EXPLORING FACTORS ASSOCIATED WITH INDIVIDUAL DIFFERENCES IN THE MENTAL HEALTH OF UNIVERSITY STUDENTS DURING THE COVID-19 PANDEMIC

by

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Abstract

Rates of anxiety and depression are known to be high in university students, and the COVID-19 pandemic appears to have exacerbated this situation slightly, especially in females. Research has consistently identified alexithymia, sensory processing sensitivity (SPS), anxiety sensitivity (AS), and childhood emotional abuse as risk factors for poor mental health outcomes. Given that linkages have also been reported between these variables, it is difficult to ascertain the unique weight of each factor in the overall prediction of mental health. The current dissertation sought to fill this gap in the literature by investigating how these and other potentially relevant variables relate to depression and anxiety in young adults engaged in widely differing levels of physical activity. In Study 1, 410 university students completed an online survey assessing current mood, alexithymia, SPS, AS, childhood emotional abuse, physical activity, and pandemic-related impacts. Over half of the participants reported moderate to extremely severe symptoms of anxiety and depression. Alexithymia, SPS, AS, and childhood emotional abuse each accounted for unique variance in prediction of both anxiety and depression. Males scored significantly lower than females on SPS and AS, but male sex emerged as an additional risk factor for depression when these variables were controlled for. Several secondary analyses were carried out using the data from the 309 female participants to gain further insights into their risk profile. The results suggested that risk for exercise dependence negatively predicted depression, and that being an athlete positively predicted anxiety, when effects related to the aforementioned personality and experiential variables were controlled. Finally, two follow-up studies were conducted involving a subgroup of the females who took part in the original investigation. The results of these studies suggested that, in females, problems exercising self control when demands of emotion and attentional processing overlap accounted for unique variance in

prediction of anxiety and that body uneasiness accounted for unique variance in prediction of both anxiety and depression, when holding variance accounted for by personality and experiential variables constant. The results from this basic research provide a more nuanced understanding of the influence of co-occurring alexithymia, SPS, AS, and childhood emotional abuse on emotional processing during the COVID-19 pandemic. They also have important implications for the development and implementation of individualized treatments for common mental disorders, particularly in females.

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Table of Contents

List of Tables

List of Figures

Abbreviations

ANOVA	Analysis of Variance
AS	Anxiety Sensitivity
ASI-3	Anxiety Sensitivity Index
BMI	Body Mass Index
CAREMS	Coach-Athlete Relationship Emotional Maltreatment Scale
COVID-19	Coronavirus Disease 2019
CTQ-SF	Childhood Trauma Questionnaire short form
DASS-21	Depression Anxiety Stress Scale
DSM	Diagnostic and Statistical Manual of Mental Disorders
EAI	Exercise Addiction Inventory
HSPS	Highly Sensitive Person Scale
IPAQ	International Physical Activity Questionnaire
mCIS	Modified Coronavirus Impact Scale
MET	Multiple of the Resting Metabolic Rate
PTSD	Post-Traumatic Stress Disorder
SPS	Sensory Processing Sensitivity
TAS-20	Toronto Alexithymia Scale

CHAPTER I: GENERAL INTRODUCTION

Researchers and psychologists have long been interested in how humans generate and experience emotion. Indeed, emotions are considered central to psychology and scientific models of both the mind and behaviour, likely because they are thought to be catalysts in a range of psychological processes such as attention, memory, and perception (Barrett, 2006). William James (1884) eloquently argued that the body and mind exert bidirectional influences on one another, such that our bodies affect our feelings and vice versa. Since then, there has been a proliferation of research on emotion-related topics, and current theories emphasize the influence of both bottom up and top-down factors on the generation, experience, and regulation of emotions (e.g., Gross, 1998; Smith et al., 2018).

There is a growing interest in exploring factors that contribute to individual differences in these important processes. A key goal of the proposed research is to extend this work by exploring how individual differences in three personality traits associated with atypicalities in emotional awareness and emotion regulation, and in experiential factors, relate to mental health. As such, I adopt a biopsychosocial theoretical framework. As discussed further below, these variables are of particular interest given the existing literature exploring their interrelationships in general and clinical samples, and in samples of athletes. The research described in this dissertation explored the unique contribution of each of these variables to the prediction of symptoms of anxiety and depression while holding variance from the others constant. It also examines how these variables relate to several other risk and protective factors that have been implicated in mental health including: activity levels and biological sex (the focus of Chapter 2); unhealthy obsession with physical fitness/exercise and inhibitory control problems (the focus of Chapter 3); and involvement in competitive sport, exposure to abusive coaching practices, and

body image problems (the focus of Chapter 4). The findings increase our understanding of factors that contribute to natural variation in emotional and cognitive processes and have the potential to inform clinical practice.

The current chapter will present important background literature on emotion generation and experience/regulation, and how individual variations in these processes characterize the three personality traits that are the focus of my dissertation. I will then discuss how early adversity and key aspects of the sport environment may impact these processes. The focus of much of the background research and of this dissertation is on young adults (≤ 24 years of age) with differing levels of engagement in sport/physical exercise. Young adults are an important focus given that (a) symptoms of anxiety and depression are most prevalent during this developmental stage compared to any other stage of the lifespan (e.g., King et al., 2008; Korten & Henderson, 2000; Krueger et al., 1998); and (b) body dissatisfaction is well-known to be linked with depression (Rawana, 2013) and with disordered eating (Jacobi & Fittig, 2010) and other unhealthy weight control behaviours (e.g., Neumark-Sztainer et al., 2006) in this age group.

Theories Regarding the Generation, Experience, and Regulation of Emotions

Although emotions vary widely it is generally assumed that there is a relatively small set of so-called "basic" emotions that share key features. For instance, Levenson (2011) proposes that basic emotions: (1) involve behavioral, expressive, and bodily responses; (2) are hardwired in the brain and influenced by learning across the lifespan; and (3) serve a specific function—namely, to trigger actions that promote survival. Ekman and Codaro's (2011) criteria for basic emotions are largely comparable with Levenson's; however, they also propose that basic emotions are characterized by distinct universal signals and physiological responses, arise automatically (without conscious demand), have quick onsets and brief durations, and trigger

automatic appraisals. These theories align well with ideas expressed in a more recent theory proposed by Smith and colleagues (2018); however, the latter theory seeks to explain how the full range of emotions are generated and experienced. As discussed below, the Smith et al. theory also meshes well with a theory put forward by Gross (1998) that was developed to explain how individuals can change the trajectories of their emotional responses/experiences (i.e., how they regulate their emotions). The theories by Smith et al. and Gross informed the present research and are described in more detail below.

According to Smith et al., (2018), an affective response can be defined as a set of coordinated changes in both the bodily state (e.g., facial muscles, body posture, hormone levels) and the cognitive/attentional state (e.g., motivation, attention) that occur in response to a particular situation. These changes can be automatically triggered in a bottom-up fashion where no prior learning has taken place (e.g., by unconditioned stimuli), but they can also be triggered by top-down factors (e.g., through the formation or reactivation of perceptual representations of current, past, or imagined events and our appraisals of them). Once the affective response has been triggered, one can represent it at the level of change that has occurred to the bodily state and at a conceptual level (by assigning meaning to it). These two types of representations can also be shaped by both bottom-up and top-down factors. By turning our attention inward and focusing on them, some of these representations can be brought to conscious awareness. This process allows us to notice changes in our bodies, such as alterations in heart rate, or to recognize and describe the emotion(s) we are feeling. However, even if particular aspects of a situation (or our affective response to it) never reach consciousness, they can still influence how we feel and act.

The theory proposed by Smith et al. (2018) can easily account for the idea that, once an emotion is generated, secondary emotions can be triggered. Secondary emotions are often influenced by prior learning and by one's beliefs about emotions (Braniecka et al., 2014). For instance, an individual might think that showing fear is a sign of weakness and subsequently feel shame. This is consistent with the idea that top-down influences impact emotion generation (Ochsner et al., 2012).

Once an emotion has been experienced, its causes can be inferred, and efforts can be made to control or regulate it. The term *emotion processing* was first introduced by Rachman (1980), who defined it as "a process whereby emotional disturbances are absorbed, and decline to the extent that other experiences and behaviour can proceed without disruption" (p. 51). Emotion processing refers to processing of both the situation that triggers a response and of the response itself. The field of emotion regulation emerged in the mid 1990s and related research has proliferated since (Gross, 1998, 1999; Koole, 2009; Tamir, 2011). Gross's *process model of emotion regulation* is considered to lead emotion regulation theory (Preece et al., 2017). Key aspects of the model are shown in Figure 1.1.

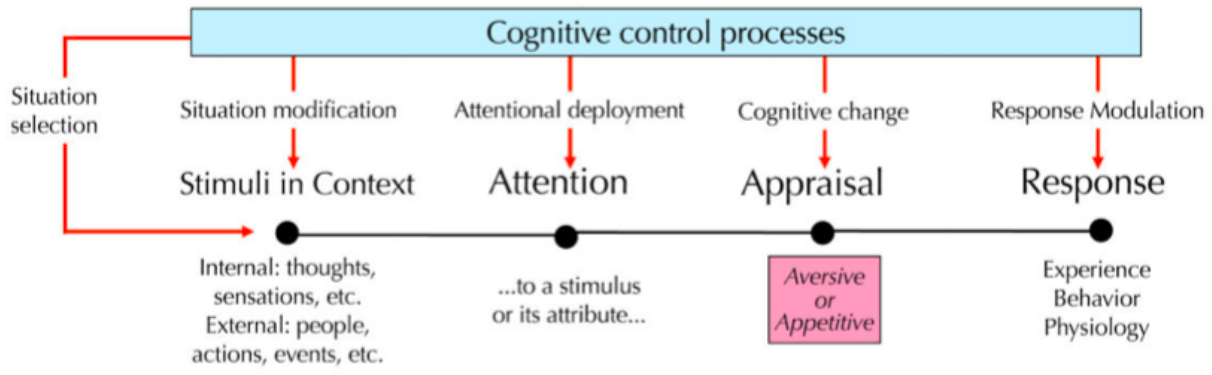


Figure 1.1. Gross's (1998) process model of emotion regulation; reproduced with permission from Ochsner, Silvers, and Buhle (2012).

The process model of emotion regulation describes emotion generation as being impacted by bottom-up and top-down processes that are largely compatible with those described by Smith and colleagues (2018). In short, Gross (1998) suggests that by integrating information about stimuli in context and attending to them (i.e., keeping representations of them active in working memory) one can generate subjectively accessible "feelings" (emotions) that can be classified (as aversive or appetitive) and described. Gross (1998) goes on to argue that these feelings are associated with different experiential, behavioural, and physiological changes.

The process model posits that strategies that can impact how emotions are generated can also be used to regulate them. As discussed by Ochsner et al. (2012), these strategies include: situation selection, situation modification, attentional deployment, cognitive change, and response modulation. Situation selection refers to altering one's approach/avoidance behaviour in relation to the input that generates emotion. In contrast, situation modification refers to altering the situation directly to change the impact it has on you (Gross, 2015). Attentional deployment refers to the process of channeling stimuli into, or out of, the emotional process and differs from situation selection in that it involves changing what one attends to, rather than changing one's physical location. Cognitive change refers to changing the meaning of an external or internal stimulus through processes such as reappraisal. Finally, response modulation refers to altering ways by which we express emotion, for example through self-medication (Khantzian, 1985), exercise (Thayer & Lane, 2000) or expressive suppression (Gross, 1998; 2015).

Within- and Between-Person Variability in Emotion Processing and Regulation

The same situation can trigger many different (unconscious) affective responses and (conscious) emotional experiences, depending on which bottom-up and top-down influences

predominate on any given occasion (Smith et al., 2018). The process model also incorporates the idea that variations in the application of the five kinds of emotion regulation strategies described above can alter how a given person feels, thinks, and acts, in both the short term and the long term (Gross, 2015). The reasoning for this is twofold. First, it is generally accepted that emotions occur over time (Cunningham & Zelazo, 2007; Gross, 2015). Thus, imposing self-regulation at different time points should result in different patterns of feelings, thoughts, and actions. Second, different regulation strategies require differing amounts of cognitive reserve, which in and of itself could have different consequences for emotional expression, experience, and physiology (Gross, 2015). In general, then, emotion regulation can be viewed as altering an emotional trajectory that would have occurred without the emotion regulation strategy in the first place. By employing different emotion regulation strategies over time, a given individual can differentially change the trajectories of the emotions they experience (Gross, 2015).

Two key sets of factors are thought to influence the development of between-person differences in the generation/experience (Smith et al., 2018) and regulation (Canli et al., 2009; Goldsmith et al., 2008) of emotions. The first of these is a set of genetic/epigenetic factors and personality traits with an innate component. Existing literature consistently suggests that there is a mild to moderate degree of heritability of emotion regulation strategies across the lifespan (Canli et al., 2009; Hawn et al., 2015). In the present research, my specific focus was on three traits believed to be partially heritable and which impact emotional awareness and regulation, namely alexithymia (Sifneos, 1973), sensory processing sensitivity (SPS; Aron et al., 2012), and anxiety sensitivity (AS; Stein et al., 1999). These traits will be described in more detail below.

The second set of factors that lead to individual differences in emotional processes relate to learning. Indeed, Smith et al. (2018, p. 381) emphasize that a range of factors including, for

example, "...early life experiences, and other innate and learning-related variables" influence these processes, as do established patterns of attention, motivation, and goal updating. My primary interest was on examining impacts of experiencing emotional abuse or other forms of adversity in childhood. Such experiences shape the development of particular "cognitive habits" that impact how emotional responses are triggered, experienced, and regulated. For example, research suggests that early life adversity may change the threshold of limbic reactivity, and perceptual and cognitive appraisals of threat (Andersen et al., 1999; Thompson, 2011). Children reared in suboptimal environments are more reactive to stress and less able to regulate their emotions, compared to those raised in more positive environments (D'Andrea et al., 2012). Interestingly, emotion dysregulation has been found to mediate the relationship between childhood emotional abuse and depressive symptoms in adulthood, highlighting the importance of emotion dysregulation in the development of depression (Crow et al., 2014).

Experiences in the early years are very important, but Smith and colleagues (2018) argue that one's entire learning history is influential in determining how different individuals generate and experience emotions. Similarly, social learning theory stresses the importance of lived experiences in shaping self-regulatory styles (i.e., how individuals regulate emotion, self-soothe, delay gratification, and tolerate environmental changes; DeGangi, 2000; Kopp, 1982). Furthering our understanding of factors such as these—which may impact mental health—is important both for the advancement of theories regarding emotion regulation (and dysregulation) and for developing more effective ways to screen for and treat these symptoms. As such, I expanded my focus beyond the early years to include experiential variables related to engagement in organized sport, including exposure to emotional abuse at the hands of a coach (Chapter 4).

Smith et al. (2018) and others (e.g., Aron et al., 2012) stress the importance of considering the interaction between genetic/epigenetic and learning-related (experiential) factors in shaping key aspects of one's personality. In the sections that follow, I discuss research suggesting that the traits of alexithymia, SPS, and AS interact with experiential factors, and with one another, to shape individual differences in the ways people generate, experience, and regulate their emotions.

Alexithymia

Alexithymia refers to a stable, multidimensional personality trait (Martínez-Sánchez et al., 2003). The term alexithymia was coined by Sifneos (1973) to describe patients with psychosomatic disorders who not only had difficulties labeling their emotions and distinguishing them from bodily sensations, but who also displayed a lack of imaginative abilities and a tendency to focus on the external environment at the expense of their own inner world. It is also characterized by flattened emotional affect (Nemiah et al., 1976). Research on this trait has proliferated over the last 40 years, but findings are often conflicting due to inconsistencies in the operationalization and assessment of alexithymia (Goerlich, 2018).

Although the features of alexithymia are continuously distributed in the general population (Bagby et al., 2020), approximately 10% of individuals fall in what is traditionally regarded as the alexithymic range (Salminen et al., 1999). Genetic, neurobiological, environmental, and developmental factors are all thought to impact the expression of alexithymia (see Karukivi & Saarijärvi, 2014). The importance of social factors is suggested by Moormann et al.'s (2008) observation that emotional warmth in one's mother positively predicted low scores on alexithymia, and that women with a history of childhood sexual abuse are prone to develop a particular subtype of alexithymia (Albach et al., 1996; Moormann et al., 1997; Moormann et al.,

2004). Other work supports the view that susceptibility to alexithymia is also heightened in individuals who experienced trauma/abuse in adolescence or adulthood (e.g., Eichhorn et al., 2014).

Preece and colleagues (2017) recently proposed the *attention-appraisal model of alexithymia*, which is based on Gross's (2015) extended process model of emotion regulation. They conceptualize difficulties identifying/describing feelings as reflecting problems at the appraisal stage, and externally oriented thinking as reflecting difficulties at the attentional deployment stage (linking it, specifically, with reduced ability to direct attention inward). Others (Jakobson & Rigby, 2021; Smith et al., 2018) have proposed broader models that suggest that problems resulting in alexithymia could arise at multiple stages of emotion processing and regulation, and that both bottom-up and top-down processes may shape its expression.

Alexithymia is considered to be a risk factor for a variety of medical conditions (Goerlich-Dobre et al., 2015; Panayiotou & Constantinou, 2017; Salminen et al., 1999) and psychopathologies (e.g., Moormann et al., 2008; Taylor et al., 1999; van der Meer et al., 2009), including anxiety and depression (Taylor & Bagby, 2004). It has consistently been associated with problems with emotion regulation, although the exact nature of the deficits remains equivocal. Thus, there is a large body of work demonstrating that individuals with alexithymia experience emotion dysregulation physiologically during emotion-inducing tasks (see Panayiotou et al., 2018 for a review). They also tend to use maladaptive cognitive emotion regulation strategies (e.g., Panayiotou et al., 2019). For example, they may have difficulty habituating towards repeated stimuli, due to both memory deficits (Luminet et al., 2006; Vermeulen et al., 2010) and difficulty learning from experience (Darrow & Follette, 2014). Alexithymia also predicts the use of maladaptive emotion regulation strategies such as

rumination, avoidance, and suppression (Sfärlea et al., 2019); this has been observed, for example, in research involving adolescent girls with anorexia nervosa or depression (Aldao et al., 2010).

Sensory Processing Sensitivity

Another trait that relates to emotion processing and regulation is SPS (Aron & Aron, 1997). SPS is a genetically predetermined trait characterized by complex cognitive processing of stimuli, having a rich inner life, showing heightened sensitivity to subtle stimuli, and experiencing heightened emotional reactivity (Aron et al., 2012). It is often measured using the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997), which includes items tapping into sensitivity to a variety of stimuli (e.g., pain, caffeine, light, hunger, and loud noises), one's appreciation for the arts and music, and whether one frequently feels overwhelmed by sensory experiences. Aron and Aron (1997) suggested that approximately 15-20% of the general population score high on SPS. Recently, however, Lionetti et al. (2018) argued that the trait is normally distributed in the general population; they describe those scoring in the low, moderate, and high ranges on the HSPS as dandelions, tulips, and orchids, respectively.

Although Aron and Aron (1997) originally conceptualized SPS as one construct, other work has suggested that it is multifaceted. Smolewska et al. (2006) conducted exploratory and confirmatory factor analyses on the HSPS and validated a model with the following three-factors: ease of excitation, low sensory threshold, and aesthetic sensitivity. These authors noted links between both ease of excitation and aesthetic sensitivity and reward responsiveness, and between ease of excitation and behavioural inhibition (see also Carver & White, 1994). These findings fit with reports that individuals with SPS tend to show increased responsivity to both positive and negative environmental stimuli and approach new situations with caution (Aron et

al., 2012). Şengül-İnal and Sümer (2020) broke the HSPS into four factors: sensitivity to external stimuli, aesthetic sensitivity, harm avoidance, and sensitivity to overstimulation. They reported associations between these factors and behavioural activation, the Big Five personality variables, and social introversion.

The existing research on SPS suggests that it is related to a host of negative outcomes including social phobia (Neal et al., 2002), perceived stress and ill-health (Benham, 2006), avoidant personality disorder (Meyer & Carver, 2000), agoraphobic avoidance (Hofmann & Bitran, 2007), and anxiety and depression (e.g., Liss et al., 2005). Smolewska and colleagues (2006) suggested that the relation between SPS and negative clinical outcomes such as these is largely attributable to scoring high on ease of excitation and low sensory threshold (rather than to exhibiting aesthetic sensitivity). Another important factor, however, relates to one's early life history. Thus, highly sensitive individuals are more likely to experience anxiety and depression if they had a negative childhood environment (Aron et al., 2005). Exposure to early trauma has also been associated with increased risk for neuroticism (Aron et al., 2012), emotion dysregulation, and psychopathology (Greven et al., 2019) in those with SPS. In contrast, when individuals with SPS are raised in a supportive environment they flourish, perhaps because they learn how to process and regulate responses to negatively valenced stimuli and show increased reward responses to positively valenced stimuli (Acevedo et al., 2016). The latter findings suggest that the negative effects of SPS might be mitigated by a supportive environment (Greven et al., 2019).

Anxiety Sensitivty

A third factor that influences emotion processing and regulation is AS (Allan et al., 2015). AS is defined as having a fear of anxiety-related physical sensations (Reiss et al., 1986). It

involves catastrophically misinterpreting benign physiological sensations that often accompany anxiety as being dangerous; indeed, individuals with high levels of AS often believe that these sensations will have deleterious consequences (Reiss, 1991). For instance, an individual with high AS might believe that an increased heart rate is a sign of a heart attack (McNally, 2002). Individuals with low levels of AS, on the other hand, might interpret this sensation as unpleasant, but not dangerous (McNally, 1999).

AS is associated with many emotional disorders, including most strongly panic disorder (e.g., Schmidt et al., 2008), but also generalized anxiety disorder (e.g., Deacon & Abramowitz, 2006; Rodriguez et al., 2004), post-traumatic stress disorder (PTSD; e.g., Asmundson & Stapleton, 2008; Marshall et al., 2010) and depression (e.g., Carleton et al., 2009). AS has been found to relate to psychological distress through increased experiential avoidance (Ugwu et al., 2020).

Extant literature largely suggests that AS is comprised of three, lower order factors that represent concerns over specific anxiety symptoms and their resulting consequences (Olthuis et al., 2014); these can be grouped into physical, cognitive, and social concerns (Taylor, 1999; Taylor et al., 2007). Physical concerns represent worry about the physical consequences of anxiety, such as the worry that heart palpitations might presage a heart attack. Cognitive concerns represent worry about the psychological impact of anxiety—for example, that difficulties concentrating might lead to mental incapacitation. Finally, social concerns represent worry about the impact of anxiety in social situations; an example would be fearing rejection if one blushes in front of others (Olthuis et al., 2014). Interestingly, these lower order factors differentially relate to psychopathology. For example, physical concerns most strongly predict panic disorder (Olthuis et al., 2014) and PTSD (Fetzner et al., 2011); social concerns most

strongly relate to social anxiety in treatment-seeking adults (Olthuis et al., 2014; Rector et al., 2007) and performance anxiety in healthy adults (Carleton et al., 2010); and cognitive concerns predict depressive symptoms in treatment-seeking adults (Olthuis et al., 2014).

Overlap Between Alexithymia, SPS, and AS

Alexithymia is associated with sensory atypicalities (Serafini et al., 2016) and a growing body of literature has demonstrated links between alexithymia and SPS. Extant research has found a relationship between reporting difficulties identifying/describing one's feelings and reporting a low sensory threshold and ease of excitation. It could be that individuals displaying strong alexithymic traits focus on external events or physical sensations rather than on their emotions, or that they become so overwhelmed by sensory stimulation that they are unable to identify or describe their feelings (Liss et al., 2008). Interestingly, Liss and colleagues (2008) found that the combination of being easily overwhelmed by one's external environment and being unable to accurately identify one's feelings was associated with increased risk for anxiety.

Consistent with Liss et al. (2008), Rigby and colleagues (2020) found that, in a sample of 106 university students, ease of excitation was positively associated with difficulties identifying/describing feeling, and that aesthetic sensitivity was negatively related to externally oriented thinking. Interestingly, these authors also found that close to 50% of individuals who scored in the upper third of the distribution of scores on a popular measure of alexithymia—the Toronto Alexithymia Scale-20 (TAS-20; Bagby et al., 1994)—could be classified as orchids based on their HSPS scores, and that externally oriented thinking and ease of excitation independently predicted how individuals evaluated positively valenced scenes. Taken together, this research supports the view that alexithymia and SPS often co-occur, and that features of both

shape how we perceive and react to our environment. Despite this, few researchers consider this overlap.

Using latent profile analysis, Jakobson and Rigby (2021) identified, in a sample of 201 university students, five classes of individuals who could be meaningfully discriminated based on their alexithymia and sensory processing profiles. Interestingly, these classes bore some similarity to five alexithymia subtypes that had been described earlier by Moormann and colleagues (2008). However, the classes also differed with regard to whether their members were most likely to score in the low, moderate, or high range for SPS. Two of the five classes were comprised of individuals who scored low on alexithymia, but only one of these groups included a large number of orchids. The Modal group scored in the mid-range on both measures. Finally, two groups scored high on alexithymia. Individuals in the first of these alexithymic groups had uniformly high TAS-20 subscale scores and reported moderate-to-high sensitivity to sensory stimulation but a very weak tendency to seek out pleasurable sensory stimulation. Individuals in the second alexithymic group reported difficulties identifying/describing their feelings but scored in the mid-range on externally oriented thinking; orchids were strongly over-represented in this group and its members appeared to be the most dysregulated, suffering the highest levels of depression, anxiety, and stress. The authors speculated that members of this class may have experienced greater early adversity and/or abuse than lexithymic orchids, and that this may have negatively impacted their ability to learn effective ways to manage their sensory sensitivity. This suggestion is consistent with literature suggesting that suboptimal childhood environments are linked to adverse mental health in individuals with SPS (e.g., Aron et al., 2005; Aron et al., 2012; Greven et al., 2019), and that emotional neglect (Aust & Bajbouj, 2014) and other substandard

environmental factors (Darrow & Follette, 2014) are associated with increased risk for alexithymia.

There is minimal research specifically linking SPS to AS, although SPS has been linked to health anxiety during the COVID-19 pandemic (Güneş & Bulut, 2022). However, others have reported moderate correlations between alexithymia and AS in both undergraduate (Devine et al., 1999) and psychiatric samples (Simpson et al., 2006; Zahradnik et al., 2009; Zeitlin & McNally, 1993). Clearly, more work is needed to expand our understanding of the multifaceted nature of alexithymia, SPS, and AS, and how these traits may interact with one another and experiential factors. Given the overlap between these variables, it is important to tease apart the unique contributions that each of these variables make to the prediction of mental health when holding variance from the other variables constant. This was one of the key goals of the present research. My adoption of this approach sets my research apart from much of the existing work in this area, which tends to focus on one variable at a time. It is hoped that the results will inform the development of new theoretical models relating to emotion processing and regulation. Ultimately, this work may also have important clinical applications (e.g., Goerlich, 2018).

The work comprising this dissertation makes another novel contribution to these efforts, as it examines not only experiential factors related to early emotional abuse, but also those related to exercise and participation in competitive sport at the local and/or elite levels. In the following section, I provide some background information relating to emotion processing and regulation in athletes that highlights why these latter experiential variables are of interest.

Exercise and Participation in Competitive Sport

A key experiential variable that I focused on in the research described in Chapter 2 was engagement in physical activity. As discussed further in that chapter, there is a large body of past

research examining links between physical exercise and emotion regulation. As noted above, emotion regulation strategies can be used to influence the nature, magnitude, and duration of our emotions, and even to initiate new ones (Gross & Thompson, 2007; Ochsner et al., 2012). Past research has demonstrated that consistent aerobic activity can increase implicit (i.e., automatic and unconscious) emotion regulation abilities among women in the general population (e.g., Zhang et al., 2019). Interestingly, this relationship appears to be largely driven by improvements in aerobic fitness, rather than in mindfulness or negative affect (Zhang et al., 2019). This is consistent with the neuronal plasticity hypothesis that suggests that exercise may change the prefrontal and parietal cortices of the brain (Colcombe et al., 2004; Hillman et al., 2008), which are implicated in emotion regulation abilities (e.g., Kohn et al., 2014; Etkin et al., 2015). In Chapter 2, I examined possible links between both changes in physical activity since the onset of the pandemic and current activity levels and mental health outcomes in a mixed-sex sample of university students.

Although exercise has generally been found to support emotion regulation and mental health, these relationships may break down in those who engage in maladaptive patterns of exercise. I explored this issue in Chapter 3, in a study that involved females at either low or high risk for exercise dependence. In a follow-up study included in that chapter, I assessed the extent to which a top-down process, namely the ability to exert inhibitory control over behaviour, accounted for unique variance in female mental health when variance accounted for by personality, childhood emotional abuse, and risk for exercise dependence were held constant.

In the first study described in Chapter 4, I explored links between engagement in competitive sport, personality, childhood emotional abuse, and mental health in females. Although athletes are generally characterized by high levels of aerobic fitness, they are also

repeatedly exposed to situations that can trigger a range of strong emotions (Hanin, 2000; Lane & Terry, 2000; Uphill & Jones, 2007). For example, athletes may experience anxiety about an upcoming competition, anger at a referee, shame over a mistake, or excitement about the possibility of winning (Uphill et al., 2012). The emotions they experience before, during, and after competition can influence sport performance (Uphill et al., 2012). Engagement in training or competitive sport also leads to repeated exposure to both physiologically demanding situations (that can trigger physiological responses that mimic or interact with emotional responses), and to distinctive social learning experiences (e.g., interactions with teammates, opponents, support staff, coaches) that could shape how one experiences and regulates one's emotions. This begs the following questions: do competitive athletes' have different personality profiles from non-athletes, and does involvement in competitive sport account for unique variance in mental health when holding personality and childhood emotional abuse constant?

In the second study described in Chapter 4, I went on to assess links between body image problems and mental health in female athletes and non-athletes. Studying this linkage in athletes is important. Like members of the general population, athletes may become overly focused on how their bodies look (e.g., Beals & Manore, 2002). This could not only create body dissatisfaction but also a range of negative affective states (e.g., body anxiety, fear of fatness, etc.) that impact mental health. Athletes experiencing these states may be at increased risk of engaging in disordered eating and/or other unhealthy practices (e.g., excessive exercise, steroid use, etc.) intended to help them manage these states, and achieve what they perceive to be a more "ideal" body shape for their sport. This suggests that it may be important to examine body-related issues (e.g., body image) when studying the emotional well-being of both athletes and non-athletes.

Finally, in a supplementary analysis undertaken in the work described in Chapter 4, I focused on a subgroup of athletes who were competing at an elite level. Examining predictors of mental health in this subgroup is of interest given past work demonstrating that athletes who compete at this level possess superior self-regulatory skills compared to age-matched controls (e.g., Anshel & Porter, 1996; Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002), particularly in metacognitive domains such as reflection, planning, self-monitoring, and evaluation (Jonker et al., 2010). While this skill set can be beneficial in competition (e.g., Brick et al., 2015; van der Sluis et al., 2019) it can also prove detrimental in some circumstances. For example, athletes who are very good at attentional deployment may become so focused on environmental events or somatic states, such as pain, that they fail to attend to their emotions and have problems understanding them (e.g., Allegre et al., 2007; Iacolino et al., 2017). Elite athletes may also weigh a desire to experience pleasant states (hedonic emotions) against a desire to experience emotions they think will be useful when exercising/participating in sport (instrumental emotions) (e.g., Uphill et al., 2012). How they do this may impact their use of emotion regulation strategies such as reappraisal and response modulation. Another reason why focusing on elite athletes was of interest to me is that the culture of high-level sport and the relationships that elite athletes have with their coaches can be considered somewhat unique and could have a large impact on athlete well-being. In the section that follows, I elaborate on this point to provide some context for the work described in Chapter 4.

Exposure to Coaches and the Culture of Sport

Competitive athletes often develop a relationship with one or more coaches. The coach-athlete relationship can be defined as all situations where a coach and an athlete's thoughts, feelings, and behaviours are inter-related (Jowett & Cockerill, 2003). One of the most well cited

coach-athlete conceptual models is Jowett's (2007) 3 + 1 Cs interdependence framework (Nicholls & Perry, 2016), which posits that the degree to which coaches and athletes are interdependent can be operationalized and measured through three constructs: closeness (i.e., the degree to which the coach and athlete trust and respect one another), commitment (i.e., the degree to which the coach and athlete are willing to maintain the athletic relationship) and complementarity (i.e., the degree to which the coach and athlete exhibit complementary behaviours). These constructs can be combined to represent perceptions of the relationship quality, both from a direct perspective (e.g., I trust my coach) and a metaperspective (e.g., My coach trusts me) (Jowett & Ntoumanis, 2004).

As will be outlined in more detail in Chapter 4, having a strong coach-athlete relationship is related to several positive outcomes (Jowett & Cramer, 2010; Jowett & Cockerill, 2003; Lafrenière et al., 2011). However, a range of factors can negatively impact the coach-athlete relationship and athlete well-being (e.g., Blanchard et al., 2009; Burke, 2001; Jowett, 2003). Stirling and Kerr (2014) proposed four vulnerability factors that may contribute to a negative and/or harmful coach-athlete relationship. The first—ontological development—includes characteristics of the coach, such as a lack of anger management skills or having firm opinions about how an athlete's behaviours or characteristics could impact their sport performance. The remaining three factors include: the microsystem (i.e., aspects of the coach-athlete relationship such as the closeness of the relationship, or the coach's position of authority); the exosystem (i.e., aspects of the sport community, including separation from family and peers, the coach being held in high regard, and lack of reporting measures); and the macrosystem (i.e., having a culture of accepting violence and aggression, and of endorsing values based around performance in sport).

To illustrate how certain coaching beliefs or practices (ontological factors) might impact how athletes come to generate, experience, and regulate their emotions, consider the following examples. A coach who believes that attending to one's feelings can hinder athletic performance may encourage an athlete to focus on their sporting goals and tune out their emotions. Those athletes who habitually fail to "turn attention inward" would be expected to have a more limited conscious experience of their emotions. If the coach also tends to describe an athlete's emotional responses in black-and-white (and generally negative) terms, the athlete may also come to formulate undifferentiated appraisals of their affective responses. Finally, coaches and sport culture also often encourage a "tough it out" attitude (Nixon, 1994, p. 86), which might reinforce an athlete's tendency to suppress emotional displays of pain or negative affect. Figure 1.2 illustrates how these different ideas map onto the process model. Of course, coaches can exert many more effects on their athletes, either intentionally or unintentionally. For example, coaches who have difficulty controlling their own emotions may be ill-equipped to serve as what Greven et al. (2019, p. 299) refer to as "external regulator" agents; i.e., individuals who can facilitate the development of effective coping strategies in athletes. As I will argue later, this might be especially harmful in the case of those athletes who have, or are at elevated risk for developing, problems with emotion processing and regulation.

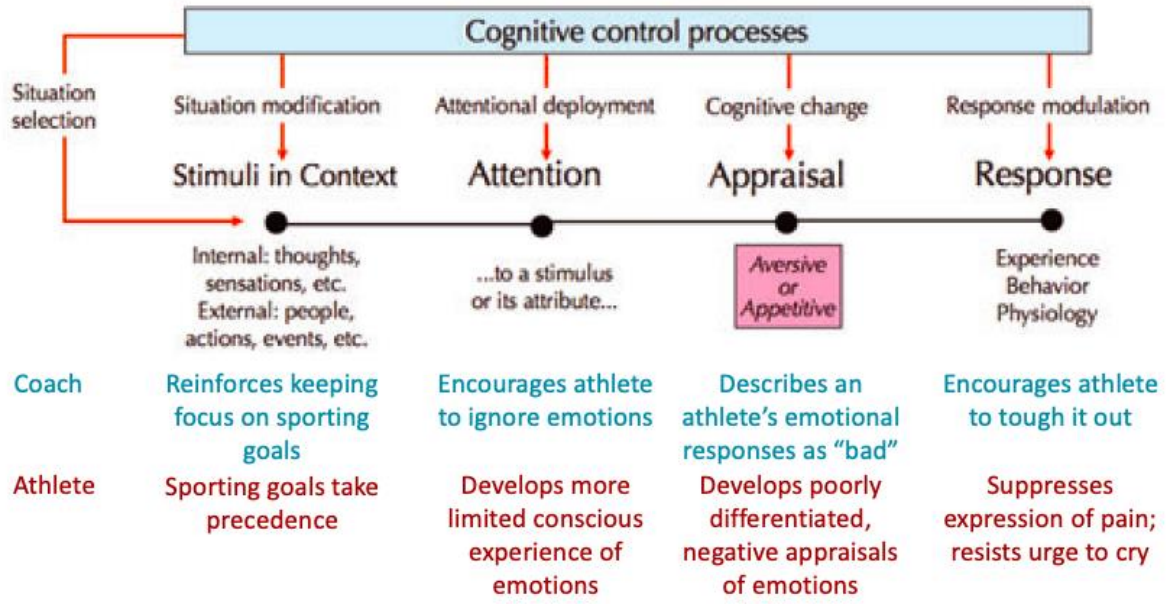


Figure 1.2. Examples of how coaching practices/beliefs can impact how an athlete experiences and exerts top-down control over their emotions. Adapted from Gross's (1998) process model of emotion regulation; reproduced with permission from Ochsner, Silvers, and Buhle (2012).

Summary and Brief Overview of the Current Research

The literature reviewed in this Chapter provides important background information about how emotions are generated and regulated, and how certain personality and learning-related (experiential) variables shape these processes. The overarching goal of the research described in the chapters that follow was to use an individual differences approach to explore how these variables relate to a range of presumed risk or protective factors for poor mental health, including: physical activity and biological sex (Chapter 2), exercise dependence and inhibitory control (Chapter 3), and involvement in competitive sport, exposure to abusive coaching practices, and problems with body image (Chapter 4). In addition, I assessed whether these presumed risk/protective factors accounted for unique variance in mental health when the effects of the personality/experiential variables were held constant. These analyses allowed me to tease apart the unique contributions that variables that are frequently confounded make to the

prediction of mental health. The findings have important implications for both theory-building and clinical practice.

Two details about the research described should be borne in mind. First, the data included in this dissertation were collected one year into the coronavirus disease 2019 (COVID-19) pandemic. This must be taken into consideration as the pandemic has created a number of unique stressors that have impacted students and members of the general population alike (see Chapter 2 for more discussion of this point). Second, all of the studies involved university students, and the research described in Chapters 3 and 4 focused on female students, specifically. This is important to note as research suggests that university students and females are at increased risk for experiencing anxiety and depression (e.g., Ibrahim et al., 2013; Li et al., 2022, Kessler et al., 1994), especially during this stressful time (Sun et al., 2023).

Of note, participants were asked to report on their biological sex (see Chapter 2 for more detail). This was motivated by my interest in exploring underlying biological differences between the males and females. However, while sex has traditionally been categorized using this binary system, it is important to acknowledge that our current understanding of human biology suggests that (like gender) sex exists on a continuum, and about 2% of the population are intersex (Blackless et al., 2000). As such, it is important to use an inclusive approach and inclusive language while measuring both gender and sex in psychological research. Moreover, it is equally crucial to recognize that excluding individuals who identify beyond the male-female binary makes them an understudied population. Although I did not do this, researchers should make a concerted effort to investigate the unique experiences of intersex and gender-diverse individuals, in order to contribute to a more comprehensive and inclusive body of psychological research.

CHAPTER 2: INDIVIDUAL DIFFERENCES IN PREDICTORS OF UNIVERSITY STUDENTS' MENTAL HEALTH DURING THE COVID-19 PANDEMIC

In March 2020, COVID-19 was declared a pandemic by the World Health Organization (2020). Since then, links between the pandemic and poor mental health outcomes have been documented in the literature. For instance, results from a recent meta-analysis suggested that the prevalence of major depressive disorder and anxiety disorders rose between 2020 and 2021 both in the US (reaching 33.7% and 28.4%, respectively) and globally (reaching 27.6% and 25.6%, respectively) (Santomauro et al., 2021). Some research among university students supports this conclusion (Kaparounaki et al., 2020; Wang et al., 2020) and suggests that these mental health problems have continued to increase in severity as the pandemic has progressed (Debowska et al., 2020).

Despite this initial evidence, more recent work suggests that the link between worsening mental health and the pandemic may not be so clear. For instance, a systematic review and meta-analysis comparing the mental health of 134 cohorts during COVID-19 with data from before the pandemic suggested more modest changes (Sun et al., 2023). Here, results suggested that the estimated change in anxiety symptoms in the general population cohorts was not significant; however, there was a small effect of worsening anxiety symptoms among females and parents. Results regarding depression indicated that there was a significant increase in symptoms in the general population but that the magnitude of this effect was small ($SMD_{change} = 0.12$). This effect was also observed in more limited samples including females, older adults, university students, and people who reported belonging to a gender or sexual minority group. Although all of these effects were small, they suggest that the pandemic may have placed university students and females, who were the focus of the present investigation, at slightly elevated risk for

experiencing anxiety and/or depression, relative to rates seen prior to the pandemic. This suggests that researchers interested in studying mental health in these groups need to take the current context into account.

There are undoubtedly a number of pandemic-related factors that could be exacerbating university students' mental health concerns. For instance, disruptions due to the pandemic and doubts related to the federal government's ability to respond to it significantly have been shown to predict depressive symptoms in U. S. college students (Stamatis et al., 2022). Loneliness has also emerged as an important predictor of mental health difficulties in young adults (Wright et al., 2021). A range of other pandemic-related factors have also likely negatively impacted mental health, such as changes in daily routines, reduction in income/employment, changes in access to medical and mental health care, and increased stress and discord in the family, to name a few.

The fact that females have been reported to be at a slightly increased risk for experiencing depression and anxiety during the pandemic (Kunzler et al., 2021; Sun et al., 2023; Wang et al., 2020) may relate, in part, to the fact that males and females have responded to the pandemic differently. For instance, males have been found to be less likely to follow pandemic related restrictions and guidelines (Litton, 2020), which could explain their higher COVID-19 mortality (Reeves & Ford, 2020). Conversely, females have reported increased levels of pandemic related stress (Yan et al., 2021) and distress (Liu et al., 2020), which may be due partly to occupying a greater percentage of jobs likely to be negatively impacted by COVID-19, such as those in retail and healthcare (Xiong et al., 2020), and partly to increased demands of childcare (Pierce et al., 2020).

In addition to the above, the onset of the COVID-19 pandemic resulted in many restrictions being put into place to try to reduce the spread of the virus, including social

distancing and social isolation (CDC, 2020). The closure of recreation facilities and gyms undoubtedly made engaging in physical activity more challenging (Wright et al., 2021). Unsurprisingly, results from a scoping review of 41 studies suggested that individuals generally decreased their physical activity during the pandemic (Caputo & Reichert, 2020). This could be problematic, given that the benefits of physical activity on physical and mental health are well documented in the literature (e.g., Pearce et al., 2022; Wahid et al., 2016), and given research conducted prior to the pandemic suggesting that the abrupt cessation of physical activity is linked to increased symptoms of depression and anxiety (Weinstein et al., 2017). Indeed, findings from another recent meta-analysis support the view that increases in sedentary activities and reductions in physical activity since the onset of the pandemic are linked to increases in global mental health, depression, anxiety, and quality of life (Runacres et al., 2021).

The absolute levels of physical activity people have been engaging in appears to be important. For example, Wright et al. (2021) found physical activity to be a strong negative predictor of depression in adolescents during the pandemic. Moreover, a systematic review by Wolf et al. (2021) suggested that people who consistently engaged in frequent exercise during the pandemic reported fewer symptoms of depression and anxiety than those who did not.

It appears that whether one maintained one's pre-pandemic levels of physical activity after the onset of the pandemic may also have had widespread effects on health, including mental health. Thus, in a sample of 3052 American adults, those who were previously active but then decreased their exercise during the pandemic reported more symptoms of depression and stress than those who maintained their pre-pandemic activity levels (Meyer et al., 2020). Interestingly, results from a study of 1098 Canadians found that those who were less active during the pandemic were also more likely to have reduced their activity since its onset, whereas those who

were more active were more likely to have increased their activity (Lesser & Nienhuis, 2020). This is consistent with earlier findings suggesting that, during stressful times, active individuals increase their activity while inactive individuals decrease their activity, possibly reflecting different coping strategies (Stults-Kolehmainen & Sinha, 2014). Lesser and Nienhuis (2020) found that inactive (but not active) individuals who decreased activity reported worse psychological health and more signs of generalized anxiety than those who maintained or increased activity. Thus, at least in those who are not particularly active, maintaining or increasing physical activity seems to be protective.

Although pandemic-related factors like those mentioned above may have made the situation worse for university students and females, in particular, it is important to note that these groups were already considered to be at elevated risk for anxiety and depression before the onset of the pandemic (e.g., Ibrahim et al., 2013; Li et al., 2022, Kessler et al., 1994). Given this, it is important to identify additional risk and protective factors for poor mental health in these groups and control for them when assessing the extent to which pandemic-related stressors, or current levels of physical activity, may be contributing to poor mental health outcomes (Osimo et al., 2021). Learning more about factors driving individual differences in mental health is critical for designing and implementing effective prevention and treatment approaches.

A key set of individual difference variables that I focused on were the three personality traits described in detail in Chapter 1, namely alexithymia, SPS, and AS. As noted earlier, these traits have overlapping features and can co-occur but, despite this, they are seldom studied together. Moreover, researchers often neglect to control for adverse childhood experiences when studying these traits, despite the fact that such experiences are thought to impact their expression (see Chapter 1 and below). In the sections that follow, I will present some evidence to suggest

that these traits and/or early experiences may also affect how individuals have responded to the pandemic as well as their current levels of anxiety and depression. I will also highlight some research examining possible sex differences in these variables, which may help to explain sex differences in both pandemic-related stress/distress and in mental health outcomes, more generally.

Personality Variables: Links to Pandemic-related Stress/Distress and Mental Health

Personality variables represent an important class of individual difference factors that relate to emotion generation and experience (e.g., Moormann et al., 2008) and emotion regulation (Finley et al., 2017; Verduyn & Brans, 2012). Interestingly, some authors argue that personality interacts with situational context in predicting emotion regulation (e.g., Kobylińska & Kusev, 2019). This may explain why certain dimensions of personality have been found to predict both emotional responses to the pandemic and mental health.

Alexithymia is a case in point. As noted in Chapter 1, alexithymia is considered a vulnerability factor for developing depression and anxiety (Taylor & Bagby, 2004). In addition, recent research shows that individuals reporting higher levels of alexithymia have poorer emotional responses to the pandemic compared to individuals with lower levels of alexithymia (Osimo et al., 2021), and that alexithymia predicts increased health anxiety during the pandemic (Gürsoy et al., 2021). Interestingly, Tang et al. (2020, p. 3) suggested that it mediates the link between “exposure to the COVID-19 pandemic” (including direct or indirect exposure to the virus itself or to stressful media messages) and symptoms of PTSD and depression among university students. This makes sense, as individuals who have trouble identifying and labeling their emotions are also likely to struggle with using reappraisal to regulate their emotions

(Connelly & Denney, 2007; van der Meer et al., 2009), thereby increasing risk for psychopathologies characterized by emotion dysregulation (Preece et al., 2017).

It is unclear whether sex differences in alexithymia may have contributed to the sex differences in levels of pandemic-related stress/distress (Liu et al., 2020; Yan et al., 2021) or mental health (Sun et al., 2023). Indeed, the evidence for sex differences in alexithymia is mixed. Levant and colleagues (2009) argued that males experience higher mean levels of alexithymia than females due to the traditional socialization of males to show a more restricted range of emotions than females (the normative male alexithymia hypothesis). However, sex had a small effect size (*Hedges' d* = .22) and this meta-analysis involved primarily clinical samples. In a review of 32 studies conducted in non-clinical populations, 14 studies found no significant gender differences, 17 studies found that males reported higher mean levels of alexithymia than females, and one study found that females reported higher mean levels of alexithymia than males (Levant et al., 2006). Despite the mixed findings, it has been recommended (e.g., Campanella et al., 2012) that individual difference factors such as alexithymia should be considered when examining sex differences in emotional processing.

SPS has also been a focus of study. Research conducted during the pandemic suggests that increased levels of SPS are related to increased pandemic related stress in older adolescents and young adults (Iimura, 2022) and to increased levels of health anxiety in adults (Güneş & Bulut, 2022). In adolescents, perceived COVID-19 impact was found to partially mediate the link between SPS and internalizing symptoms, suggesting that individuals with higher levels of SPS perceive a higher level of negative impact due to COVID-19, which increases risk for internalizing symptoms (Burgard et al., 2022). Interestingly, however, results from another mediation analysis suggested that resilience mitigated the negative effects of SPS on pandemic

related stress, suggesting that resilience is likely an important protective factor in individuals with high levels of SPS (Iimura, 2022). Women have been found to report higher levels of SPS than men (Aron & Aron, 1997; Benham, 2006); however, some researchers have suggested that this may be partly due to Western cultural norms, where sensitivity is seen as being less acceptable in males (Aron & Aron, 1997).

Finally, a limited amount of work has focused on AS, which is characterized by a fear of physical sensations arising from anxiety and its consequences (Reiss et al., 1986). Research suggests that females score higher than males on this individual difference variable (Stewart et al., 1997). Moreover, AS has been found to be a mediator between sex and pandemic-related distress (i.e., news anxiety and overall anxiety), suggesting that higher levels of AS might help explain increased distress related to the pandemic in females, specifically (DeGrace et al., 2021).

The literature cited above not only links alexithymia, SPS, and AS to indicators of emotional distress and mental health during the COVID-19 pandemic (e.g., DeGrace et al., 2021; Iimura, 2022; Osimo et al., 2021), but also highlights possible sex differences in the incidence and/or expression of these traits. Remember, however, that these traits can co-occur. For example, in Chapter 1 I cited recent work suggesting links between alexithymia and SPS (Jakobson & Rigby, 2021; Rigby et al., 2020). Given this, it is possible that past findings regarding any one of these variables may have been confounded by failing to control for the others. Clarifiying how much variance in emotional distress and/or mental health outcomes is uniquely attributable to each of these traits would be useful for theory building and may inform clinical practices, such as emotion-focused intervention planning.

Experiential Variables: Links to Pandemic-related Stress/Distress and Mental Health

It is also important to consider the role that experiential variables, such as adverse childhood experiences, play in predicting both mental health and responses to the pandemic. In one of the earliest and most influential papers on the subject, Felitti et al. (1998) characterized adverse childhood experiences as falling into seven areas: three were associated with childhood abuse (i.e., psychological abuse, physical abuse, sexual abuse) and four with aspects of household dysfunction (i.e., substance abuse, mental illness, violent treatment of mother or stepmother, and criminal behaviour). These authors reported a strong, graded relationship between the number of adverse childhood experiences one had been exposed to and experiences of physical and mental illness in adulthood. More recently, Finkelhor and colleagues (2015) suggested four additional childhood exposures that could predict difficulties later in life: low socioeconomic status, peer victimization, peer isolation/rejection, and community violence.

Research into the frequency and impact of adverse childhood experiences on emotion regulation and both anxiety-related and mood disorders has proliferated. For example, data from the 2012 Canadian Community Health Survey: Mental Health suggested that the prevalence of any type of child abuse (defined as physical abuse, sexual abuse, or exposure to intimate partner violence) was 32%, and that exposure to all types was associated with an increased risk of depression, bipolar disorder, generalized anxiety disorder, and alcohol and drug abuse/dependence (Afifi et al., 2014). Other work links adverse childhood experiences to decreased social skills, emotion regulation, and empathy in later childhood (Ray et al., 2020); depression in children and youth (Elmore et al., 2020); depression and anxiety in adulthood (Edwards et al., 2003); and suicide attempts in female adolescents (Isohookana et al., 2013). The focus of the present study was on emotional abuse. Research examining possible sex differences in exposure to this form of abuse are mixed, with some studies reporting higher rates in females

(e.g., Mathews et al., 2023; Scher et al., 2004), others reporting higher rates in males (e.g., Simsek et al., 2017), and others finding no differences between sexes (Akgöz Aktaş et al., 2023).

Recent studies suggest that adverse childhood experiences negatively predict mental health during the pandemic. For instance, in one study, adverse childhood experiences were associated with lower levels of happiness among Chinese university students (Huang et al., 2021). In another study, experiences of childhood emotional abuse were found to be associated with increased psychological distress among a sample of Italian adults, and emotion dysregulation was found to mediate this relationship (Janiri et al., 2021). But these studies may not tell the whole story. In a recent longitudinal study, researchers asked whether pandemic-related stresses account for unique variance in third-year medical students' mental health when other potentially relevant variables are controlled for (Stanislawski et al., 2023). Nearly three-quarters of the sample screened positive for depression, anxiety, or PTSD over the course of the study. Despite the vast majority of the students having experienced trauma and/or pandemic-related stressors during their clerkships, pandemic-related worries decreased over time and did not predict mental health outcomes at year end. In contrast, baseline psychological distress, childhood emotional abuse, and resilience were all found to significantly predict depression, anxiety, and/or PTSD at year-end.

Research Exploring the Interplay Between Personality Variables and Childhood Adversity/Abuse in Predicting Mental Health Outcomes

Research like that conducted by Stanislawski et al. (2023) suggests that childhood emotional abuse, emotional functioning and emotion regulation emerge as independent predictors of mental health even after controlling for pandemic-related worries. Studies that examine the interplay between personality variables and childhood adversity or abuse may

provide important insights into the mechanisms underlying these associations, and targets for intervention. In Chapter 1, I discussed links between these variables; I elaborate on that discussion here.

Research suggests that childhood abuse is associated with alexithymia. For example, adults who reported experiencing childhood abuse reported increased difficulties identifying emotions compared to adults who had not experienced abuse (Berenbaum, 1996). More recently, results from a meta-analysis of 88 studies revealed a small effect whereby higher levels of abuse experienced in childhood or adolescence was associated with higher levels of alexithymia (Khan & Jaffee, 2022). Interestingly, alexithymia was found to be more strongly related to neglect than to physical or sexual abuse in this study. Karaca Dinç et al. (2021) have presented evidence that alexithymia mediates the relationship between childhood trauma and psychopathology, including depression, anxiety, and negative self-esteem.

One's early life history is also an important factor to consider when examining outcomes of those with SPS. Indeed, highly sensitive individuals are more likely to experience anxiety and depression (Aron et al., 2005), neuroticism (Aron et al., 2012), emotion dysregulation, and psychopathology (Greven et al., 2019) if they were raised in a negative childhood environment or exposed to trauma. In contrast, when individuals with SPS are raised in a supportive environment they flourish, perhaps because they learn how to process and regulate responses to negatively valenced stimuli and show increased reward responses to positively valenced stimuli (Acevedo et al., 2016). The latter findings suggest that the negative effects of SPS might be mitigated by a supportive environment (Greven et al., 2019). In the study by Karaca Dinç et al. (2021) mentioned earlier, these authors found that SPS also mediated the positive relationship

between childhood trauma and increased negative affectivity; thus, childhood trauma positively predicted SPS, which positively predicted negative affectivity.

Research suggests that childhood abuse could increase risk for AS. For instance, past research has found that among children, stressful life experiences (i.e., health-related concerns and family discord) were longitudinally associated with increases in AS (McLaughlin & Hatzenbuehler, 2009), and childhood abuse and neglect were positive predictors of AS (Martin et al., 2014). AS has also been shown to mediate the relationships between: childhood abuse and substance use relapse risk (King et al., 2020); stressful life events and anxiety (McLaughlin & Hatzenbuehler, 2009); and childhood emotional trauma and internalizing symptoms related to anxiety and depression (Yang et al., 2022).

The Present Study

The first key objective of the present study was simply to present data collected during the COVID-19 pandemic on levels of alexithymia, SPS, AS, childhood emotional abuse, pandemic-related impacts, anxiety, and depression in a large, mixed-sex sample of university students. Although this was done largerly for descriptive purposes (to characterize my sample), based on the literature reviewed above I expected rates of anxiety and depression to be high, and that all of these study variables would be positively related with one another.

The second objective was to test for possible sex differences in these variables; this was of interest given mixed findings that have been reported for some of these variables in the literature. Here, it was expected that females would score higher than males on measures of SPS, AS, pandemic-related impacts, anxiety, and depression. It was unclear if the two groups would differ on alexithymia or on experiences of childhood emotional abuse.

The third objective was to examine how the pandemic may have differentially impacted male and female students' engagement in physical activity and whether this was related to their current mental health. Addressing this question adds to the literature exploring links between physical activity and psychological well-being. I expected to find that decreasing one's activity after the onset of the pandemic would be a risk factor for poor mental health in both sexes, whereas maintaining or increasing physical activity would be protective.

Finally, the fourth objective was to assess the unique contributions that current levels of physical activity, personality, childhood emotional abuse, COVID-19 impacts, and sex made to the prediction of mental health. Overall, scoring high on the personality variables, reporting more childhood emotional abuse, and being female were expected to increase risk for poor mental health, while engaging in more physical activity was expected to be a protective factor, when accounting for variance from the other variables. By teasing apart the unique contribution that each of my study variables made to the prediction of mental health I hoped to gain a clearer understanding of risk and protective factors impacting university students during this stressful time. Ultimately, the findings may have important implications for theory and clinical practice.

Method

Participants

The majority of participants were recruited through the Introduction to Psychology subject pool. In an effort to increase involvement of elite athletes, I also distributed recruitment materials to members of varsity sports teams at the University of Manitoba, but only four additional participants were recruited through this route. Data were collected between February 11 and March 26, 2021, which coincided with a period between the first and second waves of the

COVID-19 pandemic in Manitoba, when case counts were generally less than 100 per day (https://github.com/CSSEGISandData/COVID-19).

Details regarding data cleaning are provided below. The final sample included 410 individuals with a mean age of 19.7 years (*SD* = 3.4; range 17-44). The majority of participants identified as female (75.4%) and were Canadian citizens (83.7%). Although a large proportion identified as White/European (44.7%), almost one third of the sample (31.2%) identified as Filipino or Asian/Southeast Asian, 7.8% identified as Black, and 5% identified as First Nation/Métis.

Procedures

Participants completed an on-line survey that included measures tapping into demographics, personality variables (alexithymia, SPS, and AS), current levels of depression and anxiety, current levels of physical activity, the impact of the current pandemic in multiple domains, and emotional abuse experienced in childhood. I also included a measure of conscientious responding to check for poor effort. Data were also gathered on symptoms of exercise addiction and emotional abuse experienced when working with an athletic coach (where applicable) for two separate investigations; details regarding these two measures are described in Chapters 3 and 4, respectively. The survey was administered via the Qualtrics platform and participants completed it remotely at a time and location of their choosing. All procedures were approved by the Psychology/Sociology Research Ethics Board at the University of Manitoba. Participants gave informed consent and were compensated by receiving credit toward a course requirement, or a small honorarium. Records were maintained in compliance with the Personal Health Information Act.

Measures

Demographics

Participants reported on their age, sex, race, and citizenship. Those involved in competitive sport also supplied additional details about their sport involvement for a separate investigation; these items are described in Chapter 4.

Toronto Alexithymia Scale-20

The TAS-20 (Bagby et al., 1994) is a widely used instrument designed to measure alexithymic traits. Participants rated how well each of 20 items described them using a 5-point Likert scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). Items belong to one of three subscales which tap into key features of alexithymia: 1) difficulty identifying feelings (7 items; e.g., "I have feelings that I can't quite identify"); 2) difficulty describing feelings (5 items; e.g., "It is difficult for me to find the right words about my feelings"); and 3) externally-oriented thinking (8 items; e.g., "I prefer to analyze problems rather than just describe them"). After reverse-scoring select items, ratings were summed to create a total score that could range from 20 to 100. Traditionally, total scores equal to or greater than 61 are said to signify alexithymia, scores equal to or less than 51 are said to signify lexithymia, and scores falling in between these cut points are classified as borderline (Parker et al., 2003); however, following recommendations by Bagby et al. (2020), I treated alexithymia as a continuous variable in my analyses.

Previous work confirms good internal consistency for total scores and subscale scores of the TAS-20 (e.g., Parker et al., 2003) and good retest reliability for 5-year (Salminen et al., 2006) and 11-year (Hiirola et al., 2017) intervals. Indeed, a recent review of over 25 years of psychometric literature on this measure suggests that researchers can be confident in its

reliability and validity as a measure of alexithymia (Bagby et al., 2020). The internal consistency of the total score in the current study was good ($\alpha = .84$).

Highly Sensitive Person Scale

The HSPS (Aron & Aron, 1997) measures SPS. Participants rated how well each of 27 items described them using a 7-point Likert scale ranging from 1 (*Not at all*) to 7 (*Extremely*). A total score out of seven was obtained by computing a mean score. Recent work from Lionetti and colleagues (2018) suggests that individuals can be grouped into low, moderate, and high levels of SPS by using cut-scores corresponding to the 30th and 70th percentiles. These groups are labelled *dandelions*, *tulips*, and *orchids*, respectively. Dandelions do well in most circumstances, whereas orchids are highly sensitive and require ideal early environments to thrive. Tulips fall somewhere between these two extremes.

As noted in Chapter 1, confirmatory factor analysis has suggested that the HSPS taps into three facets of SPS: ease of excitation, low sensory threshold, and aesthetic sensitivity (Smolewska et al., 2006). The ease of excitation subscale (12 items) measures how strongly one is affected by bodily cues (e.g., pain, hunger) and how well one manages in a busy sensory environment and when multitasking (e.g., "Does being very hungry create a strong reaction in you, disrupting your concentration or mood?"). The low sensory threshold subscale (6 items) measures how strongly one is negatively impacted by sensory experiences and avoids them (e.g., "Do you make it a high priority to arrange your life to avoid upsetting or overwhelming situations?"). Finally, the aesthetic sensitivity subscale (7 items) measures aesthetic sensitivity (e.g., "Do you notice and enjoy delicate or fine scents, tastes, sounds, work of arts?"). Previous works confirm adequate to excellent internal consistency and validity of the total score and subscale scores of the HSPS (Ahadi & Basharpoor, 2010; Evers et al., 2008; Gerstenberg, 2012;

Liss et al., 2008; Smolewska et al., 2006). Only total scores were used in the present investigation; the internal consistency of the total score in the current study was good (α = .88).

Anxiety Sensitivity Index (ASI-3)

The ASI-3 (Taylor et al., 2007) measures AS. Participants rated how strongly they agreed or disagreed with each of 18 items using a 5-point Likert scale ranging from 0 (*very little*) to 4 (*very much*). Items belong to one of three, 6-item subscales that tap into three domains of concern: 1) physical (e.g., "It scares me when my heart beats rapidly"); 2) cognitive (e.g., "When my mind goes blank, I worry there is something terribly wrong with me"); and 3) social (e.g., "It scares me when I blush in front of people"). Subscale scores (range 0-24) and a total score (range 0-72) were obtained by summing relevant items together, with higher scores indicating greater severity of symptoms. Previous work confirms good internal consistency of the ASI-3 (e.g., Taylor et al., 2007). The internal consistency of the total score in the current study was excellent (α = .91).

Depression and Anxiety Subscales of the Depression Anxiety Stress Scale (DASS-21)

The DASS-21 (Lovibond and Lovibond, 1995) measures symptoms of depression, anxiety, and stress; only the anxiety and depression subscales were administered in the current investigation. Participants rated how much each of 14 statements applied to them over the past week using a 4-point Likert scale ranging from 0 (*Did not apply to me at all – NEVER*) to 3 (*Applied to me very much, or most of the time – ALMOST ALWAYS*). A total score out of 42 was obtained for each of the two subscales by summing relevant items and then multiplying by two, with higher scores indicating greater severity of symptoms. Individuals can be assigned to one of five categories (*normal, mild, moderate, severe,* and *extremely severe*) based on cut points for depression and anxiety provided in the manual. Previous work confirms good internal

consistency of the DASS-21 and good concurrent validity with the Beck Depression Inventory (Antony et al., 1998). In present study, the internal consistency of the depression (α = .90) and anxiety (α = .83) subscales of the DASS-21 were good.

International Physical Activity Questionnaire – Short Form (IPAQ short form)

The 7-item IPAQ short form measures total activity levels, as well as time spent sitting. I used the version of the IPAQ that requires respondents to reflect on a "usual week." Participants are asked to report how many days, and how much time per day, they engage in vigorous activity, moderate activity, and walking during a usual week. They are also asked to estimate how much time they spend sitting during a usual week. I also added four items to gather information about whether the time participants spent in vigorous activity, moderate active, walking, and sitting had increased, decreased, or not changed since the onset of the pandemic, bringing the total number of items to 11.

The IPAQ uses "multiples of the resting metabolic rate" (MET) to quantify physical activity (IPAQ guidelines, p. 3). The MET-minute for a given type of activity is calculated by multiplying the MET score for that activity (walking = 3.3; moderate = 4.0; vigorous = 8.0) by the amount of time (in minutes) it was performed. This score is then multiplied by the number of days per week the activity was engaged in. A total MET-minutes/week score is found by summing the scores across the three types of activities. In addition to extracting this continuous measure, participants can be grouped into three categories based on activity level (low, moderate, and vigorous) using criteria outlined in the standard scoring procedures.

In general, physical activity questionnaires lack rigorous methodological testing (van Poppel et al., 2010). Of the available options, the IPAQ short form is recommended for research (van Poppel et al., 2010), as previous work confirms good test-retest reliability and construct

validity has been established by comparing the IPAQ short form to objective measures of exercise, such as those obtained through use of an accelerometer (Craig et al., 2003). However, the correlations between self-report vs. objective measures of exercise are typically low (e.g., Craig et al., 2003)—a point I will return to in the Discussion. Importantly, reliability is similar for the version of the IPAQ in which participants reflect on the "last seven days" and the version used in the present study where they reflect on a "usual week" (Craig et al., 2003).

Modified Coronavirus Impact Scale (mCIS)

The original CIS (Stoddard et al., 2023) is a brief, self-report tool designed to measure the extent to which the current pandemic has impacted participants' lives in the following eight areas: routines, family income/employment, food access, medical health care access, mental health treatment access, access to extended family and non-family social supports, experiences of stress related to the coronavirus pandemic, and stress and discord in the family. In the present study, the scale was modified by adding one item to assess the impact of COVID-19 on stress related to changes in physical activity /participation in sport, specifically. Participants indicated their responses to each of the nine items using a 4-point Likert scale ranging from 0 (None) to 3 (Severe), and scores were summed to yield a total COVID-19 impact score. The internal consistency of the mCIS was .75, which is considered to be acceptable (Griethuijsen et al., 2015; Taber, 2018).

In addition to the above, the original CIS includes three items that ask respondents to indicate if they, an immediate family member, or an extended family member or friend had contracted coronavirus and, if so, to rate the severity of illness. Responses to these items are not reflected in the total score.

Emotional Abuse Subscale of the Childhood Trauma Questionnaire short form (CTQ-SF)

The CTQ-SF (Bernstein et al., 2003) measures different forms of abuse experienced in childhood. The 5-item emotional abuse subscale was used in the current study. Responses were made on a 5-point Likert scale ranging from 1 (*never true*) to 5 (*very often true*). Past work suggests excellent internal consistency of the CTQ-SF in adolescent and community member samples (Bernstein et al., 2003). The internal consistency of the emotional abuse subscale in the current study was good ($\alpha = .87$).

Attention Checks: Conscientious Responders Scale

The 5-item Conscientious Responders Scale measures conscientious (i.e., honest and accurate) responding (Marjanovic, et al., 2014). It can be used to detect poor effort in individuals completing self-report measures and to increase the validity of survey research. Each item has a correct answer (e.g., "To answer this question, please choose option number four, "neither agree nor disagree"), which allows one to determine whether particular instructions are followed or not. This measure has been shown to distinguish conscientious from random responding with greater than 93% accuracy (Marjanovic, et al., 2014). The five items were randomly distributed throughout all other measures.

Data Cleaning

There were 511 respondents. They were asked to identify themselves by name and email address to increase the validity of their responses (Meade & Craig, 2012). Given that the vast majority of students opted to participate to receive course credit, a number of additional recommendations by Meade and Craig were also followed to further ensure the validity of the data. First, duplicate entries were removed ($n = 2$); in these cases, only the first entry was retained. Second, participants who did not consent to the study ($n = 1$) were excluded. Third, participants who failed to complete at least one subscale of any given questionnaire ($n = 4$) were

excluded. Fourth, participants who scored at or above the 99th percentile on time-to-completion were excluded (n = 4). Fifth, following recommendations by Marjanovic et al. (2014), participants who failed to correctly answer three or more items on the Conscientious Responders Scale were excluded (n = 12).

In addition to the above exclusions, participants who failed to properly complete a questionnaire or provided ambiguous responses were excluded (n = 78). In all but three cases, these exclusions were based on responses on the IPAQ. The 75 individuals excluded based on IPAQ responses (a) had missing data, (b) had Total MET scores that were outliers, and/or (c) made implausible responses when filling out the questionnaire. To illustrate this latter point, one participant reported 20 hours of sitting per day, seven hours of walking on three days per week, seven hours of moderate activity on two days per week, and one and a half hours of vigorous activity on three days per week, suggesting that on at least three days per week this individual was engaging in more than 24 hours of activity (including sitting) thus leaving no time for sleep. I also excluded a small number of participants who reported not exercising at a particular level (vigorous, moderate, walking) despite indicating that they had increased exercising at that same level since the onset of the pandemic. I acknowledge that imposing this latter (non-standard) criterion may have led me to exclude some individuals who had briefly increased their activity level but then tapered off. Nonetheless, my goal was to try to include only those individuals who reported an increase in exercise at a given level and were able to sustain it to some degree.

That the exclusions described above did not create a biased sample is supported by the observation that the demographics of the group of individuals who were excluded were very similar to the demographics of those included in the final sample (see Participants). Thus, the majority of individuals in the excluded sample were female (78.6%) and Canadian citizens

(76.8%). Their mean age was 20.1 years (*SD* = 3.0; range 17-30) and the majority identified as White/European (44.6%) or as Filipino or Asian/Southeast Asian (41.1%).

In the final sample of 410 individuals there were between 0.0 and 0.4% missing data per scale/subscale. Using Little's MCAR test, data were found to be missing completely at random, $p \geq .08$. Expectation maximization was used to estimate missing data values. Here and below, all statistical analyses were performed using SPSS (v. 27) software.

Results

Objective 1: Characterizing the Full Sample

A first key objective of the current work was to characterize the full sample of 410 individuals by providing descriptive statistics on the study variables. This was done to facilitate comparisons with samples drawn in other studies involving university students engaged in varying levels of exercise/sport, and to illustrate the correlations between the study variables. In the full sample, scores on all variables covered virtually the whole range (see Table 2.1). Based on their responses to the DASS-21, over half of the sample reported moderate to extremely severe symptoms of depression (52.9%) and anxiety (52.9%). As expected, most variables were positively correlated with one another, with moderate to large effect size (see Table 2.2). The Total METs score (which provided a measure of overall weekly activity) and the IPAQ code (which was used to group participants according to whether they engaged in low, moderate, or high levels of activity) were strongly positively correlated with one another. They were negatively correlated with HSPS scores, and positively correlated with mCIS scores (with small effect size) but, contrary to expectations, they were not correlated with either depression or anxiety.

Objective 2: Testing for Possible Sex Differences

A second key objective of the present research was to examine possible sex differences in the study variables. Four individuals either did not disclose their sex or did not identify as either male or female; these individuals were excluded from the analyses described below. This left samples of 97 males (M_{age} = 20.5 years, *SD* = 4.5) and 309 females (M_{age} = 19.5 years, *SD* = 3.0).

Table 2.1

Characteristics of the Full Sample on Measures of Alexithymia, SPS, AS, Childhood Emotional Abuse, Depression, Anxiety, and COVID-19 Impacts (N = 410)

	M (*SD*)	Minimum	Maximum
TAS-20 Total	53.1 (11.2)	24	83
HSPS Total	4.3 (0.8)	2	6
ASI-3 Total	25.9 (13.7)	0	68
CTQ-SF	10.1 (5.2)	5	25
DASS-21: Depression	15.3 (10.8)	0	42
DASS-21: Anxiety	11.9 (9.0)	0	40
mCIS Total	8.8 (3.6)	0	18
	Mdn	Interquartile Range	
Total METS	2190	2190	

Note. SPS = Sensory Processing Sensitivity; AS = Anxiety Sensitivity; TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index; CTQ-SF = Emotional Abuse subscale of the Childhood Trauma Questionnaire short form; DASS-21 = Depression Anxiety Stress Scale; mCIS = Coronavirus Impact Scale

A series of Welch's t-tests was conducted to look for possible sex differences in the study variables (see Table 2.3). The Bonferroni correction for multiple tests was used, and a comparison was considered significant if $p \leq .007$. Results indicated that there was no sex difference in mean alexithymia scores and a follow-up chi-square test confirmed that the

proportion of individuals who scored above the traditional cut-off for alexithymia was similar in males and females. However, as expected, females had higher mean scores than males on the HSPS, and a follow-up chi-square test confirmed that there was a significant sex difference in the distribution of dandelions, tulips, and orchids [$X^2(2) = 24.031$, $p < .001$], with more than twice as many females as males being classified as highly sensitive (35.0% vs. 15.5%) based on the criterion of scoring in the upper 30th percentile of the distribution of HSPS total scores in the full sample. In addition to the above, as predicted, females also scored significantly higher than males on the ASI-3, and a similar trend was seen on the CTQ-SF.

The sexes did not differ in their current, weekly activity levels (Total METs), and a chi-square test confirmed that the proportions of males and females exercising at low, moderate, and high levels were similar [$X^2(2) = 4.96$, $p = .084$]. Contrary to expectations, males and females in the current sample did not differ in self-reported depression. In contrast, there was a trend for females to report greater anxiety (see Table 2.3). A follow-up chi-square test revealed a trend for females to be less likely to score in the mild range and more likely to score in the very severe range for anxiety compared to males [$X^2(4) = 7.93$, $p = .094$; see Figure 2.1].

As predicted, females scored higher on the mCIS (see Table 2.3). To determine whether the groups differed in any of the nine specific domains sampled with this measure, chi-square tests were once again utilised. I had no predictions regarding these specific variables; the results are presented here for descriptive purposes only. A Bonferroni correction for multiple tests was used, and an alpha level of .006 was adopted for all comparisons. There were no significant differences between groups on negative impacts related to changes in routines, family income, stress in the family, food access, or access to mental or medical health care, as assessed by the mCIS. However, females reported more moderate impacts than males related to stress due to the

Table 2.2

Bivariate Correlations Between Study Variables (N = 410)

	2[a]	3[a]	4[a]	5[a]	6[a]	7[a]	8[b]	9[b]
1 TAS-20	.39***	.54***	.31***	.27***	.55***	.49***	-.06	-.07
2 HSPS	--	.58***	.36***	.33***	.42***	.48***	-.10*	-.12*
3 ASI-3		--	.43***	.33***	.55***	.68***	.01	-.01
4 EA-CTQ			--	.34***	.48***	.44***	-.02	-.01
5 mCIS				--	.29***	.32***	.17***	.15**
6 DASS D					--	.61***	.00	-.02
7 DASS A						--	.01	-.04
8 Total METs							--	.86***
9 IPAQ Code								--

Note: TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index; EA-CTQ = emotional abuse subscale of the Child Trauma Questionnaire short form; mCIS = Coronavirus Impact Scale; DASS D and DASS A = Depression and Anxiety subscales of the 21-item Depression Anxiety Stress Scale; Total METs = IPAQ index of weekly activity level; IPAQ Code: 1 = low, 2 = moderate, 3 = high.

[a] Pearson correlation

[b] Spearman correlation

* $p < 0.05$, ** $p < .01$, *** $p < .001$ (2-tailed)

Table 2.3

Similarities and Differences Between Males and Females

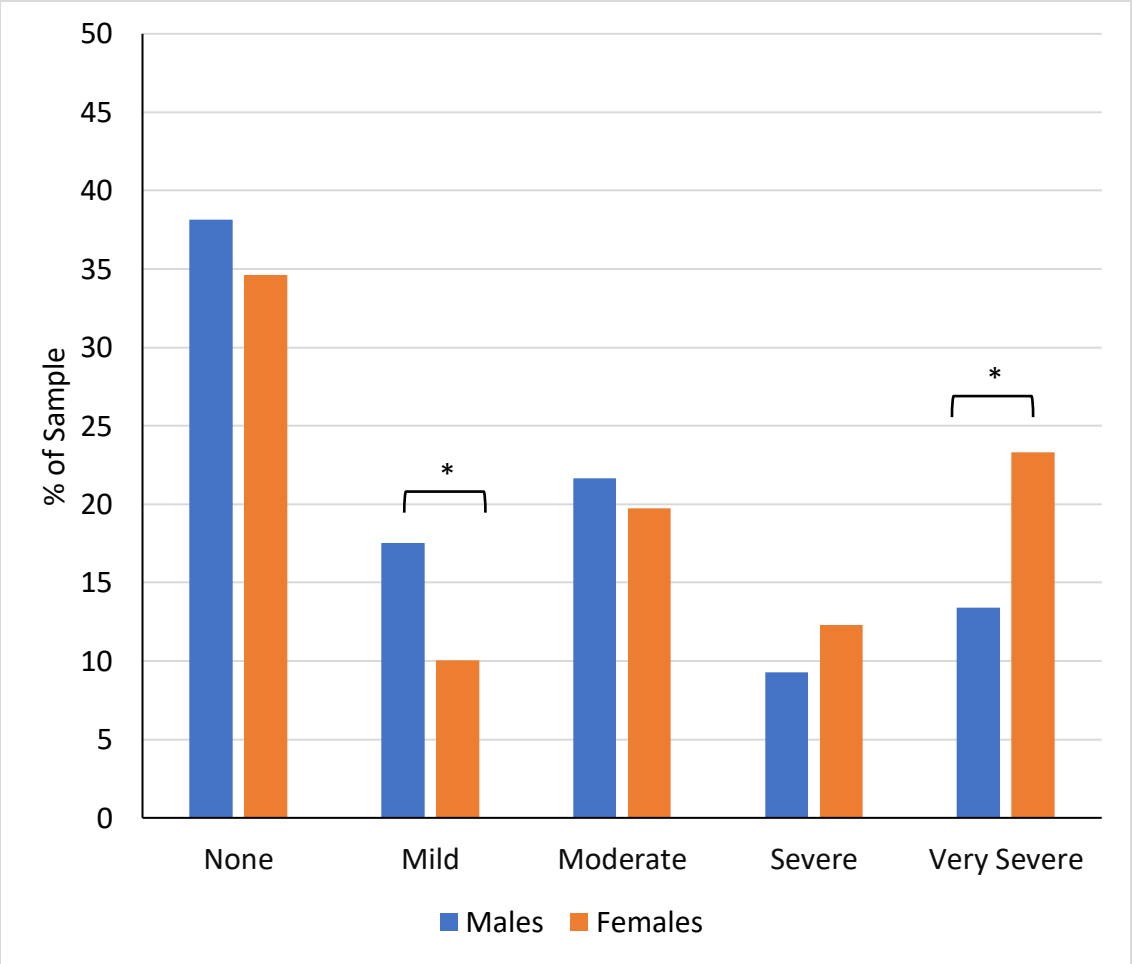
	Males (*n*=97)		Females (*n*=309)			
	M	*SD*	*M*	*SD*	*t*	*p*
TAS-20	50.9	11.1	53.6	11.1	4.645	.033
HSPS	**4**	**0.8**	**4.5**	**0.8**	**30.27**	**<.001**
ASI-3	**22.2**	**13.8**	**26.8**	**13.5**	**8.51**	**.004**
EA-CTQ	9.2	5.1	10.4	5.1	3.53	.062
mCIS	**7.8**	**3.7**	**9.1**	**3.5**	**9.28**	**.003**
DASS D	14.6	10.9	15.3	10.7	0.31	.579
DASS A	10.5	8.1	12.3	9.2	3.42	.066
Total METs	2875	2293	2553	2137	1.51	.221

Note: TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index; EA-CTQ = emotional abuse subscale of the Child Trauma Questionnaire short form; mCIS = Coronavirus Impact Scale; DASS D and DASS A = Depression and Anxiety subscales of the 21-item Depression Anxiety Stress Scale; Total METs = IPAQ index of weekly activity level.

pandemic itself and to changes in social supports [$X2(2) \geq 10.172$, $p \leq .006$ in both cases]. Finally, the sexes did not differ in reported stress associated with changes in exercise/participation in sport.

Figure 2.1

Sex Differences in the Distribution of Anxiety Scores



*$p < .05$

Objective 3: Assessing Sex Differences Relating to Pandemic-related Changes in Physical Activity and Their Links to Mental Health

Chi-square tests were used to assess possible sex differences in changes in activity since the onset of the pandemic. As expected, virtually all participants reported having increased the

time they spent sitting; this was true of both males (91%) and females (96%; group difference not significant). There was no significant difference in the proportion of males and females who reported having not changed their physical activity levels (15% vs. 20%), or who reported having increased their walking (26% vs. 29%). However, females were more likely than males to report having increased their moderate exercise [22% vs. 9%, $X^2(2)$ 8.335, $p = .015$] and their vigorous exercise [18% vs. 8%; $X^2(2)$ 6.018, $p = .049$] since the onset of the pandemic. Contrary to expectations, whether participants of either sex had increased, decreased, or not changed their activity levels (vigorous/moderate exercise or walking) after the onset of the pandemic did not relate to anxiety or depression levels (Kruskal-Wallis tests, $p \geq .351$ in each case).

Objective 4: Variables Accounting for Unique Variance in Current Mental Health

To identify variables that accounted for unique variance in mental health, I conducted separate multiple regressions predicting depression and anxiety. TAS-20, HSPS, ASI-3, CTQ-SF, mCIS, sex, and physical activity levels (low, moderate, high) were entered as predictors. The total score on the mCIS was included in the predictor set given that this variable was positively correlated with both anxiety and depression in the full sample (see Table 2.2) and because females reported being more impacted by the pandemic in a variety of domains. Including this variable also allowed me to assess participants' resilience (i.e., their ability to achieve good mental health in the face of pandemic-related stressors; Veer et al., 2021). The assumptions for multiple regression were met. The results are presented in Table 2.4.

The model was significant for depression [$F(7, 398) = 46.29$, $p < .001$] and accounted for 44.9% of the variance in depression scores. All three personality variables, childhood emotional abuse, and sex emerged as significant predictors. The model for anxiety was also significant [$F(7, 398) = 59.30$, $p < .001$] and accounted for 51.1% of the variance in anxiety scores. Again,

all three personality variables and childhood emotional abuse emerged as significant predictors. Importantly, neither COVID impacts nor physical activity levels accounted for unique variance in either model, when controlling for the other variables. The latter result was somewhat unexpected.

Table 2.4
Predictors of Depression and Anxiety in University Students

	Mental Health Outcome							
Predictors	Depression				Anxiety			
	b	*SE*	β	*p*	*b*	SE	*β*	*p*
(Constant)	-15.346	3.094		<.001	-10.129	2.446		<.001
TAS-20	**0.299**	**0.043**	**0.311**	**<.001**	**0.110**	**0.034**	**0.136**	**.001**
HSPS	**1.367**	**0.635**	**0.105**	**.032**	**1.197**	**0.502**	**0.110**	**.018**
ASI-3	**0.159**	**0.041**	**0.203**	**<.001**	**0.303**	**0.032**	**0.461**	**<.001**
EA-CTQ	**0.528**	**0.089**	**0.252**	**<.001**	**0.261**	**0.070**	**0.149**	**<.001**
mCIS	0.108	0.124	0.036	.384	0.145	0.098	0.058	.143
IPAQ Code	0.043	0.512	0.003	.933	0.001	0.405	0.000	.998
Sex	**-2.311**	**0.975**	**-0.092**	**.018**	-1.008	0.771	-0.048	.192

Note: TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index; EA-CTQ = Emotional Abuse subscale of the Child Trauma Questionnaire short form; mCIS = modified Coronavirus Impact Scale; IPAQ Code: 1 = low, 2 = moderate, 3 = high. Depression and anxiety measured using the Depression and Anxiety subscales of the 21-item Depression Anxiety Stress Scale

Discussion

This study adds to the literature showing that rates of clinically significant symptoms of anxiety and depression (e.g., Debowska et al., 2020; Kaparounaki et al., 2020; Wang et al., 2020) and rates of alexithymia (e.g., Lyvers et al., 2014) are high among university students. The high rates of alexithymia may actually reflect, in part, a response to depression. Indeed, there is evidence to suggest that the strength of alexithymic traits may fluctuate with changing

depression levels (Marchesi et al., 2008), supporting the view that depression exacerbates symptoms of alexithymia.

In contrast to some previous research conducted during the pandemic (e.g., Ocampo González et al., 2022; Sun, 2023), females were not found to be more likely to report symptoms of depression than males. In contrast, I found that females were more strongly impacted by the pandemic and showed a trend to score higher on anxiety compared to males (see also Ballarotto et al., 2021; Sun, 2023; Wang et al., 2020). These latter effects were expected, given that it is well documented that stress-related psychopathology has a higher incidence in females than in males, possibly due in part to neurobiological differences in stress reactivity (e.g., Bangasser et al., 2010). The current findings extend past work by systematically exploring risk and protective factors for mental health in university students, while controlling for potentially relevant variables. Several noteworthy findings emerged from this research regarding how patterns of activity have changed in males and females during the pandemic, and how these changes and other individual difference variables relate to the mental health of university students. These findings are outlined below.

Physical Activity

One key finding relating to physical activity was that females were more likely than males to have increased their moderate and vigorous activity levels from pre-pandemic levels. This may have been done to help them cope with the significantly higher levels of pandemic-related stress they were experiencing. Indeed, it may be that females perceived moderate and/or vigorous activity to be more effective in helping them deal with stress than walking would be. Past research conducted prior to the pandemic supports this idea, as high-intensity physical activity (rather than low-intensity activity) has found to produce long-lasting physiological

changes that contribute to the benefits of exercise on cognitive and emotional functioning (Nakagawa et al., 2020). Due to the cross-sectional nature of the current study, it is impossible to say if this shift in female's physical activity had an immediate impact on their mental health. However, it is interesting to note that recent research exploring mental health trajectories during the pandemic suggests that, although females may have presented with more severe anxiety and depression early on, they also showed more rapid improvements in mental health over time (Fancourt et al., 2021). It is conceivable that increases in moderate and vigorous activity contributed to similar rapid early improvements in female mental health in the present study; this might explain why levels of anxiety and depression were similar in males and females approximately one year after the onset of the pandemic.

Contrary to my hypothesis, current activity levels did not predict mental health when variance attributed to personality/experiential variables and participant sex was held constant. This suggests that it is important to control for these variables when assessing links between physical activity and mental health. In fact, past work suggests that exercising less frequently is associated with scoring higher on: alexithymia in males (Helmers & Mente, 1999); SPS in male and female university students (Yano et al., 2017); and AS in both females (Farris et al., 2019) and mixed samples (Moshier et al., 2015).

Nonetheless, the fact that current activity levels were not a predictor of mental health in the present study was unexpected, given previously documented benefits of physical activity on well-being (e.g., Pearce et al., 2022; Wahid et al., 2016). There are several possible explanations for this result. First, it is possible that the association between physical activity and mental health broke down in the present sample because the context of the pandemic was an overarching stressor that weakened some of these expected links, or because the majority of the students

surveyed were not only exercising less but also sitting more than they had been before the onset of the pandemic (see also Gallè et al., 2020; McCormack et al., 2021). Recent work suggests that time spent sitting is a strong predictor of mental health during the pandemic (Cheval et al., 2021; Runacres et al., 2021). Unfortunately, the data quantifying sitting time in the present study included many imprecise estimates (e.g., "most of the day") and/or missing data; as such, I was not able to examine the relationship between sitting time and mental health.

A second factor that may explain why physical activity was not more strongly related to mental health relates to how accurately activity was measured. Indeed, I had to exclude 75 participants who showed signs of careless responding on the IPAQ. This suggests that, although it is one of the most widely used measures to quantify activity levels, the IPAQ may not have generated accurate estimates of activity levels. This may be because I used the version of the IPAQ in which participants are asked to reflect on their activity during a "usual week." Although using the alternate version in which they are asked to reflect on the "past week" may have resulted in more accurate estimates of activity levels, past work actually indicates that the two versions are equally reliable (Craig et al., 2003). Nonetheless, given that correlations between self-report and objective measures of exercise are typically low (e.g., Craig et al., 2003), it may have been advisable to quantify activity through daily diaries or accelerometer recordings.

A third possible explanation for the lack of a strong link between mental health and physical activity relates to where participants were exercising, which was not measured in the present study. As noted above, data were collected between February 11 and March 20, 2021, when temperatures in Winnipeg tended to be well below freezing. It is possible that much of the physical activity participants engaged in during this time took place indoors. Past work suggests that engaging in outdoor activity has a bigger impact on negative affect (anger, sadness, and

stress) than engaging in indoor activity (Bowler et al., 2010; Dunton et al., 2015). Similarly, results from a study of physical activity and well-being in Canadian adults suggest that levels of anxiety are lower in participants who spend more (vs. less) time exercising outdoors (Lesser & Nienhuis, 2020). As such, it will be important for future work to contrast time spent indoors vs. outdoors when examining links between physical activity and mental health.

A fourth reason I did not observe a strong link between physical activity and mental health may relate to the fact that I used a composite measure of activity, rather than taking into consideration different domains of physical activity. In a recent meta-analysis, White et al. (2017) reported that some domains of physical activity (household activity and participation in physical education) are not consistently associated with better mental health, and that other domains (e.g., work-related activity) are actually associated with worse mental health.

A final reason physical activity and mental health were not strongly linked could relate to the fact that my sample may have included some individuals who were exercising at very high levels of intensity--either because they were dependent on (i.e., addicted to) exercise, and/or because they were elite or sub-elite athletes involved in competitive sport. It is possible that the relationship between physical activity and mental health is different in these subgroups than in less active individuals or in non-athletes. These possibilities were explored in the research described in Chapters 3 and 4.

Personality Variables

A strength of the current study is that I teased apart the unique variance accounted for by the three personality variables that were the focus of the present investigation in predicting mental health outcomes, rather than looking at one variable at a time. Given the intercorrelations I observed between these variables, this was deemed important because it controlled for potential

confounds and allowed for a more nuanced understanding of the true relationship between variables, which could allow researchers and clinicians to make more accurate predictions about their effects on outcomes. When I did this, I found that alexithymia, SPS, and AS all emerged as predictors of depression and anxiety, after controlling for variance in other variables. This supports past work suggesting that alexithymia (Taylor & Bagby, 2004), SPS (Liss et al., 2005), and AS (e.g., Carleton et al., 2009; Deacon & Abramowitz, 2006) are important, independent vulnerability factors for both anxiety and depression.

In addition to the above, I found that alexithymia, SPS, and AS were not only positively correlated with each other but also with the extent to which participants felt COVID-19 had impacted their lives. This finding extends other work showing that those who score high on alexithymia (Gürsoy et al., 2021), SPS (Güneş & Bulut, 2022; Iimura, 2022), and AS (DeGrace et al., 2021) report higher levels of pandemic-related stress and/or health anxiety. These results suggest that it is important to account for these personality variables when attempting to assess the impact that the COVID-19 pandemic has had on people's mental health. In the present study, I was able to show that, once variance in personality and experiential variables was accounted for, information regarding pandemic-related impacts did not improve prediction of anxiety or depression in university students. This complements the findings from Stanislawski et al. (2023), who found that pandemic-related worries did not predict severity of anxiety or depression in medical students when a range of potentially relevant variables were held constant.

Experiential Factors

As noted above, past work has suggested that alexithymia, SPS, and AS may mediate links between childhood abuse and poor mental health (Karaca Dinç et al., 2021; McLaughlin & Hatzenbuehler, 2009; Yang et al., 2022). The present analyses revealed that childhood abuse is a

significant predictor of both anxiety and depression, even when alexithymia, SPS, and AS are held constant. This suggests that factors that are linked to childhood emotional abuse but are unrelated to the personality variables constitute unique risk factors for psychopathology.

The present findings also extend other work suggesting that childhood emotional abuse is linked with increased psychological distress during the pandemic (Janiri et al., 2021). One possible explanation for this is that those who were exposed to higher levels of emotional abuse in childhood learn early on to employ maladaptive self-regulatory strategies like emotional suppression and avoidance (Gruhn & Compass, 2020). Although such strategies might be beneficial in the moment, research suggests that they are not effective in warding off problems like depression in the long-term (e.g., Liverant et al., 2008).

Biological Sex

Male sex emerged as a significant predictor of depression, when holding variance from personality and experiential factors, COVID-19 impacts, and physical activity constant. This was unexpected, as traditionally females have been found to be at higher risk for depression (Lim et al., 2018), including during the COVID-19 pandemic (Sun et al., 2023). However, as noted earlier, males and females reported similarly high rates of depression and anxiety in the present work. It is possible that these high rates were driven by different factors in members of the two sexes. If COVID-related impacts and the personality and experiential variables that females scored higher on were key variables driving the high rates of mental health problems seen in females, this might explain why male sex emerged as a vulnerability factor once I accounted for these variables. Males may experience unique stressors and societal pressures that increase their risk of developing depression. For instance, traditional gender norms may discourage men from seeking help for mental health concerns, leading to underdiagnosis and undertreatment.

As a final note relating to this topic, I will note that my decision to focus on sex- rather than gender-related differences was motivated by my interest in exploring biological differences in risk for psychopathology. However, an important avenue for future research will be to examine risk and protective factors for poor mental health in gender-diverse individuals.

Limitations

There are a number of limitations to the present work. First, as noted earlier, the study design was cross-sectional, which limits one's ability to make causal assumptions. Future work should use a longitudinal design to examine how the relationship between physical activity and mental health may change during stressful times, in males and females separately.

Another limitation of the present study is the number of individuals that needed to be excluded based off their responses to the IPAQ. This measure was chosen because the study was carried out during the pandemic, when quarantine and social distancing rules were in place. Thus, the IPAQ allowed for data collection regarding physical activity to be carried out online. Nonetheless, the results suggest significant limitations with the IPAQ, at least when using the "usual week" version. It is possible the individuals struggled to complete the measure accurately due to problems with recall and/or careless responding.

Finally, the use of online data collection techniques may have negatively impacted how accurately other constructs were measured. Although I used the Conscientious Responders Scale to try to increase the validity of participant responding, the possibility remains that participants were less attentive and careful than they might have been had they completed the measures in-person. However, recent evidence suggests that online testing has not created a major threat to the generalizability of findings during the pandemic (Peyton et al, 2022).

Conclusions

This study adds a number of important findings to the existing literature. As highlighted above, a number of factors were associated with worse mental health outcomes, including reporting higher levels of alexithymia, SPS, AS and childhood emotional abuse. Of course, it follows from this that scoring lower on these personality/experiential variables would be protective, at least in terms of risk for internalizing problems. Assessing the unique contributions these variables made to the prediction of anxiety and depression was important, given that past research has tended to ignore the fact that they are correlated. As they are often not studied together, this raises the possibility that some previously described links between these variables and other measures are confounded.

By comparing relationships between my study variables in males and females, I was able to comment on important sex differences in risk and protective factors for mental health in the context of a global pandemic. Given that females reported higher levels of SPS and AS in the present work, it is likely important to control for these factors when examining mental health in males and females moving forward. Unexpectedly, male sex emerged as a predictor of depression when accounting for variance related to other measures. In contrast, male sex did not emerge as a risk factor for anxiety; indeed, there was a trend for males to report less severe symptoms of anxiety than females. The slightly lower levels of anxiety in males could partially explain why they have been less likely to follow public health measures and restrictions during the pandemic, such as social distancing (Pflugeisen & Mou, 2021)—behaviours that could potentially have increased their risk for adverse health outcomes. It is also important to remember that the focus of the present investigation was on internalizing disorders. Some work suggests that males are at an increased risk for certain externalizing problems during the

pandemic, such as substance abuse (Holland et al., 2021). It will be important to extend this work in the future to determine risk and protective factors for these problems.

The findings reported here may have important implications for the development of individualized treatments for anxiety and depression. This topic will be explored in more detail in the final chapter of this dissertation.

CHAPTER 3: FEMALES' MENTAL HEALTH DURING THE COVID-19 PANDEMIC: LINKS TO EXERCISE DEPENDENCE AND PROBLEMS WITH INHIBITORY CONTROL

One of the more surprising findings from the research described in Chapter 2 was that self-reported physical activity was not a predictor of mental health. I offered several possible explanations for this finding, including the ideas that mental health may have been negatively impacted by time spent sitting or being indoors, or that there were limitations in how accurately physical activity was assessed. Another potentially confounding variable I considered, however, was that some of my participants may have engaged in a maladaptive pattern of physical activity. Specifically, I noted that I had not accounted for the possibility that some highly active individuals in my sample may have been addicted to, or dependent on, exercise. Exercise dependence is a disorder characterized by a lack of control over physical activity, symptoms of overtraining, and withdrawal symptoms (Hausenblas et al., 2017), which increase risk of both physical and psychological harm (Allegre et al., 2007).

In light of the above, I begin this chapter by presenting a study that involved secondary analysis of some of the data gathered as part of the research described in Chapter 2, which allowed me to explore the extent to which symptoms of exercise dependence increased risk for mental health problems in female university students. The decision to focus on females was made partly on the grounds that only a small number of males in my sample (n = 17) reported significant symptoms of exercise dependence, and partly because we have previously shown that females are strongly over-represented in a particular subtype of exercise dependence characterized by very high rates of severe depression (Van Landeghem et al., 2019). Nonetheless, I recognize that it will be important to extend the current research to males in the

future, given differences between the sexes in genetic factors (e.g., brain reward systems, biological differences) and environmental factors that influence risk and protective factors (see Fattore et al., 2014 for a review). Moreover, research also suggests that in males, but not females, levels of alexithymia increase significantly with levels of exercise dependence (Manfredi, 2022).

Study 3.1: Predictors of Mental Health in Females at Different Levels of Risk for Exercise Dependence

The term addiction refers to a re-occurring, uncontrollable action that is undertaken to obtain pleasure and escape from uncomfortable internal experiences, despite negative consequences (Goodman, 1990). Addiction is often referenced in the context of substance use, but it is now widely accepted that addiction can apply to other behaviours as well (Lejoyeux et al., 2008). For instance, gambling disorder was added into the Diagnostic and Statistical Manual of Mental Disorders-V (DSM-V) as a new mental disorder (American Psychiatric Association, 2013). Other examples of behaviours which may involve an addictive component include internet gaming (American Psychiatric Association, 2013), overeating (Powell, 1986), and—of greatest relevance to the current discussion—exercise dependence (Berczik et al., 2012). Exercise dependence refers to a maladaptive pattern of exercise that increases risk for harm (Allegre et al., 2007). It commonly co-occurs with anxiety, obsessive-compulsiveness (Spano, 2001), depression (Lichtenstein et al., 2018; Weinstein et al., 2015) and eating disorders (Cook & Hausenblas, 2008).

Not everyone who exercises at high levels of intensity has exercise dependence. One of the primary ways in which researchers have tried to distinguish between those who are committed to exercise and those who are dependent on it is by looking at individuals' reasons for exercising. This work suggests that committed exercisers primarily exercise for positive reinforcement, whereas those with exercise dependence primarily exercise for negative reinforcement (e.g., to avoid withdrawal symptoms or cope with distress) (Berczik et al., 2012). In view of this, it is interesting to note that, compared to individuals at low risk for exercise dependence, those at high-risk report engaging in higher levels of physical activity during the

pandemic and show a stronger link between exercise reduction and poor mood (Timme et al., 2022). More work is needed to explore how current levels of physical activity, or changes in physical activity, during the pandemic may be linked to mental health in individuals who are, or are not, at-risk for exercise dependence.

It is also crucial to learn more about variables other than physical activity that could be risk factors for poor mental health in those with exercise dependence during these stressful times. Some of these may overlap with variables that increase risk in those who do not suffer from exercise dependence; however, the risk profiles may differ across groups. One set of experiential factors that may be particularly important in those with exercise dependence are adverse childhood experiences. Indeed, recent work suggests that those with exercise dependence tend to report greater exposure to childhood abuse (Colledge et al., 2022), and that individuals who have experienced more childhood abuse are at higher risk for mental health problems (see Chapter 2).

A number of personality traits known to be associated with poor mental health outcomes in general populations have also been linked with an increased risk for experiencing symptoms of exercise dependence. Of greatest relevance to the present study are the traits that were the focus of the work described in Chapter 2. The most well-studied of these is alexithymia. This trait has been identified as a risk factor for behavioural addictions generally (Kandri et al., 2014; Mahapatra & Sharma, 2018; Marchetti et al., 2019) and for exercise dependence in university students, specifically (Lyvers et al., 2021; Van Landeghem et al., 2019). The link between alexithymia and exercise dependence may be explained by the idea that exercise is employed as a way to cope with negative mood states that often co-occur with alexithymia, such as depression and anxiety (e.g., Lyvers et al., 2019; Thorberg et al., 2017). In some cases, however, alexithymia may also be associated with disruptions in the processing of interoceptive signals

(Murphy et al., 2018). Interoceptive deficits could contribute to exercise dependence by reducing awareness of pain, exhaustion, or impending injury resulting from excessive exercise (see Lyvers et al., 2021). Research conducted in general samples suggests that interoceptive deficits are also risk factors for poor mental health (Nord & Garfinkel, 2022) and could increase risk for suicidality by reducing body trust (i.e., by making one feel unsafe in one's own body; Duffy et al., 2018).

Less is known about the relationships between exercise dependence and SPS or AS. However, there is some research linking excessive exercise to individual differences in both visceral (Brown et al., 2021) and somatic (Pugh & Hadjistavropoulos, 2011) sensitivity, both of which are elevated in those with these traits. In these studies, heightened sensitivity/hypervigilance to bodily cues was associated with an increased risk for exercise dependence. This may be because it makes withdrawal symptoms associated with not exercising more salient, increases health anxiety, or (like the interoceptive deficits that can occur in alexithymia) undermines body trust (e.g., Mehling et al., 2012).

Study Goals and Hypotheses

The research cited above suggests that reductions in physical activity can significantly impact the mental health of individuals at risk for exercise dependence, and highlights links between exercise dependence, personality/experiential variables, and mental health. As such, the objectives of Study 1 were threefold: (1) to compare the physical activity profiles, COVID-19 impacts, and mental health of those at low vs. high risk of exercise dependence; (2) to determine whether individuals at high (vs. low) risk for exercise dependence scored higher on the personality/experiential variables that were shown to predict mental health in the work described in Chapter 2; and (3) to assess the unique contributions that exercise dependence made to the

prediction of mental health when controlling for personality, childhood emotional abuse, and COVID-19 impacts. Regarding my first objective, I predicted that individuals at-risk for exercise dependence would be more likely to have increased their activity since the onset of the pandemic than those not at-risk for exercise dependence. This would be consistent with literature suggesting that individuals who were active during the pandemic were more likely to have increased (vs. decreased) their activity levels (Lesser & Nienhuis, 2020). I also predicted that the at-risk group might report more stress related to the impact of COVID-19 on exercise and participation in sport. Finally, consistent with past research on exercise dependence, I expected that the at-risk group would report higher levels of anxiety (Spano, 2001) and depression (Lichtenstein et al., 2018; Weinstein et al., 2015) overall, and that in this group symptoms would be most pronounced in those who had reduced their activity levels since the onset of the pandemic. Regarding my second objective, I predicted that those in the at-risk group would report higher levels of alexithymia, SPS, AS, and childhood emotional abuse than those at low risk. Finally, my third hypothesis was that reporting stronger symptoms of exercise dependence would account for unique variance in both depression and anxiety when controlling for variance from the other variables.

Method

Participants

This study involved secondary analyses of data collected from 309 female undergraduate university students engaged in widely varying levels of exercise/sport, all of whom participated in the research described in Chapter 2. The mean age of participants was 19.50 years (*SD* = 2.95; range 17-34).

Procedures and Measures

As noted earlier (p. 34), the data used in the current study were collected between the first and second waves of the COVID-19 pandemic in Manitoba, Canada (February 11 to March 26, 2021). This coincided with a time where certain indoor businesses (including gyms, fitness centres and yoga studios) were allowed to reopen at 25% capactity and outdoor gatherings of 10 people became permitted, but where risk in the province remained at the "Critical" tier (Rosen, 2021). The procedures followed in the original study are described in detail on page 35.

Data extracted for the current study were collected using several measures that were described previously (p. 36-41), namely: a demographics questionnaire, the TAS-20, the HSPS, the ASI-3, the IPAQ short form, the mCIS, the emotional abuse subscale of the CTQ-SF, and the Conscientious Responders Scale. In addition to these measures, participants in the original study also completed the Exercise Addiction Inventory (EAI; Terry et al., 2004), which is a screening tool used to assess risk for exercise dependence. In completing this measure, participants are asked to respond to six items using a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Items are summed to create a total score that can range from 6-30. Previous work suggests good reliability of the EAI (Terry et al., 2004). In the sample of 309 females included in the present study, the internal consistency of the EAI ($\alpha = .70$) was in the acceptable range (Griethuijsen et al., 2015; Taber, 2018).

Data Cleaning

Details regarding data cleaning can be found on pages 41-42.

Results

Identification of Females At-risk for Exercise Dependence

In the present study, I used a cut-score of 22 on the EAI to identify individuals who were highly symptomatic for exercise dependence (hereafter referred to as "at-risk"); this score corresponded to the 85th percentile in the distribution of EAI scores in the full (mixed-sex) sample recruited for the original study described in Chapter 2 (N = 410). Although the authors of the EAI used a slightly more conservative cut off score of 24 in their work, they noted that this value was chosen because it captured individuals who scored at or above the 85th percentile of total scores in their sample; they also noted, however, that those scoring between 13-23 would still be regarded as being "symptomatic" (Terry et al., 2004, p. 493). Based on the cut off I applied, the prevalence of being at-risk for exercise dependence was approximately 17.5% in the present sample; thus, there were 54 females considered at-risk for exercise dependence (M_{age} = 19.5 years, *SD* 2.6) and 255 females considered not at-risk for exercise dependence (M_{age} = 19.5 years, *SD* 3.0). This rate is somewhat higher than previously-reported rates of exercise dependence in "high risk" groups of university students (e.g., sport science students and those who are members of sports clubs; Li et al., 2015; Szabo & Griffiths, 2007); however, this is perhaps not surprising given that the EAI was intended for use as a screening measure, and that high EAI scores are not to be considered diagnostic of exercise dependence (Terry et al., 2004).

Objective 1: Comparing the Physical Activity Profiles, COVID-19 Impacts, and Mental Health of Those at Different Levels of Risk for Exercise Dependence

Not surprisingly, robust Welch's tests confirmed that the at-risk group was currently engaging in more vigorous activity (M = 1711 METs) than the low-risk group (M = 788 METs), $t(1) = 19.27$, $p < .001$. The groups also differed in their overall activity levels [$t(1) = 9.96$, p =

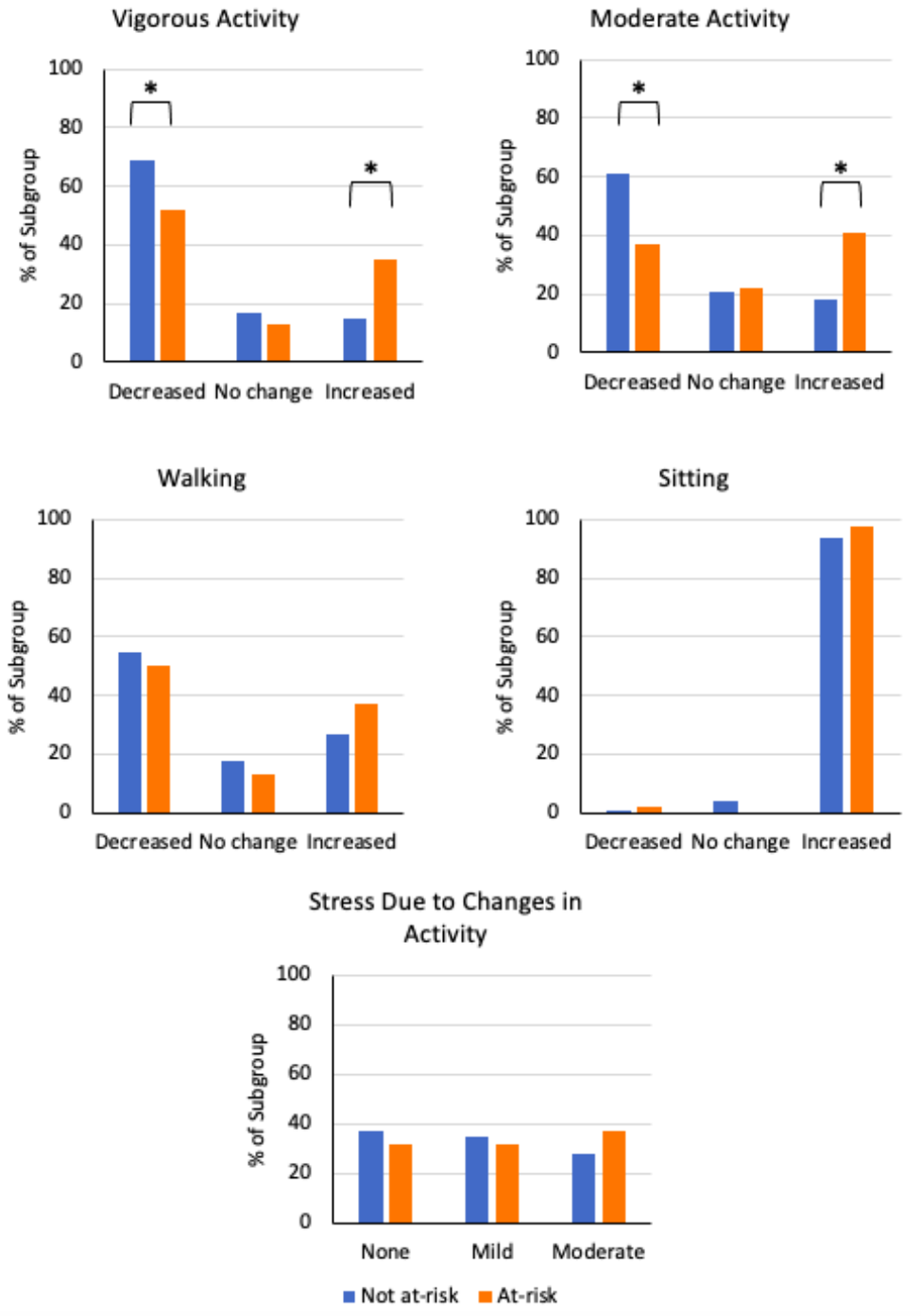
.002], with those at-risk for exercise dependence having, on average, significantly higher Total METs than the low-risk group (M = 3518 vs. M = 2348, respectively).

Chi-square tests were used to determine if the groups had altered their typical activities (vigorous activity levels, moderate activity levels, walking, and/or sitting) in different ways since the onset of the pandemic. Results suggested that there was a significant difference in how the groups modulated their vigorous and moderate activity levels [$X^2(2) \leq 14.71$, $p \leq .002$ in both cases; see Figure 3.1]. As expected, members of the at-risk group were less likely to have decreased, and more likely to have increased, both their vigorous and moderate exercise after the onset of the pandemic, compared to members of the group that was not at-risk for exercise dependence ($p < .05$ for all four contrasts). However, the groups did not differ in how they altered their walking, with the majority of both groups reporting a decrease. In addition, the overwhelming majority of both groups ($\geq$ 95.3%) reported an increase in sitting.

There was no group difference in total mCIS scores (Welch's t = 1.32, p = .253). Contrary to expectations, an examination of responses to individual questions in the mCIS revealed no group difference in the amount of stress related to the impact of COVID-19 on exercise and participation in sport, with approximately one third of each group reporting no stress, one third reporting mild stress, and one third reporting moderate stress (see Figure 3.1). Indeed, the only area in which the groups differed was in stress related to changes in self-reported access to mental health care since the onset of the pandemic [$X^2(2) = 6.39$, $p = .041$], with a larger proportion of those not at-risk for exercise dependence reporting no impact (79.6% vs. 55.6%) and a larger proportion of those at-risk for exercise dependence reporting a mild impact (31.5% vs. 16.9%) in this regard.

Figure 3.1

Pandemic-related Changes in Activity Levels in Women Not At-risk vs. At-risk for Exercise Dependence, and the Stress Associated with These Changes



* $p < .05$

Unexpectedly, Welch's tests suggested that the two groups did not differ in terms of anxiety or depression, overall [$t(1) \leq 2.93$, $p \geq .091$]. Moreover, exploratory correlation analyses showed that neither METS for vigorous activity nor total METs was related to anxiety or depression in either group ($r \leq |.083|$, $p \geq .164$ in all cases). The exception to this was that total METS was positively correlated with anxiety in the not at-risk group ($r = .140$, $p = .025$), suggesting that those who exercised more experienced greater anxiety. Overall however, current activity levels were not associated with mental health in females, regardless of their risk for exercise dependence. It is important to note, however, that this analysis treats the at-risk group as a homogeneous sample, ignoring the possibility that there may be subtypes of exercise dependence that differ with regard to susceptibility to anxiety and/or depression. I return to this point in the Discussion.

To examine how changes in activity levels related to mental health in each of the two groups, I performed separate sets of Kruskal-Wallis tests comparing anxiety and depression in those who increased, decreased, or maintained their engagement in vigorous or moderate activity. In partial support of my prediction, I observed a trend for members of the at-risk (but not the low risk) group who had either decreased or increased their moderate activity to score higher on depression than those who had maintained their pre-pandemic level of moderate activity, $X^2(2), = 4.93$, $p = .085$. These data lend preliminary support to the idea that, in women at-risk for exercise dependence, altering one's pre-pandemic activity level may reflect a maladaptive strategy that is triggered by or exacerbates depression.

Objective 2: Comparing the Personaity/Experiential Profiles of Those at Different Levels of Risk for Exercise Dependence

Inconsistent with my hypotheses, Welch's t-tests did not reveal any significant group differences in scores on the TAS-20, HSPS, ASI-3, or CTQ-SF ($t < 1.24$, $p > .269$ in all cases). However, exploratory follow-up analyses confirmed that TAS-20 scores were significantly correlated with scores on the EAI, $r(309) = .129$, $p = .023$, albeit with small effect size.

Objective 3: Does Exercise Dependence Account for Unique Variance in Current Mental Health?

To answer my third research question, I ran separate multiple linear regression models predicting anxiety and depression. Consistent with the previous chapter, I entered total scores on measures tapping into the three personality variables, childhood emotional abuse, and COVID-19 impacts as predictors. However, I also added whether one was at risk for exercise dependence or not as a categorical predictor to see if this explained unique variance in depression or anxiety scores (not at-risk = 0; at-risk = 1. Given that current activity levels were not strongly associated with mental health in either group, Total METs were not included in the regressions. Because the sample size for the at-risk group was quite small, I examined robust, bias corrected, bootstrapped 95% confidence intervals (CIs) for the parameter estimates (based on 1000 bootstrap samples) to identify significant predictors in each model.

As can be seen in Table 3.1, risk for exercise dependence negatively predicted risk for depression when holding other variables constant. This was contrary to expectations and will be discussed further below. Importantly, all three personality variables and childhood emotional abuse accounted for unique variance in depression scores even when holding risk for exercise dependence constant. Thus, controlling for exercise dependence did not change the relationships

reported in Chapter 2. In contrast, although risk for exercise dependence did not account for unique variance in anxiety scores, SPS no longer predicted anxiety when risk for exercise dependence was controlled for. Thus, unlike in Chapter 2, only alexithymia, AS, and childhood emotional abuse positively predicted symptoms of anxiety.

Table 3.1

Predictors of Mental Health in Females at Different Levels of Risk for Exercise Dependence

		B	Bias	*SE*	BCa 95% CI	
					Lower	Upper
Depression	(Constant)	-18.085	.090	2.675	-23.472	-12.77
	TAS-20	**.283**	**-.003**	**.048**	**.190**	**.373**
	HSPS	**1.54**	**-.009**	**.673**	**.182**	**2.86**
	ASI-3	**.191**	**.002**	**.046**	**.096**	**.290**
	CTQ-SF	**.507**	**-.001**	**.105**	**.323**	**.699**
	mCIS	.172	.005	.141	-0.112	.454
	ED group	**-3.259**	**.012**	**1.099**	**-5.406**	**-.934**
Anxiety	(Constant)	-11.892	.042	2.552	-17.081	-6.687
	TAS-20	**.137**	**-.001**	**.042**	**.057**	**.217**
	HSPS	.959	-.006	.596	-.217	2.135
	ASI-3	**.292**	**.000**	**.037**	**.219**	**.369**
	CTQ-SF	**.285**	**.004**	**.090**	**.103**	**.481**
	mCIS	.182	.000	.128	-.054	.431
	ED group	.328	-.030	1.021	-1.631	2.227

Note. Significant predictors shown in bold. Bias corrected and accelerated 95% confidence intervals (BCa 95% CIs) for parameter estimates are based on 1000 bootstap samples. Predictors include total scores on the Toronto Alexithymia Scale (TAS-20); Highly Sensitive Person Scale (HSPS); Anxiety Sensitivity Index (ASI-3); Emotional Abuse subscale of the Childhood Trauma Questionnaire short form (CTQ-SF); and the modified Coronavirus Impact Scale (mCIS). Whether an individual is at-risk or not at-risk for exercise dependence (ED) is also included.

Discussion

The first goal of the present study was to compare females at-risk and not at-risk for exercise dependence on their physical activity profiles during the pandemic, and whether this

was related to mental health outcomes. The two groups differed not only with regard to their current activity levels but also in how they had altered their activity levels in response to the pandemic. The fact that those at-risk for exercise dependence were more likely to report having increased their vigorous and moderate activity since the onset of the pandemic than those not considered to be at-risk qualifies earlier reports suggesting that this response is characteristic of "active" individuals, in general (Lesser & Nienhuis, 2020). It may also explain why, as a group, those at-risk for exercise dependence were not more stressed about changes in physical activity brought on by the pandemic than those not at-risk for exercise dependence.

Interestingly, current activity levels were not strongly related to mental health in either group. This suggests that the lack of an association between physical activity and mental health seen in the work described in Chapter 2 cannot be accounted for by the fact that the full sample included individuals with exercise dependence. I did find, however, that in the at-risk group there was a trend for those who decreased or increased their pre-pandemic level of moderate activity to score higher on depression than those who maintained their moderate activity level. This qualifies prior work from Wolf et al. (2021) and Meyer et al. (2020), who found that decreasing exercise levels was associated with worse mental health than maintaining levels in the general population. Results from the current study suggest that, among females, this effect may be strongest in those at-risk for exercise dependence. Although I was not able to test this directly in the present investigation, it is possible that altering activity levels may represent a maladaptive coping strategy that females at-risk for secondary exercise dependence employ, which is triggered by or exacerbates their depression. In contrast, it may be that maintainin*g* activity levels is one way that females at-risk for primary exercise dependence protect themselves against depression. More subtyping research, involving larger samples and a more thorough

characterization of symptoms associated with exercise dependence, is needed to examine these ideas. Regardless, the present results suggest that it is important when examining links between physical activity and mental health, and individual differences in responses to pandemic-related lockdowns, to screen for exercise dependence (e.g., see also Timme et al., 2022).

The second goal of this study was to determine if exercise dependence was associated with generally higher scores on personality/experiential variables that had been shown to be risk factors for poor mental health in Chapter 2. Contrary to my prediction, the two groups did not differ on symptoms of alexithymia, SPS, AS, or childhood emotional abuse. This is inconsistent with extant literature suggesting that those at-risk for exercise dependence report: stronger symptoms of alexithymia (Lyvers et al., 2021); heightened visceral (Brown et al., 2021) and somatic (Pugh & Hadjistavropoulos, 2011) sensitivity; and greater exposure to childhood abuse (Colledge et al., 2022). It is possible that group differences would emerge on some of these variables if I had compared individuals with a particular subtype of exercise dependence to those who were not at risk. Unfortunately, however, the EAI does not allow one to distinguish subtypes of exercise dependence. Recall that in primary exercise dependence exercising to excess is the primary problem, whereas in secondary exercise dependence exercise is more likely to be compulsive than addictive (e.g., Cunningham et al., 2016) and is secondary to disordered eating (Berczik et al., 2012; Hausenblas et al., 2017). Previous research in our lab indicates that secondary exercise dependence is more closely associated with both the "cognitive" alexithymic traits assessed with the TAS-20 and with depression; indeed, we found that individuals with primary exercise dependence reported even fewer signs of depression than those not at-risk for exercise dependence, suggesting that exercise may be positively reinforcing for members of this subgroup (Van Landeghem et al., 2019). Whether SPS, AS, and having a history of exposure to

childhood emotional abuse are more characteristic of primary or secondary exercise dependence is not known but should be explored in future research.

The final goal of the present study was to determine whether being at risk for exercise dependence predicted depression or anxiety when holding variance from other variables constant. Results suggested that risk for exercise dependence negatively predicted depression among females. This was unexpected, given past work suggesting that those at-risk for exercise dependence are generally at a greater risk for mental health concerns (Lichtenstein et al., 2018; Spano, 2001; Weinstein et al., 2015). However, as noted above, members of the low-risk group were more likely to have decreased, and less likely to have increased, both their vigorous and moderate exercise after the onset of the pandemic, compared to members of the at-risk group. It could be that decreases in activity are more strongly linked to depression than increases in activity (Meyer et al., 2020; Wolf et al., 2021). Another possibility is that the at-risk group included a large number of individuals with primary exercise dependence, which (as noted above) has been found to be linked with a reduced risk of experiencing symptoms of depression (Van Landeghem et al., 2019). The fact that we were not able to distinguish between primary vs. secondary exercise dependence makes it impossible to test this possibility and is considered a limitation of this study.

Exercise dependence did not account for unique variance in anxiety. It is possible that some other condition—one that is often co-morbid with exercise dependence—is a more important predictor of anxiety than exercise dependence per se. A likely candidate is co-morbid eating disorder. We have previously reported that symptoms of eating disorder is associated with secondary exercise dependence (Van Landeghem et al., 2019), and others have noted that

individuals with secondary exercise dependence display higher levels of neuroticism and lower self-esteem (Bamber et al., 2000) than individuals with primary exercise dependence.

Given that AS emerged as a significant predictor of depression even when controlling for risk of exercise dependence, clinicians should be particularly careful to assess for and treat AS in female clients who present with depression. Prior meta-analytic reviews suggest that CBT is efficacious in decreasing AS (Smits et al., 2008). Although recent work suggests that exercise can be effective in reducing AS through changes to cognitive and emotional reactions to exercising (Sabourin et al., 2015), clinicians should be encouraged to screen for exercise dependence before recommending exercise as an adjuvant therapy.

SPS continued to account for unique variance in depression in females after controlling for exercise dependence but, unlike in Chapter 2, it no longer predicted anxiety. Although this seems to suggest that there may be some shared variance between SPS and exercise dependence, I saw little evidence of this in the present study. A more detailed investigation may reveal some links that help to explain this result. For example, it may be that highly sensitive women who are at-risk for exercise dependence are less likely to exhibit particular symptoms characteristic of this disorder, such as exercising more than they intend to (intention effects) or exercising even when it creates physical, psychological, and/or interpersonal problems (continuation effects). On the other hand, their heightened sensitivity may make withdrawal effects associated with reducing their exercise more salient, which could undermine body trust (e.g., Mehling et al., 2012). Any of these effects might alter their risk for anxiety. Unfortunately, these possibilities could not be tested in the present study as the measure used to screen for exercise dependence (the EAI) does not allow one to generate a symptom profile. Future researchers should consider using a measure such as the Exercise Dependence Scale-21, which allows one to quantify how

strongly seven different symptoms of exercise dependence are expressed (Hausenblas & Downs, 2002).

Childhood emotional abuse was a significant predictor of mental health in females even when holding variance related to exercise dependence constant. This is important to note as past researchers may not have considered the potentially confounding effects of co-occurring exercise dependence when examining links between childhood emotional abuse and mental health. Further research exploring associations between these variables is warranted given that a link between exercise dependence and childhood abuse has been reported in past research (e.g., Colledge et al., 2022). Although my groups did not differ with respect to exposure to childhood emotional abuse, it is possible that they differed with respect to other forms of abuse not measured in the current study (e.g., physical, sexual), or that emotional abuse is primarily a predictor of mental health in the subgroup of at-risk individuals with secondary exercise dependence, who are also at increased risk of having a co-occurring eating disorder. Indeed, childhood emotional abuse has been found to significantly predict disordered eating in a clinical sample (Kong & Bernstein, 2009).

In conclusion, the results of the present study qualify some of the results presented in Chapter 2 and highlight the important roles that personality and experiential variables play in predicting risk for poor mental health outcomes in females at different levels of risk for exercise dependence. More subtyping research is needed to expand our understanding of how exercise dependence relates to mental health in both females and males, but it is also important to extend the present research by identifying other variables that distinguish females at low vs. high risk for exercise dependence, and how these variables might impact emotion processing/regulation and mental health. The goal of the research described in Study 3.2, described below, was to

contribute to these efforts by examining links between aspects of executive function and mental health in females who are, and those who are not, considered at-risk for exercise dependence.

Study 3.2: Inhibitory Control, Exercise Dependence, and Female Mental Health

Current theories emphasize the key role that top-down factors, such as executive functioning, play in both emotion regulation (e.g., Gross, 2015) and psychopathology (e.g, Beauchaine & Zisner, 2017). Executive function is an umbrella term that refers to the underlying cognitive capacity that allows one to initiate, strategize, coordinate, and regulate one's actions and thoughts. Executive functioning is an essential feature of Gross's model of emotion regulation (described in Chapter 1) because it is thought to support cognitive processes involved in reappraisal, response inhibition, self-control, and monitoring. These cognitive processes enable individuals to modify their emotional responses effectively and regulate their emotions in a way that aligns with their goals and the demands of the situation (Jones & Graff-Radford, 2021). The focus of the current work was on inhibitory control, which is considered one of three core aspects of executive function (Miyake et al., 2000). This facet includes the ability to inhibit unwanted thoughts, emotions, and behaviours (Berkman et al., 2009). In situations where an immediate emotional reaction may be inappropriate or unhelpful, inhibitory control may allow individuals to inhibit impulsive emotional responses and choose more adaptive behaviors (Jones & Graff-Radford, 2021). The ability to inhibit automatic emotional reactions and engage in controlled, goal-directed responses is important for effective emotion regulation, particularly when one is in an emotionally charged situation.

A number of studies have suggested that acute exercise improves executive functioning in members of the general population. Indeed, one meta-analytic study found a small effect of acute aerobic exercise on accuracy and time-dependent measures in executive function tasks, regardless of one's fitness level (Ludyga et al., 2016). Acute exercise has also been found to enhance self-control in the short-term, as evidenced by increased performance on the Stroop task

(see Chang et al., 2012 for review). This effect has been observed in adolescents (Cooper et al., 2018), adults (Chang & Etnier, 2009; Sibley et al., 2006), and older adults (Barella et al., 2010; Hyodo et al., 2012). Interestingly, meta-analytic studies (e.g., Chang et al., 2012; McMorris & Hale, 2012) actually suggest that, whereas moderate intensity exercise benefits self-control immediately after the exercise has been performed, high intensity exercise effects can last for up to one hour (Chang et al., 2012).

Acute exercise is thought to improve cognitive functioning through its impact on brain-derived neurotrophic factor (Johnston, 2009; Vaynman & Gomez-Pinilla, 2005). Neurotrophins are substances that aid in the process of neuroplasticity by signaling neurons to live, develop distinct characteristics, or increase in number in response to activity (Johnston, 2009; Vaynman & Gomez-Pinilla, 2005). Literature reviews support the idea that acute aerobic exercise increases the concentration of brain-derived neurotophic factor for a short-period of time (e.g., Knaepen et al., 2010). This may result in an increased amount of brain-derived neurotrophic factor in the bloodstream, allowing for more effective absorption, which could then initiate a series of beneficial effects on neural growth and protection.

Like acute exercise, both long-term participation in exercise (and improved physical fitness) and physical activity interventions have been found to enhance self-control and other aspects of executive function (Álvarez-Bueno et al., 2017; Archer et al., 2016; Boat & Cooper, 2019). Indeed, a recent review of randomized controlled trials found support for a relationship between moderate-to-intense activity and improvements in executive function, processing speed, and memory (Erickson et al., 2019). Intervention effects appear to be largest in children and older adults (Erickson et al., 2019; Ludyga et al. 2016; see Chen et al., 2020, for mediators of the

effect in older adults), but younger and middle-aged adults still show improvements (e.g., Cox et al., 2016).

Do the benefits of exercise on executive function seen in the general population extend to those at-risk for exercise dependence? They may not. Indeed, some common symptoms of exercise dependence—such as experiencing a lack of control over exercise, spending more time on exercise than one intends to, or continuing to exercise despite injury or negative psychological or social effects (Hausenblas & Downs, 2002)—suggest underlying problems with the ability to exert top-down (executive) control over one's behavior. In reviewing the literature in this area, I focus on studies that examined impulsivity and inhibitory control, as this literature is most directly relevant to my own research.

Recent research findings suggest that, despite exercising at high intensity, individuals with exercise dependence have more problems with impulsivity and inhibitory control than those who are not at-risk for exercise dependence. For example, two facets of impulsivity, negative urgency and sensation seeking, have been found to be positively correlated with degree of exercise dependence (Kotbagi et al., 2017). These links may suggest that individuals with exercise dependence have underlying abnormalities in the reward and inhibition systems of the brain. Consistent with this, researchers have found increased activity in reward centers (i.e., prefrontal, limbic, and striatal areas) and impaired inhibitory functioning (as reflected by lower N2 and P3 amplitudes in the orbitofrontal-dorsolateral cortices) among individuals with exercise dependence (Huang et al., 2019).

It is important to learn more about impulsivity and inhibitory control problems in individuals with exercise dependence as difficulties in these areas may not only negatively impact emotion regulation and mental health, but also increase risk for other unhealthy

behaviours. For instance, research among college students suggests that impulsivity moderates the positive relationship between physical activity and drinking (Leasure & Neighbors, 2014), and that more severe exercise dependence is associated not only with higher levels of impulsivity, but also with higher levels of binge eating, purging behaviour, and alcohol use (Ertl et al., 2022). Indeed, problems with inhibitory control/impulsivity are believed to be a feature of many (although not all) behavioral addictions (e.g., Smith et al., 2014).

The overarching goal of the current study was to contribute to the literature examining links between problems with inhibitory control and exercise dependence, risk factors for poor mental health, and mental health outcomes. In my research, I used a variant of a classic Go/No-go task to assess inhibitory control. For this reason, I begin the next section by providing some general information about this task. I then move on to discuss research examining how individuals with exercise dependence and related disorders perform on it. Finally, I discuss research demonstrating links between performance on this and related tasks and the personality, experiential, and mental health variables that are the focus of this dissertation.

Studying Inhibitory Control Using Go/No-go Tasks

In the classic Go/No-go task, participants are asked to press a key in response to one cue (the target or Go signal), and to refrain from pressing a key when presented with another cue (the distractor or No-go signal). Typically, Go trials outnumber No-go trials by a 3:1 ratio to allow for a prepotent response to develop to the Go cue. The main dependent variable is the number of false alarms on No-go trials, which provides a measure of inhibitory control. Examining accuracy (hits) and response times on Go trials can also be informative.

Researchers can use an emotional variant of the classic Go/No-go task to measure the ability to exert self-control when the demands of emotion and attentional processing overlap.

Here, targets and distractors are emotionally valenced. In a task that used expressive faces as stimuli, Hare and colleagues (2005) found that adults responded more slowly to fearful than to happy or neutral targets on Go trials and made more false alarms to happy vs. angry distractor faces. By comparison, Cohen-Gilbert et al. (2014) found that, whereas adolescents (12-15 years), emerging adults (18-25 years), and adults (26-46 years) responded more slowly on Go trials cued by threat, they showed decreased accuracy (fewer hits and more false alarms) when either the Go or the No-go cue was a threatening (vs. happy) face. Although accuracy was relatively high among all three age groups on Go trials, there was age-related improvement in accuracy (i.e., a reduction in false alarms) on No-go trials. Together, these results suggest that the emotional valence of stimuli can influence behavioural approach/avoidance tendencies, but that inhibitory control improves from adolescence to adulthood.

Links Between Go/No-go Task Performance and Exercise Dependence or Related Disorders

Several recent studies examining links between exercise and inhibitory control have incorporated exercise-related images in Go/No-go tasks. Such images can carry emotional valence for some viewers; for example, in one study such images were found to promote stronger positive feelings in frequent (vs. infrequent) exercisers (Brand & Ulrich, 2019). In an ERP study utilizing an exercise related Go/No-go task, both exercise avoiders and individuals with exercise dependence exhibited impaired accuracy compared to regular exercisers (Huang et al., 2019). Neural responses to exercise-related images (i.e., N2 and P3 amplitudes) were larger in both regular exercisers and those with exercise dependence than in exercise avoiders; they were also related to accuracy on No-go trials. Individuals with exercise dependence also scored high on a measure of neuroticism. The results supported the view that exercise dependence is associated with overactivation of the reward system and difficulties with inhibitory control. This is

consistent with other work showing that adults who have a strong motivational drive for reward exhibit faster response times on Go trials and make more false alarms on No-go trials when appetitive cues (signaling reward) are presented (Freeman & Aron, 2016).

In another study, images of sedentary individuals and individuals exercising were used as stimuli in separate blocks of a Go/No-go task (Kullmann et al., 2014). Women with anorexia nervosa and athletes displayed increased activity in the somatosensory cortex on Go trials cued by exercise-related images, compared to non-athletes. Interestingly, women with anorexia nervosa also made more false alarms to exercise-related (vs. sedentary) stimuli, suggesting that these stimuli placed increased demands on their inhibitory control resources. This might explain why they were more likely to exercise to excess than nonathletes. It is possible that these individuals were at particular risk for secondary exercise dependence; indeed, we have previously shown that rates of disordered eating, cognitive alexithymia, and severe depressive symptomology are much higher in individuals with this subtype of exercise dependence than in those exhibiting primary exercise dependence (Van Landeghem et al., 2019).

Importantly, both the Huang et al. (2019) and Kullmann et al. (2014) studies had relatively small sample sizes (N = 15-18). Furthermore, neither study assessed whether those with and without exercise dependence rated the emotional valence of the exercise-related images in the same way. As such, it would be interesting to examine performance on an emotional Go/No-go task that incorporates stimuli with more obvious positive, negative, or neutral valence.

Links Between Go/No-go Task Performance and Personality/Experiential Variables Linked to Poor Mental Health

Alexithymia has been associated with deficits in executive functioning, as evidenced by: decreased performance on the Wisconsin Card Sorting task (Zhu, 2006); worse scores on the

Behavior Rating Inventory of Executive Function-Adult Version (Koven & Thomas, 2010); and increased false alarms on Go/No-go tasks (e.g., Gökçen et al., 2016). In one study, individuals reporting more symptoms of alexithymia performed the same on an emotional Go/No-go task as those with fewer symptoms; however, at the neural level, alexithymic participants exhibited a larger P3 amplitude on trials in which negatively valenced stimuli were presented (Zhang et al., 2012). As the P3 component has been linked with response inhibition (e.g., Smith et al., 2006) these findings suggest that individuals with alexithymia may have difficulty regulating their behaviour in emotionally charged situations. More recently, Lvers et al. (2021) found that alexithymia fully mediated the link between rash impulsiveness and symptoms of exercise dependence among a mixed-sex, physically active sample.

One of the core features of SPS is showing strong behavioural inhibition in new situations (Aron & Aron, 1997), or "pausing before acting." Consistent with this, in a recent behavioural study, SPS predicted inhibitory control speed on the emotional (but not classic) version of an antisaccade task, after controlling for mood (Hoffmann et al., 2022). However, the relationship between inhibitory control and SPS appears to be complex; thus, in another recent study, links between self-reported behavioral inhibition and SPS were found to be moderated by attachment avoidance and mediated by attachment anxiety (Şengül-İnal et al., 2018). Moreover, the findings from several studies raise the possibility that perceptual load (Pacheco-Unguetti et al., 2012) or the tendency to engage in mind wandering (Maillet et al., 2020) might explain some of variance in performance on emotional GNG tasks explained by SPS.

There is a dearth of work examining links between AS and performance on emotional Go/No-go tasks. However, results from one study examining inhibitory control and AS using

homographs suggested that individuals with AS may be less able to inhibit responses to threatening cues (Amir & Beard, 2004).

In general, it appears that a history of childhood abuse is also related to poorer inhibitory control. For example, one study found that college women with a history of repeated childhood sexual abuse had poorer inhibitory control on a Go/No-go/Stop task compared to healthy controls (Navalta et al., 2006). Similarly, among a sample of male and female undergraduate students, response times to Neutral face Go stimuli in a Go/No-go task mediated the link between childhood emotional neglect and adaptation to college, such that individuals who experienced more childhood neglect responded more quickly to neutral faces, and quick responding predicted poorer adaptation to college (Welsh et al., 2017).

Childhood maltreatment could increase sensitivity to stressful situations by altering the functioning of brain regions responsible for stress and emotion regulation. Indeed, previous research has indicated that childhood trauma might have extensive impacts on the neural circuits involved in inhibitory control, stress processing, and anxiety (Elsey et al., 2015). More recently, research suggests that childhood trauma impacts inhibitory control through decreased activation of the anterior cingulate cortex (which plays an important role in both stress and inhibitory control) during times of stress (Zhai et al., 2019). Finally, a systematic review and meta-analysis suggested that childhood adversity was linked with inhibitory control (Hedges $g = -0.39$; 95% CI, −0.50 to −0.29; Johnson et al., 2021). However, the pooled estimates showed significant heterogeneity and there was evidence of publication bias. Meta-analytic results from this study also suggested that the effects are larger for those who experience deprivation (e.g., emotional neglect; food insecurity) vs. threat (e.g., emotional abuse).

Links Between Go/No-go Task Performance and Mental Health Outcomes

Adults with (vs. without) major depressive disorder have been found to respond slower to positively valenced targets in an emotional Go/No-go task (Erickson et al., 2005; Murphy et al., 1999); this may account for the negativity bias they show in a range of cognitive tasks (Colich et al., 2016). Others have reported that depressed individuals exhibit problems inhibiting the processing of negative distractors (Joormann, 2004; Joormann et al., 2007). Neurological studies suggest that abnormal activity in the frontal executive control networks may contribute to this effect (e.g., Elliott et al., 2002).

Emotional Go/No-go tasks have also been used to study links between inhibitory control and anxiety. Cognitive models of anxiety suggest that anxious individuals have an attentional bias towards threat (e.g., Beck et al., 1985). Consistent with this, research suggests that female adolescents with anxiety respond more slowly to neutral target faces when they are presented with angry distractors compared to happy distractors, whereas non-anxious female adolescents show the opposite effect (Waters & Valvoi, 2009). Male adolescents in this study showed the same pattern as non-anxious females, regardless of anxiety levels, which the authors attributed to the fact that they reported less severe anxiety overall. The authors concluded that the presence of threatening distractors can interfere with attention in anxious individuals.

Greif and Waring (2018) used a similar task with university students who reported varying levels of anxiety and depression. The young adults in this study were better able to inhibit responses to threatening faces on No-go trials if the Go cue was a neutral (vs. a happy) face. In addition, response times on Go trials were faster when the Go cue was paired with a neutral (vs. a valenced) distractor. These authors posited that the *cognitive load of emotional valence contrast* can impact the effect of threatening stimuli on performance. They suggested

that test blocks that include highly contrasting Go and No-go trials produce more conflict, and require more cognitive resources to process, than low contrast blocks. This suggests that it may be important to consider cognitive load of valence contrast when employing emotional Go/No-go tasks to study inhibitory control. Interestingly, Greif and Waring (2018) also found that feelings of anxious arousal predicted more false alarms to threatening distractors in blocks with neutral targets; that symptoms of depression predicted more false alarms in blocks that included threatening and neutral stimuli; and that greater self-reported emotional suppression predicted slower response times in high-contrast blocks featuring threatening targets and happy distractors.

Study Goals and Hypotheses

The literature reviewed above suggests that one's ability to exert inhibitory control may vary as a function of valence contrast between Go and No-go cues, and that it may be linked to both exercise dependence and personality/experiential variables that are considered risk factors for poor mental health, and to mental health outcomes. The primary goal of the proposed research was to test these predictions using an emotional Go/No-go task. As this study was a follow-up to Study 3.1, I maintained a focus on females.

My task was modeled after that used by Greif and Waring (2018). Like those authors, I expected to find that performance would generally be worst on trials in which the valence contrast between targets and distractors was large; this prediction was tested using Friedman's tests. However, I also expected to find that the ability to regulate responses to expressive faces would be related to one or more of the following: exercise dependence, alexithymia, SPS, AS, COVID-19 impacts, and exposure to childhood emotional abuse; this prediction was tested using a series of regressions. Finally, I set out to tease apart the unique contribution that task performance might make to the prediction of anxiety and/or depression in females, when holding

the effects of personality and experiential variables and self-reported exercise dependence symptom severity constant. I predicted that problems with inhibitory control (reflected primarily in a higher overall rate of false alarms) would account for unique variance in mental health outcomes. Learning more about this might help inform methods used in the identification and/or treatment of females suffering from mental health problems.

Method

Participants

Participants who completed the research described in Chapter 2, and who agreed to be contacted regarding a follow-up study, were invited to participate in the current study. After exclusions (see below), the final sample included 168 females. Their mean age was 19.7 years (*SD* = 3.2; range 16-34). The majority of participants were Canadian citizens (83.3%). Almost half identified as white/European (45.2%), about a third identified as Filipino or Asian/Southeast Asian (29.2%), 9.5% identified as Black, and 6.0% identified as Indigenous/Métis. Data for this study were collected between March 4 and April 20, 2021, which coincided with a period between the first and second waves of the COVID-19 pandemic in Canada, when daily case counts ranged from 0–178 (https://github.com/CSSEGISandData/COVID-19).

Procedures

As part of the present investigation, participants first completed an emotional Go/No-go task (described below). Following this, they supplied information about whether they had exercised that day, to allow for assessment of any acute effects related to exercise. Although subjects had consented to the re-use of data collected from them in the original study regarding stable personality traits and history of childhood emotional abuse, the two DASS-21 subscales were re-administered during the follow-up study in order to obtain current measures of

depression and anxiety. The Conscientious Responders Scale was also re-administered and used to identify and exclude participants who did not appear to be responding carefully. Participants also completed several other measures used in a separate investigation (see Chapter 4).

Data collection was carried out on-line, using the survey platform Qualtrics (for the self-report measures) and the Pavlovia platform (for the GNG task). Due to COVID-19 restrictions, participants completed this study independently at a time and place of their choosing. All procedures were approved by the Psychology/Sociology Research Ethics Board at the University of Manitoba. Participants gave informed consent and were compensated by receiving credit toward a course requirement.

Measures

Full descriptions of the self-report measures used in the present study, which included the demographics questionnaire, the depression and anxiety subscales of the DASS-21, the TAS-20, the HSPS, the ASI-3, the mCIS, the emotional abuse subscale of the CTQ-SF, the Conscientious Responders Scale, and the EAI are provided on pages 36-41 and page 64.

Emotional Go/No-go Task

Stimuli used in the emotional Go/No-go task were obtained from the Umeå face stimulus set (Samuelsson et al., 2012) and included images of six females and six males, each displaying angry (A), happy (H), and neutral (N) expressions. The stimuli were selected based on the age and race of the person depicted, and the published hit rate for expression categorization. First, I selected images of young adults (< 30 years; M = 25.5 years for both females and males), as their ages would be similar to those of the university students who completed the present study. Second, as the majority of young adults depicted in the Umeå set were Caucasian, I eliminated images of non-Caucasians. Finally, I only included images of people for whom

participants in a prior study (Samuelsson et al., 2012) had achieved a hit rate ≥ 94% for recognition of each of the three target emotions (*M* = 96.7% correct for expressions of both female and male faces).

The task was modeled after Greif and Waring (2018). Participants were asked to press a key in response to a specified facial expression (the target) and inhibit responding (i.e., not press a key) when shown any other facial expression (the distractor). The task was run in six blocks, which included the following target/distractor pairs: A/N, A/H, N/A, N/H, H/A, and H/N. Trial order within a given block was fixed, with the stipulation that each No-Go trial was preceded by either one, three, or five Go trials. The block order was randomized across participants. Within each block, participants were presented with 36 targets and 12 distractors. All face stimuli were normalized for size and presented in grayscale on a black background in the center of the screen. Faces appeared for 500 ms with a variable inter-stimulus fixation cross lasting 1–2.5 s. The task was programmed in PsychoPy 3.0 (Open Science Tools Ltd.).

Data Cleaning

A total of 345 individuals agreed to complete the follow-up study. Note that this included a number of individuals who had been excluded from the research described in Study 3.1 due to inconsistencies in their IPAQ responses; as the IPAQ was not used in the present investigation this was not grounds for exclusion. Participants were asked to provide their last name and email address to increase the validity of responses (Meade & Craig, 2012) and so that the researchers could assign course credit and identify and remove duplicate entries. A total of 28 duplicate entries were identified and removed, with only the first entry being retained. Three participants were excluded because they failed to correctly answer three or more items on the 5-item Conscientious Responders Scale (Marjanovic et al., 2014). I next excluded two participants who

failed to correctly complete a questionnaire and one whose completion time fell at the 99th percentile. I was also unable to match 14 respondents with data from the original study, and thus excluded them. In addition to the above, because the current study was focused on females, I excluded 67 males and one participant who did not specify their sex.

Some additional exclusions were made after examining participants' performance on the experimental task. Although research suggests that experimental results from studies conducted online during the pandemic are generalizable, there is also some evidence to suggest that inattentiveness has been a source of concern in these studies (Peyton et al., 2022). As such, I checked carefully for evidence of four response patterns suggestive of inattentiveness or poor effort. Specifically, I looked for evidence that participants: 1) may have reversed the response keys, as evidenced by scoring 3 or less on Go trials (≤ 8.3% accuracy) and 11 or more on No-go trials (≥ 91.7% FAs); 2) were non-responders, as evidenced by scoring 3 or less on Go trials (≤ 8.3% accuracy) and 1 or less on No-go trials (≤ 8.3% FAs); 3) were responding indiscriminately, as evidenced by scoring 33 or more on Go trials (≥ 91.7% accuracy) and scoring 11 or more on No-go trials (≥ 91.7% FAs); or 4) were responding at or below chance levels (50% correct) on Go trials. Based on these criteria, 10 individuals suspected of reversing the response keys, 11 non-responders, 12 indiscriminate responders, and 28 chance-level responders were excluded. After all exclusions, I was left with a final sample of 168 females, 25 of whom (14.9%) scored above the cut-off for being considered at-risk for exercise dependence described in Study 3.1.

Across the subscales of the DASS-21 administered in the current study, there were between 0.0% and 0.7% missing data. Using Little's MCAR test, data were found to be missing completely at random, $p \geq .11$. Expectation Maximization was used to estimate missing data values. Based on current responses, the internal consistency of the DASS-21 depression scale (α

= .91) fell in the excellent range, and the internal consistency of the DASS-21 anxiety scale (α = .82) fell in the good range.

Results

Performance on the Go/No-go Task

My hypothesis was that performance on this task would be worse when valence contrast between targets and distractors was large. Because hits (accuracy on Go trials) were not normally distributed, I tested this by submitting false alarms on No-go trials, hits, and median response times on correct Go trials in the six test blocks to separate Friedman's tests.

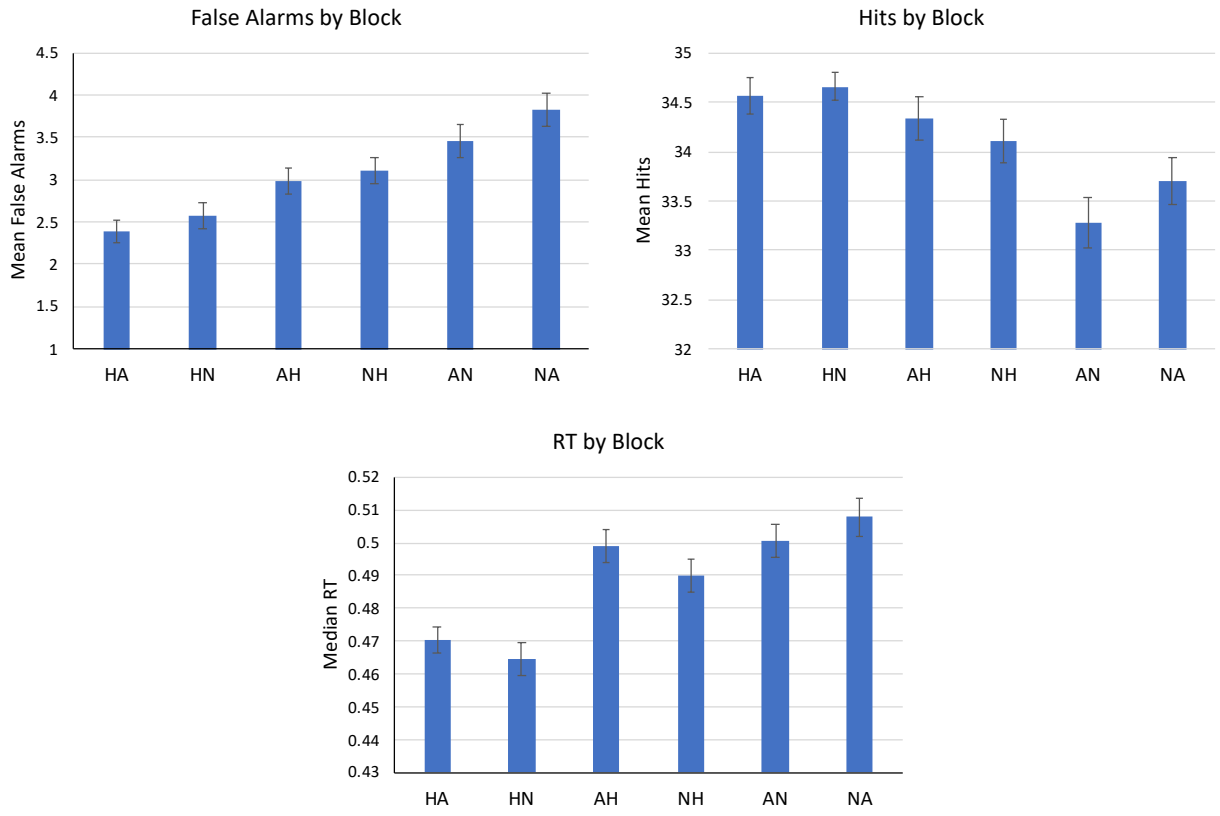
There was a significant difference in the number of false alarms made across blocks, $\chi^2(5) = 73.00$, $p = <.001$ (see Figure 3.2). Pairwise comparisons using the Bonferroni correction for multiple tests suggested that: (a) the H/A block had significantly fewer false alarms than the N/H, A/N, and N/A blocks; (b) the H/N block had significantly fewer false alarms than the A/N, and N/A blocks; and (c) there were significantly fewer false alarms in the A/H and N/H blocks than in the N/A block. (All contrasts, $p < .011$).

There was also a significant difference between blocks in accuracy (hits) on Go trials, $\chi^2(5) = 43.98$, $p < .001$. The pattern seen was essentially the reverse of that seen with false alarms (see Figure 3.2). Thus, the H/A, H/N, and A/H blocks all had more hits than either the A/N or the N/A block. There were also more hits in the N/H block than in the A/N block. (All contrasts, $p < .048$).

Finally, the median response times on Go trials significantly differed between blocks, $\chi^2(5) = 195.29$, $p < .001$. Here, correct responses on Go trials in both the H/N and H/A blocks were significantly faster than those in the A/H, N/H, A/N, and N/A blocks; and responses on Go

trials in the N/H block were faster than those in the A/N and N/A blocks (all contrasts, $p < .036$; see Figure 3.2).

Figure 3.2
Performance on the Go/No-go task in the Full Sample as a Function of Test Block



Note. HA = happy/angry; HN = happy/neutral; AH = angry/happy; NH = neutral/happy; AN = angry/neutral; NA = neutral/angry; RT = response time. Error bars represent SE.

In summary, performance in the four low contrast blocks (H/N, N/H, A/N, N/A) was worse when angry targets were paired with neutral distractors or vice versa. Performance was generally better, and similar, in the two high contrast blocks (H/A and A/H). Contrary to expectations, there were no marked differences between low and high contrast blocks (i.e., no

valence contrast effects) when the target was happy (H/A vs. H/N) or the distractor was happy (A/H vs. N/H). There was also no valence contrast effect when the target was angry (A/H vs. A/N). However, when the distractor was angry, performance was much worse in the low contrast (N/A) compared to the high contrast (H/A) block; indeed, these were the two most divergent conditions.

Because acute exercise has been shown to impact accuracy and time-dependent measures in executive function tasks (Ludyga et al., 2016), I wanted to ensure that recent exercise was not creating a confound in these analyses. Fewer than 20% of the sample (n = 33) reported having exercised already on the day they did the Go/No-go task. Mann Whitney U tests were run to examine whether differences in task performance were evident between those who had exercised and those who had not, using a Bonferroni correction to control for Type 1 error. No significant group differences were seen on any of the three measures across the six test blocks, or on average scores. Thus, there was no evidence that acute exercise might have confounded the results.

Prediction of Task Performance

Given that the residuals were not normally distributed for the regression model predicting hits, I adopted a robust technique for all analyses for consistency. Thus, I ran separate bootstrapped regression models predicting false alarms, median correct response times on Go trials, and hits, averaged across all six blocks. The TAS-20, HSPS, ASI-3, CTQ-SF, mCIS, and EAI were entered as predictors. I ran 1000 bootstrapped samples, and examined bias corrected and accelerated 95% confidence intervals to identify significant predictors. Childhood emotional abuse and exercise dependence positively predicted the average number of false alarms; the

perceived impact of COVID-19 positively predicted median response times on Go trials; and AS positively predicted the number of hits (see Table 3.2).

Table 3.2

Predictors of Task Performance in Females

Outcome Variable	Predictor	B	Bias	SE	BCa 95% CI	
					Lower	Upper
False Alarms	(Constant)	2.10	0.03	4.76	-7.40	11.83
	TAS-20	0.02	0.00	0.07	-0.14	0.16
	HSPS	1.74	-0.04	1.09	-0.37	3.71
	ASI-3	0.02	0.00	0.07	-0.13	0.17
	CTQ-SF	**0.32**	**0.00**	**0.12**	**0.05**	**0.58**
	mCIS	-0.23	0.01	0.19	-0.60	0.18
	EAI	**0.32**	**0.00**	**0.16**	**0.01**	**0.64**
RT Go Trials	(Constant)	0.501	0.000	0.032	0.437	0.569
	TAS-20	0.000	-1.25E-05	0.000	-0.001	0.001
	HSPS	-0.001	0.000	0.008	-0.016	0.015
	ASI-3	0.000	-6.54E-06	0.000	-0.001	0.000
	CTQ-SF	-0.001	9.45E-06	0.001	-0.003	0.000
	mCIS	**0.003**	**0.000**	**0.001**	**0.001**	**0.005**
	EAI	-0.002	-1.82E-05	0.001	-0.004	0.000
Hit Go Trials	(Constant)	35.15	0.00	1.02	33.34	37.21
	TAS-20	-0.01	0.00	0.01	-0.03	0.02
	HSPS	-0.24	-0.01	0.22	-0.70	0.15
	ASI-3	**0.02**	**0.00**	**0.01**	**0.01**	**0.05**
	CTQ-SF	0.03	0.00	0.02	-0.02	0.08
	mCIS	-0.03	0.00	0.04	-0.11	0.04
	EAI	-0.02	0.00	0.03	-0.07	0.04

Note. Significant predictors shown in bold. Bias corrected and accelerated 95% confidence intervals (BCa 95% CIs) for parameter estimates are based on 1000 bootstrap samples. Predictors include the total scores on the Toronto Alexithymia Scale (TAS-20); Highly Sensitive Person Scale (HSPS); Anxiety Sensitivity Index (ASI-3); Emotional Abuse subscale of the Childhood Trauma Questionnaire-Short Form (CTQ-SF); modified Coronavirus Impact Scale (mCIS); and Exercise Addiction Inventory (EAI). RT = response time.

Does Self Control Account for Unique Variance in Mental Health?

Finally, using the same bootstrapping approach, I ran two multiple regressions to determine if self control as assessed in the Go/No-go task accounted for unique variance in

anxiety or depression when alexithymia, SPS, AS, childhood emotional abuse, symptoms of exercise dependence, and impacts of the COVID-19 pandemic were held constant. Alexithymia, AS, and childhood abuse positively predicted depression; and AS, emotional abuse, and both false alarms and response times on Go trials positively predicted anxiety (see Table 3.3).

Table 3.3

Predictors of Mental Health in Females

Outcome Variable	Predictor	B	Bias	SE	BCa 95% CI	
					Lower	Upper
Depression	(Constant)	-30.45	2.24	20.87	-71.05	20.93
	TAS-20	**0.25**	**-0.01**	**0.07**	**0.13**	**0.36**
	HSPS	1.02	-0.04	1.15	-1.15	3.16
	ASI-3	**0.14**	**0.00**	**0.06**	**0.03**	**0.28**
	CTQ-SF	**0.52**	**0.01**	**0.15**	**0.24**	**0.84**
	mCIS	0.27	0.00	0.21	-0.13	0.71
	EAI	-0.23	-0.01	0.16	-0.54	0.05
	False Alarms	-0.03	0.00	0.09	-0.22	0.15
	RT Go Trials	20.96	-1.15	16.67	-12.37	48.34
	Hits Go Trials	0.28	-0.03	0.41	-0.56	0.98
Anxiety	(Constant)	-55.65	-0.16	15.44	-84.47	-25.13
	TAS-20	0.09	0.00	0.06	-0.05	0.20
	HSPS	0.93	-0.02	1.10	-1.40	3.00
	ASI-3	**0.17**	**0.00**	**0.06**	**0.05**	**0.29**
	CTQ-SF	**0.51**	**0.00**	**0.13**	**0.25**	**0.76**
	mCIS	0.14	0.00	0.21	-0.26	0.59
	EAI	0.26	0.00	0.14	-0.01	0.54
	False Alarms	**0.15**	**0.00**	**0.06**	**0.03**	**0.28**
	RT Go Trials	**39.20**	**0.24**	**11.77**	**16.50**	**63.24**
	Hits Go Trials	0.64	0.01	0.32	-0.03	1.29

Note. Significant predictors shown in bold. Bias corrected and accelerated 95% confidence intervals (BCa 95% CIs) for parameter estimates are based on 1000 bootstrap samples. Predictors include the total scores on the Toronto Alexithymia Scale (TAS-20); Highly Sensitive Person Scale (HSPS); Anxiety Sensitivity Index (ASI-3); Emotional Abuse subscale of the Childhood Trauma Questionnaire short form (CTQ-SF); modified Coronavirus Impact Scale (mCIS); Exercise Addiction Inventory (EAI); and average scores for false alarms on No-go trials, median correct response times (RT) on Go trials, and hits on Go trials across the six test blocks.

Discussion

The first goal of the current study was to test whether, in females, I would find support for Greif and Waring's (2018) theory that valence contrast between Go and No-go cues would be an important determinant of the ability to exert inhibitory control in an emotional Go/No-go task. Results revealed significant differences between blocks on false alarms, hits, and response times on Go trials. Performance was best on blocks where there was a happy target (regardless of the valence of the distractor) and worst on blocks in which an angry target was paired with a neutral distractor or vice versa. The quick responses made on Go trials seen when the Go cue was a happy face is consistent with past work which suggests that individuals respond more quickly to positively than negatively valenced and/or neutral targets (e.g., Albert et al., 2010; Hare et al., 2005; Tottenham et al., 2011). However, the fact that false alarms were most frequent in the N/A and A/N blocks is inconsistent with past work suggesting that individuals generally make more false alarms to happy (vs. negative and/or neutral) distractors (e.g., Hare et al., 2005; Tottenham et al., 2011). Finally, past work has suggested that greater contrast between the valence of targets and distractors negatively impacts task performance (Greif & Waring, 2018). In contrast, my results suggested that participants generally performed better in high contrast blocks (H/A or A/H) than in low contrast blocks.

It is possible that the discrepancies between the current findings and those reported in by Greif and Waring (2018) could, in part, reflect differences in the stimuli. For example, these authors selected faces from different racial groups (Asian, Black, and Caucasian) whereas I only selected Caucasian faces. Given that some work suggests that race and ethnicity may impact processing of emotional faces (Kawakami et al., 2017), future work could examine how the race of the participants and/or the stimulus faces impact task performance. However, a more likely

explanation for the pattern of results that I observed relates to the fact that many of my participants reported moderate-to-severe symptoms of anxiety and depression, as individuals reporting high levels of these symptoms appear to perform particularly poorly in blocks that involve neutral and threatening stimuli (see below). Regardless, the pattern of responses that I observed clearly show that emotion processing does impact viewers' ability to control their responses to face stimuli. Specifically, I found that it was generally more difficult for people to regulate their responses to negatively than positively valenced stimuli, whether those stimuli appeared as targets or distractors.

Another goal of the current study was to examine whether symptoms of exercise dependence or other personality/experiential variables associated with atypicalities in emotional awareness and regulation predicted females' performance on the emotional Go/No-go task. Regarding links to symptoms of exercise dependence, I found that females with higher EAI scores made more false alarms than females with lower EAI scores. This extends past work in which exercise dependence was related to poorer performance on an exercise related Go/No-go task (Huang et al., 2019) by suggesting that females at risk for exercise dependence may have difficulty controlling their responses in emotional contexts generally (as opposed to those specifically related to exercise). Future work could examine whether this relationship also holds in males. This would be important, given past work suggesting that females perform better than males on facial expression processing tasks generally (McClure, 2000), and on emotional Go/No-go tasks more specifically (e.g., Tottenham et al., 2011).

It is important to note that data from the Go/No-go task was capturing motor impulsivity, which impacts one's capacity for response inhibition or action cancelation (Morris & Voon, 2016). It would be interesting to examine links between exercise dependence and other aspects

of impulsivity, such as decisional impulsivity (the tendency to make impulsive choices) or waiting impulsivity (the tendency to make disadvantageous premature responses), which are thought to involve different neural systems and may present differently across disorders (Dalley et al., 2011).

It would also be interesting to see whether individuals displaying different subtypes of exercise dependence perform differently on the task. We have previously argued that secondary exercise dependence is associated with eating disorder symptomology (Van Landeghem et al., 2019). Given that Kullmann et al. (2014) reported that women with anorexia nervosa made more false alarms to exercise-related images than to images of sedentary people, it might be the case that problems with inhibitory control are more common in females with secondary exercise dependence than in those with primary exercise dependence. In fact, Bamber and colleagues (2000) found that those with secondary (but not primary) exercise dependence reported higher levels of impulsiveness than controls. This might explain why Van Landeghem et al. (2019) also found that individuals with secondary exercise dependence were more likely than those with primary exercise dependence to exercise more than they intended to (intention effects) and to continue to exercise even when it created physical, psychological, and/or interpersonal problems (continuation effects). These symptoms of exercise dependence may arise, in part, from problems with impulsivity and inhibitory control.

My analyses also revealed that those reporting more COVID-19 impacts responded more slowly on Go trials, and that those reporting stronger symptoms of AS made more hits on Go trials, when controlling for other potentially relevant variables. Perhaps surprisingly, however, alexithymia and SPS did not significantly predict task performance. It is possible that links with these two variables might have been observed if we had used neural rather than behavioural

measures. For example, past work has found abnormalities in neural activity indicative of inhibitory control problems in those with alexithymia during performance of an emotional Go/No-go task (Zhang et al., 2012). It is also possible, however, that links between inhibitory control problems and these variables that were observed in past studies—particularly regarding the ability to regulate responses to negatively valenced stimuli—reflect the fact that alexithymia (Khan & Jaffee, 2022) and poor outcomes in those with SPS (e.g., Aron et al., 2012) are both associated with childhood abuse/adversity. In the present study, I found that greater exposure to childhood emotional abuse predicted more false alarms on No-go trials, which is consistent with past reports that adverse childhood experiences negatively impact inhibitory control (e.g., Navalta et al., 2006; Welsh et al., 2017). This may be partly due to the negative impact of stress in early life on the development of the prefrontal cortex (e.g., McEwen, 2008), which mediates executive functioning (Kane & Engle, 2002). This speaks to the importance of accounting for adverse childhood experiences such as emotional abuse in studies of this kind.

A final goal of the present study was to determine whether task performance contributed to the prediction of mental health when variance from the personality and experiential variables and exercise dependence were controlled for. Interestingly, task performance accounted for unique variance in prediction of anxiety. Specifically, committing more false alarms and making slower responses on Go trials both predicted greater self-reported anxiety. Others have suggested that the problems anxious females experience in emotional Go/No-go tasks may be most apparent when neutral targets are paired with threatening distractors. Thus, Waters and Valvoi (2009) found that anxious females had slower response times to neutral faces paired with an angry than a happy distractor (whereas non-anxious females showed the opposite effect), and Greif and Waring (2018) found that anxious arousal predicted more false alarms to threatening

distractors in blocks with neutral targets. Of course, the N/A block proved to be one of the most challenging in the present study, although not more so than the A/N block. Greif and Waring (2018) suggested that individuals with high levels of anxiety may be more prone to a negativity bias, mistaking neutral stimuli for threatening stimuli. This could contribute both to slower response times on Go trials in N/A than H/A blocks, and to a high number of false alarms in A/N blocks. It might also make it easier for them to distinguish happy faces from both neutral and angry ones, which should lead to better performance in blocks involving happy targets or distractors. Thus, it is possible that a negativity bias might cause anxious individuals to show a pattern of responses across blocks that is an exaggerated version of the pattern seen in my sample, as a whole.

Interestingly, task performance did not improve prediction of depression. Past work does suggest a link between major depression and reponse times on Go trials (Erickson et al., 2005; Murphy et al., 1999); specifically, individuals with higher levels of depression have previously been found to respond more quickly to negatively valenced stimuli and more slowly to positively valenced stimuli. It has also been reported that depressed individuals have particular difficulty inhibiting the processing of negative distractors (Joormann, 2004; Joormann et al., 2007), and make more false alarms in blocks that include threatening and neutral stimuli (Greif & Waring, 2018). These links may have been obscured in the present study because I examined median response time averaged across blocks. Of course, I also held a range of other potentially relevant variables constant while assessing variance accounted for by task performance, whereas other authors have not.

Limitations

A limitation of the present study is that, due to COVID-19 protocols, participants completed the GNG task at home rather than in a lab; as noted earlier, this may have impacted some participants' attention/concentration. However, I did carefully screen for response patterns indicative of these problems. Moreover, there is research arguing that experimental data collected during the pandemic is valid, even if greater inattentiveness in participants may lead to smaller effect sizes (Peyton et al., 2022). Nonetheless, although the trends observed in the cleaned data collected here were clearly interpretable and interesting, replication in a sample tested in-person would increase confidence in the findings.

In addition to the above, the facts that the screening tool I used to assess exercise dependence was very brief and that I did not include a measure of disordered eating limited some of the conclusions I could draw. Expanding the assessment of exercise dependence and associated problems would be useful if one were to undertake subtyping research. Such research is important as it will expand our understanding of the personality and mental health profiles of those with primary vs. secondary exercise dependence, and how group membership might relate to executive functioning skills.

Conclusions

The fact that symptoms of exercise dependence predicted performance on the emotional Go/No-go task supports the view that problems with inhibitory control may be an important factor to consider when treating individuals with exercise dependence —perhaps, in particular, secondary exercise dependence. As such, it will be important in future work to replicate the presence of exercise dependence subtypes and identify their distinguishing features, as this may have important implications for diagnostic and intervention practices.

The present results also suggest that it would be beneficial to incorporate screening for childhood emotional abuse and AS in mental health assessments, as these were consistently implicated in female mental health outcomes, both in Study 3.1 and in the present investigation. It will also be important in future work to recruit a large sample of males to allow for an examination of relationships between the current study variables in this population. This seems to be particularly important, given the sex differences I observed in the research described in Chapter 2, and research suggesting that males and females show different exercise dependence symptom profiles (e.g., Weik & Hale, 2009).

Taken together, the results of Study 3.2 extend those presented in Chapter 2 by suggesting that, in addition to AS, problems with inhibitory control may be a risk factor for anxiety in females. Indeed, recent work suggests that individuals with high levels of anxiety perform worse on inhibitory control tasks (Myles et al., 2020). Theoretically, the results support the view that executive functioning skills may underlie thinking styles and emotion regulation skills that lead to psychiatric symptoms (Beauchaine & Zisner, 2017; LeMoult & Gotlib, 2019). Clinically, inhibitory control training may help anxious individuals cope with their anxiety by improving their ability to inhibit and regulate worry. For instance, inhibitory control skills may help individuals utilize reappraisal by inhibiting automatic negative thoughts and encouraging more positive beliefs to emerge (Schmeichel & Tang, 2015).

CHAPTER 4: PREDICTORS OF MENTAL HEALTH IN FEMALE ATHLETES AND NON-ATHLETES DURING THE COVID-19 PANDEMIC

In 2011, the Canadian company *RiskAnalytica* prepared a report on behalf of the Mental Health Commission of Canada. At that time, they estimated that there were 4.0 million Canadians living with either a mood or anxiety disorder (approximately 11.7% of the population; Smetanin et al., 2011). The extant literature suggests that these difficulties, referred to as common mental disorders (Gouttebarge et al., 2015), are more prevalent in young adulthood compared to any other stage of life (e.g., King et al., 2008; Korten & Henderson, 2000; Krueger et al., 1998). Consistent with this, in the early 2000s the prevalence of mood and anxiety disorders in Canadian young adults (aged 15-24 years) was estimated at 18.6%, which was considerably higher than the rates of 12.2% in adults aged 25-44, 8.8% in adults aged 45-64, and 3.4% in adults aged 65 and over (Government of Canada, 2006). Evidence suggests that problems with depression and anxiety have increased slightly in females during the COVID-19 pandemic, but with a small effect (Sun et al., 2023).

There is a widely held belief that exercise can help to reduce feelings of depression and anxiety. Indeed, the benefits of physical activity (i.e., any bodily movement that requires energy expenditure; Caspersen et al., 1985) are well-documented in the general population. For example, a meta-review of systematic reviews on the effects of exercise interventions in individuals with elevated psychopathological symptoms suggested that exercise reduces depressive symptoms across the lifespan and is more effective than control conditions in reducing symptoms of anxiety (Ashdown-Franks et al., 2020).

Given the literature supporting an association between exercise and improvements in mood/anxiety, it was surprising that physical activity did not appear to be strongly related to

mental health in the work described in Chapter 2. One factor that may have weakened this relationship was the inclusion of competitive athletes in my original sample—particularly those competing at the elite or sub-elite level. Elite athletes have been found to show comparable (e.g., Gorczynski et al., 2017; Rice et al., 2016) or, in some cases, higher rates of psychological distress and difficulties with mood/anxiety compared to non-athletes (e.g., Purcell et al., 2020; Schaal et al., 2011). Indeed, in recent years rates of anxiety and depression were estimated to range between 29% and 47.8% in elite athletes from Holland (Gouttebarge et al., 2016), Australia (Gulliver et al., 2015), and the United Kingdom (Foskett & Longstaff, 2018). The current pandemic may have exacerbated this situation. For instance, recent reports suggest that 63.6% of elite (international, national, and state) and sub-elite (local) Australian athletes (Facer-Childs et al., 2021), and 70% of female and 40% of male Swedish elite athletes (Håkansson et al., 2020), feel that the pandemic has had a negative impact on their mood. These numbers are alarming and contradict the view that athletes represent an elite group who are unaffected by mental health difficulties (Gulliver et al., 2012; Reardon & Factor, 2010).

In light of the above, the over-arching goal of the two studies included in this chapter was to assess the unique contribution that involvement in competitive sport makes to the prediction of the mental health of female university students. Because it is possible that competitive athletes and non-athletes differ on the basis of specific personality traits and/or experiential variables linked to atypicalities in emotional awareness and emotion regulation (the focus of Study 4.1), and/or in their susceptibility to body image problems that could impact mental health (the focus of Study 4.2), I checked for group differences on these measures and then accounted for them when assessing links between competitive sport and mental health so that I could isolate sport-specific factors that might increase risk for poor outcomes.

Study 4.1: Links Between Personality/Experiential Variables and Mental Health in Female Athletes and Non-Athletes

As suggested above, a wide range of variables could increase risk for poor mental health outcomes in young adults, but some of these are unique to a sporting context. To provide background for Study 4.1, I begin by discussing research examining how athletes, or exercisers more broadly, score on a range of general factors known to be related to mental health in samples representative of the general population. I then go on to examine several factors that apply to athletes, specifically. Much of this work has involved mixed-sex samples.

General Factors

Personality Factors

Personality traits represent one set of factors that could influence mental health outcomes in athletes and non-athletes, alike. Indeed, personality is considered a key variable in health psychology, influencing things like communication with health providers, adherence to treatment, and stress and coping with illness (Ferguson, 2013). The current study focused on the three personality traits that were described in detail in Chapter 1: alexithymia, SPS, and AS. Although past research (including that described in Chapters 1-3) suggests that all three variables are important predictors of mental health, the research reviewed below also suggests that: a) athletes may score differently on these variables than non-athletes; and/or b) there are links between these variables and exercise. If athletes do score differently on these variables than non-athletes that, in itself, could explain differences in the severity of mental health problems seen in these two groups. Indeed, these variables may prove to be better predictors of mental health difficulties than involvement in competitive sport, per se. In the section that follows, I review some of the past work examining these variables in samples of athletes and non-athletes.

Alexithymia in Athletes. Literature examining alexithymia in athletes is limited, and the findings are mixed. For example, in one study (Jodat et al., 2015) student athletes scored lower than their non-athletic peers on all scales of the Farsi version of the TAS-20. In contrast, Iacolino and colleagues (2017) found that athletes scored higher than non-athletes on both the TAS-20 total score and the externally oriented thinking subscale.

The discrepancy in results between the two studies cited above may be due, in part, to differences in study populations, as athletes were much more heavily involved in sport in the Iacolino et al. (2017) study. Indeed, Allegre et al. (2007) found a relationship between the intensity of exercise swimmers engaged in and the degree to which their speech pattern displayed alexithymic traits. Specifically, they found that expert swimmers' discourse was more likely to be characterized by severe alexithymic traits (i.e., little expression of feelings and emotions, proportionately more action words, and distancing of themselves from what they experienced) than amateur swimmers' discourse. Limitations of the study include its small sample size (N = 20) and exploratory nature; however, the results suggest that elite athletes might differ from amateur athletes in at least these aspects of alexithymia. The authors suggested that alexithymia may help elite athletes deal with the extreme stress they face in highly competitive environments. Indeed, it has been suggested that emotional blunting may, in fact, give them a competitive advantage (Roberts & Woodman, 2017). However, other findings suggest that alexithymia may not be adaptive in the long run. For example, as noted in Chapter 3, Van Landeghem and colleagues (2019) found that displaying strong cognitive alexithymic traits (i.e., difficulties identifying, describing, and analyzing emotions) may put those who exercise frequently at increased risk for developing a form of exercise dependence that is associated with disordered

eating and severe depression. Further work exploring links between alexithymia and engagement in competitive sport is warranted.

SPS in Athletes. There is limited work examining SPS in an athletic population. However, prior work in the general population suggests that individuals with SPS often unconsciously withdraw from society, both physically and mentally, due to feeling over-aroused and over-stimulated (Aron & Aron, 1997). This characteristic, and the shyness, fear, and neuroticism that often accompany it, could be detrimental to sport performance (Jorm et al., 2000). Indeed, Kemler (2006) found that athletes scoring high in SPS experienced greater levels of anxiety and shame regarding competitions than athletes scoring low in SPS. These effects may spill over to negatively impact functioning in other aspects of athletes' lives.

AS and Exercise. The vast majority of research examining links between AS and physical activity has been conducted in general (i.e., non-athlete) populations and in clinical samples. The findings suggest that individuals with AS are generally motivated to avoid exercise (Farris et al., 2019; Moshier et al., 2015) and report significant barriers to exercising, including physical pain, energy loss, lack of interest and motivation, and feelings of hyperarousal (Sabourin et al., 2011). Interestingly, however, mounting research in non-athlete samples suggests that exercise can be effective in reducing AS (e.g., Broman-Fulks & Storey, 2008; Sabourin et al., 2015; Watt et al., 2008); indeed, even engaging in one brief exercise session can be beneficial (Broman-Fulks et al., 2015). Research in individuals with anxiety-related disorders suggests that resistance-training may be more effective than aerobic exercise in producing this effect (LeBouthillier & Asmundson, 2017). Reduction in AS following exercise may reflect habituation due to interoceptive exposure (e.g., Boswell et al., 2013), but recent work shows that

changes in cognitive and affective reactions to exercising, rather than changes in somatic concerns, underlie the effect (Sabourin et al., 2015).

Exercise-induced reduction in AS has been posited to contribute to reductions in anxiety, depression, and somatization symptoms (Broman-Fulks et al., 2018). It also appears to reduce trauma-related symptoms in individuals with PTSD; this effect is stronger when attention is directed away from rather than towards physical sensations, although both still result in improvements (Fetzner & Asmundson, 2014). Importantly, exercise interventions show greater efficacy in individuals scoring high (vs. low) on AS (Sabourin et al., 2015).

There has been limited work examining AS in competitive athletes. It has been shown, however, that it may predispose athletes who have sustained a head injury to focus on their concussion symptoms (Hixson et al., 2017), and increase susceptibility to breakdowns in athletic performance in high-pressure situations (Clarke et al., 2020), for example. Based on the literature cited above, one might expect some athletes to be more susceptible to these kinds of effects than others. Recall that, in the work described in Chapter 2, I found that alexithymia, SPS, and AS were positively correlated. Jakobson and Rigby (2021) suggested that young adults who score high on alexithymia and SPS, and who have good interoceptive accuracy, may be especially prone to catastrophizing (see Palser et al., 2018)—a response that exacerbates the experience of pain and other bodily sensations in those with alexithymia (Ghorbani et al., 2017) and could, potentially, increase risk for AS. It may be that highly sensitive, alexithymic athletes may be particularly anxious about signs of injury or hyperarousal that could negatively impact their training or athletic performance. Research examining these traits together, rather than individually, is needed to help us develop a more fulsome understanding of their impacts on mental health.

Early Childhood Experiences

According to a 2019 report published by the Centers for Disease Control and Prevention (Merrick et al., 2019), 60.9% of adults report having experienced at least one adverse childhood experience. I noted in Chapter 2 that childhood abuse, specifically, has been linked to alexithymia (e.g., Khan & Jaffee, 2022), SPS (e.g., Karaca Dinç et al., 2021), and AS (McLaughlin & Hatzenbuehler, 2009). However, the results presented in Chapters 2 and 3 suggest that childhood emotional abuse uniquely predicts poor mental health even when holding the aforementioned three personality variables constant.

Of course, athletes are not immune to childhood adversity or its negative impacts; however, risk of exposure in athlete samples appears to be somewhat lower than that seen in the general population (Kaier et al., 2015). Indeed, in the seminal paper by Felitti et al. (1998) described above, 52% of their general sample reported at least one adverse childhood experience. Among athletes, one study found that almost half of a sample of Australian female athletes (46.7%) and 40% of Australian male athletes reported experiencing sexual abuse in childhood (Leahy et al., 2008). Interestingly, childhood psychological abuse emerged as a more consistent predictor of posttraumatic symptoms than sexual or physical abuse in this study. In another study, 34.3% of US Division I athletes reported experiencing at least one adverse childhood experience and increased adverse childhood experiences predicted increased prescription medication use, physical health complaints, and alcohol use (Kaier et al., 2015).

Factors Specifically Related to Involvement in Sport

Discrepant results regarding the prevalence of common mental disoders in athletes may reflect differences in the population of athletes being studied (Purcell et al., 2020). Indeed, there is evidence suggesting that some groups of athletes may be more prone to mental health

difficulties than other groups. A systematic review conducted by Rice and colleagues (2016) suggested that athletes are at a greater risk of experiencing a mental disorder if they are injured, approaching retirement, or experiencing performance difficulty. Research involving current and retired elite Dutch athletes suggests that common mental disorders are more common in those reporting a higher number of past severe injuries, surgeries, and recent life events; less social support; and greater career dissatisfaction (Gouttebarge et al., 2016). Career dissatisfaction also emerged as a unique predictor of anxiety and depression in elite athletes from the UK (Foskett & Longstaff, 2018).

Participation in particular types of sports may also increase risk of mental health problems, although it is important to note that there is a self-selection confound in research in this area. With this is mind, some research suggests a higher prevalence of anxiety and depression in child and adolescent athletes (ages 6-18) who are involved in individual compared to team sports (Pluhar et al., 2019); the same has been found to be true of German elite athletes (Nixdorf et al., 2013).

Of course, athletes have also been impacted by the COVID-19 pandemic in unique ways. For instance, in addition to reporting (like non-athletes) increases in screen time and reductions in physical activity, time spent outdoors, and sleeping patterns (Facer-Childs et al., 2021), athletes have reported decreases in the number of training sessions they engage in and increases in the amount of time spent training individually vs. with a team (Facer-Childs et al., 2021; Pillay et al., 2020).

Exposure to Coaches and the Culture of Sport

An additional set of factors that undoubtedly contributes to the prevalence of common mental disorders in athletes relate to the relationship an athlete has with their coach(es). Having a

strong coach-athlete relationship is related to several positive outcomes, including improved sport performance (Jowett & Cockerill, 2003), happiness (Lafrenière et al., 2011), and a strong self-concept (Jowett and Cramer, 2010). However, a range of factors can negatively impact the coach-athlete relationship, and these factors are linked to diminished well-being in athletes (e.g., Blanchard et al., 2009; Burke, 2001; Jowett, 2003). One key factor is exposure to abusive coaching (Stirling & Kerr, 2013). In a sport environment, exposure to abusive coaching may lead to dysregulation and have not only psychological effects (e.g., low mood, anger, anxiety), but also training effects (e.g., changes in motivation or focus) and performance effects (e.g., decreased or enhanced performance) (Stirling & Kerr, 2013).

To date, research focusing on experiences of overt forms of abuse in sport, such as sexual abuse, has proliferated (e.g., Brackenridge et al., 2008; Fasting & Brackenridge, 2009; Leahy et al., 2008). This has resulted in a relative lack of information on experiences of what can be more subtle or covert forms of abuse, such as emotional abuse (Stirling; 2009; Stirling & Kerr, 2008a). In the intimate partner violence literature, emotional abuse is defined as speech or behaviour that results in inflicting "rejection, humiliation and degradation, threats and/or terrorization, exploitation and/or … isolation" (Follingstad & DeHart, 2000, p. 895). Across this literature, emotional abuse is consistently identified as "coercive" and "terroristic" (Carney & Barner, 2012, p. 289).

Schaal and colleagues (2011) reported that verbal abuse and aggression were the most common types of abuse that elite French athletes reported experiencing, with younger athletes (17 years and younger) reporting more verbal abuse than older athletes. Verbal abuse from coaches can take many forms, but the most common forms seen in youth sport include shouting, belittling, issuing threats, and humiliation (Gervis & Dunn, 2004). Other types of emotionally

abusive behaviours include things such as: throwing objects or punching walls; denying attention or support (e.g., intentionally ignoring an athlete); making offensive comments about an athlete's weight and/or body shape; or spurning, terrorizing, or isolating an athlete (Gervis et al., 2016; Stirling & Kerr, 2008b). Importantly, research suggests that individuals reporting strong symptoms of SPS may be more susceptible to the effects of these kinds of negative coaching practices than those who are less sensitive (see Kemler, 2006).

Research suggests that 22 to 25% of competitive athletes experience emotional abuse from a coach (Kirby et al., 2000). These figures may underestimate the problem, however, given that these abusive experiences—which often occur in the presence of parents and other coaches and athletes (Kerr & Stirling, 2012)—are under-reported by athletes (Stirling & Kerr, 2009). Studies by Stirling and Kerr (2009; 2014) suggest that emotionally abusive coaching patterns are often tolerated (or, indeed, normalized) within an elite sport context. This may be, in part, because the coach-athlete relationship is so highly interdependent, with the coach often playing a dominant role and the athlete taking on a more submissive role (Baker et al., 2000; Brackenridge & Fasting, 2005; Brackenridge & Fasting, 2002; Parent & Bannon, 2012; Stirling & Kerr, 2014; Stirling & Kerr, 2009; Tomlinson & Yorganci, 1997). Coaches can undermine athletes' autonomy. Indeed, a recent mixed-studies review suggests that, whereas peers have more influence over whether an athlete feels competent in a sporting environment and connected with others, coaches have a stronger impact on athlete autonomy (Chu & Zhang, 2019). Coaching behaviours that undermine an athlete's autonomy can damage the coach-athlete relationship and are linked to a variety of negative sporting experiences (Brackenridge & Fasting, 2002).

The existing literature on emotional abuse in sport has primarily used qualitative research methods (e.g., Gervis & Dunn, 2004; Stirling & Kerr, 2009, 2014). The importance of such

research in allowing for the depth and richness in athletes' stories to come out is paramount. However, quantitative research allows for a specific hypothesis to be tested and may be more generalizable due to its statistical nature.

Study Objectives and Hypotheses

The vast majority of individuals (98.8%) who took part in the research described in Chapter 2 were recruited from an undergraduate Introduction to Psychology course. As such, it was expected that the sample in that study would be fairly representative of the general university student population, with participants reporting a wide range of involvement in physical activity and/or sport. The primary focus of the work described in Chapter 2 was to compare and contrast relationships between exercise, individual difference/experiential factors, and mental health in male and female university students. The overarching goal of the research described in the current chapter, in contrast, was to subdivide the female sample along the lines of their involvement in competitive sport in order to allow me to identify sport-specific factors that may increase risk of anxiety and depression in the context of a global pandemic.

The first set of objectives for Study 4.1 were to: a) compare the personality, experiential, and mental health profiles of competitive athletes to those of individuals not involved in competitive sport (hereafter referred to as non-athletes); and b) determine whether involvement in competitive or, perhaps more specifically, in team sport is associated with a lower risk of anxiety and/or depression, and/or with a different personality profile. Because the literature comparing athletes and non-athletes on alexithymia, SPS, and AS is limited and mixed findings have been reported I did not have strong directional predictions for these variables. However, by comparing the personality profiles of athletes and non-athletes, I aimed to fill a gap in the current literature. Consistent with prior work, it was hypothesized that competitive athletes would report

somewhat lower levels of adverse childhood experiences than non-athletes (Kaier et al., 2015), but no directional predictions were made regarding COVID-19 impacts. Finally, I expected that competitive athletes would report similar or higher rates of anxiety/depression than non-athletes, overall (Nixdorf et al., 2013; Pluhar et al., 2019) and that athletes involved in team sports would have different personality profiles and report lower levels of depression and anxiety than those involved in individual sports.

As noted in Chapter 2, extant work suggests that the personality variables of interest in the current study may act as mediators between childhood emotional abuse and mental health (Karaca Dinç et al., 2021; King et al., 2020; McLaughlin & Hatzenbuehler, 2009; Yang et al., 2022). However, given that these personality variables are related to one another (see Chapter 2) and may be expressed differently in athletes and non-athletes, the second objective of this study was to tease apart the independent contributions that these variables make to the prediction of mental health. I expected that the personality variables, exposure to emotional abuse in childhood, and involvement in competitive sport would each be positive predictors of depression and anxiety.

The final objective of Study 4.1 was to evaluate the relationship between recent exposure to abusive coaching and mental health in athletes. Research of this kind is essential if we are to improve our understanding of the potentially negative impact of these behaviours (Gervis et al., 2016) and effect changes to the culture of sport (Stirling & Kerr, 2010). To explore this question, I performed supplementary analyses on the subgroup of athletes competing at high levels who reported having worked with a coach in the past two years. It was hypothesized that many of these athletes would report having been exposed to emotionally abusive coaching practices, and that such exposure would predict worse mental health.

Method

Participants

The final sample of 309 female university students who took part in the research described in Chapter 2 were subdivided into two groups on the basis of self-reported engagement in competitive sport. *Athletes* were defined as individuals who had reported having participated in competitive sport within the past two years at a minimum of a local level. Based on this criterion, the present sample included 139 competitive athletes (M_{age} = 20.1 years, *SD* = 3.5) and 170 non-athletes (M_{age} = 18.8 years, *SD* = 1.9). The competition level of the athletes varied, with 37.4% reporting competing at the local level, 31.7% at the provincial level, and 30.9% at the national or international level.

Procedures

As outlined in Chapter 2, participants completed an on-line survey via Qualtrics. After giving informed consent they completed a demographic questionnaire and self-report measures tapping into: alexithymia (the TAS-20), SPS (the HSPS), and AS (the ASI-3); symptoms of depression and anxiety (DASS-21 subscales); the impact of COVID-19 on their lives (mCIS); physical activity levels (IPAQ); early childhood emotional abuse (CTQ-SF); and conscientious responding (Conscientious Responders Scale). Descriptions of these measures were provided in Chapter 2 and will not be repeated here. In addition to the above, where applicable participants provided information regarding their involvement in sport and their history of emotional abuse experienced from a coach in the past two years. Descriptions of the measures used to collect these data, which were unique to the current study, are provided below. Participants gave informed consent and were compensated by receiving credit toward a research participation

option or a small honorarium. All procedures were approved by the Psychology/Sociology Research Ethics Board at the University of Manitoba.

Measures Unique to the Current Study

Sports Involvement of Athletes

Modelling multiple studies conducted with an athletic population (e.g., Foskett & Longstaff, 2018; Gouttebarge et al., 2016), in addition to reporting their age, sex, race, and citizenship, I asked competitive athletes to identify their primary sport type (i.e., athletics, basketball, etc.), the highest level of competition they had taken part in (i.e., recreational, high school varsity, university varsity, provincial, national, international), and whether they had worked with an athletic coach in the past two years.

Coach-Athlete Relationship Emotional Maltreatment Scale (CAREMS)

The CAREMS (Dietz et al., 2016) measures how frequently athletes have experienced emotionally abusive behaviors from a coach. Participants rated how often they had experienced a given behaviour from a coach for each of 19 items using a 5-point Likert scale ranging from 1 (*never experienced this*) to 5 (*always experienced this*). Items belong to one of five subscales that tap into five types of emotional abuse: 1) performance-based disparagement (6 items; e.g., “my coach was less supportive of me when I was not training and competing well”); 2) direct personal disparagement (4 items; e.g., “my coach cursed at me or called me names”); 3) embarrassing behaviors (3 items; e.g., “my coach told embarrassing/upsetting stories about me”); 4) indirect personal disparagement (3 items; e.g., “my coach blamed my teammates’ failures on my performance”); and 5) intimidating behaviors (3 items; e.g., “my coach threatened to punish me to keep me in line during training”). Items are summed to create a total score that can range from 19 to 95, with higher scores indicating greater exposure to emotionally abusive behaviours.

Previous work confirms excellent internal consistency of the CAREMS (e.g., α = 0.96; Dietz et al., 2016), and this was also seen in the current study in females (α = .95).

Data Cleaning

As noted in Chapter 2, there was between 0.0 and 0.4% missing data across study subscales/scales. Results from Little's MCAR test suggested that data were missing completely at random ($p \geq .08$). As such, expectation maximization was used to estimate missing data values. All analyses described here and below were conducted in SPSS (v. 27) software.

Results

Objective 1a: Personality, Experiential, and Mental Health Profiles of Athletes and Non-athletes

Univariate analysis of variance (ANOVA) tests were conducted to compare athletes and non-athletes on the study variables. Assumptions of ANOVA were met. Descriptive statistics for the main effects of group are provided in Table 4.1. After Bonferroni correction, competitive athletes were found to score significantly lower on the HSPS than non-athletes. A supplementary chi-square analysis confirmed that there was a smaller proportion of Orchids in the athlete sample (28.1%) than in non-athletes (40.6%) [$X^2(2) = 8.08$, $p = .018$]. The two groups did not differ on levels of alexithymia or AS, and supplementary chi-square tests confirmed that the proportion of athletes and non-athletes scoring in the alexithymic range (28.8% vs. 35.9%) and in the upper 30th percentile of ASI-3 (35.6% vs. 34.1%) were not significantly different.[1] The groups did not differ in terms of DASS-21 depression or anxiety scores. Moreover,

[1] Note that the cut-offs for being classified as an Orchid and as scoring in the upper 30th percentile on the ASI-3 were established based on the distribution of scores seen in mixed-sex sample described in Chapter 2.

supplementary chi-square tests showed that the incidence of moderate-to-extremely-severe depression and anxiety were similar, and extremely high, in athletes and non-athletes, overall (depression: 51.1% vs. 57.6%; anxiety: 56.8% vs. 54.1%). Finally, the groups reported similar exposures to childhood emotional abuse (CTQ), similar COVID-19 impacts (mCIS), and similar overall activity levels (Total METs).

Table 4.1

Comparisons between Athletes and Non-Athletes

	Athletes	Non-Athletes				
	M (*SD*)	*M* (*SD*)	*F*	(df)	*p*	η_p^2
Depression	14.4 (10.1)	16.1 (11.1)	1.81	(1, 307)	.179	.006
Anxiety	12.8 (9.9)	11.8 (8.6)	0.82	(1, 307)	.365	.003
TAS-20	53.4 (11.3)	53.8 (11.1)	0.11	(1, 307)	.738	.000
HSPS	4.3 (0.8)	4.6 (0.8)	7.96	(1, 307)	.005	.025
ASI-3	26.4 (13.5)	27.2 (13.5)	0.33	(1, 307)	.570	.001
CTQ-SF	9.9 (5.0)	10.7 (5.2)	1.79	(1, 307)	.182	.006
mCIS	9.3 (3.4)	8.9 (3.6)	1.04	(1, 307)	.310	.003
Total METs	2764.9 (2305.6)	2605.6 (2217.5)	0.38	(1, 307)	.538	.001

Note. Depression and Anxiety scores are based off the respective subscales of the Depression Anxiety Stress Scale-21; TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index-3; CTQ-SF = Emotional Abuse subscale of the Childhood Trauma Questionnaire short form; mCIS = modified Coronavirus Impact Scale; MET = multiples of the resting metabolic rate

Objective 1b: Is Participation in Team Sport Associated with Better Mental Health and/or a Different Personality Profile?

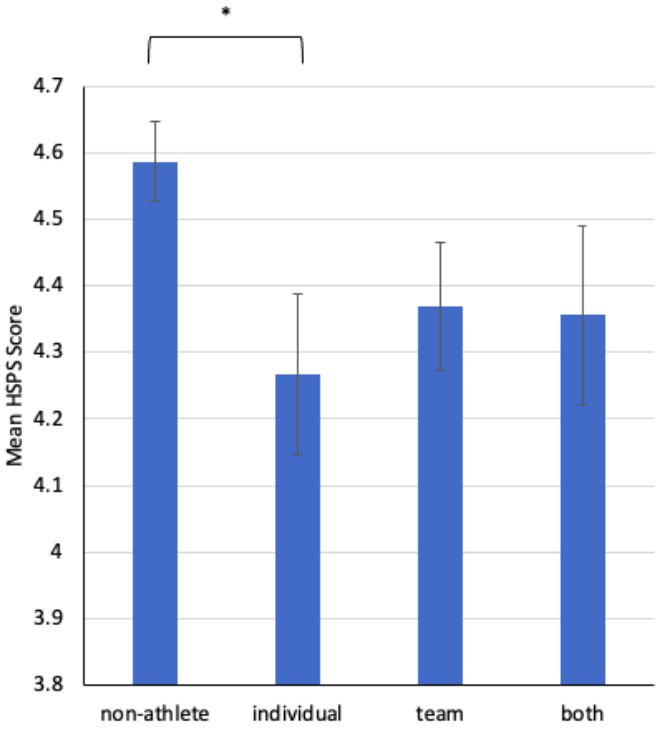
Athletes reported competing in a wide variety of sports including athletics, baseball, basketball, dance, golf, gymnastics, hockey, lacrosse, ringette, soccer, swimming, tennis, and volleyball. More than a quarter reported participating in individual sport only (29.5%), and the remainder reported participating in team (46.8%) or a combination of team and individual sport (23.7%). ANOVAs were run to compare anxiety and depression levels in these three groups and

in the group of non-athletes. There was no main effect of group in the analysis of depression scores [$F(3, 305) = 0.94$, $p = .422$, $\eta_p^2 = .009$] or anxiety scores [$F(3, 308) = 0.40$, $p = .753$, $\eta_p^2 = .004$]. Thus, the four groups reported similar levels of depression and anxiety.

ANOVAs were also run to examine whether any group differences existed on alexithymia, SPS, and AS between non-athletes and athletes who competed in individual sports, in team sports, or both. Although no group differences were seen in TAS-20 or ASI-3 scores, a significant group difference was seen for HSPS scores, $F(3, 305) = 2.79$, $p = .041$, $\eta_p^2 = .027$. Athletes who participated in individual sports scored lower than non-athletes on this variable (see Figure 4.1); a similar trend was seen for athletes who participated in team sports.

Figure 4.1

Mean Scores on the Highly Sensitive Person Scale (HSPS) in Non-Athletes and in Athletes Involved in Individual Sport, Team Sport, or a Combination of Individual and Team Sports



* $p < .05$

Objective 2: Does Participation in Sport Predict Mental Health?

To explore predictors of mental health, I conducted two multiple linear regressions—one predicting depression and the other predicting anxiety. In each regression, scores on the TAS-20, HSPS, ASI-3, and CTQ-SF were entered as predictors, using the forced entry method. In addition, I added whether one was a competitive athlete or not as a categorical predictor variable to determine whether this accounted for unique variance in mental health when the other variables were held constant. As mCIS scores were not related to mental health in the regressions presented in Chapter 2, and a preliminary regression analysis suggested that they may have exerted suppressor effects in the present study, they were not included in the final models. The models were significant in predicting both depression [$F(5, 303) = 55.038$, $p \leq .001$] and anxiety [$F(5, 303) = 57.614$, $p \leq .001$]. All four individual difference variables positively predicted both mental health outcomes. Moreover, although athlete status was not a significant predictor of depression, being an athlete was a significant positive predictor of anxiety (see Table 4.2).

Table 4.2

Predictors of Mental Health in Female Athletes and Non-Athletes

	Mental Health Outcome							
Predictors	Depression				Anxiety			
	b	SE	*β*	*p*	*b*	SE	β	*p*
TAS-20	.287	.047	.299	<.001**	.142	.040	.172	<.001**
HSPS	1.728	.707	.127	.015*	1.302	.603	.111	.032*
ASI-3	.186	.044	.235	<.001**	.293	.037	.428	<.001**
CTQ-SF	.540	.096	.257	<.001**	.321	.082	.178	<.001**
Competitive Athlete	-.504	.906	-.023	.579	1.850	.773	.100	.017*

Note: $R^2 \geq .476$, $p < .001$ for all regression models. Depression and Anxiety scores are based off the respective subscales of the Depression Anxiety Stress Scale-21; TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Persons Scale; ASI-3 = Anxiety Sensitivity Index; CTQ-SF = Emotional Abuse subscale of the Childhood Trauma Questionnaire short form.

Objective 3: Recent Adverse Coaching Experiences Among Elite Athletes

A total of 52 competitive athletes (37.4% of the athlete sample) reported having worked with a coach in their sport in the past two years and went on to complete a measure of coaching abuse (the CAREMS). As such, in this restricted sample I had the opportunity to explore the extent to which accounting for recent adverse coaching experiences explained unique variance in depression and/or anxiety, when holding the personality variables and emotional abuse experienced in early life constant. The mean age of participants in this restricted sample was 18.6 years (*SD* = 1.76, range 17-30). The proportion of athletes competing in individual sport only (32.7%), team sport only (38.5%), or a combination of individual and team sports (28.8%) was similar to that seen in the full sample of athletes. However, the majority of athletes in the restricted sample reported competing at the national/international (51.9%) or provincial level (40.4%), with only 7.7% competing at the local level. Thus, this sample represented a group of *elite* athletes.

As noted earlier (see Methods), the CAREMS assesses experiences of emotionally abusive coaching. The mean CAREMS total score in my sample of elite female athletes was 30.6 (*SD* = 14.0, range 19-78). The average score on a given CAREMS subscale can range from 1-5. Although the group means for individual subscales were quite low, overall (see Figure 4.2), scores obtained from individual athletes on any given subscale covered virtually the whole range. An examination of these scores confirmed that almost two-thirds of the athletes (63.4%) who had been coached in the past two years reported having experienced at least one of the five emotionally abusive coaching behaviours sampled in this measure “sometimes.”

For exploratory purposes, a repeated measures ANOVA was carried out to characterize the average subscale score profile of elite athletes. Given that Mauchly’s test of sphericity was

significant, the Greenhouse-Geisser test statistic was used. I had no a priori predictions regarding the profile I would see; however, the mean subscale scores did differ from one another, $F(2.79,139.24) = 24.26$, $p < .001$, $n_p^2 = .327$, with performance-based disparagement occurring more often than any other form of abuse, and indirect personal disparagement occurring less often than all forms except embarrassing behaviours ($p \leq .015$ in all cases). Direct personal disparagement, intimidating behaviours, and embarrassing behaviours were reported at intermediate levels.

Figure 4.2

Mean Scores on the CAREMS subscales

To explore links between exposure to abusive coaching and mental health, I ran separate multiple linear regression models predicting anxiety and depression. These models took a similar form to those described earlier, except that the categorical variable for participation in competitive sport was removed and replaced with the CAREMS total score. The models were

significant for both outcomes [depression: $F(5, 46) = 12.845$, $p \leq .001$; anxiety: $F(5, 46) = 22.288$, $p \leq .001$] (see Table 4.3). In this subsample of elite female athletes, alexithymia and AS uniquely predicted depression when holding all other variables constant, and SPS, AS, and recent abuse from a coach predicted anxiety when holding all other variables constant.

Table 4.3

Linear Regression Results of Predictors of Depression and Anxiety in Elite Athletes who worked with a Coach (N = 52)

	Mental Health Outcome							
Predictors	Depression				Anxiety			
	b	SE	*β*	*p*	*b*	SE	β	*p*
TAS-20	.302	.108	.358	.008**	.050	.089	.060	.578
HSPS	1.487	1.459	.122	.314	3.762	1.203	.314	.003**
ASI-3	.226	.102	.291	.031*	.339	.084	.444	<.001**
CTQ-SF	.284	.208	.159	.179	.207	.171	.118	.234
CAREMS	.049	.068	.072	.474	.140	.056	.205	.017*

Note. $R^2 \geq .583$, $p < .001$ for all regression models. Depression and Anxiety scores are based off the respective subscales of the Depression Anxiety Stress Scale-21; TAS-20 = Toronto Alexithymia Scale; HSPS = Highly Sensitive Person Scale; ASI-3 = Anxiety Sensitivity Index; CTQ-SF = emotional abuse subscale of the Childhood Trauma Questionnaire short form; CAREMS = Coach-Athlete Relationship Emotional Maltreatment Scale

*$p < .05$, **$p < .01$

Discussion

There is a paucity of literature examining the prevalence of common mental disorders among competitive athletes, and existing work has produced mixed results. This may be partly due to cross-study differences in characteristics of the athletes being studied (Purcell et al., 2020), such as in the distribution of males and females, or of team vs. individual athletes. As such, key goals of the current study were (a) to characterize the mental health of female

competitive athletes; (b) to examine group differences in the personality profiles and mental health outcomes between non-athletes and athletes competing in different types of sport (i.e., individual, team), and (c) to assess unique variance in mental health accounted for by involvement in sport, and by recent exposure to emotionally abusive coaching practices.

Depression and Competitive Sport

I observed high rates of depressive symptoms in female athletes and non-athletes alike, but the two groups did not differ on levels of depression, regardless of the type of sport the athletes were engaged in. These results are not consistent with results from a study of Turkish athletes carried out during the pandemic in which it was found that both team and individual sport athletes reported fewer symptoms of depression than their non-athletic peers (Şenışık et al., 2021); however, this study included a mixed sex sample. Inconsistent with my hypothesis, I found that participation in competitive sport (individual and/or team) did not account for unique variance in the prediction of depression. There are several possible reasons for this finding. Firstly, it is important to consider that depression can influence an individual's participation in competitive sports, rather than the other way around. Depression can reduce motivation, energy levels, and interest in activities, including sports. Therefore, individuals already experiencing depressive symptoms may be less likely to engage in sports, leading to an underrepresentation of those with depression in competitive sports. Second, it is possible that any effect of involvement in competitive sport is reduced once one controls for the individual difference factors that are the focus of this dissertation. In this regard, it is interesting to note that athletes generally reported fewer symptoms of SPS than non-athletes, and that SPS did not predict depression in the subgroup of elite athletes. It may be that repeated engagement in competitive sport helps athletes learn to regulate their reactions to busy sensory environments, or that individuals who are highly

sensitive are simply less likely to engage in sport because they find the sensory environment to be overwhelming. Either possibility could explain why the relationship between SPS and depression was not significant in athletes competing at an elite level.

The fact that alexithymia was linked to depression in the full sample and in the subgroup of elite athletes is consistent with the view that this trait is a general risk factor for depression (Taylor & Bagby, 2004). Unexpectedly, however, I found that athletes reported similar levels of alexithymia as non-athletes—a result that is at odds with reports suggesting that athletes score either lower (Jodat et al., 2015) or higher (Iacolino et al. 2017, Allegre et al., 2007) on alexithymia than non-athletes. Additional research is needed to identify factors that may contribute to these mixed results, but the fact that my sample was restricted to females may be significant.

AS was also consistently found to be related to more severe depressive symptoms. The finding that athletes and non-athletes did not differ in symptoms of AS is interesting. We might have expected athletes to score lower on AS, overall, if they had been found to be more active than non-athletes; this is based on research suggesting that exercise leads to reductions in the cognitive and affective concerns that characterize AS (Sabourin et al., 2015). As it turned out, however, the two groups reported similar activity levels, overall. Additional research is needed to determine what factors increase risk of AS in athletes and non-athletes. Among athletes, it may be that the arousal generated by exercise is seen to pose a significant barrier to meeting exercise and/or performance goals. For example, athletes may fear that strong arousal sensations could adversely affect their athletic performance, either by interfering with cognitive processes or by revealing signs of "weakness" to their competitors. These specific fears and worries may increase their risk of depression.

Unexpectedly, I found that neither childhood emotional abuse nor coaching abuse accounted for unique variance in depression in the subgroup of elite female athletes, when controlling for other relevant variables. The lack of an effect of coaching abuse on depression was surprising, particularly as Stirling and Kerr (2013) found that athletes reported experiencing low mood and feelings of worthlessness as a result of coaching abuse. This finding could partly be due to the inclusion of relevant personality variables in the analyses and speaks to the importance of accounting for these variables in research of this kind.

Anxiety, Competitive Sport, and Exposure to Emotionally Abusive Coaching Practices

Strong symptoms of anxiety were reported by both athletes and non-athletes but there were no group differences in levels of anxiety overall (see also Gorczynski et al., 2017; Rice et al., 2016), and no benefit related to participation in team sport (cf. Şenışık et al., 2021). However, consistent with hypotheses, participation in competitive sport accounted for unique variance in the prediction of anxiety. Specifically, participation in competitive sport predicted increased levels of anxiety during the pandemic, while holding variance from other variables constant. There are a number of possible reasons for this; for instance, athletes may feel a significant burden to meet expectations and fear the consequences of failure. In addition, sports competitions can be inherently unpredictable, and the uncertainty surrounding outcomes can create anxiety. Athletes may experience apprehension about the unknown—such as the performance of opponents, unpredictable game situations, or potential injuries. This unpredictability was undoubtedly even higher during the pandemic, as athletes had to cope with competition cancellations, fewer training sessions, and increased time spent training alone (Facer-Childs et al., 2021; Pillay et al., 2020). All of these variables related to the sporting context could increase overall feelings of anxiety.

Also consistent with my hypothesis, recent emotional abuse from a coach emerged as a unique predictor of anxiety in the subgroup of athletes who were competing at the elite level of sport. This observation is important as it supports the view that coaches' abusive behaviours are problematic (Gervis et al., 2016). Calls for the monitoring of coach behaviour have been put forth, including creating opportunities for athletes to report problematic behaviour (Stirling & Kerr, 2008). Initiatives that protect athletes and hold coaches accountable for these actions are needed (Stirling & Kerr, 2008).

Current estimates of emotionally abusive coaching are proposed to be around 22 to 25% (Kirby et al., 2000). As previously noted, however, these rates may underestimate the prevalence, given that emotionally abusive coaching practices are not only tolerated but often normalized in a sporting environment (Stirling & Kerr, 2009; 2014) and are under-reported by athletes (Stirling & Kerr, 2009). The results of the current study corroborate prior work suggesting that elite athletes are at risk for experiencing emotional abuse from a coach. Indeed, I found that the majority (63.4%) of athletes who had been coached in the past two years reported experiencing at least one emotionally abusive coaching behaviour "sometimes."

Prior work suggested that verbal abuse and aggression (by a coach or others) were the most common forms of abuse experienced by elite French athletes (Schaal et al., 2011), and that shouting, belittling, issuing threats, and humiliation by a coach were the most common forms of verbal abuse experienced by child athletes (Gervis & Dunn, 2004). In the present study, performance-based disparagement (e.g., "my coach was less supportive of me when I was not training and competing well") emerged as the most common form of abuse reported by elite athletes, followed by direct personal disparagement (e.g., "my coach cursed at me or called me names") and intimidating behaviours (e.g., my coach threated to punish me to keep me in line

during training"). It is not clear whether Schaal and colleagues (2011) or Gervis and Dunn (2004) directly asked about performance-based disparagement, but the present results suggest that it should be a focus of future work. The current findings should be replicated in other athlete samples, but these preliminary results suggest that training for coaches might specifically address reducing this behaviour to promote athlete mental health.

SPS and AS were also significant predictors of anxiety in the full female sample, and in the subgroup of elite female athletes. Past work suggests that AS and interoceptive exposure trigger trauma memories and predict interoceptive exposure-induced peak anxiety in individuals with PTSD (Wald & Taylor, 2008). It could be the case that hyperarousal experienced by highly sensitive elite athletes during or after competition may also trigger memories of a range of emotionally abusive coaching practices. If so, one would predict that both AS and negative coaching experiences would be especially likely to increase risk for negative mental health outcomes in competitive athletes who score high on SPS. In this case, one might find that SPS moderates the relationships between AS and/or coaching abuse and mental health. I did not test for moderation effects in the present investigation of elite athletes given limitations of sample size, but it would be interesting to do so. Learning more about the role that SPS plays in the mental health of those competing at the highest levels of sport should be an important objective of future work. Given that Kemler (2006) found that athletes scoring high in SPS also reported experiencing more shame, future researchers may want to incorporate a measure of shame in their work.

Limitations and Future Directions

The current study has a number of limitations. Firstly, the data are cross-sectional, limiting my ability to make causal claims. Future researchers should, ideally, track changes in

athletes' experiences of abuse and their mental health using longitudinal designs. Secondly, the majority of females who participated in this research were white; future researchers should replicate the current findings in males and in gender- and racially diverse samples. It would also be interesting for future researchers to examine whether the sex of the coach impacts the nature of the coach-athlete relationship, the types of abuse they engage in, and/or the psychological effects of that abuse on athletes.

Another important avenue for future research is to explore ways to use information about individual difference variables to fine-tune intervention efforts. As noted above, some authors suggest that both personality characteristics and environmental factors are important in predicting the effectiveness of specific emotion regulation strategies. For example, Kobylińska and Marchlewska (2016) found that suppression, an emotion regulation strategy that is often described as maladaptive, was more effective in individuals with low (vs. high) levels of action orientation. As such, they argue that tailoring intervention towards individuals with certain personality characteristics in specific situations, and that training many different emotion regulation strategies rather than solely focusing on one, could be beneficial. The current findings suggest that SPS is an important predictor of anxiety in elite athletes. This may be an important factor to consider when planning or implementing interventions to improve emotion regulation. For example, it could be that elite athletes with SPS may benefit from cognitive reframing in order to shift negative cognitive reactions to aversive stimuli, and that mindfulness-based interventions would be effective in reducing symptoms of alexithymia (Haase et al., 2015).

Conclusion

Rates of common mental disorders are high and have risen slightly during the COVID-19 pandemic, in both the general population (Sun et al., 2023) and in athletes (Facer-Childs et al.,

2021; Håkansson et al., 2020). The present study provides important insights into risk and protective factors for these problems.

The current study adds novel contributions to the literature by applying quantitative methods to examine female athletes' experiences of emotionally abusive coaching, and by considering multiple variables in the same analysis to tease apart the unique contributions of each to the prediction of mental health. Past qualitative work has, unsurprisingly, suggested that athletes who had experienced emotional abuse from a coach also struggled with a number of adverse mental health outcomes, including not only anxiety, but depression and disordered eating (Stirling & Kerr, 2007). However, there is a need for researchers to examine the relationships between emotionally abusive coaching practices, personality/experiential variables, and psychological, training, and performance effects. The current quantitative study is an important first step in this direction, as it suggests that abusive coaching practices predict current levels of anxiety, but not depression, when holding other individual difference factors and childhood emotional abuse constant. The idea that emotional abuse from a coach is an important driver of athlete anxiety, in particular, is consistent with athletes' perceptions. For instance, one athlete reported:

> There was a lot of anxiety and constant stress 'cause you might do something fine and then you get yelled at … I guess the idea, or his [coach's] method to his madness, was that when you go and compete you're under a lot of pressure. He wanted to implement that into the training so that we would get used to that [pressure] in a competition and be able to deal with all the emotions that your body's going through. I never took well to it though. I was pretty anxious all the time. (Male figure skater, age 23; Stirling & Kerr, 2013, p. 93).

Future work should employ longitudinal methods to examine potential causal relationships between the variables studied here and look at the role of shame in athletes who have experienced emotional abuse from a coach.

Study 4.2: Body Image and its Links to Mental Health in Female Athletes and Non-athletes

In Study 4.1, I did not find evidence that participation in competitive sport (particularly team sport) offered protection from common mental disorders; indeed, results suggested that participation in competitive sport increased risk of anxiety. The main goal of Study 4.2 was to examine whether body image (measured via self-report and perceptual measures) improved prediction of mental health, when holding personality/experiential factors and involvement in competitive sport constant. Body image was a variable of interest given past work linking body image problems to poor mental health, in both athletes and non-athletes. A brief review of work in this area is included below to provide context for the present investigation.

Body Image

Body image is a multidimensional construct. It refers to the image we have of our bodies and the attitudes we hold towards it (Slade, 1988), the former normally being assessed by having an individual estimate their body size (through a perceptual task) and the latter by exploring the cognitions they hold about their body (Skrzypek et al., 2001). Body image impacts aspects of body awareness. Specifically, Irvine et al. (2019) report that it influences exteroceptive body awareness (i.e., the body schema, or one's awareness of the body's position in and movement through space; Valenzuela-Moguillansky et al., 2017).

Problems relating to body image are common and can manifest as distorted perception of body size and/or cognitive dissatisfaction with one's body (Skrzypek et al., 2001). Estimates of the prevalence of body image dissatisfaction vary and depend on the sample population and the measurement tool (Hausenblas & Downs, 2001). Large scale survey studies report increases from 1972 to 1996 in body image dissatisfaction among both females (from 23% to 56%) and males (from 15% to 43%) (Berscheid et al., 1973; Garner, 1997). However, these figures may

underestimate prevalence given that the focus in much of the extant literature has been on concern with being overweight, even though body image dissatisfaction can also reflect concern with being underweight (Grossbard et al., 2008). Males appear to be at greater risk for the latter type of concern (Cafri & Thompson, 2004; McCreary & Sadava, 2001). For example, one study of university students found that whereas 85% of females reported a desire to lose weight, 40% of males reported a desire to lose weight and 45% reported a desire to gain weight (Drewnowski & Yee, 1987).

The incidence of body image dissatisfaction appears to have increased during the COVID-19 pandemic. For instance, among a sample of 264 adults from the UK, almost half of the sample (48.5%) indicated that they had become more concerned about the way they looked since the onset of the pandemic, and females were more likely to be increasingly concerned about their appearance than males (Robertson et al., 2021). Additionally, longitudinal work suggests that there has been an increase in the internalization of thin ideals among female university students during the pandemic (Baceviciene & Jankauskiene, 2021). Interestingly, university students in another study perceived that their weight had increased between two time points during the pandemic, even though their actual body mass index (BMI) did not change (Keel et al., 2020). Furthermore, perceived weight change was associated with increased body image concerns. Taken together, these results suggest that cognitive distortions related to body image may have increased during the COVID-19 pandemic.

Links Between Body Image Problems and Mental Health in the General Population

Body image problems are of considerable interest given that they are considered a risk factor for body-specific affective concerns (e.g., fear of getting fat, body anxiety) and changes in motivational states (e.g., drive for thinness) (Walker et al., 2018). Problems with body image can

also affect behaviour, increasing actions taken to check on, alter, or conceal the body (Hosseini & Padhy, 2020). The various problems described above could increase risk for exercise dependence and for eating and body dysmorphic disorders (Biesecker, & Martz, 1999; Carr & Szymanski, 2010; Godart et al., 2015; Grabe et al., 2008; Neumark-Sztainer et al., 2006; Olivardia et al., 2004; Vartanian et al., 2018). Of greater relevance to the present study, prior work suggests that body image dissatisfaction is also related to poor mental health outcomes (Stice, 2002; Walker et al., 2018) as well as suicidal ideation and suicide attempts (Crow et al., 2008) in both males and females. For instance, a recent meta-analysis found a positive association between body image dissatisfaction and self-reported depression and anxiety in males (Barnes et al., 2020).

The results from a number of longitudinal studies support the view that body image dissatisfaction plays a causal role in psychopathology (e.g., Ferreiro et al., 2014; Mond et al., 2011; Paxton et al., 2006). For example, among both male and female adolescents, body image dissatisfaction predicted depressive symptoms at a two- and a four-year follow up (Ferreiro et al., 2012). In more recent work, body image dissatisfaction at 14 years of age predicted drug use, self-harm behaviour, and high-risk drinking in 21-year-old females (Bornioli et al., 2019), and body image dissatisfaction at 14 years of age predicted depressive symptomology in a mixed-sex sample of 18-year-olds (Bornioli et al., 2021). Interestingly, Al Mamun et al. (2007) found that perceived weight during adolescence (in both males and females) predicted depression in young adulthood, whereas objective weight (i.e., BMI) did not. Some researchers posit that increases in depressive symptomology may also relate to the tendency to evaluate others' physical appearance that is prevalent in Western culture, especially among young females (e.g., Stice & Bearman, 2001).

Body image concerns have also been found to be positively associated with increased psychological distress during the pandemic (Robertson et al., 2021). In one study, both COVID-19 stress and anxiety improved prediction of body image dissatisfaction after controlling for variance due to age, BMI, stress, trait anxiety, and stressful life events (Swami et al., 2021). It is possible that increased exposure to thin ideals via social media could partially account for pandemic-related increases in body image problems, given reports that screen time has increased during COVID-19 (Pietrobelli et al., 2020) and that the frequency of Instagram use is positively correlated with body image dissatisfaction in adolescent and young adult females (Vall-Roqué et al., 2021). Increased sitting time and associated body changes may have also contributed to increased concern over physical appearance during the pandemic (Cooper et al., 2022).

Body Image Dissatisfaction in Athletes

Taken together, the literature reviewed above suggests that body image dissatisfaction is an important variable to consider when examining risk for poor mental health, particularly in the context of a global pandemic. As such, it is important to determine if certain groups are at higher risk than others for experiencing body image problems. Some research in this area has compared body image problems in athletes and non-athletes, but the results have been mixed. Some research suggests that rates of body dissatisfaction (Davis & Cowles, 1989; Rao & Overman, 1986) and body-specific affective concerns (e.g., fear of becoming overweight; Beals & Manore, 2002) are higher in athletes than in non-athletes. On the other hand, it has also been argued that participation in sport can serve as a protective factor against body image concerns (e.g., Miller et al., 2000) and that athletes experience comparable or lower rates of body image concerns compared to non-athletes (Anderson et al., 1996; Fulkerson et al., 1999; Hausenblas & Mack, 1999). Indeed, a meta-analysis conducted by Hausenblas and Downs (2001) found that across

gender, age, and competition level, athletes experienced a more positive body image than non-athletes, although the magnitude of this effect was small. In females, the gap between athletes' and non-athletes' risk for experiencing body dissatisfaction may have narrowed in recent years because the societal view regarding the ideal female body type appears to have shifted to include being athletic *as well as* being thin (Daniels, 2009; Thompson et al., 2003).

As is the case in general samples (see above), body image concerns appear to have increased during the COVID-19 pandemic in athletes. For example, among a sample of 204 current and retired athletes, 34.8% reported experiencing an increase in body image dissatisfaction (Buckley et al., 2021). Some athletes attributed to this to increased time spent on social media whereas others attributed it to pandemic-related reductions in exercise, training, and competition. In the following sections I explore a range of other general and sport-specific variables that may increase risk for body image problems.

General Factors Associated with Increased Risk for Body Image Problems

In females, BMI is one of the most reliable biological correlates of body image dissatisfaction, with higher BMI being associated with increased body image dissatisfaction and use of weight loss strategies (McCabe & Ricciardelli, 2001; Stice, 2002). The relationship between BMI and body image dissatisfaction in men appears more complex, with higher BMI being associated with a desire to decrease weight and increase muscle (McCabe & Ricciardelli, 2001) and lower BMI being associated with a desire to increase both weight and muscle (Jones & Crawford, 2005).

A variety of other factors are also linked to increased risk for body image dissatisfaction in males and females, including perfectionism, fear of negative evaluation, low self-esteem, and trauma (Davis et al., 2005; Stice, 2002; Thompson et al., 1999). Furthering our understanding of

possible links between body image problems and the personality factors and experiential variables that were the focus of the present dissertation may play is important from a theoretical perspective, but it is also clinically relevant as results may lead to earlier identification and more targeted treatments for a range of body-related affective concerns, both in members of the general public and in athletes, specifically. Below, I will discuss some of the existing work in this area.

There is a body of research suggesting that alexithymia and body dissatisfaction are linked (e.g., Carano et al., 2006; Fenwick & Sullivan, 2011). De Berardis and colleagues (2007) demonstrated that university students with higher levels of alexithymia reported higher levels of body dissatisfaction than university students with lower levels of alexithymia. It has been proposed that individuals who have difficulty attending to their emotions and inner world may, instead, direct their attention outward, to a negatively perceived body part (Andersen, 1988). This might not only lead to body dissatisfaction but also to difficulties identifying and describing emotions (Montebarocci et al., 2006; De Berardis et al., 2007). In support of this idea, Hayaki et al. (2002) reported a positive association between body dissatisfaction and the inability to effectively express one's emotions.

Two recent studies by Iacolino and colleagues (2017; 2019) documented links between alexithymic traits and body-related concerns/behaviours in competitive athletes. In their 2017 study, the authors found that: (a) being female and having difficulty identifying feelings predicted body uneasiness, body image related avoidance, and body image concerns; and (b) increased difficulty identifying feelings and externally oriented thinking predicted compulsive self-monitoring and global body uneasiness. These relationships were seen in both athletes and non-athletes, but athletes reported higher levels of alexithymia and greater weight phobia than

non-athletes, despite scoring lower on overall body image dissatisfaction. The authors also reported that both body image dissatisfaction and body dysmorphic disorder were linked to controlled sporting practice; they speculated that this might reflect the fact that rigorous and organized practices can aid one in attempting to achieve their ideal body image.

In their more recent study, which involved competitive dancers, Iacolino et al. (2019) reported that adolescents scored higher on body uneasiness than adults. Furthermore, female sex, externally oriented thinking, and TAS-20 total scores were predictive of body uneasiness scores. These authors speculated that some alexithymic athletes may use sport to cope with their body-related distress.

Little is known about how SPS might relate to body image. However, some research suggests that particular features associated with SPS may be linked to body dissatisfaction in individuals with eating and body dysmorphic disorders. For example, Brown et al. (2021) reported that high visceral sensitivity is associated with a range of negative outcomes, including (but not limited to) increased body dissatisfaction, cognitive restraint, disordered eating, and excessive exercise. Zucker and Bulik (2020) have argued that heightened sensitivity to somatosensory cues can contribute not only to body image disturbance but lead to a heighted sense of "feeling fat" in those with anorexia nervosa. Others have noted that women with (or with a history of) anorexia nervosa report increased sensitivity to sensory stimulation (i.e., sensory avoidance) compared to controls (Zucker et al., 2013). It may be that those displaying strong sensory avoidance combined with a strong aesthetic sense (both features of SPS; Jakobson & Rigby, 2021) find it harder than others to accept perceived imperfections in their bodies. If this impacts the perceptual representations they form of their own bodies, it might explain why

aesthetic sensitivity has been found to be a vulnerability factor for developing body dysmorphic disorder (Schieber et al., 2013).

Although sensory sensitivity may generally predict more body image concerns, another feature associated with SPS—strong visual imagery—may moderate the strength of this association. Darling and colleagues (2015) found that individuals who experience vivid visual imagery report less body dissatisfaction than those with weak imagery. One possible explanation for this relationship is that those who have stronger mental imagery may hold a more consistent self-image that is impervious to influences of external factors (e.g., social media).

There is a dearth of literature examining the link between AS and body image dissatisfaction. However, in one study examining the role of AS in eating pathology, Anestis et al. (2008) noted positive associations between AS and both drive-for-thinness and body dissatisfaction. Both of these relationships broke down in a sample of university students when the authors controlled for anxiety, depression, and impulsive behaviour, but the relationship between AS and drive-for-thinness persisted in a clinical sample of individuals diagnosed with an eating disorder even after variance attributed to these variables was accounted for.

It is also important to consider how experiential factors relate to body image issues. In this regard, findings from a recent meta-analysis suggest a positive association (low-to-moderate effect size) between adverse childhood experiences and symptoms of body dysmorphia (Longobardi et al., 2022). Moreover, results from a serial mediation analysis suggested that, in young adult females, early adversity predicted poorer self-concept, which predicted higher internalization of thin ideals, which then predicted increased body dissatisfaction (Vartanian et al., 2016). This suggests that early adversity may contribute to body dissatisfaction, in part, through its impact on one's sense of personal identity. Other work suggests that childhood

adversity relates to increased body dissatisfaction through its impact on self-criticism (Momeñe et al., 2022).

Factors Related to Sport That may Increase Risk for Body Image Problems in Athletes

Athletes may face additional, sport-specific risk factors for body image problems. For example, some researchers have suggested that male athletes participating in lean sports (e.g., long distance running) or sports that have weight divisions (e.g., wrestling) may be at increased risk for body image dissatisfaction if they believe that a thinner and/or more muscular body size could improve their performance (Grossbard et al., 2008). Athletes may also make unhealthy comparisons between themselves and their teammates or competitors, and some may be required to wear revealing or form-fitting sport uniforms that put the body on display. Female athletes have also become increasingly sexualized in the media in recent years (American Psychological Association, 2010; Kim et al., 2010), and this could be contributing to higher rates of body image dissatisfaction in this group.

Certain coaching practices may also influence the development/maintenance of body image problems in athletes (Davis & Cowles, 1989; Rao & Overman, 1986). For example, athletes often perceive pressure from their coach to achieve or maintain a certain weight presumed to be ideal for their sport type (e.g., Beals & Manore, 2002; Coker-Cranney & Reel, 2015; Galli & Reel, 2009; Reel et al., 2010). Specific attitudes and behaviours by the coach, such as commenting on (e.g., Kerr et al., 2006; Muscat & Long, 2008) and monitoring (e.g., Heffner et al., 2003; McMahon & Dinan-Thompson, 2011) an athlete's weight are linked to body image dissatisfaction in athletes. These types of coaching behaviours are common, even among coaches who have not completed proper training in nutrition (Griffin & Harris, 1996).

The Current Study

The literature reviewed above suggests that body image is an important variable to consider when examining risk for poor mental health, particularly in the context of a global pandemic. However, it also suggests that body image problems may vary as a function of involvement in competitive sport, and as a function of individual differences in personality/experiential variables. Learning more about these latter relationships and identifying the unique contribution that body image makes to the prediction of mental health outcomes when controlling for other relevant variables were the overall goals of the present investigation. To that end, I addressed a number of specific research questions.

First, I sought to determine if athletes differed from non-athletes with respect to perceived BMI, dissatisfaction with adiposity or muscularity, and/or body uneasiness. As in Study 4.1, my focus was on females. I expected athletes to experience less body dissatisfaction/uneasiness overall, but greater weight phobia, compared to non-athletes (Hausenblas & Downs, 2001; Iacolino et al., 2017). Second, I was interested in assessing links between the personality/experiential variables that are the focus of my dissertation and both perceptual and self-report measures of body image problems, when controlling for involvement in competitive sport. This would fill a gap in the literature, as past studies have typically not controlled for the fact that these variables are related to one another (see Chapter 2 and Study 4.1). Based on the literature reviewed above, I expected to find that both alexithymia and childhood emotional abuse would predict more body image problems, but how or if SPS and AS might relate to these problems was less clear. Finally, I sought to determine whether body uneasiness accounted for unique variance in the prediction of mental health after holding personality/experiential variables and involvement in competitive sport constant. This was expected to be the case.

Method

Participants

Participants who were originally recruited for the research described Chapter 2 and who agreed to be contacted regarding future research opportunities were invited to take part in the present follow-up study. Data were collected between March 4 and April 20, 2021. This timeframe occurred between the first and second waves of COVID-19 in Manitoba, where daily case counts ranged from 0-178 (https://github.com/CSSEGISandData/COVID-19). After exclusions (described below), the final sample included 90 female athletes and 126 female non-athletes; 19 of these individuals had not taken part in Study 4.1 because they had been excluded from that study due to having unreliable IPAQ scores. The mean age of participants in the final sample was 19.6 years (SD = 3.2, range 16-34). The majority of participants were Canadian citizens (80.1%); 43.1% identified as white/European, 35.4% identified as Filipino or Asian/Southeast Asian, 10.2% identified as Black, and 5.1% identified as Indigenous/Métis.

Procedure

Individuals in the final sample agreed to allow me to link new data collected for the current follow-up study with previously collected data pertaining to demographics, stable personality traits, history of childhood emotional abuse, COVID-19 impacts, and involvement in sport. The procedures that had been followed when collecting these data, and full descriptions of the measures themselves, are outlined on pages 36-41 (demographics questionnaire, TAS-20, HSPS, ASI-3, CTQ-SF, mCIS), page 64 (EAI), and page 115 (information regarding recent sports involvement, which was used to identify athletes).

In the first part of the current (follow-up) study, participants completed the emotional Go/No-go task described in Chapter 3, following procedures described on pages 87-88. They

then completed several additional measures online via Qualtrics. First, the depression and anxiety subscales of the DASS-21 (described on pages 38-39) were re-administered to obtain current ratings of mental health. Following this, participants provided biometric information and completed several measures unique to the current study, which were used to assess body image problems (see below). Intermixed with the items from the questionnaires mentioned above were the five items from the Conscientious Responders Scale (Marjanovic et al., 2014; described on page 41); inclusion of these items allowed me to check for careless responding. This study was approved by the Psychology/Sociology Research Ethics Board at the University of Manitoba. Participants gave informed consent and received credit towards a course requirement.

Measures Unique to the Current Study

Biometric Data

Information about each participant's current height and weight was used to compute their BMI. Because data were collected online due to COVID-19 restrictions, I relied on self-report to obtain these data. Participants were encouraged to use a scale to measure their weight if they had one available or, failing this, to provide their best estimate. BMI was calculated by dividing participant's weight (in lbs) by their height (in inches) squared, and multiplying the result by 703.

Body Uneasiness Test-A (Cuzzolaro et al., 2006)

The Body Uneasiness Test-A is a self-report measure used to assess several areas of body-related psychopathology (Cuzzolaro et al., 2006). Participants rated how often they experience each of 34 different body experiences using a 6-point Likert scale ranging from 0 (*Never*) to 5 (*Always*). Items are averaged to create a mean score (Global Severity Index), with higher scores indicating greater body uneasiness. A Global Severity Index score of 1.2 and

higher indicates significant discomfort with the perception of one's body (Iacolino et al., 2017). Five subscale scores can also be derived by averaging relevant items: 1) Weight Phobia (8 items; e.g., "I'm terrified of putting on weight"); 2) Body Image Concerns (9 items; e.g., "I spend a lot of time thinking about some defects of my physical appearance"); 3) Avoidance (6 items; e.g., "When I undress, I avoid looking at myself"); 4) Compulsive Self-Monitoring (5 items; e.g., "I spend a lot of time in front of the mirror"); and 5) Depersonalization (6 items; e.g., "I look at myself in the mirror and have a sensation of uneasiness and strangeness").

Perceptual Tests Assessing Dissatisfaction Relating to Adiposity and Muscularity

To assess dissatisfaction relating to adiposity and muscularity, participants completed the Female Body Scale (adiposity dimension) and the Female Fit Body Scale (muscularity dimension), respectively (Ralph-Nearman & Filik, 2020). Each measure includes a 9-point visual analog scale showing nine different female bodies increasing in either adiposity or muscularity. Participants were shown each scale twice. On the initial presentation, they were asked to identify which of the nine body figures best represented their current body. On the second presentation they were asked to indicate which figure best represented their ideal body. I computed a discrepancy score for each measure by subtracting "self" from "ideal." This score served as a measure of body dissatisfaction, with negative scores indicating a desire to be slimmer/less muscular and positive scores indicating a desire to be heavier/more muscular. Previous work confirms excellent reliability and validity of the Female Body Scale and Female Fit Body Scale (e.g., Ralph-Nearman & Filik, 2020).

Perceived BMI

Perceived BMI was measured using the version of the Body Dissatisfaction Scale (Mutale et al., 2016) designed for use with females. Participants were asked to identify which of

nine computer generated female body figures best represented their current body shape. The figures range from one appearing underweight to one appearing obese. The Body Dissatisfaction Scale applies normative data to estimate the BMI of each body figure. Previous work confirms excellent reliability and validity of the Body Dissatisfaction Scale (e.g., Mutale et al., 2016).

Data Cleaning

The data cleaning procedures followed in the follow-up study were described in Chapter 3 (pages 88-89). Exclusions were as outlined in Chapter 3, with the exception that no participants were excluded from the current investigation based on their performance on the Go/No-go task. This left a final sample of $N = 216$. Based on the criteria described in Study 4.1 (p. 114), 90 participants were classified as athletes and 126 as non-athletes. Among athletes, 25 participants (27.8%) reported competing in lean sport only, 20 participants (22.2%) reported competing in both lean and non-lean sport, and 45 (50.0%) reported competing in non-lean sport only.

Across the subscales of the Body Uneasiness Test-A and the DASS-21 subscales, there was between 0.3% and 0.7% missing data. Using Little's MCAR test, data were found to be missing completely at random, $p \geq .11$. Expectation Maximization was used to estimate missing data values. The internal consistency of the Body Uneasiness Test-A and its subscales was considered to be acceptable to excellent ($.76 \leq \alpha \leq .97$). The internal consistency of the DASS-21 depression and anxiety scales were considered to be excellent ($\alpha = .91$) and good ($\alpha = .82$), respectively.

Results

Objective 1: Assessing Group Differences in Actual or Perceived BMI and in Body Dissatisfaction/Uneasiness

To address my first research question, ANOVAs were run to examine whether any group differences existed between athletes and non-athletes on actual or perceived BMI, dissatisfaction with adiposity or muscularity, or body uneasiness. Given that data from the visual analog scales and the Global Severity Index were not normally distributed, I assessed group differences in all variables using bias-corrected accelerated 95% confidence intervals (BCa 95% CIs) that were calculated using 1000 samples. Results are described below.

BMI and Perceived BMI

Actual BMI did not differ between the groups. However, perceived BMI was higher in non-athletes (Mean Difference = 1.798, Bias = .031, SE = .587, p = .005, BCa 95% CI [.568, 3.194]). Thus, non-athletes perceived themselves to have higher BMIs than athletes, despite there being no objective difference in actual BMIs.

Visual Analog Scales Measuring Body Dissatisfaction

There was a main effect of group in the analysis of dissatisfaction with adiposity (Mean Difference = -.506, Bias = .006, SE = .180, p = .005, BCa 95% CI [-.844, -.146]) with non-athletes reporting more dissatisfaction (specifically, a stronger desire to be thinner) than athletes. Although dissatisfaction with muscularity did not differ between the two groups, the mean difference scores for athletes (.587) and non-athletes (.456) were both positive, suggesting that individuals in both groups generally wish to be more muscular than they are.

Body Uneasiness

Global Severity Index scores did not differ between the two groups ($M_{athletes}$ = 1.7, *SD* = 1.0; $M_{non\text{-}athletes}$ = 1.9, *SD* = 1.0; $F(1,214) = 1.841$, $p = .176$, $n_p^2 = .009$). Moreover, a supplementary chi-square test confirmed that, while the proportion of individuals scoring above the clinical cut-off on the Global Severity Index in both groups was alarmingly high (61.1% in athletes and 71.4% in non-athletes), they were comparable [$X^2(1) = 2.533$, $p = .112$]. Thus, athletes and non-athletes had similar levels of body uneasiness, overall. To determine if the groups scored differently with regard to weight phobia, I conducted a MANOVA on the subscales of the BUT-A, again applying bootstrapping. No significant group differences were evident for weight phobia, or for any of the other subscales.

Objective 2: Assessing Links Between Personality/Experiential Variables and Body Image Problems When Controlling for Involvement in Competitive Sport

To tease apart the unique contributions that my personality/experiential variables made to the prediction of the body image issues in athletes and non-athletes, I ran a series of bootstrapped multiple linear regressions. Scores on the TAS-20, HSPS, ASI-3, and CTQ-SF were entered as predictors in each case; I also included a categorical variable relating to involvement in competitive sport to control for differences between athletes and non-athletes. The results are presented in Table 4.4. The model predicting muscularity dissatisfaction was not significant. However, the models predicting perceived BMI, adiposity dissatisfaction and body uneasiness (Global Severity Index) were significant (see Table 4.4). Being a non-athlete was associated with greater perceived BMI; being a non-athlete and AS predicted a stronger desire to be thin; and alexithymia, AS, and childhood emotional abuse all predicted greater body uneasiness, when controlling for other variables.

Table 4.4

Predictors of Body Image Problems in Females

Outcome Variable	Predictor	B	Bias	SE	BCa 95% CI	
					Lower	Upper
Perceived BMI	(Constant)	23.322	.018	2.438	18.121	28.071
	TAS-20	.027	-.002	.031	-.032	.081
	HSPS	-.820	.019	.515	-1.916	.306
	ASI-3	.033	.000	.026	-.024	.087
	CTQ-SF	.033	-.002	.056	-.076	.134
	Competitive Athlete	**-1.970**	**.019**	**.616**	**-3.169**	**-.699**
Global Severity Index	(Constant)	-.566	.012	.382	-1.343	.279
	TAS-20	**.022**	**.000**	**.006**	**.011**	**.033**
	HSPS	.053	-.002	.100	-.149	.247
	ASI-3	**.021**	**.000**	**.005**	**.010**	**.034**
	CTQ-SF	**.041**	**-.001**	**.013**	**.018**	**.062**
	Competitive Athlete	-.185	.003	.118	-.430	.064
Muscularity	(Constant)	.609	.000	.516	-.502	1.662
	TAS-20	.010	.000	.007	-.003	.025
	HSPS	-.030	.003	.105	-.223	.168
	ASI-3	-.009	.000	.007	-.023	.004
	CTQ-SF	-.016	.000	.013	-.042	.010
	Competitive Athlete	-.152	-.005	.142	-.424	.102
Adiposity disatisfaction	(Constant)	-1.070	.042	.627	-2.473	.287
	TAS-20	-.007	.000	.008	-.023	.009
	HSPS	.203	-.009	.140	-.046	.453
	ASI-3	**-.018**	**.000**	**.008**	**-.034**	**-.002**
	CTQ-SF	-.021	.001	.017	-.054	.013
	Competitive Athlete	**.543**	**-.009**	**.175**	**.219**	**.860**

Note. Significant predictors shown in bold. Bias corrected and accelerated 95% confidence intervals (BCa 95% CIs) for parameter estimates are based on 1000 bootstrap samples. Predictors include the total scores on the Toronto Alexithymia Scale (TAS-20); Highly Sensitive Person Scale (HSPS); Anxiety Sensitivity Index (ASI-3); and the Emotional Abuse subscale of the Childhood Trauma Questionnaire-Short Form (CTQ-SF). In addition, a categorical variable was included related to involvement in competitive sport.

Objective 3: Does Body Uneasiness Account for Unique Variance in Mental Health?

The final objective of the current study was to determine if body uneasiness accounts for unique variance in mental health outcomes when holding personality/experiential variables and

involvement in competitive sport constant. To determine if this was the case, I ran separate multiple regressions predicting depression and anxiety. The predictors in each case were total scores on the TAS-20, HSPS, ASI-3, the emotional abuse subscale of the CTQ, participation in competitive sport, and Global Severity Index scores. The findings are presented in Table 4.5.

Table 4.5

Predictors of Mental Health in Females while Controlling for Body Uneasiness

Outcome Variable	Predictor	B	Bias	SE	BCa 95% CI	
					Lower	Upper
Depression	(Constant)	-10.099	.194	3.173	-16.005	-3.240
	TAS-20	**.178**	**-.002**	**.052**	**.073**	**.267**
	HSPS	.842	-.026	.694	-.567	2.113
	ASI-3	.029	.002	.053	-.076	.146
	CTQ-SF	**.392**	**-.003**	**.110**	**.178**	**.601**
	Competitive Athlete	**-2.975**	**.024**	**1.005**	**-5.002**	**-.961**
	GSI	**4.489**	**.008**	**.661**	**3.158**	**5.800**
Anxiety	(Constant)	-6.25	0.10	2.94	-12.19	0.10
	TAS-20	0.07	0.00	0.05	-0.04	0.17
	HSPS	0.52	-0.02	0.77	-0.99	1.89
	ASI-3	**0.13**	**0.00**	**0.05**	**0.05**	**0.23**
	CTQ-SF	**0.38**	**0.00**	**0.10**	**0.18**	**0.56**
	Competitive Athlete	0.51	0.03	0.87	-1.06	2.32
	GSI	**3.07**	**-0.03**	**0.66**	**1.69**	**4.30**

Note. Significant predictors shown in bold. Bias corrected and accelerated 95% confidence intervals (BCa 95% CIs) for parameter estimates are based on 1000 bootstrap samples. Predictors include the total scores on the Toronto Alexithymia Scale (TAS-20); Highly Sensitive Person Scale (HSPS); Anxiety Sensitivity Index (ASI-3); and the Emotional Abuse subscale of the Childhood Trauma Questionnaire short form (CTQ-SF). In addition, a categorical variable was included related to involvement in competitive sport. Finally, the Global Severity Index (GSI) of the Body Uneasiness Test-A was included as an additional predictor.

The models were significant in predicting both depression and anxiety. Body uneasiness emerged as a significant predictor of both models when controlling for all other varibles. In

addition, alexithymia, childhood emotional abuse, and being a non-athlete predicted depression, and both AS and childhood abuse predicted anxiety, when controlling for all other variables.

Discussion

An important focus of Study 4.2 was to examine female athletes' and non-athletes' experience of body image. This work was conducted in an undergraduate sample, given that young adults may be at particular risk for problems with body image, in part because this developmental period is accompanied by significant physical, psychological, and social changes (Jones & Crawford, 2005). This study adds to the literature by examining: 1) differences in objective and perceptual measures of body image dissatisfaction among athletes and non-athletes; 2) whether body image is predicted by personality and/or experiential variables when controlling for engagement in competitive sport; and 3) whether body image accounts for unique variance in the prediction of mental health when holding personality/experiential variables and participation in competitive sport constant.

Do Athletes and Non-Athletes Differ on Measures of Body Image?

My first research question was to determine whether athletes and non-athletes differed with respect to: actual or perceived BMI; dissatisfaction related to adiposity or muscularity measured via perceptual tests; and/or body uneasiness measured via self-report. The groups did not differ with regard to dissatisfaction with muscularity. However, non-athletes perceived themselves to be larger than athletes, despite there being no objective differences in BMI, and they also endorsed a stronger desire to be thin than athletes, even after controlling for other potentially relevant variables. Together, these findings provide support for past work suggesting that non-athletes experience a less positive body image than athletes (Hausenblas & Downs, 2001). There are several possible reasons why this may be the case. For example, it is possible

that athlete's engagement in consistent physical activity contributes to a body size/aesthetic that is more in line with cultural "ideals" (Hausenblas & Downs, 2001). Engagement in sport is also linked to improved self-esteem (e.g., Armstrong & Oomen-Early, 2009), which could have beneficial effects on body image (e.g., Clay et al., 2005). Of course, I am unable to comment on whether individuals with a more positive body image are more likely to choose to participate in sport, or whether engagement in sport promotes a more positive body image. Longitudinal work is needed to answer this question.

Is Body Image Related to Personality and/or Experiential Variables?

The second research question was to determine whether body image (measured perceptually and through self-report) was related to the three personality variables of interest in this dissertation, and to childhood emotional abuse. Unlike other authors, I assessed how much variance in body image accounted for by each of these variables when holding the others, and involvement in competitive sport, constant. Consistent with past work (e.g., De Berardis et al., 2007; Iacolino et al., 2017; 2019), global body uneasiness was positively predicted by TAS-20 scores. As suggested by Andersen (1988), this may be because those who have an externally oriented focus may fixate on a perceived body flaw, at the expense of examining their feelings. Future work could examine the role of self-esteem as a possible moderator between alexithymia and body image concerns; indeed, others have found that the link between alexithymia and body image concerns is not significant in individuals with high self-esteem (Gori et al., 2021).

I had predicted that individuals scoring high (vs. low) on the HSPS would report more body image problems. This prediction was based on previous work suggesting links between aspects of sensory/aesthetic sensitivity and body dissatisfaction (e.g., Brown et al., 2021) and body dysmorphic disorder (Schieber et al., 2013). However, HSPS scores did not emerge as a

predictor of body uneasiness in my sample when variance related to the other potentially relevant variables was held constant. In contrast, as expected, AS predicted greater adiposity dissatisfaction and body uneasiness, which complements prior work suggesting a link between AS and drive-for-thinness (Anestis et al., 2008). Although more work is needed to determine the mechanisms of this relationship, it is possible that those who fear physiological sensations associated with anxiety also feel more uncomfortable in their own bodies.

The present findings suggest that childhood emotional abuse is also linked to increased body uneasiness. This is consistent with other reports linking it to increased body dissatisfaction in athletes and non-athletes (Longobardi et al., 2022; Momeñe et al., 2022; Vartanian et al., 2016). Some have suggested that early adversity may contribute to body dissatisfaction through its impact on personal identity (Vartanian et al., 2016) and on self-criticism (Momeñe et al., 2022).

Prediction of Mental Health

In examining links between body image problems and mental health, I focused on the Global Severity Index score—a composite measure of body uneasiness. The regression analyses I conducted allowed me to tease apart the unique contribution that this variable made to the prediction of mental health. A comparison of the results presented in Table 4.2 and Table 4.5 reveals that certain personality/experiential variables that were significant predictors of mental health in Study 4.1 no longer accounted for unique variance in mental health when body uneasiness was accounted for. This may be because the sample sizes in the present follow-up study were smaller than those in Study 4.1. It is also possible, however, that body uneasiness mediates some of the links that were previously reported. This possibility could be assessed in a future study involving a larger sample. Nonetheless, the present findings highlight the fact that

body uneasiness is an important predictor of mental health in females. This corroborates other work suggesting a link between body image concerns and increased psychological distress during the pandemic (Robertson et al., 2021). It will be important to extend the current work to males, and to assess possible links between body uneasiness, coaching abuse, and mental health in future studies of competitive athletes.

Notably, in this study (unlike in Study 4.1) participation in competitive sport emerged as a unique negative predictor of depression, suggesting that it served as a protective factor. Although this is inconsistent with past work suggesting that elite athletes have comparable or worse mental health compared to non-athletes, (e.g., Gorczynski et al., 2017; Purcell et al., 2020; Rice et al., 2016; Schaal et al., 2011), my analysis controlled for a large number of relevant variables that may have introduced confounds in earlier studies. What is it about competing at an elite level that could be beneficial? One aspect that may be important is that elite athletes engage regularly in rigorous and organized practices. This might not only help elite athletes achieve their ideal body image (as argued by Iacolino et al., 2017) but also have provided the elite athletes in my study with more structure in their lives, and with increased opportunities for social interaction and support, during the COVID-19 pandemic.

Finally, even after controlling for both body uneasiness and involvement in competitive sport, AS emerged as a unique predictor of anxiety, alexithymia emerged as a unique predictor of depression, and childhood emotional abuse emerged as a significant predictor of both mental health outcomes. These findings underscore the importance of taking these variables into account when assessing and treating mental health problems in females.

Limitations and Future Directions

In addition to suffering from some of the same limitations cited in previous chapters, the present study has some unique limitations. Firstly, given physical distancing and social isolation requirements, participants were asked to weigh themselves at home before reporting their weight, but those who did not have a scale were asked to provide their best estimate. This may have reduced the validity of their actual BMI scores. Relatedly, rather than using a visual analog scale, it would have been preferable to assess perceived BMI using a psychophysical technique, such as the staircase method, the method of adjustment, or an adaptive probit estimation procedure (e.g., Gardner & Boice, 2004).

Another limitation of the present study is that, like many other researchers examining links between participation in competitive sport and body image problems, I treated athletes as a homogeneous group. It may be that vulnerability to body dissatisfaction varies across specific types of athletes. In particular, we might expect it to be somewhat more common in lean-sport and/or elite athletes. Indeed, some work suggests that athletes participating in lean sports (those that emphasize achieving/maintaining a lower body weight due to its perceived performance benefits; e.g., gymnastics) and those competing at a higher level (e.g., Division 1; Varnes et al., 2013) show reduced protection against body image concerns relative to other athletes. It will be important in future work to consider the "standard" against which these athletes may be comparing themselves. Even if lean and elite athletes feel that their bodies approach a broadly held societal ideal, they may still feel that they fall short of their sport-specific ideal. This, in turn, might impact their mental health.

Conclusion

In closing, it is important to highlight one other key finding from the two studies presented in this chapter, namely that symptoms of moderate-to-extremely severe depression and anxiety, and of clinically significant body uneasiness, were extremely high in both athletes and non-athletes. The results of the research presented here suggest a number of risk and protective factors for these concerning symptoms. This information may help clinicians fine-tune their intervention efforts, and help coaches identify how best to support the mental health of their female athletes.

CHAPTER 5: GENERAL DISCUSSION

In my dissertation research, I examined the relationship between personality and experiential variables in a broad sample of young adults engaged in widely different levels of exercise, and how these variables related to mental health, inhibitory control, and body image. I begin by briefly summarizing the results of each chapter.

In Chapter 2, I used a survey-based study to examine sex differences on study measures, and to examine predictors of mental health. Overall, I found that females reported greater impacts due to the pandemic than males, and endorsed stronger symptoms of SPS and AS compared to males. In addition, results suggested that females were more likely than males to report having increased their moderate and vigorous physical activity after the pandemic began. In examining the regression models predicting depression and anxiety, I found that sex emerged as a unique predictor of depression (but not anxiety), when holding variance from the personality and experiential variables of interest constant. More specifically, once variance from these variables was accounted for, male sex emerged as a significant predictor of depression.

Chapter 3 was comprised of two separate studies focused on females. In Study 3.1, I performed secondary analyses of the data from Chapter 2 that allowed me to examine links between my study variables and exercise dependence. I found that being at-risk for exercise dependence was negatively associated with current levels of depressive symptomology. Otherwise, no differences between females at-risk vs. not at-risk for exercise dependence in terms of mental health and personality profiles. The two groups did differ with respect to how they modulated their physical activity during the COVID-19 pandemic, qualifying the results of previous work in this area (see below). In Study 3.2, I assessed inhibitory control using an emotional Go/No-go task. Results suggested that symptoms of exercise dependence positively

predicted false alarms, suggesting that those who display greater symptoms of exercise dependence may find it more difficult to exert inhibitory control when emotion and attentional demands interact compared to those who display fewer symptoms of exercise dependence. Additionally, I found that impacts due to the pandemic, AS, and childhood emotional abuse predicted task performance, and that task performance accounted for unique variance in anxiety.

Chapter 4 consisted of two studies, again focused on females. In Study 4.1, I examined differences between athletes and non-athletes with respect to personality/experiential variables and mental health. I also assessed whether participation in sport and exposure to emotionally abusive coaching behaviours accounted for unique variance in the prediction of mental health. Individual sport athletes reported fewer symptoms of SPS than non-athletes. Additionally, I found that both participation in sport and coaching abuse accounted for unique variance in the prediction of anxiety. In Study 4.2, I examined differences between athletes and non-athletes on measures of body dissatisfaction, and links between body dissatisfaction and personality/experiential variables. I then conducted separate regression models to determine whether body uneasiness accounted for unique variance in mental health outcomes, when holding personality/experiential variables constant. Overall, my results suggested that athletes had a more positive body image than non-athletes and that body uneasiness was an important predictor of depression and anxiety in both groups when controlling for personality/experiential variables, underscoring the importance of this variable when examining mental health. In addition, not engaging in competitive sport emerged as an additional predictor of perceived BMI, dissatisfaction related to adiposity, and depression.

I now turn to a brief discussion of key themes that emerged from the results and highlight several novel contributions that my dissertation makes to the existing literature.

Physical Activity did not Predict Mental Health

One of the more surprising results from Chapter 2 was that current activity levels did not predict depression or anxiety in university students, when holding variance from relevant personality/experiential variables and participant sex constant. I suggested that one possible reason for these findings could be the fact that my sample included individuals who were at-risk for exercise dependence. However, results from Chapter 3 indicated that mental health was not related to current levels of physical activity in females, whether they were at-risk for exercise dependence or not. Overall then, physical activity did not appear to be linked to mental health in the current work. As discussed in Chapter 2, there are several possibilities for the lack of association found between physical acitivty and mental health in my dissertation, including the possibility that the link between activity and mental health which is well documented in the literature broke down due to: (a) the fact that the majority of participants were exercising less and sitting more than usual due to the pandemic; (b) inaccuracy in how activity was measured; and (c) the fact that I failed to account for the location in which participants were exercising (i.e., indoors vs. outdoors) and/or to delineate different domains of physical activity (e.g., household vs. work-related physical activity). Future researchers examining links between physical activity and mental health might consider using a more objective measure of activity and gathering information related to the locations and domains of activity that participants engaged in.

One of the novel findings from Chapter 3 was that females at-risk for exercise dependence were more likely to report having increased their vigorous and moderate activity than those not at-risk for exercise dependence. Furthermore, there was a trend in the at-risk group for those who reported changing their activity level after the onset of the pandemic to report higher levels of depression. These findings qualify past work conducted during the

pandemic that suggest that "active" individuals tend to increase their activity levels in times of stress (Lesser & Nienhuis, 2020) and that such changes are associated with worse mental health than maintaining activity levels (Meyer et al., 2020; Wolf et al., 2021). My results lend preliminary support to the idea that these effects may be specific to individuals at-risk for exercise dependence. As previously noted, it is possible that altering one's physical activity levels may represent a maladaptive coping strategy used by those at-risk for exercise dependence, although this was not tested directly in the present research.

Specific Personality Variables and Childhood Emotional Abuse are Robust Predictors of Mental Health

Overall, the present findings suggest that certain personality and experiential variables are more consistent predictors of depression and anxiety than either physical activity or impacts due to the pandemic. I discuss the variables that emerged as consistent predictors of mental health below.

Alexithymia as a Predictor of Depression

Across my dissertation, alexithymia emerged as a reliable predictor of depression in university students. Indeed, alexithymia predicted depression in every regression model. Thus, it positively predicted depression even when controlling for physical activity and biological sex (Chapter 2) and, in females, it predicted depression even when symptoms of exercise dependence and performance on an emotional Go/No-go task (Studies 3.1 and 3.2 respectively); participation in competitive sport (Study 4.1); effects related to emotionally abusive coaching (Study 4.1); and body uneasiness (Study 4.2) were held constant. Importantly, this association was also seen when effects related to SPS, AS, and childhood emotional abuse were held constant. Taken together,

the results provide strong support for the idea that alexithymia is an important personality trait to consider when examining depressive symptomology in a diverse range of individuals.

Childhood Abuse as a Predictor of Anxiety and Depression

Childhood emotional abuse predicted anxiety and depression in all models except those run on the sample of elite athletes (Study 4.1), when holding other potentially relevant variables constant. The failure to find an association in the models run on data gathered from elite athletes may have been due to the small sample size, but a more likely explanation is that exposure to emotionally abusive coaching was included as an additional predictor in these models. The effects on current mental health of this more recent abuse may have overshadowed effects related to abuse suffered earlier in life. Indeed, exposure to coaching abuse accounted for unique variance in current levels of anxiety experienced by elite athletes.

AS as a Predictor of Anxiety

Across all studies described in Chapters 2, 3, and 4, AS emerged as a predictor of anxiety. These results suggest that AS plays a unique and influential role in predicting anxiety, even when a large range of potential confounding variables have been accounted for, highlighting its importance as a psychological construct.

SPS

As noted in Chapter 1, individuals with SPS are more likely to experience anxiety, depression, emotion dysregulation and psychopathology if they also experienced childhood trauma (Aron et al., 2005; Greven et al., 2019). Thus, accounting for childhood emotional abuse in my regression models may have reduced variance related to SPS. Despite this, SPS still emerged as a predictor of mental health in several models when controlling for this variable and the two other personality traits. It significantly predicted depression and anxiety in models that

also controlled for biological sex (Chapter 2) and involvement in competitive sport (Study 4.1). In addition, it predicted depression (but not anxiety) when controlling for risk of exercise dependence (Study 3.1) and predicted anxiety (but not depression) in elite athletes when controlling for exposure to emotionally abusive coaching (Study 4.1).

Interestingly, the two models in which SPS no longer predicted either mental health outcome were those in which I held constant effects linked to performance on the Go/No-go task (Study 3.2) and body uneasiness (Study 4.2). These results seem to make sense because (a) the Go/No-go task measures the ability to exert self-control when there are competing demands for emotion and attentional processing, which could be disrupted when one is highly sensitive (Smolewska et al., 2006); and (b) SPS is characterized by heightened sensitivity to aesthetics and to both environmental and body-related sensory information (Aron et al., 2012), which could contribute to body uneasiness. Interestingly, however, when controlling for the other personality variables and childhood emotional abuse SPS did not predict either performance on the Go/No-go task or GSI scores. Further research is needed to explore the inter-relationships between my predictor variables, these outcome variables, and other aspects of potentially relevant variables such as mind-wandering tendencies (which could impact Go/No-go performance) and self-esteem (which could impact body uneasiness), for example.

Clinical Implications

Relationships between Alexithymia, SPS, AS, Childhood Emotional Abuse, and Mental Health

As described in Chapter 1, research suggests that alexithymia is a risk factor for several negative mental health outcomes. It may increase risk for psychopathology through its association with experiential avoidance (Panayiotou et al., 2015), reduced emotional awareness (Aaron et al., 2018), and psychological inflexibility (Duarte & Pinto-Gouveia, 2017). It is

important to consider screening for alexithymia in clinical practice, given its link to poorer treatment outcomes. For instance, research indicates that alexithymia moderates the prediction of depression outcome by treatment expectations in chronic pain patients (Blaettler et al., 2019). Furthermore, alexithymia has been found to be associated with spending less time in treatment and with earlier relapses among individuals with substance use disorders (Palma-Álvarez et al., 2021). In conclusion, alexithymia appears to be a clinically relevant variable to consider in treatment. The current study adds to the literature by demonstrating the importance of this variable in predicting depressive symptomology while controlling for variance from a number of different clinically relevant variables, including but not limited to SPS, AS, and childhood emotional abuse. As such, clinicians should consider targeting alexithymic traits in therapy for patients who present with depressive symptomology. Mindfulness-based therapies may be effective in this regard (Norman et al., 2019).

Also noted in Chapter 1, SPS has also been associated with poor mental health outcomes. However, there is a dearth of literature examining links between SPS and mental health while accounting for variance related to alexithymia. It is important to consider these traits in conjunction with one another, given that they can co-occur (Jakobson & Rigby, 2021). Liss and colleagues (2008) demonstrated that individuals scoring high on both difficulty identifying feelings and ease of excitation reported higher levels of anxiety. Furthermore, past research suggests that a sensory profile characteristic of individuals who score high on both SPS and alexithymia (characterized by low registration, sensory avoidance, and sensation seeking) may increase risk for psychopathology (Engel-Yeger et al., 2016; Jakobson & Rigby, 2021). This risk may be particularly high in those who have experienced early adversity (see Aron et al., 2012). Given that emotional neglect (Aust & Bajbouj, 2014) and other adverse environmental factors

(Darrow & Follette, 2014) are associated with increased risk for alexithymia, it could be the case that those with SPS who have early exposure to adverse childhood experiences may be predisposed to developing alexithymia, which in turn increases their risk for poor mental health.

As discussed in Chapter 1, the personality and experiential variables that were the focus of the present work are characterized by atypicalities in the generation, experience, and regulation of emotions. For example: alexithymia is proposed to reflect difficulties at the appraisal and attentional deployment stages of emotion regulation (Preece et al., 2017); individuals with SPS strongly and deeply process stimuli in the environment (e.g., Aron & Aron, 1997); in individuals with AS, non-acceptance of one's emotions is related to an increase in the severity of anxiety symptoms (Kashdan et al., 2008); and a negative early upbringing can alter the brain's perception of threat (Andersen et al., 1999; Thompson, 2011) and increases stress reactivity and emotion dysregulation (D'Andrea et al., 2012). Given that these variables are linked with emotional processes, learning more about these relationships can inform the development of individualized treatment. I discuss this further in the section below.

Clinical Applications

Screening participants for levels of emotional awareness may help clinicians tailor their approach for certain individuals. For instance, Smith and colleagues (2019) proposed seven distinct mechanisms by which an individual could struggle with emotional awareness, and recommended assessment tools and intervention techniques relevant to each mechanism. Of particular relevance to this thesis, they propose that one such mechanism is "poor emotion concept acquisition" (p. 481). Here, affective responses are grossly (rather than precisely) mapped onto emotional concepts, resulting in the use of coarse descriptors for one's emotional experience (e.g., indicating one feels "bad"). This is often seen in individuals with high levels of

alexithymia. Indeed, the authors suggested using the difficulty identifying/describing feelings subscales of the TAS-20 for assessment of this difficulty. Even though research suggests that alexithymia is associated with less improvement in therapy (partly due to negative reactions evoked in one's therapist; Ogrodniczuk et al., 2011), researchers have recommended that specific therapeutic techniques could still be helpful, such as those aimed at reducing avoidance of one's emotions and developing emotional schemas (Preece et al., 2017). Smith et al. (2019) similarly suggest that interventions that target psychoeducation about emotion concepts and practice increasing awareness of one's emotions may be beneficial.

Another mechanism proposed by Smith et al. (2019) is strong, maladaptive beliefs about somatic experiences (as in the case of individuals with high levels of AS). Using simulations, they demonstrated that those with frequent beliefs about experiencing dangerous somatic events were more likely to misrepresent an affective response as being a somatic response (e.g., incorrectly characterizing feelings of sadness as sickness or feelings of panic as a heart attack). For these individuals, they suggested using a measure of AS for assessment and employing psychoeducation about how emotions can be expressed in the body and about the benign nature of most physical sensations as the intervention. Prior work also suggests that exercise can help reduce levels of AS (e.g., Sabourin et al., 2015); thus, it may be a useful adjunct to therapy. The goal here, however, should be to promote only moderate increases in exercise, and only in those who are not at-risk for developing exercise dependence. This is important to minimize the chance of creating or exacerbating an unhealthy dependence on exercise. Finally, facilitating experiential work centered on feeling and recognizing one's emotions (as in emotion focused therapy; Greenberg, 2010) could also prove beneficial.

A third relevant mechanism is referred to as conscious inaccessibility or, more colloquially, avoidance and/or suppression of emotions (Smith et al., 2019). One of the primary tasks in therapy would likely include uncovering the reasons an individual employs this emotion regulation strategy. It is possible that, in the case of individuals with a traumatic upbringing, there may be a belief that talking about painful experiences would increase emotional discomfort (as is often the case in those with PTSD; Foa et al., 2008). Some psychoeducation on the value of emotions may also be useful here.

In children with high levels of SPS, parenting interventions that promote parental bonding behaviour such as warmth and affection may be beneficial (Acevedo et al., 2016). Indeed, this could even serve as a protective factor against developing alexithymia later in life, although more work is needed to test this possibility.

Limitations

I have already highlighted some of the specific limitations associated with the research described in Chapters 2, 3, and 4, but a few additional points merit discussion here. In the current study, I observed that more than half of my mixed-sex sample reported moderate-to-severe symptoms of depression and anxiety, and that approximately two-thirds of the young adult females who took part reported significant uneasiness with their own bodies. While these are important observations, I want to emphasize that I did not undertake the type of thorough, clinical assessment that would be needed to determine actual rates of clinically diagnosed mental health disorders in my samples.

An additional problem associated with my use of self-report measures is that they could have been biased by social desirability. Although using such measures made collecting data online from large samples during a global pandemic more feasible, some different findings might

have been obtained if participants had undergone a more detailed, in-person assessment. An additional limitation was that objective data related to pre-pandemic activity levels were not collected, and information concerning both changes in physical activity and current physical activity levels may have suffered from recall bias.

Finally, it is important to note that while the focus of the current investigation was on emotional abuse (either in childhood or at the hands of a coach), there are several different kinds of early adverse experiences that can impact mental health (e.g., sexual abuse, violent treatment of mother or stepmother, poverty, community violence). Thus, a limitation of the current study is that I did not examine the impact of such variables.

Concluding Remarks

My dissertation has provided novel contributions to the literature by exploring the impact of alexithymia, SPS, AS, and childhood abuse on mental health. Taken together, my results highlight the consistency with which alexithymia predicts depression and AS predicts anxiety, regardless of sex, risk for exercise dependence, and participation in sport. This work increases our understanding of the role of personality and one's environment in shaping mental health. Future research should test more complex models including those involving mediation or moderation. In addition to the variables of interest in this study, future work could examine the possible mediating roles for other variables including self-esteem and mindfulness.

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