

Dispositional Mindfulness May Have Protected Athletes from Psychological Distress During COVID-19 in Australia

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Abstract

Promoting athlete wellbeing has become a priority in elite sport, and the COVID-19 pandemic has accentuated the need for a comprehensive understanding of risk and protective factors. Existing sport research has not yet considered whether specific cognitive factors such as dispositional mindfulness and executive function may protect athletes against psychological distress. In a sample of high-performance Australian football athletes ($n = 27$), we administered measures of dispositional mindfulness (MAAS), executive function (AOSPAN; eStroop), and psychological distress (APSQ) at pre-season, coinciding with the initial (2020) COVID-19-related sport shutdown in Australia. Measures of executive function and psychological distress were re-administered at the end of the COVID-19 affected competitive season in 2020. Athletes reported significantly elevated psychological distress relative to previous estimates of distress among high-performance athletes established in prior studies. Executive functions, including working memory and inhibitory control were not

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significantly associated with psychological distress or dispositional mindfulness at either timepoint. However, baseline mindfulness was associated with reduced distress at both pre-season ($r = -0.48, p = .03$) and end of season ($r = -0.56, p = .004$), suggesting that dispositional mindfulness may have afforded protective buffering against symptoms of distress. Correlation data alone does not establish a directional connection from mindfulness to reduced distress, and future research is required to elucidate this association and/or establish the mechanism/s by which dispositional mindfulness may protect against psychological distress in this population.

Keywords

working memory, inhibitory control, athlete, sport, mental health, Australian football, cognition, wellbeing, psychological strain, mindfulness

Introduction

High-performance athletes experience mental health disorders, including depression and anxiety, at rates comparable to age-matched peers in the general population (Reardon et al., 2019; Rice et al., 2016). Reports indicate that approximately 46% of Australian athletes report clinically significant symptoms of at least one mental disorder (Gulliver et al., 2015). Moreover, athletes are exposed to a range of unique, sport-specific stressors, such as injury, competitive failure, aggression, media scrutiny, and unexpected career termination that may increase their risk for mental health concerns (Reardon et al., 2019; Rice et al., 2016). Recently, the coronavirus disease (COVID-19) pandemic and associated social lockdown measures have presented additional challenges to athletes' wellbeing, including threats to job security, financial losses, isolation from usual training environments and support networks, and concerns about contracting the virus (Hakansson et al., 2020). Many athletes have also been subjected to periods of mandatory quarantine, an experience associated with substantial detrimental psychological impacts (see Brooks et al., 2020 for review).

Athletes' difficulties adapting to changing circumstances can manifest as symptoms of psychological distress, including impaired self-regulation of behavior, mood, and motivation, and reduced athletic performance and social functioning (Rice, Parker et al., 2020). Accordingly, in the wake of the COVID-19 crisis, investigators have reported acute increases in athletes' psychological distress (Fiorilli et al., 2021), perceived stress (di Fronso et al., 2020) and depression symptoms (Pillay et al., 2020). Elite Australian athletes from a variety of sports faced significant changes in the frequency, duration, and timing of training sessions after the onset of COVID-19 lockdowns that were associated, in turn, with detrimental effects on the athletes' sleep and mental health, with specific reports of increased anxiety, depression, and stress (Facer-Childs et al., 2021). Overall, post-COVID-19 estimates of mental health symptoms among athletes have suggested increased psychological distress in 2020

(Facer-Childs et al., 2021; Fiorilli et al., 2021; di Fronso et al., 2020; Pillay et al., 2020), potentially placing athletes at higher risk of mental illness (Rice, Parker, et al., 2020).

Even prior to COVID-19, a high overall prevalence of mental health problems among elite athletes and athletes' increased exposure to potential stressors (Reardon et al., 2019) made the identification of factors that might protect athletes' psychological health and wellbeing a priority (Kuettel & Larsen, 2020). One such protective factor that has received significant research interest is mindfulness (Gross, 2020), defined as the nonjudgmental allocation of attention to present moment experiences (Brown & Ryan, 2003; Kabat-Zinn, 1990). In contrast to other approaches concerned with identifying and challenging the *content* of an individual's thoughts (e.g., cognitive behavioral therapy), mindfulness is characterized by non-reactive observation of thoughts, sensations and/or experiences occurring in the present moment (Brown & Ryan, 2003). As such, mindfulness does not aim to directly promote positive thinking, nor challenge and replace negative thoughts, but is instead characterized by a quality of flexible, non-judgmental observing of present-moment experience (Brown & Ryan, 2003; Kabat-Zinn, 1990). Mindfulness can be framed as a skill, involving distinct but interrelated processes of attention and emotion regulation, that can be enhanced with training (Bishop et al., 2004; Hölzel et al., 2011). However, irrespective of an individual's history of mindfulness training, individuals differ in their tendency, or disposition, to be mindful (Brown & Ryan, 2003; Burzler et al., 2019). Importantly, greater dispositional mindfulness has been related to athletes' reduced burnout (Gustafsson et al., 2015), enhanced coping and better emotion-regulation (Josefsson et al., 2017), lower perceived stress (Kaiseler et al., 2017), and greater subjective wellbeing (Chen et al., 2017). Moreover, protective benefits from dispositional mindfulness for psychological distress have been observed in both athletes (Moreton et al., 2020) and others in the general population (Conversano et al., 2020).

Contemporary theories of mindfulness (e.g., Hölzel et al., 2011; Malinowski, 2013; Tang et al., 2015) argue that the protective benefits from psychological distress of mindfulness may be influenced by executive functioning: higher-order cognitive processes responsible for regulating thought, emotion, attention, and behavior to produce goal-directed action (Diamond, 2013). In support of this claim, considerable evidence suggests that mindfulness and executive functioning are subserved by similar neural mechanisms, primarily in the pre-frontal cortex, and that training in mindfulness may improve executive functions (Hölzel et al., 2011; Tang et al., 2015; Taren et al., 2017). Cross-sectionally, among non-athletes, dispositional mindfulness has been positively correlated with core executive functions, including working memory and inhibitory control (Jaiswal et al., 2018; Li et al., 2021; Riggs et al., 2015).

Individual executive functioning among non-athletes has also been shown to predict emotional regulation in both laboratory and real-world contexts (Schmeichel & Tang, 2015). For example, several studies found that individuals with low working memory capacity exhibited poorer capacity to regulate intrusive negative thoughts and emotions (Hendricks & Buchanan, 2016; Schmeichel et al., 2008) and, therefore, may be at greater risk for psychological distress and poor mental health outcomes (Eftekhari et al.,

2009). Similarly, poor inhibitory control has also been linked to emotional dysregulation (for detailed discussion, see [Cardinale et al., 2019](#)).

In summary, it appears that both dispositional mindfulness and executive functioning might provide protective buffering against psychological distress, and these relationships between mindfulness, executive functioning and psychological distress have yet to be investigated among high-performance athletes, a population with established strengths in sports-related cognitive performance ([Scharfen & Memmert, 2019](#); [Voss et al., 2010](#)) and unique and significant stressors that may increase risks of mental health concerns ([Reardon et al., 2019](#); [Rice et al., 2016](#)).

The Present Study

Our aim in this study was to investigate the relationships between dispositional mindfulness, executive functioning, and psychological distress among high-performance Australian football athletes during the stress-inducing COVID-19-affected 2020 competitive season. We collected data on these variables at two timepoints: (a) pre-season—immediately after the COVID-19 induced sport shutdown in South Australia; and (b) end-of-season—following the COVID-19 adaptations through the competitive season. We chose to implement data collection across two timepoints due to the varied demands Australian footballers experience across different season-phases. For example, under ordinary circumstances, pre-season training sessions are more frequent, longer in duration, and higher in intensity, resulting in significantly higher weekly training load during the preseason phase compared to in-season ([Ritchie et al., 2015](#); [Moreira et al., 2015](#)). While overall weekly training load is lower during the competitive season, various other stressors are encountered including competition anxiety and other performance-related concerns ([Reardon et al., 2019](#)). Based on prior research in various populations that has linked dispositional mindfulness and executive functioning with enhanced emotional regulation (e.g., [Lyvers et al., 2014](#)) and reduced distress (e.g., [Conversano et al., 2020](#); [Stout & Rokke, 2010](#)), we expected significant negative correlations between (a) dispositional mindfulness and (b) executive functioning with psychological distress. Further, in accordance with theoretical frameworks that have suggested executive function may be a central skill for dispositional mindfulness ([Hölzel et al., 2011](#); [Malinowski, 2013](#)) and studies that provided empirical support to these assumptions ([Jaiswal et al., 2018](#); [Li et al., 2021](#); [Riggs et al., 2015](#)), we expected to find significant positive correlations between individual athlete's executive functioning and dispositional mindfulness.

Method

Participants

We calculated an a priori sample size estimate for correlational analysis using the *pwr* package in R (version 1.3-0; [Champeley, 2020](#)). On the basis of a one-tailed correlation

with an assumed effect size of $r = .48$ (Li et al., 2021; Moreton et al., 2020) with $\alpha = 0.05$ and desired power of 0.80, the estimated required sample size was 25 participants. Based on this estimate, we recruited 30 male Australian football athletes from one semi-professional club based in South Australia as prospective participants.

All participants provided written informed consent prior to study commencement, and those who completed data collection at both timepoints were provided with a \$100 participant honorarium. Ethical approval was provided by the University of South Australia Human Research Ethics Committee. Of the 30 prospective participants recruited through convenience sampling, three withdrew prior to commencing data collection, due to a change in mode of data collection from in-person to online as necessitated by the COVID-19 shutdown in South Australia. Thus, we relied on data from 27 athletes ($M_{age} = 22.27$, range = 18.45–29.35 years) for our analyses. Thirteen athletes (48.2%) reported fewer than three years of senior football experience, seven (25.9%) had competed semi-professionally for between 3–5 years, and seven (25.9%) had over seven years experience. At the first timepoint (pre-season), 11 athletes reported an injury currently affecting their availability to train and play. The remaining 16 athletes reported non-injury status. At follow-up (end of season), 10 athletes reported current injuries, while 17 athletes reported non-injury status. Participants were also screened for concussion history at both timepoints to control for potential concussion-related cognitive impairment (McCrea et al., 2009). No participants reported recent concussion injuries (i.e., concussions within the previous two weeks at each timepoint, lingering effects of previous concussion, and currently undergoing concussion protocol/management).

2020 COVID-19 pandemic impacts on football season and study procedure. Importantly, due to COVID-19, the 2020 football season was atypical. The competitive season was initially scheduled to commence in early May 2020, with each team to play 18 matches; but, to comply with state and federal restrictions on non-essential gatherings, the governing body of the state football league suspended the season on 16 March 2020. As athletes were initially prohibited from completing any organized training, they were banned from attending club facilities. As COVID-19 restrictions were incrementally eased, athletes then progressed through a series of return-to-play protocols that influenced normal training demands, routines, and environments. After a 2-month postponement, the shortened competitive season began, though, throughout the season, various fan attendance and social distancing restrictions remained in place. The salary cap was also reduced to zero, meaning that athletes no longer received payment from their clubs. The team participating in this research did not qualify for finals, having recorded six wins and eight losses in 14 matches. They played their final match for the season on 25 September 2020. Our pre-season data collection took place immediately after the initial suspension of the season (March 27–April 24) at the height of the first wave of COVID-19 in Australia, and our end-of-season measures were completed over the final four rounds of the 2020 season (August 31–September 25).

Materials

Psychological distress. We assessed players' psychological distress with the Athlete Psychological Strain Questionnaire (APSQ; Rice, Parker, et al., 2020). This 10-item measure was designed as a mental health screening tool for use with elite athletes. It is comprised of three subscales, including self-regulation (e.g., "I was irritable, angry or aggressive"), performance (e.g., "I found training more stressful"), and external coping (e.g., "I took unusual risks off-field"). On it, athletes rate the frequency with which they experienced each of the items over the previous four weeks, using a scale ranging from 1 (none of the time) to 5 (all of the time). The APSQ is scored by summing the item scores in each of three subscales and summing all items into a total distress score (ranging from 10–50, with higher scores indicating greater psychological distress). Internal consistency (Cronbach's $\alpha > 0.84$) and both convergent and divergent validity of the APSQ have been satisfactory in a large sample of elite Australian athletes (Rice, Olive, et al., 2020; Rice, Parker, et al., 2020).

Dispositional mindfulness. We measured the participants' dispositional mindfulness using the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS is a single-factor, 15-item scale that asks participants to rate the frequency with which they experience lapses in mindful awareness in their everyday life. Participants respond on a 6-point Likert scale from 1 (*almost always*) to 6 (*almost never*), to statements such as "I find myself doing things without paying attention." The MAAS is scored by taking the average across all items, with higher scores reflecting greater dispositional mindfulness. MAAS reliability and validity have been established as satisfactory in both general populations (Brown & Ryan, 2003) and among athletes (Mohammed et al., 2018).

Executive Function Measures

Working memory. While executive functioning can include many separate component neurocognitive skills (e.g., see Barkley, 2012), we focused on just few that will be detailed in this section of our paper. We assessed working memory using the Automated Operation Span Task (AOSPAN; Unsworth et al., 2005). The AOSPAN is a computerized task in which participants are presented with a series of simple mathematical problems (e.g., $1 * 2 + 1 = 3$) and must answer whether the given solution is true or false. These distracting math problems are interspersed with the presentation of an individual letter (e.g., A). At the end of each block of trials, varying in length from 3-7 trials, participants must identify the letters presented in order of their appearance. While performance on complex span tasks relies on the integration of multiple cognitive abilities including memory and attention (Unsworth & Engle, 2007), the AOSPAN is recognized as primarily a measure of working memory capacity (Unsworth et al., 2005). Accordingly, AOSPAN performance was operationalized as a partial span score, reflecting the total number of letters correctly recalled, with higher scores reflecting greater working memory capacity (Bijleveld & Veling, 2014; Unsworth et al., 2005).

Unsworth et al. (2005) demonstrated good psychometric properties of the AOSPAN including test-retest reliability ($r = .83$) and internal consistency reliability ($\alpha = .78$). In addition, the AOSPAN has previously been implemented in athlete populations, including players of tennis (Bijleveld & Veling, 2014) and ice-hockey (Furley & Memmert, 2012). The AOSPAN utilized in this study followed an established script described in greater detail elsewhere (Unsworth et al., 2005).

Inhibitory Control. We assessed the players' inhibitory control using an emotional Stroop (eStroop) task featuring stimuli established in a previous study (Smith & Waterman, 2003). In this task, participants are required to report the font colors of a series of word stimuli whilst inhibiting the more natural urge to read the word (Ben-Haim et al., 2016). An emotional interference effect is typically seen through extended reaction time (RT) for emotionally valenced (i.e., positive or negative) words compared to neutral words (Song et al., 2017), with this RT difference reflecting the degree to which task-irrelevant emotional information interferes with task-related cognitive processing (Song et al., 2017). Larger interference effects (in milliseconds) indicate poorer inhibitory control. We instructed our participants to report the font color of each word, as quickly and as accurately as possible, by pressing a key corresponding to the word's color. Participants first completed a practice block to become familiarized with the task and the mapping of the stimulus color to the response key (Ben-Haim et al., 2016). Practice trials presented a non-word character string (i.e., "XXXX"), five times for each color for a total of 20 trials, with the order of colors randomly selected. For testing, we used a single block of 150 sequentially presented trials (50 trials per valence category. *Note:* due to a coding error, only 149 trials were presented in the majority of tests completed. This missing data constituted 34 trials in total, or less than 0.6% of trials). Stimuli and color were randomly selected, with each stimulus presented twice. Trials began with a fixation cross presented in size 18 font for 500 ms in the center of the display, after which the trial stimulus was shown. Participants responded by pressing the appropriate response key corresponding to the font color of the word. Colors were green, red, yellow, and blue; and these were spatially mapped to the Q, W, O and P keys on the keyboard, respectively. Immediately after a response key was pressed, the fixation cross for the subsequent trial appeared, meaning that no reaction time or accuracy feedback was provided between trials. Reaction time latency (in milliseconds) and accuracy were recorded for each trial. In the present study, this task took approximately 10 minutes to complete, including practice. All participants reported normal color vision.

Procedure

After providing informed consent, participants were emailed a link to complete an online survey through LimeSurvey (LimeSurvey GmbH, 2021) that included baseline demographic questions and the measure for dispositional mindfulness (MAAS). Participants who completed the demographic questions were then directed to a second online link to complete our measures of psychological distress (APSQ) and executive

functioning (AOSPAN, eStroop). This remote data collection was implemented using the Inquisit Web platform (version 4.0.8, Millisecond, 2015). Written instructions were provided to complete the testing procedure in a quiet place with no interruptions. Once the testing procedure began, participants were not able to pause and go back to earlier tasks. Thus, psychological distress (APSQ) and executive functioning (AOSPAN; eStroop) measures were completed in a single session (approximately 25 minutes duration) at each timepoint. At the end of the season, measures of psychological distress and executive function were re-administered following the same remote data collection procedure as pre-season. Dispositional mindfulness was only tested at pre-season, as this construct is typically stable across time, without intervention, in healthy adults (Jensen et al., 2016).

Data Analysis

All data analyses were conducted in *R* version 4.0.3 (R Core Team, 2020). Some missing data was evident at each timepoint (see Table 1 for the total number of participants who completed each measure at each timepoint). Pairwise deletion occurred for each correlation test. To prepare eStroop data for analysis, we first applied a maximum reaction time latency filter of 3000 ms to all trials to eliminate extreme responses (see Lautenbach et al., 2016). At pre-season, no trials exceeded 3000 ms; thus, this initial filter did not remove any trials. At end-of-season, 10 trials were associated with reaction times of greater than 3000 ms and were, therefore, deemed extreme responses and removed from the data set. Following this initial reaction time screening, trial accuracy data were inspected. Incorrect trials (i.e., trials on which the participant did not correctly identify stimulus color) comprised 3.88% of data at pre-season and 3.27% at end of season. Chi-square analyses showed no significant between valence category differences in proportion of errors at either timepoint (p 's > .07). As a result, subsequent analyses were completed on correct trials (i.e., trials on which the participant correctly identified stimulus color) only (Ben-Haim et al., 2016). Correct trials with reaction times above or below 2.5 standard deviations from the mean were considered outliers and were removed (Ben-Haim et al., 2016). This second filter resulted in deletion of 57 outliers (1.7% of data) at pre-season and 108 outliers (3.3% of data) at end-of-season. A total of 2094 trials (neutral = 702; negative = 688; positive = 704) remained at pre-season, with 3053 trials remaining at end-of-season (neutral = 1018; negative = 1020; positive = 1015). Negative interference scores were calculated for each participant at each timepoint by subtracting mean reaction time on negative trials from mean reaction times on neutral trials. Positive interference scores were calculated by subtracting mean reaction time on positive trials from mean reaction time on neutral trials. Interference scores greater than 0 indicated a slowdown in reaction time, on average, on emotionally valenced trials compared to neutral trials.

We constructed linear mixed effects models using the lme4 (Bates et al., 2015) software package to test for between valence category differences in reaction time latency (i.e., to test for the presence of an emotional interference effect). At each

Table 1. Number of Observations, Means and Standard Deviations for Psychological Distress and Executive Function Measures at Each Timepoint.

Variable	Timepoint 1 (Pre-season)			Timepoint 2 (End-Of-Season)		
	<i>n</i>	Mean	<i>SD</i>	<i>N</i>	Mean	<i>SD</i>
Psychological distress (Athlete Psychological Strain Questionnaire)						
Self-regulation	20	8.00	1.92	26	9.00	2.79
Performance	20	7.70	2.68	26	8.38	3.31
External coping	20	2.55	0.76	26	2.58	1.14
Total distress	20	18.25	3.88	26	19.96	5.85
Working memory (Automated Operation Span Task)						
Partial span	13	58.00	6.99	22	61.14	6.85
Inhibitory control (eStroop)						
MRT—Neutral stimuli	15	561.62	77.37	22	640.57	179.03
MRT—Negative stimuli	15	564.66	79.39	22	646.73	186.59
MRT—Positive stimuli	15	563.47	74.57	22	636.50	174.26
Negative interference	15	3.04	30.46	22	6.15	27.95
Positive interference	15	1.85	27.33	22	-4.07	35.03

Note. MRT refers to mean reaction time in milliseconds in each of the three stimuli valence categories. Interference scores refer to reaction time in the respective valence categories relative to neutral.

timepoint, we included reaction time latency as the dependent variable. Valence category (three levels: neutral, negative, positive) was included as a fixed effect and participant as a random effect. Models were fit using restricted maximum likelihood and *p*-values were derived using the lmerTest package (Kuznetsova et al., 2017) with Satterthwaite degrees of freedom approximation.

Partial span scores were calculated as the total number of letters correctly recalled across the entire task. One AOSPAN partial span score at pre-season was identified as an extreme outlier, and, thus, was deleted. We confirmed normal distribution of all continuous variables via visual inspection of histograms and, statistically, through Shapiro-Wilke tests.

Distress, Executive Function, and Dispositional Mindfulness

To test for differences in distress, working memory and inhibitory control across timepoints, we conducted separate linear mixed model analyses for each outcome (APSQ total distress; AOSPAN partial span; eStroop positive interference; eStroop negative interference) as respective dependent variables. In each model, timepoint was included as a fixed effect and participant included as a random factor. Models were fit using restricted maximum likelihood and summarized with Satterthwaite degrees of freedom approximation using the lmerTest package (Kuznetsova et al., 2017). Single-

tailed, one sample *t*-tests were also conducted to investigate whether distress, working memory, and dispositional mindfulness scores in the current sample were greater than normative values or previous reports in similar populations. To compare distress, the mean APSQ total score in the present sample was compared with mean APSQ total scores established in high-performance Australian athletes (Rice, Parker et al., 2020). Working memory (AOSPAN partial span) was compared to established AOSPAN partial span normative values for young adults provided by Redick et al. (2012). Mean scores on the MAAS (dispositional mindfulness) in the present sample were compared to the mean MAAS score reported by MacKillop and Anderson (2007) in a sample of young adults.

Finally, to investigate the respective relationships between wellbeing, dispositional mindfulness, and executive functions, we conducted Pearson's product-moment correlations using the Hmisc package (v4.4–2; Harrell, 2020) for R. Separately for each timepoint, correlation matrices were calculated with psychological distress (APSQ total), dispositional mindfulness (MAAS), working memory (AOSPAN Partial Span), and interference control (Negative and Positive Interference scores). Pearson's correlation effect sizes were interpreted following guidelines from Gignac and Szodorai (2016), with $r = .10$ reflecting a small effect, $r = .20$ a medium effect, and correlations of over $r = .30$ considered a large effect size. We also calculated post-hoc observed power for each pairwise correlation using the pwr package. Importantly, these power estimates were based on a two-tailed correlation, rather than the one-tailed correlation assumed in the a priori required sample size estimate.

Results

Descriptive data, including means and standard deviations for all study measures at each timepoint, are provided in Table 1. Linear mixed model analyses comparing distress and executive function across timepoints revealed no significant changes between pre-season and end-of-season scores for any outcome (p 's > .09). Thus, total distress and executive function scores did not significantly change between the two timepoints. For eStroop interference effect analyses, Satterthwaite approximation of the linear mixed models revealed no significant effect of valence category on RT latency at either timepoint (p 's > .4).

The mean partial span score at pre-season ($M = 58.00$, $SD = 6.99$) was not significantly greater ($t(12) = 0.37$, $p = .75$, $d = 0.09$) than normative estimates for young adults ($M = 57.36$, $SD = 13.65$; Redick et al., 2012). However, at end-of-season, our participants reported a significantly higher mean partial span score ($M = 61.14$, $SD = 6.85$; $t(21) = 2.59$, $p = .009$, $d = 0.55$) than the normative value reported by Redick et al. (2012). Mean MAAS scores in the current study ($M = 4.11$, $SD = 0.68$) were not significantly higher than previous estimates in young adults reported in MacKillop and Anderson (2007; $M = 4.00$, $SD = 0.085$, $t(24) = 0.82$, $p = 0.21$, $d = 0.16$). In summary, the study sample reported similar levels of dispositional mindfulness and comparable, if not marginally superior, working memory performance compared to non-athlete

populations. However, compared to previous reports in elite Australian male athletes (Rice, Parker, et al., 2020) participants in the current study reported significantly elevated levels of psychological distress at both pre-season ($M = 18.25$, $SD = 3.88$, $t(19) = 4.13$, $p < .001$, $d = 4.70$) and end of season ($M = 19.96$, $SD = 5.85$, $t(25) = 4.61$, $p < .0001$, $d = 3.41$).

Psychological Distress, Dispositional Mindfulness, and Executive Function

Dispositional mindfulness was not significantly correlated with working memory (timepoint 1: $r(11) = 0.55$, $p = .05$, 95% CI $[-0.00, 0.85]$, $\beta = 0.52$; timepoint 2: $r(19) = -.10$, $p = .65$, 95% CI $[-0.51, 0.34]$, $\beta = 0.68$) or inhibitory control (timepoint 1: negative interference, $r(13) = -.04$, $p = .89$, 95% CI $[-0.54, 0.48]$, $\beta = 0.89$, and positive interference, $r(13) = 0.35$, $p = 0.53$, 95% CI $[-0.73, 0.20]$, $\beta = 0.53$; timepoint 2: negative interference, $r(19) = 0.42$, $p = .06$, 95% CI $[-0.02, 0.72]$, $\beta = 0.53$, and positive interference, $r(19) = 0.02$, $p = .94$, 95% CI $[-0.45, 0.42]$, $\beta = 0.94$) at either timepoint (see Tables 2 and 3). A significant, large, negative correlation was observed between dispositional mindfulness and total psychological distress at both pre-season ($r(18) = -.48$, $p = .03$, 95% CI $[-0.76, -0.04]$, $\beta = 0.51$) and end-of-season ($r(22) = -0.56$, $p = .004$, 95% CI $[-0.79, -0.20]$, $\beta = 0.51$). To determine the nature of the correlation between dispositional mindfulness and psychological distress, exploratory Pearson's correlational analyses were conducted on each psychological distress subscale. At pre-season, dispositional mindfulness was negatively correlated with the self-regulation subscale ($r(18) = -0.71$, $p = .0005$, 95% CI $[-0.88, -0.39]$, $\beta = 0.54$), but not correlated with the performance ($r(18) = -0.11$, $p = .64$, 95% CI $[-0.53, 0.35]$, $\beta = 0.68$) or external coping ($r(18) = -0.26$, $p = .26$, 95% CI $[-0.63, 0.20]$, $\beta = 0.52$) subscales of the ASPQ (psychological distress measure). At end-of-season, dispositional mindfulness was negatively correlated with the performance subscale ($r(22) = -0.59$, $p = .002$, 95% CI $[-0.80, -0.24]$, $\beta = 0.50$), but not the self-regulation ($r(22) = -0.36$, $p = .09$, 95% CI $[-0.66, 0.05]$, $\beta = 0.53$) or external coping ($r(22) = -0.14$, $p = .52$, 95% CI $[-0.51, 0.28]$, $\beta = 0.61$) subscales of the ASPQ.

No significant correlations between working memory and psychological distress were observed at either timepoint (timepoint 1: $r(11) = -0.49$, $p = .09$, 95% CI $[-0.81, 0.08]$, $\beta = 0.53$; timepoint 2: $r(20) = 0.26$, $p = .24$, 95% CI $[-0.18, 0.61]$, $\beta = 0.52$). Similarly, no significant correlations were observed between inhibitory control and psychological distress at either timepoint (timepoint 1: negative interference, $r(13) = 0.14$, $p = .62$, 95% CI $[-0.40, 0.61]$, $\beta = 0.67$, and positive interference, $r(13) = 0.21$, $p = .44$, 95% CI $[-0.34, 0.65]$, $\beta = 0.57$; timepoint 2: negative interference, $r(19) = .14$, $p = .53$, 95% CI $[-0.30, 0.53]$, $\beta = 0.61$, and positive interference, $r(19) = .20$, $p = .37$, 95% CI $[-0.57, 0.24]$, $\beta = 0.54$).

Table 2. Pre-season (Timepoint 1) Pearson's Correlation Coefficients with Confidence Intervals.

Variable	1	2	3	4
1. Dispositional mindfulness (Mindful Attention Awareness Scale)				
2. Psychological distress (Athlete Psychological Strain Questionnaire)	-0.48* [-0.76, -0.05]			
3. Working memory (Automated Operation Span Task)	0.55 [-0.00, 0.85]	-0.49 [-0.82, 0.08]		
4. Inhibitory control—(eStroop negative interference)	-0.04 [-0.54, 0.48]	0.14 [-0.40, 0.61]	-0.10 [-0.61, 0.48]	
5. Inhibitory control—(eStroop positive interference)	-0.35 [-0.73, 0.20]	0.21 [-0.34, 0.65]	-0.18 [-0.66, 0.42]	0.57* [0.08, 0.84]

Note. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

Table 3. End-of-Season (Timepoint 2) Pearson's Correlation Coefficients with Confidence Intervals.

Variable	1	2	3	4
1. Dispositional mindfulness (Mindful Attention Awareness Scale)				
2. Psychological distress (Athlete Psychological Strain Questionnaire)	-0.56 ^{**} [-0.79, -.20]			
3. Working memory (Automated Operation Span Task)	-0.10 [-0.51, .34]	0.26 [-0.18, 0.61]		
4. Inhibitory control—eStroop negative interference	0.42 [-0.02, 0.72]	0.14 [-0.30, 0.53]	0.18 [-0.27, 0.56]	
5. Inhibitory control—eStroop positive interference	-0.02 [-0.45, .42]	-0.20 [-0.57, 0.24]	-0.08 [-0.49, 0.35]	-0.01 [-0.43, 0.41]

Note: Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

Discussion

In the general population, both dispositional mindfulness and executive functioning have been associated with psychological distress, presumably in such a way that mindfulness and executive function each buffer against distress symptoms (Conversano et al., 2020; Stout & Rokke, 2010). However, possible associations between psychological distress, dispositional mindfulness and executive functioning in high-performance athletes have yet to be examined. We attempted to do so in this study with high-performance Australian football athletes who were administered these measures immediately after the COVID-19 shutdown of sports in South Australia, and at the completion of the COVID-19-adapted 2020 competitive season. We observed significantly elevated levels of psychological distress in our participant sample relative to previous estimates among high-performance athletes (Rice, Parker et al., 2020), consistent with the notion that COVID-19 and its associated restrictions placed an additional stress burden and raised mental health symptom risks of these elite athletes (Facer-Childs et al., 2021). Contrary to our hypotheses, executive functioning, including measures of working memory and inhibitory control, did not correlate with dispositional mindfulness or psychological distress at either timepoint. However, dispositional mindfulness was consistently associated with reduced psychological distress in this athlete sample.

Dispositional Mindfulness Predicted Reduced Psychological Distress

In line with our second hypothesis, we observed significant negative correlations between dispositional mindfulness and psychological distress at both timepoints. Ours was the first study to use an athlete-specific measure of psychological distress (Rice, Parker, et al., 2020) to examine the relationship between dispositional mindfulness and psychological distress among high performance athletes; and we provided support for the possibility that dispositional mindfulness is a protective factor against psychological distress in athletes (Kaiseler et al., 2017; Moreton et al., 2020).

The average severity of psychological distress was comparatively high in the present sample relative to previous reports in elite Australian athletes (Rice, Parker, et al., 2020), probably because we measured psychological distress amidst the significant added stresses associated with the COVID-19 pandemic. In the context of this naturalistic opportunity to evaluate psychological distress and its management among high performance athletes, we found that athletes with greater dispositional mindfulness reported lower distress. While our correlational research cannot assure us of presumed directional causality in this relationship, it is logical to suspect that higher dispositional mindfulness may have provided a protective buffer against psychological distress for these participants, both at the immediate onset and longer-term aftermath of COVID-19 societal and sport-specific impacts. Our data is consistent with other research showing that individuals with higher dispositional mindfulness were able to maintain lower

levels of psychological distress during the initial wave of COVID-19 (Conversano et al., 2020).

Interestingly, these exploratory correlational results suggested that mindfulness may have differentially buffered against different subtypes of distress pre-season and end-of-season timepoints, each of which was related, in turn, to different COVID-19 realities. At the first timepoint, dispositional mindfulness appeared to benefit psychological distress via more effective self-regulation. In contrast, at the end of the adapted competitive season, dispositional mindfulness appeared to buffer against performance-related distress. The pre-season timepoint was conducted during the initial weeks following the COVID-19-imposed shutdown of sport when athletes were forced into isolation from their club facilities, teammates, coaches, and other sport-related support networks. As a result, it is possible that this period taxed the athletes' emotional self-regulation and motivation particularly. Greater dispositional mindfulness may have equipped athletes with the capacity to cope more effectively with the enforced changes, thus minimizing the magnitude of distress experienced. Conversely, by the end-of-season data collection, athletes had re-engaged in relatively normal training and competition conditions, and performance-related aspects of distress such as selection pressures or personal injury may have become more salient. Thus, by conducting this study in the context of a known naturalistic stress that affected all participants, we were able to observe ways in which dispositional mindfulness may have helped athletes cope differentially and more effectively with changing stressors experienced over the course of the competitive season.

Further research is required to elucidate how psychological distress typically manifests in athletes longitudinally, navigating environmental conditions such as unpredictable training demands, travel requirements and injury status (Rice, Olive, et al., 2020; Rice, Parker, et al., 2020; Saw et al., 2016). Moreover, the mechanisms by which dispositional mindfulness may influence psychological distress in athletes are unclear. One recent study suggested that dispositional mindfulness benefited psychological distress in athletes via greater self-regulatory behaviors related to sleep hygiene, though this indirect effect did not fully mediate the relationship between mindfulness and distress (Moreton et al., 2020). Non-athlete studies have suggested that mindfulness may have beneficial, indirect effects on psychological distress via various other mediating variables such as emotion regulation, non-attachment, and rumination (Coffey & Hartman, 2008), and reduced over-responsiveness of the hypothalamic-pituitary-adrenal axis to acute stress (Creswell & Lindsay, 2014). However, this area of literature requires further investigation, particularly in athlete populations, who experience unique sport-related stressors (Reardon et al., 2019; Rice et al., 2016).

No Significant Correlations Between Executive Functioning and Mindfulness or Psychological Distress

We observed no significant relationships between executive functioning measures and dispositional mindfulness or psychological distress at either pre-season or end-of-season timepoints. Our results align in this way with findings from [Prakash et al. \(2015\)](#), who reported (a) a significant negative correlation between dispositional mindfulness and perceived stress in young adults, and (b) no significant associations between mindfulness or perceived stress with working memory, inhibitory control, or cognitive flexibility. Similarly, [Black et al. \(2011\)](#) found that working memory did not significantly predict dispositional mindfulness, affect, or psychological wellbeing among undergraduate college students. However, these null results contrast with theories of mindfulness that implicate executive functioning as a central underlying mindfulness mechanism (e.g., [Hölzel et al., 2011](#); [Malinowski, 2013](#)), and our results are inconsistent with cross-sectional research in young adult populations demonstrating enhanced executive functioning at higher levels of dispositional mindfulness ([Anicha et al., 2012](#); [Jaiswal et al., 2018](#); [Riggs et al., 2015](#)).

Given that individual differences in executive functions, in particular working memory, facilitate successful down-regulation of negative state emotions ([Schmeichel & Tang, 2015](#)) and help moderate the effects of daily stressors on mood outcomes ([Stawski et al., 2010](#)), explanations for the null relationships between executive functions with dispositional mindfulness and psychological distress are not immediately clear. It should be noted that at pre-season the correlations between working memory with dispositional mindfulness and psychological distress, respectively, trended in expected directions and approached statistical significance. Although our total number of participants ($n = 27$) exceeded our a priori required sample size estimate ($n = 25$), missing data for the cognitive testing at pre-season ($n = 13$ for AOSPAN correlations at pre-season) prevented the fulfillment of the recommended sample size and may have left us with insufficient statistical power. This problem is, perhaps, exacerbated by our having based our required sample size calculation on a single tailed, rather than two-tailed t -test, which would have yielded a larger required sample size estimate of 31 participants. Clearly, future investigators should utilize a larger sample to gain greater confidence that they have the necessary statistical power to avoid false negative results in which significant correlations are not detected due to type II statistical errors. However, whilst still underpowered, correlations between working memory, mindfulness, and distress in a larger sample ($n = 22$) at end-of-season were smaller in magnitude with wide confidence intervals overlapping zero. Moreover, inhibitory control was not correlated with mindfulness or distress at either timepoint. As a result, interpretations related to sample size or statistical power are not straightforward and there may be methodological or conceptual factors in our study to consider.

It is possible that the cognitive processes examined in isolation in each of the performance-based tests of executive functioning did not sufficiently capture the integration of executive functions necessary to enact behavioral and emotional regulation

in complex real-world situations (Erkkilä et al., 2018). Along these lines, some authors have questioned the ecological validity of performance-based tests of executive function (Chaytor & Schmitter-Edgecombe, 2003), and other researchers have suggested that self-report measures of executive function may hold greater predictive validity for symptoms of psychopathology in non-athletes (Knouse et al., 2013). Thus, a more comprehensive assessment of executive functioning is required, particularly in emotionally distressing real-world contexts such as those experienced by athletes during the COVID-19 pandemic. This interpretation may also partially explain why neither of our measures of executive functioning significantly correlated with dispositional mindfulness. It is possible that the self-report measure of dispositional mindfulness captured a more global assessment of executive control processes operating in complex, emotionally salient everyday situations. Further research is required to reconcile our mixed findings relating to the contribution of executive functions to dispositional mindfulness and psychological distress in athlete populations. Future investigations of the validity of different executive function measures in predicting distinct athlete wellbeing outcomes would be beneficial.

Limitations and Future Directions

This applied research study allowed for unique insight into the cognition and wellbeing of a sample of high-performance athletes across two timepoints during the COVID-19 affected 2020 competitive season. However, this study was subject to several limitations, particularly in relation to the delivery of cognitive testing, the capacity for cross-sectional analyses to yield information about causality and observed statistical power.

Due to COVID-19 related restrictions on non-essential public gatherings, all data collection including cognitive testing took place online. As a result, participants were not supervised whilst completing cognitive testing. Thus, participants may have completed testing in sub-optimal environments. It is also possible that participants tested in different locations or under slightly different conditions at pre-season compared to end-of-season timepoints. However, several methods were employed to minimize these risks. Explicit instructions were provided to participants in all study materials, including repeated reminders during the cognitive testing procedure itself, for participants to complete the cognitive testing in a quiet, distraction free room. Participants were also instructed to switch off their mobile phone whilst completing the testing protocol. In addition, the Inquisit web application forces full-screen mode, such that the participant is prevented from completing other tasks during testing. Finally, data handling procedures including outlier deletion for reaction time data, ensured that extreme and outlier responses (i.e., errors and/or delayed responses times that could have been the result of distraction) were not considered in data analyses.

Further, the eStroop task employed in the current study utilized non-sport-related stimuli, randomly presented in a single-block. This experimental design allowed for minimal participant burden but may have limited the effect size of the emotional

interference effect, and thus the sensitivity of the test in detecting individual differences in inhibitory control. Stroop interference effects are typically enhanced when stimuli are of specific relevance to the concerns of the study population (Williams et al., 1996), and when presented in blocked designs that present each valence category in separate blocks (Holle et al., 1997). The Sport Emotional Stroop Task (SEST; Lautenbach et al., 2016) was recently developed in German language according to these conventions, however no English language version of the SEST exists. Development of an English language SEST would advance the measurement of inhibitory control in English speaking athletes.

The longitudinal nature of the current study was a strength, as it allowed for an investigation of relationships between executive functioning and wellbeing at multiple timepoints, across distinct sport season phases, as well as across different intensities and stresses associated with the COVID-19 shutdown. While these cross-sectional analyses provide insight about the strength, significance and direction of relationships, future research is needed to elucidate causal directionality and potential mechanisms of effect for each of the relationships observed. For example, based on evidence that dispositional mindfulness may reduce the tendency to engage in negative thinking patterns and rumination (Tomlinson et al., 2018), it is intuitive to suggest that dispositional mindfulness may have afforded athletes a protective buffer against psychological distress. However, it is also possible that lower levels of distress may have facilitated a greater capacity to attend to present-moment experience with acceptance and non-judgment (i.e., to exhibit mindfulness). Reciprocal relationships are perhaps most likely, as has been suggested in the general population between mindfulness and self-regulatory behaviors (Masicampo & Baumeister, 2007). Further research is required to develop a comprehensive understanding of the inter-relationships between mindfulness, executive function, and distress in athletes.

Finally, we remind readers that our failure to show significant correlations between dispositional mindfulness and measures of executive functioning may have been related to our small sample size with implications for insufficient statistical power. Further research with a larger sample is needed. Larger samples would also allow researchers to test for mediators and moderators using more robust and theoretically informed statistical approaches. For example, multiple studies—each with over 1000 participants (Burzler et al., 2019; Tran et al., 2014)—have used structural equation modeling to test the theoretical predictions of Hölzel et al. (2011). These studies have allowed for a deeper level of insight into the relationship between mindfulness and mental health among non-athletes, with both suggesting that emotion regulation appears to be the primary mechanism of action between mindfulness and reduced distress. Similar studies among high-performance athletes will be essential to elucidate the relationship between mindfulness and distress in this unique population and may identify specific mechanisms to target in future intervention studies designed to optimize athlete wellbeing.

Conclusion

This study investigated the relationships between psychological distress, dispositional mindfulness, and executive function in high-performance Australian football athletes during the COVID-19-affected 2020 competitive season. Consistent with the notion that COVID-19 and associated social lockdown measures placed additional burden on the mental health of Australian athletes, at both pre-season and end of season phases, athletes reported significantly higher psychological distress relative to estimates among high-performance Australian athletes prior to COVID-19. Contrary to hypotheses, no significant relationships were observed between executive function and wellbeing outcomes at either timepoint, suggesting that executive function may not have provided protective buffering from distress symptoms in the athlete sample. However, results were consistent with the hypothesis of a significant negative correlation between dispositional mindfulness and distress. At both timepoints, greater dispositional mindfulness predicted reduced psychological distress, indicating that mindfulness may have been a protective factor for athlete wellbeing during the COVID-19-affected 2020 season. This study adds to the literature exploring the cognitive underpinnings of athlete wellbeing. Further research with larger samples and sufficient statistical power is required to elucidate the contribution of executive function to athlete wellbeing outcomes, and to investigate the potential mechanisms by which mindfulness may protect against distress in high-performance athletes.

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Ethics Approval

The research protocol for this study was approved by University of South Australia Human Research Ethics Committee (Protocol Number: 202849).

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