicted depressive symptoms across the study period. This finding supports initial findings reported by Tahtinen et al. (2020), who showed that brooding rumination was more

strongly linked to concurrent depressive symptoms than reflective rumination. The findings from the current study also echo results reported among non-athletes, underlining that although both types of rumination correlate with concurrent depression, only brooding predicts depressive symptoms over time (Treynor et al., 2003). As a previous studies have suggested (Ólafsson et al., 2020; Watkins & Nolen-Hoeksema, 2014) brooding may entail stable and highly habituated cognitive processes that may be activated by negative mood or distress. For example, it has been suggested that brooding rumination may be initiated automatically, without effortful control (Watkins & Baracaia, 2002), and may hence, operate as a rigid and reflexive cognitive system that is primed before more conscious or goal-directed processes, such as concrete problem solving, can be implemented (Donaldson & Lam, 2004; Nolen-Hoeksema et al., 2008). Subsequently, once initiated, disengaging from ruminative processes may be difficult (Koster et al., 2011), therefore increasing the risk for the onset of more severe and recurrent distress such as depression. Considering that attentional processes are central in optimal athletic performance (Bennett et al., 2016; Swann et al., 2017) and rumination (Joormann & Arditte, 2015), and that rumination has been implicated as transdiagnostic process predicting a range of psychological disorders (Watkins, 2009) - brooding may represent an important target for intervention and prevention when the goal is to optimise both mental health and performance in athletes. However, as noted by Kröhler & Berti (2019), rumination has rarely been explicitly tested empirically in athletes, and hence, the findings from this study provide novel and important knowledge for future research to build upon.

Validity of the Vulnerability-Stress account of the Response Styles Theory

The validity of the vulnerability-stress account of the response styles theory in the current elite-athlete sample was supported. It was found that brooding rumination moderated the relationship between perceived stress and depressive symptoms across the study period – suggesting that athletes with higher trait brooding tendencies may be more likely to exhibit elevated depressive symptoms when they experience increases in perceived stress. Hence, the mechanism by which individual

differences in depressive symptoms emerged in our elite athlete sample were similar to those previously identified in non-athlete samples. The initial findings observed in our study may have important implications for future research, intervention, and prevention initiatives in athletes. The context of elite sports is inherently stressful (Beable et al., 2017; Doherty et al., 2016; Wolanin et al., 2015), and elite athletes may be regularly exposed to situations and events that contribute to mood fluctuations (Howells & Lucassen, 2018; Jones & Sheffield, 2007). As suggested by Hjartarson et al. (2021), mood fluctuations may in turn significantly predict consequent moment-to-moment rumination – and that this relationship may be more pronounced in individuals with a habitual tendency to engage in negative thinking. Future research may hence consider building upon our initial findings by including more specific measures to test athletes' habitual negative thinking (e.g., the Habit Index of Negative Thinking; Verplanken, et al., 2007) in relation to depressive symptoms. Furthermore, considering that Gerber at al. (2018) found that mental toughness buffered the negative effects of stress on depressive symptoms –future research could explore the relationship between rumination and mental toughness, and how these constructs may interact in relation to depressive symptoms in athletes.

Practical Implications

One mechanism by which rumination may exert negative effects on the individual is by attenuating problem solving and concrete behaviours that lead to beneficial outcomes for the individual (Nolen-Hoeksema et al., 2008). Problem solving may be especially hampered among individuals who have developed brooding qualities, as brooding may represent habitual responding to negative mood. This suggests that when the individual experiences distress, brooding responses may be initiated before more adaptive goal-oriented responses can be applied (Ólafsson et al., 2020). It has been suggested that while "high-ruminators" can generate rational ideas about adaptive coping strategies, when experiencing distress, they may be less likely to engage in the behaviours needed to accomplish these strategies (Nolen-Hoeksema et al., 2008). Therefore, although athletes (and

coaches or parents) may be well-aware of the types of strategies that are most adaptive – the challenge is how to promote engagement in these behaviours when individuals are experiencing distress. The sport psychology practitioner could play an important part in developing "hands-on" approaches to promoting adaptive behavioural repertoires and in incorporating environmental cues that are incompatible with brooding responses.

Considering that brooding may be the result of conditioned learning, behavioural approaches could be effective in extinguishing learned maladaptive responses, while replacing them with new, more adaptive behaviours. For example, the "if-then" framework (Watkins, 2016) could prove useful when working with individual athletes and/or when designing interventions targeting the overall training environment. In the "if-then" framework, the aim is to first identify situations that usually trigger ruminative thought processes ("if") and second, to identify, plan, and practice more beneficial responses that are incompatible with the maladaptive behaviour ("then") (Watkins, 2016). This approach could be further developed for, and tested in, athletes in future research. Additionally, as behavioural approaches are also largely dependent on environmental stimuli (i.e., antecedents and consequences), these types of interventions could also play an important role when designing multilevel approaches to mental health promotion in elite athletes.

Limitations

There are several limitations to the current study that should be noted. First, due to the different athletic schedules, it was not possible to recruit all athletes into the study at the same time, and therefore, potential contextual influences (e.g. timing of the season) could not be explored. The small sample sizes across different sports also did not lend themselves for comparisons of sport-specific determinants. Also, although the multilevel strategy is flexible in terms of the inclusion of athletes with missing data (time) points (Abela et al., 2012; Goldstein, 2003), the relatively small sample size may have contributed to less accurate estimates of standard error variances and hence, the observed confidence intervals may have been underestimated (Maas & Hox, 2005). However, the current study aimed at making preliminary interpretations of the validity of the vulnerability-stress

account of response styles theory in the current sample, rather than to generalising more broadly to the Icelandic elite-athlete population. The internal consistency of PSS-4 was also surprisingly low in the current study. After a more detailed exploration, item 2 “In the last month, how often have you felt confident about your ability to handle your personal problems?”, showed a lack of correlation with the three remaining stress items across all time points, implying that this item may not have been well-representative of perceived stress in our elite athlete sample. Depressive symptoms at T1 were not specifically controlled for our analyses. Controlling for initial levels of depressive symptoms would have meant that all T1 data would have been excluded from models and analyses would have been constrained to two data point (T2 and T3). This controlling would have also meant that athletes responding only at T1 and T2 would not have been included in the study (only one data point after exclusion of T1 data). However, a random-effects model was included to allow for individual variation in depressive symptoms at T1. Although this does not specifically control for the effect of T1 depressive symptoms, it does account for different “starting points” in depressive symptoms when estimating individual variation in slopes. It should also be noted that the main aim of this study was to explore the validity of the response styles theory in an elite athlete sample concerning the relationship between brooding, stress and depressive symptoms. Hence, whether brooding predicted clinically significant levels of depressive symptoms was not tested. Finally, although the follow-up online questionnaires were sent to athletes six months following the previous assessment occasion, independent of when athletes initiated the study, there was considerable temporal variation in the timing of responses across athletes. Therefore, the influence of time on depressive symptoms should be interpreted with this temporal limitation in mind. Despite these limitations, the current study is an important addition to the existing athlete mental health literature, as it provided a theoretically informed prospective approach to exploring potential underlying mechanisms in individual differences in depressive symptoms in athletes.

Conclusions and Future Directions

The current study provides important empirical support for the utility of exploring cognitive vulnerability to depressive symptoms in athletes through the lens of the response styles theory. The findings suggested that elite athletes who report a tendency to brood in response to negative mood may be at a significant risk for experiencing elevated depressive symptoms when experiencing increasing levels of stress. Future studies are, however, needed to replicate our initial findings utilizing larger elite-athlete samples, and to explore whether brooding contributes to the severity of mental health issues in athletes. Furthermore, future research could explore the relationship between brooding rumination, athletic performance, and mental health issues, and to test whether prevention targeting brooding rumination leads to improved mental health benefits in athletes.

To date, most depression-related research in athletes, including the current study, have focused on depressive symptoms in athletes who have already reached elite-level status (Golding et al., 2020). However, vulnerability to depression may become established in childhood or early adolescence (Abela et al., 2012; Mezulis et al., 2006, 2010). Future studies would hence benefit from exploring the development of brooding tendencies in athletes in different youth sports environments (e.g. outcome-oriented, early initiation or specialisation) and/or youth coaching environments (e.g. criticism, excess control). If some contexts are more likely to facilitate or contribute to an increased tendency to brood, early prevention strategies could be designed to attenuate these trends.

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